The 32nd Annual Meeting of
the Korean Spinal Neurosurgery Society

KSNS 2018

KSNS! Korea Spine, New Start!

Abstract

INVITATION

존경하는 대한척추신경외과학회 회원 여러분!!

유난히 길고 무더운 여름이 지나고 가을이 시작되는 길목에서 국민의 척추건강 증진을 위해 분골쇄신(粉骨碎身)으로 노력하는 회원 여러분들을 모시고 32차 정기학술대회를 준비하게 되었습니다. 올해는 30여년간 대한민국 국민의 척추 건강을 책임지는 회원 여러분의 헌신의 노력으로 새로운 학회지 Neurospine이 탄생한 의미있는 한해를 보내고 있습니다. 오늘도 진료실, 수술실에서 각고의 노력을 하는 회원 여러분들에게 존경을 표합니다.

아름다운 항구도시 부산에서 열리는 2018년도 정기학술대회는 국내외 저명하신 분들을 모시고 현재의 추세와 지식을 공유하여 더욱 발전할 수 있는 자리를 마련하였습니다. 또한 각 분야에서 최근 가장 관심을 끌고 있는 주제들을 선정하여 훌륭한 연자들이 심혈을 기울여 강의를 준비해 주셨습니다. 회원 여러분들의 활발한 참여와 열띤 토론으로 이번 학술대회를 즐거운 학문적 축제의 장으로 만들어 주시기를 바랍니다.

대한척추신경외과학회는 일신우일신(日新又日新)의 자세로 30여년간 성장하였습니다. 또한 Neurospine이 세계로 뻗어나가는 척추신경외과학회지로 도약 할 수 있는 디딤돌이 세워졌습니다. 이는 함께 노력하고 위기를 기회로 타계하는 회원 여러분들의 헌신과 공헌 없이는 이루지 못할 성과들입니다.

다시 한번 이 자리를 빌어 학문에 대한 정진을 하는 회원 여러분께 감사 인사 드리며, 이번 정기학회에 많은 회원 여러분이 참여하여 자리를 빛내 주셨으면 좋겠습니다.

감사합니다.

2018년 9월

대한척추신경외과학회 회장 **송 근 성**

PROGRAM AT A GLANCE

Sep. 14(FRI). 2018

	Room A	Room B	Room C	Poster
08:00				
09:00				
10:00	*10:00-12:00* Pre Congress NECA Symposium 척추 진료의 사회경제적 문제 (SOCIOECONOMIC ISSUE IN CARE OF SPINE AFFECTION)			
11:00				
12:00				
13:00	*13:00-13:15* Opening			
	13:15-15:15 KSNS Knowledge Forum : Evidentiary Speculations on Spinal Topics			
14:00				
15:00				*15:15-15:40* Poster View
16:00	*15:40-16:40* Guest Lectures I			
17:00		*16:40-17:50* Award Article Session	*16:40-17:50* Free Paper Session I	
18:00	*18:00-18:30* Cocktail Party (로비)	*18:00-18:30* – 정기총회 – Cocktail Party (로비)	*18:00-18:30* Cocktail Party (로비)	
19:00	*18:30-20:30* Gala Dinner			
20:00 ~				

PROGRAM AT A GLANCE

Sep. 15(SAT). 2018

	Room A	Room B	Room C	Poster
08:00	08:00-09:10 Free Paper Session II	08:00-09:10 Free Paper Session III	08:00-09:10 Free Paper Session IV	
09:00	09:10-10:30 Award Competition Session	09:10-10:10 Guest Lectures II		
10:00				10:30-11:00 Poster View
11:00	11:00-12:00 Guest Lectures III			
12:00	12:00-13:00 Luncheon Seminar I	12:00-13:00 Luncheon Seminar II	12:00-13:00 Luncheon Seminar III	
13:00	척추학 제3판 헌정식 13:10-14:40 Plenary Session : KSNS! Korea Spine, New Start!			
14:00				14:40-15:10 Poster View
15:00	15:10-16:20 Free Paper Session V	15:10-16:20 Free Paper Session VI	15:10-16:20 Free Paper Session VII	
16:00	16:20-17:20 Award Presentation Session (학술대상 연구결과 발표)			
17:00	학술상 시상 및 경품 추첨			
18:00				
19:00				

PROGRAM

Sep. 14(FRI). 2018

Room A

10:00~12:00	**Pre-Congress Symposium** 좌장: **정천기** (서울의대), **윤승환** (인하의대)	
	척추 진료의 사회경제적 문제 (SOCIOECONOMIC ISSUE IN CARE OF SPINE AFFECTION)	
	10:00-10:15	척추 질환 관련 의료 비용 **신정우** (보건사회연구원)
	10:15-10:30	척추 질환 관련 의료행위 청구 현황과 신의료기술 등재 동향 **변의형** (건강보험심사평가원)
	10:30-10:45	소비자의 시선에서 바라본 척추 질환 치료 **황선옥** (소비자시민모임)
	10:45-11:00	신의료기술 개발 유인 및 도입 **박종연** (NECA)
	11:00-11:15	만성 질환 관리와 퇴행성 척추 질환 **정천기** (서울의대)
	11:15-11:30	변화하는 의료환경에서 학회의 역할 **윤승환** (인하의대)
	11:30-12:00	패널 토의: 척추 질환 진료의 발전 방향
12:30~13:00	등 록	
13:00~13:05	개 회	학술이사 **김세훈**
13:05~13:10	개회사	대한척추신경외과학회 회장 **송근성**
13:10~13:15	축 사	대한신경외과학회 차기 이사장 **오창완**

PROGRAM

Sep. 14(FRI). 2018

13:15~15:15	**KSNS Knowledge Forum :** **Evidentiary Speculations on Spinal Topics** 좌장: **김영백** (중앙의대), **성주경** (경북의대)	
	1. Percutaneous Endoscopic Thoracic Decompression for Thoracic Myelopathy **최 건** (포항우리들병원)	20
	2. Evaluation and management of postoperative dysphagia after cervical spine surgery **김영진** (단국의대)	22
	3. Sagittal Spinal Balance in Spinal Deformity Surgery **현승재** (서울의대)	27
	4. Discogenic pain in the literature; Is it curable disease or not? **김주한** (고려의대)	29
	5. Anabolic agents: What is beyond osteoporosis? **조대철** (경북의대)	31
	6. Understanding the biology of bone (spine) metastasis: past, present, future **박성배** (서울의대)	33
15:15~15:40	Coffee Break & Poster View	
15:40~16:40	**Guest Lectures I** 좌장: **박윤관** (고려의대), **김은상** (성균관의대)	
	1. Surgical Treatment of Vertebral Fracture **김동준** (대한척추외과학회 회장, 이화의대)	38
	2. Principles and Pitfalls of Minimal Invasive Lumbar Spinal Surgery **Dr. Ying-Kei Chan** (Hong Kong)	45
16:40~17:50	Award Article Session ROOM B Free Paper Session I ROOM C	
18:00~18:30	정기총회 ROOM B	총무이사 **윤승환**
18:30~20:30	Cocktail Party & Gala Dinner	

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Sep. 14(FRI). 2018

Room B

16:40~17:50	**Award Article Session** 좌장: **조용은** (연세의대), **박춘근** (수원월스기념병원) 1. **Lami Kim Young Soo Award** – Comparison of Cervical Alignment and Clinical Outcomes in Patients with Os Odontoideum versus Non–Os Odontoideum after Atlantoaxial Fixation **강지인** (연세의대) 48 –Effect of Myoarchitectonic Spinolaminoplasty on Concurrent Hypertension in Patients With Cervical Spondylotic Myelopathy **Kazushige Itoki** (Dokkyo University Hospital, Japan) 50 –Ossification of the Posterior Longitudinal Ligament in Cervical Spine: Prevalence, Management, and Prognosis **Jau Ching Wu** (National Yang–Ming University, Taiwan) 52 2. **윌스 학술상** –Therapeutic Efficacy–Potentiated and Diseased Organ–Targeting Nanovesicles Derived from Mesenchymal Stem Cells for Spinal Cord Injury Treatment **Hemant Kumar** (차의과대) 54 3. **백산 학술상** –기초분야 Cold Allodynia after C2 Root Resection in Sprague – Dawley Rats **정대영** (대구 참튼튼병원) 56 –임상분야 Clinical and radiological ourcomes of posterior vertebral column resection for severe spinal deformities **이병훈/현승재** (서울의대) 58
18:00~18:30	**정기총회** 총무이사 **윤승환**
18:30~20:30	Cocktail Party & Gala Dinner

PROGRAM

Sep. 14(FRI). 2018

Room C

16:40~17:50	**Free Paper Session I** (척추 외상 및 종양) 좌장: **김우경** (가천의대), **이정길** (전남의대)
18:00~18:30	정기총회 ROOM B 총무이사 **윤승환**
18:30~20:30	Cocktail Party & Gala Dinner

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Sep. 15(SAT). 2018

Room A

08:00~09:10	**Free Paper Session II** (경추) 좌장: **신현철** (성균관의대), **조정기** (가톨릭의대)
09:10~10:30	**Award Competition Session** (나누리 학술상 session) 좌장: **오성훈** (나누리병원), **진동규** (연세의대)
	1. Spinal CT to MR image synthesis using Generative Adversarial Networks (GANs) **이정환** (부산대병원) 82 2. Effect of a bisphosphonate and selective estrogen receptor modulator on bone remodeling in streptozotocin– induced diabetes and ovariectomized rat model **이영석** (경상대병원) 83 3. Synergistic Anti–Inflammatory Effects of Gold Nanoparticle and Ursodeoxycholic Acid in Spinal Cord Injury **손세일** (차의과학대 분당차병원) 84 4. Aggravating factors in sagittal imbalance in Korean Elderly Sagittal Imbalance Cohort Study **문봉주** (전남대병원) 85 5. Intraoperative neurophysiologic monitoring for cauda equina tumor surgery : retrospective correlation of clinical outcomes and neurophysiological data in 146 cases **이수범** (서울아산병원) 86 6. A new index for making decisions regarding C2 lamina decompression in cervical ossification of the posterior longitudinal ligament: The R–line **이병주** (서울아산병원) 87 7. Factors for the Acquisition of 10° Angular Change at the Lumbar Spine through Posterior Column Osteotomy in Adult Spinal Deformity Surgery **한상현** (충남대병원) 88 8. Does Extension Dysfunction Affect Postoperative Loss of Cervical Lordosis in Patients who Undergo Laminoplasty? **이수헌** (양산부산대병원) 89
10:30~11:00	Coffee Break & Poster View

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11:00~12:00	**Guest Lectures III** 좌장: **조경석** (가톨릭의대), **정용태** (인제의대)	
	1. Inflammaging: molecular aspects of disc aging **Dr. Oliver Nic Hausmann** (Switzerland)	92
	2. Nuance of Pre-psoas Surgery Technique and Pearls **Dr. Hao Wu** (China)	94
12:00~13:00	**Luncheon Seminar I** 좌장: **장태안** (서울의대), **김상우** (영남의대)	
	1. Early experience of E-coli-derived recombinant human bone morphogenetic protein-2 in spine surgery **신동아** (연세의대)	98
	2. Spinal deformity correction using poly – and uniplanar changeable screws **현승재** (서울의대)	100
13:00~13:10	**척추학 제3판 헌정식**	회장 **송근성**
13:10~14:40	**Plenary Session: KSNS! Korea Spine, New Start!** 좌장: **송근성** (부산의대), **장호열** (일산병원)	
	1. 척추학 3판: 현재를 출판하여 미래를 조명하다 **임수빈** (교과서 편찬위원장)	104
	2. Neurospine: Harmonizing Academic Development of Spinal Neurosurgery **하 윤** (Neurospine 편집위원장)	112
	3. 문케어, 예비급여, 향후 심사방향 **박진규** (PMC 박병원 원장, 의협 기획 및 보험이사)	114
14:40~15:10	Coffee Break & Poster View	
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Sep. 15(SAT). 2018

	Award Presentation Session (학술대상 연구결과 발표) 좌장: **정천기** (서울의대), **김근수** (연세의대)
16:20~17:20	1. Anti-inflammatory effect of static magnetic field generated by permanent magnets on Intervertebral disc degeneration. Development of a novel device, and the preliminary results **권우근** (고려의대) **128** 2. Can beta-endorphin be used as a biomarker for chronic low back pain? **이창현** (서울의대) **130** 3. 원발성 척추 · 척수종양 임상 데이터 수집/분석 플랫폼 개발 구축 **이선호** (성균관의대) **132**
17:20~17:50	**학술상 시상 및 경품 추첨** 총무이사 **윤승환**

PROGRAM

Sep. 15(SAT). 2018

Room B

08:00~09:10	**Free Paper Session Ⅲ** (흉요추) 좌장: **진병호** (가톨릭관동대), **김인수** (계명의대)	
09:10~10:10	**Guest Lectures Ⅱ** 좌장: **도재원** (순천향의대), **이승명** (조선의대)	
	1. Future of Spine Motion Preservation **Dr. Kingsley R. Chin** (USA)	146
	2. The optimal treatment duration of anabolic agent for fracture prevention **Dr. Donato Agnusdei** (Italy)	148
10:30~11:00	Coffee Break & Poster View	
11:00~12:00	Guest Lectures Ⅲ ROOM A	
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	1. Redefine optimal chronic pain management with Norspan **손동욱** (부산의대)	166
	2. 동반질환이 있는 환자에서 신경병증성 통증 약물 선택 시 고려할 점 **김주한** (고려의대)	168
13:00~13:10	척추학 제3판 헌정식 ROOM A	회장 **송근성**
13:10~14:40	Plenary Session : KSNS! Korea Spine, New Start! ROOM A	
14:40~15:10	Coffee Break & Poster View	
15:10~16:20	**Free Paper Session Ⅵ** (척추 일반) 좌장: **조용준** (한림의대), **김대현** (대구가톨릭의대)	
16:20~17:20	Award Presentation Session ROOM A	
17:20~17:50	학술상 시상 및 경품 추첨 ROOM A	총무이사 **윤승환**

PROGRAM

Sep. 15(SAT). 2018

Room C

08:00~09:10	**Free Paper Session IV** (MISS) 좌장: **최건** (포항우리들병원), **손문준** (인제의대)	
12:00~13:00	**Luncheon Seminar III** 좌장: **은종필** (전북의대), **김기정** (서울의대)	
	1. Long term management of PSSS treatment : Considering balance between safety and efficacy **박정윤** (연세의대)	192
	2. Well Balanced PelubiCR (More advanced than PELUBI) **구성욱** (연세의대)	194
	3. The First and Only RANKL Inhibitor: Denosumab **진용준** (인제의대)	196
15:10~16:20	**Free Paper Session VII** (변형) 좌장: **문승명** (한림의대), **이진석** (가톨릭의대)	
16:20~17:20	Award Presentation Session ROOM A	
17:20~17:50	학술상 시상 및 경품 추첨 ROOM A	총무이사 **윤승환**

PROGRAM

Poster

2018. **9. 14** (Fri.)

Pre-Congress Symposium

척추 진료의 사회경제적 문제
(SOCIOECONOMIC ISSUE IN CARE OF SPINE AFFECTION)

좌장 : **정천기** (서울의대), **윤승환** (인하의대)

1. 척추 질환 관련 의료 비용	**신정우** (보건사회연구원)
2. 척추 질환 관련 의료행위 청구 현황과 신의료 기술 등재 동향	**변의형** (건강보험심사평가원)
3. 소비자의 시선에서 바라본 척추 질환 치료	**황선옥** (소비자시민모임)
4. 신의료기술 개발 유인 및 도입	**박종연** (NECA)
5. 만성 질환 관리와 퇴행성 척추 질환	**정천기** (서울의대)
6. 변화하는 의료환경에서 학회의 역할	**윤승환** (인하의대)

2018. **9. 14** (Fri.)

KSNS Knowledge Forum : Evidentiary Speculations on Spinal Topics

좌장 : **김영백** (중앙의대), **성주경** (경북의대)

1. Percutaneous Endoscopic Thoracic Decompression for Thoracic Myelopathy — **최 건** (포항우리들병원)

2. Evaluation and management of postoperative dysphagia after cervical spine surgery — **김영진** (단국의대)

3. Sagittal Spinal Balance in Spinal Deformity Surgery — **현승재** (서울의대)

4. Discogenic pain in the literature ; Is it curable disease or not? — **김주한** (고려의대)

5. Anabolic agents : What is beyond osteoporosis? — **조대철** (경북의대)

6. Understanding the biology of bone (spine) metastasis : past, present, future — **박성배** (서울의대)

최 건

포항우리들병원

TITLES

- President of Pohang Wooridul Spine Hospital
- Executive director and Honorary President of World Congress of Minimally Invasive Spine Surgery and Techniques (WCMISST)
- President of Asia Congress of Minimally Invasive Spine Surgery and Techniques (ACMISST)
- President of Korea Minimally Invasive Spinal Surgery Society (KOMISS)
- Honorary President of Korea Research Society of Endoscopy Spine Surgery (KOSESS)
- Member of AOSpine Korea Delegates

EDUCATION

Ph.D. : Neurosurgery
2/2003 Hanyang University School of Medicine, Seoul, Korea

M.D : Neurosurgery
3/2003 Hanyang University School of Medicine, Seoul, Korea

B.S : Medicine
2/1988 Hanyang University School of Medicine, Seoul, Korea

KSNS Knowledge Forum : Evidentiary Speculations on Spinal Topics

Percutaneous Endoscopic Thoracic Decompression for Thoracic Myelopathy

최 건
포항우리들병원

Percutaneous Endoscopic Lumbar Discectomy (PELD) for treatment of lumbar disc herniations with radiculopathy is an established procedure. Based on this procedure, Percutaneous Endoscopic Thoracic Discectomy (PETD) procedure is developed to treat thoracic disc herniations. However, PETD has limitations owing to tight and confined anatomy of the thoracic foramen and small disc heights. In PETD, the working channel endoscope is in close proximity to thoracic cord. Until now PETD has only been performed for soft disc herniations.

To present technical notes on the procedure of foraminoplasty in PETD using specially designed bone drill system (MaxMore spine, Germany) in soft as well as calcified disc herniations.

This is a case series of 10 consecutive patients (9 soft and 1 calcified discs) who underwent PETD during the period of January 2017-May 2018. All procedures were performed under local anaesthesia and sedation. Foraminoplasty was performed using manual bone drill system under fluoroscopic guidance. PETD was performed using 30-degrees 6.5 mm foraminal endoscope with 4 mm working channel. The patients' symptoms and demographics were charted and clinical evaluation was done based on clinical improvement and VAS.

Mean pre-operative VAS was 8.1 and mean post-operative VAS was 4.1. The mean hospital stay was 13.9 days. Post-operative MRI showed successful decompression and adequate removal of disc fragments. There were no intra-operative complications. All patients experienced satisfactory symptomatic relief on the day of discharge

Use of manual bone drills for foraminoplasty in PETD is an effective tool is managing thoracic disc herniations (soft and calcified) with minimal soft tissue trauma, early rehabilitation and minimal complications.

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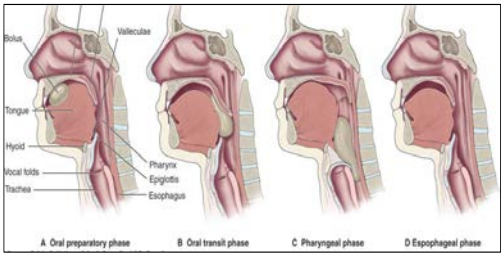
KSNS Knowledge Forum : Evidentiary Speculations on Spinal Topics

Evaluation and management of postoperative dysphagia after cervical spine surgery

김 영 진
단국의대

Introduction

• **Dysphagia**



Introduction

Incidence of Dysphagia following Ant. Cervical Surgery

- highly variable : 3~67%

  [dysphagia and dysphonia assessment tools after ant. cervical spine surgery : Clin Spine Surg 2016]

- well designed prospective study : 71%

  [What is the incidence and severity of dysphagia after ant. cervical surgery? : Clin Orthop Relat Res 2011]

- **ACDF vs TDR (10.6% vs 10.1%)**

  [Evaluation of adverse events in TDR: a meta-analysis of FDA summary of safety and effectiveness data : Global spine 2017(level II)]

Introduction

✓ **Cause of dysphagia** following ACS

- Increased r
- Soft tissue
- Osteophyte

Unclear!!!
no consensus opinion !!!

- Vagus nerve dysfunction
- Recurrent laryngeal nerve injury

[Dysphagia following anterior cervical spinal surgery : The Bone & Joint Journal 2013]
[Dysphagia and dysphonia assessment tools after ant. cervical spine surgery : Clin Spine Surg 2016]

Introduction

✓ **Risk factors of dysphagia** following ACS

- Advancing age (greater than 60yrs)*
- Revision surgery*
- ACDF > TDR*, prominent plate*, rh-BMP2*, Use of instrument
- Duration*
- Multilevel*, Higher level > lower level
- Female*, COPD, smoking, shorter and larger neck

* Prospective study

[Prospective Analysis of Incidence and Risk Factors of Dysphagia in Spine Surgery Patients : SPINE 2004 (LEVEL II)]

Dysphagia After Anterior Cervical Spine Surgery

- **Prospective study**, 29 pts,
  : AC (Anterior Cervical, 18pts), PL (Post. Lumbar, 11pts)

- **Objective**
  - **AC** surgery VS **PL** surgery (control group).
  - To determine the degree of dysphagia preop. and postop.

- **Measure of dysphagia**
  - Swallowing–Quality of Life (SWAL-QOL) survey
  - 수술 전, 수술 후 3주, 수술 후 1.5 yrs (3회 측정)

[Dysphagia After Anterior Cervical Spine Surgery : SPINE, 2011(LEVEL II)]

TABLE 1. The Swallowing-Quality of Life Questionnaire

Symptoms	Almost Always	Often	Sometimes	Hardly Ever	Never
Coughing	1	2	3	4	5
Choking when you eat food	1	2	3	4	5
Choking when you take liquids	1	2	3	4	5
Having thick saliva or phlegm	1	2	3	4	5
Gagging	1	2	3	4	5
Drooling	1	2	3	4	5
Problems chewing	1	2	3	4	5
Having excess saliva or phlegm	1	2	3	4	5
Having to clear your throat	1	2	3	4	5
Food sticking in your throat	1	2	3	4	5
Food sticking in your mouth	1	2	3	4	5
Food or liquid dribbling out of your mouth	1	2	3	4	5
Food or liquid coming out of your nose	1	2	3	4	5
Coughing food or liquid out of your mouth when it gets stuck	1	2	3	4	5

Patients are asked how often in the past month they experience these symptoms and to then circle the answer choice that best applies. A lower score indicates an increased degree of dysphagia.

[Dysphagia After Anterior Cervical Spine Surgery : SPINE, 2011(LEVEL II)]

Dysphagia After Anterior Cervical Spine Surgery

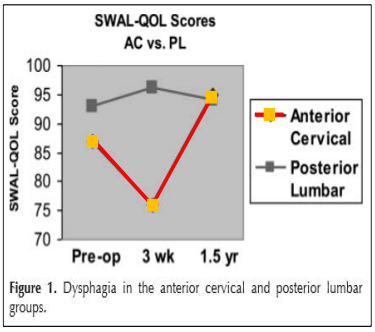


Figure 1. Dysphagia in the anterior cervical and posterior lumbar groups.

[Dysphagia After Anterior Cervical Spine Surgery : SPINE, 2011(LEVEL II)]

Dysphagia Following Spine Surgery

- 3-yr **prospective, cohort study**.

- **Objectives**
  : To compare the incidence and risk factors after ant. cervical (AC), post. cervical (PC),

- **Methods**
  - 83 pts, AC(38), PC(19), PL(26)
  - Preop. and postop. swallowing evaluation

Table 1. Dysphagia Disability Index Statements Used in Interview Format

I cough when I eat solid food.
I cough when I drink liquids.
I feel thirsty most of the time.
I've lost weight because of my swallowing problem.
I avoid some foods because of my swallowing problem.
It's hard to chew food.
I'm embarrassed to eat in public.
I'm embarrassed because of drooling.
I'm tired at the end of a meal.
I eat smaller meals more often due to my swallowing problem.
I have to swallow again before food will go down.
I don't enjoy eating as much as I used to.
I eat less because of my swallowing problem.
I am nervous because of my swallowing problem.
I feel handicapped because of my swallowing problem.
I get angry at myself because of my swallowing problem.
I'm afraid that I'll choke and stop breathing because of my swallowing problem.
I've changed my diet due to my swallowing problem.
It takes me more than 45 minutes to eat a meal.
I feel a strangling sensation when I swallow.
My swallowing problem upsets me.
I have to thicken liquids in order to swallow them.
I choke when I take my medication.
I feel that liquid goes down the wrong way when I swallow.

[Prospective Analysis of Incidence and Risk Factors of Dysphagia in Spine Surgery Patients : SPINE, 2004 (LEVEL II)]

Dysphagia Following Spine Surgery

1444 Spine • Volume 29 • Number 13 • 2004

Table 3. Comparison by Surgical Groups of Subjective Swallowing Complaints and Results of Videofluoroscopic Evaluation of Oral/Pharyngeal Swallow

Parameter	Anterior Cervical (AC)	Posterior Cervical (PC)	Posterior Lumbar (PL)	P
Preoperative DDI score	6.6 ± 6.9 (n = 28)	11.3 ± 10.2 (n = 15)	7.5 ± 11.2 (n = 26)	0.28
Postoperative mean DDI score	23.0 ± 21.3* (n = 35)	18.1 ± 20.3 (n = 16)	9.2 ± 12.7 (n = 26)	0.004
Preoperative dysphagia on VSE	0	0	1 (5.4%)	0.41
Postoperative dysphagia on VSE	18 (47%)	4 (21%)	0	0.001

* AC is significantly different from PL.

[Prospective Analysis of Incidence and Risk Factors of Dysphagia in Spine Surgery Patients : SPINE, 2004 (LEVEL II)]

Dysphagia Following Spine Surgery

- **Dysphagia** within the first few days of the procedure
  : **AC (47%), PC (21%)**

- dysphagia **recover within wks** to normal swallowing.

- Age **greater than 60 yrs** - risk factor

- **Intubation alone** was **not a risk factor** for postop. dysphagia based on objective swallow evaluations

[Prospective Analysis of Incidence and Risk Factors of Dysphagia in Spine Surgery Patients : SPINE, 2004 (LEVEL II)]

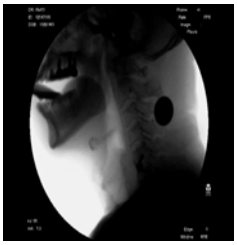
Diagnosis

✓**History and P/Exam**
- cough during or after swallow
- voice change after swallow
- lip sealing, laryngeal elevation

✓**Clinical Dysphagia Scale**
- Bazaz Classification
- Dysphagia short questionnaire
- Swallowing-quality of life questionnaire

Diagnosis

- **VFSS (Video Fluoroscopic Swallowing Study)**
  : Gold standard!!!



Management II

- postural adjustments to reduce risk of aspiration
  (e.g., chin tuck, head tilt, head rotation, head lift, lying down)
- exercises to strengthen weak facial m.

- **Electrical stimulation**

- gastrostomy

Management I

✓Reduce the risk of **airway obstruction** or **aspiration pneumonia**

- **Dietary modification**: controlling bolus size or text
- heightening sensory input prior to or during swallowing
- applying voluntary control to the swallow

Preventative measures in literature review

Table 2
Summary of the preventative measures found in our literature review

Period of time	Preventative measures
Preoperative	Performing tracheal exercise before surgery
Intraoperative	Avoiding a prolonged operative time
	Avoiding routine of rhBMP
	Small and smoother cervical plates
	Anchored spacer instead of plates
	Application of steroid before wound closure
	Considering arthroplasty
	Decreasing tracheal cuff pressure during medial retraction
	Changing the profile of the retractors used
	Changing the dissection plane

rhBMP, recombinant human bone morphogenetic protein.

[Dysphagia after anterior cervical spine surgery : The Spine Journal 2014]

Take home message I

- **Dysphasia**
  : common complication, incidence about 10%

- **Cause of Dysphagia following ACS**
  - ✓ **Increased retraction**
  - ✓ **Soft tissue swelling and edema**
  - ✓ **osteophyte**

Take home message II

- Diagnosis : VFSS
- Several Risk factors
- Remember the prevention measures

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Sagittal Spinal Balance in Spinal Deformity Surgery

현 승 재
서울의대

Changes in spinal alignment trigger several compensatory changes in the pelvis and lower extremities to maintain upright posture. Activating these mechanisms of compensation may require increased energy expenditure to maintain upright posture.

The Scoliosis Research Society-Schwab Adult Spinal Deformity (ASD) classification system allows for a uniform classification and discussion of ASD. A higher sagittal deformity classifier is associated with increased disability.

Age-related changes in spinal alignment are important to consider when setting alignment goals for deformity correction. Less-aggressive correction should be considered in older patients because of their increased risk for complications.

A structured approach to the treatment of ASD consists of 6 steps: (1) find and quantify the driver of deformity, (2) evaluate how deformity impacts global alignment, (3) define alignment targets, (4) determine spinal flexibility, (5) choose a surgical strategy, and (6) execute this strategy intraoperatively in a controlled fashion.

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KSNS Knowledge Forum : Evidentiary Speculations on Spinal Topics

Discogenic pain in the literature; Is it curable disease or not?

김 주 한
고려의대

요통은 인류의 80 %가 사는 동안에 고생하는 질환 중의 하나이며, 이 중 30-40%는 디스크에서 발생된 통증으로 알려져 있다. 대부분은 단순한 안정 가료 및 약물 치료 만으로도 회복이 가능하나, 일부분에 있어서 심한 통증이 장기간 지속이 되어, 삶의 질을 떨어뜨리고, 막대한 의료비를 지불하게 되는 심각한 상황을 초래하고 있다. 지금까지 디스크성 통증에 대한 발병 기전 등이 모호하여, 다양한 진단 기법 및 치료 방법이 제시되고 있으나, 그 효능성에 대해서는 아직도 논란의 여지가 있다.

2000년대 들어 디스크성 통증에 대한 병리학적 연구가 활발하게 이루어지고 있으며, 디스크 퇴행과 전혀 다른 기전에 의해 통증이 발생이 발생한다는 것이 알려져 있고, 그 결과에 따른 다양한 약제들이 동물 실험 및 임상 시험을 거치고 있다. 특히 유럽에서는 총 5백만 유로를 투자하여, 5년 계획으로 디스크성 통증에 대한 연구를 지원하는 등 최근 들어 이 분야 연구에 대해 상당한 투자가 이루어 지고 있다. 그러나 통증에 대한 객관적 분석의 어려움, 약제의 투입 방법 및 효능성 평가의 문제 및 위해성 등을 고려할 때 적절한 치료 방법 개발은 아직까지 요원하다. 특히 오존 치료, 고주파 치료, 메틸렌 블루 치료, 신경 성형술 및 디스크 성형술 및 줄기세포 치료 등 최신 기법 등이 제시되고 있으나, 결과 분석에 있어 대부분 고가인 치료법인 관계로 경제적 논리에 따라 좌지우지 될 수 밖에 없으며, 연구에 대한 결과를 반드시 내어야 하는 환경에서 편향된 결론 또한 양산 되고 있다.

본 저자는 최근 5년간 발표된 논문을 통한 디스크성 통증에 대한 기초연구 및 임상 결과 그리고, 다양한 치료에 대한 효능성을 분석하여, 그 이전의 문헌들과 비교하여, 신뢰성 있는 디스크성 통증에 대한 치료 기법을 확인하고, 향후 치료 기법 개발이 가능한지에 대한 의견을 제시하고 한다.

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Anabolic agents: What is beyond osteoporosis?

조 대 철
경북의대

Osteoporosis is a common skeletal disorder characterized by low bone mass, which leads to reduced bone strength and increased risk of fractures. Anabolic agents have been shown to improve bone mass and decrease fracture risk in osteoporosis patients by directly stimulating osteoblasts to produce new bone. Currently, two anabolic agents are available in the US: recombinant produced teriparatide (TPTD), which is the fully active (1-34) amino active sequence of human parathyroid hormone (PTH), and abaloparatide (APTD), a synthetic analog of parathyroid hormone-related peptide (PTHrP). At present, both agents are approved only for treatment of patients with osteoporosis at high risk of fracture. Nonetheless, their anabolic properties have led to off-label application in additional settings which include spine fusion, osteonecrosis of the jaw, arthroplasty, and fracture healing. In this article, we summarize available scientific literature regarding the efficacy, effectiveness , and safety of TPTD in these off-label settings.

박 성 배

서울의대

Education

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Medical License / Certification

Certification: Korean Board of Neurosurgery, No 1651, 2003

License: Republic of Korea, No. 66000, 1998.

Understanding the biology of bone (spine) metastasis: past, present, future

박 성 배
서울의대

Metastasis is, so far, an incurable disease. The skeleton including spine is the third most frequent site of metastasis of primary cancers. Although the overall incidence of bone metastasis is unknown, the relative incidence of bone metastasis by tumor type is 65–75% in breast cancer, 65–75% in prostate cancer, 60% in thyroid cancer, 40% in bladder cancer, 20–25% in renal cell carcinoma, and 14–45% in melanoma. The bone including spine metastasis causes mortality and morbidity with severe pain, impaired mobility, fracture, spinal cord compression, bone marrow aplasia and hypercalcemina. However, the current treatments are mainly palliative. New therapeutics are needed for the patients with bone metastasis and, it is necessary to initiate a bone management program concurrently with the initiation of cancer treatment to prevent complications of bone metastasis. Therefore, spine surgeons need to have a greater understanding of biology of bone metastasis as well as surgical treatment of spine metastasis.

The understanding of pathogenesis of bone metastasis has been developed with understanding of pathobiology of general metastasis. Why do certain cancers metastasize so readily to bone? Some primary tumors show organ specific patterns of metastasis. In 1889, Stephen Paget presented the “see and soil” hypothesis, which suggests that the interplay between the properties of cancer cells and the particular organ microenvironment determines the selective advantage of cells to grow. The studies in the late 1970s and early 80s stimulated research into the pathobiology of metastasis, resulting in extensive research into the local microenvironment, or ‘niche,’ of the primary tumor and metastatic foci. They also provided new insight into biological heterogeneity, the metastasis phenotype, and the selection of metastatic variants

during or by the process of metastasis. Now, researchers emphasize that the metastasis cascade is a multistep mechanism that leads a primary tumor cell to leave its tissue of origin, come into the circulation, losing its epithelial characteristics and becoming a disseminated tumor cell, survive in the blood, escaping from innate immune, and choose its final destination. Therefore, the terms as epithelial–mesenchymal transition (EMT), Mesencyal -Epithelial transition (MET) and interactions between tumor cells and osteocytes, osteoblasts and osteoclasts are emerged. In addition, the development of modern bioinformatics approaches helps us find and understand how interact between themselves and with their environment. Therefore, many researchers can consider the clinical data, gene-gene and

gene-environment causal interactions simultaneously. Clearly, the pathogenesis of metastasis depends on multiple interactions between metastatic cells and host homeostatic mechanisms. The interruption of these interactions will inhibit or help eradicate metastasis in the help of surgery with target therapy for bone metastasis. Clinical efforts have focused on the inhibition or destruction of tumor cells. However, strategies to treat metastatic tumor cells and modulate the host microenvironment now offer new treatment approaches as hybrid strategies (surgery + target therapy in situ).

Guest Lectures I

좌장 : **박윤관** (고려의대), **김은상** (성균관의대)

1. Surgical Treatment of Vertebral Fracture — **김동준** (대한척추외과학회 회장, 이화의대)

2. Principles and Pitfalls of Minimal Invasive Lumbar Spinal Surgery — **Dr. Ying-Kei Chan** (Hong Kong)

김 동 준

대한척추외과학회 회장, 이화의대

학력

1978년 3월–1985년 2월 연세대학교 의과대학 (의학사)
1986년 3월–1988년 2월 연세대학교 대학원 의학과 (의학석사)
1995년 3월–1998년 2월 연세대학교 대학원 의학과 (의학박사)

경력

1986년 2월 신촌세브란스병원 수련의 과정 수료
1990년 2월 신촌세브란스병원 정형외과 전공의 과정 수료 및

전문의 자격 취득

1993년 9월 이화여자대학교 의과대학 조교수 임용
현재 이화여자대학교 의과대학 교수

주요 수상 경력

대한척추외과학회, 향산학술상 수상(1997)
대한척추외과학회, 우수 논문상(임상부문) 수상(1999)
대한척추외과학회, 우수 논문상(기초부문) 수상(2000)
Eurospine, Outstanding poster 선정 (2001)
대한척추외과학회, 향산학술상 수상(2012)
대한척추외과학회, 청솔학술상 수상(2013)
기타

주요 학회 경력

대한정형외과학회 진단 및 장해위원회 위원(現)
대한척추외과학회 평의원(現)
대한척추외과학회지 편집위원(現)
대한척추외과학회장(現)
기타

Guest Lectures I

Surgical Treatment of Vertebral Fracture

김 동 준

대한척추외과학회 회장, 이화의대

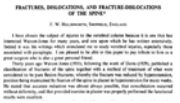
불안정성(Unstable Spine)

- 불안정(不安定) 척추란 변형의 증가와 통증, 신경 손상의 진행이 발생할 위험에 처해 있는(be at risk) 경우다. (Panjabi,1990)
- 골절의 자연 경과를 추정하게 하는 불안정성의 여부는 치료 방법의 결정에 핵심적인 요소

분류법의 역사와 종류들

- Nicoll EA in JBJS(1949)
  - 변형 진행의 위험도에 따라, 안정골절과 불안정 골절로 분류

- Holdsworth FW in JBJS(1963)
  - Nicoll의 안정성 개념을 바탕으로 골절을 형태 및 기전에 따라 6가지로 분류

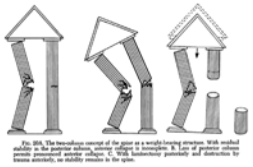


기둥 이론(Column Theory)

- 이주설(二柱設 Two-column theory)

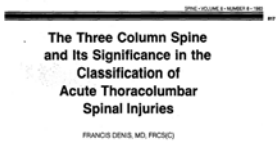
Kelly & Whiteside in Ann of Surg(1968)

; 신장 강도(tensile strength)를 가진 후방 기둥(posterior column)의 중요성을 주장



- 삼주설(三柱設 Three-column theory)

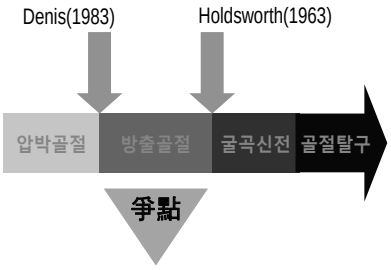
Denis F in Spine (1983)



- 29명의 비수술적 환자 중 6명에서 신경 결손이 발생.
- 척추관과 경계를 이루는 중간주가 손상되는 방출성 골절에서 이차적 불안정성(신경학적 결손)의 위험성에 대해 기술

현재로는 Denis의 삼주설 개념이
골절의 이해 및 분류에 가장
일반적으로 사용되고 있다.
그러나

불안정성의 境界



방출 골절의 불안정성 여부

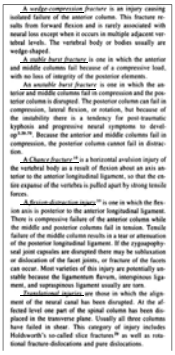
불안정하다	전부 불안정하진 않다
Denis F(1984)	McAfee(1983)
Panjabi MM(1995)	Reid DC(1988)
	Fredrickson BE(1990)
	Cantor JB(1993)
	Mumford J(1993)
	Chow GH(1996)
	Wood K(2003)

Denis 이후의 새로운 골절 분류법들

- McAfee Classification (1983)
- Load Shearing Classification- McCormack T (1994)
- AO Comprehensive Classification (1994)
- Thoracolumbar Injury Classification and Severity Score (TLICS) – Spine Trauma Study Group(2005)

Denis 이후의 새로운 골절 분류법들

- McAfee Classification (1983)



Denis 이후의 새로운 골절 분류법들

- McAfee Classification (1983)
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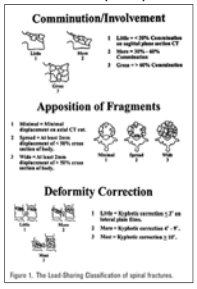

Denis 이후의 새로운 골절 분류법들

- McAfee Classification (1983)
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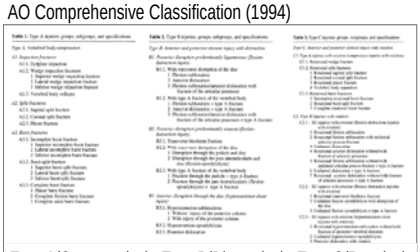
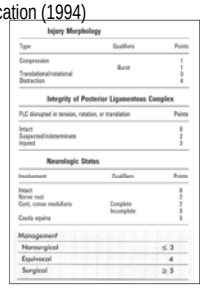


Type A(Compression), Type B(Distraction), Type C(Rotation)

Denis 이후의 새로운 골절 분류법들

- McAfee Classification (1983)
- Load Shearing Classification- McCormack T (1994)
- AO Comprehensive Classification (1994)
- *Thoracolumbar Injury Classification and Severity Score (TLICS) – Spine Trauma Study Group(2005)*



Injury Morphology

Type	Qualifiers	Points
Compression	Burst	1
Translational/rotational		3
Distraction		4

Integrity of Posterior Ligamentous Complex

PLC disrupted in tension, rotation, or translation		Points
Intact		0
Suspected/indeterminate		2
Injured		3

Neurologic Status

Involvement	Qualifiers	Points
Intact		0
Nerve root		2
Cord, conus medullaris	Complete	2
	Incomplete	3
Cauda equina		3

Management	
Nonsurgical	≤ 3
Equivocal	4
Surgical	≥ 5

Denis 이후의 새로운 골절 분류법들

- McAfee Classification (1983)
- Load Shearing Classification- McCormack T (1994)
- AO Comprehensive Classification (1994)
- Thoracolumbar Injury Classification and Severity Score (TLICS) – Spine Trauma Study Group(2005)

Based on two-column theory
후방구조의 역할에 대한 재인식

Preferred Classification in Recent Review Journals

Denis와 AO 체계는 신뢰도와 재현성이 보통(moderate) 정도의 수준이다.
-JBJS. 2005

ASSESSMENT OF TWO THORACOLUMBAR FRACTURE CLASSIFICATION SYSTEMS AS USED BY MULTIPLE SURGEONS

TLICS가 Denis와 AO와 같은 이전 분류체계에 비해 신뢰도가 높다
- J Neurosci. 2013
- J Spine. 2014

- *Thoracolumbar Injury Classification and Severity Score (TLICS) – Spine Trauma Study Group(2005)*

Injury Morphology

Type	Qualifiers	Points
Compression	Burst	1
Translational/rotational		3
Distraction		4

Integrity of Posterior Ligamentous Complex

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Neurologic Status

Involvement	Qualifiers	Points
Intact		0
Nerve root		2
Cord, conus medullaris	Complete	2
	Incomplete	3
Cauda equina		3

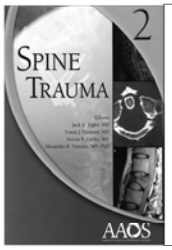
Management	
Nonsurgical	≤ 3
Equivocal	4
Surgical	≥ 5

Suggested OP Ix in textbooks

- 불완전 마비 증상을 보이며 척추관 내의 신경 조직에 압박을 가하고 있는 골편이 보여 기계적 압박을 제거하여야 하는 경우.
- 삼주 모두에 손상을 받은 골절-탈구와 방출성 골절, 후방 인대군의 파열이 동반된 손상 등
- 시상면 지수가 25도를 넘거나, 측만각이 12도를 넘는 경우

From 정형외과학(2006),
척추외과학(2004)

Suggested OP Ix in textbooks



Authors' Suggested Treatment Guidelines

An intact PLC should be considered a prerequisite for nonsurgical care. Some authors feel that more than 50% canal compromise is an indication for surgical decompression and/or stabilization. However, there are little data to support this practice routinely in a neurologically intact patient with an intact PLC. Kyphosis more than 25° to 30° and/or anterior height loss of greater than 50% is highly suggestive of posterior ligament injury. We use MRI to confirm the integrity of the PLC in equivocal cases. However, there is literature reporting

OP Ix in Public Insurance

가. 불안정성 척추골절

(1) 척추의 삼주(three column)가 모두 손상된 경우

(2) 방출성 척추골절로 인해 후만각 30도 이상 또는 압박율 40% 이상의 변형이 있거나, 척추관 침습이 50% 이상인 경우

(3) MRI상 후방인대복합체의 전체 구조의 손상이 확인된 경우

(4) 근력저하를 포함한 뚜렷한 신경학적 손상이 동반된 경우

(5) 적절한 보존적 요법에도 불구하고 심한 동통 또는 신경증상을 동반한 후만각의 진행이 발생하는 경우

Author's Preference

McAfee Classification

- ❖압박골절
- ❖안정성 방출골절
- ❖불안정성 방출골절
- ❖찬스 골절
- ❖굴곡-신연 손상
- ❖전위손상

- 신경 손상의 동반
- McAfee(1984)-후방구조 손상
- Reid DC(1988)
  - 후만각<35^0, 압박율<50%, 침습율<60%
- Fredrickson BE(1990)
  - 후만각<25^0, 침습율<50%
- Cantor JB(1993)
  - 후만각<30^0, 압박율<50%

II. 골다공증성 골절의 수술 적응증

1. 병소의 자연경과
2. 예후 예측의 수단
3. 수술 결과

1. 골다공증성 골절의 자연 경과

●골절된 경우의 2/3에서는 의사를 찾아갈 정도의 통증이 없다.

- *Nevitt MC et al. Ann Intern Med(1998)*
- *Tomayo-Orozoco et al. Am J Med(1997)*
- *Cooper et al. J Bone Miner Res(1992)*

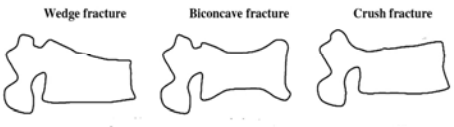
●통증은 보존적 요법에 매우 빠르게 반응한다.

- *임봉열 외.대한정형외과학회지(1992)*
- *Rapado A. Bone(1996)*
- *신병준 외. 대한정형외과학회지(2002)*

●통증은 4~6주 내에 자연적으로 대부분 소실된다.

- *Silverman. Bone(1992)*
- *Patel. Br J Rheumatology(1991)*

2. 예후 예측
- 골다공증성 골절의 분류



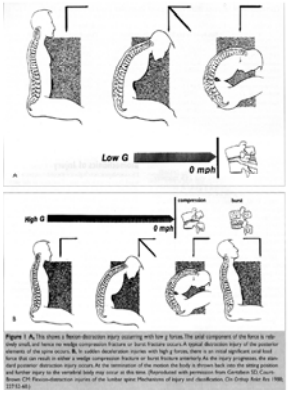
European Vertebral Osteoporosis Study Group(1999)

경과와 연관된 요소

- Ettinger 등의 연구 *(J Bone Miner Res. 1992)*
  - 2992명에 대한 임상적 연구에서
  - 골절 형태와 통증정도, 장애, 압박진행과는 무관하다.
- Ismail 등의 연구 *(Osteoporosis Int. 1999)*
  - 유럽 19개국 13562명에 대한 임상적 연구에서
  - 골절 형태와 통증의 발생과는 무관
  - Crush 형이 키높이 감소와 관계

경과와 연관된 요소

- Suzuki 등의 연구 *(Eur Spine J. 2009)*
  - 107명에 대한 임상적 연구에서
  - Crush 형에서 통증 및 QoL이 더 나쁘다.
- Matsumoto 등의 연구 *(Spine. 2011)*
  - 310명에 대한 임상적 연구에서
  - Crush 형과 수상 전 운동부족 군에서 ADL이 저하.



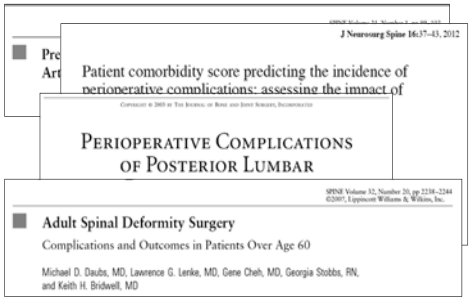
Flexion-distraction injury in OVF??

Clincal & Radiological Course according to Mcafee Classification

- 1년 이상 추시 가능한 108명의 환자를 대상
- McAfee 분류 별 골절 형태에 따른 임상적 및 방사선학적 결과 분석
- Pain Scores; 골절 형태에 따른 차이가 없었다.

	Wedge Compression	Stable Bursting	Unstable Bursting	Flexion-Distraction	*p*
Initial	7.76±0.83	7.78±0.72	8.0±0.69	7.55±0.52	0.424
1 Yr	2.96±1.37	2.98±1.17	2.89±1.41	3.27±1.42	0.882
Interval Change	4.80±1.41	4.80±1.20	5.11±1.68	4.27±1.27	0.453

3. 수술의 일반적인 결과
- 고령 환자 유합술의 결과 및 합병증

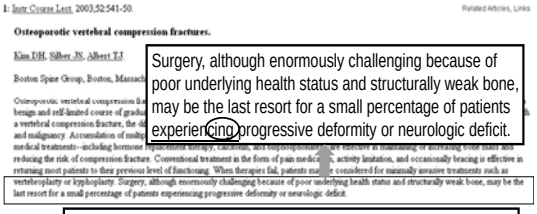


American Academy of Orthopaedic Surgeons
Clinical Practice Guideline on

The Treatment of Osteoporotic Spinal Compression Fractures

- 수상 5일 이내에 calcitonin 투여 – moderate level
- VP는 비 추천 – strong level
- KP는 선택적으로 고려 – weak level
- 기타 치료법 (안정, 보조기, 진통제, 대안치료, 전기자극, ...)은 결론 못 내림.
- 후만각의 회복과 예후와의 관계는 알 수 없음.

골다공증 골절의 수술 적응증



1: Inury Couese Lect. 2003;52:541-50. Related Articles, Links

Osteoporotic vertebral compression fractures.

Kim DH, Silber JS, Albert TJ

Boston Spine Group, Boston, Massach

Osteoporotic vertebral compression fra
benign and self-limited course of gradu
a vertebral compression fracture, the di
and malignancy. Accumulation of multip
medical treatments--including hormone
reducing the risk of compression fracture. Conventional treatment in the form of pain medica
returning most patients to their previous level of functioning. When therapies fail, patients may be considered for minimally invasive treatments such as
vertebroplasty or kyphoplasty. Surgery, although enormously challenging because of poor underlying health status and structurally weak bone, may be the
last resort for a small percentage of patients experiencing progressive deformity or neurologic deficit.

Surgery, although enormously challenging because of poor underlying health status and structurally weak bone, may be the last resort for a small percentage of patients experiencing progressive deformity or neurologic deficit.

수술은 환자의 취약한 건강상태와 골 구조 때문에, 변형의 진행이나 신경학적 결손을 겪고 있는 소수의 환자에서 최후의 방편(last resort)이 될 수 있겠다. *(AAOS ICL, 2003)*

OP Ix in Public Insurance

가. 불안정성 척추골절

(1) 척추의 삼주(three column)가 모두 손상된 경우

(2) 방출성 척추골절로 인해 후만각 30도 이상 또는 압박율 40% 이상의 변형이 있거나, 척추관 침습이 50% 이상인 경우

(3) MRI상 후방인대복합체의 전체 구조의 손상이 확인된 경우

(4) 근력저하를 포함한 뚜렷한 신경학적 손상이 동반된 경우

(5) 적절한 보존적 요법에도 불구하고 심한 동통 또는 신경증상을 동반한 후만각의 진행이 발생하는 경우

나. 골다공증성 골절(T-score ≤ -3)

(1) 뚜렷한 신경학적 결손이 있는 경우

(2) 적절한 타 치료방법에도 불구하고, 심한 통증이 장기간 지속되며 변형의 진행으로 인해 교정이 필요한 경우

일반 골절

– 현재의 Disability에 대한 처치

– 미래의 Risk에 대한 방책

골다공증성 골절

– 현재의 Disability에 대한 처치

Dr. Ying-Kei Chan

Hong Kong

QUALIFICATIONS

1991	Bachelor of Medicine and Bachelor of Surgery, MB, BS, the University of Hong Kong
1995	Fellow of Royal College of Surgeons of Edinburgh, FRCS(Ed)
1999	Fellow of the Hong Kong College of Orthopaedic Surgeons, FHKCOS
1998	Fellow of Royal College of Surgeons of Edinburgh (Orthopaedic), FRCS(Ed)Orth
1999	Fellow of the Hong Kong Academy of Medicine (Orthopaedic), FHKAM (Ortho)
2004	Foundation Fellow, Rehabilitation sub-speciality, Hong Kong College of Orthopaedic Surgeons, FHKCOS
2008	Member, American Board of Independent Medical Examiner, (CIME)

WORKING EXPERIENCE

2016–	Honorary Consultant, Canossa Hospital (Orthopaedics), Hong Kong
2015–	Honorary Consultant, United Christian Hospital, Department of Orthopaedics & Traumatology, Hong Kong
2015–	Direcctor, Dr. YK Chan & Associated Clinic
2010–2015	Consultant, Department of Orthopaedics & Traumatology, Pamela Youde Nethersole Eastern Hospital, Hong Kong
2004–2015	Chief of Spine Division, Department of Otrhopaedics & Traumatology, Panela Youde Nethersole Eastern Hopital, Hong Kong
2011–2015	Deputy Chief of Service, Dept. Orthopaedic & Traumatology, Panela Youde Nethersole Eastern Hopital, Hong Kong
2010–	Honorary Clinical Associate Professor, Faculty of Medicine, the University of Hong Kong
2012–	Honorary Clinical Associate Professor, Faculty of Medicine, the Chinese University of Hong Kong
2004–2009	Honorary Clinical Associate Professor, Faculty of Medicine, the University of Hong Kong
2004–2010	Associate Consultant: Pamela Youde Nethersole Eastern Hospital
1992–2003	Medical Officer: Queen Mary Hospital & the Duchess of Kent Children's Hospital

Guest Lectures I

Principles and Pitfalls of Minimal Invasive Lumbar Spinal Surgery

Dr. Ying-Kei Chan
Hong Kong

'Less is more' is an easily understood slogan that draws people's attention on minimally invasive spine surgery. However, the ultimate aim is not to do 'less', but to 'do no harm' with the appropriate procedure for the indicated pathology.

With the introduction of tubular instruments, modification of operative microscope, the size of surgical wound for dorsal approach lumbar spinal procedure and tissue trauma was much reduced. The use of tubular instruments in contralateral spinal decompression with unilateral approach is popular. However, the intra-spinal-canal contralateral decompressive procedure was not without risk. The reported risk of dural tear and nerve damage was around 7%. The risk was higher for tight spinal canal stenosis with gross ligamentum flavum hypertrophy. Effective contralateral spinal decompression can safely be done with an advance technique using the ligamentum flavum as the natural protective barrier. Surgical access through a bone tunnel at the ventral side of the cranial vertebra above the ligamentum flavum was established first and all the contralateral procedures were performed safely away from dura. A thick ligamentum flavum was facilitative rather obstructive for safe decompression. This technique and the surgical outcome will be discussed in detail.

Percutaneous transforminal endoscopic lumbar discectomy (PELD) is an advance surgical technique and employed direct approach to remove extruded disc. Using small diameter rigid endoscope inserted percutaneously and through intervertebral foramen, prolapse disc fragment can be directly removed through small skin incision. The innocent remaining disc and the dorsal paraspinal muscle do not need to be breech. Patients do not need to undergo general anaesthesia and can give direct feedback during surgery. Surgical access trauma, bleeding and post-operative pain are minimal. Patients recover early. However, surgical skill is demanding with steep learning curve. A thorough understanding on the difference between viewing and working zone, the outside in technique, accurate endoscope placement as well as the contraindication of this technique is crucial and will be discussed.

Minimal invasive lumbar spinal fusion with combined anterior (oblique or direct lateral) approach and posterior fixation is being increasingly popularized. However, there is a lot of controversies on its safety and efficacy. Author's personal experience on Oblique lumbar fusion will be discussed.

Award Article Session

좌장 : **조용은** (연세의대), **박춘근** (수원월스기념병원)

강 지 인

연세의대

EDUCATION

2005–2011	Wonju College of Medicine, Yonsei University, Wonju, Korea

PROFESSIONAL ACTIVITIES

2017–present	Clinical Assistant Professor, Department of Neurosurgery, Yonsei University Severance Hospital, Seoul, Korea
2016–2017	Clinical Fellow, Department of Neurosurgery, Yonsei University Severance Hospital, Seoul, Korea
2012–2016	Residency, Department of Neurosurgery, Yonsei University Wonju Severance Hospital, Wonju, Korea
2011–2012	Internship, Yonsei University Wonju Severance Hospital, Wonju, Korea

LICENSED QUALIFICATION

2016	Board of Neurosurgery, Granted by Ministry of Health and Social Affairs, Republic of Korea
2011	M.D., Granted by Ministry of Health and Social Affairs, Republic of Korea

SCIENTIFIC EXPERIENCE

Middle Meningeal Artery Embolization in Recurrent Chronic Subdural Hematoma Combined with Arachnoid Cyst. – Korean J Neurotrauma, Oct, 2015

Clinical Analysis of Delayed Surgical Epidural Hematoma. – Korean J Neurotrauma, Oct, 2015

Award Article Session

Comparison of Cervical Alignment and Clinical Outcomes in Patients with Os Odontoideum versus Non-Os Odontoideum after Atlantoaxial Fixation

Jiin Kang[1,*], Farid Yudoyono[1,2,*], Yoon Ha[1]

[1]Department of Neurosurgery, Spine and Spinal Cord Institute, Yonsei University College of Medicine, Seoul, Korea ; [2]Department of Neurosurgery, Hasan Sadikin Hospital, Faculty of Medicine, Universitas Padjadjaran, Bandung, Indonesia ; *These authors contributed equally to this study and should be considered co-first authors

Objective : The purpose of this study was to compare the effect of atlantoaxial fixation on cervical alignment and clinical outcomes in patients with os odontoideum (OO) versus non-os odontoideum (non-OO).

Methods : A total of 119 patients who underwent atlantoaxial fixation for instability were identified between January 1998 and January 2014. Inclusion criteria included age more than 21 years and diagnosis of OO and non-OO. There were 22 OO patients, and 20 non-OO patients. Measuring the Oc–C1 Cobb angle, C1–2 Cobb angle, C2–7 Cobb angle, and C2–7 sagittal vertical axis (SVA) was assessed. Clinical outcome was assessment of suboccipital pain was determined using a visual analogue scale (VAS), and Japanese Orthopedic Association (JOA) scores were obtained in all patients pre- and postoperatively.

Results : The preoperative C1–2 angle in the OO group (26.02°±10.53°) was significantly higher than the non-OO group (p=0.04). After C1–2 fixation, the OO group had significantly higher kyphotic change in the C1–2 angle (ΔC1–2) (3.2°±7.3° [OO] vs. −1.46°±7.21° [non-OO]) (p=0.04), and higher decrease in postoperative C2–7 SVA (ΔC2–7 SVA) (5.64±11.56 mm [OO] vs. −0.51± 6.57 mm [non-OO]) (p=0.04). Both groups showed improvements in the health related quality of life (HRQOL) after surgery based on the VAS and JOA score (p<0.001).

Conclusion : After fixation, kyphotic angular change in atlantoaxial joint and decrease C2–7 SVA were marked in the OO group. Both the OO and non-OO groups improved in neurological function and outcome after surgery.

Kazushige Itoki

Dokkyo University Hospital, Japan

Award Article Session

Effect of Myoarchitectonic Spinolaminoplasty on Concurrent Hypertension in Patients With Cervical Spondylotic Myelopathy

Kazushige Itoki
Dokkyo University Hospital, Japan

Jau Ching Wu

National Yang–Ming University, Taiwan

Award Article Session

Ossification of the Posterior Longitudinal Ligament in Cervical Spine: Prevalence, Management, and Prognosis

Jau Ching Wu
National Yang-Ming University, Taiwan

Hemant Kumar

차의과대

Award Article Session

Therapeutic Efficacy-Potentiated and Diseased Organ-Targeting Nanovesicles Derived from Mesenchymal Stem Cells for Spinal Cord Injury Treatment

Hemant Kumar
차의과대

정 대 영

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약력

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Award Article Session

Cold Allodynia after C2 Root Resection in Sprague – Dawley Rats

Daeyeong Chung, M.D.[1], Dae-Chul Cho, M.D., Ph.D.[2], Seong-Hyun Park, M.D., Ph.D.[2], Kyoung-Tae Kim, M.D., Ph.D.[2], Joo-Kyung Sung, M.D., Ph.D.[2], Younghoon Jeon, M.D., Ph.D.[3]

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Objective : The purpose of this study was to evaluate pain-related behaviors after bilateral C2 root resection and change in pain patterns in the suboccipital region in rats.

Methods : Male Sprague-Dawley rats were randomly assigned to three groups (n=25/group); näive, sham, and C2 resection. Three, 7, 10, and 14 days after surgery, cold allodynia was assessed using 20 μL of 99.7% acetone. c-Fos and c-Jun were immunohistochemically stained to evaluate activation of dorsal horn gray matter in C2 segments of the spinal cord 2 hours, 1 day, 7 days, and 14 days after surgery.

Results : Three days after surgery, the response to acetone in the sham group was significantly greater than in the näive group, and this significant difference between the näive and sham groups was maintained throughout the experimental period ($p<0.05$ at 3, 7, 10, and 14 days). Seven, 10, and 14 days after surgery, the C2 root resection group exhibited a significantly greater response to acetone than the näive group ($p<0.05$), and both the sham and C2 resection groups exhibited significantly greater responses to acetone compared with 3 days after surgery. No significant difference in cold allodynia was observed between the sham and C2 root resection groups throughout the experimental period. Two hours after surgery, both the sham and C2 root resection groups exhibited significant increases in c-Fos- and c-Jun-positive neurons compared with the naive group ($p=0.0021$ and $p=0.0358$ for the sham group, and $p=0.0135$ and $p=0.014$ for the C2 root resection group, respectively). One day after surgery, both the sham and C2 root resection groups exhibited significant decreases in c-Fos -positive neurons compared with two hours after surgery ($p=0.0169$ and $p=0.0123$, respectively), and these significant decreases in c-Fos immunoreactivity were maintained in both the sham and C2 root resection groups 7 and 14 days after surgery. The sham and C2 root resection groups presented a tendency toward a decrease in c-Jun-positive neurons 1, 7, and 14 days after surgery, but the decrease did not reach statistical significance.

Conclusion : We found no significant difference in cold allodynia and the early expression of c-Fos and c-Jun between the sham and C2 resection groups. Our results may support the routine resection of the C2 nerve root for posterior C1-2 fusion, but, further studies are needed.

Keywords : cold allodynia, C2 root resection, neuropathic pain, posterior atlantoaxial fusion

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EDUCATION

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HRPP IRB EDUCATIONS

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3. AAHRPP and GCP education, Feb. 27, 2015
4. GCP education, Consent under particular situation, Oct. 31, 2013
5. AAHRPP and GCP education, Sep. 8, 2011

MEDICAL LICENSURE / CERTIFICATION

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Licensure; Republic of Korea, No. 79994 Feb. 2003

Award Article Session

Clinical and radiological ourcomes of posterior vertebral column resection for severe spinal deformities

Byoung Hun Lee, M.D.,[1], Seung-Jae Hyun, M.D., Ph.D.[1], Ki-Jeong Kim, M.D., Ph.D.[1], Tae-Ahn Jahng, M.D., Ph.D.[1], Yongjung J. Kim, M.D.[2], Hyun-Jib Kim, M.D., Ph.D.[1]

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Objective: The aim of this study was to investigate clinical and radiological outcomes of patients who underwent posterior vertebral column resection (PVCR) by a single neurosurgeon in a single institution.

Materials and Methods: Thirty-four consecutive patients with severe spinal deformities who underwent PVCR between 2010 and 2016 were enrolled. The radiographic measurements included a kyphotic angle of PVCR levels (VCR angle), sagittal vertical axis (SVA), thoracic kyphosis, lumbar lordosis (LL) and spinopelvic parameters. The data of surgical time, estimated blood loss, duration of hospital stay, complications, intraoperative neurophysiologic monitoring, and the Scoliosis Research Society (SRS)-22 questionnaire were collected using retrospective review of medical records.

Results: The VCR angle, LL, and SVA values were significantly corrected after surgery. The VCR- and LL angle were changed from the average of 38.4±32.1° and -22.1±39.1° to -1.7±29.4° and -46.3±23.8°, respectively. The SVA was significantly reduced from 103.6±88.5 mm to 22.0±46.3 mm.The clinical results using SRS-22 survey improved from 2.6±0.9 to 3.4±0.8 ($p = 0.033$). There were no death and permanent neurological deficits after PVCR. However, complications occurred in 19 patients (55.9%). Those patients experienced a total of 31 complications during- and after surgery. Sixteen reoperations were performed in twelve (35.3%) patients. The incidence of transient neurological deterioration was 5.9 % (2 out of 34 patients).

Conclusion: Severe spinal deformities can be effectively corrected by PVCR. However, the PVCR technique should be utilized limitedly because surgery-related serious complications are relatively common.

Keywords: Posterior vertebral column resection, kyphotic angle, deformity correction, complication.

2018. 9. 14 (Fri.)

Free Paper Session I

(척추 외상 및 종양)

좌장 : **김우경** (가천의대), **이정길** (전남의대)

Free Paper Session I

FP I-1

Treatment outcomes of 17 patients with atypical spinal meningioma, including 4 with metastases: A retrospective observational study

Noh Sung Hyun, Gang Ji-Inn, Kim Kyung Hyun, Park Jeong Yoon, Kuh Sung Uk, Chin Dong Kyu, Kim Keun Su, Cho Yong Eun

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Purpose : Surgical and clinical outcomes were reviewed to determine the biological behavior and prognostic factors of atypical spinal meningioma. Because of the scarcity of atypical meningioma, there is a lack of research on this type of tumor and malignant transformation.

Materials and methods : We retrospectively reviewed the data from all patients on whom we performed spinal cord tumor removal between 1994 and 2016. Seventeen patients were pathologically proved to have atypical meningioma. Surgical extent and disease progression were established by the surgeon according to operative findings, postoperative MRI, and outpatient department (OPD) follow-up.

Results : Seventeen patients were included in the analysis, 12 (70%) of whom had tumors in the thoracic region, 4 (24%) of whom had tumors in the cervical region, and 1 (6%) of whom had tumors in the sacral region. Complete resection was achieved in 15 (88%) patients, and subtotal resection was performed in 2 (12%) patients. 4 (24%) patients had metastatic meningioma from brain. Among 4 patients, 3 patients administered radiotherapy after surgery as adjuvant radiotherapy. One patient who underwent surgery for anaplastic meningioma in the brain recurred, and underwent three operations in the spine. The 5- and 10-year overall survival rates were 88.3%, while the 5- and 10-year recurrence-free survival rates were 83% and 52%, respectively. Additionally the mean Ki-67 index differed significantly between patients who did and did not develop recurrence (43% vs. 14%; p=0.001).

Conclusion : Complete resection should be considered as a primary treatment modality for individuals with atypical spinal meningioma. If subtotal resection is performed, adjuvant therapy can be administered.

Free Paper Session I

FP I-2

Surgical outcome of spinal giant cell tumors

Joon Ho Yoon, Chun Kee Chung
Seoul national university

Purpose : Giant cell tumor (GCT) is benign but locally aggressive neoplasms. This study reviews the surgical outcome of GCT arising in the spine which underwent surgical treatment.

Materials and methods : A consecutive series of 9 giant cell tumor (GTC) of the spine which underwent surgical treatment was observed from 2003 to 2015 and had follow-up data more than two years. Ten patients with giant cell tumor of the spine had surgery between 2003 and 2015. Except one patient had follow-up data at least two years.

Results : All of nine patients survived and kept following-up. One lesion was located in the cervical, five lesions were in the thoracic spine, and three lesions was in the lumbar spine. Gross total removal done in eight cases and four received en-bloc resection. Preoperatively, six patients had tumor embolization. One patient underwent subtotal resection. Two patients had local relapse and adjuvant chemotherapy was done to one of them. The patient who underwent subtotal resection received adjuvant radiotherapy. There was one case that recurred after had surgery other hospital. In that case, adjuvant chemotherapy and radiotherapy was done postoperatively. Four additional surgery needed in whole series. Two was surgery for local relapse, and two was for instrumental failure.

Conclusion : GTCs are known as a kind of benign but local aggressive. In many literatures, en-bloc spondylectomy with wide margins yields good results in terms of survival. In our series, however, eight cases stable more than two years although some contamination occurred more than half of cases. The role of marginal resection important as well as en-bloc resection.

Free Paper Session I

FP I-3

Analysis of clinical and functional outcome of Sacral schwannoma with LINAC based Radiosurgery (Novalis)

Jeong Mee Park, Chae-Heuck Lee, Dong-Jun Lee, Seong Rok Han, Hae Won Koo, Moon-Jun Sohn

Inje University Ilsan Paik Hospital

Purpose : The mainstay of treatment for the patients with schwannomas is surgical excision. However, surgical excision of intraosseous and giant invasive sacral tumor often causes extensive blood loss and requires combined anterior and posterior approaches. Available studies suggest that intralesional curettage alone is probably unacceptable as it has a significantly high recurrence rate. Another issue that should be addressed intraoperatively is the potential need for spino-pelvic reconstruction if the stability is compromised. Although there is a fear of the risk of radiation induced secondary malignancy in the treatment of benign tumors, the actual occurrence is extremely rare. Stereotactic radiosurgery has increasingly become an important alternative treatment for spinal tumors. The purpose of this series was to review our outcomes of giant intraosseous and sacral schwannomas treated by upfront and adjuvant stereotactic radiosurgery.

Materials and methods : A total 87 patients of spinal schwannoma were treated by SRS. Among them, 6 patients who had giant intraosseous and sacral schwannomas (6.8%) underwent hypofractionated radiosurgery using Novalis platform (BrainLab). Outcomes analysis was performed by review of all available pre- and post-treatment documentation obtained at our institution. The control of tumor volume and radiographic changes was assessed on MR imaging. Secondary outcomes included the control of pain and status of neurologic deficit.

Results : Two patients of giant invasive sacral schwannoma were asymptomatic and were incidentally diagnosed by imaging study. Four patients of giant intraosseous schwannoma suffered from intractable pain with or without neurogenic bladder. Among these, three patients' symptoms were related to progression of residual tumors after initial surgical resection. Remaining three patients were pathologically proven by CT guided biopsy.

Male to female ratio was 2:4. Mean age was 51.3 years. Average of prescription dose was 30.5 Gy in 3 to 5 fractions. Mean GTV was 137.5 cm3 (range: 41.9 to 210.0 cm3). Median follow up period was 97.5 + 53.5 months. One lost follow up. Only one patient remained suffering from preexisiting neurogenic bladder and hydronephrosis. In our series, symptomatic cure was achieved in all cases. Local tumor control was achieved with neurologic preservation.

Conclusion : We suggest that SRS might be considered as a treatment modality with satisfactory clinical outcome and local tumor control. Although, giant intraosseous and sacral schwannomas is mainly treated by surgical resection, complete excision of the tumor remain still challenging. SRS is a reasonably safe and effective therapeutic option in terms of neurological function and motion segment preservation which is often sacrificed following surgical resection.

Free Paper Session I

FP I-4

Optimal surgical methods for solitary metastasis of the thoracolumbar spine

Sung Mo Ryu, Kyung Min Lee, Sun-Ho Lee, Whan Eoh, Eun-Sang Kim
Department of Neurosurgery, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea

Purpose : The aim of this study was to identify the optimal surgical methods for extracompartmental solitary metastasis of the thoracolumbar spine.

Materials and methods : From January 2003 to December 2017, 45 patients who underwent surgical treatment for solitary metastases of the thoracolumbar spine were analyzed. We classified the enrolled patients into 4 groups by surgical methods: Stabilization alone, decompression with stabilization, piecemeal corpectomy, and Total en bloc spondylectomy (TES). We compared the postoperative and the preoperative ASIA scale and classified it into clinical improvement, same clinical status, and neurologic deterioration. The clinical outcomes of overall survival (OS), local recurrence-free survival (RFS), and distant RFS were calculated by Kaplan-Meier survival curves and compared using log-rank test. And then, univariate Cox proportional hazards regression models were used to analyze efficiency of surgical methods.

Results : Our study population included 30 men (66.7%) and 15 woman (33.3%). The mean age at the time of surgery was 49.1 (range, 33-67) years. There were 8 cases of stabilization alone, 12 cases of decompression with stabilization, 16 cases of piecemeal corpectomy, and 9 cases of TES. Baseline characteristics, such as mean age and sex, did not differ between the four groups ($p > 0.05$). Operation time was significantly short in stabilization alone group compared with other three groups ($p < 0.001$). The local recurrence rate of TES was lower than other 3 groups, but it did not reach statistical significance. The distant recurrence rate was high in piecemeal corpectomy group compared with decompression with stabilization group ($p = 0.006$). Other factors, such as hospital stay and neurologic change, were not significantly differ between the 4 groups ($p > 0.05$). Compared with the stabilization alone group, piecemeal corpectomy group was significantly associated with a decreased OS (HR = 3.86, P = 0.037) and a decreased distant RFS (HR = 3.59, P = 0.026) in univariate Cox proportional hazards regression model.

Conclusion : Our findings suggested that surgical methods should be tailored to individual cases to maximize the tumor control and decrease the recurrence rate and the risk of postoperative complications. If the tumor is mainly located at anterior to the spinal cord, posterior approach will not sufficient to decompress the lesion and therefore vertebral body removal, such as piecemeal corpectomy or TES, should be considered. In particular, TES by experienced surgeons can be beneficial for patients affected by intracompartmental solitary spinal metastasis with a good prognosis.

Free Paper Session I

FP I-5

Causal network of genes related with bone metastasis of breast cancer using Bayesian networks

Sung Bae Park[1], Changwon Yoo[2]
[1]Seoul National University Boramae hospital, [2]Florida International University

Purpose : To obtain plausible causal network of genes commonly expressed in bone metastasis of breast cancer using Bayesian inference network.

Materials and methods : Gene expression microarray profiles of samples with bone metastasis of breast cancer, breast cancer without metastasis samples, and osteoblasts from seven different studies from Gene Expression Omnibus database. We selected the commonly expressed genes to all 48 subjects. The genes, which were registered as breast cancer related genes in KEGG, were included as candidate genes in the implementation of BANJO. Then, we got the Bayesian structure that consisted of nodes in the 1st degree Markov Blanket through implementation by using GeNIe. We assessed the prediction rate for bone metastasis, conditional independence among nodes and causality among nodes in the final model. In addition, we reported maximum relative risks of combined gene expression of the genes in the mo

Results : From 1,218 common genes of seven different Gene Expression Omnibus studies, machine learning Bayesian analysis and bioinformatics tools in conjunction with the reviewal of published papers, helped us in identifying 70 genes related to bone metastasis of breast cancer. Furthermore, the above mentioned process helped us to identify 33 significantly related and plausiby mechanistically involved genes in the development of bone metastasis as it relates to breast cancer. Some of the notable genes among the 33 genes were: NFKB2, which is known as breast cancer related gene and promotes breast cancer stem cell growth, five genes - SLC10A3, FZD1, BTNL8, KIF11, CACYBP - related with chemotherapy resistance and another five genes - KIF11, MAP2K2, PSAT1, TSPO, ZFP36L2 - known as having a relationship with cancer progression and metastasis. Further model evaluations showed that 16 genes were enough for a model to be statistically significant in terms of maximum likelihood of the causal Bayesian networks (plausible mechanistic gene interactions) and correct predictions of bone metastasis of breast cancer. Maximum relative risks of combined gene expression patterns show that the expression levels of UBIAD1, HEBP1, BTNL8, TSPO, PSAT1 and ZFP36L2 significantly affect whether a subject develops bone metastasis from breast cancer in situ or not

Conclusion : The causal Bayesian network structure seems to be a reasonable inference network with a high prediction rate of bone metastasis of breast cancer. Several genes including ZFP36L2 may be promising candidates for the diagnosis and treatment of BMBC. Causal Bayesian network analysis may provide us with a more comprehensive understanding of bone metastasis.

FP I-6

Partial Pedicle Subtraction Osteotomy (Grade III) or Modified Boachie Osteotomy (Grade IV) with Vertebral Body Remodeling for the Treatment of Posttraumatic Thoracolumbar Kyphosis

Ui Seung Hwang, Dae-Jean Jo, Ho Yong Choi
Kyung Hee University Hospital at Gangdong

Purpose : Post-traumatic kyphosis (PTK) occurs most commonly in the thoracolumbar and lumbar regions (mid- to lower-back) after an injury. Patients with PTK present with a variety of symptoms, pain, progressive deformity, and deteriorating neurologic status. Pedicle subtraction osteotomy is good surgical treatment option for severe and rigid deformity with sagittal imbalance of thoracolumbar spine. However, several complications have been reported after PSO. So, we have used partial pedicle subtraction osteotomy (Gr. III) or modified Boachie osteotomy (Gr. IV) to reduce complications; lesser body resection and more achieved correction angle through vertebral body remodeling. The purpose of this study was to assess the use of this technique for the treatment of posttraumatic thoracolumbar kyphosis and to evaluate the radiographic findings and clinical outcomes of patients.

Materials and methods : 47 consecutive patients with symptomatic posttraumatic thoracolumbar kyphosis were treated using a partial pedicle subtraction osteotomy (Gr. III) or modified Boachie osteotomy (Gr. IV) with vertebral body remodeling (Gr. III : adequate compacted bone graft insertion, Gr. IV : mesh cage support with adequate compacted bone graft insertion). The mean patient age was 61 years. The kyphosis apex ranged from T-9 to L-3. The sagittal alignment, kyphotic angle, neurological function and visual analog scale for back pain are evaluated before surgery and at follow-up.

Results : The mean preoperative regional kyphotic angle was 35°, and the mean correction angle was 41.4°. The mean surgical time was 220 minutes (range 140-435), and the mean intraoperative blood loss was 1125 ml (range 300-5000). The intraoperative complications included 2 dural tears, 4 nerve root injury, 3 superficial wound infection. The mean visual analog scale score for back pain improved from 7.4 to 3.3 at the last follow-up. All patients achieved bony anterior fusion based on the presence of trabecular bone bridging at the osteotomy site.

Conclusion : Partial pedicle subtraction osteotomy (Gr. III) and modified Boachie osteotomy (Gr. IV) with vertebral body remodeling technique achieves satisfactory kyphosis correction despite lesser body resection, direct visualization of the circumferentially decompressed spinal cord, as well as good fusion and fewer complications. Both surgical methods are good options for treating patients with posttraumatic thoracolumbar kyphosis.

Free Paper Session I

FP I-7

Clinical and Radiological Analysis of C5 Palsy in Cervical Spine Surgery Patients: A Korean Cervical Spine Study Group (KCSSG) Multicenter Study

Ho Jin Lee[1], In Ho Han[2], Jae Taek Hong[3], Yong Jun Jin[4], Dae-Chul Cho[5], Kyung Hyun Kim[6], Sun Ho Lee[7], Kyung Chul Choi[8], Seong Yi[9], Jun Jae Shin10, Jung-Woo Hur[11], Chun Kee Chung[12], Jae Keun Oh[13], Ki Jeong Kim[14], Dong Ho Kang[15]

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Purpose : The development of C5 palsy is a well–documented complication after cervical spine surgery. Although, a number of hypotheses of C5 palsy have been suggested from many single center studies or systemic reviews (meta-analysis), but it's clear pathologic mechanism is inconclusive until now. Because, a small number of study cases and fundamental limitation from the heterogenic document-based analysis may not be sufficient to investigate the pathophysiology of C5 palsy comprehensively. Therefore, we need to investigate as many as C5 palsy cases as possible to obtain more precise information and understand. The aim of the present study was to more specific evaluation of actual C5 palsy cases with radiological and clinical approach through the multi-center case series study.

Materials and methods : The authors reviewed the medical chart record and conducted radiological analysis of 87 patients (male: 68, Female: 19, mean age 61.2) who had C5 palsy after cervical spine surgery from the fifteen spine medical center from the Korea Cervical Spine Study Group (KCSSG). C5 palsy was defined as deterioration of deltoid muscle impairment one or more grades worse in a manual muscle test. We investigated multiple clinical factors (Sex/age/BMI/DM/pre-operative symptom/symptoms duration/operation level/operation method/side of C5 palsy/C5 palsy grade/course for recovery of C5 palsy/Japanese Orthopedic Association; JOA score) and radiological factors (pre-operative diagnosis/C4-5 transverse foramen diameter/lamina open angle/occupying ratio/cord shift/cord signal change;T2WI,cervical alignment; C2-7 angle; T1slope; Ishihara cervical curvature index; cord rotation; Pavlov ratio) using pre and post-operative X-ray, CT and MRI.

Results : There are 27 anterior approach surgeries, 53 posterior approach surgeries, and 3 anterior-posterior approach. Eighty (92%) cases involved C4-5 operation level and other clinical and radiological factors were demonstrated (Table 1). We conducted multiple sub-group analyses (anterior vs posterior, laminopalsty vs posterior fusion and unilateral C5 palsy vs bilateral palsy). Anterior approach group showed less value of cervical lordosis and have larger value of JOA score than posterior approach group statistical significantly. The mean diameter of C4-5 foramen was less than 2.2 mm at both group and statistical difference was not found between two groups (Table 2). Only pre-operative JOA score was larger in the laminoplasty group than posterior fusion group statistical significantly. Bilateral C5 palsy patients showed larger value of occupying ratio and symptom duration than unilateral C5 palsy cases, statistical significantly. Although statistical insignificant, T2HIZ was prominent in bilateral C5 palsy group (7/10; 70% vs 30/ 75; 40%) than unilateral C5 palsy group. In unilateral C5 palsy group, 15 cases (15/18, 83%) showed deltoid weakness at lamina open side (open-door laminoplasty). We conducted other sub-group analyses regarding to the C4-5 foramen diameter. We dived all patients into three subgroups according to the level of C5 palsy(Group A: G1-2, Group B: G3 and Group C: C4). Severe C5 palsy group (Group C) showed small value of C4-5 foramen diameter and non-discrepancy of palsy side than less severe C5 palsy group (Group B and C) ($P<0.05$). Delayed onset (POD 2days after) of C5 palsy patients showed less value of symptom duration. Late onset C5 palsy has more severe C5 palsy and less recovery rate of palsy

Conclusion : Almost cases of C5 palsy was closely related to C4-5 surgical level regardless of surgical approach. Laminoplasty and fusion group did not statistical significant differences at almost measured parameters, excepting pre-operative JOA score. Bilateral C5 palsy may be related with T2HIZ and had a larger occupying ratio and longer duration of symptoms. Lamina open side was very closely related to the side of C5 palsy and severe C5 palsy has less dimension of C4-5 foramen diameter (mean value: less than 2.2mm) and showed less discrepancy at laterality of palsy. Late onset C5 palsy has more severe C5 palsy and less recovery rate of palsy and late onset C5 palsy showed less duration of symptoms

Free Paper Session I

FP I-8

Predicting survival of spinal ependymoma patients using machine learning algorithms with SEER database

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Purpose : This study was conducted to understand the clinical and demographic factors influencing the overall survival (OS) of spinal ependymoma patients and to predict the OS with machine learning (ML) algorithms.

Materials and methods : We compiled spinal ependymoma cases diagnosed between 1973 and 2014 from the Surveillance, Epidemiology, and End Results (SEER) registry. To identify the factors influencing survival, statistical analyses were performed using the Kaplan-Meier method and Cox proportional hazards regression model. In addition, we implemented machine learning algorithms to predict the OS of spinal ependymoma patients.

Results : In the multivariate analysis model, age ≥ 65 years, histological subtype, extraneural metastasis, multiple lesions, surgery, radiation therapy, and gross total resection (GTR) were found to be independent predictors for OS. Our ML model achieved an area under the receiver operating characteristic curve (AUC) of 0.74 (95% confidence interval [CI], 0.72-0.75) for predicting a 5-year OS of spinal ependymoma and an AUC of 0.81 (95% CI, 0.80-0.83) for predicting a 10-year OS. The stepwise logistic regression model showed poorer performance by an AUC of 0.71 (95% CI, 0.70-0.72) for predicting a 5-year OS and an AUC of 0.75 (95% CI, 0.73-0.77) for predicting a 10-year OS.

Conclusion : With SEER data, we reaffirmed that therapeutic factors, such as surgery and GTR, were associated with improved OS. Compared with statistical methods, ML techniques showed satisfactory results in predicting OS although the dataset was heterogeneous and complex with numerous missing values.

Free Paper Session II

(경추)

좌장 : **신현철** (성균관의대), **조정기** (가톨릭의대)

Free Paper Session II

FP II-1

Clinical Analysis of Radiologic Measurements in Patients with Basilar Invasination

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Purpose : To investigate the correlation between two radiologic measurements and clinical outcomes in patients with basilar invasination (BI).

Materials and methods : Medical records and radiologic data was analyzed retrospectively on patients who undergone posterior atlantoaxial fusion or occipitocervical fusion for BI from January 2010 to December 2016. Patients under 15-year old, polytraumatic, tumorous and infectious pathologies were excluded. Forty-one patients were included. Modified Ranawat (MRM) and Redlund-Johnell methods (RJM) were measured at preoperative, postoperative, 3months, last follow-up. Visual Analogue Scale (VAS), Neck Disability Index (NDI) and Japanese Orthopedic Association (JOA) score were assessed. We evaluated the relationship between two radiologic measurement and clinical outcomes during the follow up.

Results : Mean age was 57.8±16 years. The mean body mass index was 23.3±4.8. Twenty-three females and 18 males. Mean follow-up was 41.1±23.2 months. Occipital numbness and neuralgia were common postoperative complications. Additionally, one neurovascular injury and three postoperative dysphagia occurred postoperatively. Radiologic measurements increased about 36% postoperatively comparing to preoperative measurements. The decrease of radiologic measurements was occurred for most patients 3 months after surgery, although clinical outcomes were not deteriorated. The improving rate of JOA score showed linear correlation with the change rate of two radiologic measurements. Especially, it is significant with MRM ($p<0.05$). This linear relationship was significant at postoperative time. Furthermore, this trend maintained until the last follow-up.

Conclusion : Neurologic status in patients with BI simply has a linear relationship with the amount of vertical reduction.

Free Paper Session II

FP II-2

Anterior Cervical Discectomy and Fusion with BGS-7 spacer (NOVOMAX®-C)

Dalsung Ryu[1], Jong-Yeol Kim[2], Keun-Su Kim[3]
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Purpose : The gold standard of bone fusion material for an anterior cervical discectomy and fusion (ACDF) is an autograft spacer from an iliac crest. Because an autograft is associated with a high risk of complications, several bone graft substitutes have been developed, including BGS-7 (CaO-SiO2-P2O5-B2O3 bioactive Glass-Ceramics). This study was conducted to obtain preliminary clinical and radiologic results of ACDF surgery using a BGS-7 spacer (NOVOMAX®-C: Spinal Interbody fusion device).

Materials and methods : Between October 2014 and June 2015, 45 consecutive ACDF surgeries using a BGS-7 spacer were performed for degenerative cervical disease. Radiologic assessments were performed using a cervical spine X-ray series at the preoperative, immediate postoperative, and last follow-up time points. Instrumental failure, including breakage, cage migration, subsidence, and fusion status, using the Brantigan and Steffee fusion grade were evaluated. Clinical outcomes were evaluated using neck VAS on the patients' final follow-up visits. The recovery rate after an ACDF surgery was also evaluated using modified Odom's criteria.

Results : Among the 45 patients who underwent an ACDF surgery using the BGS-7 spacer, there were 29 men and 16 women. The average age at the operation was 53.35 ± 10.76 years. The mean follow-up period was 12.37 ± 8.04 months. No spacer breakage was observed on X-rays during the entire follow-up period. The average subsidence length was 1.85 ± 1.49 mm per level. A subsidence greater than 3 mm was found in 11 of 45 patients (24.4%). Among a total of 34 patients who were followed for more than six months, 32 patients (94.1%) demonstrated radiologic evidence of interbody fusion, which accounts for fusion grade 4 or 5. For a total of 45 patients, 42 (93.3%) patients responded excellent or good to recovery.

Conclusion : The BGS-7 spacer demonstrated reliability as a spacer in ACDF surgery without instrumental failure. Although subsidence due to the high mechanical strength of the spacer was noted in 24.4% of enrolled patients, early stabilization with a bony bridge formation was observed at the intermediate follow-up period, and the clinical outcome was consequently favorable. Thus, the BGS-7 spacer is a safe and effective alternative to the autologous iliac graft in ACDF surgery.

Free Paper Session II

FP II-3

Posterior cervical muscle-preserving interspinous process (MIS) approach and decompression: more minimally invasive and modified Shiraish selective laminectomy

Byung-Jou Lee, Seung-Chul Rhim, Sung Woo Roh, Sang-Ryong Jeon, Jin Hoon Park
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Purpose : The importance of the cervical extensor musculature in the occurrence of loss of cervical lordosis (LCL) and neck pain after laminoplasty has been known. Therefore, various surgical methods have been developed to preserve muscle during laminoplasty. We devised the posterior cervical muscle-preserving interspinous process (MIS) approach and decompression that can approach without splitting the spinous process and applied it to selective cases. We describe the operative details of the MIS approach and decompression and clinical outcome of patients.

Materials and methods : MIS approach and decompression was performed in 9 consecutive patients who need only central decompression for the cervical stenosis. Our operation approaches the interspinous space similar to the Shiraish's method but does decompression without fracturing the spinous bifida. Outcome were assessed using mJOA, NDI, and VAS score.

Results : There were no complication, and no case require conversion to convention laminoplasty. The mean operation time was 53.8 minutes per level. And mean blood loss was 45.7 ml per level. Mean hospital stay was 2.5 days. Mean mJOA score at preoperative and postoperative state (a month) was 12.7 and 15.7, respectively. Mean NDI score at preoperative and postoperative state (a month) was 15.4 and 2.3, respectively. Especially postoperative neck VAS score was 0. Mean loss of lordosis was 1.4° ± 0.8°. The mean cervical ROM before and after surgery did not change from 44.4 ± 10.4 to 42.3 ± 11.1.

Conclusion : MIS approach and decompression is less invasive than conventional laminoplasty and Shiraish's selective laminectomy. It is a safe and effective minimally invasive technique for central stenosis by CSM.

Free Paper Session II

FP II-4

Low incidence of dysphagia and early recovery after anterior cervical discectomy and fusion using stand-alone 3D-printed porous titanium cage in single or two-level cervical disc disease

Myung-Soo Song, Kyeong-Sik Ryu, Jin-Sung Kim, Ho-Jung Chung
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Purpose : Anterior plating system yielded higher fusion rate and improved alignment after ACDF surgery but is associated with higher rates of postoperative dysphagia. With the advancement of technology, zero-profile fixation and 3D-printed stand-alone cages have been suggested to decrease the incidence of postoperative dysphagia. Objective of this study is to demonstrate the safety and efficacy of stand-alone 3D-printed porous titanium cage (3D-PTC) compared to that of anterior cervical plate and cage in patients undergoing one or two level anterior cervical discectomy and fusion (ACDF).

Materials and methods : Eighty-one patients with single or two level cervical disc disease (CDD) underwent ACDF surgery using an anterior plate and cage or 3D-PTC implant between December 2016 and December 2017. All patients complete at least 12 month postoperative follow-up survey. The clinical outcomes were evaluated using the Visual analogue scales (VAS) scores for neck and arm pain, neck disability index (NDI) scores and Recovery of postoperative dysphagia. The radiologic results were evaluated with serial plain film and 3D-CT to assess fusion status and device-related complications.

Results : Forty-two patients received an anterior plate and cage and thirty-eight received the 3D-PTC implant. There were no statistical differences in patient demographics and intraoperative details between the two groups. The VAS and NDI scores significantly improved compared with preoperative values in both groups. Fusion rates were found to be similar between the two groups.

Evaluation of postoperative radiographs revealed significantly more swelling of the prevertebral space (21.7 ± 0.8 mm) after implantation of an anterior plate compared with a stand-alone 3D-PTC implant (14.5 ± 0.9 mm, $P < 0.001$). This difference remained significant until 3-month follow-up ($P = 0.035$). The incidence of dysphagia in the 3D-PTC group was lower ($P = 0.027$) compared with that in the plate with cage group, and the symptom duration was much shorter ($p < 0.01$).

Both groups had no adverse events associated with the implant except 3 cases of cage subsidence without neurologic deterioration observed in 3D-PTC group.

Conclusion : ACDF surgery using stand-alone 3D-PTC seems safe and efficacious and lead to similar clinical and radiographic outcomes compared with anterior plating. The rate of postoperative dysphagia and its recovery was much superior with 3D-PTC compared to anterior plate and cage.

Free Paper Session II

FP II-5

The effect of an educational and interactive informed consent process for patients with cervical spondylotic myelopathy caused by ossification of the posterior longitudinal ligament

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Purpose : Cervical spondylotic myelopathy caused by ossification of the posterior longitudinal ligament (OPLL-CSM) is a slowly progressive disease and it is difficult for patients to understand the disease's specific characteristics, therapeutic plan, and prognosis. Few studies have evaluated very specific programs to improve the informed consent process for these patients. In this study, an educational and interactive informed consent (EIC) program was proposed for patients with OPLL-CSM to improve their comprehension level during the informed consent process.

Materials and methods : This prospective study evaluated patients with OPLL-CSM who either underwent the proposed EIC process (n=63) or the standard consent process (n=124). During the EIC process, we provided information about OPLL-CSM through information booklets, a video, verbal information, and initial and second physician-patient interviews. After the second physician-patient interview, the patient was requested to answer 14 medical questions to assess their knowledge about OPLL-CSM. They were asked to report the most useful educational method and the most effective method of reinforcing verbal communication. Informed consent for surgery was obtained from the patients after the second interview.

Results : The mean questionnaire scores were higher in the EIC group than in the control group (12.3±1.2 vs. 10.3±2.4; $p<0.001$). The number of correct answers was positively correlated with the education level ($\rho=0.821$, $p=0.013$). Video was selected by 50/63 patients (79.4%) as the most useful EIC process method, and the most effective method of reinforcing verbal communication was video (n=61; 96.8%). Patients in the EIC group reported having higher satisfaction with surgery ($p=0.024$) than did those in the control group, and the satisfaction scale score correlated with the number of correct answers ($\rho=0.725$, $p=0.041$).

Conclusion : We suggest that the EIC process is a good clinical consultation method. It might help physicians educate and counsel patients about OPLL-CSM and its treatment.

Free Paper Session II

FP II-6

The Risk Factors of Allogenous Bone Graft Collapse in Two Level Anterior Cervical Discectomy and Fusion

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Pusan National University Yangsan Hospital

Purpose : Anterior cervical discectomy and fusion (ACDF) is commonly used surgical procedure for cervical degenerative disease. Meanwhile, graft complications have been reported steadil, such as subsidence in using polyetheretherketone (PEEK) cage or intractable pain on harvest sites in using autogenous bone graft. To lessen these complications of other graft materials, allogenous bone graft have been popularly used. However, graft collapse also happens occasionally in its use. In this study, we investigated the risk factors of graft collapse.

Materials and methods : We retrospectively reviewed 33 patients who underwent two level ACDF with anterior plating using allogenous bone graft (Cornerstone-SR™; Medtronic Sofamor Danek, Memphis, USA) from January 2013 to June 2017. The radiologic parameters included following: 1) cervical cobb angle (CA), 2) segmental cobb angle (SA), 3) sagittal vertical axis (SVA), 4) T1 slope (T1s), 5) range of cervical motion (ROM), 6) plate size and distance from vertebral body anterior border to plate, 7) screw insertion angle, 8) disc height 9) interspinous distance. Pre- and postoperative disc height were analyzed on lateral radiograph, and then intervertebral distraction was obtained as the difference between pre- and postoperative height. More than 2 millimeter of interspinous distance difference on flexion-extension lateral radiograph was defined as pseudarthrosis. Graft collapse ratio was also calculated and more than 30 percent of the ratio was defined as graft collapse.

Results : The mean age of the patients was 56.2 ± 11.6 years and the ratio of men to female was 4.5 to 1. Total 66 segments were included with 4 segments of C3-4, 15 segments of C4-5, 29 segments of C5-6 and 18 segments of C6-7. The fusion rate was 65.2 percent and graft collapse rate was 28.8 percent. There was no association between fusion and graft collapse (p=0.175). Furthermore, there was no relation between upper / lower segment and graft collapse (p=0.786). According to multivariate logistic regression analysis, intervertebral distraction showed statistical significance (p=0.042, odd ratio = 4.147, 95% CI: 1.05 – 16.379). The receiver operating characteristic (ROC) analysis indicated that an increase of more than 2 millimeter of intervertebral distraction could serve as threshold for moderate increase of graft collapse (p=0.017, area under curve=0.689, sensitivity=68.4%, specificity=68.1%).

Conclusion : Graft collapse occurred frequently with 28.8 percent, and more than 2 millimeter of intervertebral distraction is a risk factor of graft collapse.

Free Paper Session II

FP II-7

No difference between 1D, 2D and 3D occupying ratio in reflecting the JOA score in cervical ossification of posterior longitudinal ligament

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Purpose : The goals of this study were to compare the difference among the 1 dimensional (1D) length, 2 dimensional (2D) area and 3 dimensional (3D) volume occupying ratio in terms of relationship and clinical outcome and to reveal the difference of clinical outcome and MRI signal intensity between the central and peripheral type OPLL.

Materials and methods : In total, Sixty patients (49 males and 11 females; mean age of 58.2 years old) with symptomatic OPLL included in this study. 1D and 2D occupying ratio was obtained using Centricity PACS (GE Healthcare). A 3D model was created with Digital Imaging and Communication in Medicine (DICOM) data from CT images via Centricity PACS, using medical image processing software (MIMICS®). Clinical symptoms were measured by the Japanese Orthopedic Association (JOA) score, short-form health survey (SF-36) and neck disability index (NDI). The Increased signal intensity (ISI) seen in T2-weighted MRI was divided into three groups as follows: Grade 0, none; Grade1, ISI limited to one disc level; or Grade 2, ISI beyond one disc level. The axial view of spinal canal in CT scan was divided into three equal parts vertically. Then, OPLL was categorized by central type (OPLL tip was on middle section in the canal) and peripheral type (OPLL tip was on both sides section in the canal) according to the location of most protruded tip of OPLL.

Results : The 1D, 2D and 3D occupying ratio had a significant negative relationship with JOA score (1D: $r = -0.503$, $p < 0.01$, 2D: $r = -0.506$, $p < 0.01$, 3D: $r = -0.516$, $p < 0.01$). There was also close relationship between 1D and 2D, 1D and 3D, 2D and 3D ($r = 0.652, 0.556, 0.776$).

There was little difference in JOA score between central and peripheral type (17.17 vs 17.00, $t=0.274$, $p = 0.785$). The relationship with MR ISI according to central & peripheral type showed no significant difference results ($p = 0.890$).

The each multiple regression analysis showed that the impact of 1D, 2D and 3D occupying ratio on JOA scores is not significantly different (Beta: -0.364 vs -0.411 vs -0.462).

Conclusion : There is no difference between 1D, 2D and 3D occupying ratio in reflecting the JOA score in cervical ossification of posterior longitudinal ligament. And it is sufficient to reflect the occupying ratio in clinical outcome without distinguishing between central and peripheral type.

Free Paper Session II

FP II-8

Clinical significance of Bone loss phenomenon of vertebral bodies at the operative segment after cervical arthroplasty

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Purpose : Heterotopic ossification and spontaneous fusion are complications of cervical arthroplasty. In contrast, bone loss phenomenon of vertebral bodies at the operation segment after cervical arthroplasty has also been observed. The purpose of this study is to investigate a potential complication-bone loss of the anterior portion of the vertebral bodies at the surgically treated segment after cervical total disc replacement (TDR)-and discuss the clinical significance.

Materials and methods : All enrolled patients underwent follow-up for more than 24 months after cervical arthroplasty using the Prodisc-C, Prodisc-vivo, Mobi-C, Discocerv and Baguera C disc. Clinical evaluations included recording demographic data and measuring the visual analog scale and Neck Disability Index scores. Radiographic evaluations included measurements of the functional spinal unit"s range of motion and changes such as bone loss and heterotopic ossification. The grading of the bone loss of the operative segment was classified as follows: Grade 1, disappearance of the anterior osteophyte or small minor bone loss; Grade 2, bone loss of the anterior portion of the vertebral bodies at the operation segment without exposure of the artificial disc; or Grade 3, significant bone loss with exposure of the anterior portion of the artificial disc.

Results : 247 patients were enrolled in this study. Among them, bone loss developed in 114 patients (Grade 1 in 40 patients, Grade 2 in 38 patients, and Grade 3 in 36 patients). Grade 3 bone loss was significantly associated with postoperative neck pain ($p < 0.05$). Bone loss was related to the motion preservation effect of the operative segment after cervical arthroplasty in contrast to heterotopic ossification. Incidence of bone loss was significantly higher in Baguera than other types of artificial discs ($P<0.05$).

Conclusion : Bone loss may be a potential complication of cervical TDR and affect early postoperative neck pain. However, it did not affect mid- to long-term clinical outcomes or prosthetic failure at the last follow-up. Also, this phenomenon may result in the motion preservation effect in the operative segment after cervical TDR.

2018. 9. 14 (Fri.)

Award Competition Session

(나누리 학술상 세션)

좌장 : **오성훈** (나누리병원), **진동규** (연세의대)

Award Competition Session

AC-1

Spinal CT to MR image synthesis using Generative Adversarial Networks (GANs)

Jung Hwan Lee[1], In Ho Han[1], Seong Su Joo[2], In Suk Lee[1], Yoo Sun Song[1], Dong Hwan Kim[1], Seung Han Yoo[1]

[1]Department of neurosurgery, Pusan National University Hospital, [2]Teamelysium

Purpose : Artificial intelligence (AI) and deep learning has been widely applied to medical image analysis. But, application of deep learning has focused on lesion classification of medical images using convolutional neural network. Recently, GANs, that is a type of deep learning algorithm for generating image, has been introduced, and there were some reports to apply GANs to medical imaging. The purpose of our study was to generate spinal magnetic resonance (MR) image from spinal computed tomography (CT) using GANs, and qualitatively and quantitatively evaluate the similarity of synthesized MR images to real MR images.

Materials and methods : GANs were trained to transform spinal CT image slices into spinal magnetic resonance T2 weighted (MRT2) image slices, combining adversarial loss, dual cycle-consistent loss, and voxel-wise loss. The experiments were analyzed using 260 paired of lumbar spinal CT scans and MRT2 images. Then, MRT2 images were synthesized from 15 other spinal CT scans. In order to evaluate the reality of synthetic MR images, two radiologists, two spine surgeons, and two residents blindly classified the real and synthetic MRT2 images. Second, two experienced radiologist evaluated subdividing similarity of real and synthetic MRT2 images. In addition, quantitative analysis of synthetic MRT2 images was performed using the mean absolute error (MAE) and peak signal-to-noise ratio (PSNR).

Results : The degree of similarity of synthetic MRT2 images evaluated by radiologists was 60 ~ 90%. In blind classification of real MRT2 images, the failure rates were from 0% to 40%. The MAE value of each images were ranged from 13.75 to 34.24 pixels (mean: 21.19), and PSNR of each images were ranged from 61.96 to 68.16 dB (mean: 64.92).

Conclusion : This is first study applying GANs to synthesize spinal MR image from CT. In spite of small dataset of 260, synthetic MR images were relatively well implemented. Synthesis of medical imaging using GANs is a new paradigm of AI application in medical imaging. We expect that spinal CT to MR image synthesis using GANs may replace real MR or improve diagnostic usefulness of CT. However, for clinical applications, further studies with various pathologies and large dataset are needed.

Award Competition Session

AC-2

Effect of a bisphosphonate and selective estrogen receptor modulator on bone remodeling in streptozotocininduced diabetes and ovariectomized rat model

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Purpose : Diabetes and menopause can cause severe osteoporosis. In general, menopause and diabetes can lead to an imbalance in bone turnover, which results in secondary osteoporosis. However, the efficacy of antiresorptive drugs against this form of osteoporosis has not been extensively evaluated. The aim of this study was to determine the changes in vertebral bone remodeling when postmenopausal osteoporosis is accompanied by diabetes and the efficacy of bisphosphonates and selective estrogen-receptor modulators (SERMs) against these outcomes.

Materials and methods : Streptozotocin (STZ)-induced diabetic, ovariectomized (OVX) Sprague-Dawley rats were used as the disease model. Alendronate and raloxifene were used as the bisphosphonate and SERM, respectively. We divided sixty-two female rats into 5 groups: (1) control (n = 14), (2) DM (diabetes) (n = 12), (3) DM+OVX (diabetes+ovariectomy) (n = 12), (4) DM+OVX+A (diabetes+ovariectomy+alendronate) (n = 12), and (5) DM+OVX+R (diabetes+ovariectomy+raloxifene) (n = 12). Serum biochemical markers of bone turnover, including osteocalcin and the C-telopeptide of type I collagen (CTX-1), were analyzed. We measured histomorphometric parameters of the fourth lumbar vertebrae using microcomputed tomography. Mechanical strength was evaluated by a compression test.

Results : In the DM and DM+OVX group, only the levels of osteocalcin significantly decreased compared to those of the control group at 8 weeks after ovariectomy. At 12 weeks, the serum CTX-1 levels in the DM+OVX+A and DM+OVX+R groups were significantly lower than those of the DM+OVX group, but there were no changes in the levels of osteocalcin. Bone mineral density and mechanical strength were higher in the DM+OVX+A and DM+OVX+R groups than in the DM and DM+OVX groups ($p < 0.05$).

Conclusion : Even if postmenopausal osteoporosis is accompanied by diabetes in this animal model, both alendronate and raloxifene seem to show antiresorptive effects, decreased bone turnover rates, and improved bone mechanical strength. Therefore, alendronate and raloxifene are effective in the treatment of osteoporosis even for bone loss due to DM and postmenopausal osteoporosis.

Award Competition Session

AC-3

Synergistic Anti-Inflammatory Effects of Gold Nanoparticle and Ursodeoxycholic Acid in Spinal Cord Injury

Seil Sohn, Seongjun Kim, Wan-kyu Ko
CHA University, Bundang CHA Medical Center

Purpose : The aim of this study was to evaluate the anti-inflammatory effects of gold nanoparticle (GNP) including ursodeoxycholic acid (GNP-UDCA) complex as a treatment for the injured spinal cord.

Materials and methods : A moderate mechanical compression injury was imposed on adult Sprague-Dawley (SD) rats. The post-injury locomotor functions were assessed using the Basso, Beattie, and Bresnahan (BBB) locomotor scale and the tissue volume of the injured region was analyzed using luxol fast blue and cresyl violet staining. The pro-inflammatory factors were evaluated by a quantitative real-time polymerase chain reaction (qRT-PCR) and enzyme-linked immunosorbent assay (ELISA). The phosphorylation of the extracellular signal-regulated kinase (ERK), c-Jun N-terminal kinase (JNK), and p38 in mitogen-activated protein kinase (MAPK) signaling pathways related to inflammatory responses were measured by Western blot assays. Anti-inflammatory effect of the injured region was analyzed using immunofluorescence (IF) staining.

Results : GNP-UDCA complex improved the BBB scores and promoted the recovery of the spinal cord lesions. GNP-UDCA induced the expression of anti-inflammatory mediator, arginase-1 (Arg-1). GNP-UDCA complex decreased the pro-inflammatory cytokines of TNF-α, interleukin 1-β (IL-1β), and interleukin 6 (IL-6) in the mRNA and protein levels. GNP-UDCA complex increased the anti-inflammatory cytokine, interleukin 10 (IL-10), in the mRNA and protein levels. GNP-UDCA complex suppressed the phosphorylation of ERK, JNK signals. GNP-UDCA complex reduced pro-inflammatory responses and promoted functional recoveries of the spinal cord injury (SCI) rats.

Conclusion : These results suggest that GNP-UDCA complex is a potential drug for SCI.

Award Competition Session

AC-4

Aggravating factors in sagittal imbalance in Korean Elderly Sagittal Imbalance Cohort Study

Bong Ju Moon, Jung-Kil Lee
Chonnam National University Hospital

Purpose : Natural history and aggravation of sagittal deformity in spine has been not well known. To evaluate aggravating factors of sagittal imbalance in Korean elderly sagittal imbalance cohort study, we performed various examinations for participants with sagittal imbalance for three years.

Materials and methods : We recruited 96 Korean participants who had more than SVA 5cm in Korean elderly sagittal imbalance cohort study at first year and then 69 participants were revisit 2 years later. We evaluated the radiological parameters, MRI, compression fracture, central stenosis, foraminal stenosis, BMD and muscle fatty change, muscle volume, and health related quality of life (HRQOL) from patients` survey. We analyzed the associated factors of aggravation of spinal sagittal imbalance. The aggravation was defined by SVA > 3cm compared to first SVA value or PI-LL > 5 degrees or PT increase more than 3 degrees.

Results : Thirty-nine participants (aggravating group: AG) among 69 participants followed by 2 years had aggravation of sagittal imbalance. The others, 30 participants (non-aggravating group: NAG) had no aggravation of sagittal imbalance. Mean SVA of AG (126.80mm) was higher than SVA of NAG (59.41mm) with statistically significance. PI-LL of AG (36.84°) was higher than that of NAG (25.18°). Age, Sex, BMI, BMD, central stenosis, foraminal stenosis, muscle fatty change, and muscle volume were not different between two groups except multifidus volume (656.21 in AG vs 767.03 in NAG, p =0.034). ODI and SF-36 is not different in two groups. Logistic regression analysis showed higher SVA (OR= 1.013, 95% CI= 1.002-1.025, p = 0.024) correlated with aggravation of sagittal imbalance.

Conclusion : High SVA, small MF volume, and high PI-LL were found significantly in aggravating group of sagittal imbalance. SVA is an aggravating factor in sagittal imbalance. We should consider high SVA and small multifidus muscle volume regarding aggravation of sagittal imbalance.

Award Competition Session

AC-5

Intraoperative neurophysiologic monitoring for cauda equina tumor surgery : retrospective correlation of clinical outcomes and neurophysiological data in 146 cases

Subum Lee, Seung Chul Rhim
Asan Medical Center

Purpose : Cauda equine tumors usually require surgery due to their impingement on neighboring nerve roots, often resulting in pain and neurological deficits. Recently, advanced surgical techniques and use of intraoperative neurophysiologic monitoring (IONM) assist tumor resection safely and immediately detect neural damage in operative field. We report a single surgeon experiences of surgical treatment in 146 patients with primary tumors of cauda equina under IONM

Materials and methods : Patients with intradural and intra-extra dural spinal tumors under T12 level who underwent surgical treatment by a single surgeon were collected from March 2008 to June 2018. Surgery without IONM, intramedullary and metastatic tumors were excluded. Clinical presentation, extent of resection, recurrence, and neurologic outcomes immediately after surgery were recorded. Correlations between postoperative motor weakness and IONM results were retrospectively reviewed. The authors calculated the sensitivity, specificity, and positive and negative predictive values of intraoperative triggered electromyography (t-EMG). The results for other IONMs such as Somatosensory and motor evoked potentials(MEP), bulbocavernous reflex monitoring were also examined

Results : Total 146 patients were treated by surgical series. Sex distribution was more female than male (M:F = 68:78). Mean age was 46.2±15.3. Pain and numbness were the most common symptom of 129 patients, and 78 of them relieved after surgery. In histologically, tumor was confirmed as 119 schwannoma, 10 myxopapillary ependymoma, 4 meningioma, and 10 other kinds of pathologies. Gross total resection was achieved in 121 patients, and five of them were recurred. Subtotal or partial resection in 25 patients and recurrence was occurred in 15 patients. Mean clinical follow up duration was 24.8±21.7 months and mean magnetic resonance imaging follow up duration was 21.1±21.5 months. Fourteen (9.59%) of the 146 patients showed permanent motor deficit or bladder bowel symptom. t-EMG during cauda equina surgery resulted in a sensitivity of 0.25, specificity of 0.92, positive predictive value of 0.27, and negative predictive value of 0.91. MEP was monitored together for 102 patients, and sensitivity (0.56) and positive predictive value (0.36) were higher in this group.

Conclusion : t-EMG was the most important decision making process to decide whether to cut the rootlet. Intraoperative t-EMG monitoring has high specificity and negative predictive value. If t-EMG is positive, maximum effort should be made to preserve the rootlet through meticulous dissection. When the t-EMG was positive but root sacrifice was not avoided, motor deficit was found in 3 cases (27%). Using both t-EMG and MEP complementary can increase detecting power for postoperative neurologic deficit

AC-6

A new index for making decisions regarding C2 lamina decompression in cervical ossification of the posterior longitudinal ligament: The R-line

Byung-Jou Lee, Seung-Chul Rhim, Sung Woo Roh, Sang-Ryong Jeon, Jin Hoon Park
Asan Medical Center

Purpose : Determining the degree of C2 lamina decompression in OPLL extending to the C2 level is difficult. To analyze the association between radiographic factors and postoperative C2 cord shifting and evaluate the usefulness of the R-line (rostral line) as a new index for determining the degree of C2 lamina decompression in ossification of the posterior longitudinal ligament (OPLL) extending to the C2 level.

Materials and methods : We established the R-line to determine the degree of C2 lamina decompression in relation to factors associated with C2 cord shifting. We divided 36 consecutive patients into the incomplete and complete decompression groups and compared the correspondence between the degree of C2 lamina decompression using the R-line and actual degree of decompression in each group.

Results : The maximal degree of cord compression by OPLL and C2–3 local segment lordotic angle correlated with postoperative C2 cord shifting. The R-line was defined as the line that moves backward by normal cord diameter at the posterior edge of the OPLL of maximal compressed cord level by OPLL and parallel to the line passing through the center of the C2–3 vertebral body. In the incomplete decompression group, the actual degree of decompression was insufficient compared with the degree of C2 lamina decompression using the R-line.

Conclusion : If the R-line touches the upper half of the posterior C2 lamina, total laminectomy of C2 should be performed. The R-line is a practical tool for making decisions regarding C2 lamina decompression in OPLL extending to the C2 level.

Award Competition Session

AC-7

Factors for the Acquisition of 10° Angular Change at the Lumbar Spine through Posterior Column Osteotomy in Adult Spinal Deformity Surgery

Sanghyun Han[1], Hyun-Jib Kim[2], Tae-Ahn Jahng[2], Ki-jeong Kim[2], Seung-Jae Hyun[2]

[1]Department of Neurosurgery, Chungnam National University Hospital, Chungnam National University College of Medicine, [2]Department of Neurosurgery, Spine Center, Seoul National University Bundang Hospital, Seoul National University College of Medicine

Purpose : Posterior column osteotomy (PCO) has been known to provide an angular change (AC) of approximately 10° in sagittal plane deformity. However, whether PCO could actually obtain 10° AC according to the particular level at the lumbar spine and which factors can affect the gain of ≥10° AC after PCO remain to be elucidated. The aim of this study was to identify the factors that affect the gain of ≥10° AC through PCO by comparison of radiographic measurements between an AC group and a control group before and after adult spinal deformity (ASD) surgery.

Materials and methods : Forty consecutive patients who underwent multilevel PCOs for ASD in a single institute between 2012 and 2016 were included in this study. PCO was performed in 142 disc space levels of the lumbar spine. We defined the disc space level that obtained >10° AC in the sagittal plane by PCO as AC group, and the rest as controls. The modified Pfirrmann grade, surgical level, implementation of the transforaminal lumbar interbody fusion (TLIF), and radiographic measurements were compared between the groups.

Results : Of the 142 disc space levels, 67 and 75 were assigned to the AC and control groups, respectively. Multivariate analysis identified the surgical level at L4–L5 (odds ratio [OR] = 3.802, 95% confidence interval [CI]: 1.127–12.827, P = 0.031), the execution of TLIF (OR = 3.303, 95% CI: 1.258–8.674, P = 0.015), and preoperative kyphotic disc space angle (OR = 1.397, 95% CI: 1.231–1.585, P < 0.001) as the factors that significantly affected ≥10° AC in the sagittal plane after PCO.

Conclusion : In ASD surgery, PCO cannot always achieve ≥10° AC in the sagittal plane. The factors that can affect the ability of PCO to obtain ≥10° AC in ASD surgery were surgical level at L4–L5, execution of TLIF with PCO, and preoperative kyphotic disc space angle.

Award Competition Session

AC-8

Does Extension Dysfunction Affect Postoperative Loss of Cervical Lordosis in Patients who Undergo Laminoplasty?

Suhun Lee, Geunsung Song, Junseok Lee, Kyungtag Kang, Doo Kyung Son, Dongwuk Son
Pusan National University Yangsan Hospital

Purpose : To investigate whether loss of cervical lordosis (LCL) after laminoplasty can be predicted from specific preoperative dynamic radiograph measurements. Recent studies have focused on the correlation between LCL after laminoplasty and T1 slope. These studies explain this correlation through the injury of the posterior neck muscular-ligament complex (PMLC); however, this muscle injury model could not explain the less kyphotic change in high T1s patients, as reported in some studies as controversy. We have focused on the PMLC constriction reservoir which was represented by extension function (EF).

Materials and methods : We retrospectively analyzed 50 consecutive patients who underwent open-door laminoplasty (>1-year follow-up). EF is defined as extension C2–7 Cobb's angle (CA) minus neutral C2–7 CA (Ext CA - CA). LCL is defined as follow-up CA minus preoperative CA [CA (FU) - CA (PRE)], and significant kyphotic change was defined as LCL<¬10°.

Results : The distribution of LCL was -3.70±7.98 and the significant kyphotic change occurred in 20% of the patients (10/50). EF, C2-7 sagittal vertical axis (PRE), and C2 slope (PRE) were found to be risk factors for LCL by multiple linear regression analysis. The receiver operating characteristic curve analysis revealed that EF could predict the significant kyphotic change well than previously known risk factors. The cutoff value of EF was 14°. No significant kyphotic change occurred at EF ≥14°. Upon limiting the number of patients with preoperative straight curvature (n=28), there is also no significant kyphotic change occurred in any patient whose EF was ≥14°.

Conclusion : :In our study sample, we found that there is no relation between T1 slope and LCL. We have identified a new factor, EF, that could predict LCL after laminoplasty. No significant kyphotic changes after laminoplasty occurred particularly when the EF was ≥ 14.

2018. **9. 15** (Sat.)

Guest Lectures III

좌장 : **조경석** (가톨릭의대), **정용태** (인제의대)

1. Inflammaging: molecular aspects of disc aging — **Dr. Oliver Nic Hausmann** (Switzerland)

2. Nuance of Pre-psoas Surgery Technique and Pearls — **Dr. Hao Wu** (China)

Dr. Oliver Nic Hausmann

Switzerland

Medical Education

Medical Training
1984–1990 School of Medicine, University of Basel

Habilitation / PhD
2004 Venia docendi, Medical Faculty of the University Basel
Thesis: 'Neurobiology of the Spinal Cord Injury.'

Postgraduate Training and Fellowships in Neurosurgery and Spine Surgery
1991–1999 Residency / Chief–Resident / Consultant–in–function in Neurosurgery
University Clinics Basel and Aarau, Switzerland

Professional Status
since 2003 Consultant for Neurosurgery, Hirslanden Klinik St.Anna Lucerne, Switzerland
Head of the Neuro– and Spine Center, Hirslanden Klinik St.Anna, Lucerne

Professional Memberships
– Swiss Association of Neurosurgery (SGNC)
President of the Society since September 2016–2018
Past–President 2018–2020
– European Neurosurgical Association (EANS)
– Swiss Association of Spine Surgery (SGS)
– Cervical Spine Research Society, European Section (CSRS)

Academic Activites
– Teaching at the Medical Faculty of the University of Basel and Bern
– Member of the editorial board of:
  – European Spine Journal
  – Central European Neurosurgery
  – Neurospine

Guest Lectures III

Inflammaging: molecular aspects of disc aging

Dr. Oliver Nic Hausmann
Switzerland

Degeneration of the intervertebral disc (IVD) – triggered by aging, mechanical stress, traumatic injury, infection, inflammation and other factors – has a significant role in the development of the low back pain. Back pain not only has a high prevalence, but also a major socio-economic impact. With the aging population, its occurrence and costs are expected to even grow in the future.

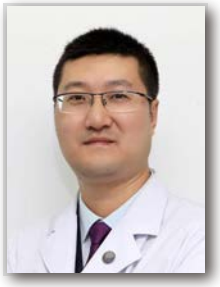
Disc degeneration is characterized by matrix breakdown, loss in proteoglycans and thus water content, disc height loss and an increase in inflammatory molecules. The upregulation of proinflammatory cytokines, such as IL-1□, IL-6, IL-8 or TNF-α, together with aged-related immune deficiency, leads to so-called inflammaging - low-grade, chronic inflammation with a crucial role in pain development. Due to their putative role in pain-transduction and inflammation, Ca2+ permeable Transient Receptor Potential (TRP) channels (TRPC6 and TRPV4) may contribute to disc degeneration and discogenic pain and hence be of mechanistic relevance in disc inflammaging.

Further, the expression of cytokines that have previously gained little or no attention in disc research (INFA1, IFNA8, INFB1, IL-15) may be essential in the process of disc degeneration, as they were affected by central patient/tissue characteristics, such as the degeneration grade, age and degree of the disc degeneration itself. However, despite the relevance of these molecular processes, current therapies target symptoms, but not underlying the causes.

In summary, the biological and biomechanical changes that occur in a degenerated disc, reflects the connection between disc degeneration and inflammaging. It highlights factors that enhance the inflammatory processes in disc pathologies and suggests future research avenues.

Dr. Hao Wu

China



Education

1994–2001	M.D. Bethune Medical University, Changchun, Jilin Province, China
2002–2005	PhD Capital Medical University,Beijing,China

Post-Graduate Training

2015	Promoted to chief physician in Dept of Neurosurgery, Beijing
2014	Learnt OLIF Approach in Boston Medical Center, USA
2013–2014	Participated in World Federation of Neurosurgical Societies (WFNS) and Served as the Host in the Spine Chapter, Seoul, Korea
2012–2013	Learnt MISS Technology in North American Spine Center, USA
2011–2012	Promoted to be Associate Senior Doctor in Dept of Neurosurgery, Beijing Xuanwu Hospital, Beijing, China
2006–2010	Promoted to be Attending Doctor in Dept of Neurosurgery, Beijing Xuanwu Hospital, Beijing, China
2005–2006	Chief Resident in Dept of Neurosurgery, Beijing Xuanwu Hospital, Beijing, China
2004–2005	Learnt from President of the World Federation of Neurosurgery, Professor M. Samii, Germany D. Certification and Licensure: Medical Practitioner's License: National Health and Family Planning Commission of PRC

Honors and Awards

2005	Outstanding Paper Award, Doctoral Forum of Xuanwu Hospital

Guest Lectures III

Nuance of Pre-psoas Surgery Technique and Pearls

Dr. Hao Wu
China

OLIF First described by Michael Mayer in 1997 and involves an MIS access to the disc space via a corridor between the peritoneum and psoas muscle. The phrase “oblique lumbar interbody fusion” or OLIF was first coined by Silvestre in 2012. Advantages of OLIF over LLIF include keep psoas intact (Rare neurological injury), no access limitation, rare ureter or vascular injury and better alignment. The indications, features, and tips and tricks of OLIF were introduced. Some meaningful OLIF cases were also introduced in the presentation.

Luncheon Seminar I

좌장 : **장태안** (서울의대), **김상우** (영남의대)

1. Early experience of E-coli-derived recombinant human bone morphogenetic protein-2 in spine surgery
신동아 (연세의대)

2. Spinal deformity correction using poly – and uniplanar changeable screws **현승재** (서울의대)

신 동 아

연세의대

Internship

1998–1999 Severance Hospital Seoul, Republic of Korea

Residency

1999–2003 Severance Hospital Seoul, Republic of Korea Neurosurgery

Board Certified

2003 Korean Board of Neurosurgery

Private Practice

2003–2004 Jamsil Spine Hospital–Attending Seoul, Republic of Korea

Academic Appointments

2004–2006 Presbyterian Medical Center Department of Neurosurgery Associate Attending
2004–Present Korean Spinal Intervention Society Spine Intervention Procedure Program Instructor
2006–2007 Yonsei University College of Medicine Department of Neurosurgery Clinical Fellow
2007–2012 CHA University Department of Neurosurgery Assistant Professor
2012–Present Yonsei University College of Medicine Department of Neurosurgery Clinical Associate Professor
2011–Present Gwangju Institute of Science and Technology (GIST) Department of Medical Engineering Adjunct Professor

Professional Associations Member

2003–Present Korean Neurosurgical Society
2004–Present Korean Spinal Neurosurgery Society
2004–Present Korean Pain Intervention Society
2004–Present Korean Minimally Invasive Spine Surgery Society
2004–2006 Korean Society of Thermology
1999–Present Korean Medical Society
2007–Present American Association of Neurological Surgeons
2006–Present International Spinal Intervention Society
2014–Present Korean Pain Research Society
2014–Present International Association for Study of Pain

Luncheon Seminar I

Early experience of E-coli-derived recombinant human bone morphogenetic protein-2 in spine surgery

신 동 아
연세의대

현 승 재

서울의대

EDUCATION

Ph.D., Aug. 2007–Jun. 2009	Chung–Ang University College of Medicine, Seoul, South Korea (Instructed by professor Young–Baeg Kim, M.D., Ph.D.)
M.S., Aug. 2004–Feb. 2007	Chung–Ang University College of Medicine, Seoul, South Korea (Instructed by professor Jong–Sik Suk, M.D., Ph.D.)
B.S., Mar. 1999–Feb. 2003	Chung–Ang University College of Medicine, Seoul, South Korea PreMedic School, Mar. 1997 – Feb. 1999 Chung–Ang University College of Nature and Science, Seoul, South Korea

HRPP IRB EDUCATIONS

1. AAHRPP and KGCP education ([on]–17–CRI–00005538), Jun. 12, 2017
2. AAHRPP and KGCP education ([on]–16–CRI–00006726), Jun. 17, 2016
3. AAHRPP and GCP education, Feb. 27, 2015
4. GCP education, Consent under particular situation, Oct. 31, 2013
5. AAHRPP and GCP education, Sep. 8, 2011

MEDICAL LICENSURE / CERTIFICATION

Certification: Korean Board of Neurosurgery, No.2086 Feb. 2008
Licensure; Republic of Korea, No. 79994 Feb. 2003

Luncheon Seminar I

Spinal deformity correction using poly – and uniplanar changeable screws

현 승 재
서울의대

2018. **9. 15** (Sat.)

Plenary Session :
KSNS! Korea Spine, New Start!

좌장 : **송근성** (부산의대), **장호열** (일산병원)

1. 척추학 3판: 현재를 출판하여 미래를 조명하다 — **임수빈** (교과서 편찬위원장)

2. Neurospine: Harmonizing Academic Development of Spinal Neurosurgery — **하 윤** (Neurospine 편집위원장)

3. 문케어, 예비급여, 향후 심사방향 — **박진규** (PMC 박병원 원장, 의협 기획 및 보험이사)

임 수 빈

교과서 편찬위원장

Education

1992	College of Medicine, Soonchunhyang University (B.S.)
1997	Neurosurgical Board, Korea

Clinical Practice

1997–2000	Chief of Neurosurgery Nonsan Military Hospital , Military Medical Officer. Captain
2000–2001	Clinical Fellow in spine section; Asan Medical Center(AMC), Ulsan University
2001–2007	Instructor, assistant professor, Soonchunhyang University bucheon Hospital, Department of Neurosurgery
2002	San Francisco Stanford University, USA : Balloon Kyphoplasty Research
2003	Herne Hospital , Germany, Endoscopic spinal surgery abroad study
2003	De Jong Jarc Monard Hospital, France. ELIF & posterolateral fusion surgery abroad study
2007–2011	Associate professor, Soonchunhyang University bucheon Hospital, Department of Neurosurgery
2009–2010	Visiting professor, University of Washington Physiology–Biophysics, National Primate Research Center, Seattle, USA
2012–present	Professor, Soonchunhyang University bucheon Hospital, Department of Neurosurgery
2016–present	Department chairman in Neurosurgery

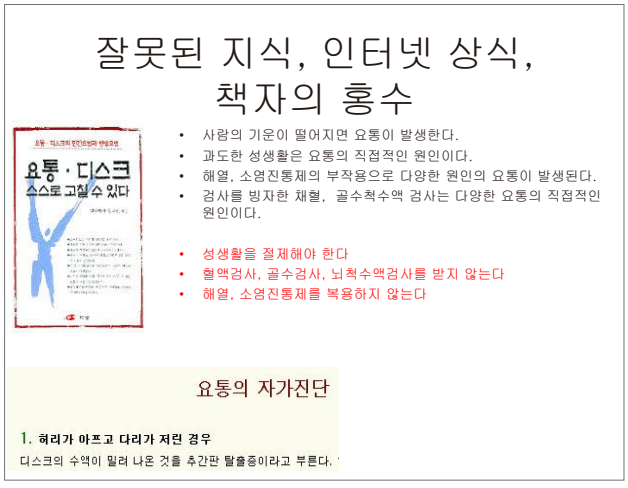
Academic activities

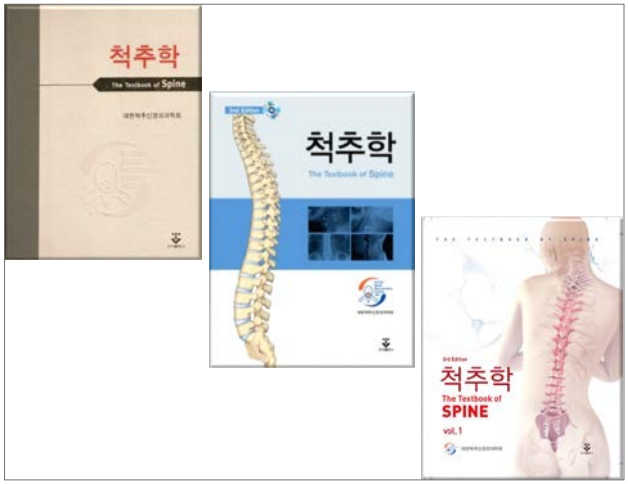
Permanent member of Korean Neurological Surgery Society (1997)
Permanent member of Neuro–Pain Society (2002)
Permanent member of Neurotraumatology Society (2002)
Permanent member of Korean Spinal Neurosurgery Society (2004)
Trustee of the Korean Spinal Neurosurgery Society (2007)
Review board of Journal of Korean Neurosurgical Society (2007)
Steering committee of Korean Cervical Spine Research Society (2008)
Review board of Korean Journal of Spine (2009)
Project director of Basic Spine Research Society (2012)
Trustee director of Korean Spinal Cord Society (2016)
Chairman of Textbook committee of Korean Spinal Neurosurgery (2017)

Plenary Session : KSNS! Korea Spine, New Start!

척추학 3판: 현재를 출판하여 미래를 조명하다

임 수 빈
교과서 편찬위원장





1부. 디스크를 논쟁하다 _ 디스크는 현대인을 위협하는 심각한 질병인가?

발이나 발가락에 감각이 없디스크와 협착증, 환상 속에만 존재하는 괴물들
허리가 아프고 엉덩이가 쑤시고 다리가 당기는 건 신경 때문?
CT와 MRI가 부리는 마법, 두려움과 걱정의 상업화
허리 통증, 엉덩이와 허벅지가 당기고 저린 진짜 이유으면 무조건 수술대로 직행?
협착증은 허리를 펴거나 걷거나 운동해선 절대 안 되는 병?
몇 주 만에 간단히 치료할 것을 놓치고 악화시키는 척추 수술

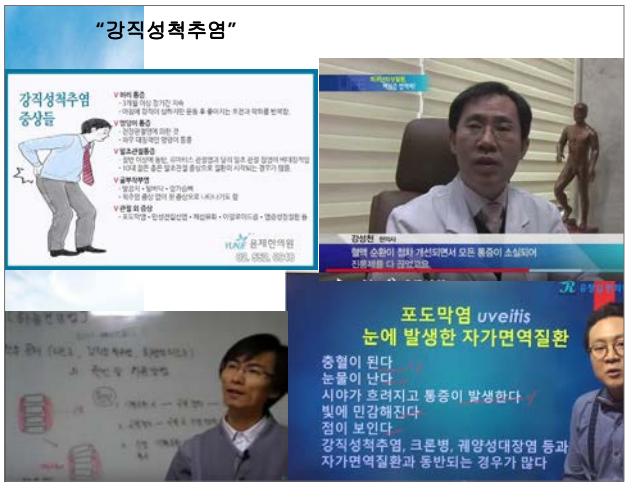
2부. 허리, 엉덩이, 다리 통증 _ 통증은 나 혼자만의 힘으로 다스릴 수 있다
근육에 쌓인 긴장을 풀어주는 2가지 기본 원리를 기억하라
굳어져 있는 허리 근육을 효과적으로 풀어주는 스트레칭
굳어진 허리 근육 부위 두들기기와 눌러주기
스트레칭, 두들기기, 눌러주기의 횟수와 주의할 점들
허리에서 다리까지 전체적으로 풀어주는 스트레칭 방법
엉덩이와 허벅지를 중점적으로 스트레칭 하는 방법
종아리 근육을 중점적으로 부드럽게 하는 스트레칭
엉덩이, 허벅지, 종아리의 두들기기와 눌러주기 방법
증세별로 요긴한 스트레칭, 두들기기, 눌러주기 방법들
……

에필로그 _ 용기를 내십시오, 할 수 있습니다…
[출처] [디스크 권하는 사회] 절대로 스트레칭 및 근육 풀기 따라하지 말 것..이란 이유|**작성자** 청개구리

"환자들이 찾아와 허리나 엉덩이 통증을 호소하거나 엉덩이와 다리가 저리다고 하면 의사들은 대개 엑스레이를 찍고, 더 심하면 엠아르아이(MRI)를 찍어보자고 합니다. 그러곤 디스크가 튀어나온 영상을 보여주고 수술을 하기도 합니다. 그런데 낫지 않습니다. 수술 뒤 나았다가도 재발합니다. 왜 그럴까요?"

그는 이 의문을 풀기 위해 십수년 전부터 협착증과 디스크 수술 과정을 수없이 지켜봤다. "의대 교과서에 나와 있는 진단명을 의심만으로 뒤집을 수는 없었다"고도 했다. 수술 과정을 지켜본 결과, 우리가 상상하거나 엠아르아이 영상에서 보이는 것과는 달리, 척추신경은 실제로는 눌려 있지 않았다고 했다. "병원에선 척추신경이 눌린 결과 허리에서 엉덩이·다리까지 이어지는 통증이나 저림 증세가 나타난다고 설명하는데 정작 척추신경은 통통한 원래 모양 그대로 잘 있습니다."

그는 병원에서 디스크나 척추관협착증이라 진단하는 통증은 해당 부위 근육이 굳어져 생긴다고 본다. 근육은 본디 길이가 늘어나고 줄어드는 운동을 하도록 되어 있는데 일정 기간 그런 변화(운동)가 없는 긴장된 순간이 반복되면 굳어진다. 말랑말랑해야 할 근육이 굳어져서 근육 속 말초신경이 통증을 느낀다는 것이다. 어릴 적 두 팔



척추학 교과서 발간과정

- 2016.11.3 첫 편집회의, 편집위원 대면
  - 대한신경외과 사무실, 챕터구조 결정
- 첫 원고청탁 이메일 발송 2016.11.8
  - 2017 동계학술대회
- 일러스트 작업/수정
- 8차 교정

편집 Workshop

- 오크밸리, 2박3일 합숙
- **용어의 통일화, 오류 수정, 챕터간 일관성, 일러스트 개선작업, 인덱싱 작업**

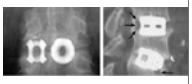
2018-04-20 (금)	주제	발표자
06:00 ~ 06::10	집결 및 이동	
06:10 ~ 06:40	저녁 식사 및 척추학 교과서 편집원칙 공유	편집위원장
07:40 ~ 10:50	척추학 교과서 편집	
	취침	
2018-04-21 (토)	주제	
08:00 ~ 09::10	기상, 개인정비, 조식	
09:10 ~ 12:30	척추학 교과서 편집	
12:30 ~ 02:00	점심식사	
02:00 ~ 03:30	척추학 교과서 편집	
03:30 ~ 04:00	휴식	
04:00 ~ 05:30	척추학 교과서 편집	

척추학 3판 중점을 둔 부분

- 수술 술기 부분은 축소
  - Surgical atlas of spine 발간
- Indication, Complication 중점.
  - 질환별 합병증 자세히 기술
  - 법원 자문시 참고자료
- 저자조정 (ghost author ..)
  - 은퇴저자 집필진에서 제외
  - 새로운 저자 영입

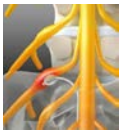
국내 척추 수술 초창기

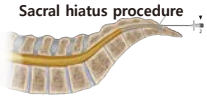
- 1976 Microscope
- 1984 Chymopapain
- 1988 Nucleotome
- 1990 Interbody cage
- 1993 연성고정술
- …



가까운 과거 근거 획득

- 2002 Endoscopic surgery symposium
- 2007 Artificial disc symposium
- 2009 Spine deformity symposium





수많은 척추치료 방법의 명멸

- Evidence based
- Outcome based

교과서의 미래

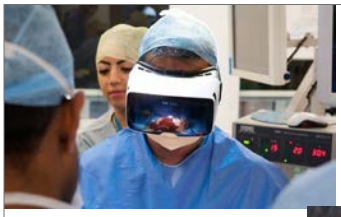
- Cell/protein/tissue : 22
- New material : 6
- 3d printing device : 5
- Minimal invasive surgery : 3
- Surgical technique : 2
- Wearable device : 1
- Robot : 1
- Big data : 1

Spine fixation system

- Screw & nuts → all system similar
- Rigid → Flexible,
  Biodegradable polymer

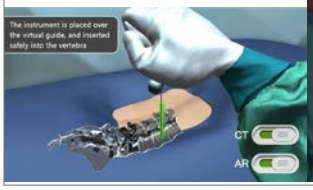
미래의 교과서에 실린 내용
3D printed implant

Robot assisted/computer guided spine surgery



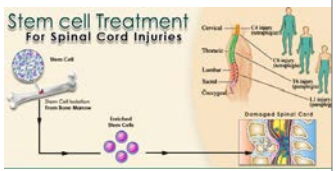
Virtual Reality

Augmented Reality



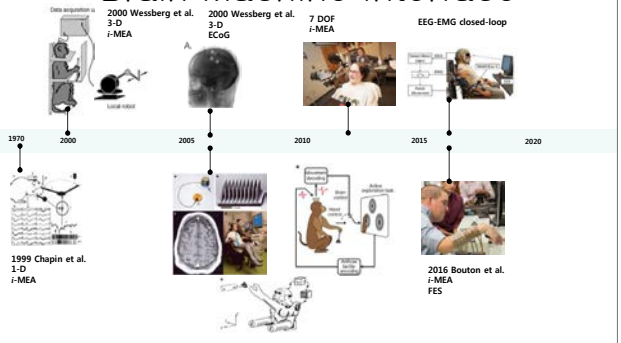
Cord injury

- Biologic
  - Stem cell, growth factor, BMP2 proteins,



- Electronic
  - Brain Machine Interface, neural interface

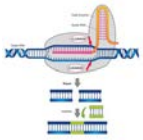
연구중인 내용
Brain Machine Interface



CRISPR CAS9
유전자 편집

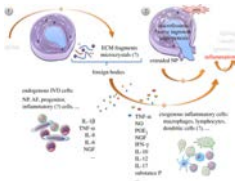
- 3세대 유전자가위 protein → RNA
- 특정염기서열 인식/편집

유전병, 암 치료



OPLL, AS, AIS, RA

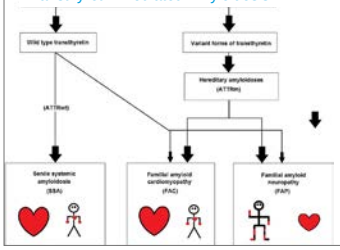
Disc degeneration



끊임없는 새로운 치료법의 등장

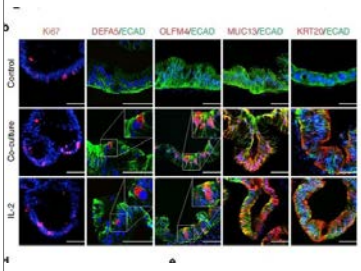
First-Ever FDA Approval of an RNAi Therapeutics
ONPATTRO™ (patisiran)
Aug 10, 2018

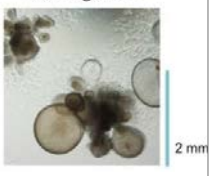
Transthyretin-Mediated Amyloidosis



"인간 장기 생산도 멀지 않다"-줄기세포로 인간 장기 유사조직 만드는 데 세계 최초 성공

중앙일보 2018.08.09 15:50

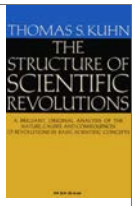




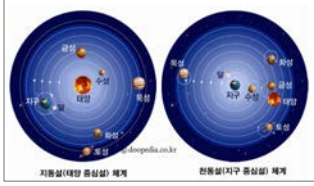
Artificial disc ⇨ **3d printed Disc, V-Body, cord ?**

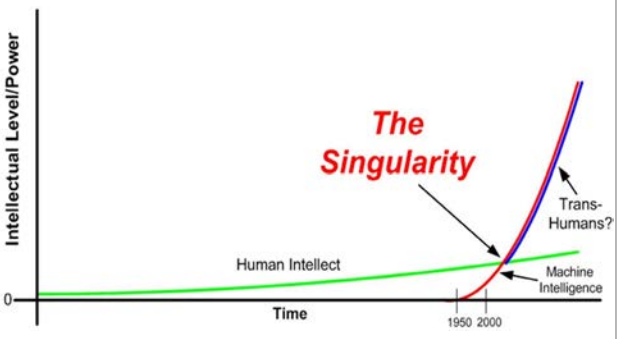
과학혁명의 구조
Thomas Kuhn

1922 - 1996



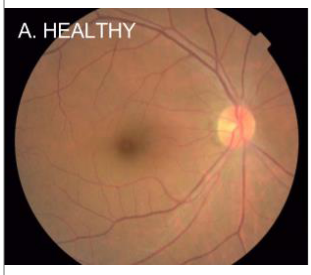
- 사실이라고 굳게 믿었던 기존지식 무너짐
- 더 나은 설명을 위한 패러다임- 혁명적 변화

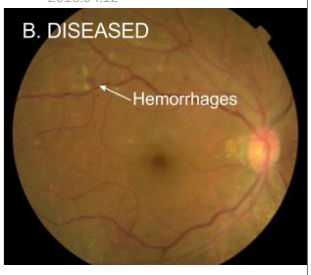




美 FDA, 당뇨병성 망막증 AI 진단장치 최초 승인

2018.04.12





Machine learning	0.95
안과전문의 8	0.91

2016 JAMA

AI 시대에서 교과서는?

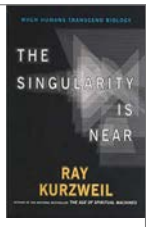
- 의무기록, 유전정보, big data → 조언
- 의료 data, 의료 이미지분석 → 진단
- 생체data, 원격전송 → 조기관리, Wellbeing

반복적이고 변화 변수가 적은 의료분야

진단, 처방

시술 , 수술

Raymond Kurzweil
google, AI

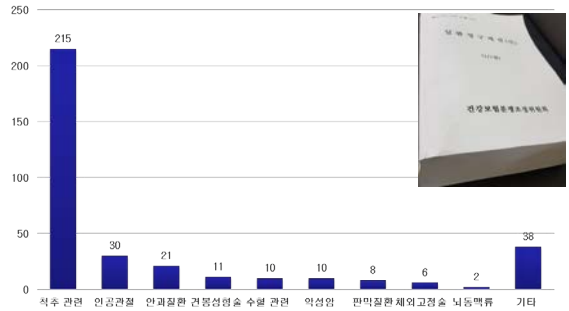


- AI가 인간의 지능을 뛰어넘는 시기
- Brain simulation
- 인간지능과 인공지능의 융합

현실

- 무분별한 삭감- 저수가
- 심사의뢰- 특정 진료과/심사위원에 편중
- 획일적 가이드라인 – 보존적 치료 기간
  - 예외규정 적용 인색

2018.7 심평원 조정처분
외과6 분과 351건 중



- Thoracic pedicle screw for deformity
  1994

P-Screw 독점화

수가개선
대국민 홍보
자정노력

심사위원 실명제
연령상한제

OS 척추의사와의 협조, 화합


TEXTBOOK OF
SPINAL
SURGERY
척추외과학
척추학
The Textbook of
SPINE
vol.1

하 윤

Neurospine 편집위원장

Plenary Session : KSNS! Korea Spine, New Start!

Neurospine: Harmonizing Academic Development of Spinal Neurosurgery

하 윤
Neurospine 편집위원장

박 진 규

PMC 박병원 원장, 의협 기획 및 보험이사

학력

–1993	순천향대 서울병원 대학교 (학사) 신경외과
	순천향대 서울병원 대학원 (석사) 신경외과
–2001	순천향대 서울병원 대학원 (박사) 신경외과

경력

現 의료법인 갈렌의료재단 PMC박병원 이사장
現 대한의사협회 기획/보험이사
現 경기도의사회 부의장
現 대한신경외과학회 상임이사
現 대한말초신경학회 회장
現 대한신경외과 병원협의회 부회장
現 대한신경외과 의사회 수석부회장

Plenary Session : KSNS! Korea Spine, New Start!

문케어, 예비급여, 향후 심사방향

박 진 규

PMC 박병원 원장, 의협 기획 및 보험이사

2018. 9. 15 (Sat.)

Free Paper Session V

(기초)

좌장 : **이상구** (가천의대), **박승우** (강원의대)

Free Paper Session V

FP V-1

Biomechanical Investigation of Extragraft Bone Bridging after Anterior Cervical Discectomy and Fusion

Yong Jun Jin[1], Won Man Park[2]
[1]Inje University Seoul Paik Hospital, [2]Elsoltec Inc.

Purpose : Anterior cervical discectomy and fusion (ACDF) is a widely used surgical method to treat a patient with a degenerated disc of the cervical spine since first reported in the 1950s by Cloward [1] and Robinson and Smith [2]. Currently interbody cages are widely used in ACDF as a safe alternative to the iliac bone graft [3, 4]. The cage is reportedly very useful to provide stabilization, increase segmental height and foraminal height, improve lordosis, and prevent breakdown at the operated motion segment [5]. It has been reported that achieving a sloid interbody union with bridging trabeculae is critical for successful outcomes of ACDF [6]. However biomechanical role of the extragraft bone bridging (ExGBB) was not well investigated. In this study, we developed various finite element models of the cervical spinal motion segment C5-C6 which showed the sequential progress of ExGBB posterior to the cervical cage after ACDF. Biomechanical effects of the ExGBB formation on the operated motion segment were investigated.

Materials and methods : A validated three-dimensional finite element (FE) model of the C5-C6 motion segment was used in this study. Discectomy and interbody fusion using a polyether ether ketone cage was described in the FE model based on the pre-operative plan established by spine surgeon, one of the authors of this study. Six and twenty FE models describing ExGBB formation steps during flexion and extension, respectively were developed based on bone adaptation algorithm based on SED. Then the developed models were tested under flexion and extension motions, because flexion-extension motion is the most common in daily activity, ExGBB formation is generally observed at the posterior region to inserted cage, and that affects flexion and extension motions. Inferior plane of the C6 vertebra was fixed in all directions and bending moments of 1.5 Nm were applied along flexion and extension directions with a compressive force of 50 N along flower load direction. Changes in biomechanical behaviors of the motion segment including intersegmental rotation and distribution of stress and strain energy density (SED) were investigated

Results : Intersegmental angle was not changed in flexion regardless of extragraft bone formation step, while the angle decreased with extragraft bone formation in extension (Fig. 1). When extragraft bone was not formed, intersegmental rotation angles under 1.5 Nm moment of flexion and extension were 0.73° and 1.02°, respectively. In

extension, the angle decreased to 0.86°, 0.76°, 0.77°, 0.68°, and 0.44° with extragraft bone formation after the first, second, third, fourth, and fifth steps, respectively. Then the angle slightly changed till the extragraft bone formation was terminated. The final extension angle after the 20th step was 0.32°.

The maximum von Mises stress on the cancellous bone was predicted at the region, which is posterior and adjacent to the cage, in both flexion and extension (Fig. 2). The initial maximum von-Mises stress and SED, when the extragraft formation was not generated, were 2.95 MPa and 0.039 MPa in flexion, and 4.74 MPa and 0.103 MPa in extension, respectively. In flexion, both stress and SED decreased with HO formation and slightly changed until extragraft bone formation was terminated. With extragraft bone formation, a step-wise decrease in von Mises stress and SED was predicted in extension. The final stress and SED values were 0.84 MPa and 0.002 MPa, respectively in extension.

Conclusion : Several previously published studied have investigated biomechanical role of ExGBB or heterotopic ossification after ACDF or total disc replacement [7, 8]. However, the geometry of the bone formation was assumed, or its final shape were predicted in the studies. This study is the first study, in which the progress of the bone formation of the ExGBB were developed and its biomechanical effects were investigated. ExGBB formation could be classify as two phases which are soft and hard bridging. While the soft bridging, in which ExGBB was formed in only cancellous bone section of the vertebrae, dramatically increase stability of the operated motion segment and reduced intersegmental rotation, hard bridging, in which ExGBB was reached to the cortical bone section of two vertebrae, minimized the maximum stress and SED on the cancellous bone to the minimum.

Free Paper Session V

FP V-2

Advance of Treatment and Prognosis in Pyogenic Spondylodiscitis: Use of Simultaneous PET-MR Imaging

Ikchan Jeon[1], Eunjung Kong[1], Chulpyo Hong[2], Sangwoo Kim[1]
[1]Department of Neurosurgery, Yeungnam University Hospital, [2]Department of radiological science, Catholic University of Daegu

Purpose : As people are aging, spinal infection also rapidly increasing. Spinal infection requires long-term antibiotics and accompanies several complications during the treatment period. There are still no definite guidelines for the use of antibiotics, and existing hematological and radiological methods are insufficient in the judgment of remission. Recently, simultaneous Fluorine-18 fluorodeoxyglucose positron emission tomography/magnetic resonance (PET/MR) imaging shows great potential as a new option in spinal infection. In this study, we present the application of PET/MR imaging to evaluate treatment response and the clinical usefulness in terms of treatment and prognosis.

Materials and methods : Retrospective study. From January 2017 to February 2018, 85 patients (53 male and 30 female, mean ages of 63.67±11.61 years old) were enrolled among total 95 patients with pyogenic thoraco-lumbar spondylodiscitis without other cause of infectious condition. 12 patients were excluded due to death (2), follow-up loss (9), and severe other complication (1). The evaluation of treatment response was performed after at least three weeks of parenteral antibiotics. We analyzed clinical characteristics related with PET/MR imaging, parenteral antibiotics period, rate of recurrence, and result of bacterial culture.

Results : Bacteremia, epidural abscess, and extent of infection were the statistical significant clinical factors related with longer parenteral antibiotics period ($p<0.05$). There were no definite clinical factors which can explain recurrence (6%, 5/83). However, application of PET/MR imaging was the independent factor decreasing parenteral antibiotics period over 10 days (40.59±17.33 days vs 51.47±18.44 days, $p<0.05$). The incidence of recurrence in the patients with PET/MR imaging was also low even though there was no statistical difference (2.9% (1/34) vs 8.2% (4/49)). Bacterial culture was confirmed at only 40.9% (34/83), and methicillin-sensitive staphylococcus species was the most common pathogen (35.3%, 12/34).

Conclusion : PET/MR imaging is an independent valuable method to evaluate treatment response which is not affected by other general conditions. We think decrease of parenteral antibiotics period and lower recurrence rate could be achieved by using PET/MR imaging despite negative bacterial culture, extent of infection, and limitation of existing methods.

FP V-3

The efficacy of human-adipose tissue derived stem cells (h-ADSCs) in spine fusion using rat ovariectomy osteoporosis model

In Suk Bae[1], Hyoung-Joon Chun[1], Min Kyun Na[2]
[1]Hanyang University Seoul Hospital, [2]Severance Hospital

Purpose : An important objective of the spinal fusion surgery is solid arthrodesis of the spinal segment, however the rate of pseudoarthrodesis has been reported from 5 % to 43 %. Human-adipose tissue derived stem cells (h-ADSCs) can induce osteogenesis in spine fusion models. The purpose of this study is to evaluate the efficacy of h-ADSCs in spinal fusion in osteoporotic rat models.

Materials and methods : Female Sprague-Dawley rats (n=40) were ovariectomized and randomized into two group: ovariectomy (OVX) (OVX + fusion), and h-ADSCs (OVX + fusion + h-ADSCs). Six weeks after ovariectomy, bilateral lumbar spine fusion was performed using autologous iliac bone with/without h-ADSCs. For each group manual palpation, lateral ending, morphogenic examinations, and histologic findings were evaluated after 6 weeks.

Results : The volume of fusion bed was not significantly different between two groups. However, the density of fusion bed in h-ADSCs group was higher than OVS group. The manual palpation (70 % vs. 40 %, p=0.112) and lateral bending (95 % vs. 55 %, p=0.011) also showed higher fusion rate in h-ADSCs group. In histologic examination, the new bone formations were seen at the fusion bed between lamina and implanted iliac crest bone in the h-ADSCs group. In contrast, in the OVX group, the fusion masses were composed of fibroblastic proliferation.

Conclusion : h-ADSCs could accelerate bone formation and consolidation without overgrowth. H-ADSCs are potential strategy for spinal fusion and may be a more efficient method of obtaining spinal fusion over currently used grafting substances.

Free Paper Session V

FP V-4

Association of Ischemic Stroke with Ankylosing Spondylitis: A Nationwide Longitudinal Cohort Study

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Purpose : The purpose of this nationwide age- and sex-matched longitudinal follow-up study was to investigate the risk of developing ischemic stroke in Ankylosing Spondylitis (AS).

Materials and methods : The data in this study, spanning from January 1, 2010 to December 31, 2014, was obtained from a database maintained by the Korean National Health Insurance Service. A total of 12,988 patients with a diagnosis of AS were enrolled. The control group consisted of 64,940 age-sex stratified matching subjects without AS. The 6 year ischemic stroke incidence rate for each group was calculated using the Kaplan-Meier method. Cox proportional hazards regression analysis was used to estimate the hazard ratio of ischemic stroke.

Results : During the follow-up period, 73 patients (0.56%) in the AS group and 250 patients (0.38%) in the control group developed ischemic stroke (P = 0.0041). The hazard ratio of ischemic stroke in the AS group was 1.46 (95% confidence interval [95% CI], 1.13–1.90) after adjusting for age and sex. The adjusted hazard ratio of ischemic stroke in the AS group was 1.35 (95% CI, 1.04–1.75) after controlling for demographics and comorbid medical disorders. According to subgroup analysis, in female and diabetes and non-hypertension and dyslipidemia subgroups, ischemic stroke incidence rates were significantly higher in AS patients than those in control group.

Conclusion : Our nationwide longitudinal study suggests an increased risk of ischemic stroke in AS patients.

FP V-5

Bicortical screw purchase at upper instrumented vertebra (UIV) can cause UIV fracture after adult spinal deformity surgery: a finite element analysis study

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Purpose : To examine the biomechanical stress distribution at the UIV according to unicortical- and bicortical purchase model by finite element (FE) analysis.

Materials and methods : A T8 to Sacrum with implant finite element model (FEM) was developed and validated. The pedicle screws were unicortically or bicortically inserted from T10 to L5, and each purchase model was compared and the von Mises (V.M.) yield stress of T10 was calculated. According to the range of motion (flexion, extension, lateral bending and axial rotation) of lumber spine, boundary condition values were set as 15°, 15°, 10°, 4°.

Results : Although the two stress values did not show a significant difference between the unicortical- and bicortical purchase models in the flexion and extension behavior, bicortical purchase model showed a larger stress distribution. However, the asymmetric behavior was significantly greater in the case of lateral bending and the rotation behavior. The greater stress was observed on the spinal body surface abutting the implanted screw. Although the maximum stress was observed around the implanted screw in the bicortical purchase model under axial loading, the V.M. stress of both models was not significantly different.

Conclusion : Bicortical purchase model showed a larger stress distribution than the unicortical model, especially in the case of lateral bending and the rotation behavior. Our biomechanical simulation by FEA indicates that bicortical fixation at UIV can be a major risk factor for early UIV compression fracture after adult spinal deformity surgery.

Free Paper Session V

FP V-6

Bone regeneration effect of the high tricalcium phosphate concentrated biocomposite plate and screw system in the osteoporotic rabbit model

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Department of Neurosurgery, Soonchunhyang University Bucheon Hospital

Purpose : The aim of this study was to evaluate the bone regeneration effect high tricalcium phosphate concentrated biocomposite plate and screw system in the osteoporotic rabbit model

Materials and methods : Tweenty-eight female New zealand rabbits (3kg - 3.5kg) were divided into 4 groups and three groups were underwent bilateral ovariohysterectomy (OHE) and two groups were inserted at proximal tibia in the two implantation groups; Sham group (control), bilateral ovariohysterectomy (OHE)-induced osteoporosis group (OHE), OHE and biodegradable (PLGA (poly-lactic-co-glycolic acid) without beta–TCP (tricalcium phosphate) plate and screw insertion group (OHE with BSR), OHE and biocomposite (PLGA (poly-lactic-co-glycolic acid) with beta–TCP) plate and screw insertion group (OHE with CSR). The rabbits were kept staying in identical environments. Implantation in the ovariohysterectomized rabbits was delayed by 6 weeks following the procedure to allow osteoporotic changes to occur. 24 weeks after OHE (Sixteen weeks after screw insertion), tibiae were extracted and surface soft tissues were removed without injury of inserted screw. We checked shape and degradation status such as appearance and hardness, etc. The extracted tibiae were scanned by exo-vivo micro-CT and were evaluated by H&E, Masson's trichrome and immunohistochemical stain for pathological assessment. The evaluation parameters were bone mineral density (BMD), trabecular bone volume (BV/TV), trabecular number (Tb.N), trabecular thickness, and trabecular separation (Tb.Sp)

Results : The control group had the highest values of bone mineral density (BMD), bone volume (BV)/total volume (TV), trabecular thickness (Tb.Th) and trabecular number (Tb.N) and the lowest values of trabecular separation (Tb. Sp) compared to the ovariectomized groups. In the pairwise comparison between ovariectomized groups, OHE with CSR group showed significantly higher BMD, BV/TV and Tb.N than the other two groups (OVX and OHE with BSR) and significantly lower Tb.Sp. In micro-CT images, there was clear evidence of new trabecular formation near the screw insertion site in the OHE with CSR groupy. Analyses of H&E and Masson's trichrome stained sections showed more and thicker trabecular bone around the implant in the OHE with CSR group compared to the OVX and OHE with BSR group.

Conclusion : Biocomposite screws can improve local bone quality and facilitate bon regeneration in an osteoporotic rat model.

Free Paper Session V

FP V-7

Whole Exome Sequencing to Identify Genetic Variants Associated with Sagittal Imbalance of Spine

Byeongwoo Kim[1], Keung Nyun Kim[1], Dong Kyu Chin[1], Jung-Kil Lee[2], Seung Hwan Yoon[3], Yoon Ha[1], Dong Yup Lee[4], Poong Gee Ahn[4], Jae Keun Oh[5], Bong Ju Moon[2], Jun jeong Choi[6], Dal sung Ryu[3], Ju won Kang[6]

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Purpose : Sagittal imbalance (SI) of spine has become a clinical entity of importance among the elderly that causes painful disability and physical impairment. In previous study, the authors have investigated the risk factors of this malalignment and also suggested the possibility of genetic association with regard to its development and progression. Whole exome sequencing has emerged as a fascinating method to reveal the genetic background of a disease.

Materials and methods : We investigated the influence of genetic variants on SI using whole exome sequencing in 120 individuals with SI among which 64 with severe phenotypes of SI. Statistical analyses included single variant analysis for common variants (MAF>0.01) and rare variant analysis for low frequency and rare variants (MAF<0.05). A joint calling strategy, and stringent variant and individual-level quality control (QC) were applied for all WES datasets. For gene based burden test, we used the PLINK/SEQ estimate of the smallest achievable empirical P-value for a gene (I-value) to adopt an adjusted Bonferroni correction for multiple testing. $P < 3 \times 10\text{-}6$ ($P < 0.05$ after applying a Bonferroni correction for 20,000 genes tested was adopted for genome wide significance.

Results : We did not identify individual common variants that reached exome-wide significance using single variant analysis and rare variant analysis. In the rare variant analysis, CLASP1 showed the lowest p value but again did not reach the significance threshold. In conclusion, we failed to find any significant variants or genes responsible for the development of SI.

Conclusion : Nonetheless, our results leave open the possibility that rare variants in CLASP1 contribute to the risk of SI, considering previous results of the presence of pathogenic SNPs in this genes in, osteodysplastic primordial dwarfism, type 1 (Roifman syndrome) in which spondyloepiphyseal dysplasia was reported.

Free Paper Session V

FP V-8

Biomechanical Characterization of Three Iliac Screw Fixation Techniques: A Finite Element Study

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Purpose : We aim to characterize the biomechanical properties of a modified iliac screw fixation method compared with the classic iliac screw fixation and the S2 alar iliac screw (S2AI) fixation using a FEM.

Materials and methods : A three-dimensional, non-linear FEM of lumbosacral spine and pelvis (L1-pelvis) was modified to simulate 3 different iliac screw fixations based on posterior screw fusion. The peak von Mises stress (PVMS) values of the iliac screws in the 3 different iliac screw fixations were recorded in during flexion/extension/axial rotation/lateral bending. The interaction stress which arose between the screw head and the shaft of iliac screws, was also measured for each case.

Results : The PVMS values of the 3 different iliac screw fixation techniques were lower than the fatigue strength levels under physiological loadings. PVMS of iliac screws was observed in the screw shaft for S2AI, in the screw neck for the modified iliac screw technique, and in the offset connectors of the classic iliac screw technique. The interaction between the screw head and the neck was compressed in modified iliac screw fixation technique. On the other hand, distraction force was observed in the S2AI technique between the screw head and the screw shaft.

Conclusion : This FEM study supports our previous clinical results, which found that the modified iliac screw fixation technique can be an effective alternative sacropelvic fixation technique comparable to the classic iliac screw and the S2AI technique.

Award Presentation Session

(학술대상 연구결과 발표)

좌장 : **정천기** (서울의대), **김근수** (연세의대)

1. Anti-inflammatory effect of static magnetic field generated by permanent magnets on Intervertebral disc degeneration. Development of a novel device, and the preliminary results — **권우근** (고려의대)

2. Can beta-endorphin be used as a biomarker for chronic low back pain? — **이창현** (서울의대)

3. 원발성 척추 · 척수종양 임상 데이터 수집/분석 플랫폼 개발 구축 — **이선호** (성균관의대)

권 우 근

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국제 AO spine 정회원

Award Presentation Session

Anti-inflammatory effect of static magnetic field generated by permanent magnets on Intervertebral disc degeneration. Development of a novel device, and the preliminary results

권 우 근
고려의대

Background: Degenerative disc diseases (DDDs) which are known to be strongly related with intractable chronic back pain, are associated with macrophage-mediated inflammation in the intervertebral disc (IVD). The pathomechanism of DDD is still poorly understood, and many effort to find anti-inflammatory strategies are of interest in the field of spinal surgery.

Objective: To identify the effect of static magnetic field (SMF) generated by permanent magnets on the production of inflammatory mediators, angiogenic factors, and extracellularmatrix-regulating enzymes of IVD cells during inflammatory reactions.

Methods: Human nucleus pulposus (NP) and annulus fibrosus (AF) cells harvested during surgery for DDDs were cultured in three different media; macrophage conditioned media or interleukin (IL)-1β-stimulated media or co-culture with activated THP-1 cells. They were cultured under two different environments, under SMF exposure or without any SMF exposure. Protein extraction for interacellular analysis by western blotting was done. IL-6, IL-8, vascular endothelial growth factor (VEGF), vascular cell adhesion molecule (VCAM), matrix metalloproteinase (MMP)-1,MMP-3, tissue inhibitor ofmetalloprotease (TIMP)-1, and TIMP-2 in conditioned media are to be measured by an enzyme-linked immunosorbent assay (ELISA).

Results: AF cells and NP cells expressed lower level of inflammatory cytokines (IL-8 and -6) when they were cultured under the exposure to SMF, compared to the control group with no SMF exposure. The decreased expression of inflammatory cytokines were found in all three different types of inflammatory stimulation; macrophage conditioned media or interleukin (IL)-1β-stimulated media or co-culture with activated THP-1 cells. However the statistical significance are to be further studied as we are still lack of repeated experiments. Western blotting for the intracellular inflammatory pathway analysis are to be done as well.

Conclusion: We have invented and developed a novel device that can generate SMF, which is also adjustable and can generate different strengths of SMF as intended. Exposure to SMF generated by permanent magnets seem to influence the IVD during inflammatory reactions, however further repeated experiments are needed to find if this results are statistically significant. We hope we find the anti-inflammatory effect of SMF on IVDs by this study and introduce a new possible non-invasive approach to DDD treatment.

이 창 현

서울의대

Award Presentation Session

Can beta-endorphin be used as a biomarker for chronic low back pain?

이 창 현
서울의대

이 선 호

성균관의대

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연구 분야

신경재생연구, 줄기세포, 빅데이터, 기계학습

Award Presentation Session

원발성 척추 · 척수종양 임상 데이터 수집/분석 플랫폼 개발 구축

이 선 호[1], 장 웅 규[2], 김 성 환[3]

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대한척추종양연구회는 원발성 척추종양 및 척수종양의 임상연구 기반을 위한 국내 원발성 척추 및 척수종양 전문가 네트워크를 구축하는 사업을 진행하였다. 각 종양의 특성에 맞는 역학 자료 생성 및 수집을 위한 프로토콜을 정립하여 임상 정보와 생체 정보를 포함하는 환자 레지스트리를 확립하고자 하였다. 또한 향후 중개연구와 임상연구를 효율적으로 연계할 수 있는 시스템을 구축하고 및 치료 개발을 위한 전향적 연구를 수행할 수 있는 인적, 물적 기반 마련을 목표로 하였다.

Task Force 팀은 먼저 임상데이터 웨어 하우스 구축을 수행하였다. 또한, 임상정보의 경우 대부분 비 표준화된 상태로 존재하여 표준화 작업이 수행하였다. 또한 TF팀은 임상 데이터를 이용한 분석 포털 개발하였으며 병원의 임상의, 연구자 및 공공으로 활용될 수 있도록 데이터의 통합 분석의 모델을 제시하고, 통합 데이터에 대한 데이터 프로세싱 및 검색 등의 기능이 가능한 시각화 인터페이스로 서비스 시스템을 개발하였다.

연구회는 구축된 플랫폼을 이용하여 원발성 척추 척수종양의 역학적, 임상적 특성에 대한 포괄적 파악을 위해 기초적인 국내 현황 및 역학에 대한 자료의 확보하기를 기대하고 있다. 추후 2단계 사업에서는 골격계 전이암 데이터베이스 구축을 추진하여 치료의 새로운 타겟으로 제시하여 새로운 치료법 개발 및 항암 치료제의 개발로 이어지기를 기대한다.

2018. 9. 15 (Sat.)

Free Paper Session III

(흉요추)

좌장 : **진병호** (가톨릭관동대), **김인수** (계명의대)

Free Paper Session III

FP III-1

Risk factors for adjacent segment degeneration after single level posterior lumbar fusion and protective role of interspinous process device

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Keimyung University Dongsan Medical Center

Purpose : Adjacent segment degeneration (ASD) is a well-known complication of lumbar fusion surgery. Several studies have evaluated the risk factors of ASD. Recently, applying an interspinous process device at the adjacent segment to pedicle screw instrumentation to create a dynamic transition zone has been reported. The aim of this study is to verify the risk factors of ASD and to assess the protective role of DIAM(Device for Interspinous Assisted Motion).

Materials and methods : This retrospective study reviewed 51 patients, who underwent the posterior lumbar interbody fusion (PLIF) with DIAM or not, between 2005 and 2016 and who were followed up for more than 24 months. In group A (14 cases), the patients underwent PLIF and DIAM implantation at cephalad level, while in group B (37cases), the patients received PLIF only. Several parameters were measured using pre- and postoperative radiographs and Magnetic Resonance Image(MRI), including lumbar lordosis(LL), pelvic incidence(PI), pelvic tilt (PT), PI-LL, segmental Cobbs angle, disc height, spondylolisthesis, and segmental instability (last four parameters were at adjacent level). In MRI, modified pfirrmann grade, paraspinal muscles cross-sectional area(CSA) and relative CSA(rCSA), goutallier grade were measured.

Results : Solid interbody fusion was observed in all cases. In radiographic findings, there was no preoperative risk factor significantly associated with development of ASD. Preoperative LL, PT, disc height and spondylolisthesis at adjacent level were associated with development of ASD, but not significantly. In MRI findings, preoperative higher pfirrmann grade and goutallier grade were significantly associated with development of ASD. Postoperative changes, such as narrowing of disc height, segmental instability, progression of spondylolisthesis at adjacent level, worsening of pfirrmann grade and decrease of paraspinal muscles were checked in ASD. Then, postoperative change of disc height narrowing of adjacent level (-0.635±0.383 in group A vs -1.182±0.986 in group B ; p=0.006) was significantly associated with protective role of DIAM. There were differences between the groups in postoperative change of LL, PI, PI-LL, segmental instability and spondylolisthesis at adjacent level, loss of paraspinal muscles, but not significantly.

Conclusion : The occurrence of a radiologic ASD is most likely multifactorial and related to preoperative sagittal balance and paraspinal muscles. DIAM system after single level PLIF could correct LL, PI-LL and prevent disc height narrowing, segmental instability, progression of spondylolisthesis at adjacent level and loss of paraspinal muscles. Therefore, placing a DIAM system plus PLIF would help slow down the progress of ASD.

FP III-2

New spondylolisthesis reduction technique for lumbar spondylolisthesis with long sleeve type percutaneous screw system : Percutaneous screw "swing or rocking" technique

Bumsoo Park, Yong-Eun Cho, Keun-Su Kim, Dong-Kyu Chin, Sung-Uk Kuh, Kyung-Hyun Kim, Jung Yoon Park

Department of Neurosurgery, The Spine and Spinal cord Institute, Gangnam Severance Spine Hospital, Yonsei University College of Medicine

Purpose : Various surgical methods for treating spondylolisthesis have been introduced. Minimally invasive transforaminal lumbar interbody fusion with percutaneous pedicle screw and rod system is one of the treatment options for those conditions. Base on this approach, intraoperative reduction could be additionally achieved using what the author call a "swing" technique. This study was conducted to compare the efficacy of patients treated with conventional MIS with the ones recieved the swing technique.

Materials and methods : This study consists of 30 consecutive patients treated over a year. Of those patients, 15 were treated with operative reduction via minimally invasive transforaminal lumbar interbody fusion (MIS-TLIF) and "Swing" technique whereas the other 15 received standard MIS-TLIF. Swing technique is a reduction method performed after placing all the constructs and by swinging the entire system back and forth several times in attempt to correct the spondylolisthesis and find a certain point when the vertebral bodies are aligned. After confirming enough correction of spondylolisthesis by swing technique, final tightening of the caps are done.

Various grades of lumbar spondylolisthesis (18 Meyerding Grade I and 12 Meyerding Grade II) were included in the study. The clinical outcomes were measured using the visual analog scale (VAS) for pain. Operation time and blood loss were checked for perioperative results. Meyerding grade, percentage of slippage, reduction rate, segmental lordosis and lumbar lordosis (LL) were measured to compare the radiological outcomes for both groups. The patients were shortly followed.

Results : The symptoms were markedly relieved with the "swing" technique. The VAS scores improved from 6.9±1.6 to 2.9±2.4. Comparing the VAS scores between the two groups, there were no difference pre and postoperatively. The operation time and intraoperative blood loss between the two groups also had no significant difference. Radiological parameters improved better with the swing technique. The percentage of slippage was corrected with the swing technique from 24.1±7.3 preoperatively to 4.7±5.3 postoperatively. Whereas the slippage was corrected from 21.8±7.0 to 8.9±5.8 with the conventional method. The percent of slippage significantly decreased more with the swing technique. There were no complications related with the procedure.

Conclusion : When long sleeve type percutaneous screw system was use, minimally invasive reduction using this "swing" technique for monosegmental spondylolisthesis is effective. Using this technique, not only can it alleviate the symptom but also it can achieve near complete reduction of slippage.

Free Paper Session III

FP III-3

Percutaneous biportal endoscopic treatment for far out syndrome of L5 nerve root. Clinical results and Surgical technique

Dong Hwa Heo, Choon Keun Park
Neurosurgery, Spine Center, The Leon Wiltse Memorial Hospital

Purpose : Far out syndrome is extraforaminal entrapment of L5 nerve root and characterized by transitional lumbosacral vertebrae. Far out extraforaminal stenosis of L5-S1 is one of reasons of L5 radiculopathy. Although minimally invasive surgeries have been performed for selective decompression of L5 nerve root, endoscopic approach was rarely attempted. Recently, the authors have tried to decompression of L5 nerve root in patients with far out syndrome using percutaneous biportal endoscopic approach. The purpose of this study is to analysis clinical outcomes and present percutaneous biportal endoscopic approach for far out syndrome.

Materials and methods : We have treated fourteen symptomatic cases of far out syndrome with the percutaneous biportal endoscopic technique. All enrolled patients have been followed up more than 6 months. We investigated modified Mcnab criteria, visual analog scale (VAS), and Oswestry disability index (ODI) for analyzing of postoperative outcomes. And, we analyzed postoperative complications and predisposing factors for poor clinical outcome.

Results : Mean ODI and VAS were significantly improved after endoscopic decompression ($P<0.05$). There were 3 cases of excellent, 7 cases of good, 3 cases of fair, and 1 case of poor outcome by modified Mcnab criteria. Concomitant ruptured disc herniation was a predisposing factor for good and excellent outcomes after endoscopic surgery ($P<0.05$). Postoperative abdominal pain occurred in 2 patients. Postoperative abdominal pain may be related with retroperitoneal fluid collection and was resolved by conservative management.

Conclusion : We suggested that percutaneous biportal endoscopic technique may be an alternative treatment method in cases of far out syndrome. However, we need long-term follow-up and a more detailed study for more accurate evaluation of this technique.

Free Paper Session III

FP III-4

Cost effectiveness comparison between open microdiscectomy and endoscopic discectomy for lumbar disc herniation

Kyung-Chul Choi
the Leon Wiltse Memorial Hospital, Anyang

Purpose : To assess cost effectiveness of four surgical techniques which are microdiscectomy (MD), percutaneous endoscopic lumbar discectomy (PELD), percutaneous endoscopic interlaminar discectomy (PEID), and unilateral biportal endoscopic discectomy (UBED) for lumbar disc herniation

Materials and methods : Five hundred sixty-five patients who underwent the four surgical techniques between 20 and 60 years were reviewed up to 1 year postoperatively. Health care costs were defined as sum of direct costs which were included National Health Insurance covered and uncovered costs from operation through 1-year follow-up and indirect costs include the costs incurred by work loss. The direct costs can be defined as the sum of primary hospital costs associated with operation and secondary hospital costs associated with postoperative course management and unexpected events after surgery. Incremental cost-effectiveness ratio (ICER) was determined using cost/quality-adjusted life year (QALY).

Results : One hundred fifty-seven patients of PELD, 132 of PEID, 140 of UBED and 136 of MD were enrolled. There were no differences between the groups in baseline demographics. The direct costs of PELD, PEID, UBED and MD were $3,037.9±963.9, $3,179.8±566.9, $3,328.3±925.6, and $3,625.8±800.1, respectively ($p<0.01$). The indirect costs of PELD, PEID, UBED and MD were $574.5±495.9, $587.8±488.3, $647.4±455.6 and $759.7±491.7, respectively ($p<0.01$). 1-year QALY gains were 0.208 for PELD, 0.211 for PEID, 0.194 for UBED and 0.186 for MD. ICER (costs/QALY) was highest in the MD ($30,215.2±22,202.8, $p<0.01$). ICERs of PELD, PEID and UBED were $22,402.7±17,710.4, $ 23,730.2±28,497.3 and $23,344.6±13,257.8 respectively. Compared with MD, endoscopic discectomy (ED) saved additional net cost of $34,576 per QALY ($p<0.01$). There was no significant difference of ICERs in three endoscopic techniques.

Conclusion : Endoscopic discectomy was more cost effective than MD at 1-year follow up.

Free Paper Session III

FP III-5

Surgical Outcomes According to Dekyphosis in Patients with Ossification of the Posterior Longitudinal Ligament in the Thoracic Spine

Soo Yeon Kim, Seung-Jae Hyun, Ki-Jeong Kim, Tae-Ahn Jahng Jahng, Hyun-Jib Kim
Seoul National University Bundang Hospital

Purpose : Ossification of posterior longitudinal ligament (OPLL) in the thoracic spine is less common compared with that in the cervical spine. Thoracic OPLL sometimes produces chronic compressive myelopathy that is usually progressive, and unfavorable by conservative treatment. Although surgical intervention is often needed, the standard surgical method has not been established. Recently, it has been reported that posterior decompression with dekyphosis is effective surgical technique for favorable clinical outcome.

The purpose of this study was to evaluate the surgical outcomes in patients with thoracic OPLL according to dekyphosis procedure and to identify predictive factors for the surgical results.

Materials and methods : A total of 25 patients with thoracic OPLL who underwent surgery for myelopathy from May 2004 to March 2017, were retrospectively reviewed. Patients with cervical myelopathy were excluded. We assessed the clinical outcomes according to various surgical approaches. The modified Japanese orthopedic association (JOA) scores for the thoracic spine (total: 11 points) and JOA recovery rates were used for investigating surgical outcomes.

Results : Of the 25 patients, 10 patients were male and the others were female. The mean JOA score was 6.7±2.3 points preoperatively and 8.8±1.8 points postoperatively, yielding a mean recovery rate of 53.8±31.0%. The mean patients' age at surgery was 52.4 years and mean follow-up period was 40.2 months. According to surgical approaches, 7 patients underwent anterior approaches, 13 patients underwent posterior approaches, 5 patients underwent combined approaches. Recovery rates were different depending on various factors. Age (≥55 years) and high signal intensity on preoperative magnetic resonance (MR) image were significant predictors of the lower recovery rate after surgery ($p<0.05$). Posterior decompression with dekyphosis procedure was related to the excellent surgical outcomes ($p =0.047$).

Conclusion : We evaluated the surgical outcomes associated with various factors of patients who had thoracic OPLL. In this study, our result elucidated that old age (≥55 years) and presence of intramedullary high signal intensity on preoperative MR images were risk factors related to poor surgical outcomes. In the meanwhile, posterior decompression with dekyphosis affected favorable clinical outcome. Posterior approach with dekyphosis procedure can be a recommendable surgical option for favorable results.

FP III-6

The Fate of UIV, UIV+1 compression fractures after long level spinal fixation. : What should we do? observation vs. revision surgery

Bang Sang Hahn, Kyung-Hyun Kim, Yong-Eun Cho, Keun-Su Kim, Dong-Kyu Chin, Sung-Uk Kuh, Jung Yoon Park

Department of Neurosurgery, The Spine and Spinal cord institute, Gangnam Severance spin hospital, Yonsei University College of medicine

Purpose : Compression fractures of UIV, UIV+1 after long segment spinal fixation for adult spinal deformity are commonly detected on follow up x-rays. It is important to early recognize specific characteristics of dangerous compression fractures which needs to be surgically corrected in the future, because such conditions can result in severe neurologic deficits and poor clinical outcome. The purpose of this study is to investigate the early radiologic characteristics of UIV, UIV+1 compression fractures after long segment spinal fixation surgery.

Materials and methods : A total 27 patients who presented newly developed compression fracture at UIV, UIV+1 after long segment spinal fixation (minimum 5 vertebral bodies, LIV of L5 or distal) were reviewed retrospectively. Patients were divided into 2 groups according to following management: revisional surgical correction (Group A, n=13) and conservative care (Group B, n=14). Pre- and postoperative images, and images taken shortly before and after the occurrence of fracture were evaluated for radiologic characteristics

Results : Mean age was 73.3±5.3 and 72.0±4.5; mean BMD was -2.17±0.9 and -1.97±0.8; mean fused vertebral level was 7.3±1.6 and 7.7±2.2 for groups A and B, respectively ($p>0.05$). Both group showed SVA correction after long segment spinal fixation (δSVA, A : 53.7±73.8mm, B : 51.0±72.1mm) without significant differences between groups ($p >0.05$). Both group showed improvement of PI-LL mismatch after long level spine surgery (A : from 34.5±22 to 14.2±13, $p <0.002$; B: from 33.9±24 to 15.5±14, $p <0.012$). In group A (n=13), 10 patients (76%) ended up presenting weakness of lower extremities and especially 3 of them were paraplegic status before revision surgery. The other 3 patients (23%) in group A were neurologically stable and underwent revision surgery due to severe back or leg pain. There were no neurologic deteriorations in Group B patients.

Wedging rate of compressed vertebral body and Local kyphotic angle increased in both groups shortly after the occurrence of compression fracture, but without significant differences between groups ($p >0.05$). Shortly after the compression fracture, Group A showed greater decrement of Disc height ($p<0.001$) than Group B. Binary logistic regression indicated decrement of Disc height was a risk factor of future revision surgery.

Conclusion : UIV, UIV+1 Compression fractures with greater decrement of disc height at early stage were associated with future neurological deterioration and necessity of revisional corrective surgery.

Free Paper Session III

FP III-7

The relation between the insertion of the sacral alar iliac screws above 1st and 2nd dorsal sacral foramen and the sacral nerve root injury using 3D cadaveric pelvis model

Young-seop Park, Suhyun Hwang, Won Heo, Gyeong Hee Lee
Gyeongsang National University Changwon Hospital

Purpose : To assess the possibility of sacral nerve root injury when sacral alar iliac (SAI) screws insertion performed through 1st and 2nd dorsal sacral foramen by virtually placing two 8.5mm-sized screws (S1AI and S2AI screw) and introduce the practical landmarks for fluoroscopically guided procedure.

Materials and methods : 82 cadaveric pelvises (42 males and 40 females) underwent continuous 1.0 mm slice computed tomography (CT) scans. CT images imported into Mimics® software to reconstruct the 3D model of pelvis. The 8.5mm-sized pedicle screw was processed into a 3D model using a 3D-sensor at the actual size and optimally placed as SAI screw above dorsal sacral foramen using Mimics® software. The sacral nerve root injury, cortical violation along the screw path, intraosseous screw length the relationship with adjacent structures were assessed. If the screw length was shorter than 65mm, the pelvis was assigned as impossible model

Results : There was no cortical violation around sacral nerve root canal in all screws and the ideal SAI screw trajectory directed to the anterior infeior iliac spine (AIIS) (Fig 1). The average length of S1AI screw was 105.3mm (range 71.5-115mm, SD 9.7) and S2AI screw, 90.3mm (range 47.5-115mm, SD 22.26). Fifteen models were assigned as impossible model just owing to short S2AI screw (range 47.5-62.4mm, SD 4.41) and they all had the iliac groove. In the model with iliac groove, the S2AI screw should be directed more outward to avoid the cortical perforation around the groove.

Conclusion : The optimal entry point of SAI screws had a wide range including the extent of the 1st and 2nd dorsal sacral foramen. If there was the iliac groove, the S2AI screw could not reach a sufficient intraosseous length. To assess the possibility of a S2AI screw fixation preoperatively, the iliac grove has to be verified through 3D reconstruction images of CT scans.

Free Paper Session III

FP III-8

Influence of diabetes mellitus in patients with lumbar spinal stenosis : A nationwide population-based study

Chang Kyu Lee[1], Sun Kyu Choi[2], Kwangryeol Kim[1], Insoo Kim[1]
[1]Keimyung University Dongsan medical center, [2]Biostatistics and Epidemiology, Neurosurgery, Yonsei University College of Medicine

Purpose : To evaluate the relationship of co-morbidities, medical cost, and surgical outcome in diabetes mellitus(DM) patients with lumbar spinal stenosis (LSS).

Materials and methods : Data from patients over the age of 50 who were diagnosed with LSS were collected between 2005 and 2007 from the Korean National Health Insurance Database (n=14,304). After following them for 8 years, comparison between the "DM group" (n=3,482) and the "non-DM group" (n=10,822) was assessed. Cox proportional hazard regressions were used to examine the relationships of DM, hypertension (HTN), cardiovascular disease (CVD), chronic kidney disease (CKD), cerebrovascular disease (ICH), and surgery for LSS. Admission rate and medical cost for DM patients with LSS were also assessed. Overall survival rate for DM patients with LSS who underwent lumbar surgery were assessed.

Results : Mortality of DM group was about 1.3 times higher than that of non-DM group in LSS patients. DM with co-morbidities including HTN(Hazard ratio [HR], 1.40; 95% confidence Interval [CI], 1.25-1.56; $p<0.001$), CVD (HR, 1.53; 95% CI, 1.36-1.73; $p<0.001$) CKD (HR, 3.2; 95% CI, 2.69-3.75; $p<0.001$), and ICH (HR, 1.69; 95% CI, 1.49-1.91; $p<0.001$) increased risk of mortality. Mean hospitalization and average medical expense of DM group were 34.8 days and 1,597 USD, respectively. Mean hospitalization and average medical cost of DM group who underwent lumbar surgery were 35.4 days and 2,322 USD, which were 3.7 days longer and 948 USD higher compared with conservative treatment for LSS. Survival rate of DM group with surgery for LSS had a tendency for positive prognosis compared with that of DM group with conservative treatment, but not significantly ($p=0.2$)

Conclusion : DM was associated with poor prognosis, significantly with CKD, and increasing medical cost in LSS patients. Nevertheless, surgical treatment for LSS in DM patients was related with good prognosis compared to conservative treatment

2018. **9. 15** (Sat.)

Guest Lectures II

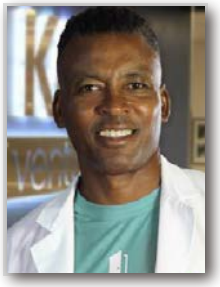
좌장 : **도재원** (순천향의대), **이승명** (조선의대)

1. Future of Spine Motion Preservation — **Dr. Kingsley R. Chin** (USA)

2. The optimal treatment duration of anabolic agent for fracture prevention — **Dr. Donato Agnusdei** (Italy)

Dr. Kingsley R. Chin

USA



EDUCATION

1992–1996	Harvard Medical School (Honors), M.D.
1987–1989	Columbia University (Electrical Engineering, Honors, Eta Kappa NU), B.Sc.
1984–1987	Columbia University (Mathematics), B.A.

POSTGRADUATE TRAINING AND FELLOWSHIP APPOINTMENTS

2002–2003	Fellowship, Spine Surgery, Director, Henry H Bohlman, MD Spine Institute, Case Western Reserve University, Cleveland, OH
2001–2002	Fellowship, Adult Orthopedic Joint & Reconstructive Surgery, Director John Ready, MD West Roxbury VA and Harvard Medical School, Boston, MA
1997–2001	Residency Orthopaedic Surgery, Directors Henry Mankin, MD/James Herndon, MD Massachusetts General Hospital and Harvard Medical School, Boston, MA
1996–1997	Intern in General Surgery Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, MA

UNIVERSITY FACULTY APPOINTMENTS

2018–2018	Professor Adjunct University of Technology, Kingston, Jamaica
2015–2018	Professor Voluntary Herbert Wertheim College of Medicine at FIU, Florida, USA
2012–2018	Professor Affiliate Charles E. Schmidt School of Medicine at FAU, Florida, USA
2003–2007	Professor Assistant University of Pennsylvania Medical School, Philadelphia PA, USA
2003–2004	Clinical Fellow University Hospitals at Case Western Reserve University, Cleveland OH, USA
1997–2002	Clinical Fellow Massachusetts General Hospital at Harvard Medical School, Boston MA USA
1996–1997	Clinical Fellow Beth–Israel Deaconess Hospitals at Harvard Medical School, Boston MA USA

ABBREVIATED ACHIEVEMENTS

2005	Editor/Reviewer 7+ journals (Spine, The Spine Journal, CORR, AJO,…)
2003	Chief Spine Surgery University of Pennsylvania Medical School, Philadelphia PA USA
1995	Publications 40+ issued patents | 300+ scientific papers, invited lectures & presentations | 4+ books
1989	President Senior Class Columbia University School of Engineering, New York City, NY, USA
1988	Player of the Year, Ivy League, Division I Intercollegiate Soccer

CERTIFICATION/LICENSURE

Florida | New York | New Jersey | Jamaica

American Board of Orthopaedic Surgery Diplomat | National Board of Medical Examiners Diplomat

Future of Spine Motion Preservation

Dr. Kingsley R. Chin
USA

The extraordinary advancement of treatment for spinal disorders over the past several decades is entering a new multi-faceted phase with the emergence of new technology, patient engagement, and business infrastructure that offers opportunity to treat patients with better and more complete care. The core of this opportunity is the treatment of low-back pain. Spinal fusion is still considered the "gold standard" in the treatment of low-back pain but fusion is also associated with adverse side effects including degeneration of adjacent levels. Recent advancements in motion-preservation viscoelastic technologies such as disc replacement, facet replacement, and posterior dynamic stabilization devices have opened the door for new treatment options that will change the gold standard and the future of spine treatment and patient care. This presentation provides a technical, surgical, and business perspective from the past and in the present, and how insurance, spine specialty hospitals, insurance, and patient engagement will be instrumental in furthering the development of spinal care.

Dr. Donato Agnusdei

Italy

Education

Undergraduate/Graduate

11/1968–07/1974 Laurea in Medicina e Chirurgia (Degree in Medicine and Surgery Diploma, undergraduate/graduate combined program) Siena University, School of Medicine, Siena Italy
Date of graduation: 07/19/1974
Grade: 110/110 cum laude

Postgraduate

11/1974–4/1977 School of Specialization in Cardiovascular Diseases, Siena University, School of Medicine, Siena Italy
Date of graduation: 04/16/1977
Grade: 70/70 cum laude

08/1974–09/1976 Fellowship in Internal Medicine, Institute of Medical Semeiotics, Siena University, School of Medicine, Siena
Director: Tullio di Perri, MD

10/1976–09/1979 Assistant in Internal Medicine, Ospedale S. Cristofano, Montepulciano, Siena

10/1976–09/1979 Assistant in Emergency Department, University Hospital, University of Siena, Siena

11/1990–7/1995 School of Specialization in Endocrinology, Siena University, School of Medicine, Siena
Date of graduation: 11/07/1995
Grade: 70/70

Academic Position/Employment

Assistant Professor of Medicine, 1980–1996
Institute of Internal Medicine – University of Siena

Board Certification

Italian Board of Specialty in Cardiology: 1977
Italian Board of Specialty in Endocrinology: 1995

Editorial Responsibilities

Journal of Endocrinological Investigation: 1989–2006
Clinica delle Malattie dell'Osso: 1988–1995
Italian Journal of Bone and Electrolyte Metabolism 1990–2003

The optimal treatment duration of anabolic agent for fracture prevention

Dr. Donato Agnusdei
Italy

Disclaimer

- The information contained herein represents the opinion of the speaker, not necessarily that of Eli Lilly and Company or its affiliates
- The speaker is currently consultant for Eli Lilly & Company, and former employee.

Conflict of Interest Disclosure

Dr. Donato Agnusdei

▪The speaker must disclose to the audience any ties to Eli Lilly, Lilly Korea or Lilly Partner the speaker has. (it can be either verbal or written).

▪Example] I have the following financial relationships to disclose

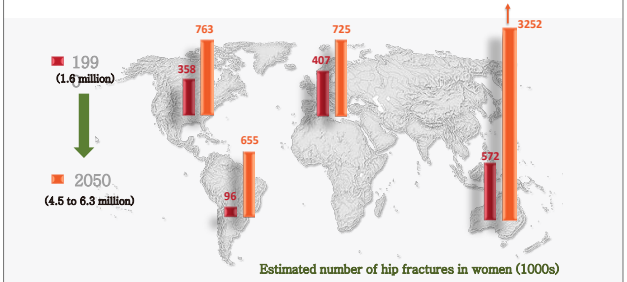
- Employee: Gil-Dong Hong, Lilly Korea, OBU MR.
- Leadership position/advisory role for: xxx, Inc.
- Stakeholder in: YYY corporation, ZZZ Corporation
- Honoraria (Lecture fee) from: AAA Pharmaceutical company, BBB Corporation.
- Honoraria (Manuscript fee) from: CCC Corporation
- Grant/Research funding from: DDD Corporation
- Other/remuneration from: WWW Corporation

- Or -

- I have no financial relationships to disclose.

Ageing Population

Worldwide, the number of hip fractures is projected to increase significantly in the next 50 years



IOF website – http://www.iofbonehealth.org/facts-and-statistics/index.html11-5-2013

4

Prevalence of osteoporotic fractures

- Worldwide, an osteoporotic fracture occurs every 3 seconds
- Osteoporosis causes more than 8.9 million fractures annually

International Osteoporosis Foundation. Facts and Statistics. https://www.iofbonehealth.org/facts-statistics. Sept 23, 2017

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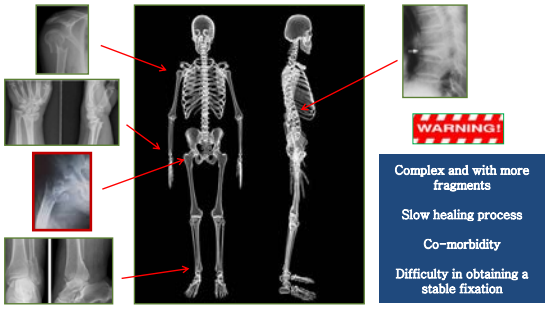
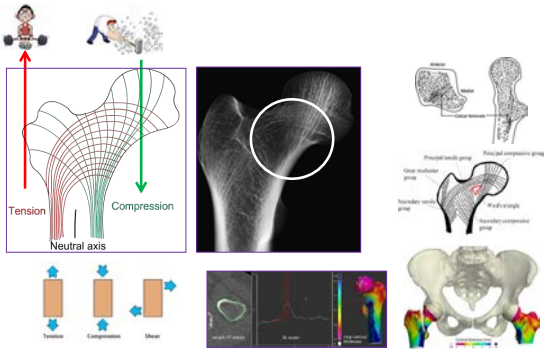
Osteoporotic Fracture Sites



6

1. Kanis JA, et al. *Osteoporos Int* 2001;12:417-27;
2. NOF. *Clinician's Guide to Prevention and Treatment of Osteoporosis*. http://nof.org/files/nof/public/content/file/2791/upload/919.pdf ;
3. Kanis JA, et al. *Osteoporos Int* 2001;12:989-95.

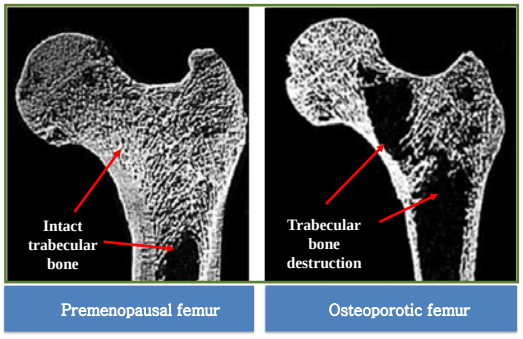
Mechanical Properties of Bone



7

Poole KE, et al. *J Bone Miner Res* (2010); 25: 482-491
Poole KE, et al. *PLoS One* 7 (2012): e38466

As trabecular bone is lost, the remaining cortical bone becomes even more important for bone strength



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Zebaze RM et Al. Lancet, 2010: 9727: 1729-1736

Changes of mechanical and structural properties in the osteoporotic bone

- Reduction in mineral content (provides strenght and stiffness);
- Reduction of proteic content (limits the damage consequent to an impact);
- Reduction of the ability to oppose to deformations (rigidity);
- Reduction to absorbe energy (resistence);
- Reduction to adapt to repetitive loads (fatigue resistence);
- Reduction to inhibit the progression of the lesion (resistence to fracture);
- Increase of Anisotropy (major number of trabeculae with orientation on the principal load axis), and therefore increase risk for abnormal loads (falls);
- Increase of Microdamages (manifestation related to repetitive micro-stress on bony tissue, age-related).

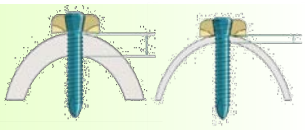
9

1. Lopez MJ, Edwards III RB, Markel MD. Healing of normal and osteoporotic bone. In: An YH, ed Orthopaedic issues in osteoporosis. Boca raton. CRC Press. 2003:55-70.
2. Rohrl PJ, Blauw E, Zurcher C, et al. Evidence for a diminished maturation of preosteoblasts into osteoblasts during aging in rats: an ultrastructural analysis. *J Bone Miner Res*. 1994;9

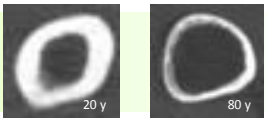
Age-Related Changes to Cortical Bone

Decrease of cortical thickness[1,2]

Increase in cortical bone porosity (increase in inner and outer diameter)[1,2]



The risk for fractures of the femoral neck increases 13-fold from ages 60 to 80[3]

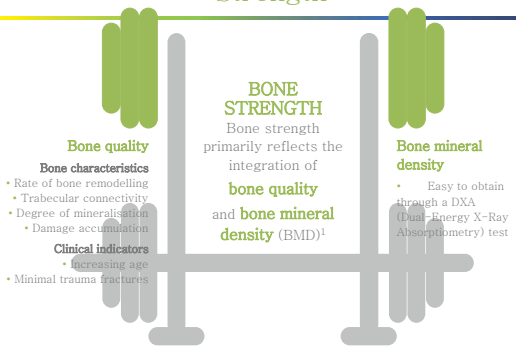


y = years.

10

1. Seeman E. *Rheumatology*. 2008:47(suppl 4):iv2-iv8. 2. Augat P, Schorlemmer S. *Age Aging*. 2006:35(suppl 2):ii27-ii31.
3. Brockstedt H, Kassem M, Eriksen EF, et al. *Bone*. 1993:14:681-691.

Identifying Patients With Low Bone Strength



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1. NIH Consensus Development Panel on osteoporosis prevention, diagnosis, and therapy. *JAMA*. 2001:285:785-795.

Technical challenges of fracture fixation in osteoporotic bone

- Impaired ability of osteoporotic bone to hold screws or support implants
- Crushing of cancellous bone with subsequent voids after fracture reduction

These factors can lead to a higher risk of failure at the implant–bone interface before healing is achieved

Goldhahn J, et al. Calcif Tissue Int 2012;90:343–53

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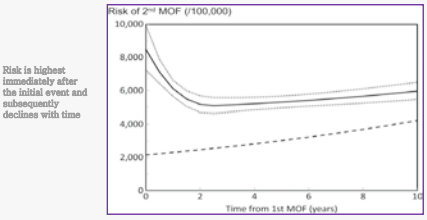
Fractures Increase the Risk of Future Fractures

Identification and Management of Patients at Increased Risk of Osteoporotic Fracture: outcomes of an ESCEO expert consensus meeting[1]



Risk per 100,000 (95% confidence interval) of a second major osteoporotic fracture (*MOF*) after a first MOF for a woman aged 75 years at her first fracture. Knots for the spline function are set at 0.5, 2.5 and 15 years of follow-up after the first fracture. The *dashed line* is the risk of first MOF in the whole population (n = 18,872) for a woman aged 75 years at baseline.

1. J.A. Kanis et Al. Osteoporos Int. 2017; 28(7): 2023-2034

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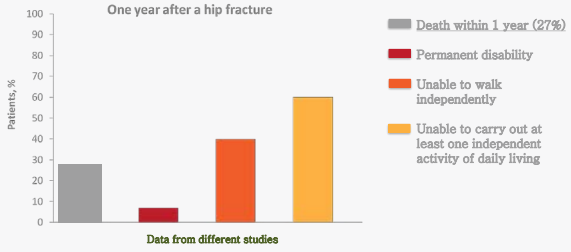
Consequences of a hip fracture

Functional results
Many patients lose their independence and require long-term nursing care

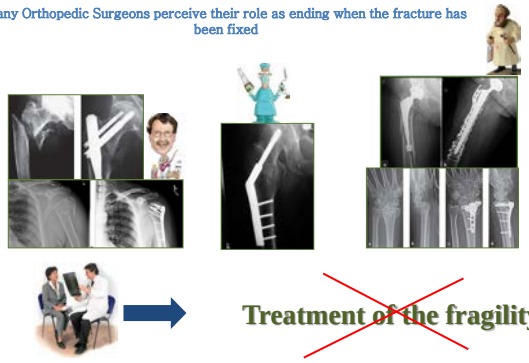


Panula J, et Al. BMC Musculoskelet Disord, 2011Aguirre J. J Gerontol A Biol Sci Med Sci 2000;55:498–507

14

Role of Orthopedic Surgeons

Many Orthopedic Surgeons perceive their role as ending when the fracture has been fixed



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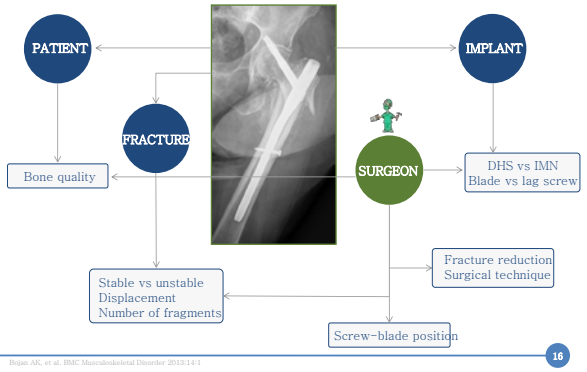
Speaker's own contribution

Risk factors of a surgical failure are related to the Orthopedic Surgeon



Bojan AK, et al. BMC Musculoskeletal Disorder 2013;14:1

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Opportunities for the Orthopedic Surgeon

- First and often the ONLY physician that fragility fracture patients see.
- Has the opportunity to not only fix the fracture, but also to evaluate whether the fracture may be related to Osteoporosis.
- Able to coordinate secondary fracture prevention with other treating physicians to improve the long-term care and outcomes of these patients.


Ward Round


Operating Room


Discharging

17

Speaker's own contribution

Alarming fact

Despite availability of therapies proven to reduce fracture risk by improving bone mass and quality, even in patients who have already suffered a fracture, diagnosis
and treatment of Osteoporosis remains low in patients with Fragility Fracture

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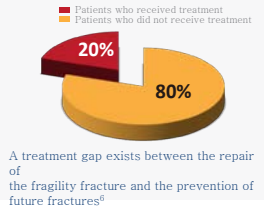
Speaker's own contribution

Osteoporosis care post-fracture

70% of Fragility Fracture Patients die within the 5th year after
the traumatic event, only 30% survive!
Medications for Osteoporosis decrease of 30-69% the risk of
incidence of further fracture[1]

- Only ~20% of patients with a history of hip fracture or other fragility fracture received treatment for osteoporosis2-5
- These data indicate that there are many missed opportunities for preventing future fractures



A treatment gap exists between the repair of
the fragility fracture and the prevention of future fractures[6]

19

1. Jennings et AL. Osteoporosis Int., 2010. 2. Dell RM, et al. *J Bone Joint Surg Am* 2009;91(suppl 6):79-86; 3. Solomon DH, et al. *Am J Med* 2003;115(5):398-400.
4. Andrade SE, et al. *Arch Intern Med* 2003;163:2052-57; 5. Harrington JT, et al. *Arthritis Rheum* 2002;47(6):651-54;
6. AOA. About Own the Bone. http://www.ownthebone.org/about-own-the-bone.aspx.

Therapeutic options for osteoporosis

Inhibitors bone resorption = antiresorptive:

- **Bisphosphonates**
  - Alendronate
  - Risedronate
  - Zoledronate
- **Denosumab**
- **Selective estrogen receptor modulators (SERMs)**
  - Raloxifene

Stimulator bone formation = osteoanabolic:

- **Parathyroid hormone 1-34 teriparatide (Forsteo®)**

Unspecified MOA:

Weekly teriparatide
Active Vitamin D metabolites

20

Speaker's own contribution

Osteoporosis Treatments Have Different Effects on the Bone Remodelling Cycle

	Function	Primary effect	Secondary effect	Bone turnover	BMD effect	Bone volume
Anabolic agent FORSTEO (teriparatide [rDNA origin] injection)	New bone formation[1]	Osteoblast activity[1]	Osteoclast activity[1]	Turnover[2]	New bone formation: skeletal mass[1]	Bone volume[3]
Antiresorptive agents (bisphosphonates, denosumab, raloxifene)	Bone resorption[4,5]	Osteoclast activity[4,5]	Osteoblast activity[4,5]	Turnover[4,5]	Fill in the remodelling space; mineralisation of existing bone[4-6]	No effect

BMD = bone mineral density; rDNA = recombinant DNA.

Information regarding mechanisms of action does not provide evidence of comparative fracture protection.

21

1. FORTEO Prescribing Information. 2. Arlot M, et al. *J Bone Miner Res.* 2005;20(7):1244-1253. 3. Jiang Y, et al. *J Bone Miner Res.* 2003;18(11):1932-1941. 4. Fleisch H. *Endocr Rev.* 1998;19(1):80-100. 5. Russell RG, et al. *Osteoporos Int.* 1999;9:S66-S80. 6. Riggs BL, Parfitt AM. *J Bone Miner Res.* 2005;20:177-184.

Effect of Antiresorptive Agents on Bone Remodeling[1]

Before treatment with an antiresorptive agent

- More resorption sites[1]
- Deep, underfilled resorption sites and stress risers[1]
- Greater risk of perforation

After treatment with an antiresorptive agent

- Fewer resorption sites[1]
- Filled-in resorption sites[1]
- Less risk of perforation

Unremodeled bone Newly remodeled bone

Antiresorptives decrease bone resorption, thereby causing fewer and more readily filled resorption sites

22

1. Adapted from Riggs BL, Parfitt AM. *J Bone Miner Res.* 2005;20:177-184.

Treatment with Antiresorptive Agents Increases Bone Mineralization[1]

After treatment with an antiresorptive agent

- During bone remodeling, older, more mineralized bone is replaced by younger, less mineralized bone.

Consequence of antiresorptive treatment

- In the setting of lower bone turnover, bone age increases and bone continues to accumulate mineral for many years.

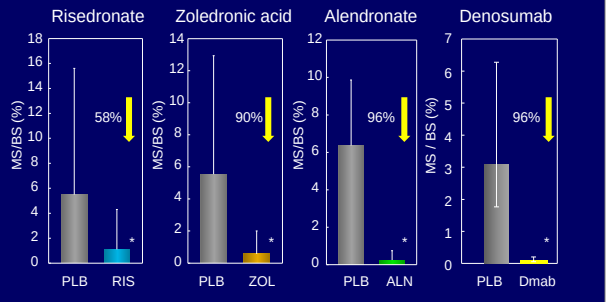
Less mineralized bone (younger) Intermediate mineralized bone More mineralized bone (older)

Antiresorptives decrease bone resorption, thereby causing fewer and more readily filled resorption sites

23

1. Adapted from Riggs BL, Parfitt AM. *J Bone Miner Res.* 2005;20:177-184.

New Bone Formation on Trabecular Surfaces in Women on Antiresorptive Therapies and Controls



Eriksen EF et al, Bone 2002;31: 620– 625

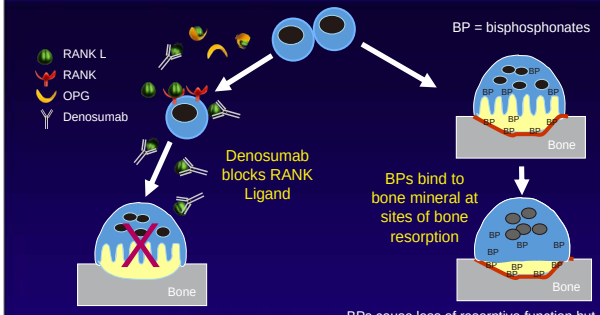
Recker R et al JBMR 2008;23:6-16

Chavassieux PM et al, J Clin Invest 1997;100:1475

Reid IR et al, JBMR 2010;25:2256-65

24

Denosumab and bisphosphonates work differently



Denosumab blocks osteoclast formation, function and survival

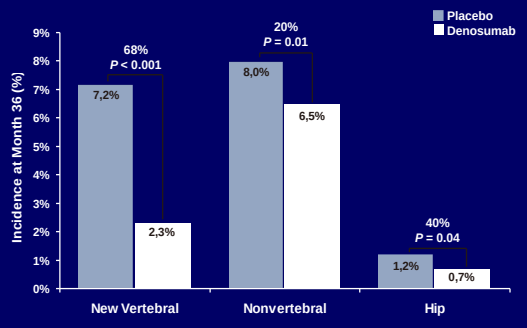
BPs cause loss of resorptive function but 'disabled' osteoclasts may persist

25

Speaker's own contribution

Denosumab Efficacy at 3 years

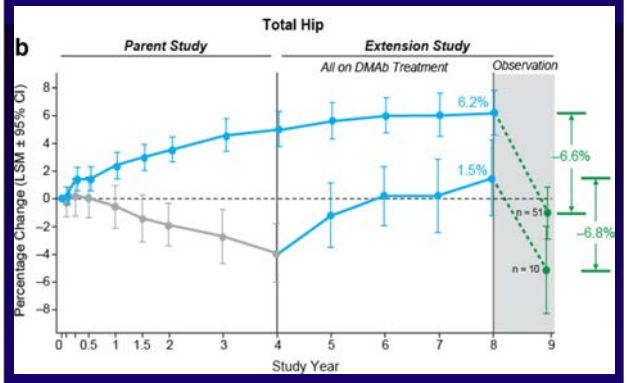
Phase 3: The FREEDOM Trial



Cummings SR, et al. N Engl J Med. 2009 Aug 20;361(8):756-65

26

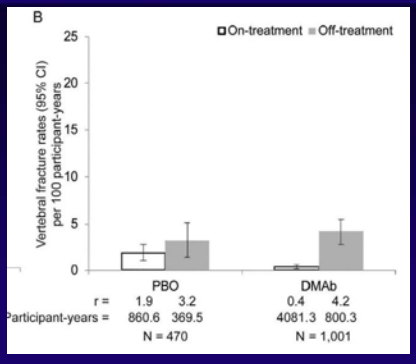
Discontinuation of Dmab after 8 years- Phase 2 Study



McClung MR et al, Osteoporos Int (2017) 28:1723–1732

27

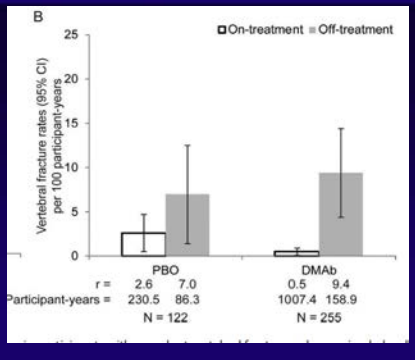
Freedom Study and Follow up: Discontinuation and Multiple Vertebral Fractures



Cummings SR et al J Bone Miner Res. 2018;33:190–198

28

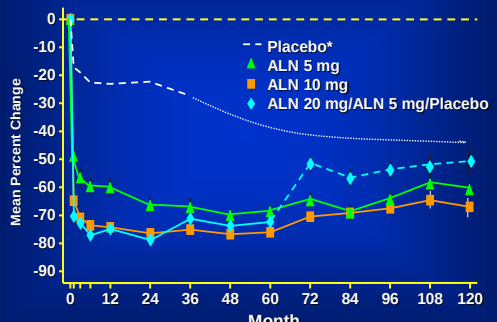
Freedom Study and Follow up: Discontinuation and Multiple Vertebral Fractures Patients with Prevalent Vertebral Fractures



Cummings SR et al J Bone Miner Res. 2018;33:190–198

29

Long term inhibition of bone turnover with alendronate - Urine NTx



*Patients enrolled in the original, 3 year study

Bone HG et al *N Engl J Med* 2004;350:1189–1199

31

Turnover and fragility: low turnover

- Ages the bone structure.
- May cause hyper-mineralization by increasing the rigidity.
- Increase the incidence of microcracks and fatigue-related injuries.
- Reduces repair microcracks.
- Slows down the remodeling of the bone callus in case of fracture.

Seeman E. *Advances in Osteoporotic Fracture Management* 2: 2–8. 2002

32

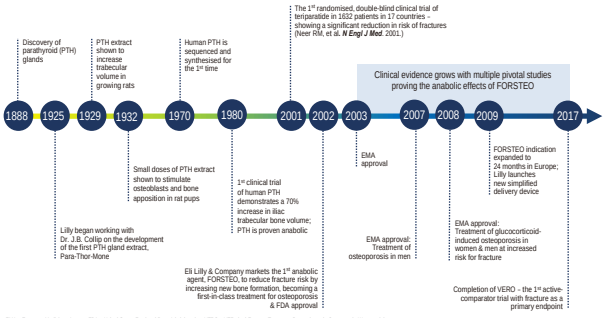
Atypical Femoral Fractures and Bisphosphonate Use

- **Atypical Femoral Fractures are associated with use of Bisphosphonates, and the risk is directly proportional to the duration of the treatment[1]**
  - Subtrochanteric and femoral shaft fractures are more common in patients who have been exposed to long-term bisphosphonates (>3 years; median treatment 7 years)[2]
- **Medical management of Atypical Femoral Fractures per ASBMR task force includes[2]**
  - Discontinuation of Bisphosphonates
  - Adequate supplementation of Calcium and Vitamin D
  - Consideration of Teriparatide therapy for those who appear not to heal on conservative therapy

1. Meier et al. *Arch Intern Med* 2012;172(12):930–6.
2. Shane et al. *J Bone Miner Res* 2010;25(11):2267–94

33

THE FORSTEO STORY
FROM DISCOVERY TO PRESENT DAY



EMA = European Medicines Agency; FDA = United States Food and Drug Administration; VERO = VERtebral Fracture Treatment Comparisons in Osteoporotic Women trial.

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Speaker's own contribution

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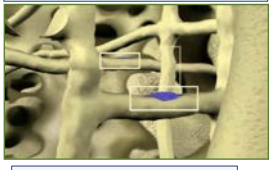
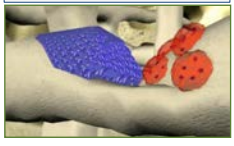
Mechanism of Action of Teriparatide ([rDNA origin] injection)[1]

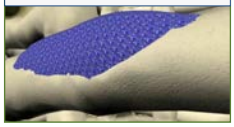
Osteblasts are directly activated. Bone formation occurs without prior resorption.



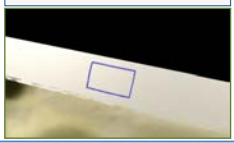
Bone remodeling rate is increased.



When bone formation is completed, more bone is formed than was removed.



New bone is also formed on cortical bone surfaces.



1. Dempster DW. Examining the Bone Remodeling Cycle. Copyright ©2003 Eli Lilly and Company. All rights reserved.

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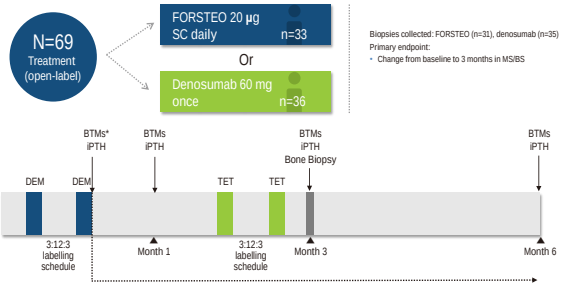
ANABOLICS VS. ANTIRESORPTIVES TRIAL
AVA[1]



*Bone turnover markers measured: P1NP and CTX.

BTMs = bone turnover markers; CTX = carboxyterminal cross-linking telopeptide of type 1 collagen; DEM = demeclocycline; iPTH = intact parathyroid hormone; MS/BS = mineralising surface/bone surface; P1NP = procollagen type 1 N-terminal propeptide; SC = subcutaneous; TET = tetracycline.
1. Dempster DW, et al. *J Bone Miner Res*. 2016;DOI:10.1002/jbmr.2804.

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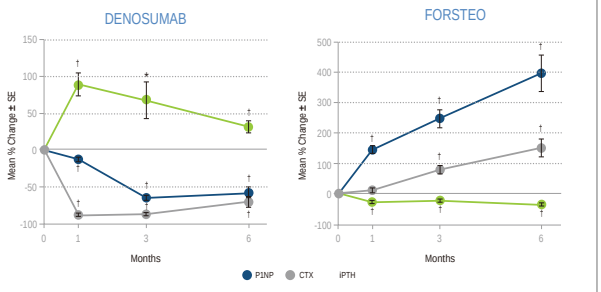
FORSTEO STIMULATED BONE FORMATION INDICES[1]



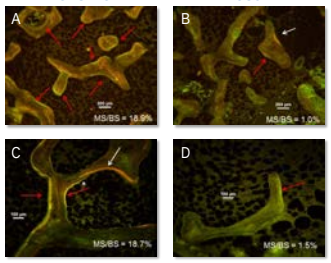
*p=0.01 for within treatment group comparison from baseline to each time point using T-test.
†p<0.001 for within treatment group comparison from baseline to each time point.

CTX = carboxyterminal cross-linking telopeptide of type 1 collagen; iPTH = intact parathyroid hormone; P1NP = procollagen type 1 N-terminal propeptide; SE = standard error.

1. Dempster DW, et al. *J Clin Endocrinol Metab.* 2016;101(4):1353-1363.

FRACTURE NOW 37

QUADRUPLE LABELLING SHOWS NEW BONE FORMATION AT 3 MONTHS WITH FORSTEO VS. DENOSUMAB[1]



Low power (upper panels) and high power (bottom panels) images of samples, each from a different subject, representative of the Month 3 median values for MS/BS for each treatment group (18.73% FORSTEO vs. 0.96% denosumab); white arrows indicate first labelling period (DEM) at baseline; red arrows indicate second labelling period (TET) at 3 months.

DEM = demeclocycline; MS/BS = mineralizing surface/bone surface; TET = tetracycline.

1. Dempster DW, et al. *J Clin Endocrinol Metab.* 2016;101(4):1353-1363.

FRACTURE NOW 38

AVA – STUDY:
Effects of Teriparatide and Denosumab on Bone Formation

Teriparatide → increases Bone formation- trabecular
- intracortical
- periostal

Osteo-Anabolic Effect

Denosumab → reduces bone formation
- reduction of Osteclasts activity
- rapid reduction of remodeling, later phase supressed bone formation
- prolonged mineralization time

No Osteo-anabolic Effect, Antiresorptive

Dempster et al. J Clin Endocrinol Metab. 2016 Apr;101(4):1353-63

39

AVA
CONCLUSIONS[1]

- During the time that iPTH is elevated after denosumab administration, serum markers of bone formation and resorption were markedly reduced; conversely, bone turnover markers with FORSTEO treatment were significantly elevated
- Observed increase in iPTH is not unique to denosumab; it may be an attribute of antiresorptive class, as iPTH also increases in response to alendronate and zoledronic acid
- Denosumab-induced increases in iPTH, when examined in parallel with changes in bone turnover markers and a full panel of histomorphometric indices across 4 bone envelopes, are not consistent with and do not support early bone-forming activity of this drug

AVA = Anabolics vs. Antiresorptives Trial. iPTH = intact parathyroid hormone.

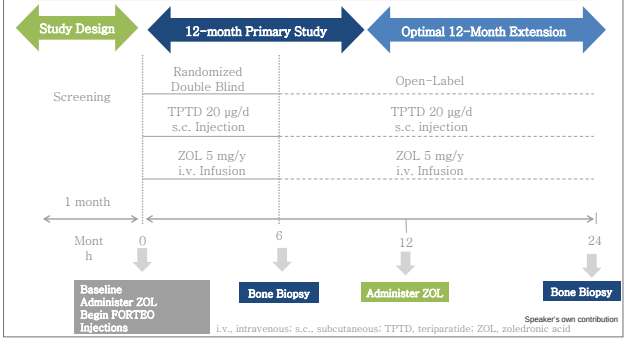
1. Dempster DW, et al. *J Clin Endocrinol Metab.* 2016;101(4):1353-1363.

FRACTURE NOW 40

A Longitudinal Study of Skeletal Histomorphometry at 6 and 24 months across Four Bone Envelopes in Postmenopausal Women with Osteoporosis receiving Teriparatide or Zoledronic Acid: the SHOTZ Trial

Dempster et al. J Bone Miner Res. 31(7), 1429–39, 2016

OBJECTIVES: Assess longitudinal histomorphometric changes between and within TPTD and ZOL treatment groups in the cancellous, endocortical, intracortical and periosteal bone envelopes in postmenopausal women with osteoporosis with evaluable biopsies at months 6 and 24

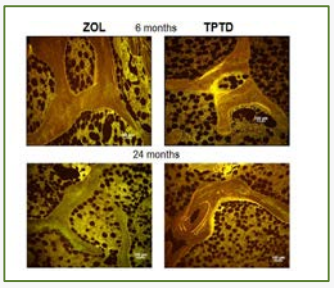


Speaker's own contribution

i.v., intravenous; s.c., subcutaneous; TPTD, teriparatide; ZOL, zoledronic acid

Tetracycline Labels in Cancellous Bone

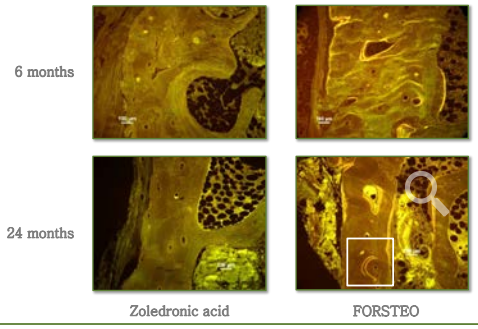
Bone Histomorphometry after Tetracycline labeling Allows Quantification Of Bone Structure And Cellular Activity[1,2]



1. Dempster et al. *J Bone Miner Res.* 2013;28(1):2–17
2. Recker RR et al. *Bone.* 2011;49(5):955–64

42

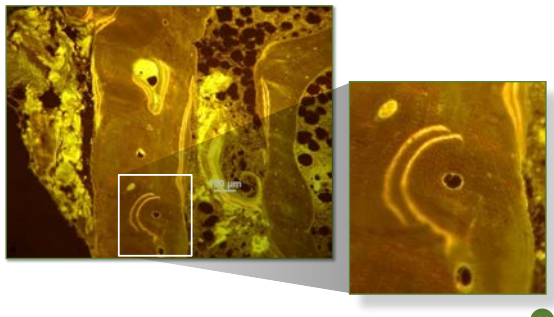
FORSTEO Builds New Cortical Bone Over 24 Months Across All 3 Bone Envelopes[1]



1. Dempster DW, et al. *J Bone Miner Res.* 2016;31(7):1429–1439.

43

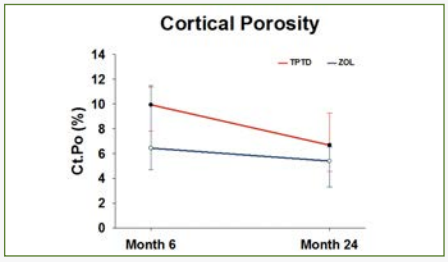
Cortical "Pores" Being Filled With New Bone in a FORSTEO-Treated Subject at 24 Months[1]



1. Dempster DW, et al. *J Bone Miner Res.* 2016;31(7):1429–1439.

44

Static Indices for Paired Data Set (Ct.Po)



Cancellous endpoints: n=10 for TPTD; n=9 for ZOL.
Endocortical, intracortical, and periosteal endpoints: n=7 for TPTD; n=9 for ZOL

Ct.Po, cortical porosity; TPTD, teriparatide; ZOL, zoledronic acid

1. Dempster DW, et al. *J Bone Miner Res.* 2016;31(7):1429–1439.

45

SHOTZ: Conclusions[1]

- Tissue-level mechanisms underlying increases in BMD seen with each drug are fundamentally different;
- Study demonstrates that bone formation indices are higher with TPTD treatment than with ZOL in all 4 bone envelopes and this difference persists for at least 2 years;
- TPTD stimulates bone formation throughout the duration of treatment; the magnitude of response in cortical bone remains robust at 24 months;
- Higher intracortical remodeling rate with TPTD may confer long-term benefits because older bone is replaced by new bone throughout the cortical skeleton;

BMD = bone mineral density; SHOTZ = Skeletal Histomorphometry in Subjects on Teriparatide or Zoledronic Acid Therapy Trial.

1. Dempster DW, et al. *J Bone Miner Res.* 2016;31(7):1429–1439.

46

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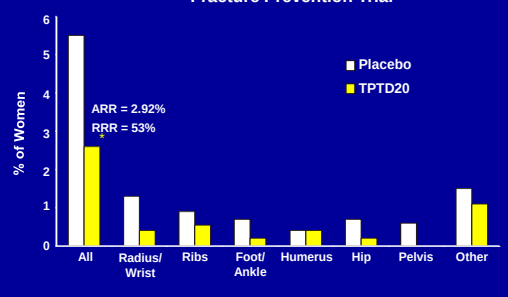
Teriparatide and the Proximal Femur

- What happens to cortical bone?
- Is bone formation increased as this site?
- What is the effect on nonvertebral fracture, a composite endpoint that includes hip?

47
Speaker's own contribution

Teriparatide Reduces Incidence of Nonvertebral Fragility Fractures

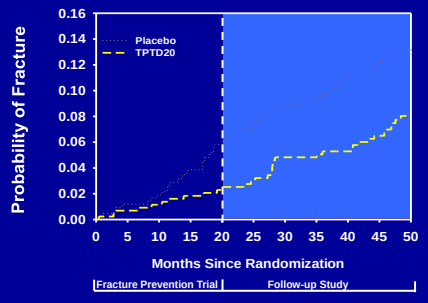


*p<.05 vs. placebo

Neer et al. *N Engl J Med* 2001;344(19):1434-41.

48

Fracture Prevention Trial Follow-up: Proportion of Women Who Had ≥1 Nonvertebral Fragility Fracture



Prince et al. *J Bone Miner Res* 2005;20(9):1507-13.

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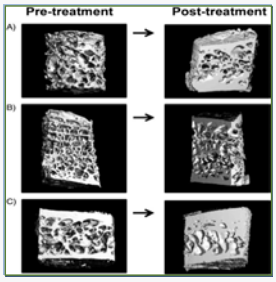
Teriparatide increases both Bone Formation and Resorption in Postmenopausal women

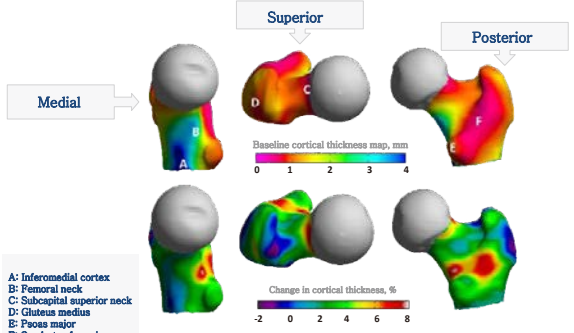


Analysis of iliac crest biopsy specimens from 55 women who participated in the Fracture Prevention Trial

1. Eriksen EF, et al, Literature review: The effects of teriparatide therapy at the hip in patients with osteoporosis. Bone (2014), 67 (2014) 246–256

50

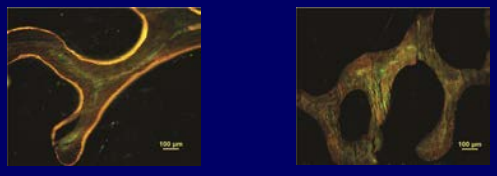
Teriparatide increases cortical bone thickness



Poole KE, et al. PLoS ONE 2011;6(1):e16190

51

Femoral Neck Trabecular Bone in Patients Undergoing Elective THA and Pretreated with TPTD vs Placebo



Teriparatide Treated | Placebo

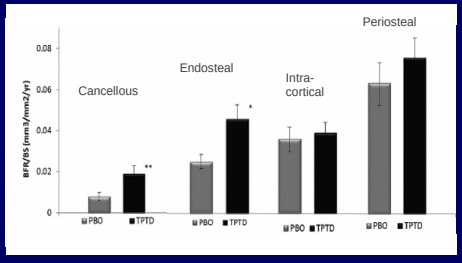
- Approximately 6 weeks of TPTD prior to elective THA
- Double dosing of tetracycline after approximately 3 weeks of TPTD
- During the THR, an intact sample of the femoral neck (FN) was procured, fixed

Cosman et al "Teraparatide Stimulates Bone Formation Rapidly in the Human Femoral Neck" JCEM 101: 1498–1505, 2016

52

Bone Formation at the Hip During Teriparatide

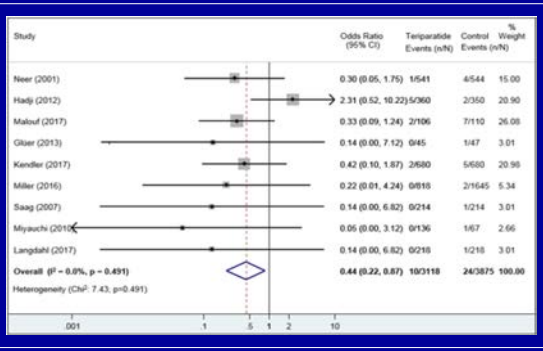
40 pts undergoing total hip replacement for osteoarthritis treated with teriparatide vs. placebo for 6 weeks, bone sample obtained after tetracycline double labeling



Cosman et al. JCEM 101: 1498–1505, 2016

53

Meta-analysis of Hip fracture reduction with Teriparatide - ECTS 2018



Diez-Perez A et al, Calcif Tissue Int (2018) 102:S1–S159

54

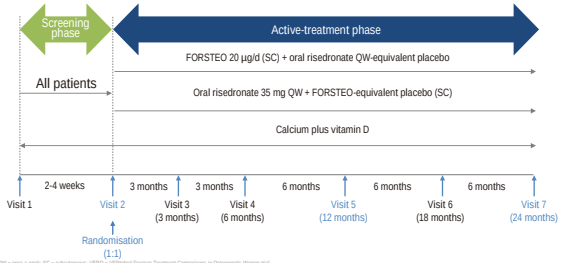
Who are the best candidates for the Forsteo Therapy?

- **Patients with older age, lower BMD, and with an osteoporotic fracture**
- **Teriparatide represents a rational and good approach to steroid-induced osteoporosis**
- **Teriparatide shows significant superior efficacy versus antiresorptives (VERO study)**

55
Speaker's own contribution

FORSTEO VS. RISEDRONATE IN SEVERE OSTEOPOROSIS
VERO[1]

- The largest controlled trial with FORSTEO and the first 24-month, randomised, active-controlled trial that assessed fracture risk reduction as the primary endpoint in postmenopausal women with osteoporosis



d = day; QW = once a week; SC = subcutaneous; VERO = VERtebral Fracture Treatment Comparisons in Osteoporotic Women trial.
1. Kendler D, et al. Lancet. 2018;391:230-40.

FRACTURE NOW 56

VERO:
FRACTURE ENDPOINTS[1]

Primary endpoint	Key gated secondary endpoints	Key non-gated secondary endpoint	Exploratory endpoint
Patients (%) with ≥1 new vertebral fractures during the 24-month study	• Pooled new and worsened vertebral fractures • Clinical fractures* • Non-vertebral fragility fractures • Major non-vertebral fragility fractures	New moderate or severe vertebral fractures or new multiple (≥2) vertebral fractures	Clinical vertebral fractures

*Composite of clinical vertebral and non-vertebral fragility fractures.

VERO = VERtebral Fracture Treatment Comparisons in Osteoporotic Women trial.
1. Kendler D, et al. Lancet. 2018;391:230-40.

FRACTURE NOW 57

VERO:
KEY BASELINE CHARACTERISTICS[1]

Characteristics		FORSTEO (N=680)	Risedronate (N=680)
Age (years), mean (SD)		72.6 (8.77)	71.6 (8.58)
Bone mineral density, mean (SD)*	Lumbar spine	-2.27 (1.24)	-2.29 (1.22)
	Femoral neck	-2.27 (0.76)	-2.24 (0.74)
Patients with ≥1 vertebral fractures, n (%)		679 (100)	679 (100)
Patients with ≥1 non-vertebral fractures after 40 years of age, n (%)		298 (44)	284 (42)
Mean (SD) number of prevalent vertebral fractures		2.7 (2.1)	2.7 (2.1)
Grade of the most severe vertebral fracture, n (%)†	SQ3	606 (89)	612 (90.0)

*Number of SDs below the respective mean bone mineral density in young adults.

SD = standard deviation; VERO = VERtebral Fracture Treatment Comparisons in Osteoporotic Women trial.
1. Kendler D, et al. Lancet. 2018;391:230-40.

FRACTURE NOW 58

VERO:
PREVIOUS OSTEOPOROSIS THERAPY[1]

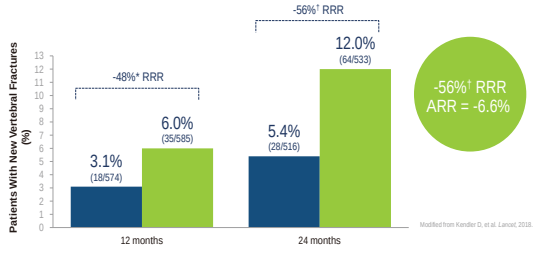
	Number (%) of patients		Treatment duration (years), median (IQR)	
Previous osteoporosis therapy	FORSTEO (N=680)	Risedronate (N=680)	FORSTEO (N=680)	Risedronate (N=680)
Patients with ≥1 previous osteoporosis drugs	496 (73)	485 (71)	3.2 (1.0-6.8)	3.3 (1.0-6.3)
Antiresorptives	418 (61)	410 (60)	3.8 (1.2-7.0)	3.7 (1.2-6.3)
Bisphosphonates	402 (59)	386 (57)	3.6 (1.1-7.0)	3.6 (1.3-6.1)
Calcium or vitamin D only	64 (9%)	69 (10%)	0.3 (0.1-3.1)	0.3 (0.1-2.2)
Selective estrogen receptor modulators	21 (3%)	26 (4%)	4.2 (1.2-6.2)	2.5 (1.0-7.4)
HRT or ERT	9 (1%)	3 (<1%)	3.2 (2.8-4.0)	14.9 (7.0-22.7)
Other osteoporosis therapy*	78 (12%)	80 (12%)	1.0 (0.5-2.1)	0.7 (0.1-2.3)

*Other therapies included: strontium ranelate (n=76), denosumab (n=49), calcitonin (n=34), 1α-hydroxy-vitamin D (n=9), fluoride (n=4), and 1,25-di-hydroxy-vitamin D (n=1).

ERT = estrogen replacement therapy; HRT = hormone replacement therapy; IQR = interquartile range; SD = standard deviation; VERO = VERtebral Fracture Treatment Comparisons in Osteoporotic Women trial.
1. Kendler D, et al. Lancet. 2018;391:230-40.

FRACTURE NOW 59

FORSTEO SIGNIFICANTLY REDUCED NEW VERTEBRAL FRACTURES VS. RISEDRONATE AT 12 AND 24 MONTHS[1]
PRIMARY ENDPOINT
INCIDENCE OF NEW VERTEBRAL FRACTURES



Modified from Kendler D, et al. Lancet. 2018.

*p<0.019 vs. risedronate; †p<0.0001 vs. risedronate.

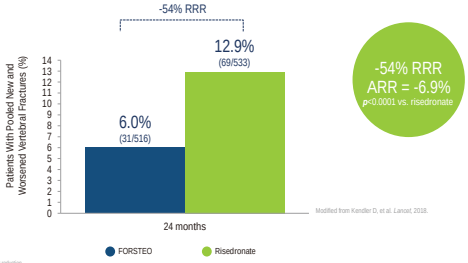
ARR = absolute risk reduction; RRR = relative risk reduction.
1. Kendler D, et al. Lancet. 2018;391:230-40.

FRACTURE NOW 60

FORSTEO SIGNIFICANTLY REDUCED NEW & WORSENED VERTEBRAL FRACTURES[1]

SECONDARY GATED ENDPOINT

INCIDENCE OF POOLED NEW AND WORSENED VERTEBRAL FRACTURES



-54% RRR
ARR = -6.9%
p<0.0001 vs. risedronate

Modified from Kendler D, et al. *Lancet*. 2018.

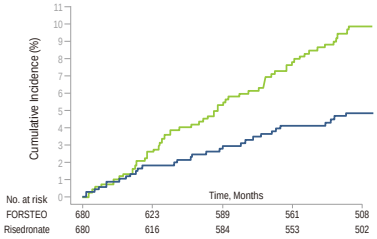
ARR = absolute risk reduction; RRR = relative risk reduction.
1. Kendler D, et al. Lancet. 2018;391:230-40.

FRACTURE NOW 61

FORSTEO SIGNIFICANTLY REDUCED CLINICAL FRACTURES[1]

2ND SECONDARY GATED ENDPOINT

CUMULATIVE INCIDENCE OF POOLED CLINICAL FRACTURES*: KAPLAN-MEIER ESTIMATES



Hazard ratio: 0.48
(95% CI: 0.32, 0.74)
p=0.0009

Modified from Kendler D, et al. *Lancet*. 2018.

*Clinical vertebral and non-vertebral fragility fractures: clavicle, scapula, ribs, sternum, sacrum, coccyx, humerus, radius, ulna, carpus, pelvis, hip, femur, patella, tibia, fibula, ankle, calcaneus, tarsus, or metatarsus.

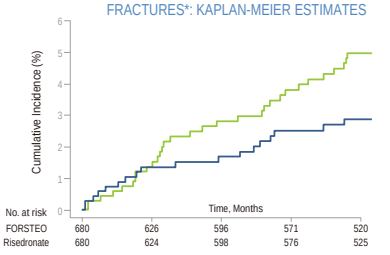
CI = confidence interval.
1. Kendler D, et al. Lancet. 2018;391:230-40.

FRACTURE NOW 62

THE INCIDENCE OF MAJOR NON-VERTEBRAL FRAGILITY FRACTURES WAS NOT STATISTICALLY SIGNIFICANTLY DIFFERENT BETWEEN FORSTEO AND RISEDRONATE TREATED PATIENTS[1]

4TH SECONDARY GATED ENDPOINT

CUMULATIVE INCIDENCE OF NON-VERTEBRAL MAJOR FRAGILITY FRACTURES*: KAPLAN-MEIER ESTIMATES



Hazard ratio: 0.58
(95% CI: 0.32, 1.05)
p=0.06

Modified from Kendler D, et al. *Lancet*. 2018.

*Fracture of hip, radius, humerus, ribs, pelvis, tibia, or femur.

CI = confidence interval.
1. Kendler D, et al. Lancet. 2018;391:230-40.

FRACTURE NOW 63

COUNT OF INCIDENT OF NON-VERTEBRAL FRAGILITY FRACTURES[1]

	FORSTEO (N=680)	Risedronate (N=680)
Patients with at least 1 non-vertebral fragility fracture, n (%)	25 (3.7)	38 (5.6)
with 1 non-vertebral fragility fracture	23 (3.4)	28 (4.1)
with 2 non-vertebral fragility fractures	2 (0.3)	10 (1.5)
Total number of non-vertebral fragility fractures	27	48

Adjusted rate ratio for FORSTEO vs. risedronate: 0.56 (0.35; 0.90) *p*=0.017*

*Non-longitudinal analysis of fracture occurrence was carried out using a Poisson regression model (Poisson distribution and log link) including the following variables: treatment, antecedent of recent clinical vertebral fractures, and recent use of bisphosphonate.

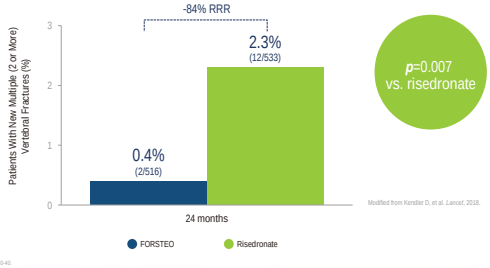
1. Kendler D, et al. Lancet. 2018;391:230-40.

FRACTURE NOW 64

FORSTEO SIGNIFICANTLY REDUCED NEW MULTIPLE VERTEBRAL FRACTURES[1]

SECONDARY NON-GATED ENDPOINT

INCIDENCE OF NEW MULTIPLE (2 OR MORE) VERTEBRAL FRACTURES



p=0.007
vs. risedronate

Modified from Kendler D, et al. *Lancet*. 2018.

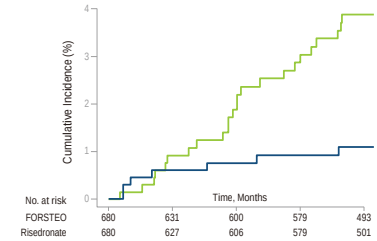
RRR = relative risk reduction.
1. Kendler D, et al. Lancet. 2018;391:230-40.

FRACTURE NOW 65

FORSTEO SIGNIFICANTLY REDUCED CLINICAL VERTEBRAL FRACTURES[1]

EXPLORATORY ENDPOINT

CUMULATIVE INCIDENCE OF CLINICAL VERTEBRAL FRACTURE: KAPLAN-MEIER ESTIMATE



Hazard ratio: 0.29
(95% CI: 0.14, 0.58)
p=0.002

CI = confidence interval.
1. Kendler D, et al. Lancet. 2018;391:230-40.

FRACTURE NOW 66

VERO
SAFETY PROFILE CONSISTENT WITH PRESCRIBING INFORMATION[1]

Adverse events summary	Patients, %		Fisher's p-value
	FORSTEO (N=680)	Risedronate (N=680)	
≥1 adverse events	72.8	73.5	0.76
Serious adverse events	20.1	16.9	0.13
Related to study drug	12.8	9.7	0.07
Related to study procedure	0.6	0.6	1.000
Leading to treatment discontinuation	9.9	7.1	0.06
Leading to death*	2.2	1.0	0.13
Selected adverse events			
Pain in hands or feet	5.4	2.6	0.013
Dizziness	4.4	1.8	0.007
Hypercalcaemia	2.2	0.1	<0.001
Pain	1.5	0.3	0.038

*All deaths were considered unrelated to study drug.
VERO = VERtebral Fracture Treatment Comparisons in Osteoporotic Women trial.
1. Kendler D, et al. Lancet. 2018;391:230-40.

FRACTURE NOW! 68

VERO
CONCLUSIONS[1]

- In postmenopausal women with established osteoporosis who are at high risk for fracture, FORSTEO significantly reduced vertebral and clinical fractures compared with risedronate
- FORSTEO was more effective than risedronate at preventing vertebral fractures in patients with severe osteoporosis, and confirms previous data in clinical trials of FORSTEO vs. bisphosphonates with fracture as a secondary endpoint
- Clinicians should consider FORSTEO for optimal management for patients with osteoporosis who have prevalent vertebral fractures

VERO = VERtebral Fracture Treatment Comparisons in Osteoporotic Women trial.
1. Kendler D, et al. Lancet. 2018;391:230-40.

FRACTURE NOW! 69

Clinical Question:

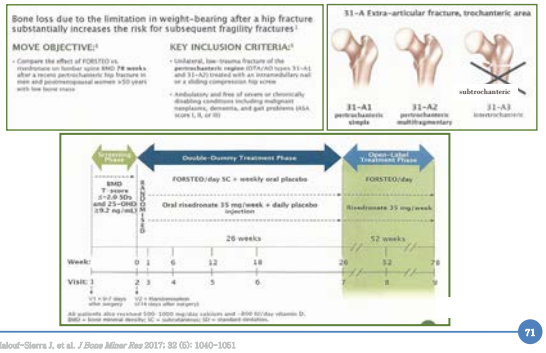
- **When to start Teriparatide after a fracture?**

Disclaimer: Use of TPTD for fracture is not an approved indication in the label.

Speaker's own contribution

MOVE: Teriparatide vs Risedronate over 78 weeks in Patients with Hip Fractures

CLINICAL TRIAL



1. Malouf-Sierra J, et al. *J Bone Miner Res* 2017; 32 (5): 1040–1051

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MOVE: FORSTEO vs. Risedronate Over 78 Weeks in Patients with Hip Fractures[1]

CLINICAL TRIAL

Bone loss due to the limitation in weight-bearing after a hip fracture substantially increases the risk for subsequent fragility fractures[1]

MOVE OBJECTIVE:[1]

- Compare the effect of FORSTEO vs. risedronate on lumbar spine BMD **78 weeks** after a recent pertrochanteric hip fracture in men and postmenopausal women >50 years with low bone mass

KEY INCLUSION CRITERIA:[1]

- Unilateral, low-trauma fracture of the **pertrochanteric region** (OTA/AO types 31-A1 and 31-A2) treated with an intramedullary nail or a sliding compression hip screw
- Ambulatory and free of severe or chronically disabling conditions including malignant neoplasms, dementia, and gait problems (ASA score I, II, or III)

ASA = American Society of Anesthesiologists; BMD = bone mineral density; OTA/AO = American Orthopaedic Trauma Association/Arbeitsgemeinschaft für Osteosynthesefragen (Association for the Study of Internal Fixation).

1. Malouf-Sierra J, et al. *J Bone Miner Res.* 2017;32(5):1040–1051.

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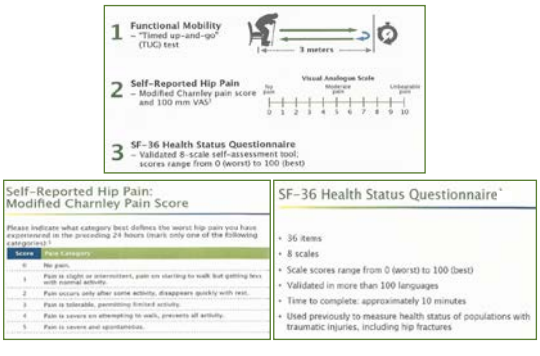
Functional Outcomes



1. Podsiadlo D, et al. *J Am Geriatr Soc.* 1991; 39: 142–148. 2. Ingemarsson AH, et al. *J Rehabil Med.* 2003; 35: 76–83. 3. Wilcock CK. *British Med J.* 1978; 2: 37–39. 4. Tidermark J, et al. *Qual Life Res.* 2003; 12: 1069–79. 5. Aspenberg P, et al. *J Bone Joint Surg Am.* 2010; 98: 1868–78. 6. Jagial S, et al. *J Bone Joint Surg Am.* 2000; 82-A: 955–62. 7. Petersen MG, et al. *Osteoporos Int.* 2002; 13: 296–302. 8. Mattson P, et al. *J Bone Joint Surg Br.* 2005; 87: 1203–9.

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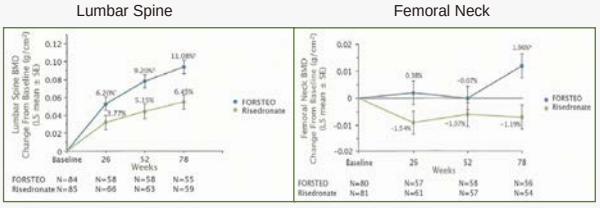
Teriparatide increases Lumbar Spine & Femoral Neck BMD at week 78 significantly more than Risedronate



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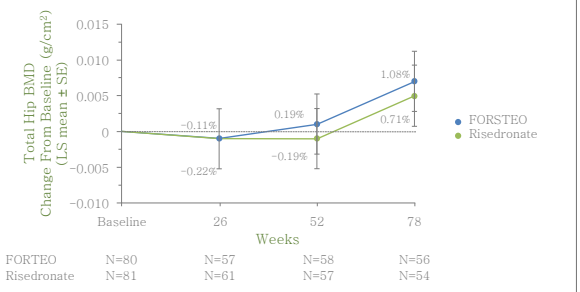
Malouf-Sierra J, et al. *J Bone Miner Res.* 2017; 32 (5): 1040–1051

FORSTEO Increased Total Hip BMD at Week 78 – No Significant Difference from Risedronate[1]



FORTEO	N=80	N=57	N=58	N=56
Risedronate	N=81	N=61	N=57	N=54

MMRM adjusted by treatment, baseline total hip BMD, visit, treatment–by–visit interaction, type of fracture (A1 vs. A2), and glucocorticoid use at baseline.
BMD = bone mineral density; LS = least squares; MMRM = mixed model for repeated measures; SE = standard error.

1. Malouf-Sierra J, et al. *J Bone Miner Res.* 2017;32(5):1040–1051.

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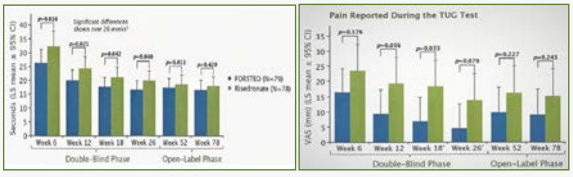
Teriparatide Patients have significantly Better Functional Mobility: Up-and-Go (TUG) Test and Less Hip Pain



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Malouf-Sierra J, et al. *J Bone Miner Res.* 2017; 32 (5): 1040–1051

No significant differences between Teriparatide and Risedronate in reporting Serious Adverse Event

Laboratory Analysis

Hyperuricemia and Hypercalcemia were more frequent with Teriparatide at 6– and 26–week follow up visits, respectively, but without any clinical symptoms

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Malouf-Sierra J, et al. *J Bone Miner Res.* 2017; 32 (5): 1040–1051

Conclusions

Teriparatide over 78 weeks was associated with superior efficacy vs. Risedronate in elderly patients with a recent pertrochanteric hip fracture:

- **Significantly greater increase** in lumbar BMD at all time points;
- **Significantly increase** in femoral neck BMD at week 78;
- Significantly shorter time to complete the TUG test compared with Risedronate up to 26 weeks;
- **Significantly less hip pain** at weeks 12, 18, and 26.

No evidence that either treatment was unsafe when used immediately after fracture repair.

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Malouf-Sierra J, et al. *J Bone Miner Res.* 2017; 32 (5): 1040–1051

COMMONLY ASKED QUESTIONS ABOUT FORSTEO AND THE OSTEOPOROSIS TREATMENT CONTINUUM

- Is FORSTEO effective for patients with prior antiresorptive use?
- What are my options after FORSTEO therapy?
- Why should I treat for 24 months?

Speaker's own contribution

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WHERE FORSTEO FITS WITHIN THE OSTEOPOROSIS TREATMENT CONTINUUM

Osteoporosis Treatment Continuum

Inadequate responders

- Antiresorptive — Should be considered when early stages of osteoporosis (not high risk or treatment failure)
- FORSTEO 18-**24 months** — Should be considered for the patient who has had an inadequate response while on an antiresorptive, such as: fracture, BMD loss, intolerance
- Antiresorptive — Maintenance therapy following treatment with FORSTEO

Naive patients

- FORSTEO 18-**24 months** — Should be considered for the patient who has fractured
- Antiresorptive — Maintenance therapy following treatment with FORSTEO

BMD = bone mineral density.

Speaker's own contribution

EUROPEAN STUDY OF FORSTEO

EUROFORS[1]

N=868

Ambulatory postmenopausal women with L-spine, total hip, or femoral neck BMD T-**score** ≤-2.5 **plus ≥1 vertebral** or non-vertebral fractures

Substudy 1 (treatment naive + AR pretreated)

- FORSTEO 20 µg SC daily x1 year n=634
- FORSTEO 20 µg SC daily x1 year n=234

All patients received calcium 500 mg + vitamin D 400-800 IU orally once daily

RANDOMISE 3:1:1

- FORSTEO 20 µg SC daily x1 year n=305
- Raloxifene 60 mg orally daily x1 year n=100
- No active treatment x1 year n=102

Substudy 2 (AR-inadequate responders)

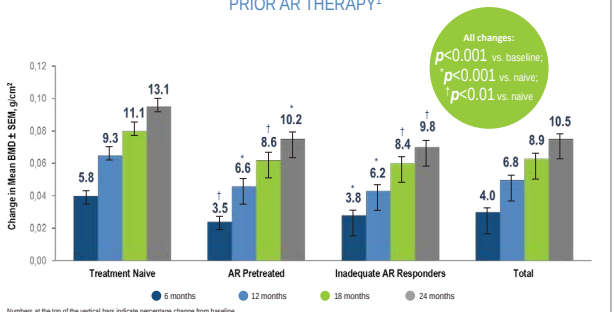
- FORSTEO 20 µg SC daily x1 year n=199

AR = antiresorptive; BMD = bone mineral density; SC = subcutaneous.

1. Obermayer-Pietsch BM, et al. *J Bone Miner Res*. 2008;23(10):1591-1600.

EUROFORS

FORSTEO INCREASED LUMBAR SPINE BMD IN PATIENTS WITH OR WITHOUT PRIOR AR THERAPY[1]



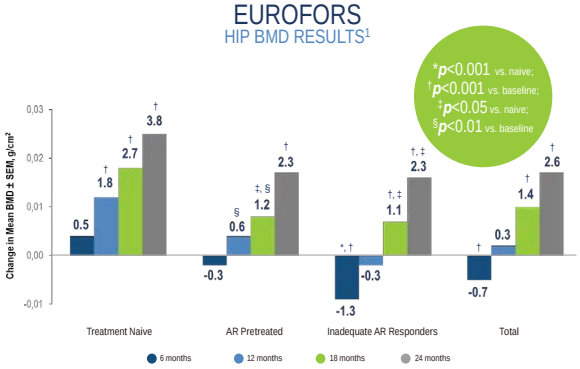
Numbers at the top of the vertical bars indicate percentage change from baseline.

AR = antiresorptive; BMD = bone mineral density; EUROFORS = European Study of FORSTEO; SEM = standard error of the mean.

1. Obermayer-Pietsch BM, et al. *J Bone Miner Res*. 2008;23(10):1591-1600.

EUROFORS

HIP BMD RESULTS[1]

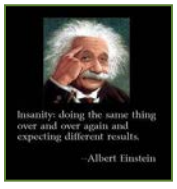


AR = antiresorptive; BMD = bone mineral density; EUROFORS = European Study of FORSTEO; SEM = standard error of the mean.

1. Obermayer-Pietsch BM, et al. *J Bone Miner Res*. 2008;23(10):1591-1600.

Take Home Messages

- Fragility fractures are common and will increase in the future
- Osteoporotic fractures are associated with a significant morbidity and mortality
- The best predictor of a fragility fracture is a previous one
- Most patients with fragility fractures are not currently evaluated or treated for Osteoporosis



THIS MUST BE ADDRESSED

Speaker's own contribution

OBJECTIVES

URGENCY TO TREAT → FIXING

STOP OSTEOPOROTIC FRACTURE CASCADE → ADHERENCE TO THERAPY

Speaker's own contribution

Treatment Goals for Osteoporosis

What is appropriate for the patient?

Preserve Existing Bone

- Osteopenic T-score
- Osteoporotic T-score, no fractures or signs/symptoms of fracture
- Tolerance with antiresorptive therapy; no significant bone loss on antiresorptive therapy

Rebuild Bone

- Low BMD
- One or more fractures due to Osteoporosis
- Failure on or intolerance to previous osteoporosis therapy

Antiresorptive Treatment | **Anabolic Treatment**

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Speaker's own contribution

"A NEW IDENTITY"

Orthopedic Surgeon → *FIX & TREAT* → "Bone Surgeon"

Dept. of Orthopaedics

"The Good Orthopedic"

"Bone Unit"

- Caring of pre-operative bone loss (MRI evaluation, Drug therapy support)
- Caring of the prosthesis, intramedullary nailing or plating stability
- Using medications for Osteoporosis to prevent re-fracture
- Caring of bone remodelling

FIX & PROTECT

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Speaker's own contribution

Terry Pratchett
(UK, 1958 – 2015)
British fantasy, Science fiction and children's Author

"Inside every older person there is a younger person wondering what the heck happened!?"

Speaker's own contribution

포스테오® 효능 · 효과

효능 · 효과

- ☑ 폐경기 이후 여성 및 골절의 위험이 높은 남성에 대한 골다공증의 치료
- ☑ 골절의 위험이 높은 여성 및 남성에 있어서 지속적인 글루코코르티코이드 요법과 관련된 골다공증의 치료

FORSTEO prescribing information 포스테오 국내 제품설명서(개정일 2015년 8월 26일)

포스테오® 용법용량

- ☑ 권장용량은 1일 1회 이 약 20 마이크로그람을 대퇴부 또는 복부에 피하에 자가주사 합니다
- ☑ 포스테오의 사용기간은 최대 24개월입니다
- ☑ 음식섭취가 불충분한 경우, 칼슘과 비타민D 보조제를 추가적으로 섭취하여합니다
- ☑ 치료가 끝난 후에는 다른 골다공증 치료를 계속할 수 있습니다
- ☑ 포스테오 펜은 28일간 사용 가능한 양이 담겨 있습니다
- ☑ 포스테오 펜은 2℃ ~ 8℃(냉장보관)에 보관합니다
- ☑ 포스테오 펜을 얼리지 마십시오. 만약 얼었다면 사용하지 마십시오

FORSTEO prescribing information 포스테오 국내 제품설명서(개정일 2015년 8월 26일)

포스테오® 사용상의 주의사항

"다음환자에는 투여하지 말것"

- ☑ 테리파라타이드 또는 이 약의 부형제 성분에 대하여 과민반응
- ☑ 기존의 고칼슘혈증
- ☑ 중증의 신장기능 손상
- ☑ 일차적인 골다공증 이외의 대사성 골 질환 (부갑상선 기능항진증 및 뼈의 Paget's disease 포함)
- ☑ Alkaline phophatase의 충분히 설명되지 않는 상승
- ☑ 임부 및 수유부
- ☑ 이전에 골격에 방사선 치료를 한 경우
- ☑ 골격 악성종양 또는 골전이가 있는 환자

FORSTEO prescribing information 포스테오 국내 제품설명서(개정일 2015년 8월 26일)

Luncheon Seminar II

좌장 : **박관호** (중앙보훈병원), **조용재** (이화의대)

1. Redefine optimal chronic pain management with Norspan — **손동욱** (부산의대)

2. 동반질환이 있는 환자에서 신경병증성 통증 약물 선택 시 고려할 점 — **김주한** (고려의대)

손 동 욱

부산의대

학력
부산대학교 의과대학 의학과
부산대학교 대학원 의학석사
부산대학교 대학원 의학박사

경력
University of California DAVIS Neurological Surgery 교환교수
양산부산대학교병원 신경외과 기금부교수
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Luncheon Seminar II

Redefine optimal chronic pain management with Norspan

손 동 욱
부산의대

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SPINE Journal 및 JOR 등 다수 저널 Reviewer

Luncheon Seminar II

동반질환이 있는 환자에서 신경병증성 통증 약물 선택 시 고려할 점

김 주 한
고려의대

2018. 9. 15 (Sat.)

Free Paper Session VI

(척추 일반)

좌장 : **조용준** (한림의대), **김대현** (대구가톨릭의대)

Free Paper Session VI

FP VI-1

The surgical outcome of thoracic ossification of the posterior longitudinal ligament

Sung Hwan Hwang, Chun Kee Chung, Chi Heon Kim, Seung Heon Yang, Chang-Hyun Lee
Seoul National University Hospital

Purpose : One of common causes of thoracic myelopathy is ossification of the posterior longitudinal ligament (OPLL). OPLL extirpation and indirect posterior decompression with corrective fusion are commonly used for the treatment of this disease. So, we compared each patients when the two methods were performed.

Materials and methods : From January 2003 to December 2016, 24 patients (male: 7, female: 17, mean age: 53.3 years) with thoracic myelopathy due to OPLL were included in the study group. 14 patients were classified as OPLL extirpation and 10 patients were classified as indirect posterior decompression with corrective fusion. We compared gender, age, BMI, symptom duration, canal diameter ratio of OPLL, operation time, blood loss, complication after surgery, kyphosis angle change after instrumentation, preoperative and 1 year postoperative the Japanese Orthopedic Association's score.

Results : There were significant differences only in complication after surgery, kyphosis angle change after instrumentation according to the two surgical methods. Complication after surgery was 1.88 times more likely to occur with OPLL extirpation group (p=0.022). Kyphosis angle change after instrumentation was 1.37° kyphosis for OPLL extirpation group, but 2.2° kyphosis was decreased for indirect posterior decompression with corrective fusion (p=0.017). Myelopathy was not aggravated in any case after surgery.

Conclusion : Corrective fusion for T-OPLL with anterior lesion is thought to be indirectly decompression by artificially reducing thoracic kyphosis. There is no significant difference surgical outcome between OPLL extirpation and indirect posterior decompression with corrective fusion.

Neurological improvement was observed in both patients with thoracic myelopathy with OPLL extirpation and indirect posterior decompression with corrective fusion. However, complication after surgery is tended to be larger after surgery in OPLL extirpation. We can not judge which operations are better, but can consider indirect posterior decompression with corrective fusion that is less invasive and less complication.

FP VI-2

Accuracy of pedicle screw trajectory using intraoperative 3D CT (O-arm) and navigation system

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Purpose : With the increasing interest in robot surgery, the use of intraoperative navigation is becoming increasingly important in the field of spinal surgery. Some recent studies have demonstrated the merits and accuracy of computer assisted screw insertion in spinal surgery. The purpose of this study was to evaluate the accuracy of pedicle screw insertion in thoracic and lumbosacral spine surgery using O-arm and navigation system

Materials and methods : To evaluate the accuracy of o-arm and navigation system in 26 patients who underwent thoracic and lumbosacral spinal pedicle screw insertion, we compared the intra-operative CT images after screw insertion with virtual navigation images. Angles between mid-sagittal line and screw insertion were measured and analyzed in axial images for each vertebrae. The demographics and operative factors of the patients were also compared and analyzed.

Results : We analyzed 26 patients with 64 pedicle screws. The mean age of the patients was 59.34 years and 16 (61.54%) were male. The mean operation time was 299.35 minutes. The mean blood loss was 1073.08 ml. The mean angular difference was 3.36 ° ± 2.20 ° in the axial image. There was excellent agreement between actual and virtual pedicle screw trajectories in the axial plane with ICC = 0.99 (95%CI: 0.992-0.995) ($p<0.01$). When comparing thoracic and lumbar screws, there was a significant difference in the sagittal angulation between the two distributions.

Conclusion : Intraoperative O-arm and navigation system showed high accuracy. However, it should be based on medical knowledge, anatomical knowledge and surgical skill and experience to overcome some error possibility and patient safety.

Free Paper Session VI

FP VI-3

Surgical Experiences of Posterior-only Approach for Complicated Kummell's Disease

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Purpose : Osteoporotic vertebral compression fractures are stable spinal injuries and are well-managed through conservative treatment. However, nonunion occurred in 13.5% of cases, leading to progressive vertebral body collapse, kyphosis and delayed neurologic deficit. This condition is known as Kummell"s disease, which is defined as a delayed vertebral collapse after the asymptomatic minor spine trauma caused by avascular osteonecrosis. Surgical treatment is required in that kyphosis and intravertebral instability are present at the time of diagnosis in most cases. Options for surgery are anterior approach, posterior approach, and combined anterior-posterior procedure. The ideal surgiacal approach remains controversial.

The anterior approach is better for correction of kyphosis than the posterior approach, but it has long operation time, large damage to internal organs and high blood loss. Anterior approach is of high risk in elderly patient. In our institution, we operated on a posterior-only approach, either posterior fixation or closing wedge osteotomy, to patients with Kummell"s disease. The purpose of this study is to report the surgical outcome of posterior-only approach and to review the surgical technique of closing wedge osteotomy.

Materials and methods : Twenty patients with Kummell's disease were indicated for surgical intervention using either posterior fixation (n=8) or closing wedge osteotomy(n=12). Average patient age was 76 years (range : 57-85) with 8:12 male to female ratio.

Results : All of the patients showed postoperative improvement of kyphosis. Segmental Kyphosis decreased from 26.7° to 14.6° (Range of kyphosis correction : 14-36°) after surgery. However, postoperative complications were still high even with posterior only approach. There were 11 complications : four accidental durotomy, two symptomatic screw pullout, four junctional fractures and one pulmonary embolism with acute renal failure.

Conclusion : Almost every patient with Kummell's disease is elderly and has osteoporosis. If you only stick to the local problem, you will fail to treat complicated Kummell's disease.

Although the closing wedge osteotomy is aggressive and technically demanding treatment option, it can be a good option for achieving successful treatment of this complicated disease.

Free Paper Session VI

FP VI-4

The surgical wound problems with the use of rhBMP-2 in thoracic and lumbar spine fusions

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Purpose : rhBMP-2 has been increasingly used in spinal fusions over the past decade. Early studies reported that the use of rhBMP-2 is associated with decreased operative time, blood loss, and pain scores, as well as improved fusion rates. However, some patients may have wound problems including soft tissue swelling, surgical site oozing, and infection, may develop.The purpose of this study is to investigate wound problems possibly associated with the use of rhBMP-2 in posterior thoracicand lumbar spine fusions.

Materials and methods : Using the institutional electronic medical records, we retrospectively reviewed all patients between January 2017 and August 2018 that underwent posterior thoracicand lumbar spine fusions with rhBMP-2 (Novosis, CGBio, Korea). Patient demographics, operative, and complication during hospitalization information were collected.

Results : During the study period, 136 patients who underwent posterior spine fusion procedure with rhBMP-2, and 36 patients (26.6%) developed surgical site oozing. Of the 36 patients, 6 (16.6%) required intravenous antibiotics but only 3 (8.3%) required operative intervention. Most of the patients were minor oozing and was treated with regular wound dressing.

Conclusion : In this single-institution study, there is no significant difference in the rate of wound problems following posterior thoracic and lumbar spinal fusions using rhBMP.

Free Paper Session VI

FP VI-5

Clinical practice guidelines for usage of conventional radiofrequency denervation in patients with chronic low back pain originating from the facet joints

Chang-Hyun Lee, Chun Kee Chung
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Purpose : Low back pain (LBP) is the leading contributor to years lived with disability. Radiofrequency denervation is commonly used for the treatment of chronic facet joint pain that has been refractory to more conservative treatments, although the evidence supporting this treatment has been controversial. We also aimed to provide an overview of the recommendations regarding the treatments contained in current clinical practice guidelines for patients with facet joint pain in primary care.

Materials and methods : We searched PubMed, Embase, Web of Science, and the Cochrane Database for randomized controlled trials regarding radiofrequency denervation and control treatments for back pain. Changes in VAS pain scores of the radiofrequency group were compared with those of the control group as well as the minimal clinically important difference (MCID) for back pain VAS. The panel used methods adapted from the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) Working Group to rate the recommendations included in this guideline. Each recommendation received a separate grade for the strength of the recommendation (strong or weak) and for the quality of evidence (high, moderate, or poor).

Results : We included data from seven trials involving 454 patients who had undergone radiofrequency denervation (231 patients) and control treatments such as sham or epidural block procedures (223 patients). The radiofrequency group exhibited significantly greater improvements in back pain score when compared with the control group for 1-year follow-up. Although the average improvement in VAS scores exceeded the MCID, the lower limit of the 95% CI encompassed the MCID. A subgroup of patients who responded very well to diagnostic block procedures demonstrated significant improvements in back pain relative to the control group at all times. When placed into our meta-regression model, the response to diagnostic block procedure was responsible for a statistically significant portion of treatment effect. Studies published over the last two decades revealed that radiofrequency denervation reduced back pain significantly in patients with facet joint disease compared with the MCID and control treatments.

Conclusion : Utility of conventional radiofrequency denervation for treatment of chronic LBP due to facet joint degeneration are depending on the diagnostic medial branch block. Conventional radiofrequency denervation resulted in significant reductions in low back pain originating from the facet joints in patients showing the best response (>80% pain reduction) to diagnostic block over the first 12 months when compared with sham procedures or epidural nerve blocks.

FP VI-6

Risk Factors for Delirium After Posterior Lumbar interbody fusion for spinal stenosis in Elderly Patients Aged 65 Years or Older, comparing with age groups older than 75 years

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Purpose : Spine surgeries in elderly patients have increased in recent years due to aging of society and recent advances in surgical techniques, and postoperative complications have become more of a concern. Postoperative delirium is a common complication in elderly patients that impairs recovery and increases morbidity and mortality. Though, Many studies about perioperative delirium after spinal surgery have been reported, there are few report about single surgical technique and single disease.

The objective of the study was to analyze postoperative delirium associated with spine surgery in patients aged 75 years or older with spinal stenosis who had posterior lumbar interbody fusion.

Materials and methods : A retrospective was performed in 62 patients 75 years of age or older who underwent PLIF due to spinal stenosis from 2016 to 2018. Postoperative complications, incidence of postoperative delirium, and hazard ratios of patient-specific and surgical risk factors were examined. Patient demographics, comorbidities, length of stay, and mortality were also assessed.

Results : A total geriatric patients (>65)who had PLIF for spinal stenosis for 2 years was 121 patients. Of these, 62 patients (51.2%) over than 75 years old. The overall incidence of delirium was 18.0%. Patients older than 75 years had a statistically greater incidence of delirium than patients of 65 to 74 years old). Patients experiencing delirium were significantly older and more likely to be female than nonaffected patients ($P < 0.001$). Patients with delirium in both cohorts demonstrated significantly greater comorbidities, length of stay. The presence of delirium was associated with an increased morbidity rate and length of stay. Logistic regression demonstrated that independent predictors of delirium included older age, alcohol/drug abuse, depression, psychotic disorders, deficiency anemia, fluid/electrolyte disorders, and weight loss.

Conclusion : The results of our study demonstrated an overall incidence of 18.0% in patients over than 75 years old who had PLIF for spinal stenosis. Overall analysis demonstrated an increased incidence of delirium in older females with greater comorbid conditions. Delirium was found to be associated with increased length of stay, costs, and mortality in all patients undergoing lumbar spine surgery. We recommend that we try to put greater effort into recognizing risk factors of delirium and timely diagnosing this situation and managing promptly this unintended situation.

Free Paper Session VI

FP VI-7

Patient's comoribities as the main reason of readmission within 360 days after degenerative lumbar spine surgery in eldery patients over 70 years

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Purpose : The purpose of this study was to investigate the readmission rate within 360 days and to identify the risk factors for readmission after degenerative lumbar spine surgery in eldery patients over 70 years

Materials and methods : This study included a total of 1248 patients over 70 years old who underwent spinal surgery between November 2005 and April 2015. In each patient, age, sex, body mass index, ASA physical status classification score and the presence of hypertension, diabetes mellitus, and asthma were examined. Hemoglobin (Hb), platelet (Plt) and other lab values were retrospectively reviewed. Based on this, the association between postoperative hospital readmission and each variable was analyzed by univariate, multivariate logistic regression.

Results : As a result, 213 patients (17.07%) out of a total of 1248 patients were rehospitalized within one year. In the univariate logistic regression analysis, age (p = 0.027), male (p = 0.006), Heart disease (p = 0.000), ICU stay (p = 0.000) and Hospital days (p = 0.000) were statistically significant. In multivariate logistic regression analysis, sex (OR: 0.410, p = 0.000), Hb (OR: 0.797, p = 0.001), Platelet (OR: 1.003, p = 0.009), asthma (OR: 2.283, p = 0.050) were the risk factors for 1 year readmission.

Conclusion : In this study, female, low Hb levels, high Plt count and the presence of heart disease and asthma were the risk factors for re-admission for one year. More careful attention and treatment will be needed for patients with these risk factors in patients over 70 years old.

FP VI-8

Updated Precision surgery; Screw Placement Accuracy and technical tips in the posterior Atlantoaxial Fusion using the newest generation of O-arm 2 and navigation system

Seong Yi, Seong-Bae An, Tae Woo Kim, Jong Joo Lee, Dong Ah Shin, Yoon Ha, Keung Nyun Kim, Do Heum Yoon

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Purpose : C1-C2 stabilization can be challenging due to the complex anatomy of the upper cervical vertebrae. We describe 10 consecutive cases of C1–C2 fusion using intraoperative navigation to aid in the screw placement at the atlantoaxial (C1–C2) junction using the newest generation of O-arm 2 and navigation system.

Materials and methods : In 2018, 10 patients underwent posterior atlantoaxial fusion using intraoperative frameless stereotactic O-arm 2 Surgical Imaging and S8 Stealth-Station Surgical Navigation System (Medtronic, Inc., Minneapolis, Minnesota, United States). Outcome measures included screw accuracy, neurologic status and surgical complications. C1 lateral mass Screw accuracy was evaluated using modification of the All India Institute of Medical Sciences outcome-based classification described for grading of thoracic pedicle screws. C2 pedicle screw accuracy was evaluated by grading system; Grade 0, no deviation; the screw was contained in the pedicle. Grade 1, deviation less than 2 mm. Grade 2, deviation more than 2 mm and less than 4 mm. Grade 3, deviation more than 4 mm.

Results : Total 10 patients were enrolled in this study. Mean age was 61.0 ± 12.6 years, male to female ratio was 5:5. 6 patients had fusion at C1–C2 only, and in the remaining 4 patients, fixation extended up to occiput or down to C3 or C7 according to patients' cervical pathology. Diseases categorized into Os odontoideum 5, C1-C2 instability 3, Basilar invagination 1, Metastatic tumor 1. Out of 37 screws placed, all demonstrated minimal divergence from desired placement in either C1 lateral mass or C2 pedicle. Only one of 18 C1 lateral mass screw was minimal violation of cortex as type II, but it was acceptable. All of 19 C2 pedicle screw was ideal placement with Grade 0. The mean operative time was 171.83 min and the mean blood loss was 188.33 mL. The average radiation dosing due to intraoperative imaging was 54.61 mGy. No neurovascular compromise was seen following the use of intraoperative guided screw placement. All patients went on to solid initial fixation.

Conclusion : C1–C2 fusion using computed tomography-guided navigation is a safe and effective way to treat atlantoaxial instability. Intraoperative neuronavigation allows for high accuracy of screw placement, limits complications by sparing injury to the critical structures in the upper cervical spine, and can help surgeons make intraoperative decisions regarding complex pathology.

2018. 9. 15 (Sat.)

Free Paper Session IV

(MISS)

좌장 : **최 건** (포항우리들병원), **손문준** (인제의대)

Free Paper Session IV

FP IV-1

Risk factor analysis for postoperative urinary retention after lateral lumbar interbody fusion

Dong Hwan Kim
Seoul National Universtiy Hospital

Purpose : Our purpose was to determine the the incidence of aand risk factors for POUR.

Materials and methods : A total of 102 consecutive patients (male: female = 30: 72, mean age, 67.1 years) who underwent lateral lumbar interbody fusion were included. Systematic postoperative voiding care protocol was applied to all patients to monitor them for the development of POUR.

A 14fr. foley catheter was inserted intraoperatively and removed in the PACU. The patients were encouraged to void within 6 hours postoperatively and thereafter. After each voiding, the postvoid residual urine (PVR) was measured by an ultrasound bladder scan. POUR was defined as the inability to void or having a PVR≥100 mL for more than 2 days after surgery.

Results : The incidence of POUR was 13.7% (14/102). Older age ($p < 0.0001$) and a long duration of surgery were significant risk factors. presence of diabetes mellitus, preoperative history of voiding difficulty were also significant risk factors.

Conclusion : POUR was a common postoperative complication of lateral lumbar interbody fusion

It is advisable to adopt a systematic postoperative voiding care protocol to prevent bladder overdistension and detrusor damage especially in elderly patients and those who underwent longer surgery.

FP IV-2

Comparison of the efficacy of unilateral biportal endoscopic decompression (UBE) vs. microscopic discectomy (MD) in reducing the muscle injury

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Purpose : This study was aimed to compare the efficacy of unilateral biportal endoscopic decompression (UBE) and microscopic discectomy (MD) in reducing muscle injury by measuring the serum levels of creatine phosphokinase (CK) and lactate dehydrogenase (LDH).

Materials and methods : Thirty-two patients with a degenerative lumbar stenosis or herniated lumbar disc underwent decompression surgery. Among them, 15 patients underwent UBE (UBE group, n = 15) and 17 patients underwent MD (MD group, n = 17). The CK and LDH were determined at admission and 1, 3, 5 days after surgery. Pain was also measured using visual analogue scale (VAS).

Results : The mean age was higher in the UBE group than the MD group but it was not statistically significant (59.4 ± 16.41 vs. 49.7 ± 12.31, p = 0.073). The mean CK level did not show significant difference at admission. However, 1, 3 and 5 days after surgery, it was higher in the MD group (147.7 ± 53.93 vs. 593.7 ± 147.27, p < 0.001; 261.8 ± 91.41 vs. 1014.1 ± 418.47, p < 0.001; 158.1 ± 129.83 vs. 616.9 ± 387.79, p < 0.001). The mean LDH level was also higher in the MD group during whole research period, but it was not statistically significant (p = 0.27). The operation time was significantly shorter in the MD group (46.0 ± 4.50 vs. 79.6 ± 24.39, p < 0.001). The UBE group showed more reduction of VAS score in terms of back pain after surgery (4.15 ± 1.06 vs. 6.07 ± 1.87, p = 0.003; 3.38 ± 0.87 vs. 5.07 ± 1.48, p = 0.001; 2.15 ± 0.68 vs. 4.07 ± 0.79, p < 0.001).

Conclusion : Both muscle injury indicator and VAS back score were better in the UBE group after surgery. Therefore, we can conclude that UBE procedure is less invasive and efficient than conventional surgery.

Free Paper Session IV

FP IV-3

Efficiency of ligamentotaxis in minimally invasive oblique lateral lumbar interbody fusion (MIS-OLIF) without posterior decompression for the treatment of degenerative lumbar disease

Jung-Woo Hur, Myung-Soo Song, Ho-Jung Chung, Kyeong-Sik Ryu, Jin-Sung Kim
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Purpose : Indirect decompression using posterior longitudinal ligament (PLL) ligamentotaxis with posterior stabilization was found to be a useful technique for some patients with stable thoracolumbar burst fractures. Recent studies advocate the usefulness of indirect decompression with large lateral interbody cage in some selected cases, but its efficiency has not been proven yet. The purpose of this study was to demonstrate the clinical and radiological results of indirect decompression using PLL ligamentotaxis in minimally invasive oblique lateral interbody fusion (MIS-OLIF) without posterior decompression for the treatment of degenerative lumbar disease.

Materials and methods : We have retrospectively reviewed 236 patients who underwent MIS-OLIF without posterior decompression for the treatment of single or two level degenerative lumbar diseases since November 2013 to May 2018. Clinical outcomes were measured using the visual analog scale (VAS) scores and Oswestry Disability Index (ODI). Radiologic measurements were determined using plain lateral radiographs and sagittal and axial magnetic resonance imaging. Measurements included disc height, foraminal height, foraminal area, canal diameter and cross sectional area (CSA) of thecal sac at the disc level. Differences in preoperative and postoperative radiologic parameters were compared, and the relationship between the ratio of extension and that of the preoperative values were assessed.

Results : There was significant improvement of clinical results after the surgery. Substantial dimensional increment was demonstrated in all radiographic parameters, with increases of 49.1% in average disc height, 33.7% in foraminal height, 44.5% in foraminal area, 37.4% in central canal diameter and 36.2% in CSA. The median extension ratios were inversely correlated with preoperative values. Six patients (2.5%) required additional posterior decompression for symptomatic remnant neural compression. Comparing slippage group with stenosis (without slippage) group, slippage group yielded better extension ratios in radiographic parameters with statistical significance.

Conclusion : There was significant improvement of clinical results after the surgery. Substantial dimensional increment was demonstrated in all radiographic parameters, with increases of 49.1% in average disc height, 33.7% in foraminal height, 44.5% in foraminal area, 37.4% in central canal diameter and 36.2% in CSA. The median extension ratios were inversely correlated with preoperative values. Six patients (2.5%) required additional posterior decompression for symptomatic remnant neural compression. Comparing slippage group with stenosis (without slippage) group, slippage group yielded better extension ratios in radiographic parameters with statistical significance.

FP IV-4

Postoperative longitudinal outcomes in patients with residual disc fragments after percutaneous endoscopic lumbar discectomy

Seung Heon Yang, Chi Heon Kim, Chun Kee Chung, Jonghyuk Baek
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Purpose : The aim of the present study was to compare the longitudinal clinical outcomes between PELD patients in whom the complete removal of disc fragments was achieved (complete group) and those in whom residual disc fragments were observed on postoperative MRI (residual group).

Materials and methods : A total of 225 patients were included (complete group, n=187 and residual group, n=38). Clinical assessments were performed using the visual analogue pain score for the leg (VAS-L, x/10) and back (VAS-B, x/10) and the Korean version of the Oswestry Disability Index (K-ODI, x/45). A linear mixed-effects model was used to analyze changes during the first 24 postoperative months.

Results : One month after surgery, significant improvements in the VAS-L, VAS-B and K-ODI values were observed and were maintained during the first 24 postoperative months. No differences in these changes were noted between the groups. Early re-operation (during the first 3 postoperative months) was performed in 3 patients in the residual group (7.9%) and in 4 patients in the complete group (2.1%) ($p = 0.10$).

Conclusion : When residual disc tissue is observed in asymptomatic patients, a 'watchful waiting' strategy may be preferable to immediate re-operation. However, an increased early re-operation rate is expected for patients with residual disc tissue.

Free Paper Session IV

FP IV-5

Clinical and radiologic outcomes of single-level direct lateral lumbar interbody fusion in patients with osteopenia

Jong-myung Jung, Seung Heon Yang, Chi Heon Kim, Chun Kee Chung
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Purpose : The direct lateral interbody fusion (DLIF) is a useful stand-alone and adjunct surgical approach for many spinal conditions. One complication of DLIF is subsidence of the interbody graft into the vertebral bodies, resulting in severe pain, impaired arthrodesis and potentially fracture of the body. Low bone density, as measured by T score on DEXA scanning, has also been postulated to increase the risk of subsidence. This study aims to determine whether or not the osteopenia should influence the surgical results in DLIF surgery.

Materials and methods : A retrospective review of collected data was performed on all patients who underwent single-level DLIF at our institution. We utilized the T score obtained from the femoral neck DEXA scans, which is used to determine overall fracture risk. A total 62 patients were included in this study, including 28 in osteopenia group and 34 in normal group. The clinical and radiologic characteristics were compared at pre-operative and at 1 and 2 years post-operatively.

Results : There were no significant statistical differences in perioperative parameters except BMD between 2 groups. At post-operative 2 years, there was a statistically significant difference in disc height and IVF height at index level between the two groups ($p = 0.039$, 0.044, respectively), but there was no significant difference in TLL ($p = 0.179$). At 24-month postoperative, 92.9% of osteopenia group and 97.1% of normal group were solidly fused ($p = 0.585$). All postoperative clinical scores (VAS back pain, VAS leg pain and Owestry disability index) improved similarly in both groups without significant difference. The difference in the rate of subsidence between the groups was not significant (7.1% in the osteopenia group and 2.9% in the normal group, $p = 0.585$).

Conclusion : Patients with osteopenia who undergo single-level DLIF exhibited favorable clinical and radiological outcomes.

Free Paper Session IV

FP IV-6

Postoperative ileus after ALIF and LLIF for the degenerative spinal disease

Donguk Lee, Junseok Bae, Sang-Ho Lee, Woojoo Lee, Jin-Ho Seo, Young-Sik Bae, Sang-Ha Shin
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Purpose : Postoperative ileus (POI) after retroperitoneal approach is relatively common complications in the early postoperative period. Both anterior lumbar interbody fusion (ALIF) and lateral lumbar interbody fusion (LLIF) are a minimally invasive approach to the anterior disc space. However, manipulation of bowel is different. This study is to compare the incidence and risk factors of postoperative ileus (POI) after ALIF and LLIF.

Materials and methods : A retrospective review was performed of records of patients who underwent ALIF or LLIF for more than 2 levels above L4-5 between Jan. 2015 and Jan. 2018 by a single surgeon. Patients with infections and trauma were excluded. Patients with prolonged and recurrent POI were identified by two independent research fellows. Conflict of their review was confirmed by a senior surgeon. Demographic and perioperative details were reviewed and analyzed to find risk factors for POI.

Results : 95 patients (19 males, 66.2±7.4 years old) were included. There were 60 ALIF and 35 LLIF. The incidence of POI was 15.8%. Patients underwent ALIF had a significantly higher incidence of POI than LLIF (21.7% vs. 5.7%, p=0.041). Males had a higher incidence of POI than females (31.6% vs. 11.8%, p=0.036). Other factors such as age, body weight, BMI, op time, estimated blood loss, a number of index level, length of hospital stay, smoking and DM were not correlated with POI.

Conclusion : There was the relatively high incidence of POI after ALIF and males. Retraction at the multilevel ALIF, including the upper lumbar level, seems to be related to the POI. LLIF has advantages in this respect because it provides access without retraction.

Free Paper Session IV

FP IV-7

Therapeutic feasibility of full endoscopic decompression in oneto three-level lumbar canal stenosis via a single skin port using a new endoscopic system, Percutaneous Stenoscopic Lumbar Decompression (PSLD) : A Single-Center Experience of 450 case

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Purpose : The new endoscopic system, Percutaneous Stenoscopic Lumbar Decompression (PSLD), optimized for lumbar stenosis is appropriate for a surgeon to perform laminectomy, flavectomy, foraminotomy, and discectomy and is designed to provide an easy handling during the unilateral approach and bilateral decompression as well as multi-level decompression. The system is composed of 8.4 mm of the working sleeve and 5.7 mm of the working channel in diameter and 12° of the field of view.

Materials and methods : The study was retrospectively conducted involving 450 consecutive cases (254 males and 196 females) of degenerative lumbar stenosis treated with PSLD under spinal epidural anesthesia between April 1, 2016, and December 31, 2016. The total surgical disc level was 532 and the study included 388 patients of 1 level operation, 42 patients (84) of 2 levels and 20 patients (60) of 3 levels with 1 skin incision. The cross-sectional area of the spinal canal was measured in MRI by a third party. A comparison was made with regard to the decompressed canal between the preoperative controls and the postoperative treated. The data of operative results, including the length of stay, operation time, and surgical complications were collected to analyze the results. The patients were clinically assessed based on the VAS score (visual analog scale score for the back and legs), preoperatively and at postoperative 1week, 3 months and12 months. Also, the patients were assessed based on Oswestry Disability Index (ODI) preoperatively and at postoperative 3 months and 12 months.

Results : Postoperative MRI revealed that PSLD increased the cross-sectional area of the canal by 52.0% compared to preoperative one at the index segment ($P<0.001$), and demonstrated minimal damage to the normal soft tissues including muscles and the extent of removed normal bony tissues. The mean improvement in VAS score and ODI were 4.0 ($P<0.001$) and 40% ($P<0.001$), respectively. Mean duration of operating time was 32 minutes for bilateral decompression of 1-disc level, 64 minutes of 2-discs levels and 95 minutes of 3-discs levels, and mean hospital stay was 1.42 days in 1-level.

Conclusion : The present study demonstrates that full endoscopic decompressing procedures using PSLD have a therapeutic feasibility in the surgical treatment of lumbar stenosis. It has been validated that mono-portal PSLD holds potential in managing both mono- and multilevel spinal stenosis. Accordingly, PSLD could be an alternative to microscopic decompression or MED with various advantages in the surgical management of lumbar stenosis.

FP IV-8

Comparison of direct lateral (DLIF) and oblique lateral (OLIF) interbody fusion for treatment of degenerative lumbar spine

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Purpose : To compare direct lateral (DLIF) and oblique lateral (OLIF) approaches for treatment of degenerative lumbar spine, in terms of clinical and radiological outcomes.

Materials and methods : From January 2013 to Jane 2017, 74 patients underwent lumbar interbody fusion for DLIF (n=57, mean age 70.3±8.2 years) or OLIF (n=17, mean age 72.1±6.7) were included. VAS and ODI were used to evaluate the clinical outcomes. Regional cobb's angle (CA), lumbar lordosis (LL), sagittal vertical axis (SVA), cage position, subsidence, and proximal junctional kyphosis were analyzed radiologically. Subsidence was defined from 0% to 100% as decreasing rate comparing to postoperative disc height. Complication rates was also studied according to each approach.

Results : All patients presented good clinical outcomes regardless of surgical approaches. DLIF was slightly higher in improvement of VAS than OLIF. Postoperative regional LL was improved significantly in OLIF than in DLIF. Mean correction was 10.2±12.6° in DLIF and 17.3±17.8° in OLIF according to adjusted surgical levels. Regional CA and SVA was not significant. Anterior position of cage was 49.6% in DLIF and 59% in OLIF. Mean subsidence was occurred 12.5±17.0% in DLIF and 2.6±18.6% in OLIF. Proximal junctional kyphosis was not different in both groups. DLIF had 36.8% of weakness of transient psoas muscle, most patients recovered in 3 months. One patient (1.7%) prolonged weakness for 8 months. OLIF had 17.6% of weakness of transient psoas muscle. One epigastric artery injury and one lymphatic channel injury were occurred.

Conclusion : DLIF and OLIF represent safe and effective procedures for treatment of degenerative lumbar spine. OLIF was more effective in correcting regional lumbar lordosis and preventing subsidence, but attention should be paid to vascular injury.

2018. **9. 15** (Sat.)

Luncheon Seminar III

좌장 : **은종필** (전북의대), **김기정** (서울의대)

1. Long term management of PSSS treatment : Considering balance between safety and efficacy
박정윤 (연세의대)

2. Well Balanced PelubiCR (More advanced than PELUBI) **구성욱** (연세의대)

3. The First and Only RANKL Inhibitor: Denosumab **진용준** (인제의대)

박 정 윤

연세의대

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Luncheon Seminar III

Long term management of PSSS treatment : Considering balance between safety and efficacy

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Luncheon Seminar III

Well Balanced PelubiCR (More advanced than PELUBI)

구 성 욱
연세의대

진 용 준

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학력 및 경력

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Luncheon Seminar III

The First and Only RANKL Inhibitor: Denosumab

진 용 준
인제의대

2018. 9. 15 (Sat.)

Free Paper Session VII

(변형)

좌장 : **문승명** (한림의대), **이진석** (가톨릭의대)

Free Paper Session VII

FP VII-1

Surgical and Radiographic Outcomes Following Pedicle Subtraction Osteotomy: Minimum Two-year Follow-up Data

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Purpose : The purpose of this study was to report the results of pedicle subtraction osteotomy (PSO) for fixed sagittal imbalance with a minimum two-year follow-up. Besides, authors evaluated the effect of adjunctive multi-level posterior column osteotomy (PCO) on achievement of additional lumbar lordosis during PSO.

Materials and methods : A total of thirty-one consecutive patients undergoing PSO for fixed sagittal imbalance were enrolled and analyzed. Correction angle of osteotomized vertebra (PSO angle) and other radiographic parameters including pelvic incidence (PI), thoracic kyphosis (TK), lumbar lordosis (LL), and sagittal vertical axis (SVA) were evaluated. Clinical outcomes and surgical complications were also assessed.

Results : The mean age was 66.0 ± 9.3 years with a mean follow-up period of 33.2 ± 10.5 months. The mean number of fused segments was 9.6 ± 3.5. The mean operative time and surgical bleeding were 475.9 ± 160.5 minutes, and 1406.1 ± 932.1 mL, respectively. The preoperative SRS-22 score was 2.3 ± 0.7, and improved to 3.2 ± 0.8 at the final follow-up. The mean pelvic incidence was 54.5 ± 9.5°. Lumbar lordosis was changed from 7.0 ± 28.9° to –50.2 ± 13.2°. The PSO angle was 33.7 ± 13.5° (15.6 ± 20.1° preoperatively, –16.1 ± 19.4° postoperatively). The difference of correction angle of LL (57.3°) was greater about 23.6° than which of PSO angle (33.7°). SVA was improved from 189.5 ± 93.0 mm, preoperatively to 12.4 ± 40.8 mm, postoperatively. There occurred six, eight, and fourteen cases of complications at intraoperative, early (< 2 weeks) postoperative, and late (≥ 2 weeks) postoperative period, respectively. Additional operations were needed in nine patients due to the complications.

Conclusion : PSO could provide satisfactory results for patients with fixed sagittal imbalance regarding clinical and radiographic outcomes. Additional correction of LL could be achieved with conduction of adjunctive multi-level PCOs during PSO.

Free Paper Session VII

FP VII-2

Risk factors for ASD after multi level lumbar Fusion: segment flexibility

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Purpose : The objective of this study is to confirm the effects of risk factors on Adjacent Segment Disease (ASD).

Materials and methods : We analyzed the records of patients who underwent lumbar or lumbosacral multiple instrumented fusions between August 2007 and March 2017. Of these patients, 65 patients who needed secondary operations because of ASD were included in this study. We measured the segment flexibility of proximal screw disc level and distal screw disc level. Also we measured pfirrman grade of proximal screw disc level and distal screw disc level by analyzing the patient"s imaging test.

Results : Of the 65 patients, 40 patients had an ASD in the proximal level and 24 patients had an ASD in the distal level.

1 patient has an ASD both up and down.

Of the 39 patients who received multiple screws only on the lumbar level, 25 patients had an ASD in the proximal level and 14 patients had an ASD in the distal level.

ASD occurred in location that large segment flexibilty site in 38 patients (97.4%).

The relationship between location of asd and pelvic parameters was not statistically significant. but the relationship between location of asd and lumbar lordosis was statistically significant. [p=0.005]

Conclusion : Segement flexibilty is risk factors of Adjacent Segment Disease (ASD) with Multiple lumbar fusion.

Free Paper Session VII

FP VII-3

Pedicle screw trajectory at upper instrumented vertebra and proximal junctional kyphosis

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Purpose : The aim of this study was to investigate the risk of proximal junction kyphosis (PJK) and proximal junction failure (PJF) associated with upper instrumented vertebra (UIV) screw trajectory (straight forward vs mixed vs anatomic).

Materials and methods : A single-center, single-surgeon consecutive series of adult patients who underwent lumbar fusion for ≥ 4 levels (that is, the UIV of the thoracolumbar spine [T9–L2] and the lower instrumented vertebra at the sacrum or pelvis) were retrospectively reviewed. Patients were divided into 3 groups according to UIV screw trajectory: Group S, 2 straight forward screw fixation; Group M, 1 straight forward screw fixation and 1 anatomic trajectory screw fixation; and Group A, 2 anatomic trajectory screw fixation. Age, sex, bone mineral density, diagnosis, follow-up periods, several balance-related parameters (sagittal vertical axis [SVA], lumbar lordosis [LL], pelvic incidence [PI], UIV angle), UIV polymethylmethacrylate augmentation, UIV bicortical screw, PJK and PJF were evaluated.

Results : A total of 83 patients were included in this study, including 51 in the S group, 16 in the M group, and 16 in the A group. The mean age was 67.6 ± 11.9, 70.0 ± 7.9, and 69.4 ± 5.6 years; the mean bone mineral density was -2.1 ± 1.2, -2.2 ± 1.0, and -2.4 ± 1.2; and the mean number of levels fused was 8.2 ± 1.7, 7.9 ± 1.6, and 8.1 ± 1.2 in Groups S, M, and A, respectively ($p > 0.05$). There were no significant differences in balance-related parameters (SVA, LL, PI, PI–LL, and UIV angle) among the groups. PJK in Groups S (12 patients [23.5%]), M (7 patients [43.8%]), and A (9 patients [56.3%]) increased in sequence by group ($p = 0.044$). Anatomic trajectory screw fixation increased the risk for PJF compared to straight forward screw fixation (3 patients [18.8%] vs 1 patients [2.0%]; OR 11.0, $p = 0.040$).

Conclusion : Anatomic trajectory screw fixation at the UIV is a major risk factor for PJK and PJF. To reduce the proximal junctional failure, straight forward screw fixation at the UIV is essential in adult spinal deformity correction surgery.

Free Paper Session VII

FP VII-4

Effect of iliac bolt screws on spinopelvic parameters in adult lumbar degenerative flat back correction surgery: A 2-year follow up study

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Purpose : To analyze the effect of IBSs on spinopelvic parameters 2 years after ALDFB surgery, since the corrected spinopelvic parameters change over time. A retrospective analysis of the effect of iliac bolt screws (IBSs) on spinopelvic parameters after 2 years in adult lumbar degenerative flat back (ALDFB) surgery was performed.

Materials and methods : A total of 50 consecutive patients who underwent long level instrumented fusion to the sacrum or pelvis for ALDFB were retrospectively included in this study and were followed-up for 24 months. Patients were categorized into 4 groups based on the upper instrumented vertebrae (UIV; above T10 vs. below L1) and lower instrumented vertebrae (LIV; ilium using IBSs vs. sacrum using S1 pedicle screw): Group 1I (above T10 of UIV and ilium of LIV), Group 1S (above T10 of UIV and sacrum of LIV), Group 2I (below L1 of UIV and ilium of LIV), and Group 2S (below L1 of UIV and sacrum of LIV).

Results : The degree change of lumbar lordosis (LL), pelvic incidence, and LL mismatching of Group 1S was significantly larger than that of Group 1I. The degree change of thoracolumbar junction of Group 1S was significantly larger than that of Group 1I. The degree change of thoracic kyphosis (TK) of Group 1I was significantly larger than that of Group 1S. The postoperative 1-month and 2-year Oswestry disability index (ODI) value of Group 2S was significantly lower than that of Group 2I.

Conclusion : If the UIV is above the T10, IBSs can be required for stabilization of the spinopelvic parameters except TK, but these screws do not affect ODI improvement. If the UIV is below the L1, IBSs do not cause significant changes in spinopelvic parameters, but the non-iliac fixation group showed significant ODI improvement.

Free Paper Session VII

FP VII-5

Radiologic analysis of subaxial sagittal alignment after atlantoaxial fusion

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Purpose : Atlantoaxial subluxation is a relatively common disease and various technique for posterior correction and fusion, such as Harm technique are used for treating atlantoaxial subluxation. However, there are few studies about postoperative sagittal alignment change after atlantoaxial fusion. The purpose of this study was to evaluate the change of cervical alignment and analyze the risk factor of postoperative kyphotic change of subaxial spine after atlantaxial fusion.

Materials and methods : We retrospectively reviewed 25 patients who were underwent atlantoaxial fusion for atlantoaxial subluxation from January 2013 to December 2016. There were 15 males and 11 females; resulting in 11 degenerative cervical disease and 15 traumatic cases. Angles of occipital slope (OC), OC1, C12, C23, C27, T1 slope, sagittal vertical axis(SVA), space available for the spinal cord (SAC) were measured on lateral radiographs in the neutral position. The range motion (ROM) and atlantodental interval (ADI) were measured on the lateral radiographs in the flexion and extension position. Linear correlation analysis and multivariate analyses were conducted to determine the risk factors for postoperative kyphotic change of subaxial cervical spine.

Results : The mean angles of preoperative OC, C12, OC2, C2 slope, C27 were 4.92, 19.36, 11.74, -5.91 and 16.67 respectively. In final follow up, these angles were changed to 4.06, 19.72, 11.29, -7.07 and 15.17 respectively. Significant reduction in ADI and increase in SAC were observed postoperatively. ($P<0.05$) However, except 2 parameters, there were no statistically significant changes postoperatively. In linear correlation analysis, difference of angle of C27 is the significant negative correlation to the occipital slope. ($r=-0.466$, $P=0.019$) In multivariate regression analysis, high occipital slope can be a predictor of the risk factor of the subaxial kyphosis of the cervical spine.

Conclusion : Occipital slope is useful indicator of the degree of vertical alteration in person's gaze. It can be a predictor of the subaxial kyphosis of the cervical spine after atlantoaxial fusion. To avoid the postoperative misalignment of the subaxial cervical spine, we should pay more attention to the cervical alignment of the patient in preoperative period.

Free Paper Session VII

FP VII-6

Life style influences the postoperative outcomes after corrective surgery in adult spinal deformity: A comparison of rural- and urban- dwelling environment

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Purpose : There are many factors that affect the outcomes of surgery in adult spinal deformity patients, including the severity of deformity and imbalance, method of surgery, patient factors, and social factors. However, unlike adolescent idiopathic scoliosis, no study has been reported with regard to the relationship between the life style and physical factors and surgical outcomes in the patients with adult spinal deformity. The objective of this study was to analyze the significance of life style and physical factors influencing the postoperative outcomes with adult spinal deformity patients residing in urban (U) and rural (R) environments.

Materials and methods : We retrospectively reviewed data from patients who had undergone adult spinal deformity surgery with sacropelvic fixation at a single institution between June 2011 and May 2017, and a minimum 1 year follow up. We divide these patients into two groups (U and R). Preoperative demographic data were reviewed and radiographic parameters were measured preoperatively, immediate postoperatively, 1 month, 3 month, 6 months and at the final follow-up. Kaplan-meier analysis was used for evaluating the timing and incidence of PJK and Rod fracture between two groups.

Results : There were 59 patients with 25 in the urban and 34 in the rural with sacropelvic fixation. The patients of the groups were similar in terms of age, gender, preoperative diagnosis, fused levels, bone mineral density, Body mean index, HTN, DM, Smoking history and preoperative radiological parameters. There were no differences between the two groups in the postoperative radiographic parameters, clinical outcomes and complications, but PJK was statistically significant higher in R group (R: 18 [52.9%] vs. U: 5 [20.0%], p=.015).

Conclusion : Life-style influences the proximal junctional kyphosis in patients with adult spinal deformity. Surgeon should keep in mind this information in case of preoperative counselling, informed consent and postoperative education for life style change for the patients with adult spinal deformity.

Free Paper Session VII

FP VII-7

A new nomenclature system for the treatment of cervical spine deformity; Developing system and Preliminary report

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Purpose : Treatment of cervical spine deformity (CSD) challenges the surgeon due to the surrounding neurovascular structures. Although there have been recent advances in standardized classification and nomenclature system for osteotomy technique to manage adult thoracolumbar deformity, only one classification system for cervical osteotomy techniques currently exist. Moreover, there is lack of standardization regarding the grade of cervical osteotomies. So, the purpose of this study to develop a unified nomenclature system for systematizing osteotomy techniques that can briefly describe the surgical approach, the grade of osteotomy, and the sequence of CSD surgeries

Materials and methods : We used classification system which is similar to the TNM staging for cancer evaluation.

APF system is a notation system that describes the surgical approach, the grade of osteotomy, the sequence of CSD surgeries and the information of fixation using alphanumeric codes:

• A describes the grades of anterior osteotomy technique - Anterior osteotomies are divided into four grades. Grades of osteotomies correspond to the extent of bony resection and increasing degree of destabilizing potential.

• P describes the grades of posterior osteotomy technique - Posterior osteotomies are divided into six grades. (Description sequence of A and P is the order of surgical approach. If the anterior surgery is performed first, A is described first. If posterior surgery is performed first, P is first written.)

• F describes the level and methods of fixation (three different fixation techniques)

Results : APF description system is an anatomical description for the surgical treatment of cervical spine deformity. For example, if we perform focal kyphosis patients with C56 corpectomy, SPO C4567, and Posterior fixation C3-T1, it can be expressed as "A2 (C56) / P4 (C4-7) / PCF (C3-T1)".

New system can be applied on all kinds of CSD and its basic principles are; 1) applicability to all anatomic sites; 2) the capability to describe the surgical approach (anterior or posterior) and the sequence of treatment (combined approach or 540-degree surgery; A-P-A, P-A-P); 3) facilitate the exchange of information not only between surgeons but also between treatment centers. 4) contribute to the continuing investigation of CSD.

Conclusion : This study introduces the new classification and nomenclature system (APF system) of the CSD surgery to understand the sequence of the surgical correction, the grade of osteotomy and the fixation techniques.

This new classification system (APF system) can provide a consistent description of the various osteotomies performed in cervical spine deformity surgery. Its use will provide a common frame for cervical deformity correction surgery and help communicate between surgeons. However further study is necessary to validate the reliability of this classification. Multicenter study may confirm the classification system is consistent and reliable.

FP VII-8

Cervical parameters affecting horizontal gaze in asymptomatic patients in the Korean population

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Purpose : Several studies have identified the importance of T1 slope and the relationship with the cervical sagittal balance, but there is no study of the relationship with horizontal gaze. We investigate the relationship between horizontal gaze and cervical parameters.

Materials and methods : For a year in 2017, cervical neutral lateral radiographs were taken in 225 asymptomatic Korean people as part of a premium routine screening program at the Healthcare System. The cervical parameters (O-C2 lordosis, C2-7 lordosis, C2-7 sagittal vertical axis (SVA), T1 slope, thoracic inlet angle, neck tilt, and T1 slope minus C2-7 lordosis) and slope of McGregor's line were measured.

Results : Slope of McGregor"s line was statistically significantly correlated with O-C2 lordosis, C2-7 lordosis, C2-7 SVA, and T1 slope minus C2-7 lordosis (r=0.461, r=0.272, r=-0.237, r=-0.337, respectively). As a result of the linear regression, Slope of McGregor"s line was 3.0779 + 0.7916 * O-C2 lordosis + 0.1103 * C2-7 lordosis - 0.1318 * C2-7 SVA - 0.5453 * T1 slope minus C2-7 lordosis.

Conclusion : The cervical posture eventually changes to maintain horizontal gaze. The importance of T1 slope was emphasized but had no direct effect on horizontal gaze. Horizontal gaze is a combination of several cervical parameters.

Poster

Poster

P-1

What Are the Risk Factors Associating Delirium after Lumbar Spine Surgery in Elderly Patients? a Prospective Case-control Study

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Purpose : To prospectively explore the incidence and risk factors for postoperative delirium in elderly patients with lumbar spine surgery

Materials and methods : 148 individuals with 65 years old or more were enrolled to undergo spine surgeries in this prospective study. Delirium was diagnosed by short confusion assessment method. Logistic regression analysis identified the risk factors associating postoperative delirium.

Results : 83 patients (56.1%) who only underwent lumbar surgeries were finally recruited. An incidence of 14.5% delirium occurred after the gerontic lumbar surgeries. Compared with non-delirium group, occurrence of preoperative parkinsonism was significant higher in delirium group (41.7% vs 8.5%, p = 0.002), so did preoperative C-reactive protein (7.0 ± 15.2 mg/L vs 1.3 ± 2.3 mg/L, p = 0.017). Of the risk factors, male sex (OR = 0.10, 95% CI = 0.01-0.66, p = 0.017), parkinsonism (OR = 5.83, 95% CI = 1.03-32.89, p = 0.046), and lower baseline mini-mental state examination (MMSE) score (OR = 0.71, 95% CI = 0.52-0.97, p = 0.032) were independently related to postoperative delirium in the elderly patients with lumbar surgery.

Conclusion : An incidence of 14.5% delirium occurred in elderly patients after lumbar spine surgeries. Male sex, parkinsonism and lower baseline MMSE score were independent risk factors for postoperative delirium in elderly patients with lumbar surgeries.

Poster

P-2

Relationship Between Development of Adjacent Segment Disease and Degree of Laminectomy After 1 Level Lumbar Fusion on spondylolisthesis

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Bogang Hospital

Purpose : Posterior lumbar interbody fusion (PLIF) is widely considered as an effective surgical method for patients with degenerative lumbar disease such as stenosis, degenerative spondylolisthesis (DS), isthmic spondylolisthesis (IS). PLIF accelerates the degeneration of adjacent motion segments. The process of PLIF for DS and IS are different from laminectomy, removal of posterior complex (spinous process, supraspinous ligament, interspinous ligament). The purpose of this study is to investigate relationship between development of adjacent segment disease (ASD) and degree of laminectomy for 1 level PLIF for DS and IS.

Materials and methods : A retrospective trial was performed on patients who received 1 level PLIF surgery between January, 2012 and June, 2016. Three hundred fifty six patients were with spondylolisthesis, only 124 patients were included who were followed up at least 2 years. There were 33 males and 91 females, with an average age of 61.2 years (38~82years). The mean follow-up period was 42.1 months. Spondylolisthesis group was subclassified as DS and IS group. ASD includes spondylolisthesis, DDD, HLD . Clinical results were measured by ODI and VAS ad radiological findings were measured by X-ray and the presence of ASD along with 2 year-follow-up period and last vist.

Results : There were 86 patients in DS group and 38 patients in IS group. Only 17 patients in DS group and 6 patients in IS group had ASD. There was no statistically significant difference between type of spondylolisthesis and the presence of ASD(P=0.559), and VAS(P=0.720) checked at last follow-up. Fourteen patients in L3-4, 83 patients in L4-5, 27 patients in L5-S1 level. Two patients in L3-4, 16 patients in L4-5 and 5 patients in L5-S1 showed ASD and there was no statistically significant difference between operation level and presence of ASD (P=0.906), and VAS (P=0.243). Regarding age, old aged patients over 65 had worse VAS results than patients below 64(P=0.032) even there was no statistically significant difference between age and presence of ASD.

Conclusion : There are many reported factors which show the relationship between development of adjacent segment disease and degree of laminectomy on spondylolisthesis. However, in our study, the only statistically significant factors were age, over 65 and VAS results. Our study is limited because of small number of cases and follow-up loss. We may need more number of cases and longer term follow-up.

Poster

P-3

Perforated Gastric Ulcer after Microdiscectomy – 2 Cases Report

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Purpose : Panperitonitis with Perforated gastric ulcer is a rare emergency condition associated with microdiscectomy. The causes of gastric ulcer are Helicobacter pylori, use of non-steroidal anti-inflammatory drugs (NSAID), low-dose aspirin, anticoagulants and so on. And untreated stress also can be a one of risk factor. Severe pain after lumbar disc rupture and microdiscectomy itself can be a strong stress to the body and taking pain killers such as NSAID, steroid can aggravate the gastric ulcer, it is rare to progress even to the state of perforation and panperitonitis. We report 2 cases with pan-peritonitis because of perforated gastric ulcer after lumbar microdiscect

Materials and methods : Case 1. A37-year-old male presented with lower back pain, severe sciatica on the right L4, 5 dermatome, and weakness of right ankle dorsiflexion for 6 days. Neurologic examination revealed that muscle strength of right foot extensor was grade 0. MRI showed left sided downward disc herniation. Because of left side foot drop, microdiscectomy was performed and intravenous steroids were used. On the third day after operation, he complained severe abdominal pain. After checking of Abdomen erect X-ray, we found out the free air collection under diaphragm. We sent him to the university hospital.

Results : Case 2. A45-year-old male presented with severe lower back pain, severe sciatica on the both L4, 5 dermatome. MRI showed left sided extruded and centrally downward huge disc herniation with bulging disc. Because of intractable pain, microdiscectomy at the L4-5 on the left was performed. On second day after operation, he still complained of severe back and leg pain and decreased anal tone and urinary incontinence that intravenous steroids were used and sequestrectomy on L5-S1, left sided was performed. On the fourth day after second operation, he complained severe abdominal pain. After checking of Abdomen erect X-ray, we found out the free air collection and sent him to the university hospital.

Conclusion : We hereby report 2 cases of perforated gastric ulcer after microdiscectomy. All 2 cases were under use of steroid injection for improvement of motor weakness. We can construe the reason for perforated gastric ulcer after microdiscectomy as use of steroid, pain killers and heavy stress to the body and taking a pain killers. Considering the consequence of such complication as perforated gastric ulcer, we must be careful when the patient complaints abdominal pain on the use of the medication such as steroid, NSAID after surgery.

Poster

P-4

Feasibility of Full Endoscopic Spine Surgery in Patients Over the Age of 70 Years With Degenerative Lumbar Spine Disease

Jeong Hoon Kim, Hyeun Sung Kim
Nanoori Suwon Hospital

Purpose : Degenerative spine disease, encompassing disc prolapse and stenosis, is a common ailment in old age. This prospective study was undertaken to evaluate the role of endoscopic spine surgery in elderly patients (above 70 years of age) with clinical and radiological follow-up.

Materials and methods : In this study, a retrospective analysis was conducted of 53 patients with lumbar disc prolapse or spinal stenosis who were treated with percutaneous endoscopic discectomy or decompression from November 2015 to June 2017. Clinical follow-up was done at 1 week, 3 months, and 1 year, and at yearly intervals thereafter. The outcomes were assessed using the modified Macnab criteria, a visual analogue scale, and the Oswestry Disability Index.

Results : Of the 53 patients, 21 were men and 32 were women. Their mean age was 76±4 years. The mean follow-up period was 17 months. Percutaneous endoscopic discectomy was performed in 24 patients and endoscopic decompression in 24 patients, while 5 patients underwent combined surgery. An excellent outcome in terms of the MacNab criteria was observed in 9 patients (16.98%), a good outcome in 38 patients (71.7%), and a poor outcome in 6 patients (11.3%). Of the 6 patients with a poor outcome, 5 (9.4%, 5 of 53) developed recurrent disc prolapse, and 1 developed hematoma with motor weakness. All 6 of these cases required revision surgery.

Conclusion : Managing degenerative spine disease in elderly patients with multiple comorbidities is a challenging task. Percutaneous endoscopic spine surgery is pivotal for addressing this concern. The authors have shown that optimal results can be achieved with various types of disc prolapse and stenosis with favorable long-term outcomes.

Poster

P-5

Surgical treatment and postoperative complication of Tarlov cyst

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Purpose : Tarlov cysts occur most commonly on extradural components of the sacral and coccygeal nerve roots. These lesions are often found incidentally, with an estimated prevalence of 4%–9%. They are mostly asymptomatic. Surgical treatment for few cases of symptomatic Tarlov"s cyst is necessary, but complication after the surgery is not uncommon.

Materials and methods : .

Results : There are three compilcation cases of Tarlov"s cysts.

First, a 64-year-old man presented with left leg pain due to S1 radiculopathy caused by Tarlov"s cyst. After decompression and cyst removal, his symptom was relieved. After 2 weeks of operation, skin infection was occured and debridement was performed. Cyst was recurred, but because of smaller size than before and decompressive laminectomy, the symptom was not recurred.

Second, a 56-year-old woman presented with right leg pain due to S2 radiculopathy caused by Tarlov"s cyst. After decompression and cyst removal, his symptom was relieved. After a month of operation, back pain is getting worse. Enhanced MRI showed L5/S1 spondylodicitis. Treating this lesion and preexisting L4/5 spondylolisthesis, L4/5, L5/S1 ALIF was done. After the surgery, back pain and radiculopathy was resolved.

Third, a 30-year-old man presented with perineal pain, urinary frequency and hypotonic anal sphincter due to S2 Tarlov"s cyst. After surgery, perineal pain and urinary frequency was improved, discharged at POD 6days. But 3 days after discharge, he complained headache and dizziness. After saline loading and bed rest, symptom was relieved.

Conclusion : Tarlov"s cysts surgery should be carefully applied to indications due to high possibility of complications. Long-term conservative treatment is ineffective, and surgery is necessary if symptoms are severe. Preoperative complications should be explained in advance. Surgery is needed when the size of the cyst is large, the cyst penestrate the bone, s2 root is compressed, or there is perineal symptoms. Cyst recurrence may be present, but usually the size is smaller than before, laminectomy is performed. So nerve compression is decreased and symptoms are improved.

Poster

P-6

Combined therapy of valproic acid and neuronal cell-specific gene expression system for spinal cord injury

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Purpose : Spinal cord injury (SCI) is a damage to cord and it makes a neurologic dysfunction. Following SCI, interruption of the blood vessels can lead to ischemic injury. Recovering the disruption of blood vessel is a key part of SCI"s treatment. In order to restore the blood supply following SCI, we performed gene therapy using valproic acid (VPA) combined with induced neural stem cells (iNSCs), which were generated by direct reprogramming from patient fibroblasts.

Materials and methods : After confirm the neural differentiation potential using several small molecules, plasmid containing neuron-specific enolase (NSE) promoter was transfected and cultured under normoxia or hypoxia conditions. VPA was treated in cultured iNSC. After promoter activity was measured using luciferase, gene was replaced to VEGF.

Results : Induced neural stem cell from human epidermal cells was differentiated into neuron. Luciferase assay revealed that neuron-specific promoter showed strong gene expression in iNSC. Moreover, iNSC transfected pNSE showed higher gene expression under hypoxia conditions mimic neurologic disease in vitro. In addition VPA enhanced gene expression. Replaced VEGF gene also showed high gene expression level under hypoxia conditions and with neuron-specific promoter and VPA in vitro and in vivo.

Conclusion : iNSC has a great potential in cell therapy to treat neural degeneration disease. According to gene expression level, neuronal promoter showed strong activity in iNSC. Moreover, NSE promoter enhanced gene expression under hypoxia conditions. Also VPA made synergic effect on improving gene expression. It indicates that applied cell and gene therapy with VPA represent a promising combined treatment in neural disease.

Poster

P-7

Clinico-Histological study of High Intensity Zones and the role of Percutaneous Endoscopic Lumbar Annuloplasty as Therapy with 3 Years Follow-up

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Purpose : Chronic back pain has been associated with high intensity zones (HIZs) on MRI. Our objectives are to study: any correlation between HIZs on MRI and presence of granulation tissue; symptoms in patients with HIZ; therapeutic efficacy of percutaneous endoscopic lumbar annuloplasty (PELAN) in such patients

Materials and methods : A retrospective study conducted in a single institution where PELAN was done from 2012 to 2014. All patients underwent thorough physical and radiologic evaluation. Intra-operatively, posterior sub-annular tissue biopsy was done. Clinical and functional outcome were assessed using visual analogue score (VAS), Owestry disability score (ODI) and modified Mcnab criteria. Patients were followed-up at one month, six months, one year and two years.

Results : A total of 24 patients were included. The mean age of the study population was 47.29. Mean and minimum follow-up periods were 29 and 24 months respectively. All patients were questioned about their symptoms. Sitting intolerance and dramatic relief after unloading were complained by all. None had neurological deficits. Mean pre-op VAS score was 7.5 significantly improving to 2.5 at 2 year follow-up, while ODI was 69.1 significantly improving to 29. 62.5% (15 patients) had excellent functional outcome while good and fair outcomes were reported by 25% and 12.5 % patients respectively. Out of 24 biopsy samples, 19 patients (79.17%) patients had positive granulation tissue finding on histopathological examination.

Conclusion : This study reaffirms the findings that HIZ represents granulation tissue, although it is still difficult to say that presence of HIZ represents symptomatic disc. However it is quite evident that, granulation tissue and free nerve ending in posterior annulus plays an important role in generating nociceptive stimulus. Excellent clinical and functional outcomes following PELAN treatment, support the above hypothesis and opens an excellent therapeutic alternative for the management of back pain.

Poster

P-8

Tapia's syndrome following posterior cervical decompression sugery : A case report

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Purpose : Tapia syndrome is a rare idiopathic complication characterized by hoarseness of voice and difficulty in tongue movement. It is thought to be caused by injury to the 10th and 12th cranial nerves without involvement of the pharyngeal branches of the 10th nerve. The authors report a case of Tapia syndrome after posterior cervical spine surgery.

Materials and methods : A 62-year-old male with right hand pain and grasp weakness for 3 months was admitted. On MRI, central disc extrusion in C6 to T1 level and foraminal stenosis of right C7-T1 was noted. The patient underwent decompression surgery for the stenotic lesions which was successfully accomplished by the foraminotomy and discectomy procedure via posterior approach.

Results : Postoperatively, the patient complained hoarseness of voice and dysphagia. His tongue was deviated to right and uvula was mildly deviated to left side showed vocal cord palsy. Intravenous steroid and oral vitamins were administered. On postoperative 6 month follow-up, the symptoms fully recovered. It is postulated that the symptoms were caused by compression by the cuff pressure of the endotracheal tube on the cranial nerves.

Conclusion : This case report indicates that spine surgeons must be aware of this rare but frustrating syndrome and warn the patients about the possible outcomes.

Poster

P-9

Regulation of cAMP and GSK3 signaling pathways contributes to the neuronal conversion of glioma

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Yonsei University

Purpose : Glioma is the most malignant type of primary central nervous system tumors, and has an extremely poor prognosis. One potential therapeutic approach is to induce the terminal differentiation of glioma through the forced expression of pro-neural factors. Our goal is to show the proof of concept of the neuronal conversion of C6 glioma through the combined action of small molecules.

Materials and methods : We investigated the various changes in gene expression, cell-specific marker expression, signaling pathways, physiological characteristics, and morphology in glioma after combination treatment with two small molecules (CHIR99021, a glycogen synthase kinase 3 [GSK3] inhibitor and forskolin, a cyclic adenosine monophosphate [cAMP] activator).

Results : Here, we show that the combined action of CHIR99021 and forskolin converted malignant glioma into fully differentiated neurons with no malignant characteristics; inhibited the proliferation of malignant glioma; and significantly down-regulated gene ontology and gene expression profiles related to cell division, gliogenesis, and angiogenesis in small molecule–induced neurons. In vivo, the combined action of CHIR99021 and forskolin markedly delayed neurological deficits and significantly reduced the tumor volume.

Conclusion : We suggest that reprogramming technology may be a potential treatment strategy replacing the therapeutic paradigm of traditional treatment of malignant glioma, and a combination molecule comprising a GSK3 inhibitor and a cAMP inducer could be the next generation of anticancer drugs.

Poster

P-10

Strategy for personalized medicine based on ALS patient-derived stem cells using CRISPR/Cas9-mediated genome editing

Yeomin Yun, Yoon Ha
Yonsei University

Purpose : Amyotrophic lateral sclerosis (ALS) is a neurodegenerative disease that causes dysfunction of the motor neuron. Motor neuron which is responsible for controlling voluntary muscles movement in the spinal cord, brainstem and brain progressively deteriorate and die. It leads to muscle weakness, paralysis and eventually respiratory failure to death. The precise cause of ALS is not known, only 5% to 10% of cases are known as associated with genetic problem. Considering various novel genetic mutations have been reported and poorly understood pathophysiology of ALS, the development of personalized therapy that target the patient's own genetic mutation and restore motor neuron function would provide the most promising treatment.

Materials and methods : From a case of male patient presenting with ALS, Next generation sequencing (NGS) discovered a point mutation in a gene. In order to assess the genotype-phenotype, patient-derived fibroblast was directly reprogrammed to generate induced neural stem cell (iNSC). Gene correction of point mutation using CRISPR/Cas9 system was performed in patient-derived induced pluripotent stem cells (iPS). To target the precise mutated sequence, we designed specific sgRNA and donor DNA as well as proper transfection methods.

Results : Whole genome sequencing of ALS patient and his parents revealed maternally inherited variant. We investigate the pathophysiology in patient-derived cells and impaired phenotype caused by a mutation. iNSC revealed the cellular dysfunction such as proliferation and apoptosis compared to normal cell line. Similarly, patient-derived iNSC showed less responsiveness to copper compare to normal cell line. We obtained isogenic cell line with gene corrected iPS. Investigation of pathophysiology between patient-derived cells and gene corrected cells revealed that function is partly rescued and cellular function such as proliferation and neural differentiation is improved.

Conclusion : Reprogrammed stem cells from patient somatic cell are suitable to investigate the mechanism, pathology and gene-editing. NGS can give the genetic evidence and candidates of disease. The CRISPR/Cas9 system can target the sequence precisely and homology directed repair (HDR)-mediated gene editing allows a correction of point mutation. As a result, these new technologies are capable of precise genomic analysis in patient genetic background and this strategy would be the most promising approach to personalized precision medicine.

Poster

P-11

Prediction of the modified frailty index and risk factor of postoperative complications after spine surgery over 75 years

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Purpose : Spine surgery for ≥ 75 years older patients is associated with high complication rate and mortality. The modified Frailty Index (mFI) is evaluation tool to describe the frailness of an individual and how their preoperative status may impact postoperative survival and outcomes. To determine if the mFI could be used to predict postoperative complications in ≥75 years older patients undergoing surgery with instrumentation.

Materials and methods : The authors performed a retrospective review of the perioperative course of 138 patients who underwent thoracolumbar instrumentation spine surgery at their form 2011 to 2016. The preoperative risk factors were 11 variables of modified frailty index (mFI) and body mass index (kg / cm2), preoperative hemoglobin, platelet, albumin, creatinine and anesthetic time, operation time, estimated blood loss, and transfusion amount were measured. The outcomes assessed were 60-day occurrences of complication. These were then summarized in groups; death, cardiac arrest, deep vein thrombosis, myocardial infarction, postoperative intubation, pulmonary embolism, stroke, sepsis, acute kidney injury, pneumonia, surgical infection and urinary tract infection.

Results : Major complications after spinal instrumentation surgery occurred in 34 of 138 patients. (24.6%) The mean mFI score was 0.18. Using the mFI, 67.4% (n=93) were pre-frail (mFI: 0.09~0.18) and 31.9% (n 44) were frail (mFI ≥ 0.27) state. There was a statistically significant difference in major complications when the albumin level was low and the operation was performed with infection or trauma. The mFI was more useful predictor of postoperative complication than ASA score.

Conclusion : The mFI can successfully predict the postoperative morbidity and mortality for ≥75 years older patients undergoing spine surgery. A higher mFI was associated with a higher risk of postoperative morbidity and mortality, providing an additional tool to improve perioperative risk stratification.

Poster

P-12

Spinal cord injury therapy by in vivo reprogramming

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Purpose : Spinal cord injury is induced by trauma or compression that often leads to blocking the stimulus, and disorder to function of motor system, sensory and autonomic nervous system. The fundamental treatment of spinal cord injury is not yet developed. Generally, it has been applied that decompression therapy, drug treatment and rehabilitation for spinal cord injury. However, the treatments have shown that limited effects. Because of that reason, new treatments are in the studying including gene therapy and stem cell therapy. Among them, in vivo reprogramming is regarded as promising futuristic technology. In this study, we used in vivo reprogramming technology for treatment of spinal cord injury by reprogramming the astrocytes to neurons.

Materials and methods : In this study, we used two kinds of astrocytes that human astrocytes and primary astrocytes from mouse. These cells were direct reprogramming by specific vectors for 6 weeks. After then reprogramming cells verify by immunocytochemistry. At the In vivo study, male C57BL/6 mice (n=10, postnatal 7 weeks) were randomized into three groups: Group 1= normal group, Group 2= PBS group and Group 3= reprogrammed group. Genetic transduction was conducted 2 weeks after spinal cord injury and subjects were observed for 6 weeks. To evaluate functional behavior, each group was examined with basso mouse scale (open field test). Also, immunohistochemistry proceed for reveal in vivo direct reprogramming and neuronal regeneration.

Results : At the in vitro study, the both kinds of astrocytes were reprogrammed from astrocyte to neurons by reprogramming. Also, we verified the behavior was improved and astrocytes were reprogrammed to neurons, when we applied in vivo reprogramming technology to spinal cord injury animal models.

Conclusion : In vivo reprogramming technology improve functional behavior and enhanced neuronal regeneration of spinal cord injury. From these results, in vivo reprogramming technology can use as promising futuristic technology to spinal cord injury.

Poster

P-13

Inhibition of MAOB-dependent GABA from reactive astrocytes cause neuronal regeneration, remyelination, and functional recovery after spinal cord injury

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Purpose : Spinal cord injury transforms naive astrocytes into reactive astrocytes, which become glial scar that can interrupt axonal regeneration and functional recovery. In the previous study, we identified phenotypic change that known as reactive astrocytes can produce GABA from putrescine at mitochondria by specific enzyme MaoB. Also we confirmed that MaoB work critical roles at the brain degeneration disease. The aim of this study is to reveal the effects of MaoB inhibition on nerve regeneration and pain control in a spinal cord injury.

Materials and methods : We tested behavior recovery, neuropathic pain test, immunohistochemistry, western blot analysis and transmission electron microscopy imaging at various animal spinal cord injury model for verify the role of MaoB enzyme. All experiment groups divided to four groups (n=20), normal, normal/ MaoB inhibition group, SCI and SCI/ MaoB inhibition group. MaoB inhibition administration 2 weeks later after spinal cord injury when the glial scar is formed. After administration, we observed for 8 weeks.

Results : MaoB inhibition showed significantly enhanced functional recovery of hind limb and released neuropathic pain. Histological analysis of spinal cord tissue revealed that MaoB inhibition reduced reactivity of astrocytes and dropped the level of MaoB and GABA to normal level. As well as, it was improved neuronal regeneration. These regenerated nervous tissues were well re-myelinated and operated properly. Also, MaoB inhibition restrains recruiting immune cells to lesion of injured spinal cord.

Conclusion : MaoB inhibition improve neuronal regeneration with remyelination and inhibition of reactivation of astrocytes. It was inducing behavioral recovery and reduction of neuropathic pain. Combined these dates suggest that the MaoB inhibition has therapeutic effects to spinal cord injury.

Poster

P-14

Simultaneous expression of Fahr's syndrome and thoracic OPLL developed by idiopathic hypoparathyroidism

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Purpose : Fahr's syndrome presenting multiple and symmetric calcification of basal ganglia and cerebral cortex is rare, and idiopathic hypoparatyroidism is known as one of the causes. The relationship between ossification of ligamentum flavum and idiopathic hypoparatyroidism is also reported in a few cases. Here, we report a patient presenting simultaneous Fahr's syndrome and thoracic OPLL developed by idiopathic hypoparatyroidism.

Materials and methods : We report a case of concomitant Fahr's syndrome and thoracic OPLL with idiopathic hypoparatyroidism in 53 years old female. The patient showed gait disturbance and both leg weakness (Grade 3) for 4 months after slip down, and has the history of anti-epileptic medication for several years. We found increased deep tendon reflex on physical examination and thoracic myelopathic sign on neurophysiological study. Magnetic resonance (MR) imaging revealed cord compression by the mixed-type OPLL from T5 to T9, and decompressive surgery was planned. Sudden onset generalized tonic-clonic seizure attack developed before the surgery. Hypocalcemia (3.7mg/dL) with QT prologation on electrocadiogram, hypomagnesemia (1.4mg/dL), hyperphosphatemia (7.7mg/dL), hypoparathyroidism, and normal range of vitamin D was noted. Brain study showed Fahr's syndrome with multiple and symmetric calcification of basal ganglia, cerebral cortex, and cerebellum. The planned surgery was performed after correction of hypocalcemia and hypomagnesemia.

Results : The symptoms including leg weakness and gait disturbance improved completely on 10 months follow-up. During the follow-up periods after surgery, endocrinologist and nephrologist tried to reveal the cause of hypothyroidism and hypomagnesemia. Hypomagnesemia was normalized with supplement of oral magnesium, nutritional deficiency was the main reason. However, neither the cause of hypoparathyroidism nor correction of sufficient correction of hypocalcemia was not still achieved, and concluded as idiopathic hypoparathyroidism.

Conclusion : Simultaneous expression of Fahr's syndrome and OPLL related with idiopathic hypoparatyroidism is very rare. However, we recommend considering the possibility of hypoparathyroidism and association of Fahr's syndrome when we evaluate the patients with OPLL to avoid the risks of sudden onset seizure and cardiac arrhythmia.

Poster

P-15

Holospinal epidural abscess of the spinal axis after spinal epidural injections

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Purpose : Epidural or transforaminal spinal injection is a commonly used modality in the treatment of degenerative spinal diseases. Although serious complications from the procedure are rare, epidural abscess is life-threatening conditions, and need additional medical and surgical intervention. The holospinal epidural abscesses (HEAs) after spinal injection is extremely infrequent and requires unique management. The objective of this study is to report a patient with fatal HEA after frequent spinal epidural injections.

Materials and methods : A 71-year-old female patient presented with severe neck and low back pain with general weakness. This patient had received lumbar and cervical transforaminal epidural injections several times in private clinics. The magnetic resonance imaging showed epidural abscess from upper cervical to upper lumbar area with cord compression. We immediately treated using skip laminectomies and epidural catheter irrigation techniques.

Results : Methicillin Sensitive Staphylococcus aureus was identified from abscesses and also blood samples. We treated with susceptible antibiotics for 8 weeks. The patient completely recovered without any complications.

Conclusion : Frequent spinal epidural steroid injections can cause serious spinal infections. In serious cases, early surgical intervention is absolutely necessary for neural decompression and confirmation of microorganism.

Poster

P-16

Anti-osteoporotic effects of blue mussel-derived bioactive peptide via BMP and MAPKs-induced osteogenic activity for the treatment of osteoporosis

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Purpose : Osteoporosis is associated with bone mass loss and decreased bone strength, and an imbalance between bone formation and resorption. Marine bioactive peptides could be one of effective therapeutic strategies for managing of osteoporosis due to their high potential bioactivities with osteogenic benefits. In this study, osteogenic effect of novel osteogenic peptides extracts from blue mussel protein hydrolysate (BMPHs) were examined in mouse mesenchymal stem cells (MSCs) and bone protective effects of BMPH treatment investigated in ovariectomized (OVX) mice as an osteoporosis animal model.

Materials and methods : Eight-week-old female C57BL/6 mice were surgically ovariectomized (OVX) using bilateral ventral incisions of 0.5 cm. The sham-operated models (Sham) were prepared by the same procedures of OVX without removing their ovaries. The mice were fed with a low calcium pellet diet containing 0.01% calcium to accelerate the induction of osteoporosis. The mice were randomly assigned into 6 different groups (n = 5 for each group) as follows: Sham (PBS-treated), OVX-C (PBS-treated), OVX-P1 (P1 peptide-treated), OVX-P2 (P2 peptide-treated), and OVX-Est (17β-estradiol-treated) as a positive control. Then, normal (Nor; the mice with feeding a normal calcium diet and PBS-treated) was served as a negative control. After all experiment, the serum osteocalcin concentration and alkaline phosphatase activity were measured as a specific biomarker of bone formation and the bone-architecture of fixed femur was examined by 3D Micro-CT scanner.

Results : OVX mouse supplemented with BMPHs for 2 months showed osteoprotective effects, resulted in an increase of bone mineral density (BMD), the bone volume and trabecular number, and inhibition of bone loss compared with OVX control mouse. The serum activity of ALP and osteocalcin (OC), which is correlated with the loss of bone formation contents, also significantly reduced with BMPHs treatment compared with OVX control mouse.

Conclusion : These results showed that the anti-osteoporotic properties of BMPHs is associated with the The serum activity of ALP and osteocalcin. And we suggest that BMPHs could be health-promoting functional food ingredients against osteoporosis.

Poster

P-17

Do all kinds of lumbar disc herniation can be treated under the percutaneous endoscopic lumbar discectomy?

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Purpose : Percutaneous endoscopic surgery in lumbar disc herniation has the advantage of minimizing laminectomy size and muscle dissection. In addition, small incision, early mobilization, and lesser post-surgery pain increases patients satisfaction after surgery. We performed percutaneous endoscopic surgery for all patients with lumbar disc herniation since November 2015, In addition, we segmented the aspects of the disc herniation disease and present the clinical results.

Materials and methods : We prospectively analyzed patients who performed lumbar endoscopic surgery with lumbar disc herniation disease. All patients visited single surgeon outpatient clinic from November 2015 to April 2017, and they all underwent percutaneous endoscopy. The disc herniation pattern was classified to central, paracentral, inferior migation, superior migration, high canal compromised, foraminal and far lateral. The preoperative and postoperative VAS score, ODI, and, motor power change were checked and the macnab score was analyzed to evaluate the surgical satisfaction.

Results : We performed 172 cases of PETLD and 59 cases of PEILD.

In PETLD group, there were 83 cases of central to paracentral disc, 8 cases of superior migration,38 cases of inferior migration, 9 cases of high canal compromise, 18 cases of foraminal, 11 cases of far-lateral and another 5 cases. The preoperative VAS score was 7.64 and decreased to 1.7 at last follow up.($p<0.05$) ODI was also significantly decreased from 69.8 to 22.9.($p<0.05$) Motor power grade increased from 3.97 to 4.9. The Macnab score showed excellent results in 75 cases, good results in 92 cases and fair results in 5 cases.

In PEILD group, there were 37 cases of central to paracentral disc, 1 case of superior migration, 11 cases of inferior migration, 3 cases of high canal compromise, 3 cases of foraminal, 1 case of dorsal and 1 case of disc degeneration. The preoperative VAS score was 7.46 and decreased to 1.73 at last follow up.($p<0.05$) ODI was also significantly decreased from 70.1 to 23.2.($p<0.05$) Motor power grade increased from 4.24 to 4.9. The Macnab score showed excellent results in 28 cases, good results in 27 cases and fair results in 4 cases.

Conclusion : For all kind of disc herniation, treatment with percutaneous endoscopy was possible without consideration of open surgery. Among them, cauda equina syndrome patients with highly compromised canal, patients with highly inferior, superior migrated disc, foraminal and far lateral disc were also included. PELD could be applied to all kinds of disc herniation disease, and it could replace microscopic open surgery.

Poster

P-18

Diagnosis and Treatment of Intraoperative Esophageal Rupture on Revision Anterior Cervical Spine Surgery: Two case report

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Purpose : Intraoperative esophageal injury in anterior cervical spine surgery is rare. But it is devastating complication to patient and surgeon. Injury identification is most importance. After confirming injury, proper response should be performed.

Materials and methods : Case I : 49 years old women visit our clinic with repeated surgical wound infection. She underwent anterior cervical discectomy and fusion (ACDF) with plating 1 year ago. Despite an anti-biotics treatment, infection was repeated. Image study revealed abscess formation nearby implant. Implant removal was planned. Intraoperatively, plating and infected allo interbody bone was removed. However, esophageal mucosa exposure was suspicious near implant removal site. Lavin tube was inserted to injured esophagus and it was cached in oral cavity. Thoracic surgery performed primary sutured of perforated esophagus. Muscular layer suture was added. For one week, board spectrum antibiotic was injected with NPO and total intravenous nutrition. In a barium esophagography. dye was not leaked. Oral diet was re-intake. 2 weeks later, patient was discharged.

Case II : 74 years old women visit out clinic with chronic dysphagia. 20 years ago, she underwent ACDF. Allo-bone and metal foreign body presented at image study. On pre-operative EGS, there is no structure abnormality. Intraoperatively, foreign body was removed. On removal site, large esophageal mucosa was exposure. Intraoperative EGS, L-tube confirmed esophageal ruptured. Thoracic surgeon performed diverticulectomy using gastrointestinal anastomosis stapler. After 1 weeks NPO and L-tube insertion with broad spectrum anti-biotics, oral diet was re-intake with confirming in a barium esophagography.

Results : Esophageal injury during anterior cervical spine procedures is a rare occurrence, with reported rates that range from 0.3%~1.6% in anterior cervical spine surgery. Concern for acute intraoperative injury should prompt visual inspection of the esophagus. Intra-esophageal dye injection, Lavin tube insertion and intraoperative esophagoscope have been suggested for identifying injury site. When a direct esophageal injury occurs and is noted intraoperatively, direct repair at the time of surgery with absorbable suture is indicated. Intraoperative placement of a nasogastric tube, drain, and standard closure should follow. The patient should be treated with broad-spectrum antibiotics. Oral feeding can be initiated after a barium swallow study with no evidence of extravasation. Early detection is importance for excellent outcome.

Conclusion : We report two cases which esophagus was injured and treated for anterior cervical spine surgery.

Poster

P-19

Single stage anterior-posterior decompression with minithoracotomy for simultaneous ossification of the posterior longitudinal ligament and ossification of the ligamentum flavum at the same level: technical report of 2 cases

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Purpose : The aim of this study is to report the clinical outcome of surgery in patients with simultaneous ossification of the posterior longitudinal ligament and ossification of the ligamentum flavum at the same level

Materials and methods : We conducted a retrospective review of two patients underwent surgery for single stage decompression of OPLL and OLF at the same level.

Results : Simultaneous OPLL and OLF occurred at the T8-9 in 29-year-old male and at the T4-5 in 52-year-old female with thoracic myelopathy. Mini-thoracotomy with transpleural approach and total extirpation of the OPLL and decompression of OLF was performed. Dural leak was happened during decompression of 2nd case. Both of patients experienced no postoperative complications. Postoperatively, symptoms were greatly improved. The Japanese Orthopedic Association score improved from 4 and 4 preoperatively to 8 and 9 at final follow-up, respectively.

Conclusion : Single stage anterior-posterior decompression with mini-thoracotomy can be safe and effective treatment option for simultaneous OPLL and OLF in the same level.

Poster

P-20

Postoperative spinal epidural hematoma : A case report

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Purpose : Postoperative epidural hematomas are rare but classic complication of spinal surgery. Epidural hematomas occur in approximately 0.10%-0.24% of all spine surgeries. Here, we report a case of postoperative spinal epidural hematoma after lumbar unilateral approach, bilateral simple decompression with microdisectomy, with an emphasis on possible causes and prognosis.

Materials and methods : A 50-year-old man presented with both leg radiating pain with neurogenic intermittent claudication (VAS score 7).

He had an aortic valve replacement operation for aortic valve regurgitation 30 years ago. We were unable to perform MRI because of artificial heart valves, and we were forced to diagnose with CT only.

Results : The patient's symptoms resolved after surgery. The patient had been on a warfarin regimen since heart valve replacement operation was performed. We did not use subfascial darin because we did not observe active bleeding during surgery (Fig 2A). The patient complained of both leg motor weakness and radiating pain 12 hours after the operation. We checked follow up lumbar sprine CT. (Fig 2B). Follow up CT confirmed the effacemnet of epidural space, possibly due to epidural hematoma. We performed hematoma evacuation and subfascial drain insertion. No apparent hemorrhage point was observed in the field of surgery. After surgery the patient's symptoms were improved slightly (Fig 3).

For surgery, warfarin was stopped and heparin was in use, and the daily amount of drain was less than 10cc, so drain was removed at POD#4. At POD#5, no deterioration of the patient symptoms was observed, but the swelling in the surgical site was observed, and the surgery was determined to be a recurrence of the bleeding. In the field of surgery, we were able to identify subcutaneous and epidural bleeding. So, we performed 2nd hematoma evacuation and subfascial drain insertion.

Conclusion : A postoperative symptomatic epidural hematoma is rare complication. However, if the diagnosis and treatment of epidural hematoma is delayed, the patient"s neurological outcomes are very poor. Therefore, patients with high incidence of complications should be more careful and in the event of numbness, weakness, or severe pain, diagnosis and treatment through rapid examination is necessary.

Poster

P-21

The usefulness of ICG videoangiography in the cervical spine surgery to evaluate the patency of VA

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Purpose : Indocyanine green (ICG) videoangiography is a new technique that allows for real-time evaluation of blood flow in the aneurysm and vessels. ICG videoangiography is a useful addition to cerebrovascular neurosurgery.

We evaluate the usefulness and limitation of ICG videoangiography during the cervical posterior fixation to evaluate the patency of the vertebral artery in the cases with high risk of VA injury.

Materials and methods : We performed a surveillance data collected between Feb. 2012 and August 2018, 28 patients (19 female, 9 male; mean age, 54.5 years) were evaluated. Near infrared ICG angiography was applied after the posterior screw fixation in the cases of high riding VA at the level of C2 vertebra, V3 segment anomaly and the situation of the VA injury was suspected during the surgical procedure.

Results : ICG videoangiography is useful in different types of upper cervical posterior surgery. This technique is useful to evaluate the VA patency after screw instrumentation especially in the cases of the VA anomaly and high riding VA. And it is useful to identify the vessel patency after the inevitable VA management during the procedure. Overall, the procedure interrupted the surgical procedure for less than 5 minutes. One case of adverse skin reaction to the dye was encountered due to the dye leakage outside the vessel during the injection.

ICG videoangiography has some limitations such as its inability to be viewed outside of the observed plane of illumination with infrared light and inconsistent complete washout, making repeated viewing sometimes difficult in structures surrounded by thick and excessive tissue.

Quantitative evaluation of vessel flow is not possible with ICG videoangiography.

Conclusion : ICG angiography could be a simple intraoperative evaluating tool with which the patency of the extracranial vertebral artery can be assessed. Compared with digital subtraction angiography, ICG angiography requires less time, personnel, and equipment, is safer, and can resolve smaller vessels, but is limited by the surgeon's viewing angle and the depth of penetration of the infrared light. Even though it is necessary to expose the VA above the C1 arch or lateral to the C1 lateral mass to identify the ICG flow in the cases of CVJ surgery, it can be a useful tool to verify the patency of the possibly damaged VA during the screw placement. Unlike ultrasound technology, this technique is a hands-off method that can inform the surgeon about the flow patency of the extracranial vertebral artery

Poster

P-22

Bilateral decompression through unilateral approach (BDUA) combined with TLIF to spondylolisthesis patients having bilateral radiculopathy

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Purpose : There are many surgical options to treat spondylolisthesis patients presenting both leg pain. Bilateral direct decompression with PLIF or TLIF and posterior stabilization is ordinary concept, or indirect decompression with ALIF, OLIF, or DLIF are acceptable also. But wide operation field and transabdominal approachs were considerable to time spent, blood loss, and clinical results. So we introduced tubular retractor guided bilateral decompression through unilateral approach (BDUA) combined with TLIF on this pathology. The aim of this study was to evaluate clinical efficacy of this procedure.

Materials and methods : From Jun. 2014 to May 2017, 20 patients of spondylolisthesis were treated by tubular retractor guided bilateral decompression through unilateral approach combined with TLIF and posterior stabilization with pedicle screws and rods. 14 female and the others male, median ages 56 were enrolled. All patients had back pain and both leg pain suffered degenerative or spondylolytic spondylolisthesis. And electrophysiologic studies applyied to all treated patients were represented suggested or evidence of radiculopathy on both legs. Higher grade of Meyerding's grades such as 3 or more were exclusion criteria. Clinical outcomes were measured by VAS on back and both leg pain on time intervals. And functional outcomes were estimated by MAcNab and SF 36 scores.

Results : Mean VAS scores of back pain was improved 7.6 to 2.3 ($P<0.05$). Mean VAS scores of each leg pain was improved 7.8 to 2.3 on right leg and 7.6 to 2.2 on left leg ($P<0.05$). MacNab criterias were mostly exellent and good and SF-36 was also improved. Electrophysiologic studies after 6months of surgery represented improving or improved radiculopathy. There was no revision case.

Conclusion : BDUA with TLIF on spondylolisthesis having both leg symptoms was clinically effective, safe and time saving alternative procedure.

Poster

P-23

Combined Laminoplasty with Unilateral Lateral Mass Screw Fixation in Acute Cervical Cord Injury pre-existing Ossification of the Posterior Longitudinal Ligament

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Purpose : Multilevel laminoplasty maybe very vulnerable state for cervical stability in OPLL with acute cord injury. To explore and analyze the outcomes and factors that affect the prognosis of open-door laminoplasty with unilateral lateral mass screw fusion in acute cervical cord injury pre-existing cervical ossification posterior longitudinal ligament (C-OPLL).

Materials and methods : From January 2011 to December 2016, combined surgery was performed for acute cervical cord injury preexisting C-OPLL in single spine center. The subjects of this study were 14 men and 3 women of mean age 65± 11 years (range, 51-81) with a mean follow-up of 22.8 months.

All MR imaging studies showed multiple C-OPLL with spinal cord signal change. A retrospective review of clinical outcomes, radiological changes, and surgical data were conducted.

Results : The cause was slip down on 8 cases, traffic accident 1, but unknown was 8. Average laminoplasty level was 3.9 and the average screw fixation level was 4.0. Including C2 fusion case were 10 and C7 fusion level were 6. Modified Japanese Orthopedic Association score improved from an average of 7.3±3.6 to 10.9±4.0 points. According to Nurick's grades symptom improvement was 3.7±1.0 to 2.4±1.5 statistically significant. The overall of changing in C2-7 SVA was 26.1mm to 31.9mm. The aver¬age of preoperative cervical curvature was 10.3°±9.5° and postoperative cervical curvature was 10.6°±6.9° and last follow-up was 7.5°±7.0°. No significant surgical complication was encountered without 3 screw halo evidences. In C2 fixation, the change of cervical curvature angle was 8.6°± 4.6° to 7.7°±3.9° but in skipped C2 fixation, 13.6°± 8.8° to 7.2°± 9.9°.

Conclusion : Despite the small cohort and the short follow-up duration, combined open door laminoplasty and Unilateral lateral mass screw fixation can help to maintain cervical curvature and stability without obvious complication in multilevel cervical OPLL with acute cord injury. Including C2 fixation was superior to keep the C2-7 lordotic angle during the follow-up period in multilevel C-OPLL.

Poster

P-24

Reconstruction for cervical corpectomy using flanged titanium mesh cage replacing anterior plate

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Purpose : We present anterior cervical corpectomy and fusion (ACCF) with flanged titanium mesh cage (TMC) replacing anterior plate in the treatment of cervical spondylotic myelopathy (CSM) and ossified posterior longitudinal ligament. (OPLL)

Materials and methods : Fifty patients with CSM or OPLL who underwent ACCF with flanged TMC were retrospectively investigated. The Odom`s criteria was used to assess the clinical outcome. Radiographic evaluation included TMC subsidence, fusion status and interbody height.

Results : Thirty-eight patients underwent single-level and 12 patients underwent 2-level corpectomy with a mean follow-up period of 16.8 month. Forty-four (88%) had excellent (38%) or 25(50%) outcome. Two patients (4%) were categorized as poor who C5 palsy occur. At last follow-up fusion rate was 100% and severe subsidence rate was 34%. There was no significant difference in subsidence among Odom`s criteria (P=0.381) and between 1 level corpectomy group and 2 level corpectomy group (P=0.127).

Conclusion : The satisfactory outcomes in this study indicated that the flanged TMC was an effective graft for cervical reconstruction.

Poster

P-25

The higher frailty score and lower self-care activity are associated with higher grades of sagittal spinopelvic malalignment in the elderly population

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Purpose : As society ages, it is important to assess their frailties, activities and the state of the spine. Frailty increases the risk for mortality, loss of activites of daily living, hospitalization, physical limitation, falls and fractures. In our study, the Korean version of the FRAIL scale was used as a measure of frailty. Activities of daily living (ADL) and instrumental activities of daily living (IADL) are known to be associated with quality of life (QOL) and are used as measuring instruments for functional status in regard to the elderly. Sagittal spinopelvic parameters reflect the health of the spine, are used as criteria for planning of surgical interventions and evaluation of the treatment effect. The aim of this study was to assess the relationship of frailty with ADL, IADL and sagittal spinopelvic parameters in the elderly.

Materials and methods : Patients hospitalized for spine surgery at our hospital between March 2015 and June 2017 were prospectively enrolled. On the day of admission, we measured the height and weight of patients, examined past history, conducted a radiographic test and measured sagittal spinopelvic parameters. The survey was conducted by two experienced nurses, including FRAIL scale, ADL, IADL. Sex, age, BMI, Comorbidity, Smoking, FRAIL scale, Sagittal spinopelvic parameter (C7 Sagittal vertical axis (SVA), T1 pelvic angle, Pelvic tilt (PT), Pelvic incidence (PI), Lumbar lordosis (LL)), ADL, IADL were included in the analysis.

Results : Data from 87 patients aged over 75years who hospitalized for spine surgery were analyzed. Multiple regression analysis was performed to identify predictors of sagittal spinopelvic parameters. The higher degree of impairment in the FRAIL scale was significantly associated with the longer SVA (p =.027), the larger angle of T1PA (p =.015), PT (p =.004), PI-LL value (p =.002). And the higher degree of ADL was associated with the larger angle of T1PA (p =.008), PT (p =.045). Also, the higher degree of IADL was significantly correlated with the longer SVA (p =.005), the larger angle of T1PA (p =.002), PI-LL (p =.016).

Conclusion : The higher frailty score is associated with higher grades of sagittal spinopelvic malalignment as well as ADL in the elderly population. Also, the higher ADL and IADL scores are associated with grades of sagittal spinopelvic malalignment. Although the causal relationship is unclear due to cross sectional study, three parameters (frailty, activities of daily living, sagittal spinopelvic parameter) are closely related to each other in the elderly.

Poster

P-26

Application of simultaneous PET-MR imaging in pyogenic spondylodiscitis

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Purpose : There is still no definite correlation between follow-up Magnetic resonance (MR) imaging findings and clinical status for monitoring treatment response in spinal infection. Furthermore, several factors related with general condition can have an influence on blood inflammatory indexes. Recently, Fluorine-18 fluorodeoxyglucose positron emission tomography (F-18 FDG PET) shows great potential as new option. Simultaneous F-18 FDG PET and MR (PET/MR) imaging make us to expect a huge synergic effect in a view of anatomic and metabolic advantages.

Materials and methods : Prospective study. From January 2017 to February 2018, 34 patients with pyogenic thoraco-lumbar spondylodiscitis were enrolled. Decision making for treatment response (good or poor-response) was performed based on clinical symptoms, blood inflammatory marker (ESR and CRP), and one or two times of PET/MR imaging in the patients after at least three weeks of antibiotic therapy. We compared the differences of clinical data including ESR, CRP, and PET/MR imaging between good-response group (n=28, group A) and poor-response group (n=16, group B) (10 patients of group B were also included to group A after a successful treatment), and analyzed the recurrence rate at least 6 months of follow-up period in group A.

Results : Good-response group showed lower ESR (45.64±29.33 vs. 72.31±29.20), CRP (0.95±1.38 vs. 2.83±2.64), and SUVmax (4.15±1.42 vs. 6.84±2.23) in group A than group B ($p<0.05$). There was a difference in the distribution of F-18 FDG uptake depends on treatment response. F-18 FDG uptake was limited to destroyed disc in group A compared with the broad involvement to vertebral body in group B. SUVmax was the most reliable diagnostic method with cut-off value 5.14, sensitivity 93.8%, specificity 82.1%, positive predictive value 75%, and negative predictive value 95.8%. There was one patient with recurrence during the follow-up period (1/28, 3.6%).

Conclusion : PET/MR imaging is an independent valuable method which is unaffected by other conditions with higher sensitivity and negative predictive value for evaluating treatment response in pyogenic spondylodiscitis. We need to obtain the best MR sequences which can reflect the result of PET to be more helpful.

Poster

P-27

Use of Teriparatide for Elderly Patients with Unstable Thoracolumbar Injury

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Purpose : Treatment of thoracolumbar fracture is still controversial. There are debates between surgery and conservative treatment in the patients with 4 score of thoracolumbar injury classification and severity (TLICS) score. Especially in elderly patients, applying the existing theory is often useless because of severe osteoporosis and medical problems.

Materials and methods : Case series. 17 female patients (mean ages of 75.24±9.80 years old) with thoracolumbar fracture treated conservatively using teriparatide (6.00±2.80 (3-14) months) were enrolled. Fracture type includes 14 burst and 3 distractive fractures without neurological deficits. TLICS scores of all patients were above 4 and mean score was 4.65±0.99 (4-7). Load sharing (LS) score was 6.53±1.12 (5-8). Radiological factors including kyphotic angle (KA), segmental vertebral kyphotic angle (SVKA), compression ratio (CR), and body height (anterior:AH, middle: MH, posterior: PH) were analyzed. Functional status was evaluated with Macnab classification.

Results : There were no statistical significant differences between pre- and post-treatment in the all of radiologic factors including KA (17.06±10.04 vs 21.38±12.20), SVKA (15.82±8.83 vs 16.60±8.33), CR (34.51±42.86 vs 44.96±35.29), AH (15.99±8.19 vs 13.67±8.20), MH (13.73±5.37 vs 11.37±5.46), PH (26.55±3.97 vs 25.57±4.75) ($p>0.05$). Kyphosis did not progress significantly, and vertebral body sank to a similar extent antero-posteriorly. There was a statistical significant improvement in functional status ($p<0.05$).

Conclusion : Teriparatide has bone-forming and fracture healing effects. In elderly patients with unstable thoracolumbar fracture who are not allowed to get a surgical modality, teriparatide can be carefully considered a goof option.

Poster

P-28

Circumferential Decompression through Posterior Approach for Upper Thoracic Ossification of Posterior Longitudinal Ligament, a Case Report and Literature Review

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Purpose : To demonstrate the efficacy and safety of decompression by trans-pedicular approach for myelopathy associated with ossification of the longitudinal ligament (OPLL) in the upper thoracic spine.

Materials and methods : A 67-year-old man presented with bowel and bladder dysfunction, trunkal numbness below T3 dermatome, and tingling and numbness in both lower limbs. Pathologic reflexes of lower limbs such as babinski sign and ankle clonus were shown positive response. On computed tomography (CT) and magnetic resonance imaging (MRI), there were cord compression by the OPLL from mid cervical to upper thoracic spine.

Results : C5 and C6 body corpectomy, OPLL removal and structural reconstruction were performed anteriorly in the usual way. 2 weeks after first operation, decompression of the spinal cord in the T1 and T2 spine was performed by posterior approach. Direct access to ventral portion of cord was possible without cord shifting after laminectomy and partial pediculectomy of T2. As looking directly at the lesion on the lateral side of the cord, partial corpectomy and removal of the OPLL were performed. After that, lateral mass screw fixation from C4 to C7 and pedicle screw fixation at T1, T3 and T4 were performed for stabilization of the spine and prevention worsening kyphosis after decompression for thoracic OPLL.

Conclusion : The optimal objective of surgery for OPLL of the thoracic spine is to completely decompress the spinal cord. Although posterior indirect decompression such as laminectomy or laminoplasty has been reported frequently, the advances in surgical techniques at the thoracic spine have allowed the possibility of anterior decompression, that is more effective than posterior decompression.

For anterior decompression via anterior approach for upper thoracic spine, there are ways to cervicothoracic or trans-sternal approach. However, these anterior approaches have a relatively high rate of postoperative complications and require a skilled surgical technique.

Circumferential decompression through posterior approach includes the transpedicular, costotransversectomy, and lateral extracavitary approaches. Only for the removal of OPLL rather than corpectomy, it may not be necessary to perform costotransversectomy and lateral extracavitary approaches at the risk of pleural exposure. We were able to effectively and safely remove the OPLL without shifting cord through the trans-pedicular approach.

Poster

P-29

Primary dural repair in the hemilaminectomy approach for intradural spinal tumors

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Purpose : We describe an effective surgical technique in primary repair of the spinal dura during hemilaminectomy approach for intradural spinal tumors.

Materials and methods : A midline skin incision was made and the paravertebral muscles were detached on the unilateral side. Under microscopic magnification, a unilateral limited laminectomy was performed. The dura was then opened paramedially. After the tumor was removed, the dura was closed with black silk 6-0 suture to obtain a waterproof closure. When the suture repairs were performed, we grasp the needle reversely by using Castroviejo needle holders and the dural suture is performed with a needle holder held in the surgeon's right hand. At this point, the dural edge should be gently elevated with either micro forceps or a sutured string and the needle passes the dura as horizontal and forward direction, which facilitates dural suture in narrowing working space.

Results : When the dural suture repairs were performed after hemilaminectomy approach for intradural spinal tumors, it is somewhat difficult to close the dura matter because the space for the needle working was a little narrow. But we were able to do more easily dural suture by using that method.

Conclusion : After the intradural spinal tumor was removed by using the hemilaminectomy approach, it is helpful to grasp the needle reversely by using Castroviejo needle holders and passes it the dura as forward direction in primary repair of the spinal dura.

Poster

P-30

Brown-Séquard Syndrome caused by Acute Traumatic Cervical Disc Herniation

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Purpose : Brown-Séquard syndrome (BSS) is an incomplete spinal cord injury that was caused by damage to one half of the spinal cord. Most of the BSS is a result of penetrating trauma or tumor, and relatively acute cervical disc herniation is a rare cause of BSS. This case report presents the treatment and progress of BSS caused by herniated cervical disc.

Materials and methods : A 34-year-old man was admitted to the hospital with posterior neck pain and left hemiplegia. Sensory below the C4 dermatome showed lowered proprioception sensation and numbness in the left side, and lowered pain, temperature sensation of the right side. Patient also showed voiding difficulty. Motor grade of Left arm and leg were 0. MRI image showed a huge trans-ligamentous herniated disc, which ruptured from central part to the left side at the level of C3-4. Anterior cervical discectomy and fusion was performed at C3-4 level.

Results : After emergency surgery, patient's motor recovered to grade 2 and voiding function also recovered. MRI show a complete removal of herniated disc. Patient discharged 23 days later after surgery with the motor grade 4+ and ambulation status.

Conclusion : BSS was rarely caused by an acute herniated cervical disc. This case will be helpful to make a rapid diagnosis with a patient who shows characteristic clinical symptom of BSS and radiological finding of herniated cervical disc. Doing quickly accurate diagnosis and immediate decompressive surgery would raise the possibility of good surgical outcome.

Poster

P-31

Long Term Follow-up of Clinical and Radiological Changes after AECD: Case Report

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Purpose : Percutaneous endoscopic cervical discectomy (PECD), using a laser and microforceps for cervical intervertebral disc herniation, has been regarded as an effective treatment modality in selected cases. However, many spine surgeons have worried about the postoperative instability, disc space narrowing and segmental kyphosis of the cervical spine after discectomy without fusion.

Materials and methods : We report two cases who had been conducted PECD at least 19 years ago, and present the course of the patients. These cases had cervical intervertebral disc herniation and they underwent PECD that removed selectively ruptured particle only.

Results : In both cases, the symptom was improved after PECD, and the patients were not admitted to the hospital with any problems until now. In the radiological evaluation, it was confirmed that the area where underwent PECD was not unstable and disc height was not decreased significantly. Furthermore, sagittal alignment and segmental motion of the cervical vertebra were maintained.

Conclusion : Good clinical results have been shown over the long term, as seen in the two cases above. Disc height was not significantly different from before surgery, and it turned out that there is no need to worry about adjacent segmental disease after surgery such as anterior cervical discectomy and fusion (ACDF). Thus, PECD can be considered as a good alternative treatment option that compared to standard ACDF in well-selected cervical intervertebral disc herniation patients.

Poster

P-32

Usage of Paravertebral Foramen screws (PVFS); only a salvage technique for Cervical Pedicle screws (CPS)?

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Purpose : CPS are a very effective fixation technique for reconstruction of cervical deformity or trauma, but it is technically demanding due to anatomical environment. Because lateral mass screw (LMS) have different entry points from that of CPS, in case of failing insertion of the CPS, it is difficult to connect between CPS and LMS. Moreover, if there is wide medial decompression in the lateral mass, it is almost impossible to insert LMS. PVFS were an adequate technique for salvage fixation of CPS. The entry point of PVFS gives enough room for posterior decompression and facilitates to connect to CPS. However, there can be more useful aspects of PVFS. In this study, authors evaluated the usage of PVFS for alternative fixation with CPS (not only for salvage screwing) and the stability of PVFS.

Materials and methods : Between April 2012 and April 2018, 120 cervical CPS (108) and PVFS (12) were inserted in 27 patients (CPS only; 21 and CPS+PVFS; 6) under lateral fluoroscopic guidance by a single surgeon. Salvage fixation after failure of CPS was excluded and PVFS were only used middle level between CPS. The misplacements of CPS were evaluated by Postoperative CT images. The failure of instruments and instability of fused segments were evaluated by lateral plain X-ray images. All operation were performed under intraoperative EP monitoring. The mean follow up period was 19 months.

Results : The total misplacement of CPS was 17 (15.7%; medial 5, lateral 6, superior 1, inferior 5), but there was no neurologic complication although there were 2 complete involvement of the vertebral foramen. Medial involvements of CPS did not compress spinal cord and there was no radiating pain due to breach of superior or inferior wall of the pedicle. 6 patients (CPS+PVFS) had 18 level fixation (36 screws) and showed 11.1% misplacements (CPS; 16.7%). There was no hardware failure or instability of fused level during observation period.

Conclusion : The error rate of CPS insertion was constant, but the alternative PVFS can decrease the opportunities of errors comparing to pure CPS. PVFS did not show instability when it mixed with CPS. The technique of PVFS assisting CPS seems to be a safer technique comparing to pure CPS fixation and can secure the advantage of CPS fixation.