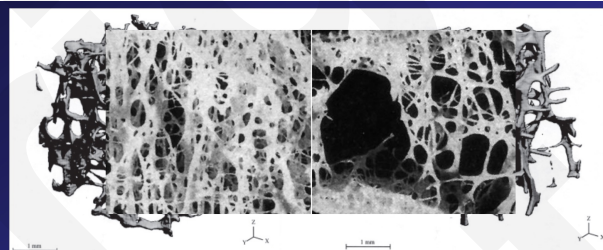


Osteoporotic Fractures With Neurology: Management Options Anterior Or Posterior?



The Consensus Conferences in Copenhagen 1990, Hong Kong 1993, and Amsterdam 1996, defined osteoporosis: "Osteoporosis is a systemic skeletal disease characterized by low bone mass and microarchitectural deterioration of bone tissue with a consequent increase in bone fragility and susceptibility to fracture. The magnitude of peak bone mass and the rate of duration of bone loss determine the likelihood of developing osteoporosis."

- Bone mass (how much is still left)
- Loss of bone mass (how much is lost)
- Microstructural changes (how is the bone structured)



- Normal: T-score + or -1 SD
- Osteopenia: T-score -1 to -2.5 SD
- Osteoporosis: T-score -2.5 or less



Synopsis of secondary osteoporosis

Inflammatory disease	Rheumatoid arthritis Inflammatory bowel disease Cystic fibrosis	Miscellaneous	Pregnancy/lactation Ankylosing spondylitis Hypercalciuric nephrolithiasis
Bone marrow disorders	Multiple myeloma Mastocytosis Leukemia	Drugs	Alcohol Caffeine Anticonvulsants Methotrexate Heparin Cyclosporin
Disorders associated with immobilization	Parkinson disease Poliomyelitis Cerebral palsy Paraplegia		
Defective synthesis of connective tissue	Osteogenesis imperfecta Marfan syndrome Homocystinuria		
Disorders associated with hypogonadism	Athletic amenorrhea (marathon runner osteoporosis) Hemochromatosis Turner syndrome Klinefelter syndrome Postchemotherapy Hypopituitarism		
Disorders associated with low body weight	Anorexia nervosa Diabetes mellitus type 1		
Disorders associated with malabsorption	Celiac disease Postgastrectomy Liver disease Total parenteral nutrition		
Endocrinological disorders	Thyroidotoxicosis Hyperparathyroidism		

- **Primary:**
 - Post menopausal – 90%
 - Senile

Make sure there is no underlying cause for the #

Table 5.3-1
Secondary osteoporosis as a consequence of a preexisting disease.

Incidence of vertebral fracture in Europe: Results from the European prospective osteoporosis study (EPOS)

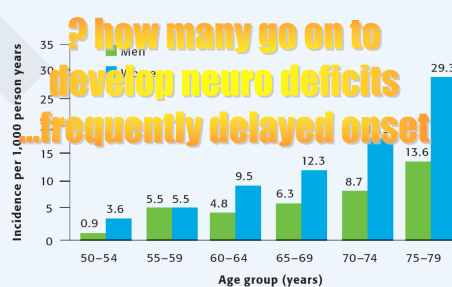
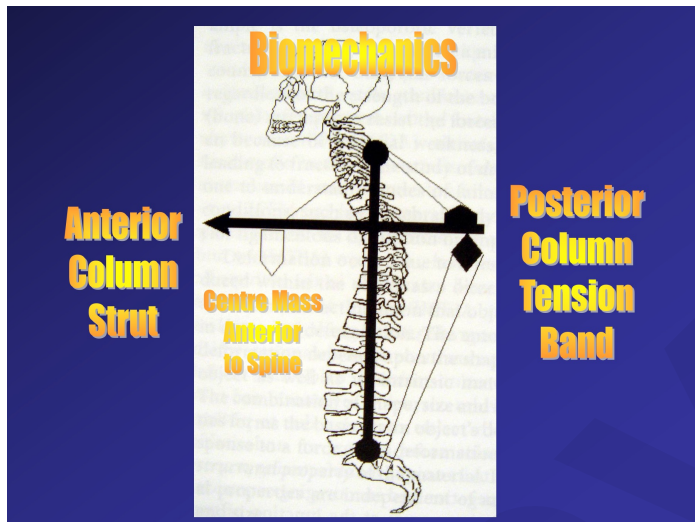


Fig 8-1

There is an exponential increase of fracture incidence with increasing age. Close to 3% of women in the age group of 75-80 will sustain a vertebral body compression fracture within one year [4].



Clinical Instability

The loss of the ability of the spine under physiological loads to maintain its pattern of displacement so that there is no initial or additional neurological deficit, no major deformity and no incapacitating pain




Osteoporosis

canal compromise

improvement in neurological deficit

Maintain Function

Realign
Stabilize
Decompress
Prevent Late Pain / Deformity

Biomechanics



The Personalities

Anterior or posterior surgery

- Personality of the patient
 - Age – old!
 - Comorbidities
 - RS / CVS / CNS / Peripheral / GI / Nutrition etc etc
 - Bone stock - poor
 - Energy of injury / other injuries
 - Time since injury
 - Thin dura and Fracture adherent to dura
- Personality of the fracture
 - Canal compromise
 - Neurologic compromise
 - Kyphosis
 - Anterior collapse / comminution
 - Progression
- Personality of the surgeon



Anterior or posterior surgery

Posterior surgery is mainstay

NOT THE SAME IN OSTEOPOROSIS

posterior approach technically easy low morbidity

short segment fixation

reduction of deformity & canal compromise

posterior approach Important for dislocation / realign



Anterior or posterior surgery

Anterior surgery for significant anterior comminution

Corpectomy direct cord decompression vs. posterior indirect

stabilization of instability

posterior fixation cannot provide anterior column support

NOT THE SAME IN OSTEOPOROSIS

frequent Specialist Training



Load-sharing classification ©Cormack, Gaines et al spine 1994 **28 pts**

COMMINUTION	APPOSITION	KYPHOSIS
 1. Little < 30% comminution	 1. Minimal minimal apposition	 1. Little < 4° correction
 2. More 30-60% comminution	 2. Moderate moderate apposition	 2. More 4-9° correction
 3. Gross > 60% comminution	 3. Wide > 2mm of > 50%	 3. Most > 9° correction

score from 3 to 9

≤ 6 = posterior surgery

> 6 = anterior surgery

NOT THE SAME IN OSTEOPOROSIS

on sagittal CT on axial CT on lateral x-ray - **POST OP**

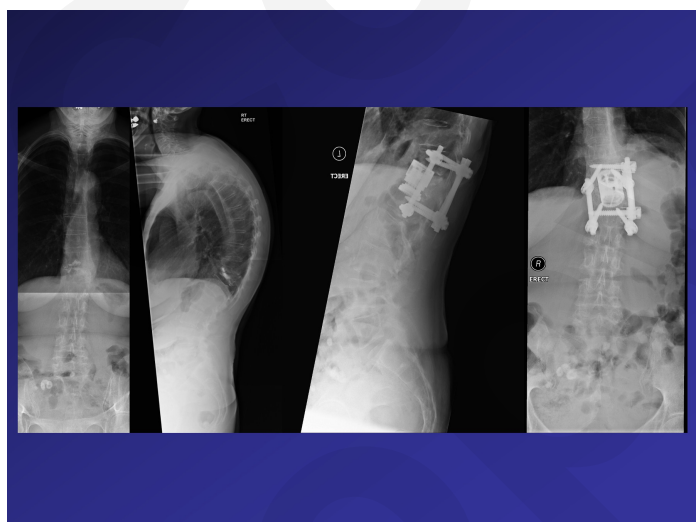
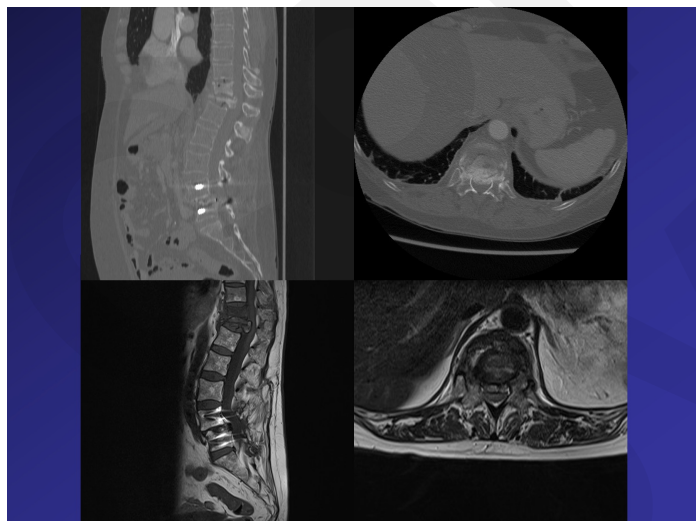
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• The bone is sh...

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WILBUR

YOU CAN'T POLISH A TURD... BUT YOU CAN GIVE IT A LITTLE TOUCH OF GOLD SPRAY PAINT





Posterior Spinal Instrumentation in Osteoporosis

- **Hardware pullout**
 - Pain / Prominence
 - Loss of deformity correction
- **Junctional Kyphosis**
- **Loosening**
- **Pseudarthrosis**
- Anterior – higher complications...?

Hu Spine 1997 Suppl 24

Posterior Spinal Instrumentation in Osteoporosis

- **Multiple fixation points**
 - Long fixation? – How long?
- **Sublaminar wires best**
 - But risk neurological injury
 - Not an option if decompressing
- **Hook / Claw construct proximally**
- **Screw hole preparation**
- **Big screws**
- **Augmentation**
- **Anterior Column Insufficiency – need support**

Hu Spine 1997 Suppl 24

SPINE Volume 31, Number 19 Suppl, pp S144-S151
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Instrumentation-Related Complications of Multilevel Fusions for Adult Spinal Deformity Patients Over Age 65

Surgical Considerations and Treatment Options in Patients With Poor Bone Quality

Christopher J. DeWald, MD, and Thomas Stanley, MD

Table 1. Early and Late Instrumentation Complications

Mechanism of Failure	No.	Levels Instrumented
Early complications		
Compression fracture: LIV	3	T11-sacrum, T12-sacrum, T5-sacrum
Compression fracture: Adj	2	L1-S1, T11-pelvis
Pedicle fracture	1	T11-pelvis
Late complications		
Pseudarthrosis	4	T8-pelvis, T11-sacrum, T2-T12, T12-L5
Screw lucency: cephalad	1	T10-L5
Screw lucency: caudad	1	L1-sacrum
Compression fracture: LIV	2	Pseudarthrosis
Compression fracture: Adj	1	Lucencies around cephalad screws
Painful iliac screws	1	T10-T11 disc herniation
Painful instrumentation	1	Painful iliac screws
Herniated disc: cephalad	1	T10-sacrum
Progressive thoracic kyphosis	6	T9-L4, T10-L5, T11-pelvis, T12-pelvis, T12-sacrum, T12-sacrum, L1-L5

LIV = last instrumented vertebrae; Adj = adjacent vertebrae.

- **38 pts over 5 yrs**
- **Early #s 13%**
- **Late Junt Kyphosis 26%**
- **Recommend:**
 - multiple fixation points
 - cement augmentation (esp cephalad)
 - iliac screws
- **Ultimate T score for an op unknown...**

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Clinical Article

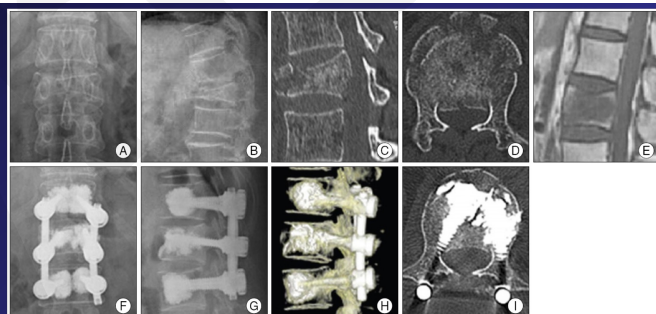
Bone Cement Augmentation of Short Segment Fixation for Unstable Burst Fracture in Severe Osteoporosis

Hyeun Sung Kim, M.D.,¹ Sung Keun Park, M.D.,¹ Hoon Joy, M.D.,¹ Jae Kwang Ryu, M.D.,¹ Seok Won Kim, M.D.,² Chang Il Ju, M.D.²

Department of Neurosurgery,¹ Mok-Po Han Kook Hospital, Mokpo, Korea

Department of Neurosurgery,² School of Medicine, Chosun University, Gwangju, Korea

- **Retrospective 20 pts, 61yrs, T score < -3**
- **neuro intact, >50% collapse, >20° kyphosis**
- **T11 (3), T12 (6), L1 (8), L2 (3) #s**
- **Supine hyperextension soft roll for 2/7**
- **Augmented screws (solid) over 3 levels incl #**

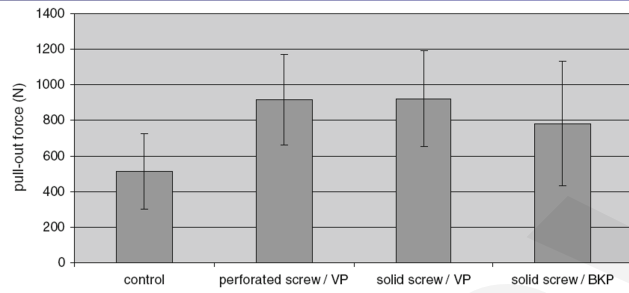


- **FU 15/12**
- **No major complications**
- **McNab outcomes – 19/20 excellent / good**
- **Kyphosis correction maintained**

ORIGINAL ARTICLE

Assessment of different screw augmentation techniques and screw designs in osteoporotic spines

S. Becker · A. Chavanne · R. Spitaler · K. Kropik · N. Aigner · M. Ogon · H. Redl



ORIGINAL ARTICLE

Severe thoracolumbar osteoporotic burst fractures: Treatment combining open kyphoplasty and short-segment fixation

B. Blondel*, S. Fuentes*, P. Metellus, T. Adetchessi, G. Pech-Gourg, H. Dufour

Orthopaedics & Traumatology: Surgery & Research (2009) 95, 359–364



- 11/12 pts lami, kypho and fix
- 72 yrs
- Mean FU 14/12
- Neuro development from # over 18/7

Table 1 Clinical summary.

No.	Age	Sex	Level	Type of fracture	Osteosynthesis	Preoperative Frankel score	Postoperative Frankel score	Preoperative kyphosis	Postoperative kyphosis
1	65	M	L1	Flat	Yes	D	E	18	6
2	80	F	T12	Wedge	Yes	D	E	10	4
3	71	M	T11	Flat	Yes	D	E	20	8
4	78	F	L1	Wedge	Yes	D	E	18	6
5	65	F	T11	Wedge	Yes	D	E	18	8
6	86	F	T12	Wedge	Yes	D	E	8	0
7	78	F	L1	Flat	Yes	D	E	12	2
8	63	F	L1	Wedge	No	C	D	14	6
9	73	F	T12	Flat	Yes	C	D	16	4
10	83	F	T12	Flat	Yes	D	E	20	6
11	44	M	L2	Flat	Yes	D	E	16	2
12	82	F	T11	Wedge	Yes	C	E	18	6

- Laminectomy, instrumentation and fracture reduction then kyphoplasty
- All had improvement in neurology
- 2 cement leaks – not clinically significant
- 2 wound infections
- 2 UTIs

ORIGINAL ARTICLE

Posterior instrumented fusion without neural decompression for incomplete neurological deficits following vertebral collapse in the osteoporotic thoracolumbar spine

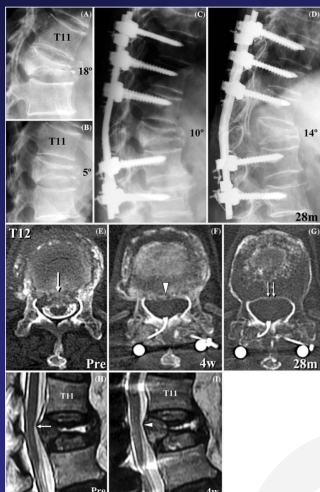
Hiromi Ataka · Takaaki Tanno · Masashi Yamazaki

Table 1 Data of surgeries for 14 patients

Case no.	Age (years)	Sex	Case of osteoporosis	Affected level	Levels of old VB fx	Fusion levels	Anchor of posterior instrumented fusion	Sublaminar wiring	Hook
1	80F	Scallop	T12	T11, L2	T7–L3	L3	T8, T9, T10, T11, T12, L1, L2, L3	–	T7, T9, L1, L3
2	67F	Scallop	T10	L1, L3, L4	T7–L3	T11, L2, L3	–	–	T7, T8, T9
3	74F	Scallop	T11	–	T7–L3	T10, L2, L3	–	–	T7, T8, L3
4	46F	RA	T8	T6, T7	T4–T11	T4, T5, T6, T9, T10, T11	–	T4, T5, T6, T9, T10, T11	–
5	79F	Scallop	T11	L4	T9–L1	T9, T10, T12, L1	–	–	L1
6	83F	Scallop	T12	–	T9–L2	T9, T10, T11, T12, L1, L2	–	T9, T10, T11, T12, L1, L2	–
7	66F	RA	L1	T12, L3	T10–L4	T10, T11, T12, L2, L3, L4	–	T10, T11, T12, L2, L3, L4	–
8	71M	Scallop	L1	–	T10–L2	T10, T11, T12, L2	–	T10, T11	L2
9	72M	Alcoholism	T11	T7, T9, L1	T7–L2	T7, T8, T9, T10, T12, L1, L2	–	T7, T12, L1	–
10	72F	RA	T12	–	T9–L3	T9, T10, T11, L1, L2, L3	–	T9, T10, L1, L2, L3	–
11	74F	RA	T8	T7, T11	T4–T12	T4, T5, T6, T7, T9, T10, T11, T12	–	T4, T5, T6, T10, T11, T12	–
12	72M	Scallop	T12	–	T9–L2	T9, T10, T11, L2, L3	–	T9, T10, L2, L3	–
13	81F	Scallop	T12	T10	T9–L2	T9, T10, T11, L2, L3	–	T9, T10, L2, L3	–
14	86M	Scallop	L1	–	T10–L3	T10, T11, T12, L2, L3	–	T10, T11, L2, L3	–

VB fx: vertebral fracture; RA: rheumatoid arthritis

- 14 pts
- OP#s with delayed neuro deficits
- 73 yrs
- FU 25/12



	Postoperative Neurological Status						
	A	B	C	D1	D2	D3	E
A							
B							
C					2		3
D1							6
D2						1	1
D3							1
E							

- All improved neurology

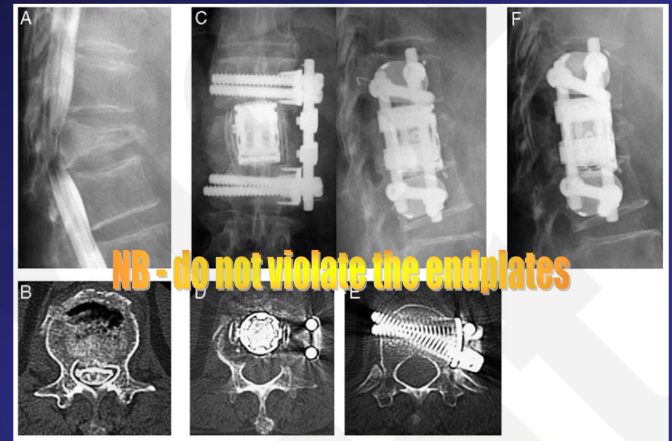
Case no.	Fusion levels	Levels of subsequent fx	Surgery to subsequent fx (mo)	Local kyphosis angle at subsequent fx (°)	Final follow-up
1	T7–L3	T8	1	1	5
		T10	6	3	3
2	T7–L3	L1	12	16	20
		T7	4	6	11
3	T7–L3	T5	36	2	7
		T6	3	7	9
8	T10–L2	L4	36	–15	–12
		L2	6	–3	1
10	T9–L3	T9	1	4	7
		L5	12	–34	–31
11	T4–T12	T4	1.5	14	15
12	T9–L2	T8	17	2	7

50% subsequent #s

Role of Major Spine Surgery Using Kaneda Anterior Instrumentation for Osteoporotic Vertebral Collapse

Masahiro Kanayama, MD, Takashi Ishida, MD, Tomoyuki Hashimoto, MD, Keiichi Shigenobu, MD, Daisuke Togawa, MD, Fumihiko Oha, MD, and Kiyoshi Kaneda, MD

- 31 pts mean 71 yrs FU 57/12
- 26 single #s, 5 multilevel
- 1 Crest, 12 Ti cages, 18 Ceramic spacers
- 6 (19%) required posterior reinforcement
 - Early kyphosis / screw migration
 - All multilevel / "severe OP" (also had resp compls)
- 90% < 4hrs, 80% < 600ml blood loss, all fused
- Deemed 80% successful technique

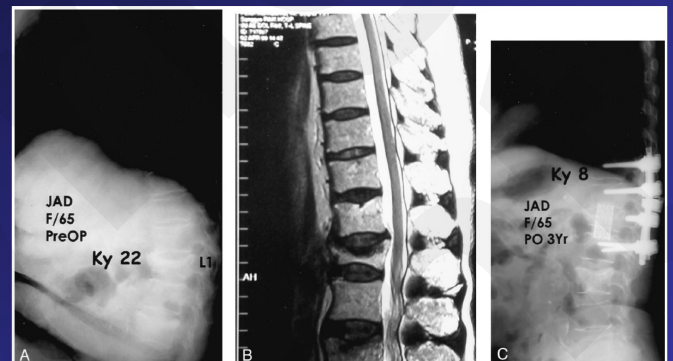


1-level correctomy and 2-level fusion (1 at T7-9; 1 at T9-11; 1 at T10-12; 6 at T11-L1; 14 at T12-L2; and 3 at L1-3), and 5 had 2-level correctomy and 3-level fusion (1 at T12-L3; 1 at T10-L1; and 3 at T11-L2).

Anterior-Posterior Surgery Versus Posterior Closing Wedge Osteotomy in Posttraumatic Kyphosis With Neurologic Compromised Osteoporotic Fracture

Se-Il Suk, MD, PhD, Jin-Hyok Kim, MD, PhD, Sang-Min Lee, MD, PhD, Ewy-Ryong Chung, MD, PhD, and Jung-Hee Lee, MD

- Retrospective
- OP# with PTKD and neuro deficit
- 15-16/12 post injury
- 63 yrs FU 3.5yrs
- 20TL, 6L #s
- 11 AP 15 Post approaches



	Anterior-Posterior (n = 11)		Closing Wedge Osteotomy (n = 15)	
	Preoperative	Postoperative	Preoperative	Postoperative
A	1	1	2	2
B	1	1	5	8
C	1	6	8	5
D	8	4	8	5
E				
Improvement	7/11		11/15	

* No statistical difference in preoperative and postoperative Frankel grade between two groups.

	Anterior-Posterior (n = 11)	Closing Wedge Osteotomy (n = 15)
Pneumonia	2	
Superficial infection	1	
Screw loosening	2	2
Fracture out of fusion	1	1

	Anterior-Posterior (n = 11)	Closing Wedge Osteotomy (n = 15)
Preoperative vertebral body collapse	58.5 ± 13.6%	62.4 ± 22.3%
Kyphosis		
Preoperative*	22.2 ± 8.4°	34.1 ± 12.0°
Immediate postoperative	6.8 ± 8.3°	5.3 ± 8.5°
Final follow-up	11.0 ± 9.6°	8.4 ± 10.7°
Correction*	11.2 ± 12.4°	25.7 ± 12.2°
Loss of correction	4.2 ± 4.6° (27.3 ± 34.1%)	3.1 ± 5.6° (10.8 ± 27.1%)
Non-union	0	0
Operation time (min)*	350.6 ± 110.5	214.7 ± 50.3
Estimated blood loss (mL)*	289.3 ± 180.2	193.0 ± 81.0
Fusion level*	3.2 ± 0.8	4.3 ± 1.1
Ambulation (days)	6.2	5.8

* p < 0.05, Mann-Whitney U test

Recommend Post Only Appr

Anterior versus posterior surgery for osteoporotic vertebral collapse with neurological deficit in the thoracolumbar spine

Kenzo Uchida · Shigeru Kobayashi · Masahiko Matsuzaki ·
Hideaki Nakajima · Seiichiro Shimada ·
Takafumi Yayama · Ryuichiro Sato ·
Hisatoshi Baba

- Retrospective, 52 pts, 70 yrs, 5 yr FU
- Mean time from # 5/12 – all initial conserv Mx
- Single level # with neuro deficit (grad onset)
- 1991 – 1996 24 Post, 1996 – 2003 28 Ant
- Senior author did all ops

- Anterior vs Posterior:
 - Kyphosis correction NS
 - Overall neurological outcome NS
- Neurological outcome was better in wedge type #s compared to flat - irrespective of surgical approach ($p < 0.01$)
- 6 in each group metal probs
- 2 in each group pseud
- Ant – 4 chest problems, 2 superficial infection
- Post – 1 superficial infection
- Op time equal
- Blood loss > in post surgery group

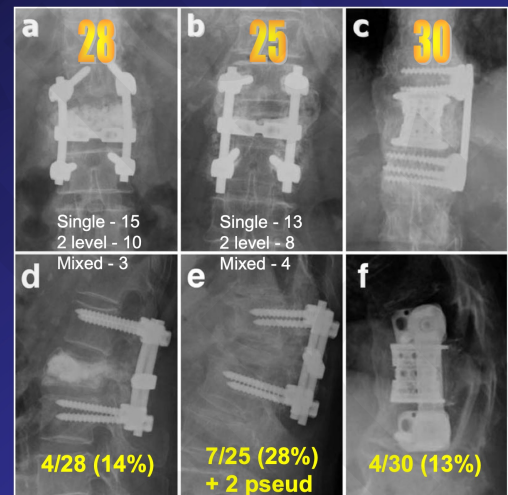
Vertebroplasty-augmented short-segment posterior fixation of osteoporotic vertebral collapse with neurological deficit in the thoracolumbar spine: comparisons with posterior surgery without vertebroplasty and anterior surgery

Clinical article

KENZO UCHIDA, M.D., Ph.D., HIDEAKI NAKAJIMA, M.D., Ph.D.,
TAKAFUMI YAYAMA, M.D., Ph.D., TSUYOSHI MIYAZAKI, M.D., Ph.D., TAKAYUKI HIRAI, M.D.,
SHIGERU KOBAYASHI, M.D., Ph.D., KEIJIRO CHINO, M.D., Ph.D.,
ALEXANDER RODRIGUEZ GUERRERO, M.D., A. HISATOSHI BABA, M.D., Ph.D.

Department of Orthopaedics and Rehabilitation Medicine, Fukuoka University of Medical Sciences,
Fukuoka, Japan

- Retrospective 83 pts, 71 yrs
- FU 4.4 yrs (all >3yrs)
- Mean time from # 5/12 – all initial conserv Mx
- Single level # with neuro deficit (grad onset)
- 3 Groups - Senior author did all ops
- All decompressed



Clinical Parameter	Group A	Group B	Group C	p Value†
no. of cases	28	25	30	
sex (M/F)	5/23	4/21	5/25	
age (yrs)	72.2 ± 9.0	69.3 ± 7.5	71.4 ± 5.3	NS
lumbar spine BMD, in g/cm ²	0.68 ± 0.15 (21 patients)	0.64 ± 0.13 (14 patients)	0.67 ± 0.14 (23 patients)	NS
type of traumatic event				
fall	16	13	15	
lifting objects	4	2	4	
standing up motion	2	2	2	
bending motion	1	3	1	
undetermined cause	5	5	8	
affected vertebra				
T-11	5	6	3	
T-12	10	10	11	
L-1	9	7	12	
L-2	4	2	4	
disease duration (mos)	5.2 ± 2.2	5.3 ± 2.0	5.0 ± 1.7	NS
preop neurological score	7.6 ± 1.6	7.8 ± 1.5	7.3 ± 2.2	NS
preop VAS score	7.7 ± 0.9	7.8 ± 0.9	7.8 ± 1.0	NS
FU period (yrs)	3.9 ± 2.0	4.7 ± 2.1	4.5 ± 1.9	NS

Parameter	Group A	Group B	Group C	p Value*
preop neurological score	7.6 ± 1.6	7.8 ± 1.5	7.3 ± 2.2	NS
postop (4–6 wks) neurological score	12.0 ± 1.5	11.8 ± 1.2	12.1 ± 1.8	NS
FU neurological score	11.6 ± 1.5	11.5 ± 1.4	11.8 ± 2.1	NS
neurological improvement rate (%) at FU	63.5 ± 20.2	59.6 ± 18.9	67.7 ± 28.1	NS
preop VAS score	7.7 ± 0.9	7.8 ± 0.9	7.8 ± 1.0	NS
postop (4–6 wks) VAS score	2.4 ± 1.4	2.7 ± 1.2	2.9 ± 1.3	NS
FU VAS score	2.1 ± 1.0	2.4 ± 1.0	2.7 ± 1.1	NS

Kyphotic Angle	Group A	Group B	Group C	p Value*
preop (°)	22.4 ± 6.6	24.7 ± 11.7	25.5 ± 10.5	NS
postop (°)	10.5 ± 7.7	8.9 ± 6.0	13.9 ± 6.8	NS† NS, ‡ 0.007§
FU (°)	15.1 ± 5.6	17.7 ± 7.3	18.5 ± 9.9	NS
kyphotic loss at FU (°)	4.6 ± 4.5	8.6 ± 6.2	4.5 ± 5.9	0.0171, † NS, ‡ 0.0180§

* Calculated using the Kruskal-Wallis test and the Bonferroni-Dunn post hoc test.

† Comparison between Groups A and B.

‡ Comparison between Groups A and C.

§ Comparison between Groups B and C.

- Conclusion:
 - Short posterior + VP as good as anterior surgery

Apical Lordosating Osteotomy and Minimal Segment Fixation for the Treatment of Thoracic or Thoracolumbar Osteoporotic Kyphosis



Fig-1A

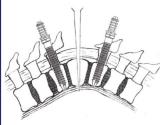


Fig-1B



Fig-1 C



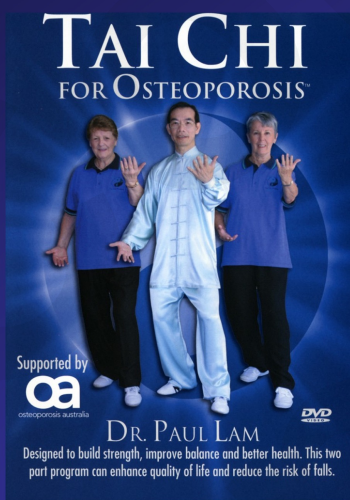
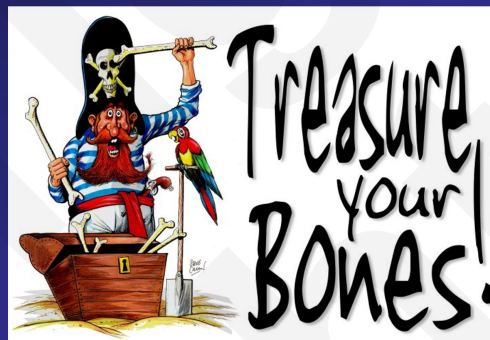
Fig-1 D

- 26 pts, 72 yrs
- Posterior only deformity correction over short segment
- Satis results

Kao-Wen Chang, MD, Ying-Yu Chen, MD, Chien-Chung Lin, MD,
Hsiang-Lan Hsu, BA, and Ke-Chun Pai, BA
Taiwan Spine Center and Department of Orthopaedic Surgery
Armed Forces Taichung General Hospital, Taiwan, Republic of China

Conclusion

- Consider the pathology and personalities and...



- Posterior
 - Realign
 - Restore Tension Band
 - Ligamentotaxis
 - Indirect Canal Decompression
- Anterior
 - Column support
 - Decompression
- A and P
- Posterior Qs
 - Short or long
 - +/- Fracture screws
 - +/- Cross Links
 - Decompression
 - Fuse
 - Augment
 - Bone
 - Screws
 - Claws / Sublaminar Wires
- Anterior Qs
 - Structural Allograft
 - Cage and Autograft
 - Expandable Cage
 - Metal or PEEK
 - Rods or Plate