

Balloon kyphoplasty for treatment of osteoporotic vertebral compression fracture

Essay

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Abstract

Osteoporosis is the epidemic of this century in the western and Asian countries. Vertebral compression fractures are a common and often debilitating expression of this disease. Progressive loss of posture as a result of these fractures is one of the major problems related with an enormous impact on the quality of life (**Kado et al., 1999**).

Deformities are the most frequent cause of osteoporotic vertebral compression fracture (OVCF) pain .The degree of kyphosis caused by the OVCF correlates well with the patient's physical function (independent of pain), mental well-being, pulmonary function, increased mortality and the risk of further fractures (**Pluijm et al., 2000**).

Key Words :

Vertebral body – Computed tomography – Standard deviation .

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Contents

• List of tables.....	I
• List of figures.....	II-V
• List of abbreviations.....	VI
• Chapter (1) Osteoporotic vertebral compression fracture.....	1- 21
• Chapter (2) Kyphoplasty Techniques & materials.....	22- 59
• Chapter (3) Kyphoplasty Results.....	60-81
• Chapter (4) Balloon Kyphoplasty versus Vertebroplasty for vertebral compression fractures.....	82-96
• Chapter (5) References.....	97-108
• Chapter (6) Summary.....	109-110
• Chapter (7) Arabic summary.	

List of tables

Table No.	Table content	Page
1-1	World Health Organization Criteria for Osteoporosis	1
1-2	Risk Factors	3
1-3	Complications Associated with Osteoporotic VCFs and immobility	8
3-1	increases in vertebral height after kyphoplasty	64
3-2	Height restoration at vertebral compression fractures	76
3-3	Angular restoration at VCF and Spanning Spinal Segments	76
3-4	Multilevel Kyphoplasty and Drop-Off of Angular Correction	77
3-5	Angular and Height Correction at vertebral compression fracture in Thoracic Versus Lumbar Spine	78
3-6	SF-36 Sub-Domain Raw Scores	79
4-1	Summary of characteristics and quality of nonrandomized comparative studies	94
4-2	Efficacy outcomes across comparative studies	95
4-3	Efficacy outcomes across case series studies	96
4-4	Summary of safety outcomes	96

List of figures

Fig. No.	Description	Page
1-1	density of bone (A) normal bone, (B) osteoporotic bones	5
1-2	Biomechanical explanation of subsequent fractures after a VCF	6
1-3	Wedging of VB	7
1-4	X-RAY showing VCFs	14
1-5	(A,b,c)Classification of vertebral fractures by type and grade.	15
1-6	Local Kyphosis angle.	16
1-7	Measurement of Cobb angle.	17
1-8	MRI T2 showing acute VCFs in T10	18
1-9	C.T scan showing vertebral burst fracture with canal compromise	19
2-1	Restoration of vertebral body height	22
2-2	Inflatable bone tamp	23
2-3	A. CT showing burst fracture with posterior wall destruction, B. CT after vertebroplasty showing posterior cement leakage, C. lateral plain X-ray showing the extension of the leakage	25
2-4	The pedicles serving as landmark & a K-wire is inserted under fluoroscopic biplanar control, Ideally, the final position of the balloons should be centered between the end plates within the anterior two-thirds of the vertebral body	26
2-5	Balloon Inflation Geometry Comparison Chart	27

2-6	Kyphoplasty procedure	28
2-7	Five steps of Kyphoplasty.	29
2-8 (a-c)	Drawing of the transcostovertebral placement of the bone biopsy needle with the tip just penetrating the lateral pedicle at its base.	31
2-9	Axial drawing of a single kyphoplasty balloon placed convergently through the transcostovertebral approach	32
2-10	kyphoplasty to restore height & sagittal alignment	33
2-11	Sagittal tomography (A) and lateral radiograph (B) demonstrating extravertebral leakage of PMMA anteriorly and laterally	48
2-12	Loss of reduction after balloon deflation and cementing indicates an inherent problem related to the technique of kyphoplasty.	50
2-13(a,b)	Potential problems related to cement reinforcement.	51
2-14(a-c)	Natural history of osteoporotic fractures in a 73year-old woman. a) Both fractures	52
2-15 (a,b)	a). Lateral wall burst fracture from the expanding balloon. b).egg shell cementoplasty. A shell of cement can be seen around the expanding balloon	54
2-16	schematic representation of the BAER (balloon assisted endplate reduction) and vertebroplasty	56
2-17	The modified Magerl (AO/ASIF) classification of thoracolumbar injuries	57
2-18 (a-c)	A woman 68 years old. a biconcavity fracture(Pincer type) of L2 after minor trauma. In order to restore the endplate impression.	58
2-19(a-c)	30-year-old female with A3 type L 1 fracture: (a) Trauma lateral x-ray and midsagittal T2 weighted MR images. (b) Postoperative standing lateral x-ray and MRI. (c) Standing AP /lateral x-ray and MRI two years after trauma and six months after hardware removal	59

3-1	Loss of reduction after balloon deflation and cementing indicates an inherent problem related to the technique of kyphoplasty.	62
3-2	Histogram of vertebral levels treated by kyphoplasty.	63
3-3 (a-d)	Superior wedge OVCF with a kyphotic deformity of 24.2°. a) Expanding bone tamp. b-d) Restoration of vertebral height and significant correction of kyphosis (9.9°) by balloon expansion	66
3-4	Mean restoration of vertebral body height after balloon kyphoplasty.	66
3-5	Kyphosis correction after balloon kyphoplasty by a mean of 7.9°	67
3-6	Mean improvement of back pain as rated on VAS before balloon kyphoplasty (8.5 cm), and one week (2.5 cm) and one month (1.5 cm) after balloon kyphoplasty	68
3-7	VCF disability showed marked improvement of functions after balloon kyphoplasty as rated on the Oswestry disability questionnaire at one month after surgery	68
3-8	Etiology of the vertebral compression fractures (osteoporotic, traumatic, osteolytic metastasis, hemangiomas)	72
3-9	A: Percentage of vertebral compression improved from 26.6% to 15.0% after the procedure. B: Improvement in the kyphotic angle of the vertebral bodies after the procedure	73
3-10	Mean VAS (Visual Analogue Scale) scores.	74
3-11	Percentage of the height available for restoration of the anterior, medial, and posterior vertebral body height	75
4-1	vertebroplasty & kyphoplasty	83

4-2	reduction in kyphotic angle	86
4-3	Schematic of testing apparatus	91
4-4	Characteristic lateral x-rays of specimen through testing sequence	93

List of abbreviations

1. NOF (National Osteoporosis Foundation).
2. VB (vertebral body).
3. VCFs (vertebral compression fractures).
4. OVCFs (osteoporotic vertebral compression fractures).
5. C.T (Computed tomography).
6. Ha (anterior vertebral height).
7. Han (normal anterior vertebral height).
8. Haf (fractured anterior vertebral height).
9. Hp, Hp' (posterior vertebral height).
10. Hpn (normal posterior vertebral height).
11. Hpf (fractured posterior vertebral height).
12. Hm (middle vertebral height).
13. SD (standard deviation).
14. MRI (Magnetic Resonance Imaging).
15. BMD (Bone Mineral Densitometry).
16. Q.C.T (dual-energy quantitative computed tomography).
17. DEXA (dual-energy X-ray absorptiometry).
18. PMMA (polymethylmethacrylate).
19. IBT (inflatable bone tamp).
20. psi (pound per square inch).
21. ap (anteroposterior).
22. lat (lateral).
23. FDA (Food & Drug Association in USA).
24. Ha/TCP (hydroxyapatite/tricalcium phosphate).
25. BAER (Balloon assisted endplate reduction).
26. SF36 (short form 36).
27. VAS (visual analogue scale).
28. ANOVA (Analysis of variance).
29. C.V (coefficient of variation).
30. Ka (kyphotic angle).
31. SI (sagittal Index).
32. BKP (balloon kyphoplasty).

Chapter (1)

*Osteoporotic vertebral
compression fracture*

The Consensus Development Conference (1991) defined osteoporosis as a disease that is characterized by low bone mass and micro architectural deterioration of bone tissue, leading to enhanced bone fragility and a consequent increase in fracture risk. The National Osteoporosis Foundation (NOF) in the United States added to the definition in (2000) by incorporating the bone mineral density T-scores according to the WHO criteria for Osteoporosis to provide diagnostic criteria to classify the extent of the process (table 1-1) (**Denise et al., 2005**).

Table 1 -1 **World Health Organization Criteria for Osteoporosis (Denise et al., 2005).**

<i>Normal:</i>	T-score within 1 SD of young adult reference.
<i>Osteopenia:</i>	T-score 1 to <2.5 SD below the young adult reference.
<i>Osteoporosis:</i>	T-score ≥ 2.5 SD below the young adult reference.
<i>Severe osteoporosis:</i>	T-score ≥ 2.5 SD below the young adult reference with ≥ 1 fracture.

(SD i.e.; standard deviation)

The National Osteoporosis Foundation (NOF) estimates that 44 million (55%) Americans aged over 50 years have osteopenia / osteoporosis. Women account for most of the affected individuals; with 50% of women aged 80 having osteoporosis. Osteoporosis is considered a major public health concern, with an estimated 1.5 million osteoporotic

vertebral compression fractures in the United States with direct and indirect cost for the year 2002 was \$17billion, with the projected cost for the year 2030 at greater than \$60 billion (**NOF Prevalence Report, 2002**).

Increased morbidity and mortality in this population affected with vertebral compression fractures is related to progressive spinal deformity, compromised pulmonary function, pain and complications associated with immobility (deep vein thrombosis, infection, muscle atrophy, pressure sores) (**Kahn et al., 2004**).

Primary osteoporosis is age-related bone loss (type II) and is generally seen in post-menopausal (type I) women, whereas secondary osteoporosis develops with long-term glucocorticoid use, long term thyroid replacement therapy, diseases (hyperthyroidism, hyperparathyroidism), post bilateral oophorectomy (**Old et al., 2004**).

Additional variables that adversely influence osteoporosis include dietary factors (high protein, low calcium, high caffeine), sedentary lifestyle, malabsorption states, low body weight, moderate to heavy alcohol intake and cigarette smoking (Table 1-2) (**Kahn et al., 2004**).

Table 1-2 **Risk Factors (Denise et al., 2005).***Non modifiable risk factors:*

Sex: female > male

Age: males, >70 years; females, 45–50 years (post menopause)

Modifiable risk factors:

Moderate to heavy alcohol intake

Dietary (high protein, low calcium, high caffeine intake)

Sedentary lifestyle

Low body weight

Disease-related risk factors:

Long-term steroid use

Long-term thyroid replacement therapy

Hyperthyroidism

Hyperparathyroidism

Malabsorptive states

Amenorrhea

Bilateral oophrectomy

Primary osteoporosis is subdivided into type I (postmenopausal) and type II (age related). Type I indicate women who demonstrate excessive bone loss within 15-20 years after menopause and is associated with the diminished estrogen level. The precise role of estrogen in maintaining bone density has not been fully determined, although it is felt to play a part in maintaining bone mass density (**Peacock et al., 2002**).

After menopause, the primary source for estrogen is in the adipose tissue, so this account for the fact that it is uncommon for obese patients to contract osteoporosis. Type II is excessive bone loss that is seen after age 70 and is seen in both sexes (**Kahn et al., 2004**).

A normal process of gradual bone loss (1% per year) occurs after approximately age 35 when the body bone remodeling shifts from osteoblastic activity (bone formation) to increased osteoclastic activity (bone reabsorption). Thus, as one's age increases, bone density decreases, placing one at risk for osteoporosis (**Compston et al., 2001**).

The majority of the skeleton is composed of cortical bone (80%), with the remainder being composed of trabecular bone (20%) (**Compston et al., 2001**).

Within the vertebra, the cancellous bone provides an architectural supportive frame for the vertebral bodies. Ninety percent of the biomechanical load is borne by the cancellous bone, even though the outer cortical bone is ten times stronger (**Kayanja et al., 2004**).

Peak bone mass is reached in early adulthood (age 17–28). Many variables (dietary, physical activity, medications, and life habits) affect an individual's peak bone mass, although 60% – 80% is felt to be genetically determined (**Peacock et al., 2002**).

Bone mass remains relatively stable in women until menopause, or roughly the age of 44 – 55; at this time, women can demonstrate a rapid bone loss (25% – 30%) over 5 –10 years compared to men, who have a gradual loss of 1% loss per year(**Compston et al., 2001**).