

Kyphoplasty Reduction of Osteoporotic Vertebral Compression Fractures: Correction of Local Kyphosis versus Overall Sagittal Alignment

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INTRODUCTION: Cement augmentation has been a safe and effective method in the treatment of symptomatic vertebral compression fractures (VCFs). In addition to providing rapid pain relief, kyphoplasty with balloon tamps can reduce acute fractures resulting in improvement of deformity, and allows controlled cement placement under lower pressure. The restoration of normal overall spinal sagittal alignment in the elderly patient with a VCF and kyphotic deformity, if possible, would have obvious benefits. Although significant correction of local kyphosis (fractured vertebra) has been reported in the literature, to our knowledge there have been no reports with a large sample size on whether this leads to an improved overall sagittal alignment.

METHODS: A total of 1,025 consecutive patients with symptomatic VCFs who underwent a minimum of 1 to 3-level kyphoplasty procedures were included in the study. All procedures were done in a single institute by a single surgeon over a period of 20+ years. Preoperative and postoperative radiographs were analyzed to quantify local and overall spinal sagittal alignment correction. Preoperative and postoperative vertebral heights at the fractured levels were also measured and categorized into anterior, middle, or posterior vertebral heights. Radiographic analysis was done via digital imaging software (Joints - Medstrat, Downers Grove, IL). Clinical outcomes were also measured using the Visual Analog Scale (VAS) and Oswestry Disability Index (ODI) scores.

RESULTS: Measurements revealed that kyphoplasty reduced local kyphotic deformity at the fractured vertebra by an average of 7.7° (66% of preoperative kyphosis). This result however did not translate to similar correction in overall sagittal alignment. In fact, angular correction decreased to 3.0° (26% of preoperative) when measured 1 level above and below. The angular correction further decreased to 1.8° and 1.1° (15% and 9% of preoperative), respectively, at spans of 2 and 3 levels above and below. Average height gain was highest in the middle of the vertebral body (45% increase) compared to the anterior or posterior edges (20% and 6% increases, respectively). With multilevel kyphoplasty procedures, higher angular gains were seen over more vertebrae compared to the 7.7° for a single level kyphoplasty: 8.1° over 2 levels and 8.0° over 3 levels for 2 and 3-level kyphoplasty procedures, respectively. Kyphoplasty was able to achieve higher angular reduction in thoracic versus lumbar fractures (9.0 vs 6.6° , $P < 0.01$). The angular correction was also better maintained over adjacent segments in the thoracic spine. The vast majority of patients were satisfied with their results with significantly reduced scores in VAS (8 to 2, $p < 0.05$) and ODI (74 to 28, $p < 0.05$) at final follow-up.

DISCUSSION AND CONCLUSION:

The majority of kyphosis correction by kyphoplasty is limited to the vertebral body treated. The majority of height gained after kyphoplasty occurs in the midbody. Higher correction over longer spans of the spine can be achieved with multilevel kyphoplasty procedures, in proportion to the number of levels addressed. Not with standing its well-published clinical efficacy, which was also reproduced in this very large number of patients, it is unrealistic to expect a 1, 2 or even 3-level kyphoplasty to improve significantly the overall sagittal alignment after VCFs.

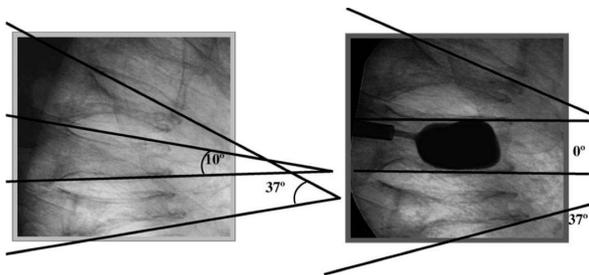


Figure 1. Many cases have been observed in which significant angular reduction produced by kyphoplasty at the level of the fracture does not translate to similar correction in spinal segments spanned by adjacent vertebrae or overall spinal sagittal alignment. For example, these figures show a VCF (left) completely reduced by the kyphoplasty balloon (right), but the kyphosis of the spanning segments stays at approximately 37 degrees.

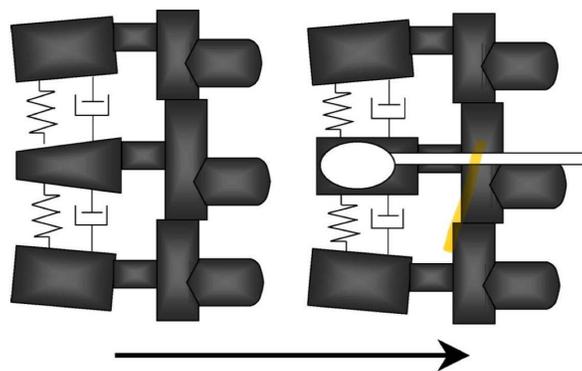


Figure 2. Schematic of kyphoplasty procedure. The intervertebral disc is a viscoelastic structure, represented by a spring and dashpot, which absorbs a significant amount of the correction imparted by balloon inflation. Thus, the local correction is largely within the neutral zone of the endplate-disc-endplate complex.