"Vertebral Body Stenting" a New Method for Vertebral Augmentation Compared to Kyphoplasty in Vitro

Introduction: Vertebroplasty and balloon kyphoplasty are well-established minimally invasive treatment options for osteoporotic vertebral compression fractures. In this context, the disadvantages of both procedures are either incomplete fracture reduction or a significant loss of reduction after balloon deflation and before cement injection. In the present study for the first time a new method called “vertebral body stenting” (VBS) was tested and compared to balloon kyphoplasty (BKP) in vitro. VBS uses specially designed stents which can be implanted extra- or transpedicularly and balloon-expanded inside the vertebral body.

Methods: 24 fresh frozen human osteoporotic vertebral bodies (T11-L5) of four donors were used. Determination of the bone mineral density (BMD) was performed by dual energy X-ray absorptiometry (DEXA). The study was accepted by the local ethic commission and was performed in interdisciplinary cooperation. After generating typical compression fractures (type Genant grade 3; fig. 1), vertebral bodies were reduced under preload (110 N) by BKP (n=12, fig. 2) or by VBS (n=12, fig. 3), and then stabilized by PMMA bone cement. Each step of the procedure was done under fluoroscopic control and analysed quantitatively. Finally, static and dynamic biomechanical tests were performed. All data are expressed as means ± SEM. After proving the assumption of normality and equal variance across groups, differences between groups were assessed using ANOVA followed by the appropriate post-hoc comparison test.

Results: A complete reduction of the fractured vertebral body height was achieved by both systems. There was a significant loss of reduction after balloon deflation in BKP compared to VBS, and a significant total height gain by VBS (mean ± SEM in %, p<0.05; Figs. 4, 5), demonstrated by i) anterior height loss after deflation in relation to preoperative height [BKP:11.7±1.8; VBS:3.7±1.1], ii) anterior height loss after deflation in relation to reposition height [BKP:58; VBS:21], and iii) total anterior height gain [BKP:8.0±2.7; VBS:13.3±2.2]). Biomechanical tests showed no significant differences between both systems.

Discussion: VBS is a new innovative method which allows for the complete reduction of vertebral compression fractures and maintains this result by use of a specific mechanical stable stent. The height loss during reduction after balloon deflation is significantly decreased by using VBS compared to BKP offering a new promising option for minimum invasive vertebral augmentation.