Editorial

Percutaneous treatment for thoraco-lumbar osteoporotic vertebral body fractures (TLOVF): current trends, limitations, and suggested approaches

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Background & current trends

Thoraco-lumbar osteoporotic vertebral fractures (TLOVF) are a major public health problem, affecting 750,000 people per year in the United States. Given the increasing longevity of the elderly population, their incidence is rising constantly (1). Medical treatment including analgesics, braces, bed rest, as well as physiotherapy and rehabilitation remains inadequate; delaying only the natural evolution of the osteoporotic disease (2).

While the main goal of medical treatment is to decrease pain, none of these treatments can restore deformity or re-establish the biomechanics of the spine. Nonetheless some types of medical treatment, such as prolonged bed rest, can worsen the patient's symptoms by increasing bone demineralization and lead to a cascade of osteoporotic fractures that are deleterious to the patient. For this reason, percutaneous treatments of vertebral body fractures have been developed.

Vertebroplasty (VP), first developed in France in 1984 by Galibert, improved significantly pain management. However, despite the ability of this innovative percutaneous treatment to control pain, it was limited in recovering normal biomechanical properties of the spine. Not until 1998 when balloon kyphoplasty (BKP) was used, allowing not only pain management but also better restoration of vertebral body height and thus correction of kyphosis (3,4).

Although there are no conventional guidelines for the use of either technique, they currently constitute the gold standard of percutaneous interventions used in the surgical management of osteoporotic vertebral fractures. In order to standardize the indications, most series in the literature support the use of VP for vertebral fractures with height loss inferior to 30% and kyphoplasty for height loss superior to 30% (5,6).

Data published in the literature seem to reveal no differences in clinical outcomes; mainly visual analogue scale (VAS) and Oswerty disability index (ODI) between VP and BKP. However, BKP provides a better biomechanical recovery of the vertebra (notably vertebral body height and kyphosis) with a lower cement leakage risk (7). BKP achieve this biomechanical fixation, through a simple yet delicate process of balloon inflation inside the collapsed vertebral body, restoring this way its body height before injecting polymethyl methacrylate (PMMA or bone cement). Moreover, the expanded balloon creates a cavity inside the vertebral body, allowing proper containment of bone cement and thus reducing cement leakage (8).

Although BKP enables a more effective recovery of the vertebral body height, it fails to achieve optimal results

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owing to the necessity of balloon deflation and removal before cement injection. This process, requiring usually few minutes, leads to some loss of the recovered vertebral body height and thus to a diminished biomechanical recovery (9). Consequently, new implantable devices have been developed aiming at preserving the recovered body height of the fractured vertebra. Recently third-generation percutaneous vertebral augmentation has been developed, such as vertebral body stenting (VBS), Spine Jack (SJ) and OsseoFix. These techniques are currently used worldwide.

Limitations & impediments

Cement leaks

While BKP provides better cement control within a balloon newly formed cavity compared to simple cementoplasty (CM); the new devices such as stents or SJs offer better cement control. The expansion of the SJ device causes a preferential direction of the flow of the PMMA reducing the risk of leakage. However, the current common belief is that VBS offers better containment of the cement than all other devices, since it remains within the stent; preventing this way any leak through its mesh (10).

Posterior fixation

The need for posterior stabilization in osteoporotic fractures is still controversial (11) and only a few comparative studies are available (12). The data seem to conclude that there is no significant difference in pain or ODI. Some studies claim even better postoperative ODI and VAS scores without posterior fixation. However, these results are disproved by greater functional degradation without long-term fixation (12). Given the diffuse demineralization of the vertebral bone, the question of posterior fixation strength should be raised in all cases of osteoporotic fractures. Thus, the severity of the general osteoporotic disease should be assessed prior to posterior fixation because of the risk of screw failure.

Posterior wall protrusion (PWP)

Fractures with PWP remain the main obstacle to percutaneous surgical treatment. Although the neurological examination is normal, many authors and scientific societies argue that percutaneous approach is not suitable (13). Most series exclude patients with PWP greater than 20% (14). The only data regarding PWP greater than 50% is that of non-osteoporotic post-traumatic fractures (10,15). To our knowledge, some of these studies have even managed post-traumatic fractures with PWP greater than 75%, with good postoperative results and without neurological deterioration. While the current data in the literature concerning non-osteoporotic post-traumatic vertebral body fractures does not take into consideration the severity of PWP as a limitation of percutaneous interventions; it remains less conclusive regarding osteoporotic vertebral fractures.

Indeed, it can be argued that the osteoporotic nature of the fracture involves a greater risk of mobilization of the posterior wall and leakage of cement into the canal due to the low density of cancellous bone (11). Some studies show better control of PWP with percutaneous implant, probably due to the better allocation of stents or SJ in a craniocaudal direction only, limiting the thrust force against the posterior wall (16)

In our opinion, the severity of the PWP itself should not be considered as a theoretical limitation on its own; and the type of fracture should be studied on a case-by-case basis to deliver the most appropriate treatment option.

Secondary adjacent-level fracture (SALF)

It should be considered that the SALF rate is more important in osteoporotic fractures, because of the overall bone demineralization and poorer bone quality. On the other hand, the SALF rate for non-osteoporotic, post-traumatic fractures is very low. We consider that instrumentation may increase the risk of SALF in osteoporotic patients. However, the VBS probably applies a lower strain on the plates of the adjacent vertebrae compared with other implantable devices. Indeed, VBS allow a good cement maintenance and anchor the fractured bone fragments without applying pressure on the plates. On the contrary, SJ deployment involves greater cranio-caudal strains on adjacent plates that could justify a higher SALF rate (17).

Feature of A2 (Magerl classification)

This type of fracture is characterized by a line separating the vertebral body into two large blocks, leading to a higher rate of pseudarthrosis and intervertebral disc protrusion. BKP can be a debatable option, however we consider that VBS remains the best choice to manage this

type of fractures. BKP appears to be less appropriate for intervertebral disc reintegration, owing to the possible disc relapse after balloon deflation. Moreover, stents allow anchoring and maintenance of the bony blocks, avoiding this way pseudarthrosis. SJ profile and mode of deployment does not appear suitable for this type of fractures.

Suggested management strategies

One of the major issues is that only one third of patients suffering from fractures are symptomatic, with deleterious manifestations affecting their quality of life.

Therefore, we can identify two groups of patients. The first one presenting a recent osteoporotic fracture with an immediate onset of clinical signs, primarily thoracolumbar pain. While the second one presents an osteoporotic fracture that was asymptomatic and thus not detected early on; and becomes symptomatic later due to an important spinal distortion into kyphosis. These spinal deformities can lead to a cascade of clinical adverse events (reduced pulmonary function, restriction of the thoraco-abdominal contents, reduced mobility, depression) that considerably alter the quality of life, and reduces life expectancy (18,19).

What should be taken into consideration first, is the realization of the essential act to alleviate patient suffering and improve his ODI. For this reason, percutaneous treatment should be sought as first resort whenever possible. In addition, we must choose carefully whether instrumentation is necessary or not, especially in patients suffering from osteoporosis. In most of these osteoporotic cases, we do not advise to add a posterior fixation, especially with advanced osteoporotic disease.

Unfortunately, there is no clear consensus favoring one type of percutaneous device over the other. However, based on our experience at our trauma center we retain BKP and VBS as the ultimate techniques to deal with osteoporotic fractures.

Concerning the second type of patient, surgical treatment should aim at restoring the patient's normal biomechanics, while taking into consideration the advanced age of the patient and the associated comorbidities. Open surgical approach with fixation will always be acceptable. However percutaneous treatment should be considered especially in the absence of associated neurological deficits, knowing that percutaneous approach presents lower complications, decreased morbidity, and better postoperative pain control.

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