

Osteoporotic vertebral compression fractures: The effect of Vertebroplasty and Kyphoplasty including local kyphosis correction on pain relief

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ABSTRACT

Vertebral compression fractures (VCFs) are the most common complication of osteoporosis. Most of the times VCFs lead the patients to the health care system because of the severe pain and many of them require surgical approaches for pain relief. Percutaneous vertebroplasty (PVP) and balloon kyphoplasty (BK) represent two surgical procedures involving percutaneous injection of bone cement into a collapsed vertebra. The aim of these two techniques is to restore vertebral height and to provide pain relief. Percutaneous vertebroplasty may provide correction of the local kyphosis, however it does not seem to play an important role on pain relief. We reviewed reports of these two procedures in patients with osteoporosis. Most of the case reports suggested that an over 67% relief of patients symptoms, but there are also complications which are relative to these methods. Some of these complications include new VCFs in adjacent adjacent levels as well as pain due to cement extravasation.

Key Words: Vertebral fractures; Osteoporosis; Vertebroplasty; Kyphoplasty

Introduction

Osteoporosis is an epidemic of the modern world. It actually has an effect on 28 billion Americans and this number is expected to be increased through the next decades. Osteoporosis and its complications broke out as life expectancy has been extended. Vertebral Compression Fractures (VCFs) tend to be the most common complication of osteoporosis and they do happen with high frequency as 750,000 VCFs per year. Moreover, one third of the above fractures cause height loss, spinal deformity (kyphosis, scoliosis), acute and chronic pain, restriction of thoracic contents leading to respiratory complications, impaired mobility and disability.

At the same time, 85% of symptomatic patients with acute VCF will settle with 12 weeks of conservative treatment. However, the remaining 15% of patients with chronic pain, not responding to conservative treatment, will seek surgical treatment. The main goal is to relieve pain and help the patients gain the loss of quality of their lives. It is generally accepted that wide surgical approaches and implants cause frequent failures and non-union due to low bone quality of elderly patients. As for the correction of the local kyphosis, the angular reduction sustained by kyphoplasty at the level of the VCF does not reflect to similar correction of the overall spinal sagittal alignment [1]. Over the last

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decades several minimally invasive techniques have gained popularity. Especially, vertebroplasty and kyphoplasty are two percutaneous procedures which improve the quality of life and offer pain relief to 67% of the patients [2].

The purpose of this study was to retrieve recent data on the treatment of chronic pain following VCFs with vertebroplasty and kyphoplasty and assess pain relief following vertebral height restoration. A PUBMED search was performed using the terms 'Vertebroplasty' and 'Kyphoplasty' to determine effectiveness on pain relief in patients with VCFs and to investigate its impact following local kyphosis correction. Only studies on patients with osteoporotic fractures were included.

Vertebroplasty is the percutaneous injection of PMMA into a fractured vertebral body through one or two bone biopsy needles. Percutaneous vertebroplasty (PVP) has been performed since the 1980. It was first used as a treatment of an aggressive hemangioma but soon later it was noticed that this operation is effective for painful vertebral compression fractures [3-5]. Today PVP is performed worldwide mostly for the treatment of painful osteoporotic vertebral compression fractures, and it is generally seen as a safe procedure providing pain relief and improving patient's physical and mental functions [4,5]. Kyphoplasty involves inserting bone tamp/balloon into the vertebra, under image guidance. When inflated with radiocontrast medium, the inflatable bone tamps compacts the cancellous bone and reexpands the body, thus the endplates are elevated without expanding the fractured vertebral body laterally or posteriorly. To achieve an "en masse" reduction, usually two balloons are required. The expansion of the balloons offers local kyphosis correction. The cavity facilitates the placement of thick PMMA under low pressure, decreasing associated risks related to the deformity, filling control and vertebral stability, thus safely decreasing pain and improving mobility [6].

Patients with prolonged VCFs associated pain have been treated with these percutaneous procedures. The best candidates appear to be patients with focal, intense, deep pain and evidence of a progressive VCF by conventional radiography and MRI. In most studies, patients were submitted to the percutaneous

procedure when pain lasted several weeks following injury.

Discussion

During or soon after the procedure, X-ray or CT imaging is performed to evaluate the vertebral filling and exclude nerve roots and spinal cord compression. Following surgery, patients remain supine 1-2 hours to allow complete curing of the PMMA. From the first postoperative day and two weeks following treatment, pain relief was significantly improved compared to conservatively treated patients [7]. Winking et al. indicated that a total of 92% of patients who underwent percutaneous PMMA vertebroplasty reported an immediate pain relief that lasted for a minimum of one year after the procedure. Two weeks after treatment, pain relief was less significant and the reason was a new VCF in adjacent vertebral bodies [8].

Vormoolen et al [9] stated that the presence of bone marrow edema (BME) is an important radiologic criterion associated with pain. The same study mentions that 94% of patients with BME demonstrated pain relief during the first month and 97% the first trimester after the procedure. On the other hand, only 71% of those without BME showed pain decrease during the same periods. Therefore, it is clear that these percutaneous procedures offer a quicker pain relief in a higher percentage of patients with VCFs, than those who underwent conservative treatment. Pain reduction from initial visit to 3-month follow-up is comparable. Furthermore, new adjacent fractures are observed in the PVP groups and nearly none in the group of conservative treatment [4].

Conservative treatment and PV are both associated with significant improvement in pain and quality of life, in patients with VCFs over the first year [10]. Although patients treated with PVP show greater pain relief soon after treatment, they demonstrate a higher risk for a new VCF. PVP is a fair treatment for patients with sub-acute painful osteoporotic vertebral fractures; however the majority of fractures will heal after 8-12 weeks of conservative treatment with subsequent pain decline [3]. The risk of a new VCF in a level adjacent to a treated fracture exists and must be taken under consideration before the procedure. In addition, the new fractures occur nearly with the same frequen-

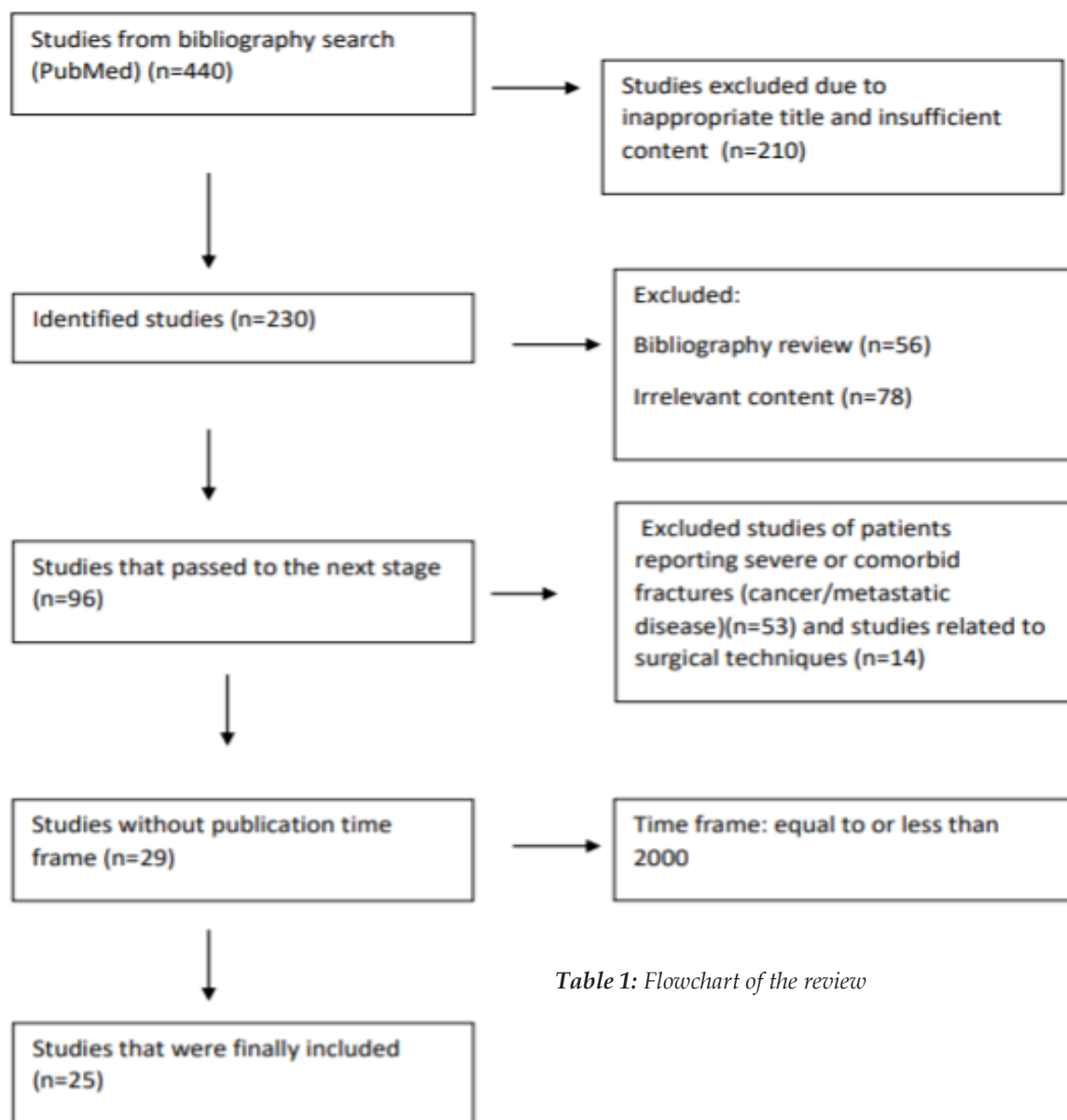


Table 1: Flowchart of the review

cy both in kyphoplasty and vertebroplasty.


It is generally accepted that the modified weight-bearing effects following kyphoplasty or vertebroplasty and the increased vertebral stiffness are the major factors for the development of new VCFs. Recent studies indicate that nearly 25% of patients treated with PVP develop one or more new VCFs in the first year follow-up. The majority of them suffers from a new VCF during the first three months, located at adjacent levels to the previous VCF [11]. Other studies with longer follow-up (48 months) report that

52% of the treated patients developed a new VCF. In general, 1/4 patients who underwent PVP will develop a new VCF in the following year. It must be mentioned that BK tends to have lower risk to cause an adjacent-level compression fracture because of the effective restoration of the overall spinal balance [12]. Despite the risk of new fractures, the benefit from VB/BK is greater because regaining painless mobility is a weapon to combat osteoporosis, as the lack of loads weakens BMD [13]. Evaluation for secondary causes of osteoporosis and treatment with appropriate phar-

macologic agents for osteoporosis is particularly important for these patients. It must also be maintained that the volume of the PMMA does not seem to affect the risk of new VCF [2], however insufficient cement filling of the vertebral body may lead to unrelieved pain which will probably require reoperation [14].

As for the correction of the spinal deformity, it is more significant in patients with BK [15] but there is still no direct relationship found between local kyphosis correction and pain relief. Partial vertebral height restoration does not result in additional pain relief or improved quality of life [1]. Even in studies including patients with 8,8 degrees of correction, according to Cobb's technique, no significant difference was shown, compared to patients with no height restoration. Moreover, it must be considered that it is unrealistic to expect a 1 or 2 level kyphoplasty to improve significantly the overall sagittal alignment after VCFs. Of course, kyphoplasty is effective in partially reducing the angular deformity and regaining lost height of a VCF, however, the angular reduction at the level of the VCF does not translate to similar correction of the overall spinal sagittal alignment [16]. Furthermore, the volume of the inserted PMMA does not reduce kyphosis [17]. As far as for the inserted PMMA is concerned, although BK offers greater kyphosis correction, it is associated with lower rate of cement leakage. A very interesting finding in the case of height restoration of the fractured vertebrae is that an adjacent fracture is induced not due to elevated stiffness of the treated vertebra, but instead due to an anterior shift of the upper body [18].

In conclusion, both VB and BK are pain relief procedures. Vertebroplasty offers greater pain relief while kyphoplasty improves quality of life. It must be mentioned that both minimally invasive procedures im-

prove functionally the patients to a greater degree than conservative treatment [19]. Especially for the elderly patients, vertebroplasty results in earlier hospital discharge and lower readmission rates [20]. Moreover, PVP and BK are related with a lower risk of re-fractures at the treated level, in contrast with non-surgical treatment. When compared directly, BK and PVP had the similar risks of re-fractures at the treated level [21]. As far as the correction of local kyphosis is concerned, despite the fact that vertebral height restoration can be achieved with vertebral augmentation procedures (especially with BK), there has never been shown to result in improved post-VCF clinical outcomes (improvement of the pain or mobility) or reduced post-VCF morbidity [22]. It must be clarified that the height restoration from BK does not seem to have an effect on fracture pain, however an improved spinal alignment is related to improved pulmonary mechanics, decreased pain associated with spinal deformity and reduced risk of an adjacent-level vertebral fracture [23]. Considering the radiological outcomes, although BK has the advantage on this section, still it does not seem to have any clinical relevance [24]. Concerning mortality, the latest data support that vertebral augmentation (more specifically BK slightly more than VB) lead to 22% reduction compared to conservative treatment [5]. Although these percutaneous procedures offer pain relief and improve quality of life, there are still several important questions concerning their mechanism and effectiveness that will need to be answered [25]. 

Conflicts of Interest

The authors declare no conflict of interest.

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