

Vertebral fragility fractures: where do we stand?

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Abstract Vertebral fragility fractures (VFF) constitutes a major complication of osteoporosis affecting the quality of patient life. Debates about diagnosis and therapeutic measures are still ongoing. VFF might be considered as an independent factor of severe osteoporosis. Magnetic resonance image can be a useful diagnostic tool by giving more information than simple X-ray regarding the severity of the fracture, the healing process, the neurological damage, and possible secondary metastasis. Vertebroplasty and kyphoplasty, even a conservative treatment, have been applied to treat such fractures; we will discuss each technique and to our belief, any technique used should take into consideration the restoration of the normal curvature of the spine.

Keywords Vertebral · Osteoporosis · Fracture · Kyphoplasty · Vertebroplasty

Introduction

Osteoporosis is a skeletal disorder characterized by compromised bone strength predisposing individual to an increased risk of fracture [1, 2]. It involves mainly quality of bone, namely its microarchitecture.

Fragility fractures are a major health issue in the world and in our region, among which vertebral fractures are the most frequent. Despite the considerable evolution in understanding the disease, many problems in the diagnosis and treatment of such fractures are yet to be solved. We will try, in this article, to point out some of the main aspects of the problem, specifically its epidemiological magnitude, its physiological impact, its diagnosis, as well as therapeutic options (the percutaneous modalities in particular) and indications.

Magnitude of the problem

Osteoporotic fractures constitute a large-scale health problem. One in three women and one in five men will have an osteoporotic fracture during their lifetime [3].

According to United Nations figures, Asia—including the Middle East—is projected to witness the highest increase in incidence of hip fractures on the planet in the few upcoming years [4]. At the same time, the number of fragility fractures worldwide would exceed largely that of heart attacks, stroke, and breast cancer combined (Graph 1) [5]. Among all fragility fractures, vertebral fragility fractures (VFFs) are the most common (Graph 2).

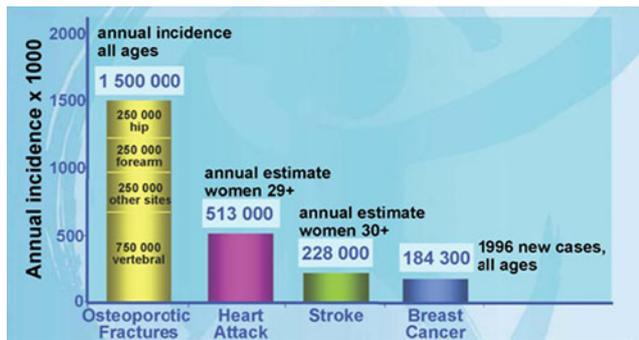
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Graph 1 Osteoporotic fractures: comparison with other diseases [5]

Pathophysiology

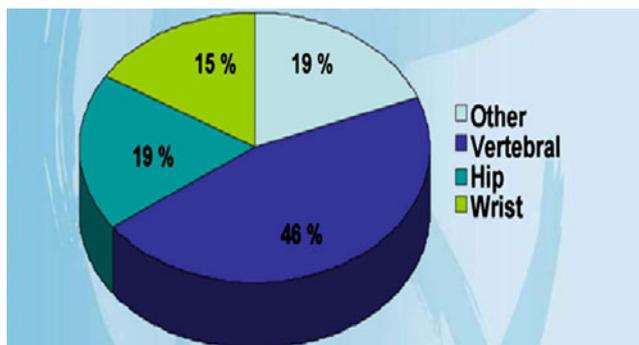
It is now established that a vertebral fracture may play a major causative role in leading to another one in a very short time, mimicking a domino effect, due to changes in the overall sagittal equilibrium of the spine. One out of five postmenopausal women with such a fracture will have a new one within 1 year (Graph 3) [6].

In 2007, Ego Seeman team studied the spinal morphometry of 700 Lebanese women, which is a newly adopted concept, taking into consideration the physiological and pathological curvatures of the whole spine. It helped in giving more accurate data in the diagnosis of vertebral deformities, and in showing the impact of one VFF on the overall morphology of the spine [7]. On that basis, a vertebral fracture by itself could be considered as a major risk factor in establishing the diagnosis of severe osteoporosis, independent of bone mineral density.

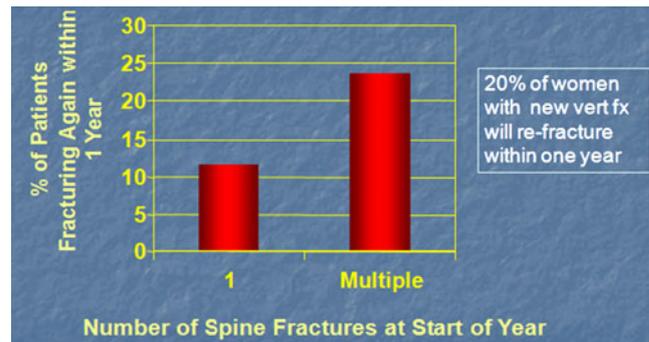
Clinical significance of VFF

In a prospective study done by Nevitt et al., a significant association is found between radiologically detected vertebral fractures, pain, and daily function [8].

Vertebral fractures are associated with a high rate of back pain, disability, at least 1 day of bed rest, and at least 7 days of limited activity. They are also responsible for loss of height,



Graph 2 Distribution of osteoporotic fractures



Graph 3 Risk of subsequent fractures at 1 year [6]

protruding abdomen, reduced respiratory function, hence, a high propensity for a diminished quality of life.

In a study done by Center et al., the mortality rate for fragility fractures was found to be higher in men than in women due probably to more frequent comorbidities in men. On the other hand, the number of vertebral fractures at baseline was proportional to the increase in mortality [9].

Diagnostic issues

The problem of missed vertebral fractures is a worldwide issue. Gehlbach et al. reviewed more than 900 patients over 60 years of age, having had a chest X-ray (CXR). Fifty-two percent of the CXR reports mentioned a vertebral fracture, among which only 7% were treated for osteoporosis [10].

Vertebral fractures cannot only go unrecognized, but even the X-ray reading is subject to immense reproducibility issues. Genant et al. made a great contribution to the classification of vertebral fractures, but mild or grade 1 fractures are still difficult to detect sometimes [11]. Even when performing a computerized morphometry, the placement of three points on the limits of each vertebral plateau is simple but still operator dependant (Fig. 1).

The importance of magnetic resonance image (MRI) in the diagnosis of vertebral fractures should be highlighted here in distinguishing between acute and old consolidated fractures, which is essential for future treatment, as well as eliminating other etiologies causing the fracture, such as multiple myeloma or metastatic lesions. MRI also helps in the detection and assessment of any damage to neurological structures, namely the spinal cord and nerve roots.

Treatment patterns of VFF

Physicians involved in the treatment of VFF are generally confronted to one of the following situations:

- A single or multiple levels fracture

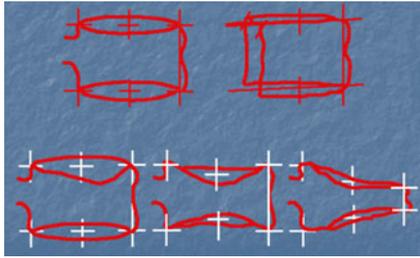


Fig. 1 Six-point technique for detecting a vertebral fracture [11]

- A fracture causing persistent instability, where the vertebra has collapsed completely or suffers from a massive fracture leading to severe kyphosis and reduced pulmonary function. As previously noted, the overall morphology of the spine is thus jeopardized.
- A fracture with neurological damage.

The therapeutic arsenal used in dealing with these situations comprises the following:

- Conservative treatment: bed rest, corset (less frequently a body cast), rehabilitation, painkillers, etc.
 - Vertebroplasty or kyphoplasty
 - In the case of neurological damage or posterior column involvement, a decompression laminectomy with instrumentation and use of bone augmentation if necessary
- a- Vertebroplasty and kyphoplasty:

– Definitions

Vertebroplasty is defined as the stabilization of a VFF by injecting cement into the collapsed vertebral body (Fig. 2).

Kyphoplasty is done by creation of a cavity in the collapsed vertebral body using an inflatable balloon, then filling it with cement (Fig. 3).

Fig. 2 Vertebroplasty of D12

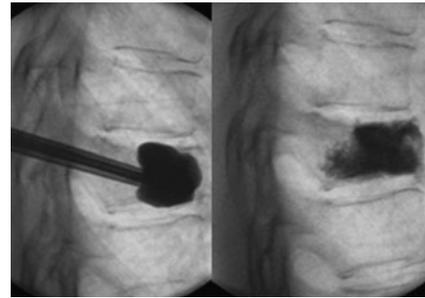


Fig. 3 Kyphoplasty of a collapsed lumbar vertebra

- Potential complications

As for any invasive intervention, some complications might occur:

Although it is a relatively simple technique, vertebroplasty can lead to serious complications especially related to the leaking of cement, which can embolize the venous plexus or flow into the spinal canal. Figure 4 illustrates the case of a 78-year-old woman with a T12 fracture who benefited from vertebroplasty combined with posterior instrumentation, with accidental leaking of cement during the first procedure.

However, we still believe that this can be avoided by testing the viscosity of the cement before, and using continuous X-ray control during the injection process. If any leak is seen, the operator can wait for a minute, then go forth with the procedure. Pressure on the spinal cord from the presence of peridural cement can be relieved by decompression laminectomy in extreme cases.

Viscosity is therefore the key element to keep in mind to reduce this risk.

Fig. 4 Cement leaking in the canal during kyphoplasty



- General indications and guidelines

The use of MRI in establishing the diagnosis and evaluating the status of VFF is gradually becoming a routine practice.
- Indications for bone augmentation in case of:
 - Persistent instability resulting from the VFF, that is, an impending risk of having subsequent fractures, even if pain is subsiding
 - Progressive consecutive collapse of the vertebrae, again, even if pain is subsiding well after each fracture
 - Collapse of more than 20% of the fractured vertebra
 - Persistent pain and markedly decreased functionality

On the other hand, bone augmentation is not a suitable option in vertebra plana, and in cases requiring open surgical stabilization.
- Efficacy of the procedures
 - Kyphoplasty

The main targeted outcomes with kyphoplasty are the relief of pain and the restoration of vertebral height. Taylor and Eck reported similar but consistent pain relief with either vertebroplasty or kyphoplasty, but better documentation of gains in patient functionality and quality of life with kyphoplasty [12, 13].

On the other hand, some companies claim a better reduction of vertebral height using a newly designed vertebral body stent system. However, kyphoplasty with either balloon or stent is unlikely to lead to complete restoration of vertebral height.
 - Vertebroplasty

Two recent articles, published in 2009 by the University of Melbourne and Mayo Rochester, each compared the clinical outcomes of a patient group having had a vertebroplasty to a control group who had a sham procedure. Both articles showed no differences between treated and untreated patients in any of the targeted outcomes at any time point [14, 15].

It is also important to note that neither vertebroplasty nor kyphoplasty actually reduce the risk of further vertebral fractures.

b- Other treatment modalities:

- Restoration of spinal curvatures:

As to emphasize once again on the importance of restoration of spinal balance and curvatures, this technique is recently recognized and aiming to restore the normal spinal curvature, but its efficacy

in preventing further fractures still needs to be proven. More experience and randomized studies are needed to evaluate the functional outcome after such procedure, especially on the long term.

– Surgery

Surgical options generally include laminectomy with or without instrumentation and rarely replacement of the vertebral body with a cage by an anterolateral approach (Fig. 5), and should be seriously considered when neurological damage is present.

Conclusion

VFFs are a large-scale health issue, predicted to become increasingly important in the upcoming years. Several diagnostic and therapeutic difficulties remain, but many can be outrun by the use of MRI for accurate evaluation, and of relatively easy percutaneous techniques, namely vertebroplasty and kyphoplasty. These techniques help in the relief of pain and improvement of quality of life, but little evidence exists on their efficacy in restoring vertebral height or preventing further fractures, not to mention their possibly serious complications such as cement leak. Additional randomized studies remain necessary to evaluate the efficacy and long-term outcomes of these procedures and probably the use of other material than the cement: bone substitute, etc., might improve the outcome and reduce the risk of complications.

The restoration of the spinal curvature is becoming more and more an option in the treatment of VFF.

Fig. 5 Posterior instrumentation combined with vertebral stenting by anterior approach



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