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Vertebroplasty and Kyphoplasty: Indications and Results, a Preliminary Senegalese Experience from the Neurosurgery Department of the CHNU of Fann

El Hadj cheikh Ndiaye Sy*, Celebre Mualaba*, Amidou Adjamou, Maguette Mbaye, Mbaye Thioub, Momar Code Ba

Neurosurgical Clinic, CHNU Fann, Dakar, Senegal
Email: *cheikh-sy@live.fr, *mualabcl01@gmail.com

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Abstract

Introduction: Vertebroplasty and kyphoplasty are percutaneous techniques that consist in injecting an acrylic cement into the body of a pathological vertebra. This work aims to report the experience the of Fann's neurosurgery department in treating certain spinal pathologies by vertebroplasty and kyphoplasty. **Methods:** During a 3-year period from July 1, 2019 to July 31, 2022, we conducted a retrospective, descriptive and analytical study, including patients who underwent vertebroplasty or kyphoplasty for dorsolumbar spinal pathology. **Results:** The mean age of the 13 patients in our study was 51.61 years. Female gender was predominant in 62% (n = 8). The context of spontaneous onset was found in six patients. Nine patients had a VAS (visual analogue scale) ≥ 8 (69.23%). On clinical examination, all patients had a syndrome without neurological deficits. 84.61% of patients had a CT scan (n = 11). The dorsolumbar hinge was most affected with 53.85% of cases. Seven patients had a vertebral compression of between 25% and. The average degree of kyphosis was 8˚ and seven patients had a degree of kyphosis ≥ 10˚. Tumour aetiology accounted for 46.15% of cases. Kyphoplasty was performed in 61.53% (n = 9) of the cases and vertebroplasty was performed in 38.47% (n = 4) of the patients. Kyphoplasty was associated with biopsy in two cases and with osteosynthesis in one patient. Vertebroplasty was always associated with a biopsy. The evolution was favourable with a significant reduction in pain and vertebral kyphosis. The mean VAS decreased from 8.15 to 0.69 three months after treatment and the mean kyphosis decreased from 8˚ to 2˚. **Conclusion:** Kyphoplasty and vertebroplasty as percutaneous techniques allow consolidation of the vertebral body and pain relief. Kyphoplasty alone not

only reduces pain but also restores the height of the compacted vertebral body.

Keywords

Vertebroplasty and Kyphoplasty, Indications and Results, Preliminary Senegalese Experience

1. Introduction

Vertebroplasty is a percutaneous technique that was published by Galibert and Deramond in 1987 and consists of injecting acrylic cement into the body of a pathological vertebra [1]. It allows for vertebral consolidation and a reduction in pain symptoms. This therapy, which was initially used to treat spinal angiomas [2] has been developed [3] with an extended application to the treatment of secondary osteolytic malignant neoplastic lesions and also to the treatment of vertebral osteoporotic fracture lesions [1].

Kyphoplasty (kyphoplasty) or spondyloplasty is a percutaneous technique that consists of a controlled expansion of the vertebral body using a balloon, a jack system (spine jack*), or a stent. These vertebral re-expansion devices are used to push back the depressed vertebral plateau before the injection of acrylic cement in order to stabilize the vertebral body. Kyphoplasty aims to restore satisfactory vertebral height, at least partially reduce the sometimes large vertebral kyphosis angle in some fractures with wedge deformity, and reduce pain [4].

These are two non-invasive methods of treating spinal pain related to vertebral body injury [5]. Their interest lies in their minimally invasive nature, their respect for the spinal musculature, their rapidity of implementation, their analgesic efficacy and their stabilizing action.

The objective of this work is to report the experience of the neurosurgery department of the Fann University Hospital in the treatment of vertebral compression fractures by vertebroplasty and kyphoplasty by giving the different indications and their results.

2. Methods

This is a retrospective, descriptive and analytical study, spread over a period of three (3) years from 1er July 2019 to 31 July 2022, study carried out in the neurosurgery department of the University Hospital of FANN.

This study involved all patients who underwent vertebroplasty or kyphoplasty for dorsolumbar spinal pathology during our study period.

A pre-operative clinical and paraclinical assessment was always carried out before carrying out the surgical procedure. It includes the following elements: age, sex, personal history, family history, mode of revelation, location and type of back pain, the intensity of back pain (EVA), general examination, neurological examination and establishment of the FRANKEL score, spinal examination

and somatic examination complete.

The radiological assessment was carried out using one or a combination of the examinations below: Standard frontal and profile radiography. To appreciate the importance of compression and kyphosis, and to study spinal statics.

Axial section CT with reconstructions to allow a study of the spine as well as the para-spinal spaces. It allowed us to correctly assess the presence of cortical lysis and the general texture of the vertebrae. It enabled us to assess the possibility of cement leaking into the perirachidian spaces by highlighting damage to the posterior wall and the pedicles.

Magnetic resonance imaging: MRI with its different sections (axial, coronal, sagittal) and the T1, T1 + gadolinium, T2, Flair signal as well as the STIR signal, allowed us to assess the invasion of the soft tissues and the presence of an epidermis. It allowed us to find pathological fractures, symptomatic or not, and to specify their recent or old character according to their signal.

The TAP scanner was carried out in search of the primary location in front of a probable metastatic spinal lesion.

PET scanner, scintigraphy (to find millimetric lesions) and bone densitometry were not performed in our patients for reasons of unavailability.

Pre-anesthetic consultation: During this, the patient is classified according to the ASA score and is characterized as fit or not for the upcoming surgery.

In addition to an image intensifier, a spinal surgery table and a running box, the materials required include: The Jamshidi Bone Access Trocar, The guide pin, The forest, The ghost, The working cannula, The contralateral locating pin, The cement mixer, The injection cannula, Vertebral body expansion hardware (Spine Jack), Kyphon* type PMMA acrylic cement, The injection syringe

Approach: The route used is the transpedicular route. It is a route that allows good filling while obtaining a satisfactory analgesic effect. It is most used for the thoracic and lumbar spine. The bilateral approach is preferred in malignant or traumatic collapses. While the unilateral transpedicular approach is used in osteoporotic compression.

The transpedicular approach can be performed percutaneously or openly.

3. Procedure

It is carried out in several steps: Procubitus installation under AG + IOT with the blocks under the shoulders and iliac crests (to allow good thoracic expansion and good abdominal relaxation), without forgetting to protect the compression points. Rigorous asepsis, scopic identification of the pathological vertebra from the front and side, marking, painting with yellow betadine, infiltration of local anesthetic and sterile draping. A skin incision of approximately 1 cm in the percutaneous technique at the different entry points. Pedicle puncture under scopic control from the front and side, with the bone access needle (Jamshidi). Introduction of the guide pin.

Removal of the bone access needle, drilling of the vertebral body and in-

troduction of the working cannula in the case of kyphoplasty to pass the spine jack and perform the expansion of the vertebral body. And all under scopic control from the front and profile. In the case of vertebroplasty, after the removal of the bone needle, the injection cannula is directly introduced under scopic control from the front and side. Injection of cement under careful scopic profile control and immediate cessation of the procedure in the event of a leak; the quantity of injection is variable and depends on the quality of the filling of the vertebrae. Removing the cannula. Taking frontal and profile shots for a final check.

Our analysis focused on epidemiological, clinical, paraclinical, therapeutic and evolutionary parameters. The data were collected using a survey form that included the parameters studied.

4. Results

4.1. Epidemiological Data

During our three-year study period, we performed thirteen cases of vertebroplasty and kyphoplasty, with an annual frequency of 4.3 cases per year. The average age of our patients was 51.61 years with extremes ranging from 30 to 80 years. The 40 - 50 age group was the most frequent with five cases, followed by the 30 - 40 and 70 - 80 age groups with three cases each. In our series, there were five males and eight females with a sex ratio of 0.6. In our series, one patient had a history of osteoporosis and three had a primary breast tumor.

4.2. Clinical Data

The spontaneous clinical context was found in six patients; four were admitted after a fall and three after a road accident. The only sign found in all patients was spinal pain. The only sign that was found in all patients was spinal pain, which was back pain in five cases and low back pain in eight cases. The intensity of the pain was assessed by the visual analog scale (VAS). In our series, the mean VAS (visual analog scale) was 8.15. Patients with a VAS ≥ 8 represented 69.23% of the cases (n = 9), including three patients who had pain of maximum intensity. On neurological examination, we did not find any sensitivity disorder, motor disorder or vesical-sphincter disorder in all the patients in our series. They were therefore all classified as FRANKEL E. On spinal examination, the 13 patients in our study had localized spinal pain, four had paravertebral muscle contracture and two had a spinal deformity of the kyphosis type.

4.3. Paraclinical Data

In our series, 84.61% (n = 11) of the patients had a CT scan. The two who did not have a CT scan were operated on the basis of an MRI. In addition, 30.77% (n = 4) of the patients in the series had a CT scan for a suspected secondary location. Seven patients, representing 53.85% of the cases in our study, had a standard radiograph of the affected spinal segment. Some of them had it as an initial

check-up for spinal pain and others as a postoperative check-up. The dorsolumbar hinge was the most affected in our series with 53.85% of cases (n = 7). It was followed in second place by the lumbar region, which accounted for 30.77%, and then the dorsal region, which accounted for 15.38% of cases (n = 2). The first lumbar vertebra was the most affected in 38.46% (n = 5) of cases. It was followed by the second lumbar vertebra and the last thoracic vertebra, which accounted for 23.07% (n = 3) and 15.38% (n = 2) of cases respectively. More than half of the patients in our study had a corporal compression of between 25% and 50% (n = 7). Three patients had a vertebral compression of less than 25% and in three patients there was no loss of vertebral body height. Seven patients in our series (53.84%) had a degree of kyphosis ≥ 10˚. Four had no spinal deformity (30.77%) and two had a degree of kyphosis equal to 5˚ (15.39%). The average degree of kyphosis was 8˚. Tumour lesions were the main etiology in 46.15% of cases (n = 6). They were followed by traumatic etiology, which accounted for 30.77% (n = 4) and osteoporotic compression fractures, which accounted for 23.08% (n = 3).

Among the tumor etiologies, we recorded three cases of vertebral metastases of breast cancer, one case of vertebral angioma, one case of solitary bone cyst and one case of vertebral compression by myeloma. In the post-traumatic vertebral fractures in our study, we found two cases of Margel type A3-1, one case of Margel type A1-2 and one case of type A2-3. The vertebral compression fractures of osteoporotic origin were found in three patients who were 70, 76 and 80 years old.

4.4. Treatment

The average time to surgery after diagnosis was 8.23 days in our series and 6 patients were operated on within 7 - 14 days.

Kyphoplasty was the most dominant procedure in our series and accounted for 61.53% (n = 9). Vertebroplasty was performed in 38.47% (n = 4) of patients. Kyphoplasty was associated with biopsy in two cases and with osteosynthesis in one patient. Vertebroplasty was always associated with a biopsy. All the types of interventions are summarized in Table 1.

The percutaneous transpedicular approach was performed on twelve patients in our study. One patient had an open transpedicular approach. The approach was unipedicular in 38.46% (n = 5) of cases and bilateral in 61.54% (n = 8).

Table 1. Type of intervention for patients in our series.

Type of intervention	Frequency	Percentage
Kyphoplasty	6	46.15
Kyphoplasty + biopsy	2	15.38
Kyphoplasty + osteosynthesis	1	7.69
Vertebroplasty + biopsy	4	38.47
TOTAL	13	100

4.5. Evolution

All patients in our study experienced a significant decrease in their pre-operative pain intensity after surgery. The mean VAS 24 hours after surgery was 2.38 compared to 8.15 pre-operatively. At three months postoperatively, the mean VAS decreased from 2.38 to 0.69. Of the ten patients who had vertebral compression, four recovered normal vertebral height after treatment. Four of our patients who had vertebral compression between 25% and 50% achieved a partial correction of vertebral height to less than 25%. Two patients who had a vertebral compression of less than 25% pre-operatively did not show a vertebral height correction after treatment. The average degree of kyphosis decreased from 8˚ to 2˚ post-operatively. Three of the nine patients who had vertebral kyphosis regained normalization of the vertebral curvature after treatment. Five patients had a decrease in their degree of kyphosis to 5˚.

Our study had 1 case of cement disc leakage, 1 case of cement paravertebral leakage and 2 cases of cement venous leakage. No local or general complications were reported.

We present one case (Figure 1) in order to illustrate our experience and result.

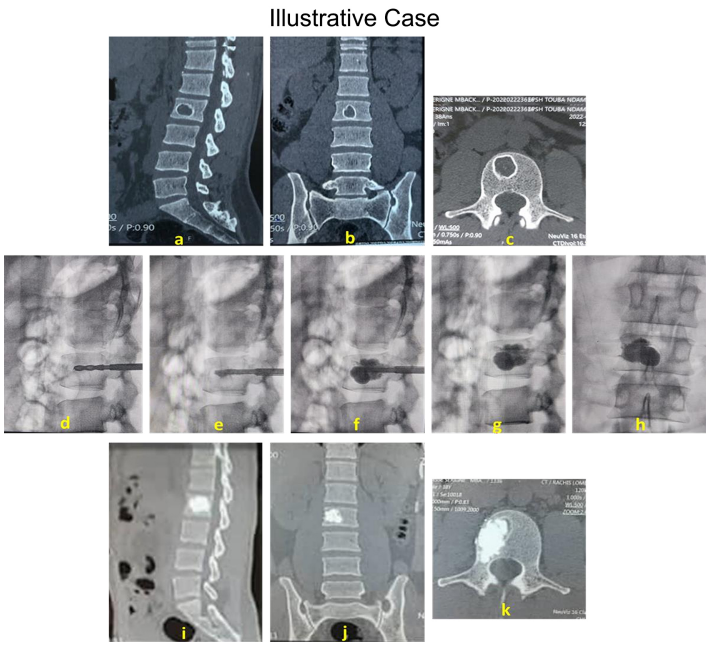

Figure 1. Solitary bone cyst of L2 in a 38-year-old man treated with vertebroplasty. CT scan of the lumbosacral spine in sagittal reconstruction. (a) coronal reconstruction; (b) and axial section; (c) before vertebroplasty. The vertebral body of L2 shows a rounded hypodense lesion with a hyperdense wall with regular contours corresponding to a benign-looking bone cyst of the vertebral body. Under constant scopic control, we introduce a working cannula (guide tube) withthe guide tube and drill assembly into the vertebral body up to the cyst to take biopsy samples; (d) Start injection of bone cement with a cement injector; (e) Filling the cystic cavity with bone cement; (f) Removal of the injector and guide tube and lateral view; (g) Frontal scan at the end of the procedure; (h) CT scan with sagittal reconstruction; (i) coronal reconstruction; (j) and axial section; (k) after vertebroplasty showing good filling of the cystic cavity with bone cement.

5. Discussion

Vertebroplasty and kyphoplasty are generally performed in young adults and elderly subjects. It is predominant in women and this is due to the senile hormonal disorders of women responsible for osteoporosis-inducing osteoporotic compression fractures [6]. At menopause, women have a physiological vertebral state (osteoporosis) which favors the occurrence of vertebral compression fractures. These occur during daily activities or spontaneously and can occur after minimal trauma to the spine. In a prospective European study of vertebral compression fractures, the annual incidence rate was 10.7/1000 for women and 5.7/1000 for men, with a twofold increase in incidence in postmenopausal women [1]. The only reason for consultation that was found in all patients in our series was spinal pain, as in the series by Kawtar [6] and Layton *et al.* [7]. This pain results from localized compression of spinal nerve structures and inflammatory reaction after trauma. The intensity of pre-operative pain was found in almost all the subjects in our study and was assessed at a VAS of 6 or more. Therefore, the primary objective of kyphoplasty or vertebroplasty is to control pain. And secondly, to allow vertebral consolidation or even restoration of the height of the vertebral body in the case of kyphoplasty. The CT scan in the axial section with coronal and sagittal reconstructions allows a good study of the spine and the peri-spinal spaces. Thus, CT offers a perfect visualization of pedicle-Lamar, disco-corneal lesions, with a very detailed evaluation of the degree of canal stenosis and potential neuro-aggression factors [8] [9]. It also has the advantage of being a non-aggressive examination that requires minimal mobilisation of patients. However, performing this examination in the supine position and in unloading does not allow the dynamic behaviour of the spine to be assessed [10]. Two subjects in our series had not had a CT scan and were operated on the basis of an MRI scan. MRI remains the examination of choice for the study of soft tissue and content relationships. It allows the impact of a bone lesion on the neurological structures to be assessed, in particular to highlight the suffering of the marrow. MRI can show spinal cord injuries, assess ligament integrity and detect disc injuries. It is also of great interest in the diagnosis of tumour-induced compression. In our series, a spinal cord MRI was performed in 4 patients. Standard radiographs of the front and side remain essential to assess the uniqueness or multiplicity of lesions as well as the importance of deformations and displacements. The dorsolumbar hinge was the most affected area with 7 (53.8%) of the 13 patients in our series and the first lumbar vertebra was the most affected. Lateral, anterior or anteroposterior vertebral compression leads to an imbalance of the spinal segmental statics. Due to the histological structure of the vertebral body, vertebral compression is often anterior and therefore exposes the vertebral and segmental kyphosis angles. In the case of anteroposterior compression, the effraction of the posterior wall is not an absolute contraindication to cementoplasty. It does, however, require more careful injection of the cement under close scopic surveillance. Spinal pain in elderly subjects in a low-income socio-eco-

nomic context is poorly investigated and is treated with long-term analgesics (self-medication or prescribed by a carer). This could explain the high rate of vertebral compression fractures of osteoporotic origin due to a lack of consultation in the case of the least spinal symptoms.

Osteoplastic procedures such as kyphoplasty or vertebroplasty, which use fast-curing synthetic resins composed of polymethylmethacrylate (PMMA), allow rapid stabilization of a painful vertebral fracture by compression and prevent further sintering of the collapsed vertebral bodies [11]. Various publications in the literature show a satisfactory reduction in pain with these osteoplastic procedures [6] [12] [13]. Kyphoplasty was the most performed procedure in our series with 9 cases out of 13. It was performed in all patients with significant vertebral height loss associated with vertebral kyphosis. Some authors do not recommend kyphoplasty in cases of osteoporotic vertebral compression fractures [14] [15] [16]. They believe that there is a risk of creating compression fractures in the overlying and underlying segment during the expansion of the pathological vertebral body. The expansion material used for vertebral body expansion in all patients in our series was the spine jack*. Other authors recommend the use of a balloon or stent for the expansion of the pathological vertebral body [16] [17] [18]. In contrast to the spine jack* and the stent, which are left in the neo-cavity created after vertebral expansion, the balloon is removed before cement injection with a subsequent risk of secondary compression. Percutaneous Spine Jack* kyphoplasty is a minimally invasive technique using 3rd generation devices for durable compression expansion and consolidation of the vertebral fracture. These titanium spinal expanders prevent the secondary loss of vertebral body height seen with balloon kyphoplasty [19]. Biomechanically, titanium spinal extension is superior to balloon extension in terms of restoration of sagittal balance and maintenance of vertebral height [19].

The Spine Jack*, with its jack-like mechanism, allows the vertebra to be lifted from the inside via a minimally invasive surgical procedure. It offers an effective and rapid solution to treat these fractures, while restoring balance to the spine. This optimal spinal restoration is achieved by the large opening of the device which can reach a maximum expansion height of 17 mm. The treatment goals in all our patients were pain control and consolidation of the fracture site. It is important to know that not all spinal pain in the aftermath of an osteoporotic fracture is suitable for vertebroplasty. In the majority of cases, the pain directly related to the fracture improves within a few weeks as the fracture site heals. However, the deformity caused by the fracture may trigger joint, ligament, or muscle pain. This potential static cause of pain should be kept in mind, especially when it lasts longer than 6 - 8 weeks [20]. The transpedicular bi-pedicular approach used in our series not only restores the height of the vertebral body but also provides uniformity. The unipedicular approach is required in vertebral pedicle damage or lateralized corporal injury cases. Most operators use a transpedicular approach which has the advantage of containing any cement reflux in the

vertebra. The bi-pedicular approach requires more time but allows a better distribution of the cement. According to the recommendations of the Osteoporosis Association, the management of osteoporotic compression fractures is also based on the medical treatment of osteoporosis. This usually consists of basic therapy with calcium and vitamin D on the one hand, and osteotropic therapy on the other, which is often mainly carried out with biphosphonates [20]. Vertebral consolidation and restoration of vertebral height by means of cementoplasty techniques help to combat pain and thus increase the functional potential of patients. The patients in our study experienced a total correction or a reduction or cessation of vertebral kyphosis after vertebroplasty or kyphoplasty. The average decrease in kyphosis was 6˚.

6. Conclusion

Kyphoplasty and vertebroplasty are percutaneous spinal techniques, capable of ensuring the consolidation of the vertebral body and relieving pain. Kyphoplasty alone not only reduces pain but also restores the height of the compacted vertebral body. These two techniques are part of the therapeutic revolution in the management of spinal pathology.

List of Abbreviations

VAS: visual analog scale
MRI: magnetic resonance imaging

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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