

# Minimally invasive surgery in lumbar spine trauma: about 45 cases

**Kaoutar Moutaouakil\*, Mounir Rghioui\*\*, Abdessamad El Azhari \*\*, Fadwa Fliyou \*\***

\* Department of Neurosurgery, Cheikh Khalifa international hospital, Casablanca, Morocco

\*\*Department of Neurosurgery, Mohamed VI International hospital, Casablanca, Morocco

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## Abstract

### Introduction :

Minimally invasive spinal surgery is a recent concept which continues to evolve and be enhanced by new technologies. It brings together a set of surgical techniques, whose main objective is to reduce trauma associated to the conventional surgical approach while ensuring an identical result.

### Method :

It is a retrospective descriptive study of patients undergoing surgery due to back injury in the Neurosurgery Departments of the Sheikh Khalifa International University Hospital and the MOHAMED VI International University Hospital, over a 2- year period from January 2019 to January 2021, with a minimum follow-up of 5 months. We included in our study 45 patients with lumbar spine fracture treated by minimally invasive percutaneous approach, while excluding patients with pathological fracture, neurological deficit and history of spinal surgery. Data were collected from medical records, based on clinical, radiological and surgical data.

### Results :

The average age of our patients is 48 years with extremes ranging from 20 to 80 years. The lumbar spine injuries are due to different mechanisms, mainly secondary to trauma induced by falls .The average age of our patients is 48 years with extremes ranging from 20 to 80 years. The lumbar. Spinal trauma was isolated in 32 cases (71.1%). All patients reported low back pain when admitted, the pain was rated as sever (8/10 to 9/10) on the E.V.A scale in 77.8% of patients. Clinical examination found spinal stiffness with no associated neurological damage. The most affected level of injury was the first lumbar vertebra: 49%. The fracture was complex in 32 patients (72.7% of cases). It was of type A according to the Magerl classification in 75% of cases, especially A3.3 and A3.2. In addition to a fast recovery and a decrease of pain, the radiological follow-up shows an improvement of the vertebral kyphosis from 1.4° to 2.5°.

### Conclusion :

The minimally invasive method has clear advantages as it is less invasive, significantly reduces intraoperative blood loss and lowers the rate of infection. However, its application depends largely on the spinal pathology in question, the

patient's physiognomy, the surgeon's experience and the available infrastructure.

## I. INTRODUCTION

Minimally invasive spine surgery is a recent concept that continues to evolve and be enriched with new technologies. It brings together a set of surgical techniques whose main objective is to reduce trauma related to the approach while ensuring a good result. This is a descriptive, retrospective, analytical study of patients operated for lumbar spine trauma in the Neurosurgery Departments of the Sheikh Khalifa International University Hospital and the Mohamed VI International University Hospital over a 2- year period from January 2019 to January 2021 with a minimum follow-up of 5 months. We included in our study 45 patients with lumbar spine fracture treated by minimally invasive percutaneous approach, while excluding patients with pathological fracture, neurological deficit and history of spinal surgery. Data were collected from medical records, based on clinical, radiological and surgical data. while excluding patients with pathological fracture, neurological deficit and history of spinal surgery. Data were collected from medical records, based on clinical, radiological and surgical data.

## II. Material and Method:

We retrospectively studied the records of all patients, admitted on following a lumbar spine trauma in our departments from January 2019 to January 2021. In this study we included 45 patients operated only by minimally invasive techniques. The surgery was either for antalgic purposes or to stabilize the spine. We analysed the data related to the patient (age, previous history, current work), the presence or not of neurological deficit. Pain was also evaluated according to the Huskisson visual analog scale (VAS). We also analyzed the radiological images taken before and after surgery in order to measure the local spinal kyphosis angle. Only 5 patients were operated under local

anaesthesia coupled with sedation. The approach was transpedicular in all patients.

### III. RESULTS

Between January 2019 and January 2021, 45 patients received surgical management following spinal trauma, 18 by kyphoplasty (36%) and 27 by vertebroplasty (64%). The majority were male, with a sex ratio of 2. The mean age was 48 years (20- 80 y). 28 patients had no concomitant disorders, while 4 were diabetic, 7 were followed for hypertensive heart disease, 1 patient was followed for hypothyroidism and 5 for chronic respiratory pathologies, namely COPD and asthma. The main circumstances in which the injury occurred are: MVA, falls and work accidents. Spinal trauma was isolated in 71.1% of cases without any additional lesions.

All patients reported low back pain when admitted, the pain was rated as severe (8/10 to 9/10) on the E.V.A scale in 77.8% of patients. Clinical examination found spinal stiffness with no associated neurological damage. They have been classified as FRANKEL E, according to the FRANKEL classification modified by ASIA.

All patients underwent a spinal scan upon admission. Magnetic resonance imaging (MRI) was conducted in 26% of patients to scan the disco-ligament device adjacent to the fracture. The first lumbar vertebra was most impacted by the fractures in 48.9% of the cases.

A complex fracture occurred in 72.7% of patients, a type A by Magerl classification (75%), in particular A3.3 and A3.2.

All surgeries were performed under general anaesthesia, except for 5 patients that underwent cyphoplasty under local anaesthesia with mild sedation. The mean surgical duration was 1 hour. No intra-operative occurrences were noted for our 45 subjects. Mean blood loss was estimated to be 60 ml, no transfusion was required for patients included in this study. Complications occurred in 20% of the subjects and were: meningeal breach (2 cases), scar infection with good evolution under antibiotics (2 cases), interdiscal leakage and cement anterior (5 cases) without clinical repercussion (Figure 1). It should be noted that none of the material has been removed from our series.

We evaluated the clinical evolution via pre-defined forms to calculate the functional score of the Oswestry Disability Index (ODI); 26 patients had an ODI score between 0 and 20%, 19 had a score between 21% and 40%. We noted that the ODI functional score was higher in patients with work-related accidents or paulytrauma victim. the average length of the sick leave period was 12.47 weeks. Six patients benefited from a professional reclassification justified by associated injuries.

The radiological analysis took into consideration several local and regional parameters: vertebral kyphosis (VK), regional kyphosis, and traumatic regional angulation (ART). The mean lumbar lordosis (LL) for all fractures was 55° (49° - 57°). Of the 45 fractures that were treated, the mean preoperative vertebral kyphosis was 13.4° (19°-17°) and the mean preoperative ART was 14.5° (6.6° - 15.9°). In the immediate postoperative period, the mean CV decreased to 9.6° (7.9° - 11.3°) and the mean corrected ART was 12° (21° ; - 7°). During the follow-up , an

increase in VK was noted at 2-3 months (15.2°), 6-9 months (14.7°) and final (14.2°). The mean postoperative ART decreased in the immediate postoperative period (11.4°) and at 2-3 months (12.3°) compared with the preoperative ART (14.5°).

### IV. DISCUSSION

Percutaneous fixation of the lumbar spine was first described by Magerl, who used an external fixator.<sup>(1,6)</sup> Subsequently, a first percutaneous lumbar pedicle fixation was described and performed by Mathews and Long.<sup>(5,7)</sup> Later, Lowery and Kulkarni described a similar technique in which rods were placed.<sup>(5)</sup> Percutaneous fixation techniques for posterior pedicle screw shafts may be indicated for stable burst or flexion distraction lesions with or without fusion. They do not necessarily require late removal of the implants.<sup>(3)</sup>

Vertebroplasty was invented by Galibert and Deramond in 1987.<sup>(5)</sup> It consists in radio-guided injection of polymethylmetacrylate (PMMA) into the weakened part of the vertebral body, for pain relief and/or stabilization purposes.<sup>(5)</sup> It is performed by introducing the implant into the vertebra through the pedicle, under the control of scopy, by percutaneous way, trocars of various sizes allowing the injection of suitable surgical cement.<sup>(10)</sup> It was first used for the treatment of painful and aggressive vertebral angiomas.<sup>(3)</sup> Then the indication was extended in 1989 to the treatment of vertebral compression of tumor or osteoporotic origin.<sup>(4)</sup> It was until 1997 that the first results of vertebroplasty were published in the United States.<sup>(9)</sup>

In 1990, Reiley developed kyphoplasty, which is based on the use of an inflatable balloon that is placed at the level of the vertebral body to treat a vertebral collapse in order to restore height. Secondly, the procedure was combined with Vertebroplasty. The first results were published in 2001.<sup>(11,12)</sup> Kyphoplasty was introduced in France in 2004 by treating a small group of patients in certain centers.<sup>(13)</sup> The use of polymethylmethacrylate (PMMA) cement in surgery dates back to the early 1960s.<sup>(14)</sup> to fix the hip prosthesis in the femoral shaft.<sup>(15)</sup> And then, PMMA has been widely used to fill bone cavities or spinal prostheses in several surgical procedures.<sup>(14)</sup> Non-invasive techniques are becoming more and more numerous and used to replace the so-called "classical" techniques even though they are currently part of the therapeutic armamentarium for the management of non-neurological thoracolumbar fractures of type A2, A3 and B.<sup>(15)</sup>

There is no randomized clinical trial comparing the clinical and functional outcomes of non-invasive techniques with those of conventional techniques.<sup>(16)</sup> Most of the publications found were retrospective and monocentric, with small population samples.<sup>(16)</sup> To confirm the observed trend, a multi-site, prospective, randomized study is required.<sup>(16)</sup>

However, our review of the literature revealed a number of benefits attributed to minimally invasive techniques. In addition

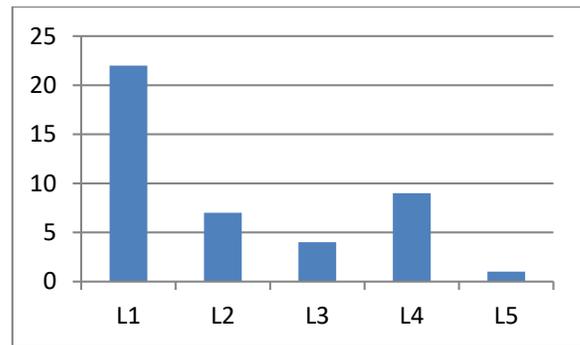
to a smaller incision ; the respect of the muscular insertion causing less muscle retraction and better maintenance of muscle tone, which would explain the painless recovery .<sup>(17, 18, 20)</sup>

According to the literature blood loss is estimated at 50CC for the mini-invasive techniques, against 200 CC in open surgery for the same set-up.<sup>(19)</sup> an intraoperative transfusion remains exceptional.<sup>(19,17)</sup>

In 2008, a published study by R. Assaker included 40 subjects with no neurological deficit who were stabilized by posterior percutaneous fixation and followed up for a period of 6 to 28 months with an average of 12 months.<sup>(8)</sup> These fractures were single-stage fractures, bursting fractures, or bending distraction fractures (AO Types A2, A3, and B1)<sup>(8)</sup> In the same study, the average time from incision to closure was 75 minutes, the average loss of correction was 7.5°, no case of infection was identified and no patient was found to require a transfusion.<sup>(8)</sup>

Similarly, according to the data found in the literature, percutaneous pedicle aiming under fluoroscopy, seems to expose the patient to fewer pedicle effractions than the open technique.<sup>(22)</sup> Ringel et al. showed that 87% of the screws were correctly positioned, 10% were tolerable, and 3% were unacceptable, leading to neurological problems and requiring revision by conventional means.<sup>(22,23)</sup> The rate of malpositioning was highest at the sacral level (40%).<sup>(24)</sup> On the other hand, the irradiation rate remains higher in kyphoplasty and vertebroplasty.<sup>(25)</sup> Rampersaud and Al showed that the areas most affected were: the hands, the thyroid and the thorax.<sup>(26)</sup> The dose received decreased by half if the surgeon positioned himself on the other side of the source. The time of exposure to radiation was 5.7 minutes for percutaneous surgery and 3.7 minutes for open surgery.<sup>(26)</sup> Similar results were found by the team of Schmidt.<sup>(21)</sup> Since 2007, with the availability of the C-arm 3D, fluoroscopy is no longer useful after the incision.<sup>(27)</sup> Images are only required before the incision, in the operating room.<sup>(27)</sup> By means of 3D navigation systems, radiation exposure can be considerably reduced with an increase of the surgical precision.<sup>(27)</sup> Although there is no consensus, the purpose of removing the hardware is to free the fixed lumbar discs and restore flexibility to the spine after a consolidation period varying from 8 to 12 months depending on the authors. A loss of disc correction may be noted after removal of the hardware, usually without clinical repercussions.<sup>(26)</sup> Correction may be noted after removal of the hardware, usually without clinical repercussions.<sup>(26)</sup>

largely on the spinal pathology, the patient's physiognomy, and the surgeon's experience.



Graph 1 : graph illustrating the different levels of fractures managed during our study

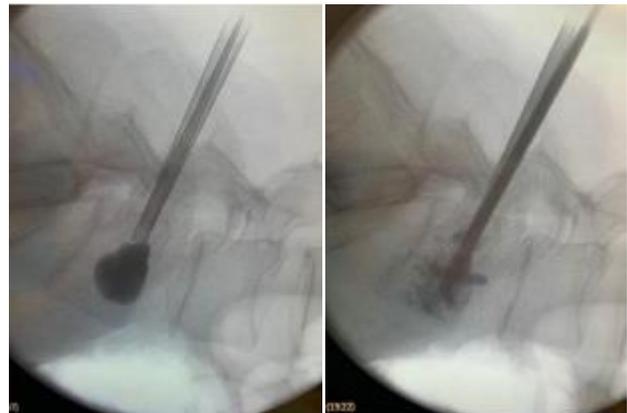


Figure 1 : Intraoperative radiological images showing migration of the cement towards the vertebral disc without clinical repercussions

## V CONCLUSION

The minimally invasive method has clear advantages as it is less invasive, significantly reduces intra-operative blood loss and lowers the rate of infection. However, its application depends

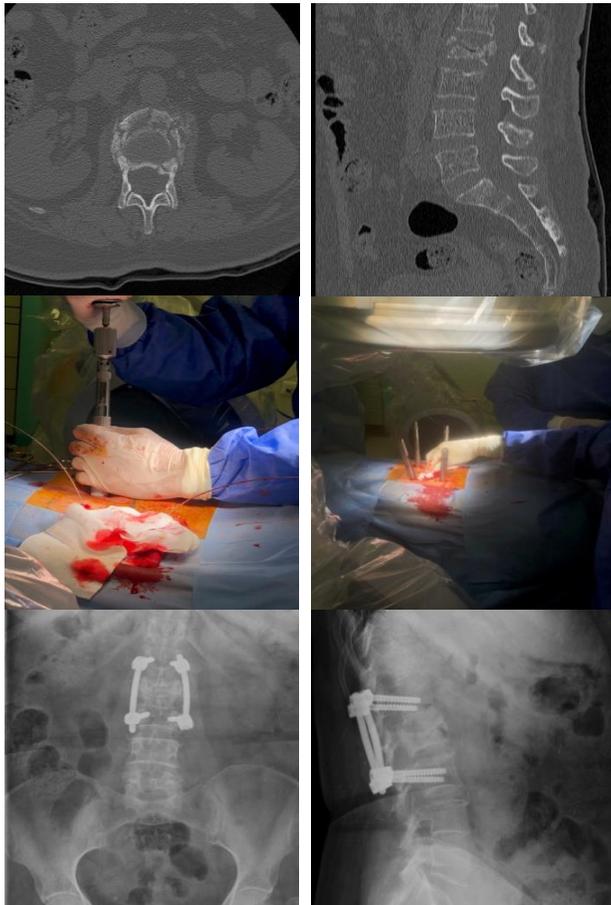


figure 3 : L2 staged vertebroplasty, bilateral pedicle location under scopy



Figure 4 : CT guided navigation

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#### AUTHORS

- First Author** – Kaoutar Moutaouakil, Neurosurgery Resident, kaoutar.moutaouakil0190@gmail.com
- Second Author** – Mounir Rghioui, Neurosurgery Fellow , mounir.rghioui@gmail.com.
- Third Author** – Abdessamad El Azhari, head of department of neurosurgery, Mohammed VI university of health sciences.
- Fourth Author** – Fadwa Fliyou, Neursurgery Fellow, fadwa.fliyou@gmail.com
- Correspondence Author** – Moutaouakil Kaoutar, , kaoutar.moutaouakil0190@gmail.com