ISSN 1220-8841 (Print)
ISSN 2344-4959 (Online)

ROMANIAN
NEUROSURGERY

Vol. XXXVIII | No. 4 December 2024

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DOI: 10.33962/roneuro-2024-174

Romanian Neurosurgery (2024) XXXVIII (4): pp. 455-460
DOI: 10.33962/roneuro-2024-174
www.journals.lapub.co.uk/index.php/roneurosurgery

Comparison between minimally invasive percutaneous pedicle screw fixation versus open pedicle screw fixation for geriatric osteoporotic spine fracture in a rural hospital

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Abstract

Background: Research aimed to see if minimally invasive percutaneous pedicle screw fixation (MIPPS)or open pedicle screw fixation (OPS) worked effectively for geriatric osteoporotic fractures (#) of the spine.

Methods: In the department of neurosurgery at the tertiary care centre, 60 cases of geriatric osteoporotic vertebral # were divided into a MIPPS set (n=30 MIPPS) and an OPS set (n=30, conventional OPS).

Results: The experimental set surgical time, surgical bleeding, incision size, days of hospital stay, and incidence of postoperative complications were smaller than those in the control set (all P <0.05). Both sets' Visual Analogue Scale (VAS) and Oswestry Disability Index (ODI) improved 6 months following surgery, with the experimental set showing the most improvement (all P<0.05).

Conclusions: Both sets of MIPPS and OPS may accomplish adequate internal fixation, with the former having reduced trauma, a less surgical duration, a quicker recovery, fewer postsurgical problems, and less post-surgical discomfort.

Keywords
minimally invasive spine surgery, osteoporotic fracture

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Introduction

Osteoporosis is a frequent condition among the aged, particularly among women. Because of loss of bone density and failure of bone microarchitecture in patients, osteoporotic # can be readily caused by little external force; this is typical in wrists, spines, and hips [1]. One of the leading causes of disability and mortality in the elderly is osteoporotic vertebral fracture # (OVF) [2]. The question of how to enhance the therapy of geriatric OVF has become a research hotspot as well as a tough issue. Geriatric OVF treatment aims to promote fracture healing, decrease operative problems, improve immediate and long-term postoperative life quality, and avoid secondary fracture. conservative and surgical therapy options are available. Bed rest, lower back functional exercise, and medication therapy are the most common noninvasive treatments. Conservative therapy can help to avoid operation morbidity, but it can also cause bedsores, hypostatic

ISSN online 2344-4959
© Romanian Society of Neurosurgery

First published
December 2024 by
London Academic Publishing
www.lapub.co.uk

pneumonia, and unpleasant symptoms including low back discomfort due to its inability to maintain vertebral height [2]. At the moment, geriatric OVF is generally treated surgically, with OPS as the standard operational approach. Pedicle screws have high biological stability and can offer effective fixation [3]. An open procedure, on the other hand, entails a vast operating region and may result in surgical trauma as well as several postoperative problems [4]. Although MIPPS is a relatively new surgical option, its clinical efficacy is still debated. The effectiveness of MIPPS was investigated in this study.

Methods

From August 2022 to December 2023, 60 peoples with geriatric OVF were treated in the department of neurosurgery at a tertiary care center, with 42 males and 18 females ranging in age from 60 to 81 years.

Criteria for inclusion: 1) people aged 60 years; 2) people diagnosed with osteoporosis in bone density examination (t value of -2.5 or more) and compression fracture of the spine with fracture time not exceeding 1 month by imaging examination [4]; 3) people diagnosed with single vertebral fracture; 4) people without nerve injury; 5) people who signed an informed consent form.

Criteria for exclusion: 1) people with numerous vertebral body fractures; 2) people complicated by serious internal medicine disorders or organ failure; 3) people with old injuries; This study was approved by the Ethics Committee of Affiliated Hospital The people and their families were informed and gave their consent and the research conformed to the provisions of the Declaration of Helsinki.

Operative methods

Each patient was given GA and tracheal intubation before being positioned in the prone posture with their abdomen in the air. The same set of doctors treated all of the patients. The OPS set received traditional open reduction and internal fixation. The location of the injured vertebra was found using a C-arm X-ray machine, and the injured vertebra was used as the center point for a spinal posterior longitudinal incision, on which the incision was created conventionally, and the position of the wounded vertebra was exposed. Two pedicle screws were inserted into the upper and lower vertebrae and secured with connecting rods until adequate reduction was achieved. To avoid infection, patients were frequently given perioperative antibiotics [5]. The MIPPS set had treatment with percutaneous pedicle screw fixation, which was less invasive. A C-arm x-ray machine was used for anteroposterior fluoroscopy, and the entry point of pedicle screws was identified by the junction of four 2.0 Kirschner wire projection lines. Then, a 1.5-2.0 cm longitudinal incision was made at the entrance point of the pedicles to bluntly separate the surrounding muscles, clear exposed joints, and introduce a location pin (notice that the angle of pin insertion should be abducted by 10-15 degrees). Under fluoroscopy, an expanding duct was introduced along the pin, a functioning channel was installed, and pedicle screws were fastened in. A curved fixe bar was introduced from top to bottom through subcutaneous muscle tissue, and the screw is tightened the C-arm x-ray equipment was used to guide the reduction and fixing procedures. After washing the incision, the skin was sutured [5]. (Figure 1)

Complications were treated as follows. 1) Active exercise for patients with deep venous thrombosis to help exercise ankles, knees, and hip joints following surgery, as well as to apply medications that block thrombosis in the meanwhile. 2) For delayed union, we appropriately treated the union, observed whether or not the union could be effective, performed internal fixation when the union was unsuccessful, and added external fixation as needed.

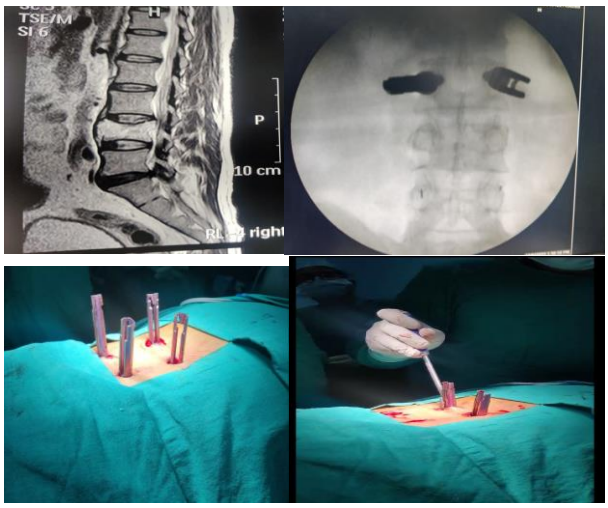

Figure 1. Minimally invasive percutaneous pedicle screw fixation

Outcome measures

The following were the primary outcome measures.

1) Imaging diagnostic indexes: Pre- and post-surgery percentages of vertebral height, kyphotic angle, and disc height. The percentage of vertebral body height equals the front height of the damaged vertebra/the average height of the front of the upper and inferior vertebral bodies multiplied by 100%. In the damaged vertebra, the kyphotic angle is the angle formed between the upper endplate of the upper vertebral body and the lower endplate of the inferior vertebral body. The gap between the damaged vertebra and the lower vertebral body is referred to as disc height. 2) Clinical effect: 6 months after surgery, VAS and ODI [6, 7]. The patients judged their pain based on their own emotions. The greater the VAS score, the more critical the pain. The ODI addressed ten different facets of pain, including pain degree, daily self-care, sitting, standing, walking, carrying things, sexual life, social life, sleep problems, and tourism. The more serious the malfunction, the higher the ODI score.

Secondary outcome measures include: Variables during surgery: The surgery time, intraoperative blood loss, incision length, and days of hospitalization of the two sets were examined and compared. Postoperative problems (such as delayed union, deep vein thrombosis, and so on) were compared between the two groups. Indicator of discharge: The wound healed quickly. There were no problems or they were addressed.

Statistical analysis the data were statistically analyzed with SPSS 19.0. Measurement data was expressed as mean ± standard deviation. Independent sample t test was used for comparison between the two groups. The enumeration data were processed with $\chi 2$ test and expressed in $\chi 2$. $P<0.05$ is statistically significant.

Results

In the OPS sets 30 patients (20 males and 10 females) received OPS, and 30 patients (22 males and 8 females) in the MIPPS set received MIPPS. There were no significant differences in gender or age between the two groups (both $P>0.05$). Refer Table 1. Evaluation of perioperative factors between the two groups surgical time in the MIPPS set was lesser than that in the OPS set (81.75±11.58minutes vs. 108.62±17.34 minutes respectively, $P<0.05$). surgical bleeding in the MIPPS set was significantly lower than that in the OPS set (70.48±15.86mL vs. 278.20±44.13 mL respectively, $P<0.05$). Incision size in the MIPPS set was significantly smaller than that in the OPS set (5.34±2.52 cm vs. 13.89±1.43cm respectively, $P<0.05$). The surgical time, surgical bleeding, incision size and hospitalization days in the MIPPS set were all significantly decreased than those in the OPS set

Table 1. Evaluation of perioperative variables.

	OPS set	MIPPS set	P value
Case	30	30	
Age	71.22±9.41	72.22±8.50	NS
Gender M/F	20/10	22/8	NS
Surgical time (min)	108.62±17.34	81.75±11.58	**<0.05**
Surgical bleeding (mL)	278.20±44.13	70.48±15.86	**<0.05**
Incision size (cm)	13.89±1.43	5.34±2.52	**<0.05**
Days of hospital stay (day)	15.15±4.41	7.85±1.23	**<0.05**

Imaging diagnostic indicators were compared between the two sets before and after internal fixation. Before surgery, there was no significant difference in the percentage of vertebral size, kyphotic angle, or disc size between sets (all $P>0.05$). One week and six months after surgery, the percentage of vertebral size and disc size rose in the MIPPS and OPS sets, but the kyphotic angle reduced in the MIPPS set (all $P<0.05$).

VAS scores were compared between the two sets before and after surgery. Before surgery, there was no significant difference in VAS across sets ($P>0.05$). Six months after surgery, both groups' VAS ratings were reduced (both $P<0.05$).

ODI comparison between the two sets before and after surgery There was no significant difference in ODI between sets before internal fixation ($P>0.05$). ODI of the two sets reduced significantly six months after surgery (both $P<0.05$),

Table 2. Evaluation of outcome and imaging diagnostic Indexes.

	OPS set	MIPPS set
VAS		
Before SURGERY	8.2±1.12	8.8±1.01
6 months after fixation	5.2±1.03*	3.7±1.04*
ODI		
Before SURGERY	42.2±2.45	44.2±2.06
6 months after fixation	18.2±2.08*	10.2±1.98*

Percentage of vertebral height (%)		
Before fixation	58.11±17.08	55.13±20.33
1 week after fixation	88.41±10.11*	89.37±9.07*
6 months after fixation	86.38±9.59*	87.93±9.35*
Kyphotic angle (°)		
Before SURGERY	15.92±4.61	16.05±5.37
1 week after fixation	5.66±1.24*	4.60±1.36*
6 months after fixation	6.41±1.90*	5.93±1.07*
Disc height (mm)		
Before SURGERY	6.32±1.07	6.90±1.85
1 week after fixation	23.11±4.03*	22.32±5.07*
6 months after fixation	21.97±5.39*	21.15±5.81*

Compared with before internal fixation in the same set, *P<0.05.

In the comparison of postoperative complications between the two sets, there was one instance of screw position errors, one case of deep venous thrombosis, one case of soft tissue infection, and two cases of delayed union in the OPS set (30 cases). There was only one occurrence of delayed union in the MIPPS set. There was no screw loosening in either set. The MIPPS set had fewer postoperative complications than the OPS set, although there was no statistical difference.

Table 3. Evaluation of postoperative complications

	OPS set 30	MIPPS set 30	P value
Screw position error	1	0	
Deep venous thrombosis	1	0	
Soft tissue infection	1	0	
Delayed union	2	1	
Total (n, %)	5 (16.66%)	1(3.33%)	NS

Discussion

One of the most frequent disorders among the elderly is osteoporosis [8]. geriatric OVF is a common and dangerous osteoporosis consequence. In the clinic, conservative and surgical therapies for geriatric OVF are primarily used. Conservative therapy may result in an array of problems with no clear impact [9]. As a result, when their conditions may be fulfilled, patients frequently choose surgical therapy. The fundamental goal of surgical therapy is to alleviate pain, enhance fracture healing, prevent postoperative complications, and improve a people's standard of life [10]. Its surgical methods include OPS and MIPPS.

Traditional OPS fixation can provide good correction effects and contribute to spinal stabilization, but it requires a more than 10 cm long incision along the patient's back and the removal of an extensive portion of paravertebral muscles, which harms surrounding soft tissue, causes reduce postsurgical recovery, and may also cause paraspinal muscle destruction and leave complications such as chronic low back problems and pain [11-13].

With the advancement, MIPPS has steadily gained acceptance in clinical practice. Gelb et al. demonstrated that, when compared to traditional OPS , MIPPS can protect paraspinal muscles and has the advantages of smaller intraoperative blood loss, fewer normal structural trauma, quick postsurgical recovery, and fewer side effects such as postsurgical backache [14]. The study included 60 patients with geriatric OVF to assess the clinical outcomes of MIPPS against OPS. (1) Following surgery, the percentage of vertebral height and disc height in the MIPPS set and those in the OPS set increased. In contrast, the kyphotic angle in the MIPPS set and those in the OPS set decreased, indicating that both operation types can effectively restore spinal height and disc height.

After surgery, there was no significant difference in the percentage of vertebral height, disc height, or kyphotic angle between the two sets, indicating that both surgery types had the same therapeutic effect (Table 2). The findings were congruent with those of Li et al. [7]. (2) The MIPPS sets surgical time, surgical bleeding, incision size, and days of hospitalization were shorter than those in the OPS set, and no screw breaking was observed in either set, indicating that MIPPS has effective outcomes, little trauma, few hospital stay days, quickly postoperative recovery, just a few postoperative complications, and can provide patients with better postoperative life quality (Tables 2 and 3)Chen et al.'s investigation was also compatible with the findings of this study (15). Some researchers argue that there is no substantial difference in surgical time between the two types of operations, which might be attributed to early reporting time and mediocre surgical procedures [16]. (3) The VAS score and ODI of the two groups were substantially lower 6 months after internal fixation than before internal fixation, and the VAS

score and ODI of the people treated with MIPPS reduced more significantly, indicating that both operation types can decrease pain and relieve disorder, but MIPPS can provide greater advantages than OPS. (Figures 1).

In the end, both OPS and MIPPS are effective for the treatment of geriatric OVF, with the latter offering smaller trauma, less surgical time, a faster recovery, and a higher post-surgical standard of living for patients. Most experts agree with this study that MIPPS can produce good surgical results with fewer complications and faster recovery [17-20]. However, there are certain drawbacks to MIPPS:(1) It is ineffective for upper and middle thoracic #, as well as fractures with nerve damage [4]; (2) the number of X-ray exposures is increased, as is the duration [21]. As a result, in order to do MIPPS, surgeons must be knowledgeable and familiar with the spine, as well as confident in their surgical indications.

(1) Fresh unstable spinal #; (2) # with no stenosis of the spinal canal along with no hematoma and foreign body in spinal canal; (3) Spinal # with no nerve injury; and (4) # with no interlocking of facet joints were indications for MIPPS in the treatment of geriatric OVF. (1) A C-arm is necessary to precisely detect damaged vertebrae and pedicles before internal fixation; (2) The pin end should be abducted by 15 degrees in the direction of inserting the pin, and the pin can be inserted immediately when the pin reaches facet joint.

Limitations of this study

Because it is hard to catch up on older patients in both sets, the follow-up period in postoperative imaging, VAS score, and ODI is rather short. Thus, while it may be demonstrated that MIPPS is better than OPS in a short period, long-term follow-up data are still required to assess the two procedures' long-term consequences. Furthermore, it only included patients with spinal # who required just internal fixation treatment, not patients with large # spaces who required both internal fixation and vertebroplasty surgery. Thus, in future tests, it will be necessary to determine whether treatments are superior in patients with large # spaces

Conclusion

In conclusion, OPS fixation, as well as MIPPS fixation, are both successful treatments for geriatric OVF. In comparison to conventional OPS fixation, MIPPS fixation results in fewer surgical bleeding, a quicker surgical time, smaller muscle and soft tissue injuries, quicker postsurgical recovery, a smaller incision scar, fewer days of hospitalisation, less pain, fewer postsurgical complications, and a better standard of life; however, MIPPS is more difficult in terms of surgical tools and technical aspects. If the patient's economic circumstances and surgical indications permit, MIPPS is worthy of therapeutic advancement.

Abbreviations

MIPPS - minimally invasive percutaneous pedicle screw fixation
OPS- open pedicle screw fixation
OVF - osteoporotic vertebral fracture
VAS- visual analogue scale
ODI - Oswestry Disability Index
-fractures

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