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ORIGINAL ARTICLE

Effects of minimally invasive percutaneous and trans-spatium intermuscular short-segment pedicle instrumentation on thoracolumbar mono-segmental vertebral fractures without neurological compromise

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KEYWORDS
Spinal fractures;
Pedicle screws;
Minimally invasive surgery
Trans-muscular spatium approach

Summary
Objective: To compare the outcomes of minimally invasive percutaneous short-segment pedicle instrumentation (SSPI) with that of trans-spatium intermuscular SSPI on thoracolumbar mono-segmental vertebral fracture without neurological compromise.
Methods: A total of 39 patients with thoracolumbar mono-segmental vertebral fracture without neurological deficit receiving treatment between January 2009 and July 2011 were enrolled. Percutaneous SSPI was performed for 18 patients (the percutaneous group), and trans-spatium intermuscular SSPI was performed for 21 patients (the trans-spatium intermuscular group). Peroperative indices, intraoperative radiation exposure time, postoperative and follow-up lumbodorsal pain, function scores, and radiological data were compared.
Results: The percutaneous group had significantly less intraoperative blood loss and less severe postoperative pains, but suffered significantly longer fluoroscopy time and higher hospitalization costs compared with the trans-spatium intermuscular group. No significant difference was observed in operating time. All patients were followed up for 17.3 ± 9.2 months (ranging from 5 to 35 months). No significant differences were observed between the two groups in terms of postoperative relative vertebral height (RVH) and regional kyphotic angle (RKA), as well as last follow-up RVH, RKA, lumbodorsal pain, and Oswestry disability index.
Conclusion: Percutaneous SSPI has the virtues of less intraoperative blood loss and less severe pains in the treatment of thoracolumbar mono-segmental vertebral fracture without

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neurological deficit. When compared with trans-spatium intermuscular SSPI, it results in longer intraoperative radiation exposure time and a higher surgery cost. To us, percutaneous SSPI has no advantage over trans-spatium intermuscular SSPI in therapeutic outcomes.
Level of evidence: Level IV. Retrospective study.

Introduction

Thoracolumbar spinal fractures are a very common type of spinal injuries. Posterior short-segment pedicle instrumentation (SSPI) is one of the most widely adopted surgical procedures for such a condition nowadays, and its curative effect has been acknowledged in clinical practice for years. However, traditional SSPI requires the dissection of the paravertebral muscle and fascia tissues attached to the spinous process, vertebral lamina, and zygapophysis. This requirement consequently leads to an iatrogenic damage to the midspinal line and thus becomes one of the important factors causing spinal unstability and pains. In addition, screw placement in the traditional SSPI results in an incidence of epistatic zygapophysial joint injury as high as 24% [1], which becomes an important factor causing adjacent segmental degeneration.

Therefore, minimizing the invasiveness of surgical procedures to reduce the occurrence of iatrogenic sequelae has long been an expectation of patients with thoracolumbar fractures as well as a goal that spinal surgeons are striving for. With the development of technique and surgical instruments, both percutaneous and trans-muscular spatium SSPI have been applied in the treatment of thoracolumbar mono-segmental vertebral fracture nowadays. The trans-muscular spatium approach was first proposed by Wiltse LL et al. in 1968 [2]. After years' evolution, the originally designed bilateral incisions (3 cm long) along the median line have been replaced by a single incision [3]. Although reaching the screw entry point of the zygapophysial pedicle directly through the spatium between the musculi longissimus and the multifidus still belongs to a type of open approach, the trans-muscular spatium approach causes much less damages to the paravertebral muscles compared with the traditional one [4]; therefore, this approach protects the integrity of the paravertebral muscles sufficiently and avoids a damage to the zygapophysial joint, thereby reflecting the concept of ''minimal invasiveness''. In contrast, the percutaneous approach makes a further step: it minimizes incision length, only causes small damages to the paravertebral muscles and reduces intraoperative blood loss. Furthermore, screw placement in this procedure is monitored fluoroscopically, which thereby increases the accuracy of screw placement. These features endow the percutaneous approach with a real sense of ''minimal invasiveness''. Nowadays, the percutaneous approach has been more and more widely applied in the treatment of thoracolumbar fractures [5—7]. Its combination with transforaminal lumbar interbody fusion (ILIF) has also been applied in the treatment of lumbar vertebral degenerative diseases [8,9].

Clinical practice has shown that although percutaneous SSPI has a similar curative effect on thoracolumbar fractures compared with the traditional procedure, it does have advantages in operating time, intraoperative blood loss, and postoperative recovery time [10—12]. Nevertheless, for most cases of thoracolumbar fractures without neurological defects, trans-muscular spatium SSPI can also be adopted, and this approach can greatly reduce intraoperative blood loss and lessen the damages to the paravertebral muscles as well. To the best of our knowledge, no report on whether percutaneous SSPI is more advantageous than intermuscular spatium SSPI in the treatment of such type of fractures exists in literature.

Therefore, we conducted the current study to compare the curative effects of percutaneous and intermuscular spatium SSPI on thoracolumbar mono-segmental vertebral fractures without neurological defects.

Subjects and methods

Subjects

The selection criteria included:

- thoracolumbar (T11-L2) mono-segmental vertebral fracture which was typed A, B1.2, or B2.3 according to AO typing;
- treatment time between January 2009 and July 2011;
- and SSPI.

Patients met any of the following criteria were excluded:

- non-passable burst bone fragments posterior to the injured vertebra, or dislocated vertebral fracture;
- thoracolumbar fracture accompanied with neurological defects or serious injuries of other spinous segments;
- thoracolumbar fracture accompanied with injuries of other associated sites which might cause severe disability or death;
- thoracolumbar fracture which had to be treated with vertebral screw placement, anterior surgery, or vertebroplasty;
- simultaneous surgery for injuries or degenerative diseases of other spinal segments;
- and thoracolumbar fracture accompanied by serious medical diseases, which might greatly affect the outcomes of the current study.

Percutaneous or trans-muscular spatium SSPI was decided according to factors such as patients' willingness, their ability to shoulder economically, and so on.

This study was conducted in accordance with the declaration of Helsinki and approved by the Ethics Committee of Shanghai Jiao Tong University.