Preoperative Planning of the Lateral Entry Point Is Necessary in Percutaneous L5 Vertebroplasty

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OBJECTIVE: **To compare treatment outcomes and complications between the computer-assisted preoperative planning of lateral entry approach and the traditional approach for L5 percutaneous vertebroplasty.**

METHODS: **In this prospective randomized clinical study performed from January 2008 to December 2014, 68 patients scheduled for L5 percutaneous vertebroplasty were divided at random into group A, in which the traditional transpedicle approach was used, and group B, in which the computer-assisted lateral entry point approach was used. A visual analog scale and Oswestry Disability Index were evaluated preoperatively, postoperatively, and at the latest follow-up.**

RESULTS: **Patient demographics were similar in the 2 groups. The mean duration of follow-up was 65 months. The mean distance between the entry point and the midline was 3.05 ± 0.5 cm in group A and 7.04 ± 0.7 cm in group B. The mean inclination angle measured on the preoperative axial image was 17.1 ± 3.4° in group A and 41 ± 3.8° in group B. Clinical outcomes were comparable in the 2 groups; however, cement leakage was significantly greater in group A ($P < 0.001$).**

CONCLUSIONS: **Owing to the hemispherical morphology and convergent pedicle axis of the L5 vertebrae, a more lateral skin entry point and convergent angle of the puncture needle should be emphasized to reach the optimal point according to the preoperative assessment. The approach involving computer-assisted preoperative planning of the lateral entry point was associated with a higher rate of bilateral cement infiltration with fewer complications.**

INTRODUCTION

Percutaneous vertebroplasty (PVP) is an effective treatment for painful osteoporotic compression fractures.[1] A complete understanding of the anatomy and orientation of the pedicle and vertebrae is essential for accurate needle placement during PVP.

PVP can be applied through either a unilateral or a bilateral transpedicular approach, with equal clinical outcomes.[2] The optimal target point for the unilateral approach is in the anterior one-third of vertebrae.[3] If the puncture can be performed at the optimal point, then bilateral cement distribution can be similar to that seen when using the bilateral pedicular approach.[2]

L5 vertebral osteoporotic fracture is uncommon, accounts for only approximately 2% of thoracolumbar fractures.[4] Consequently, the incidence of painful L5 vertebrae requiring PVP is far more uncommon, representing 2% to 5% of all thoracolumbar PVPs.[5,6] The L5 vertebrae has a more hemispherical morphology, associated with its more convergent pedicle angle (PA) compared with the other lumbar vertebrae with a posterior-anterior axis.[7,8] The rarity of painful L5 vertebrae and the unfamiliar vertebrae morphology poses challenges for spine surgeons performing PVP procedures.

The objective of this study was to compare the treatment outcome and cement leakage between a computer-assisted

Key words
- Lateral entry point
- Lumbar morphology
- Percutaneous vertebroplasty
- Vertebral osteoporotic fracture

Abbreviations and Acronyms
ODI: Oswestry Disability Index
PA: pedicle angle
PVP: Percutaneous vertebroplasty
VAS: visual analog scale
TITA: transverse intertangential angle

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approach with a lateral entry point and a traditional approach for L5 percutaneous vertebroplasty.

METHODS

This prospective study, performed between January 2008 and December 2014, enrolled a total of 68 patients who underwent percutaneous L5 vertebroplasty at our institution. The inclusion criteria were persistent back pain without improvement after conservative treatment during a 4-week follow-up. Conservative treatment included analgesic medication, bed rest, orthotics, hot or cold packs, and physical therapy. Radiologic evaluations before the operation included plain anteroposterior and lateral radiographs, magnetic resonance imaging (MRI) or computed tomography (CT) scan, and a whole-body bone scan. The exclusion criteria included multiple-level fracture, neurologic deficit, spondylolisthesis, suspected malignancy, and infectious diseases.

All procedures were conducted in accordance with the ethical standards of the Institutional Research Committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Informed consent was obtained from all study participants.

Patients were distributed at random to either group A or group B, using computer-generated random numbers. The patients in group A underwent PVP with a traditionally planned entry point on the unilateral pedicle by intraoperative fluoroscopy. The distance between the midline and entry point was recorded intraoperatively. For the patients in group B, preoperative planning was done using a computer program (SmartViewer 3.2; Taiwan Electronic Data Processing Cooperation, Taipei, Taiwan) to confirm the skin entry point by measuring the distance between the skin entry point and the midline of the spinal process through the selected slice on the anteroposterior CT or MRI image. The entry point was determined through preoperative measurement in group B, and the course of the puncture passed through the pedicle, simulating the inclination angle measured preoperatively. The needle and the trocar were advanced to the optimal target point under fluoroscopy. Following confirmation of the tip position, cement deposition was performed. Cement deposition was terminated when epidural, venous, or endplate extravasation was noted.

Radiologic outcomes were evaluated by anteroposterior and lateral plain film postoperatively and at the latest follow-up. Unilateral or bilateral cement distribution was recorded. Postoperative clinical outcomes were evaluated with the visual analog scale (VAS) for back pain and the the Oswestry Disability Index (ODI) at preoperative, postoperative, and latest follow-up. The latest follow-up was scheduled for 2 years after the operation. The workflow of exclusion criteria and primary outcome measures are summarized in Figure 1.

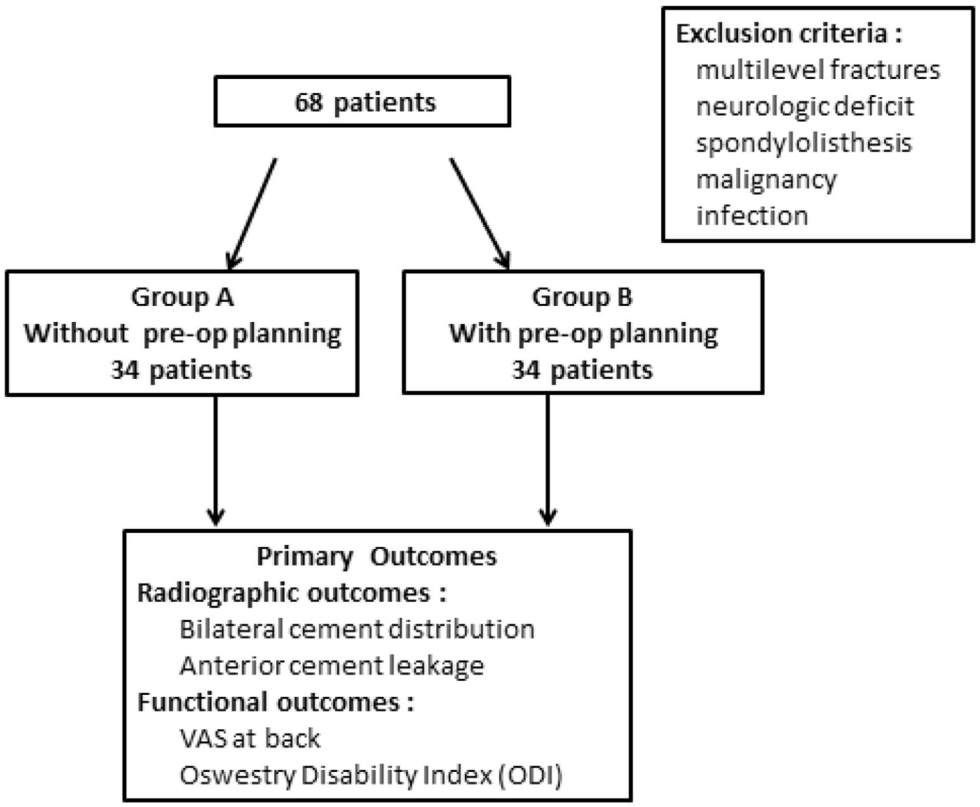

Figure 1. Workflow summarizing exclusion criteria and primary outcome measures.