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Basic Science

The insertion technique of translaminar screws in the thoracic spine: computed tomography and cadaveric validation

Woojin Cho, MD, PhD[a], Jason T. Le, BS[b], Adam L. Shimer, MD[b], Brian C. Werner, MD[b], John A. Glaser, MD[c], Francis H. Shen, MD[b,*]

[a]*Department of Orthopaedic Surgery, Albert Einstein College of Medicine, 3400 Bainbridge Ave, 6th Fl. New York, NY 10461, USA*
[b]*Department of Orthopaedic Surgery, University of Virginia School of Medicine, 400 Ray C. Hunt Drive, Ste 330, Charlottesville, VA 22903, USA*
[c]*Department of Orthopaedic Surgery, Medical University of South Carolina, 171 Ashley Ave, Charleston, SC 29403, USA*

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Abstract

BACKGROUND CONTEXT: Translaminar screws can be a good salvage technique in some cases of severe deformities, infection, tumor, osteoporosis, and revision cases with altered anatomy. To our knowledge, the insertion technique for translaminar screws in the thoracic spine has not been studied.
PURPOSE: To suggest a safe insertion technique of translaminar screws in the thoracic spine.
STUDY DESIGN: A cadaveric study.
METHODS: Fifteen cadaveric spines were harvested from T1 to T12, and 1-mm computed tomography (CT) scans and three-dimensional reconstructions were obtained to rule out any bony anomaly. Eleven of the cadaveric spines were separated at each level from T1 to T12 (Group S) and four were not separated (Group N-S). Translaminar screws were inserted into every level along the trajectories proposed by the previous studies. The screw diameter was determined based on the reference article. For T1–T6, the screw diameter selected was 4 mm, and for T7–T12, a 3.5-mm diameter screw was used instead. The entry point for the 1° screw was at a distance equal to the diameter of the desired screw above the inferior margin of the spinolaminar junction. To create the trajectory, a drill guide was inserted at the entry point and directed toward the middle portion of the base of the transverse process of the contralateral side and was followed carefully to not break the inner/outer cortex of the lamina. The length of the drilled hole, representing the trajectory of the screw made by the drill guide, was measured, and the 1° screws were inserted according to the length measured. The entry point for the 2° screw was at a distance equal to the diameter of the screw below the superior margin of the base of the spinous process and lamina junction. The drill guide was pointed toward the inferior angle of the contralateral junction of the rib and the vertebra along the slope of the contralateral lamina. The 2° screw was inserted in the same manner as previously described. The 2° screw diameter was downsized if there was not enough space because of the 1° screw. For each vertebra from the 11 separated cadaveric spines, inner or outer cortex breakage was checked visually. For the remaining four nonseparated spines, CT scans were used to find any inner or outer cortex breakage.

FDA device/drug status: Not Approved for this indication (Translaminar screws).

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* Corresponding author. Department of Orthopaedic Surgery, University of Virginia School of Medicine, 400 Ray C. Hunt Drive, Ste 330, Charlottesville, VA 22903, USA. Tel.: (434) 243-0250; fax: (434) 243-0252.

E-mail address: FHS2G@hscmail.mcc.virginia.edu (F.H. Shen)

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RESULTS: Thirty-three vertebral levels were abandoned from Group S because of altered anatomy (eg, fusion, fracture during separation, anatomical anomaly of having only 11 thoracic spine segments). Out of 147 vertebral levels, there was no vertebra that did not allow screw insertion. No specimen required using smaller diameter 2° screw because of blockage of the 1° screw. There was no cortical breakage by the screws in Group S. In Group N-S, CT scan showed four inner cortex breakages and three outer cortex breakages, all of which were slight cortical breakages. There were no facet injuries due to the screws in Group N-S. There was no blockage of the ribs during screw placement in all specimens, and the drill guide could lean against the rib for guidance because the angle of the rib and the opposite lamina tended to be the same.

CONCLUSIONS: Translaminar screws can be inserted relatively safely in the thoracic spine. For the 1° translaminar screw, the entry point is at a distance equal to the diameter of the desired screw superior to the inferior margin of the lamina-spinous process junction. The trajectory should be targeted toward the center of the base of the contralateral transverse process. For the 2° translaminar screw, the entry point is at a distance equal to the diameter of the desired screw below the superior margin of lamina-spinous process junction, and the target is the inferior angle of the junction of the rib and vertebra on the contralateral side.

Keywords: Insertion technique; Translaminar screws; Thoracic spine; CT; Cadaveric; Validation

Introduction

Currently, there are many available options for spinal fixation. Among them, translaminar screws can be a good salvage technique in some cases of severe deformities, infection, tumor, osteoporosis, and revision cases with altered anatomy. Since the first description of translaminar screws in C2 by Wright [1], many clinical trials and anatomical or biomechanical studies have been performed in the axial and subaxial cervical spine [2–8]. More recently, it has been expanded down to the upper thoracic spine, with many studies showing successful clinical outcome and sound biomechanical properties [9–13].

To our knowledge, however, the insertion technique for translaminar screws in the entire thoracic spine has not been studied. The purpose of the study was to suggest a safe insertion technique of translaminar screws in the thoracic spine.

Methods

Fifteen cadaveric spines were harvested from T1 to T12 and 1-mm computed tomography (CT) scans and three-dimensional reconstructions were obtained to rule out any bony anomaly. Eleven of the cadaveric spines were separated at each level from T1 to T12 (Group S) and four were not separated (Group N-S). Translaminar screws were inserted into every level along the trajectories proposed by the previous studies [14] as shown in Fig. 1. The trajectory was aimed to maximize the bony purchase. The screw diameter was determined based on the reference article [15]. For T1–T6, the screw diameter selected was 4 mm, and for T7–T12, a 3.5-mm diameter screw was used instead.

The entry point for the 1° screw was at a distance equal to the diameter of the desired screw above the inferior margin of the spinolaminar junction. To create the trajectory, a drill guide was inserted at the entry point and directed

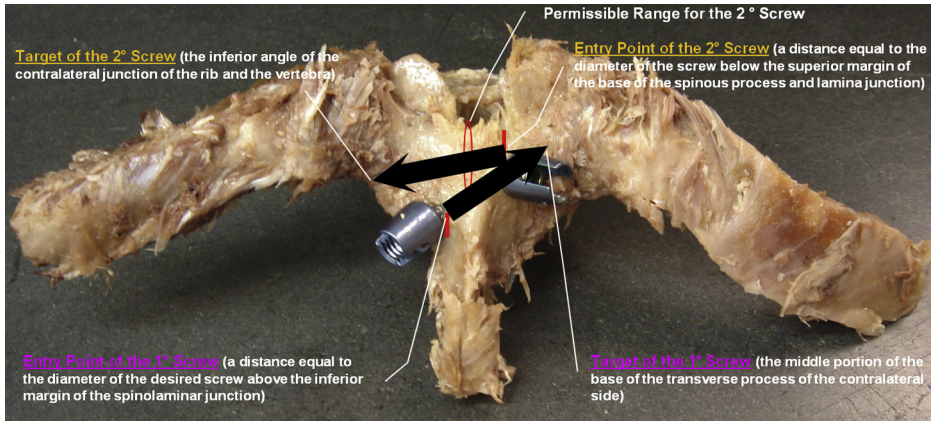

Fig. 1. The trajectories of the translaminar screws in the thoracic spine.