INTRODUCTION: The thoracoscopic approach has been used extensively at many centers for anterior release and fusion before an open posterior instrumentation is performed. Some authors have been concerned that the technique may not provide sufficient visualization or exposure to safely and completely remove the disc because of the proximity to the spinal cord and great vessels. Although multilevel thoracoscopic release now is in use clinically at some centers, reports of its safe or effective disc removal in an animal model are limited. The purpose of this study was to investigate the safety and completeness of discectomy with respect to the learning curve of the surgeon in a porcine model of thoracoscopic anterior fusion with instrumentation.

METHODS: Thirty-two skeletally mature swine underwent five level (T5-T10) anterior thoracic instrumentation and fusion using thoracoscopic techniques after approval of the Institutional Animal Care and Use Committee. The animals were divided into two groups. Group 1, early experience (n = 16); Group 2, late experience animals (n = 16). General anesthesia was administered with double lung ventilation. The animals were placed in the left lateral decubitus position to allow for access to the right chest and spine. A single anterior portal was placed on the right chest in the anterior axillary line to accommodate a thoracoscope. Four posterior portals were placed directly over the vertebral bodies of T5-T10 under visualization through the thoracoscope.

Discectomies were performed from T5 to T10. The ipsilateral annulus was incised, beginning at the rib head and then extending anteriorly to incise the entire anterior longitudinal ligament and the anterior aspect of the contralateral annulus. Disc shavers in sequentially increasing sizes were then introduced into the disc space and to disrupt the annulus and nucleus pulposus without creating excessive bleeding from vertebral end-plate penetration. The disc material was excised, and the endplate was removed with curets and rasps until bleeding bone was visualized. At the completion of the discectomy, the disc space was visualized to ensure nearly complete disc excision. The same surgeon performed all discectomies.

Following discectomies at each level, the disc spaces were packed with either autograft (rib or iliac crest) or an osteogenic protein. The spine was instrumented form T5 to T10 with use of stainless steel Eclipse endoscopic instrumentation (Medtronic Sofamor Danek, Memphis, TN). No postoperative immobilization was used. The animals were monitored daily by trained personnel.

At 4 months, spines were harvested and sectioned longitudinally through the mid-vertebrae and underwent undecalcified processing. The slides were cut, ground and polished using the EXAKT Microgrinding Device (EXAKT Inc., Norderstedt, Germany) to a final thickness of 30–40 microns and stained using a rapid bone stain (Sanderson’s Rapid Bone Stain Solution, Surgipath Medical Industries, Richmond, IL).

The histomorphometric analysis for each disc level was performed using an automated digitizing imaging analysis system coupled to a light microscope (KS300, Carl Zeiss, Vision GmbH, Germany). The easily discernible margins of the total disc annular area for each disc level were identified histologically at twenty times and forty times magnification with use of the remaining posterior end plates, the junction of new bone and/or fibrous tissue and the original vertebral bone. The posterior longitudinal ligament (PLL) in each disc was examined histologically.

To determine the percent disc excision (%DE) in anterior-posterior direction, the following were measured: the posterior vertebral body (PVB) line was drawn through the most posterior aspect of the vertebra body, D1 was the distance from anterior confines of the vertebral body to PVB; D2 was the distance from most posterior extent of the discencyte to PVB. The %DE in anterior-posterior direction was calculated by dividing (D1-D2) by D1 (Figure 1). To determine the disc discectomy in superior-inferior direction, the endplate removal state was evaluated in each disc level with respect to double endplate removal (Figure 2-A), single endplate removal (Figure 2-B), or non endplate removal (Figure 2-C). The data were analyzed using \(^{2}\)-Test to identify differences between the two groups.

RESULTS: All animals survived and tolerated the procedures well, and there were no perioperative complications. The histological analysis revealed no evidence for PLL injury or spinal canal encroachment.

In group 1, the mean %DE was 67 ± 11%. Of the 80 discectomies, 26 had disc excision of > 75%; 48 had 50% to 75%; and 6 had < 50%. In the 80 discectomies, there were 47 discectomies with double endplate removal; 23 with single endplate removal; and 10 without endplate resection.

In group 2, the mean %DE was 69 ± 10%. Of the 80 discectomies, 24 had disc excision of > 75%; 53 had 50% to 75%; and 3 had < 50%. In the 80 discectomies, there are 45 discectomies with double endplate removal; 33 with single endplate removal; and 2 without endplate resection.

In comparing the group 1 and group 2 analysis, no significant differences were found between the two groups except 1) the disc discectomies without endplate removal in early experience were significantly more than in late experience group (P < 0.05); 2) the disc discectomies with endplate removal in late experience group were significantly more than the early experience group (P < 0.05).

CONCLUSIONS: Video-assisted thoracoscopic discectomy is a safe and allows for significant amount of disc material removal. There was no difference in the percentage of disc removed with experience in this model. However, a learning curve for endplate removal does exist, complete endplate resection continues to be a challenge.

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