Changes in Neuroforaminal Dimensions with 2 Level Axial Lumbar Interbody Fusion at L4-S1 with Graduated Distraction through the Implant
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Aims: Paracoccygeal approach to L4-S1 levels with transsacral instrumentation is a recent development. The design of the 2 level transsacral implant can theoretically allow distraction of the disc space and the neuroforamen utilizing a differential thread pitch at L4-L5 and manual distraction at L5-S1. The purpose of this study was to examine the changes in neuroforaminal height at L4-L5 and L5-S1 after insertion and graduated foraminal distraction using the 2 level transsacral implant.

Methods: Six fresh human cadaveric lumbar spines were harvested keeping the soft tissues intact. The discectomy and insertion of the transsacral implant was performed through the presacral space via a working channel formed by passing a series of reamers over a guide wire. Radial disc debulkers, tissue extractors and rasps were used for discectomy. The implant was a 2 piece assembly that consisted of the L4-L5 and sacral segment lagged together by a distraction rod. The pitch differential between L4 and L5 components distracted the L4-L5 disc space, while the L5-S1 disc space was manually distracted by the driver, which engages the distraction rod. The distraction rod was designed to rotate in the L4-L5 segment while the sacral segment acted as an anchor. Distraction was carried out by rotating the screw driver through half a rotation at a time. B/L neuroforaminal heights at L4-L5 and L5-S1 were measured preoperatively and then at every half rotation of the driver using a manual caliper. Distraction was continued until either the driver lost resistance or the implant was seen backing out at the sacrum.

Results: Mean L4-5 neuroforaminal height increased from 18.2 ± 3.1mm to 20.3 ± 2.9mm on the left and from 18.8 ± 2.8mm to 20.6 ± 2.3mm on the right (P< 0.05). Mean L5-S1 neuroforaminal height increased from 15.7 ± 3.0mm to 18.4 ± 2.8mm on the left and from 15.6 ± 2.1mm to 18.3 ± 1.8mm on the right (P< 0.05). Figure 1 shows the increase in neuroforaminal height at L5-S1 as the disc space is distracted. The slope was significantly greater than zero with approximately 1mm/revolution of the driver. Maximum distraction occurred between 2-3.5 revolutions of the driver.

Conclusion: In this in vitro model, the two level transsacral implant caused a significant increase in the neuroforaminal heights at L4-L5 and L5-S1. Graduated manual distraction was possible at L5-S1 with an
average of 1mm neuroforaminal distraction per revolution allowed for the first 2 revolutions. On further
distraction, the transsacral screw can start losing purchase. The ability and the limit of L5-S1 distraction,
especially beyond the first 2 revolutions of distraction, can be difficult to predict based on variables like
bone quality and disc space pliability. Clinical effect of neuroforaminal distraction with this implant is still
to be determined.