[SMISS 2017]

Increased Foraminotomy Efficiency with Reduced Spinal Instability and Patient Strain: Cadaver Study and Preliminary Clinical Experience

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Introduction:

Foraminotomy, the increase of foraminal volume aimed to prevent nerve root compression, offers shorter hospitalization, faster recovery and lower cost, when compared to spinal fusion. Unfortunately, the foramen may be difficult to access, especially while through a minimally-invasive approach, necessitating healthy bone removal which could lead to spinal instability.

Here we present our experience using a curved drill to reach difficult areas and perform a more efficient decompression. The curved shape allows smaller access while reducing healthy bone destruction, making it comfortable for a minimally-invasive setting. Bone removal ability and healthy-tissue sparing (reducing the risk of spinal instability) were evaluated and compared to traditional tools and techniques in a cadaver study.

Methods:

The device was compared to traditional tools on the lumbar vertebras of three cadavers. CT scans performed before and after the procedures were used to quantify the relative changes of the lateral recess diameter, foraminal area, minimal-foraminal-volume (foraminal area multiplied by lateral recess diameter), and the pars-interarticularis (pars) diameter (indicating potential spinal instability).

This approach was tested in 7 open and 31 minimal-invasive spinal decompression procedures. Several patients were previously intended for spinal fusion due to difficult foraminal access. Procedure outcome for the open-approach procedures was assessed using intraoperative and post-operative parameters.

Results:

Foraminal area, lateral recess diameter and minimal-foraminal-volume increases were higher by 129%, 92% and 115%, respectively, for the cadaver foramina treated by the new device compared to traditional methods ($p=0.11$, 0.11 and 0.03, respectively). Average pars decrease was reduced by 24% suggesting this device enables a more effective procedure while sparing healthy tissue and reducing the risk of spinal instability.

All 38 procedures were uneventful. For the evaluated 7 open-approach procedures, procedure lengths were shorter than corresponding similar procedures at the same institution. An average of 1.7 device passes was required for each foramen. Average length-of-stay was 2.2 days, 0.6 days shorter than previous average length-of-stay at the same institution and 4.4 days shorter than the average TLIF length-of-stay. Patient pain and disability improved at follow-up.

Conclusion:

Using a curved drill enables better access to the foramen and further potential increase of the foraminal volume, in open and minimally-invasive approaches, without compromising spinal stability, allowing more patients to avoid fusion in favor of a foraminotomy.