Adjacent Level Autograft Harvest for Anterior Cervical Discectomy and Fusion: Operative Technique, Clinical Outcomes, and Biomechanical Evaluation in a Novel Saw Bones Model of Graft Subsidence

Introduction: Anterior cervical discectomy and fusion (ACDF) is a commonly performed surgical intervention for the treatment of cervical radiculopathy and myelopathy. To reduce donor site morbidity and improve fusion rates a novel technique to harvest autograft from the adjacent vertebral body is described and clinical outcomes reported. A biomechanical model of cage subsidence is developed in the cervical spine mimicking osteoporotic bone conditions and endplate force distribution.

Methods: Twelve patients underwent a novel grafting technique for ACDF in which autograft was procured from the vertebral body adjacent to the operative disk. Patients were followed for two years using visual analog pain scale and radiographic evaluation of fusion. Additionally, polyurethane foam (grade 10pcf density) modeling osteoporotic cancellous bone was cut to cervical vertebral body dimensions and divided into groups: with or without 0.5mm polymer endcaps, recreating the force distribution of the superior osseous endplate, and Rectangular (4x4x6mm) or Cylindrical (r=2mm, h=8mm) autograft harvest sites cored out from the adjacent vertebral body. N=20 per group. An additional 20 specimens were left as intact controls. A PEEK interbody cage was placed atop each specimen. Anterior plate fixation was performed mimicking intra-operative screw position. Samples were subjected to direct cranio-caudal compression by a mechanical press at 0.1mm/s. The failure point of the force distribution curve was calculated.

Results:
Patients experienced clinically meaningful reduction in radicular symptoms with an average VAS score decrease from 5.0 pre-op to 1.1 (p=0.0013) at 2 years. Patients also experienced significant resolution of neck pain with average VAS score decrease from 7.1 pre-op to 2.7 (p=0.0018) at 2 years. All patients achieved radiographic fusion. There were no complications. All biomechanical specimens demonstrated subsidence as the mode of failure. The presence of intact osseous endplates increased failure strength by at least 20% or more in all groups (23.1% for cylindrical core, 22.3% for rectangular core, and 20.0% for control). Coring out autograft harvest sites reduced peak compressive strength as compared with the intact control group: 15.0% for rectangular and 12.3% for cylindrical cores. This reduction in strength was partially offset by the presence of an intact osseous endplate: down to 12.5% for rectangular and down to 8.7% for cylindrical cores.

Conclusion: Additional donor site morbidity or the quality of bone graft may be improved by use of this technique without compromising clinical outcomes in ACDF. The biomechanical integrity of the harvest level is decreased but this may be within an acceptable sub-clinical range. It is important to maintain the integrity of the osseous endplate during ACDF. Harvest site geometry balances technique challenges with biomechanical effects and may not be clinically relevant.