

Graft Type Affects Residual Motion But Not Clinical Outcomes Three Years After Anterior Cervical Discectomy and Fusion

Romano Sebastiani¹, Clarissa LeVasseur², Samuel Pitcairn², Kimberly Hua¹, Christopher Como², Shelley Olivera Barbosa², Jeremy Shaw², William Donaldson², Joon Y Lee², William Anderst²

University of Pittsburgh School of Medicine and ²Department of Orthopaedic Surgery, Pittsburgh, PA

Email of Presenting Author: rss74@pitt.edu

DISCLOSURES: Sebastiani (N), LeVasseur (N), Pitcairn (N), Hua (N), Como (N), Olivera Barbosa (N), Shaw (N), Donaldson (N), Lee (N), Anderst (5: Smith&Nephew)

INTRODUCTION: Anterior cervical discectomy and fusion (ACDF) continues to be the surgical standard of care for patients with cervical radiculopathy and myelopathy [1]. ACDF is performed over 150,000 times each year in the United States, and this number is projected to increase by 13% over the next 20 years [2]. Although many patients develop a solid fusion when assessed via static imaging, dynamic imaging has shown that most patients continue to exhibit residual motion at the arthrodesis [3]. The choice of autograft versus allograft is one primary factor surgeons can control to potentially affect residual motion at the arthrodesis site. Our previous work found that patients who received allograft had higher rates of pseudoarthrosis one year after surgery compared to patients who received autograft, despite no differences in Patient-Reported Outcomes (PROs) between graft types [4]. However, the midterm effects of graft type on residual motion and pseudoarthrosis remains unclear. Therefore, the objectives of this study were to determine the impact of graft type on residual motion at three years post-ACDF and to assess the relationship between residual motion and PROs. It was hypothesized that residual motion after allograft would be greater than after autograft at three years post-surgery, and that PROs would be better after autograft.

METHODS: Patients scheduled to receive either one-level (C5-C6 or C6-C7) or two-level (C4-C6 or C5-C7) cervical arthrodesis were recruited and consented to participate in this IRB-approved study. Participants completed the Neck Disability Index (NDI) and Cervical Spine Outcomes Questionnaire (CSOQ) prior to, one year, and three years after surgery. Synchronized biplane radiographs were collected at 30 images/second before, one year (1YR-POST), and three years (3YR-POST) following ACDF as participants moved through full range of motion (ROM) flexion/extension and axial rotation for 3 trials per movement. A validated volumetric model-based tracking technique was used to match digitally reconstructed radiographs created from CT scans of the participants' cervical spine to the biplane radiographs with an accuracy of better than 1° in rotation [3]. Intervertebral ROM was calculated during each dynamic movement trial using coordinate systems established within each vertebra [5] and following a standard method for calculating intervertebral rotations [6]. The average residual motion was calculated for each patient, each movement, and each test session from the three corresponding movement trials. Pseudoarthrosis was defined as greater than 3° of flexion/extension residual motion based upon previous studies utilizing 2° [7] plus our measurement accuracy of 1°. The effect of graft type on dynamic residual motion and PROs was assessed using 2 x 2 (Group x TestDate) Mixed Model ANOVAs with significance set at $p < 0.05$.

RESULTS: Data from 34 (15M, 19F; average age 50.6±6years) of the 65 participants who have completed 3YR testing have been processed. Ten patients received autograft while 24 received allograft. A total of 612 dynamic trials were included in the analysis. Residual motion at the arthrodesis site was greater after allograft than after autograft during flexion/extension (1YR: $p = 0.029$; 3YR: $p = 0.011$) (Figure 1). No changes in residual ROM were found from 1YR-POST to 3YR-POST for either group (all $p > 0.59$). No differences in PROs were identified between autograft and allograft groups and between 1YR-POST and 3YR-POST time points (all $p > 0.08$) (Figure 2). The pseudoarthrosis rate was 0% and 10% (0 and 1, respectively, out of 10) for autograft at 1YR-POST and 3YR-POST and 35.3% and 38.2% (12 and 13, respectively, out of 24) for allograft using the 3° criterion for pseudoarthrosis. No patients underwent revision surgery prior to the three-year postoperative testing.

DISCUSSION: This interim analysis indicates that residual ROM, PROs, and pseudoarthrosis rates are almost identical when comparing one year to three years post-ACDF, suggesting negligible change in residual motion or clinical outcomes from one to three years post-ACDF. The results suggest that a small amount of residual motion at the arthrodesis site does not affect clinical outcomes. This counters prior research that emphasized the importance of obtaining solid fusion post-ACDF to achieve the best clinical outcomes [8, 9]. The inability to find differences in PROs between autograft and allograft further highlights the clinical similarities between these two graft choices. The relatively high pseudoarthrosis rate for allograft was expected given the use of dynamic biplane radiography and our low threshold. These results are limited to the 3-years post-surgical timepoint and need to be confirmed in the complete cohort.

SIGNIFICANCE: This study illustrates that a small amount of residual motion three years after ACDF does not indicate surgical failure and may not warrant surgical revision. Allograft may serve as an equivalent graft choice to autograft without associated donor site complications.

REFERENCES: [1] Song & Choi, Asian Spine Journal (2014). [2] Neifert, et al, World Neurosurgery (2020). [3]. Anderst, et al, Spine (2016). [4]. Couch, et al, Spine (2021). [5] Panjabi, et al, Spine (1976). [6] Panjabi, et al, J Bone Joint Surg Am (1994). [7] Shriver, et al, Spine J (2015). [8] Newman, Spine (1976). [9] Lee, et al, Spine J (2023).

ACKNOWLEDGEMENTS: This work was supported by NIH grant #R01AR069543.



