Pain in the neck? New surgical method could be game-changing

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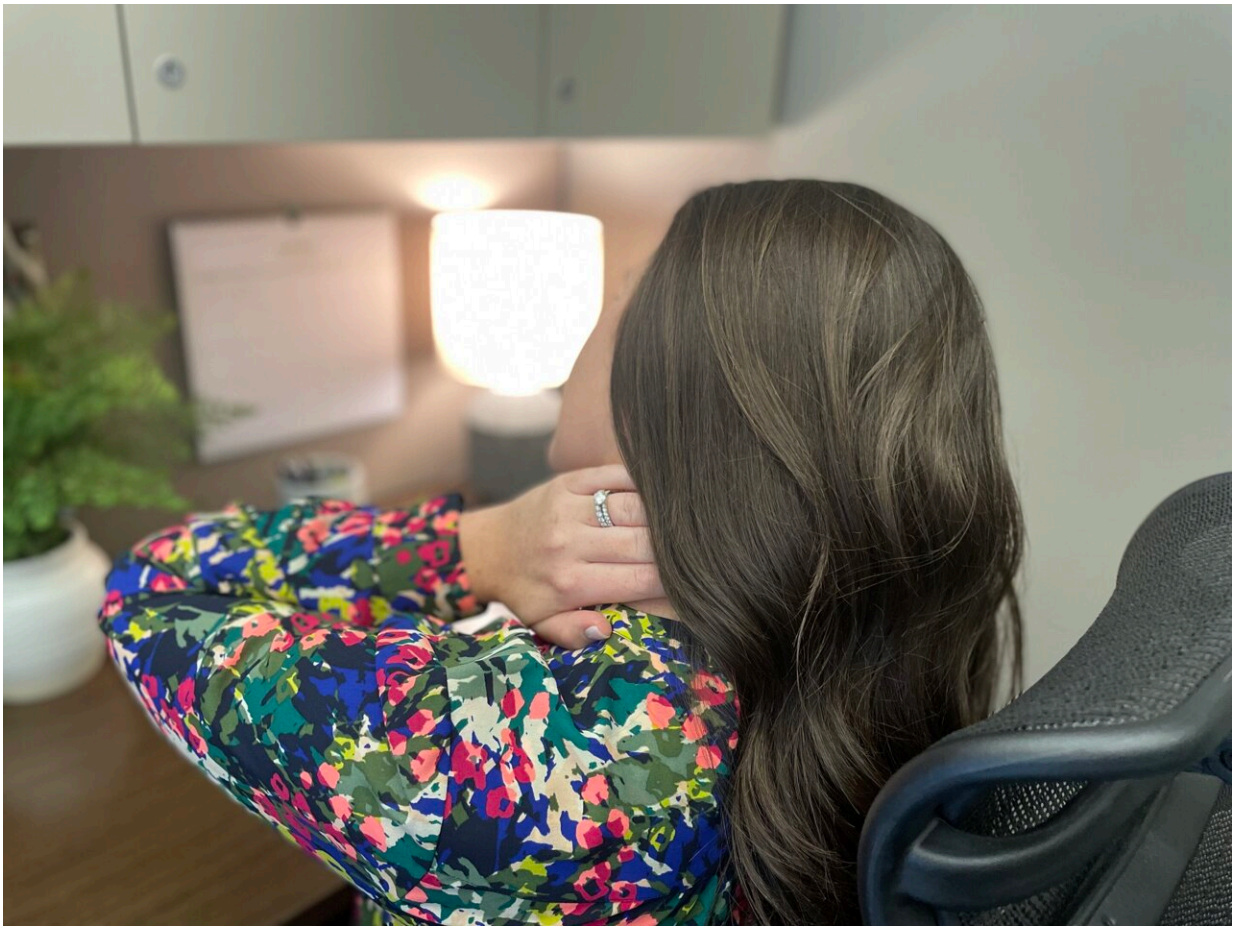

A new study shows promising clinical outcomes for patients with degenerative cervical spine disease. Credit: Florida Atlantic University

Anterior cervical discectomy and fusion (ACDF) is a common type of neck surgery that involves removing a damaged disc to relieve pressure on the spinal cord or nerve root and thereby alleviate associated pain, numbness, weakness or tingling. The damaged disc is removed from between two vertebral bones along with simultaneous fusion surgery. The fusion involves placing a bone graft or "cage" and/or implants where the disc was originally located to stabilize and strengthen the area.

The use of cages for ACDF are important postoperatively to the alignment of the cervical spine and to maintain the intervertebral disc height. Few studies, however, have examined the impact of the underlying cancellous or "spongy" bone contact with regards to handling large loads from the cage. Moreover, it is still not clear whether a cage with or without screws will be the best choice for long-term fusion as the micromotion or sliding distance and subsidence or penetration of the cage still take place repeatedly.

Researchers from Florida Atlantic University's College of Engineering and Computer Science, in collaboration with Frank Vrionis, M.D., senior author of the study and director of the Marcus Neuroscience Institute, part of Baptist Health; and professor of surgery, FAU's Schmidt College of Medicine, are the first to evaluate the effect of the range of motion, cage migration and subsidence using variable angle screws. Marcus Neuroscience Institute has its hub on Boca Raton Regional Hospital's campus and satellite locations at Bethesda Hospital in Boynton Beach and Deerfield Beach.

For the study, researchers developed five finite element models from a cervical spine model. The first model was an intact spine model, and the second model was an altered model with cage insertion and a 2-level static plate. The other three models were altered models with the same cage insertion and a 2-level dynamic plate. They compared ACDF cages with and without screws on the biomechanical characteristics of the

human spine, implanted cage, and associated hardware by comparing the micro motion and subsidence.

Results of the study, published in *The Spine Journal*, the journal *World Neurosurgery* and *Asian Spine Journal* showed that the cage-screw and anterior plating combination model has promising potential to reduce the risk of micro motion and subsidence of implanted cages in two or more level ACDFs. This method could increase the stiffness of the construct and reduce the incidence of clinical and fusion failure following ACDF, which in turn, could decrease the need for revision surgeries or supplemental posterior realignment.

"Anterior cervical discectomy and fusion is widely used to treat patients with spinal disorders, where the cage is a critical component to achieve satisfactory fusion results. The risk factors for cage migration are multifactorial and include patient factors, radiological characteristics, surgical techniques and postoperative factors," said Vrionis. "Our results showed that the plate used in our study provided directional stability and obtained excellent fusion, indicating promising clinical outcomes for patients with degenerative cervical spine disease."

Vrionis further explains that because of the biomechanical stability of the current construct, there has been no need for a rigid cervical collar, which is typically used by other surgeons.

"In addition, with more than 100 clinical cases, there has been no evidence of pseudarthrosis or lack of fusion, which is a treated complication of anterior cervical disc surgery," said Vrionis.

A lower screw rotational angle resulted in superior biomechanical performance and lower incidence of migration and subsidence compared with a higher rotational angle in multilevel applications, regardless of loading. The researchers believe the underlying mechanism may be due

to the cage-screw bonded to the bone and the constrained bottom of C5 vertebra making it more rigid.

"Our research aims to develop a platform for next generation patient-specific spine surgery by combining intelligent image process, AI technology/machine learning, finite element simulation and 3D printing to help surgeons design a surgery plan for each patient, " Chi-Tay Tsai, Ph.D., study co-author and a professor, FAU Department of Ocean and Mechanical Engineering, and director, FAU Spine Biomechanical Laboratory.

Researchers demonstrated that the cage-screw was able to prevent subsidence in all loading scenarios better than the cage without screws.

"Our clinical and biomechanical data have shown that the outcomes with the rigid static plate are very good. The main reason may be due to greater contact area between the cortical and cancellous bone in the cage-screw than that in unanchored cage constructs," said Tsai.

ACDF is one of the most commonly performed spinal operations in the United States with an average of 137,000 procedures performed each year.

"The novel methodology developed by our researchers in collaboration with Drs. Vrionis and O'Connor of the Marcus Neuroscience Institute holds great promise to enhance anterior cervical discectomy and fusion and ultimately help to alleviate the pain and discomfort patients experience from various disorders of the spine and neck," said Stella Batalama, Ph.D., dean, FAU College of Engineering and Computer Science.

More information: Maohua Lin et al, Cage-screw and anterior plating combination reduces the risk of micromotion and subsidence in

multilevel anterior cervical discectomy and fusion—a finite element study, *The Spine Journal* (2021). DOI: 10.1016/j.spinee.2021.01.015

Maohua Lin et al, Finite Element Analysis of the Effect of Dynamic Plating on Two-Level Anterior Cervical Discectomy Fusion Biomechanics, *World Neurosurgery* (2022). DOI: 10.1016/j.wneu.2022.02.032

Maohua Lin et al, Biomechanical Study of Cervical Endplate Removal on Subsidence and Migration in Multilevel Anterior Cervical Discectomy and Fusion, *Asian Spine Journal* (2022). DOI: 10.31616/asj.2021.0424