Feasibility of a Resorbable Anterior Cervical Graft Containment Plate

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Abstract:
This article reviews the background of anterior cervical plating for one- and two-level discectomy for degenerative disease and justifies the design and testing of a cervical plate composed of a resorbable material. Special consideration is given to modifications of implant design and related implant tools because these less rigid materials have different mechanical properties compared to metallic plates. Our cadaveric and animal in vivo testing methodologies, a novel testing method that reliably quantifies graft containment, and data from a representative sample are presented. The advantages and disadvantages of resorbable plating are also discussed.

Editor’s Comments

Cervical plate fixation is a common procedure performed by spine surgeons for many conditions. The authors describe a cervical plate made of a non-metallic material that would be MRI compatible, less stiff than titanium, and partially resorbable. They list the advantages as including the elimination of adverse effects on spinal biomechanics, and the elimination of possible late hardware complications with a rigid plate.

Based on craniofacial fixation, a resorbable polylactide polymer plate fixation system has been created for anterior cervical spine surgery. It has recessed screw holes, 1.6 mm thickness and holes wider apart than titanium plates. The plate does not disappear or get substantially resorbed. The implanted plate gets degraded over time via anaerobic metabolism (hydrolysis) and at 9 months it retains 70% of its original strength. The plating system incorporates a screwhead design that prevents stripping.

Installation of the system appears similar to others with the exception that the plate is softened in a hot water bath before insertion so it can conform to vertebral contours. Once cooled in situ it becomes rigid and retains the shape including that of the individual vertebrae. Testing included human cadaveric models with various loads and directions, testing for graft extrusion, and other evidence of problems with gross failure defined as significant graft fracture or fragmentation creating loss of support across the anterior column. Although this article did not include in vivo data comparisons from a sheep model, this report detected no endplate damage during cadaveric testing.

The authors’ stated goals for this fixation system are similar to others: increase fusion rates above those of bone graft alone, contain the graft such that dislodgement does not occur, and avoid implant complications which maintaining enough rigidity to allow arthrodesis. Other considerations include load sharing and effects that might affect fusion. There is a succinct discussion of the properties of successful anterior cervical fixation systems and their accepted efficacies, noting that graft-related complications are significantly decreased in instrumented cases. Advantages include: reduction in the need for post-operative external fixation devices, immediate international fixation with creation of a tension band and buttress plate that resists movement at the graft site, and prevention of instability while maintaining compression of graft.

The authors list criticisms of metallic/titanium fixators: MRI artifacts which force the use of CT scanning with less specificity in the post-operative cases; increase in degenerative changes at adjacent levels associated with plate fixators because of disruption of the anterior spinal ligament disruption from the plates, and the postulation that the high rigidity of the titanium plate and its stiffness may contribute to local spine problems. Metallic plates do not permit visualization of the graft as the plates are opaque. The plates do persist intact after fusion has occurred.
Advantages described by the authors: resorbable plates may shield patients from accelerated degeneration of adjacent segments. The design of this plate system allows subsidence via screw toggling because of resorption-induced weakening of the material. The significant plus of this system is that it may be as effective as the metallic systems but lack the MRI artifact problems. They do not note that a problem with this system may be fracture under stress over a short time—something described for the facial fixation systems made of the same material.

Spine surgeons need to know of developments in device research and innovation. The authors describe an innovative adaptation of a fixation system. Because the cranio-facial plates are FDA-approved already, the anterior cervical version may be able to be introduced sooner. That the authors are considering rigidity as a “selling point” may be moot. The lack of MRI artifact and rigidity lasting more than 4 months may be enough—if cervical fusion does not occur by that time, clinical failure of the fusion is not uncommon. The downsides of this system are “too thick” plate thickness, fear of screwhead stripping during install or replacement and possible mechanical problems removing the system. Once fusion has occurred degeneration of adjacent segments may occur whether there is a plate or not. Conjecture about accelerated degeneration of adjacent segments has been debated for years and there are no definitive conclusions yet.

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