Pedicle screw augmentation

Pedicle screws can be augmented with polymethylmethacrylate (PMMA) cement through cannulated and fenestrated pedicle screws to improve screw anchorage. To overcome the drawbacks of PMMA, a modified augmentation technique applying a self-curing elastomeric material into a balloon-created cavity prior to screw insertion was developed and evaluated. The aim of the study was to compare the effect of the established and novel augmentation technique on pedicle screw anchorage in a biomechanical in vitro experiment.

In ten lumbar vertebral bodies, the right pedicles were instrumented with monoaxial cannulated and fenestrated pedicle screws and augmented in situ with 2 ml PMMA. The left pedicles were instrumented with monoaxial cannulated pedicle screws. Prior to left screw insertion, a balloon cavity was created and filled with 3 ml of self-curing elastomer (silicone). Each screw was subjected to a cranio-caudal cyclic load starting from - 50 to 50 N while the upper load was increased by 5 N every 100 load cycles until loosening or 11,000 cycles (600 N). After cyclic loading, a pullout test of the screws was conducted.

The mean cycles to screw loosening were 9824 ± 1982 and 7401 ± 1644 for the elastomer and PMMA group, respectively (P = 0.012). The post-cycling pullout test of the loosened screws showed differences in the failure mode and failure load, with predominantly pedicle/vertebrae fractures in the PMMA group (1188.6 N ± 288.1) and screw pullout through the pedicle (671.3 N ± 332.1) in the elastomer group.

The modified pedicle screw augmentation technique involving a balloon cavity creation and a self-curing elastomeric silicone resulted in a significantly improved pedicle screw anchorage under cyclic cranio-caudal loading when compared to conventional in situ PMMA augmentation [1].

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Schmoelz W, Keiler A, Konschake M, Lindtner RA, Gasbarrini A. Effect of pedicle screw augmentation with a self-curing elastomeric material under cranio-caudal cyclic loading-a cadaveric biomechanical study. J Orthop Surg Res. 2018 Oct 11;13(1):251. doi: 10.1186/s13018-018-0958-z. PubMed PMID: 30305126; PubMed Central PMCID: PMC6180648.