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Biomaterials characterization and pedicle screws fixation in lumbar spine: A review

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Instability of the lumbar spine is caused by various factors that include degenerative disc, herniated disc, traumatic, and other disorders. Pedicle screws are widely used as a main fixation device to construct rigid linkages of vertebrae to be fully functional and stable. Other various technologies and methods have been used to restore the stabilization. Loosening of pedicle screws has been the main cause of concerns. This could happen either errors in installing processor very poor bone qualities due to osteoporosis. Additionally, Shear force and tension/compression force would change as spine goes through different phases such as extension, flexion, bending and rotation. The pullout strength of augmented pedicle screws was increased in both primary and salvage procedures by 119% ($p = 0.001$) and 162% ($p = 0.01$), respectively. Self-centering pedicle screws at different trajectories (0° , 10° , 20° , and 30°) showed the same pullout strength as inserted in a straight-ahead trajectory. The outer cylindrical and inner conical shape of pedicle screws showed the highest pullout strength in Grades 5 and 15 foams (synthetic bone). An outer cylindrical and inner conical shape with a V-shape thread showed the highest pullout strength in all foam grades. The maximum pullout strength was observed at axial pullout configuration at 0° . For the Grade 15 (240 kg/m^3) foam, there was the decline in pull out strength. The decrease in pullout strength was highest for Grade 10 (160 kg/m^3) foam. The maximum pullout strength of 2176 N (0.32-g/cm^3 Sawbones) on all densities. Type 1 Pedicle screw showed the best fixation due to smaller conical core diameter and smaller thread pitch (Screw 2, 2 mm; Screws 1 and 3, 3 mm).

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