World Academy of Science, Engineering and Technology
International Journal of Bioengineering and Life Sciences
Vol:14, No:04, 2020

A Review on Development of Pedicle Screws and Characterization of Biomaterials for Fixation in Lumbar Spine

Authors : Shri Dubey, Jamal Ghorieshi

Abstract : Instability of the lumbar spine is caused by various factors that include degenerative disc, herniated disc, traumatic injuries, and other disorders. Pedicle screws are widely used as a main fixation device to construct rigid linkages of vertebrae to provide a fully functional and stable spine. Various technologies and methods have been used to restore the stabilization. However, loosening of pedicle screws is the main cause of concerns for neurosurgeons. This could happen due to poor bone quality with osteoporosis as well as types of pedicle screw used. Compatibilities and stabilities of pedicle screws with bone depend on design (thread design, length, and diameter) and material. Grip length and pullout strength affect the motion and stability of the spine when it goes through different phases such as extension, flexion, and rotation. Pullout strength of augmented pedicle screws is 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°) show the same pullout strength as insertion in a straight-ahead trajectory. The outer cylindrical and inner conical shape of pedicle screws show the highest pullout strength in Grades 5 and 15 foams (synthetic bone). An outer cylindrical and inner conical shape with a V-shape thread exhibit the highest pullout strength in all foam grades. The maximum observed pullout strength is at axial pullout configuration at 0°. For Grade 15 (240 kg/m^3) foam, there is a decline in pull out strength. The largest decrease in pullout strength is reported 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 shows the best fixation due to smaller conical core diameter and smaller thread pitch (Screw 2 with 2 mm; Screws 1 and 3 with 3 mm).

Keywords : polymethylmethacrylate, PMMA, classical pedicle screws, CPS, expandable poly-ether-ether-ketone shell, EPEEKS, includes translaminar facet screw, TLFS, poly-ether-ether-ketone, PEEK, transfacetopedicular screw, TFPS
Conference Title : ICBMC 2020 : International Conference on Biomaterials and Materials Characterization
Conference Location : Boston, United States
Conference Dates : April 23-24, 2020