Perbandingan pullout strength sekrup pedikel antara lintasan konvensional, lintasan kortikal infero-superior, dan lintasan kortikal supero-inferior pada lumbal babi Yorkshire: suatu studi biomekanik = Pedicle screw pullout strength comparison between conventional pedicle screw trajectory, cortical infero-superior trajectory, and cortical supero-inferior trajectory in yorkshire lumbar porcine: a biomechanical study

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Abstrak

Instrumentasi posterior mengharuskan dipertahankannya fiksasi stabil sekrup pedikel di tulang belakang untuk mencapai fusi. Hal ini dapat menjadi sulit terutama pada kondisi tertentu, misalnya pada penurunan densitas masa tulang pedikel. Teknik insersi sekrup dengan lintasan kortikal diharapkan menambah antarmuka sekrup dan tulang dengan meningkatkan engagement antara sekrup dengan korteks tulang. Lintasan sekrup dari arah kortikal infero-superior serta kortikal supero-inferior diharapkan memiliki keunggulan kekuatan cabut (pullout strength) dibandingkan dengan lintasan konvensional dalam mengatasi masalah ini. Penelitian ini bertujuan untuk mendapatkan profil biomekanik awal lintasan kortikal dan perbedaan pull out strength lintasan konvensional (Weinstein, 1992), kortikal infero-superior (Santoni, 2009), dan kortikal supero-inferior. Metode: Sampel dari lumbal (L1-L5) babi Yorkshire (n=30) dilakukan pengukuran morfometri dan dibagi secara acak. Sampel dilakukan pengeboran dan sekrup dimasukkan ke dalam tulang dengan tiga lintasan: konvensional, kortikal infero-superior, dan kortikal supero-inferior. Arah lintasan diperiksa kembali dengan sinar-x. Dilakukan penarikan sekrup dengan arah sesuai aksis insersi sekrup dengan kecepatan translasi 5mm/menit. Hasil dicatat dengan satuan Newton (N). Hasil: Didapatkan rata-rata nilai uji tarik pada kelompok konvensional, infero-superior, dan supero-inferior masing-masing 491,72 (187.23) N, 822,16 (295.73) N, dan 644,14 (201.97) N. Lintasan kortikal infero-superior dan kortikal supero-inferior masing-masing mendapatkan nilai 67% dan 30% lebih tinggi dibandingkan dengan lintasan konvensional. Hasil uji ANOVA satu arah dan uji post-hoc Tukey menunjukkan perbedaan signifikan antara lintasan kortikal infero-superior dengan konvensional ($p<0.01$). Kesimpulan: Lintasan sekrup dalam tulang lumbal dapat memengaruhi nilai pullout sekrup. Keterlibatan tulang kortikal pada lintasan insersi sekrup baru ini bisa meningkatkan nilai pullout sekrup pedikel. Secara statistik pullout strength lintasan kortikal infero-superior dan kortikal supero-inferior tidak ada perbedaan. Studi ini menunjukkan nilai pullout yang lebih tinggi sebesar 30% dari lintasan yang disarankan peneliti dibandingkan dengan lintasan konvensional, walaupun tidak ada perbedaan signifikan secara statistik.

.....Introduction: Posterior instrumentation is aimed to achieve spinal fusion which is helped by maintaining a stable pedicle screw insertion within the pedicle. This presents a challenge especially in conditions with low bone quality. Pedicle screw insertion with cortical bone trajectory is designed to add interface between the screw and the bone through engagement between pedicles and the cortex when compared to conventional pedicle screw insertion. Pedicle screw insertion trajectory from cortical infero-superior and the proposed cortical supero-inferior should obtain better pull out performance when compared with conventional pedicle trajectory. We aim to evaluate the pull out strength differences between conventional

(Weinstein, 1992) pedicle screw trajectory, cortical infero-superior (Santoni, 2009), and a proposed cortical supero-inferior trajectory. Methods: Samples from Yorkshire porcine lumbar spine (L1-L5) (n=30) were relieved of soft tissue attachments and dried. Morphometric measurements were conducted and the samples were randomly assigned to three groups. The screws were inserted into the vertebrae by drilling with the three trajectories: conventional, cortical infero-superior, and cortical supero-inferior. The trajectory of the screws were examined using x-rays. Pull-out tests were conducted by applying uniaxial traction in line with the screw trajectory with a translational speed of 5mm/minutes. The results of the pull-out are measured in Newton (N). Results: We obtained a mean value of pullout force in conventional trajectory 491,72 (187.2) N, cortical infero-superior 822,16 (295.73) N, and cortical supero-inferior 644,14 (201.97) N. Cortical infero-superior trajectory and cortical supero-inferior trajectory attained 67% and 30% higher pullout mean respectively. Using one-way ANOVA and a post-hoc Tukey test revealed a significant difference between cortical infero-superior and conventional trajectory ($p<0.01$). Differing pull out strengths between cortical infero-superior and supero-inferior trajectory showed no statistical significance. Our study showed a 30% higher pull-out strength in our proposed trajectory compared with conventional trajectory although not statistically significant. Conclusion: The trajectory of the screws within the lumbar spine seemed to have an impact in pullout strength. Cortical bone engagement using the novel trajectories may increase screw pullout strength of pedicle screws.