A finite element analysis on stress change of spinal pedicle screw system after adding laminal hook

Wang, Y.*, Pan, T.*, Liu, X.Y.*, Zhu, X.P.*

*Department of Orthopaedics, Dongguan People's Hospital, Dongguan 523018 Guangdong Province, China

Abstract

Aim: To evaluate the stress of the spinal pedicle screw internal fixation system after adding laminal hooks. Methods: The experiment was carried out in the Mechanics Experiment Center, College of Traffic and Communication, South China University of Technology on October 20, 2005. Three-dimensional finite element analysis was applied to establish the model of the spinal pedicle screw system. The length of the pedicle screw and the rod was 40 mm and 120 mm respectively. The diameter of both was 6 mm. The height of the laminal hook was 9 mm and length was 22 mm. The finite element model of pedicle screw system was established using ANSYS 8.0 software to restrain the caudal pedicle screw and endosurface of caudal laminal hook, the loading was vertical to the cephalic pedicle screw. 3 Stress measurement: The stress change of spinal pedicle screw internal fixation system with or without laminal hooks was explored under 5 N·m anteflexion torque. Results: After adding hooks, the load-bearing points increased in number and became well-distributed. The stress on those points was significantly decreased, where was easily broken in clinic. The stress of axial direction was significantly decreased at the end of pedicle screws after hook added, especially in caudal pedicle screw where was decreased by 37.08%. The stress of shearing was significantly decreased in the conjunction of screw-rod, the cephalic and caudal screws, which was decreased by 44.02% and 60.71% respectively. Conclusion: After novel hooks add, the stress of the pedicle screw system is well-distributed, significantly at the end of caudal screw and the conjunction of screw-rod. Thus the breakage of pedicle screws decreases.

Language of original document

Chinese
Index Keywords

EMTREE medical terms: article; bone screw; computer program; controlled study; finite element analysis; mechanical stress; orthopedic equipment; osteosynthesis; shear stress; spine surgery; torque

Tradenames

Device tradename: ANSYS 8.0.

References (18)


2. Wilcox, R.K.


5. McLain RF. The biomechanics of long versus short fixation for thoracolumbar spine fractures. Spine 2006;31(11S) Suppl S70-S79


7. Harrington, P.R.

8. Chinese source.
9  Cook, S.D., Salkeld, S.L., Stanley, T., Faciane, A., Miller, S.D.
Biomechanical study of pedicle screw fixation in severely osteoporotic bone
doi: 10.1016/j.spinee.2003.11.010

View at publisher

10  Chinese source.

11  

12  Tan, J.-S., Kwon, B.K., Dvorak, M.F., Fisher, C.G., Oxlund, T.R.
Pedicle screw motion in the osteoporotic spine after augmentation with laminar
hooks, sublaminar wires, or calcium phosphate cement: A comparative analysis
doi: 10.1097/01.BRS.0000134569.63542.49

View at publisher

13  Diedrich, O., Kraft, C.N., Lüning, C., Perlick, L., Pennekamp, P.H.
Stability of different interbody fusion techniques after pedicle screw loosening

View at publisher

14  Renner, S.M., Lim, T.H., Kim, W.J., Katolik, L., An, H.S., Andersson, G.B.
Augmentation of pedicle screw fixation strength using an injectable calcium
phosphate cement as a function of injection timing and method.

15  Stančič, M.F., Mićović, V., Potočnjak, M.
Hook-rod with pedicle screw fixation for unstable spinal fracture: Technical note

16  Yerby, S.A., Ehteshami, J.R., McLain, R.F.
Offset laminar hooks decrease bending moments of pedicle screws during in situ
contouring
doi: 10.1097/00007632-199702150-00004

View at publisher

17  Chinese source.

18  Chinese source.

© Pan, T.: Department of Orthopaedics, Sun Yat-sen University, Guangzhou 510080 Guangdong Province,
China; email: pantao@126.com
© Copyright 2009 Elsevier B.V., All rights reserved.

Journal of Clinical Rehabilitative Tissue Engineering Research
Volume 11, Issue 22, 3 June 2007, Pages 4292-4295