A biomechanical effect on laminectomy and dekyphosis for thoracic OPLL

Tadaki Okayama, Hideki Murakami, Satoru Demura, Satoshi Kato, Katsuhito Yoshioka, Hiroyuki Tsuchiya

Department of Orthopaedic Surgery, Graduate School of Medical Science, Kanazawa University, Kanazawa, JAPAN
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Disclosure

The authors received no benefits or funds in support of this study.
We successfully performed a two-step circumspinal decompression for the treatment of thoracic ossification of the posterior longitudinal ligament (OPLL). In the first step, extensive laminectomy is performed according to the extent of the ossified lesion; this is followed by correcting the fixation of kyphosis (dekyphosis) using instrumentation. In the second step, the OPLL is removed by anterior approach, and then the circumspinal decompression is completed.
Purpose

• In this study, we reconstructed the first step using a finite element model (FEM) to enable us to clearly present the effects of the first step.

Method

① Reconstructed the thoracic OPLL using a FEM
② Reconstructed the posterior decompression
③ Reconstructed the dekyphosis
Reconstructed the thoracic OPLL

• A commercially available FEM of the human body, THUMS, was used to model the operative procedure.
• The spinal cord, nerve root, and OPLL were incorporated into this model.
• OPLL was reconstructed at T8/9 level of the thoracic spine.
After applying the imposed displacement to the OPLL, the mechanical stress on the spinal cord was measured, with OPLL occupancy rates in the spinal canal being between 0% and 70%.
Reconstructed the posterior decompression

- We removed the lamina of T8 and T9 from the model before laminectomy, and thus regarded the model as being representing the state after laminectomy.
- The mechanical stress on the spinal cord was measured
We use the laminectomy model in which the OPLL occupancy rate is 70%, for reconstructed the dekyphosis.

The change in the stress was analyzed after imposed displacement by which the spine was decreased the cobb angle by 10 degrees between T7 to T11.
Results and Discussion

• When the occupancy rate was greater than 60%, the stress on the spinal cord decreased after laminectomy compared to before laminectomy.
• When the occupancy rate was 70%, the stress put on the spinal cord was 618 kPa before laminectomy and 295 kPa after laminectomy. The stress put on the spinal cord is decreased by 52.3%.
• We found that laminectomy was more effective when the OPLL occupancy rate was greater.

• This demonstrates that the pressure on the spine is indirectly reduced by dekyphosis.
Conclusion

• We reconstructed the OPLL model using a finite element model.
• After the laminectomy, when the occupancy rate is 70%, the stress put on the spinal cord is decreased by 52.3%.
• We found that laminectomy was more effective when the OPLL occupancy rate was greater.
• When the dekyphosis angle was 10 degrees, the stress on the spinal cord decreased by 14.6%.
• This study demonstrates that the pressure on the spine is indirectly reduced by dekyphosis.