BIOMECHANICAL RESULTS OF ALICI SPINAL SYSTEM IN DIFFERENT APPLICATIONS

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ABSTRACT:

Alıcı Spinal System, that is used in the treatment of various spinal deformities and fractures, has been analyzed on calf spine models.

Proper segments were been obtained from fresh calf spines. All of the segments were from the same level and of the members of the same age group. In Group-I, anterior screw was applied superiorly and inferiorly, in Group-II, superiorly and inferiorly screw application was performed through posterior approach. In Group-III, superior hook, inferior screw combination was applied posteriorly. In Group-IV, Posterior hook-hook combination was applied. Systems were interconnected by rods and telescopic nuts. In Groups II, III and IV, also transverse connectors were added. After the completion of stabilization, anterior and middle columns of intermedier segment was destroyed by an osteotome.

The top and bottom segments of each model were covered with polyester to make the samples suitable for testing. Samples were undergone axial loading under Instron 1114 type test machine. Compression rate was 0.2 cm/min., paper speed was 2 cm/min.

Results were recorded graphically. Tests were repeated seven times for each group.

Statistically mean values for each group were as follows: In Group-I, anterior spinal system 10980 N, in Group - II 14320 N, in Group - III 7900 N and in Group-IV 7180 N.

Biomechanical axial loading test results were analyzed statistically.

Key Words: *Biomechanics, Alıcı Spinal System.*

Today, many types of instruments are employed in the treatment of spinal diseases, deformities and fractures. These offer many types of treatment alternatives according to surgical incision and level of the spine to be stabilized. In present time, hundreds of spinal instrument models are available and offer different alternatives consisting many implants such as rods, corclage wires, platen, hooks, screws (1, 8, 9, 13, 17, 24).

Alıcı Spinal System, that is used in Turkey and some other contries commonly, initially applied in 1989 and proposed in the treatment of many spinal problems (1). This system, which is being applicable anteriorly and posteriorly, consists of rods, transpedicular screws, laminar and pedicular hooks, anterior screw system, telescopic nuts and transverse connectors (1).

In this study, Alıcı spinal instruments was applied to unstable spine calf models in forms of anterior and posterior transpedicular screws, posterior hook-screw, posterior hook-hook combinations. Then, each of these models were undergone axial loading and stability of each combination against axial loads was investigated.

MATERIALS AND METHODS

Twenty-eight fresh calf spine models were provided. Calves were 12-16 months (average: 14.7) old. Because of anatomical properties of calf spine thoracolumber junction that is the best place for instrumentation, was accepted as standard region. Only this region was used for tests.

Intervertebral and paravertebral muscles of calf spines were stripped off soon after slaughter. However, anterior longitudinal ligament, posterior longitudinal ligament, interspinous ligament and intervertebral discs have preserved. Models were wrapped with wet towels and preserved, in the refrigerator at +4°C and models were undergone testing in the first 8 hours (average : 410 min.)

Four groups of experiments were created. In group-I, Alıcı Anterior Spinal System, In groups II, III and IV Alıcı Posterior Spinal System combinations were applied.

Anterior Spinal System has applied in Group-I. Five segments of thoracolumber junction have used

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for this group. Staples and anterior screws have placed superiorly and inferiorly. System has interconnected with rods and telescopic nuts. Anterior and middle columns of intermediary segment was destroyed by means of an osteotome.

In group II, five segments of thoracolumber junction were also prepared. Transpedicular screws have applied bilaterally and, superiorly and inferiorly. System has interconnected by rods and telescopic nuts. Two transverse connectors have also used superiorly and inferiorly. Intermedier vertebrae was destroyed as in Group-I.

In Group-III, spinal model was similar to the other groups. Transpedicular screws were applied bilaterally to the 4th vertebra. Then, open pedicular hooks were settled between 1st and 2nd segment. Hook and screw system were interconnected by rods and telescopic nuts. Finally, transverse connectors were applied superiorly and inferiorly. Intermedier segment was destroyed as in other groups.

In Group-IV, five segments of thoracolomber junction was used as spinal model. Open pedicular hooks were applied between the upper two segments and open laminar hooks were settled between the inferior segments bilaterally. System was interconnected by means of rods and telescopic nuts. Transverse connectors were also applied routinely. Anterior and middle segments of intermedier segment was destroyed as done previously.

Top and bottom segments of models were covered with polyester to make them ready for biomechanical tests. Rods, screws and hooks of the system were kept out of polyester.

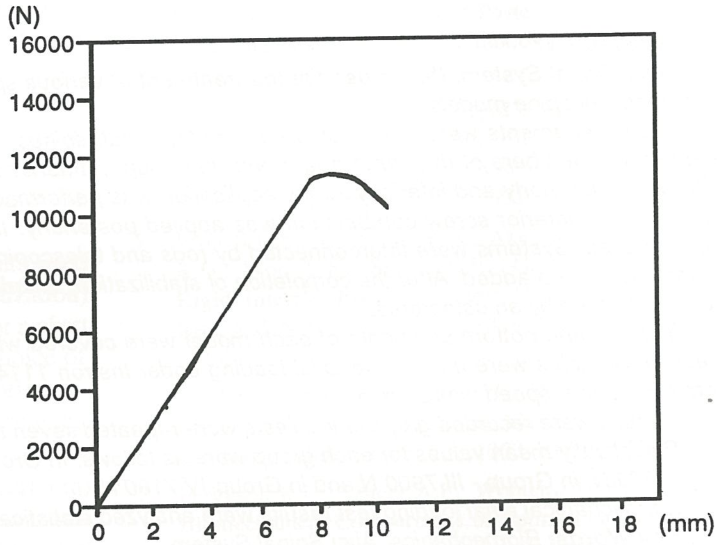
Seven samples of each group were undergone axial loading.

Test was been performed under Instron 1114 type test machine only as acute axial loading. Graphical results wer erecorded (compression load rate 0.2 cm/min. Paper speed 2 cm/min.). Recorded values were converted to Newton unit and average value of repeated tests for each group were calculated.

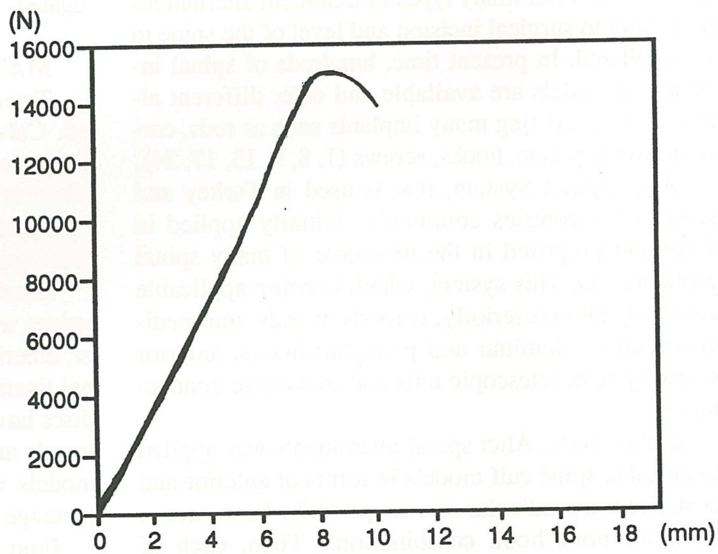
RESULTS

Tests were repeated seven times for each group and average of these values were recorded. Stability values against axial loading forces were as follows.

In Group-I, Anterior Alıcı Spinal System was deformed beyond mean 10980 N. (min: 10020 N - max : 12100 N) (Graphic 1.).



Graphic 1. Curve of Axial Loads-Deformation in Anterior Alıcı Spinal System Application

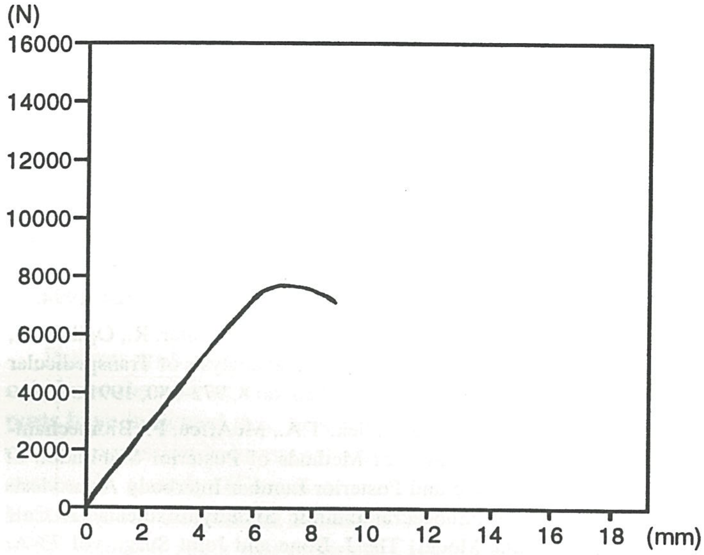


Graphic 2. Curve of Axial Loads-Deformation in Posterior Transpedicular Screw Application

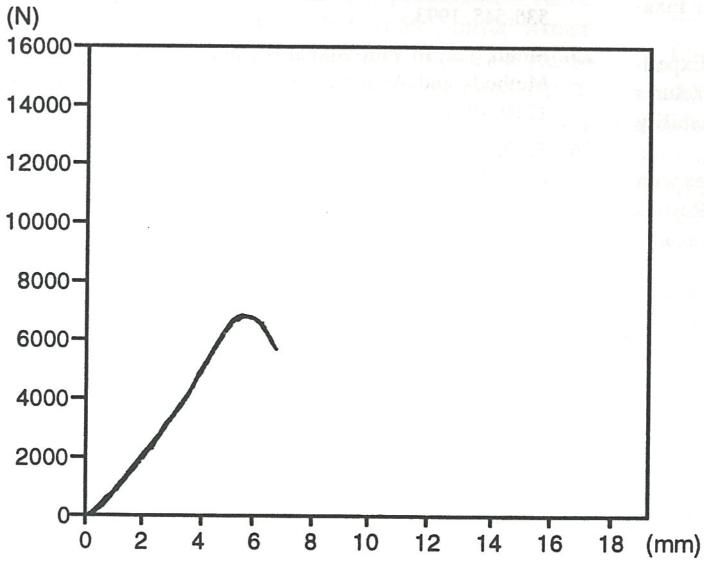
In Group-II, (Alıcı Transpedicular Screw Spinal System) deformation was observed beyond mean values 14320 N (min: 13800 N - 15440 N). (Graphic - 2).

In Group-III, (Hook - Transpedicular screw combination) mean deforming force has recorded as 7900 N (min: 7100 N - max: 8300 N) (Graphic - 3).

In Group IV, (Posterior Alıcı Spinal System hook-hook combinant) mean deforming force was 7180 N (min : 6960 - max : 7310). (Graphic - 4).



Graphic 3. Curve of Axial Loads-Deformation in Posterior Hook-Transpedicular Screw Application



Graphic 4. Curve of Axial Loads-Deformation in Posterior Hook-Hook Application

DISCUSSION

Today, many types of instrument systems were been used in the treatment of spinal diseases, deformities and fractures. Although these systems offer to surgeons many different treatment possibilities, anatomical considerations, scientific, and biomechanical results, and surgeon's experience effects the choice (3, 4, 6, 22, 27).

Alıcı Spinal System, that is used in the treatment of spinal diseases, deformities and fractures since 1989, is the capable of providing of three-dimensional stabilization (1).

Alıcı Spinal System is able to be applied through anterior and posterior approaches in the treatment of vertebrae fractures.

In an unstable vertebra, in which anterior and middle columns was fractured (7), aim is to provide normal anatomic aligment of vertebral column, to recreate stabilization, too.

Although results of hook application seem to be inferior in comparison with anterior and posterior Transpedicular systems, anatomical differences of laminea and pediculae of calf spine made us suspicious about the results (23). In addition, independently of the anatomic characteristics of human spine it's impossible to apply transpedicular screws above Thoracal 11 level, therefore, hooks system has no alternative at this level (1, 20, 22, 24, 27). Although, there are many scientific data concerning high resistance of transpedicular system against all types of loadings, not only difficulty of its application, but also its high risk of neurodeficit during the application frightened surgeons (6, 27).

Anterior spinal instrumentation is inevitably indicated in cases such as anterior columnar compression exceeds 50%. In these cases anterior approach is very useful for a sufficient decompression (7, 10, 13).

All these biomechanical results, comments and scientific data indicate that, Alıcı Spinal System that is used for unstable burst fractures of vertebrae (anteriorly and posteriorly), has sufficient strength against axial loads.

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