Biomechanical Analysis of a Novel Cervical Spine Posterior Fixation Using Bio-derived Tendon in the Goat Cervical Ligament Complex Injury Model

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Introduction: The stability and motion of posterior cervical spine has considerable limitations regarding torn ligament complex. Conventional posterior cervical spine fixations are associated with high rates of loss of motor function in adjacent segment. Non-fusion techniques may offer potential alternatives for recreating a valid dynamic stability. The biomechanical testing was performed with the purpose of investigating a novel cervical spine posterior fixation using the bio-derived freeze-dried tendon could provide enough stability and motion preservation in animal cervical ligament complex injury model.

Materials and methods: Fifteen fresh cadaveric C2-C6 sheep cervical spine specimens were harvested and tested for the data of intact status as normal control group. Then, through resection of the ligament complex in posterior cervical spine (C3-C4), the unstable spines were randomly divided into three groups:
(1) injury control group (n=5)
(2) screw-rods fixation group: stabilization with screw-rods on C3-C4 (n=5);
(3) tendon reconstruction group: stabilization with bio-derived freeze-dried tendon on C3-C4 (n=5), freeze-dried tendon were cross-fixed with “8” shapped in the 3-4 cervical bilatera facet joints.

After implanting insertion, the specimens were loaded nondestructively with pure moments cycled from 0.75 to 3.5 Newton-meter for flexion, extension, right and left lateral bending, and axial rotation on a test apparatus. The range of motion (ROM) data for each fixation scenario was calculated, and a statistical analysis was performed respectively (P< 0.05, ANOVA).

Results: In flexion loading, the ROM values of the tendon fixation group and screw-rods fixation group indicated there were significant differences (P < 0.05), while the tendon fixation group and normal control group shared no significant differences (P>0.05). In lateral bending and axial rotation mode, the ROM values of tendon fixation group increased largely compared with screw-rods fixation group (P < 0.05), however the ROM values of tendon fixation group had no significant statistically difference with normal control group and injury control group (P>0.05).

Discussion: The novel cervical spine posterior fixation using the bio-derived frozen dried tendon can provide enough stability in flexion motion, and do not limit the lateral bending and axial rotation motion which have provided simulated range of motion in animal model. Whether the novel fixation and the bio-derived material could prove a good biocompatibility and Mechanical Properties remains to be established in further studies.

Keywords: Cervical posterior fixation; ligament complex; biomechanics; stability; motion preservation