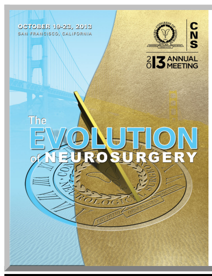

Ligamentous Stabilizers of the Occipitocervical Junction

Kris Radcliff MD (1); Mir Hussain BS (2); Mark Moldavsky BS (2); Noelle F Klocke MS (2); Todd Albert MD (1); Alexander R. Vaccaro MD (1); Saif Khalil PhD (2); Brandon Bucklen PhD (2)

1.Rothman Instutite, Philadelphia, PA

2.Globus Medical, Inc., Audubon, PA

Introduction

The contributions of the ligaments at the craniocervical junction to overall stability and the effects of the occipitoatlantal (OA) joint capsules on pathological translation are unknown. Determining which stabilizing ligaments are most important in restraining pathological translation could assist in understanding subluxation.

Methods

Seven cadaveric specimens were tested with a six degrees of freedom spine simulator under the conditions (Figure 1): intact [A]; clivus/alar removal (CR)[B], transverse ligament destruction (TLD)[C], OA joint capsulotomy (C0-C1 JC)[D], and atlanto-axial joint capsulotomy (C1-C2 JC)[E]. Flexion-extension (FE), lateral bending (LB), axial rotation (AR) was applied (2.5N-m) to a C0-C2 segment while anterior-posterior (AP), cranial-caudal (CC), and medial-lateral (ML) translations were recorded. Average motions were normalized to intact (Intact = 100%) for each joint.

Test Sequence

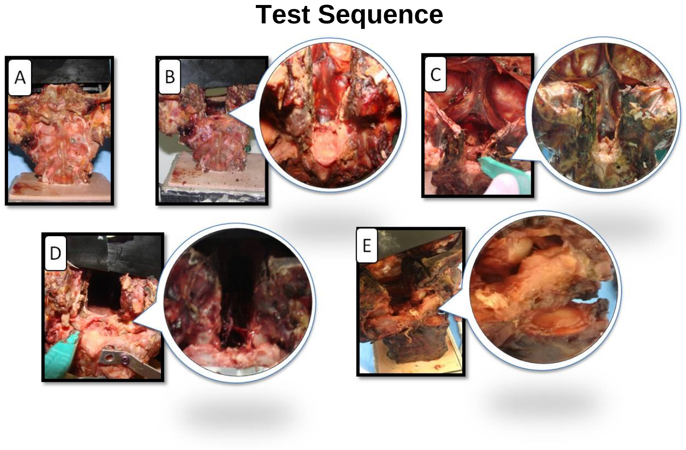

Figure 1: Incremental recreation of the injury.

Results

Due to coupled motion in the cervical region, all rotations were recorded simutaneously to quantify secondary motion increases along with primary applied motion. Below, only statistically significant findings have been reported, all other results can be seen in the figures (Figure 2-4).

At the C0-C1 joint, there were significant ($p<0.05$) increases from at TLD (154%), and C0-C1 JC (174%) from intact in FE (Figure 2), and TLD (178%) and C0-C1 JC (224%) from intact in AR(Figure 4). AP translation, during LB (Figure 3), increased significantly following TLD (248% of intact). CC translation, during FE, increased significantly following TLD (188%) and C0-C1 JC (361%) from intact.

At the C1-C2 joint, there were significant increases at TLD (172%) from intact in FE (Figure 2). Likewise TLD (286%) and C1-C2 JC (332%) also signficantly increased from intact in LB (Figure 3). In AR (Figure 4) there were no statistical differences. AP translation increased significantly following CR (280% of intact) during LB. CC translation also increased significantly following CR (205%) and TLD (298%), during LB.

Flexion-Extension

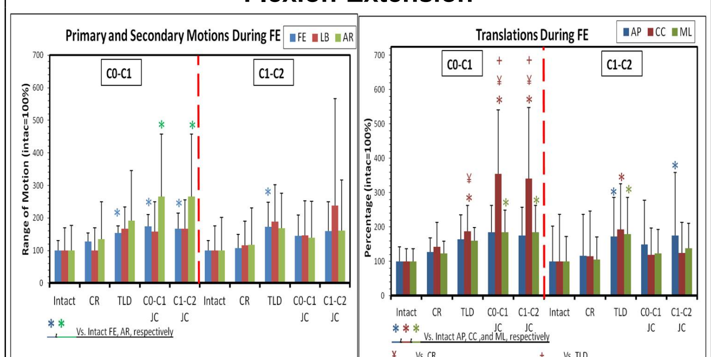

Figure 2: Primary, secondary motions, and translations during applied flexion-extension.

Lateral Bending

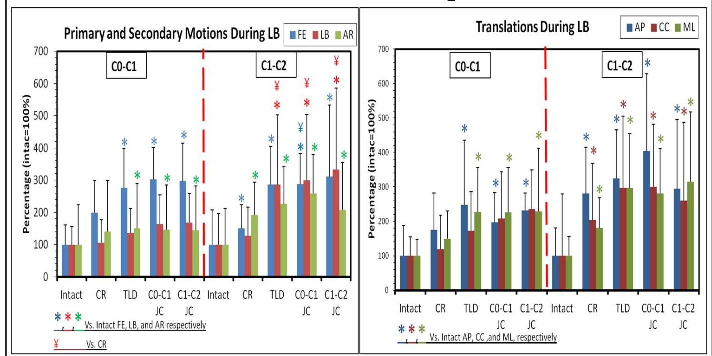

Figure 3: Primary, secondary motions, and translations during applied lateral bending.

Axial Rotation

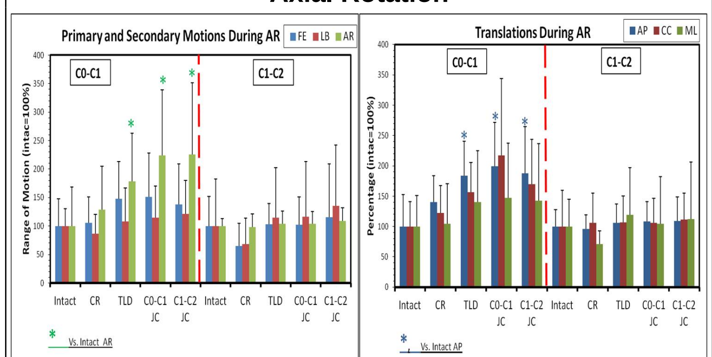

Figure 4: Primary, secondary motions, and translations during applied axial rotation.

Conclusions

The transverse and alar ligaments appear to be the main stabilizers of the craniocervical junction. The vertical structures attaching on the clivus and C0-C1 joint capsules appear to function as secondary stabilizers. Severe craniocervical trauma models should should consider sectioning of all of these restraining structures for future studies.