INTRODUCTION

Fractures of the odontoid process are the most common cervical spine injuries in the elderly, and of these, type II fractures are the most frequent [1,2]. In this patient population, these fractures commonly occur with low-energy injury mechanisms, including falls from a standing height. With this mechanism, some restraints to displacement, such as those provided by the ligamentous structures, remain intact. The stabilizing role of these soft tissue restraints in this context has not been explored in the literature.

In a study by Crawford et al., the authors evaluated multiple injury scenarios for the atlanto-axial joint including a simulated type II odontoid fracture [3]. They found that an odontoid fracture did increase C0-C1 and C1-C2 range of motion; however, they did not examine the influence of specific soft tissue restraints in this setting.

The purpose of this study was to determine the restraint to pathological motion provided by the passive soft tissues stabilizers surrounding the C1-C2 joint in the setting of a simulated type II odontoid fracture in cadavers older than 75 years of age.

METHODS

Ten cadaveric CO-C2 spinal segments (mean age: 78 ± 6 years) were studied. Specimens were tested under simulated axial rotation with an applied moment of ±1Nm and with the direct application of 10N anteriorly-directed force to the body of C2 to induce sagittal translation (Figure 1). Optical motion data were initially collected for the intact state, and after a simulated dens fracture.

The specimens were then divided into two groups (Protocol 1 & 2), where one group underwent unilateral then bilateral C1-C2 facet capsular injuries followed by anterior longitudinal ligament injuries. The second group underwent the anterior longitudinal ligament injury prior to the same capsular injuries.

Changes in axial range of motion (ROM) and C1-C2 translation were recorded and were analyzed using two-way repeated measures ANOVAs and post-hoc Student-Newman-Keuls tests (α = 0.05).

RESULTS

In axial rotation, there was an increase in ROM by approximately 13% with the fracture of the dens compared to the intact state (p<0.05). An increase was also present for each subsequent soft-tissue injury state compared to the previous (p<0.05); however, there was no difference found between the two soft tissue sectioning protocols.

For sagittal translation testing, it was found that the odontoid fracture alone showed an increase of 3mm of C1-C2 translation compared to intact (p<0.05). Further soft tissue injuries did not show an increase until the complete injury state (Figure 2).

DISCUSSION

While odontoid fractures in the elderly are common cervical spine injuries, controversy exists as to the most appropriate treatment. Conservative treatment for this patient cohort has been demonstrated to be effective and safe [4].

The provocative sagittal translation loading demonstrated the previously recognized role of the dens as a primary stabilizer. There was essentially no translation in the intact state and the dens fracture led to an increase in translation of approximately 3mm. However, no further increase was seen with sequential ligament sectioning until all tested ligaments were sectioned. This illustrates that the ligaments do not provide a cumulative influence, but rather an “all or nothing” effect. This helps to support the hypothesis that the surrounding soft tissues will provide an important stabilizing influence in an odontoid fracture produced by a low energy mechanism in an elderly patient.

SIGNIFICANCE

This study identifies that type II odontoid fractures without associated soft tissue injury may be stable under certain loading modes.

REFERENCES