

C1 Lateral Mass Displacement and Transverse Atlantal Ligament Failure in Jefferson's Fracture: A Biomechanical Rationale for the "Rule of Spence"

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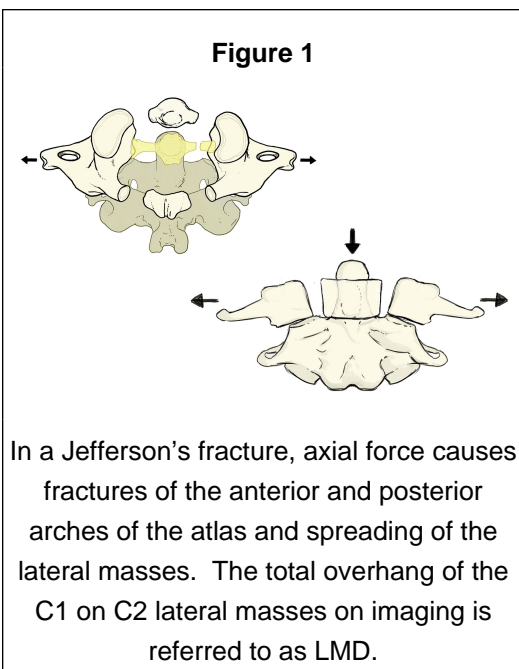


Introduction

Jefferson's fracture, first described in 1927, represents a bursting fracture of the C1 ring with lateral displacement of the lateral masses (Figure 1). In 1970, Spence, et al. determined that if the total lateral mass displacement (LMD) exceeds 6.9 mm, there is high likelihood of transverse atlantal ligament (TAL) rupture. Several recent radiographic studies have questioned the accuracy and validity of the "rule of Spence" and it lacks biomechanical support.

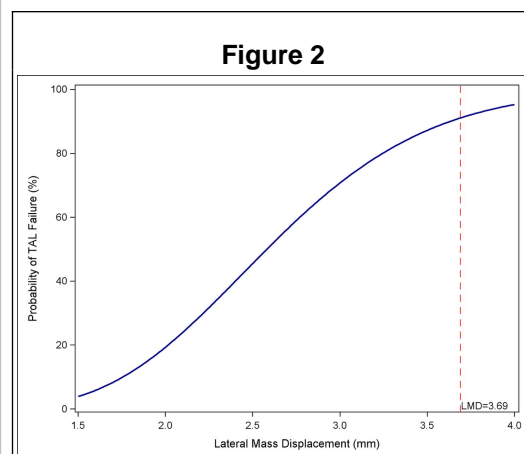
Methods

Using a universal materials testing machine, cadaveric TALs were stretched laterally until failure. A high-resolution, high-speed camera was utilized to measure the displacement of the lateral masses upon TAL failure.

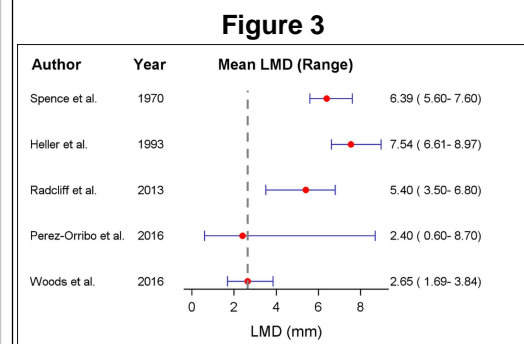


Results

5 cadaveric specimens were tested (N=5). 4 of the 5 TALs ruptured and 1 TAL avulsed from its attachment to the lateral mass. The average LMD upon TAL failure was 2.65 mm (\pm 0.84 mm). The average force required to cause failure of the TAL was 235 N (\pm 121 N). From our data analysis, if LMD exceeds 3.69 mm there is >95% probability of TAL failure.



Probability of TAL failure based on LMD.



Average LMD in subjects with TAL failure in our study compared to previously published reports.

Conclusions

Our findings suggests that the rule of Spence is a conceptually valid measure of TAL integrity; however, TAL failure occurred at an average LMD of 2.7 mm, which is significantly less than reported by Spence et al ($P < .001$). Based on our findings, we strongly encourage clinicians to have a high index of suspicion for TAL injury if LMD exceeds 3.69 mm.

Learning Objectives

By the conclusion of this session, participants should be able to:

1. Describe the clinical importance of the "rule of Spence"
2. Discuss the accuracy of previously published threshold values for lateral mass overhang that indicate transverse atlantal ligament injury.
3. Identify an accurate threshold for lateral mass displacement that will indicate transverse atlantal ligament compromise.

References

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