

LOAD TO FAILURE IN HAMATE AND SCAPHOID BONES: A CADAVERIC ANALYSIS

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ABSTRACT

Background: Hamate and scaphoid fractures are common injuries and can be problematic if not recognized early. There is a current lack of biomechanical data on the loading capacity of the carpals. The purpose of this study was to evaluate the ultimate force to failure in both cadaveric hamate and scaphoid bones. **Methods:** Six fully embalmed cadavers were used for this study, with an average age of 86 years (range of 70-92 years) with four being males and two being females. Each specimen was placed within a standardized analyzer with a circular probe individually focused over the scaphoid and hamate bones followed by precise compressive loading to failure. Data was recorded during fracture induction following a standardized protocol. CT scans were used to confirm presence of fracture. **Findings:** Compression testing revealed the average load to failure of 498N (SD 131N) for the hamate bone and 1000N (216N) for the scaphoid bone. Statistical analysis revealed a significant difference in average load to failure between the hamate and scaphoid bones ($p < 0.001$). However, no statistical differences were observed between matched right and left specimens or between specimens from male versus female cadavers. **Interpretation:** This study identifies an average minimum force required to induce fracture of each the scaphoid and hamate. Current literature holds limited data such as this. Our study may assist in highlighting a benchmark for preventive strategies to limiting carpal fractures, such as brace types and strength.

Keywords: hamate, scaphoid, carpal, biomechanics, compressive strength

INTRODUCTION

Fractures of the hamate and scaphoid are common orthopaedic injuries that result from traumatic events or repetitive stress. The hamate bone, situated in the distal row of the carpus, and the scaphoid bone, located within the proximal row, play crucial roles in wrist biomechanics and stability [1,2]. Despite the anatomical proximity of these two bones, they are subject to distinct mechanical forces and fracture behaviors, which necessitate a comprehensive understanding of their mechanical properties and load to failure characteristics.

Hamate fractures are commonly observed in athletes, particularly those engaged in sports involving repetitive gripping, swinging motions, or direct impact on the ulnar side of the hand, such as golf, baseball, tennis, and other racquet sports [3]. The hook of the hamate, a prominent palmar bony projection located at the distal aspect of the hamate, is particularly susceptible to fracture due to its vulnerable position and exposure to high forces during athletic activities [4]. Fractures of the hook of hamate often present with symptoms such as localized tenderness, pain with wrist motion, weakness in grip strength, and occasionally, ulnar nerve symptoms. Prompt recognition and management of hook of hamate fractures are crucial to prevent complications such as non-union, chronic pain, and ulnar nerve dysfunction, which can significantly impact an athletes performance and overall function [5].