ANALYSIS OF COMPLEX *IN-VIVO* CARPAL BONE MOTIONS

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INTRODUCTION

Many common musculoskeletal disorders affect the wrist joint. An understanding of both asymptomatic and symptomatic wrist motion is required to design effective treatments for these disorders. Unfortunately, the *in-vivo* three-dimensional kinematics of the wrist in pathological conditions is poorly understood. Recently some researchers have developed novel methods to examine carpal bone kinematics from CT images [1-5]. However, so far researchers have applied these methods only to simple flexion-extension or radial-ulnar deviation motions[4-8]. In this study, we studied complex carpal bone motions for one normal subject.

METHODS

A healthy left wrist from a 48 year old female was CT scanned in three positions: the clinical neutral position of the forearm, the pronated and maximum extended wrist posture, and the supinated and maximum flexed wrist posture. The scans were obtained using a GE8800 scanner at 120kV and 40mA. The voxel size was 0.234mm X 0.234mm X 1.0mm. Each carpal bone as well as the radius and ulna were volumetrically separated. Proprietary software based on the marching cubes algorithm was used to produce three-dimensional reconstructions of each bone. The radius bones from each posture were aligned to remove any errors introduced by movement of the patient’s forearm between CT scans. Principal axes registration methods developed by Upal et al [3] were used to quantify the carpal bone kinematics. Helical axis parameters were used for the motion analysis.

RESULTS AND DISCUSSION

*In-vivo* carpal bone kinematics during complex wrist movements differed from the previously studied simple motions. For example, previous studies have found that the primary motion of the capitare follows the global motion of the wrist during simple wrist flexion-extension [5-7]. Surprisingly for the complex pronation and extension motion, the capitare rotated ulnarily out of the plane of motion. The only previous study of pisiform motion has shown that during flexion-extension the pisiform moves in the plane of motion [8]. However, during pronation and extension, the pisiform rotated ulnarily; while in flexion and supination, the rotation was a combination of flexion and supination. As well, the trapezial and trapezoid did not rotate together as one unit. In addition, during combined flexion and supination, the carpal bones followed the global wrist joint motion more closely than during combined extension and pronation.

Although these findings provide grounds to question previous carpal bone kinematics theories, much more research is required to understand the causal mechanisms and to develop the framework needed to design effective treatments for wrist joint disorders.

REFERENCES

