INTRODUCTION-In the treatment of wrist arthritis, motion-preserving procedures are commonly preferred over complete arthrodesis because it is perceived these procedures provide higher patient satisfaction. Potential reasons for higher satisfaction include better function and reduced impact on other joints. However, reported risks with these procedures include further arthritic changes, failure of fusion, and implant loosening. To justify the risks and added technical challenges associated with these procedures, the benefits should be objectively measurable.

Our goals were to quantify and compare the impairments caused by reduced and absent wrist motion using objective measurements of task performance and perceived impairment, and to assess the compensatory motions of the shoulder, elbow, forearm and trunk imposed by impaired wrist motion.

METHODS-After obtaining IRB approval, twenty-one subjects (average age 23.8 years) without upper extremity compromise were recruited from the local community. After informed consent was obtained from all subjects, each was tested on three consecutive days and only the dominant side was tested. A custom brace (Figure 1) containing a single hinge at the wrist was made for each subject.

The mini-BIRDS® electromagnetic tracking system (Ascension Technology, Inc., Burlington, VT) was used to track wrist, forearm, and only the dominant side was tested. Positions of the shoulder, elbow, forearm and trunk imposed by impaired wrist motion were measured as ipsilateral forearm, elbow, shoulder, and trunk motions, respectively.

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The mini-BIRDS® electromagnetic tracking system (Ascension Technology, Inc., Burlington, VT) was used to track wrist, forearm, elbow, and shoulder motions of the tested extremity and the trunk. Joint motion was determined by the relative changes between receiver positions. During testing, the amount of flexion/extension permitted in the wrist by the brace was measured to assess its degrees of restriction. The DASH (Disabilities of the Arm, Shoulder and Hand) and PRWE (Patient Rated Wrist Evaluation) standardized patient questionnaires were administered to each subject to assess the difficulty of completing various tasks.

Task performance was measured under three conditions: 1) unrestricted wrist motion without the brace 2) fully restricted wrist motion with the hinged locked in neutral wrist position (0° flexion/extension), and 3) partially restricted wrist motion with the hinge permitting 30° flexion and 30° extension. Each subject performed the Jebsen hand function test, a timed test with seven tasks: writing, card turning, placing small objects in a can, simulated feeding, stacking checkers, lifting light objects and lifting heavy objects. The subjects then performed a series of 13 tasks obtained from the DASH, PRWE, and previous studies on wrist and elbow motions. As with the Jebsen Test data, times were reported as the total time to complete all 13 tasks. Perceived difficulty of task completion was measured by the completion of a modified version of the DASH and PRWE, as well as a study specific questionnaire regarding tasks in the Jebsen test and the 13 Activities of Daily Living.

The process began with the subject completing a baseline DASH and PRWE surveys. The subject was allowed a practice run of the tasks in the Jebsen test and ADL list without the brace; no measurements were taken at that time. Subjects were then braced, randomly assigned an order of bracing method (limited hinge motion versus no hinge motion), and instructed to wear the brace until testing the next day.

On reporting the next day for testing, the subject completed the DASH and PRWE. The Jebsen test was then performed with instructions to complete each task as quickly as possible with total time to complete each task recorded in seconds. The 13 ADL were then performed, with each task timed and joint motions recorded. Subjects then completed the Jebsen and ADL surveys. After completing the ADL under the restricted motion condition, the brace was removed and the protocol repeated. The subject was dismissed wearing the brace set for the other condition of restricted motion. The third day, the protocol was repeated as on the second day.

RESULTS-Times to complete the Jebsen test were significantly increased (p<0.05) for both the fully and partially restricted wrists. The average times for the Jebsen test were 41 seconds for the unrestricted wrist, 47 for the partially restricted wrist, and 49 seconds for the fully restricted wrist. The times were highly variable among subjects, with standard deviations of 4.8, 5.8, and 9.4 seconds respectively.

Like the Jebsen test, the times for the ADL test significantly increased (p<0.05) for both the fully and partially restricted wrists (Figure 2). The average times for the ADL increased from 47 seconds for the unrestricted wrist to 55 for the partially restricted wrist to 57 seconds for the fully restricted wrist. Again the times were highly variable among subjects, with standard deviations of 9.3, 11.7, and 16.9 seconds respectively.

DISCUSSION-An individual’s perceived impairment with performance of common tasks appears to be influenced by their available wrist motion, however there is marked variability in perceptions. Simulated motion preserving procedures rated better than simulated arthrodesis by several parameters but the differences were not as great as we had anticipated. Thus, it may be hard to predict a patient’s response to reduced wrist motion. The amount of flexion and extension necessary to achieve high satisfaction may be greater than that provided by common motion preserving procedures despite small reductions in physical performance. Similarly, satisfaction with function following complete wrist arthrodesis may rank lower than common physical measurements would suggest.