Correlation between Global Wrist Laxity and Movement of the Scaphoid and the Lunate in Various Places During Radio Ulnar Deviation of the Wrist

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ABSTRACT

Introduction: In the intact wrist, three dimensional motions of the carpal bones has been reported as a screw displacement axis representation of the motion as the angular motion of the bones or as translations between the bones, however the latter has frequently been quantified as a displacement in the direction of the screw axis. Current research aimed to establish correlation between global wrist laxity and movement of the scaphoid and the lunate in various places during radio ulnar deviation of the wrist.

Material and methods: The proposed study was a prospective study conducted in the Department of Orthopedics, RMCH, Bareilly, UP, comprising 100 healthy volunteers with equal sex ration who never had any symptoms pertaining to their wrist joint. An informed written consent was obtained. Standard posterolateral and true lateral radiograph of wrist were made to exclude any radiological abnormality. PA and lateral radiograph were obtained in full radial and ulnar deviation. A custom-made positioning device was used to ensure proper placement of the hand and wrist during the examination.

Results: We observed that the age varied from 21 years to 40 years. Radial deviation varied from 10 to 25 degree with mean of 18.06 degree. Ulnar deviation varied from 25 to 60 degree with mean of 36.51 degree. Laxity score varied from 31 to 100 with mean of 64.20.

Conclusion: Within the limitations of the present study, it can be concluded that the ulnar deviation of the wrist is seen to cause radial translation ad dorsal rotation of the proximal carpal row. Similarly, the radial deviation was seen to cause ulnar translation and volar rotation of the proximal carpal row.

Keywords: Global Wrist Laxity, Movement of the Scaphoid, Lunate, Radio Ulnar Deviation of the Wrist

INTRODUCTION

In the intact wrist, three dimensional motion of the carpal bones has been reported as a screw displacement axis representation of the motion as the angular motion of the bones or as translations between the bones, however the latter has frequently been quantified as a displacement in the direction of the screw axis.[1,2] Individual carpal translations in the intact wrist relative to the radius has been reported by Kobayashi et al.[3,4] They reported that in wrist extension the carpal bones translated radially; in flexion, the lunate and triquetrum translated radially; and in ulnar deviation, the proximal row translated radially. Many activities involving the wrist are motions that require a combination of wrist flexion-extension and radial-ulnar deviation.[5] These motions frequently include a dart-throw type of motion.1 Although the in vivo and in vitro motions of the wrist carpal bones during planar wrist flexion-extension and planar wrist radial-ulnar deviation have been studied.[6] Hence, the present study was conducted to establish correlation between global wrist laxity and movement of the scaphoid and the lunate in various places during radio ulnar deviation of the wrist.

MATERIAL AND METHODS

The proposed study was a prospective study conducted in the Department of Orthopedics, RMCH, Bareilly, UP comprising 100 healthy volunteers with equal sex ration who never had any symptoms pertaining to their wrist joint. An informed written consent was obtained. Standard posterolateral and true lateral radiograph of wrist were made to exclude any radiological abnormality. PA and lateral radiograph were obtained in full radial and ulnar deviation. A custom-made positioning device was used to ensure proper placement of the hand and wrist during the examination.

Inclusion criteria

100 healthy volunteers between age group 20 to 40 years with equal sex ratio.

Exclusion criteria

1. Past history of wrist injury.
2. Heavy manual labour.
3. Systemic collagen vascular disease.

Global wrist laxity was determined by measuring hyper mobility of the thumb column and measuring maximum passive flexion and extension of the wrist.

The statistical analysis of the data was done using SPSS version 11.0 for windows. Pearson's correlation coefficient

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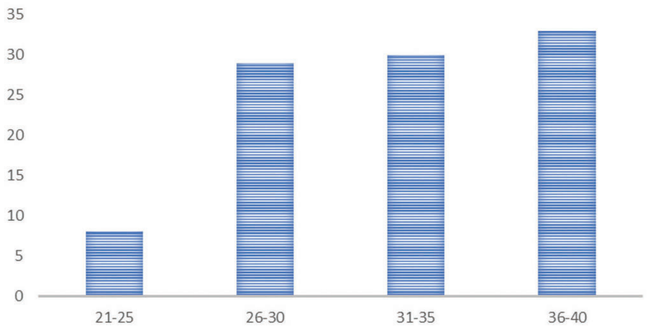
How to cite this article: Ashish Agarwal, Varun Agarwal. Correlation between global wrist laxity and movement of the scaphoid and the lunate in various places during radio ulnar deviation of the wrist. International Journal of Contemporary Medical Research 2020;7(7):G1-G3.

DOI: http://dx.doi.org/10.21276/ijcmr.2020.7.7.4

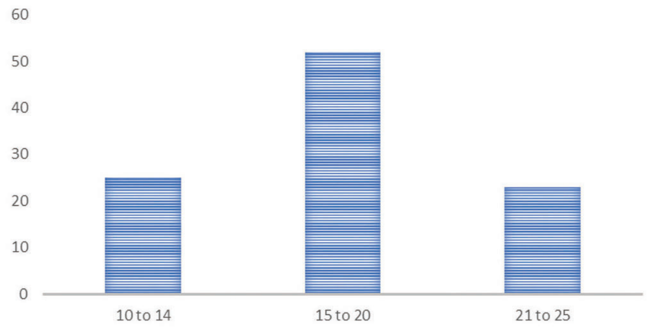
was used for checking the relationship between various indices. A p-value of 0.05 and lesser was defined to be statistical significant.

RESULTS

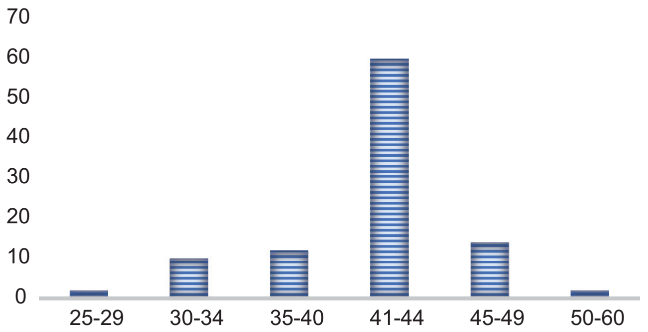
The age varied from 21 years to 40 years. Radial deviation varied from 10 to 25 degree with mean of 18.06 degree. Ulnar deviation varied from 25 to 60 degree with mean of 36.51 degree. Laxity score varied from 31 to 100 with mean of 64.20. Maximum number of subjects were in the age group of 36-40 years and minimum in 21-25 years (graph-1). Maximum subjects had radial deviation from 15-20 degrees (graph-2). Maximum subjects had Ulnar deviation from 41-44 degrees (graph-3) and laxity score of 61-70 (graph-4).



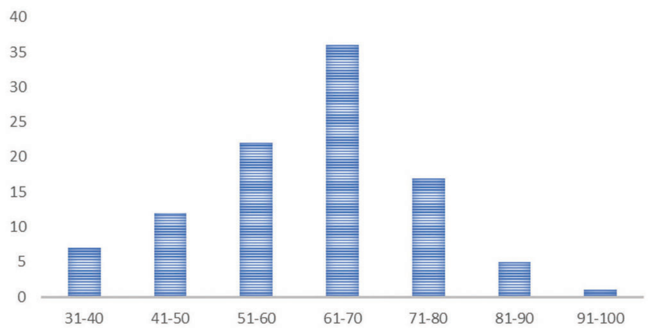
Graph-1: Age gender wise distribution



Graph-2: Radial deviation



Graph-3: Ulnar deviation



Graph-4: Laxity score

DISCUSSION

In the present study, we observed that the age varied from 21 years to 40 years. Radial deviation varied from 10 to 25 degree with mean of 18.06 degree. Ulnar deviation varied from 25 to 60 degree with mean of 36.51 degree. Laxity score varied from 31 to 100 with mean of 64.20. Tang JB et al investigated scaphoid and lunate movement in radial deviation and in slight and moderate ulnar deviation ranges in vivo. They obtained computed tomography scans of the right wrists from 20° radial deviation to 40° ulnar deviation in 20° increments in 6 volunteers. The 3-dimensional bony structures of the wrist, including the distal radius and ulna, were reconstructed with customized software. The changes in position of the scaphoid and lunate along flexion-extension motion (FEM), radioulnar deviation (RUD), and supination-pronation axes in 3 parts--radial deviation and slight and moderate ulnar deviation--of the carpal RUD were calculated and analyzed. During carpal RUD, scaphoid and lunate motion along 3 axes--FEM, RUD, and supination-pronation--were the greatest in the middle third of the measured RUD (from neutral position to 20° ulnar deviation) and the smallest in radial deviation. Scaphoid motion along the FEM, RUD, and supination-pronation axes in the middle third was about half that in the entire motion range. In the middle motion range, lunate movement along the FEM and RUD axes was also the greatest. They concluded that during carpal RUD, the greatest scaphoid and lunate movement occurs in the middle of the arc--slight ulnar deviation--which the wrist frequently adopts to accomplish major hand actions. At radial deviation, scaphoid and lunate motion is the smallest.[7] Werner FW et al determined the amount of scaphoid and lunate translation that occurs in normal cadaver wrists during wrist motion and b) to quantify the change in ulnar translation when specific dorsal and volar wrist ligaments were sectioned. The scaphoid and lunate motion of 37 cadaver wrists were measured during wrist radioulnar deviation and flexion-extension motions using a wrist joint motion simulator. The location of centroids of the bones were quantified during each motion in the intact wrists and after sectioning either two dorsal ligaments along with the scapholunate interosseous ligament or two volar ligaments and the scapholunate interosseous ligament. In the intact wrist the scaphoid and lunate statistically translated radially with wrist ulnar deviation. With wrist flexion the scaphoid moved volarly and the lunate dorsally. After sectioning either the dorsal or volar ligaments, the scaphoid moved radially. After sectioning the dorsal or volar ligaments, the lunate statistically moved ulnarly and volarly. These results indicate that measureable changes in the scaphoid and lunate translation occur with wrist motion and change with ligament sectioning. However, for the ligaments that were sectioned, these changes are small and an attempt to clinically measure these translations of the scaphoid and lunate radiographically may be limited. The results support the conclusion that ulnar translocation does not occur unless multiple ligaments are sectioned. Injury of more than the scapholunate interosseous ligament along with either the dorsal intercarpal and dorsal radiocarpal or the radioscaphocapitate and scaphotrapezial ligaments are needed to have large amounts of volar and ulnar translation.[8]

Short WH et al simultaneously monitored scaphoid, lunate, and global wrist motion in three dimensions and concurrently collect data on the pressure distribution in the radiocarpal and ulnocarpal joints. This information was collected dynamically in real time while the wrist was moved in reproducible, physiologic cycles of motion. The scaphoid and lunate flex and extend as well as pronate and supinate while the wrist moves in the plane of flexion and extension. There is minimal radial and ulnar deviation of these carpal bones during this motion. During wrist radial and ulnar deviation, the scaphoid and lunate both flex and extend as well as deviate radially and ulnarly. The pressures in the wrist also change as the wrist moves. Pressures in the wrist are not evenly distributed and, during some movements, are localized to specific areas. The data also support the concept that there is a hysteresis effect on both the carpal bones and the pressure distribution patterns while the wrist is moving. The results of this study can provide baseline data to compare with other studies that evaluate various pathologic abnormalities of the wrist joint.[9] Werner FW et al determined the in vitro motion of the scaphoid and lunate during wrist circumduction and wrist dart-throw motions and to see how these motions change after the ligamentous stabilizers of the scaphoid and lunate are sectioned in a manner simulating scapholunate instability. Twenty-one fresh-frozen cadaver forearms were moved through a dart-throw motion and a circumduction motion using a wrist joint simulator. Scaphoid and lunate motion were measured with the wrist ligaments intact and after sectioning of the scapholunate interosseous ligament, the scaphotrapezium ligament, and the radioscaphocapitate ligament. In the intact wrist the scaphoid and lunate moved more during circumduction than during the dart-throw motion. With ligamentous sectioning the scaphoid flexed more and the lunate extended more during both the circumduction and dart-throw motions. During the circumduction motion both before and after sectioning the global motion of the scaphoid was greater than that of the lunate. After sectioning the scaphoid motion increased and the lunate motion decreased. They concluded that the scaphoid and lunate motions were observed to change remarkably after ligamentous sectioning. The observed changes in carpal motion correlate with the clinical observation that after ligamentous injury arthritic changes occur in the radioscaphoid joint and not in the radiolunate joint. Analysis of the injured wrist in positions that combine flexion-extension and radial-ulnar deviation may allow noninvasive diagnosis of specific wrist ligament injuries.[10]

CONCLUSION

Within the limitations of the present study, it can be concluded that the ulnar deviation of the wrist is seen to cause radial translation ad dorsal rotation of the proximal carpal row. Similarly, the radial deviation was seen to cause ulnar translation and volar rotation of the proximal carpal row.

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Source of Support: Nil; **Conflict of Interest:** None

Submitted: 08-05-2020; **Accepted:** 05-06-2020; **Published:** 04-07-2020