A Goniometric study of radial and ulnar deviation of wrist joint in the population of central Gujarat

Hetal V. Vaishnani1, Savita H. Gadekar2, Samta Gaur3, Nita A. Tanna4, K.V. Bondre5, A. Gandotra6, G.V. Shah7 and Jasmin H. Jasani8

1. Introduction
The measurement of joint motion is an important component of a comprehensive physical examination of the extremities by which one enables health professionals to accurately assess dysfunction and rehabilitative progress.

Goniometry is an important part of a comprehensive evaluation of joints and surrounding soft tissues. A comprehensive evaluation typically begins by interviewing the subject and reviewing records to obtain an accurate
A description of current symptoms, functional abilities, occupational and recreational activities and past medical history.\(^1\)

Osteokinematics refer to the movement of the shafts of the bone rather than the movement of joint surface. The movements of the shafts of bones are usually described in terms of the rotary motion. Goniometry measures the angles created by the rotary motion of the shaft of the bone\(^1\).

The amount of motion that is available at a joint is called the range of motion. The starting position for measuring all range of motion, except rotations in the transverse plane, is the anatomical position. Three notation systems have been used to define range of motion. The 0-to 180-degree system, the 180-to 0-degree system of notation is widely used throughout the world. First described by Silver\(^2\) in 1923, its use has been supported by many authorities.

The type of motion that is available at a joint varies according to the age, sex, and structure of the joint. Gajdosik and Bohannon\(^3\) (1987) state, physical therapists judge the validity of most range of motion measurements based on their anatomical knowledge and their applied skills of visual inspection, palpation of bony landmarks and accurate alignment of the Goniometer.

The capsular pattern at the wrist is an equal limitation of flexion and extension. A slight limitation in both radial and ulnar deviation is also present.

The purpose of this study is to determine the effects of age and gender on wrist motion in 400 normal subjects on both sides of hands through Universal Goniometer in Central Gujarat Population.

To determine normal range of motion or angle of joint at wrist joint via the performance of active joint motion by the subject during the evaluation allows the examiner to screen for abnormal movements and gain information about the subjects’ willingness to move. Resisted isometric muscle contraction and special tests are used in conjunction with Goniometry to help isolate the injured anatomical structure.

2. Material and Method

The study has been carried out on healthy adult individuals. The subject aged between 21 to 60 years and with sexual dimorphism (in male & female) were further group as follows:

<table>
<thead>
<tr>
<th>Group</th>
<th>Age Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>21 to 30</td>
</tr>
<tr>
<td>Group 2</td>
<td>31 to 40</td>
</tr>
<tr>
<td>Group 3</td>
<td>41 to 50</td>
</tr>
<tr>
<td>Group 4</td>
<td>51 to 60</td>
</tr>
</tbody>
</table>

Each group contains 100 subjects for examination in present study.

- All the subjects studied had normal wrist joint skeleton which were included in my study. Both hands (Right & Left) are used for the study.
- Subjects having any history of wrist joint surgery, trauma, Rheumatoid arthritis, Gout and any other type of abnormality were excluded from the study.

2.1 Materials

Measurements were taken by Universal Goniometer. It has a body and two thin extensions called arms, a stationary arm and a moving arm. It can be either a half-circle instrument with 0 to 180 or full circle Goniometer 0 to 360 and from 360 to 0. We used Goniometer half circle with a reading from 0 to 180.

2.2 Method

Position of the subject so that he or she is sitting next to supporting surface. The shoulder is abducted to 90\(^\circ\) and the elbow is flexed to 90\(^\circ\). The forearm is positioned midway between supination and pronation so that the palm of the hand faces the ground. The forearm rests on the supporting surface, but the hand is free to move. Avoid radial or ulnar deviation of the wrist and flexion of the fingers.

2.2.1 Normal End – Feel in radial deviation

Usually the end feel is hard because of contact between the radial styloid process and the scaphoid, but it may be firm because of tension in the Ulnar collateral ligament, ulnocarpal ligament and ulnar portion of the joint capsule.

2.2.2 Normal End – Feel in ulnar deviation

The end feel is firm because of tension in the radial collateral ligament and the radial portion of the joint capsule.
2.2.3 Goniometer Alignment

(a) Center the fulcrum of the goniometer over the middle of the dorsal aspect of the wrist over the capitate.
(b) Align the proximal arm with the dorsal midline of the forearm, using the lateral epicondyle of the humerus for reference.
(c) Align the distal arm with the dorsal midline of the third metacarpal.

2.2.4 Statistical analysis of the data collected as follows

The mean is obtained by summing up the measurement and dividing the total by number of measurements

A series of observation is indicated by letter X and individual reading by $X_1, X_2, ..., X_n$

The mean of series is denoted by $\bar{X}$

The number of observation by $n$

The sum of observation by $\sum$

Formula for calculation of mean is:

$$\bar{X} = \frac{\text{Total or sum of the observation}}{\text{number of observation}} \quad \text{or} \quad \bar{X} = \frac{\sum X}{n}$$

$n$ = Number of observation

2.2.5 Standard Deviation

This is a measure of the scatter of observations around their mean. Defined a “Root- means- square- Deviation”. It is denoted by Greek letter sigma.

$$SD = \frac{\sum(X - \bar{X})^2}{n - 1}$$

Analysis was performed on anonymous data using SPSS version 13.0.
p – Value of < 0.05 was considered to represent a statistically significant difference.

3. Observation

Following tables are self-explanatory.

Table No.1-The effect of age on radial and ulnar deviation at wrist joint in 200 normal male individuals

<table>
<thead>
<tr>
<th>Motion</th>
<th>Age group I (21-30 Yrs.) n=50</th>
<th>Age group II (31-40 Yrs.) n=50</th>
<th>Age group III (41-50 Yrs.) n=50</th>
<th>Age group IV (51-60 Yrs.) n=50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrist radial-deviation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RIGHT</td>
<td>6-25° 17.78 4.36</td>
<td>9-25° 17.28 3.78</td>
<td>8-30° 15.92 4.08</td>
<td>10-25° 16.08 3.83</td>
</tr>
<tr>
<td>LEFT</td>
<td>10-29° 20.34 4.09</td>
<td>12-35° 19.86 4.76</td>
<td>9-30° 18.14 4.15</td>
<td>11-26° 17.44 3.11</td>
</tr>
<tr>
<td>Wrist ulnar deviation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RIGHT</td>
<td>13-48° 34.8 7.24</td>
<td>18-48° 33.28 7.23</td>
<td>20-46° 33.92 6.69</td>
<td>26-43° 32.16 4.46</td>
</tr>
<tr>
<td>LEFT</td>
<td>24-50° 38.5 6.47</td>
<td>20-50° 35.3 7.02</td>
<td>19-50° 34.62 6.83</td>
<td>27-47° 33.36 3.77</td>
</tr>
</tbody>
</table>
Table No.2-The effect of age on radial and ulnar deviation at wrist joint in 200 normal female individuals

<table>
<thead>
<tr>
<th>Motion</th>
<th>Age group I (21-30 Yrs.) n=50</th>
<th>Age group II (31-40 Yrs.) n=50</th>
<th>Age group III (41-50 Yrs.) n=50</th>
<th>Age group IV (51-60 Yrs.) n=50</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>Mean</td>
<td>SD</td>
<td>Range</td>
</tr>
<tr>
<td>Wrist radial-deviation</td>
<td>RIGHT</td>
<td>6-25°</td>
<td>18.04</td>
<td>4.36</td>
</tr>
<tr>
<td></td>
<td>LEFT</td>
<td>10-35°</td>
<td>20.42</td>
<td>4.30</td>
</tr>
<tr>
<td>Wrist ulnar deviation</td>
<td>RIGHT</td>
<td>18-50°</td>
<td>34.76</td>
<td>6.54</td>
</tr>
<tr>
<td></td>
<td>LEFT</td>
<td>26-50°</td>
<td>37.84</td>
<td>5.44</td>
</tr>
</tbody>
</table>

Table No.3-Radial and ulnar deviation at wrist joint a comparison between male (n =200) and female (N=200)

<table>
<thead>
<tr>
<th>Motion</th>
<th>Measurements of Movement (Male) n=200</th>
<th>Measurements of Movement (Female) n=200</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>Mean</td>
</tr>
<tr>
<td>Wrist radial-deviation</td>
<td>RIGHT</td>
<td>6-27°</td>
</tr>
<tr>
<td></td>
<td>LEFT</td>
<td>9-35°</td>
</tr>
<tr>
<td>Wrist ulnar deviation</td>
<td>RIGHT</td>
<td>13-48°</td>
</tr>
<tr>
<td></td>
<td>LEFT</td>
<td>9-50°</td>
</tr>
</tbody>
</table>

Table No.4-The effect of age on radial and ulnar deviation at wrist joint in 400 [200 male + 200 female] individuals

<table>
<thead>
<tr>
<th>Motion</th>
<th>Age group I (21-30 Yrs.) n=100</th>
<th>Age group II (31-40 Yrs.) n=100</th>
<th>Age group III (41-50 Yrs.) n=100</th>
<th>Age group IV (51-60 Yrs.) n=100</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>Mean</td>
<td>SD</td>
<td>Range</td>
</tr>
<tr>
<td>Wrist radial-deviation</td>
<td>RIGHT</td>
<td>6-25°</td>
<td>17.91</td>
<td>4.33</td>
</tr>
<tr>
<td>Wrist ulnar deviation</td>
<td>RIGHT</td>
<td>13-50°</td>
<td>34.78</td>
<td>6.86</td>
</tr>
<tr>
<td></td>
<td>LEFT</td>
<td>24-50°</td>
<td>38.17</td>
<td>5.95</td>
</tr>
</tbody>
</table>

4. Discussion and conclusions

During the period from Jan ‘2010 to June ‘2011 subjects measurement for wrist joint were studied at Sumandep Vidhyapeeth, Piparia.

The Goniometric measurements are done for determining a position and total amount of motion available at particular joint.

In a present study 400 volunteers subject were studied, and they are divided in 4 Age group. Group I (21 year to 30 year),Group II (31 year to 40 year), Group III (41 year to 50year), Group IV (51 year to 60 year), and in each group there are 100 subjects (50 Male + 50 Female).

4.1 Wrist Radial Deviation

As per Table No.v01 and 02 : In our study in the age Group I (21-30 years), the average range of motion 17.78 ± 4.36 in right hand and 20.34 ± 4.09 in left hand in male, and 18.04 ± 4.36 in right hand and 20.42 ± 4.30 in left hand in female. In the age Group II (31-40 years), the average range of motion 17.28 ± 3.78 in right hand and 19.86 ± 4.76 in left hand in male, and 17.46 ± 5.58 in right hand and 20.1 ± 3.85 in left hand in female. In the age Group III (41-50 years), the
average range of motion 15.92 ± 4.08 in right hand and 18.14 ± 4.15 in left hand in male, and 17.4 ± 5.04 in right hand and 19.02 ± 5.25 in left hand in female. In the age Group IV (51-60 years), the average range of motion 16.08 ± 3.83 in right hand and 17.44 ± 3.11 in left hand in 50 males, and 16.54 ± 3.60 in right hand and 17.74 ± 3.16 in left hand in female.

As per Table No.03 : In our study average range of motion for radial deviation 16.76 ± 4.66 in male and 17.20 ± 4.21 in female in right hand. And 18.94 ± 4.21 in male and 19.21 ± 4.26 in female in left hand. So, female has higher range of motion than male in both right and left hands.

As per Table No.04 : In the present study mean range of motion in the age Group I (21-30 years) the average ROM is 17.91 ± 4.33 in right hand and 20.38 ± 4.18 in left hand. In age Group II (31 year to 40 year) the average range of motion is 17.06 ± 3.70 in right hand and 19.76 ± 4.24 in left hand. In Group III (41 year to 50 year), the average range of motion is 16.66 ± 4.62 in right hand and 18.58 ± 4.73 in left hand. In age Group IV (51 year to 60 year), average range of motion is 16.31 ± 3.71 in right hand and 17.59 ± 3.12 in left hand.

As per our study average range of movement decreases with increasing age in radial deviation for both hands.

r value of table no. 8 is r = -0.147 in right hand and r = -0.243. It suggests range of motion decreases with increasing age.

Green and Wolf (1989) in their study conducted on Rosemont population (10 males and 10 females) shows an average range of motion of wrist radial deviation 25.4° ± 2.0 in age group 18 to 55 years. As compared to our observation in the same group of males and females the value of Green and Wolf is higher.

Gerhardt Von Bonin et al.: In their study 11 male and 06 female, radial deviation for male average range of motion 14.5 ± 0.34 and in female average range of motion 21.7 ± 0.25. So, female have higher range of motion than male.

4.2 Wrist Ulnar Deviation

As per Table No.01 and 02 : In our study in the age Group I (21-30 years), the average range of motion 34.8 ± 7.24 in right hand and 38.5 ± 6.47 in left hand in male, and 34.76 ± 6.54 in right hand and 37.84 ± 5.44 in left hand in female. In the age Group II (31-40 years), the average range of motion 33.28 ± 7.23 in right hand and 35.3 ± 7.02 in left hand in male and 34.9 ± 5.99 in right hand and 37.74 ± 5.98 in left hand in female. In the age Group III (41-50 years), the average range of motion 33.92 ± 6.69 in right hand and 34.62 ± 6.83 in left hand in male, and 33.98 ± 6.81 in right hand and 35.26 ± 7.03 in left hand in female. In the age Group IV (51-60 years), the average range of motion 32.16 ± 4.46 in right hand and 33.36 ± 3.77 in left hand in male, and 32.52 ± 4.91 in right hand and 34.4 ± 4.54 in left hand in female.

As per table no.03 : In our study average range of motion for ulnar deviation 33.88 ± 6.31 in male and 33.90 ± 6.29 in female in right hand and 35.44 ± 6.41 in male and 36.11 ± 6.10 in female in left hand. So, female has higher range of motion than male in both right and left hands.

As per table No.04 : In the present study mean range of motion in the age Group I (21-30 years) the average range of motion is 34.78 ± 6.86 in right hand and 38.17 ± 5.95 in left hand. In age Group II (31 year to 40 year) the average range of motion is 33.82 ± 6.94 in right hand and 36.12 ± 6.85 in left hand. In Group III (41 year to 50 year), the average range of motion is 33.95 ± 6.72 in right hand and 34.94 ± 6.90 in left hand. In age Group IV (51 year to 60 year), average range of motion is 32.34 ± 4.67 in right hand and 33.88 ± 4.19 in left hand.

r value of the table no. 8 is r = -0.106 in right hand and r = -0.232. It suggests range of motion decreases with increasing age.

So, as per our study average range of movement decreases with increasing age in ulnar deviation for both hands.

Green and Wolf (1989) in their study on Rosemont population (10 males and 10 females) found that an average range of motion of ulnar deviation is 39.2° ± 2.1 in age group 18 to 55 years. As compared to our observation in the same age group of males and females the value of Green and Wolf is higher.

Gerhardt Von Bonin et al.: in their study 11 male and 06 females, ulnar deviation for male average range of motion 29.3 ± 0.26 and in female average range of motion 34.5 ± 0.39. So, female have higher range of motion than male in their study.
5. Conclusion

In the present study 400 volunteers subjects were studied and they are divided in 4 Age groups. Group I (21 year to 30 year), Group II (31 year to 40 year), Group III (41 year to 50 year), Group IV (51 year to 60 year), and in each group there are 100 subjects (50 Males + 50 Females).

Each subject was tested radial and ulnar deviation on both hands with the help of Universal Goniometry.

i. In my present study average range of motion significantly decreases with increasing age.

ii. In my present study average range of motion was significantly higher in female than in male.

iii. In my present study average range of motion was significantly greater in left hand than in the right hand.

iv. The range of motion was reduced with the increase of age because of the presence of osteoporosis, cumulative damage and obesity with aging process.\(^7\)

v. Generally, females tend to have greater range of motions, due to the anatomical and physiological differences, such as the size of muscle mass, joint geometry and hormone. Other factors, such as dominate side, the time of day and training that may affect joint flexibility.\(^7\)

vi. The reduced mobility on the right side compare with that on the left might have been the result of slight degenerative changes in the joint as well as damage to the ligaments of the right upper extremity in the right handed population.\(^8\)

References