Original Research
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Relationship between radiographic carpal indices and grip strength

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Abstract

Background: The measurement of hand grip strength has several clinical applications to evaluate chronic hand disability, response to treatment, and work capacity after hand injury.

Methods: We measured hand grip strength of 41 adults and compared their maximum strength with radiographic indices.

Results: There was a significant relationship between hand grip strength and carpal height, third metacarpal and capitate length (All p-values<0.05).

Conclusions: In addition to established factors such as sex, upper limb muscle and joint status, wrist radiographic indices are significantly determinants of hand power grip.

Keywords: Wrist radiography, Hand grip strength, Wrist measurement.

Introduction

Hand grip strength can be measured by various methods and instruments. Mechanical instruments measure grip strength through the tension produced in a steel spring and calculated in kilograms or pounds of force [1,2,3]. Pneumatic instruments such as a modified sphygmomanometer based on compression of an air-filled compartment, therefore measure grip pressure rather than grip strength.

The limitation of pneumatic instruments is the variation in surface area over which pressure is applied. This leads to variable pressure, with larger hands producing lower pressure than smaller-sized hands [4]. This type of instrument measures grip pressure, rather than grip force.

Hydraulic instruments measure grip force in kilograms or pounds. Maximum grip force is obtained with the shoulder in neutral position, the elbow at 90° flexion, the back straight the wrist at 0°-30° extension and 0°-15° ulnar deviation.

Wrist and hand dimensions and the angles of the distal radius can theoretically alter carpal biomechanics and thus determine maximum hand grip strength. This study was designed to evaluate relationship between maximum grip strength and radiographic carpal dimensions and indices.

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Methods

A total of 41 adults were included in this study. All were recruited among patients who came to the hospital because of contralateral hand injury. We measured wrist radiographic indices in posteroanterior and lateral view x-rays, and calculated hand grip strength. All wrist x-rays obtained with the wrist and forearm in neutral position, the elbow in 90° flexion and the shoulder in 90° abduction. The X- Ray tube was aligned 90° vertical to the radial styloid, 30 inches (76 cm) from the table. In posteroanterior x-ray, we measured wrist dimensions such as carpal height, radial-carpal distance, ulnar-carpal distance, third metacarpal length and in lateral view we measured angles (Figs.1and 2).

We compared lengths, angles and indices or ratios with Hand grip strength measured with a Jamar dynamometer [1].

Statistical Analysis

Statistical comparisons were done with independent T-tests, and linear regression was used to determine correlation between variables. Values of p less than 0.05 were considered statistically significant.

Results

Mean right hand grip strength was 29.3 (SD= 9.1) kilogram and mean left hand grip strength was 27.3 (SD= 7.3) kilogram (table 1). Hand grip strength was lower in older subgroup (41-60Years) but the difference was not statistically significant (p= 0.065, Table2). Hand grip strength was significantly lower in women than in men (p= 0.001, table3). Significant relationships were found between hand power grip and carpal height, third metacarpal and capitates length (Figures 3, 4 and 5). We also found significant relationships between hand power grip and transverse dimensions of the wrist such as radial-carpal distance and ulnar-carpal distance (Figs. 6 and 7).

Analysis of all carpal angles and indices detected no significant relationships between hand power grip and angles such as radial

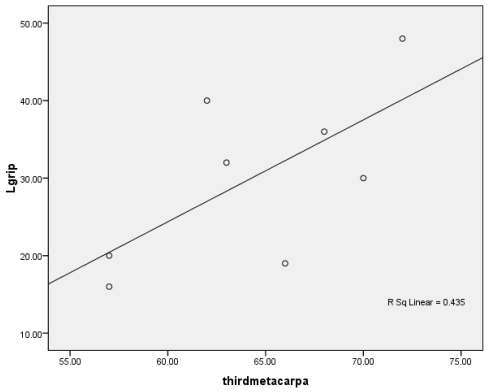

Fig. 4. Relationship between third metacarpal length and power grip. Y= 51.4 ± [.3(x)], p= 0.001.

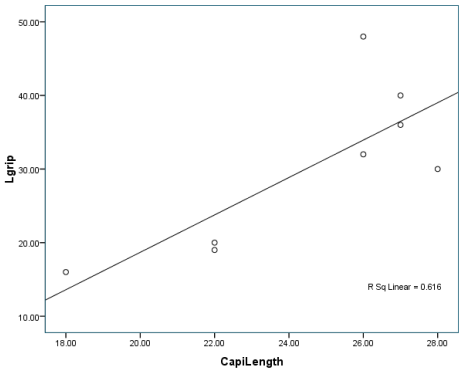

Fig. 5. Relationship between capitates length and power grip. Y = 19.0 ± [.09 (x)], p = 0.001.

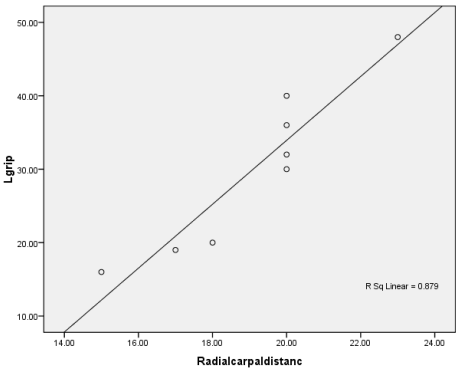

Fig. 6. Relationship between radial carpal distance and power grip. Y=15± [1.1(x)], p= 0.001.

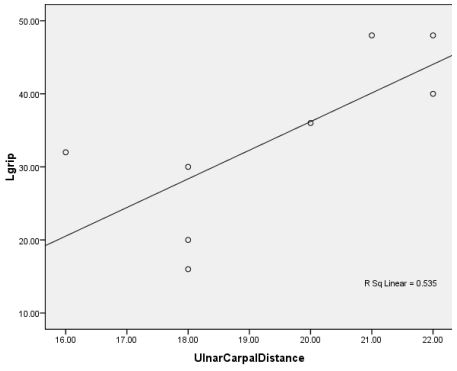

Fig. 7. Relationship between ulnar carpal distance and power grip. Y = 13.49± [1.8(x)], p= 0.001.

Table 1. General results of power grip measurement.

	Mean	Median ± SD*
Right , power grip (kg)	29.3	26 ± 9.1
Left ,power grip (kg)	27.3	26 ± 7.3

*Median with standard deviation

Table 2. Changes of grip according to age.

	20 -40Y	41 -60 Y	p value
Right power grip(kg) (mean ± SD)	29.8 ± 11.9	28.5 ± 5.7	NS*
Left , power grip (kg) (mean ± SD)	29 ± 8.7	24.5 ± 2.9	**NS***

*No Significant

Table 3. Changes of grip according to sex.

	Male	Female	p value
Right , power grip(kg) (mean ± SD)	50 ± 5.6	27 ± 5.9	.001
Left ,power grip(kg) (mean ± SD)	31.3 ± 9.8	24.7 ± 3.8	.001

inclination, radial tilt or, scapholunate angle.

Discussion

Hand power grip measurements reflect the functional status of the upper extremity. Hand grip strength is also used to estimate overall muscle strength and predict health-related prognoses [5]. Our findings show that hand grip strength was significantly greater in men than in women, and that hand grip strength decreased with increasing age.

The conditions which most frequently impair hand grip strength are:

1) Amputation,

2) Limited motion of the fingers, wrist, forearm, elbow or shoulder

3) Pain,

4) Muscular weakness [6].

The instrument used most widely to measure hand grip strength is the Jamar dynamometer. This hydraulic instrument, that, measures grip strength force in kilograms or pounds [4] is inexpensive [7,8], simple to use, and has been found accurate and reproducible [9, 10, 11].

Conclusion

In normal populations, age, sex, dominance, functional status of the hand, wrist, forearm, elbow and shoulder as well as an individual's general muscle power are established factors that determined hand power grip strength.

Radiographic parameters such as carpal height, third metacarpal length, capitate length, radial-carpal distance and ulnar-carpal distance were significant determinants of hand grip strength in our sample. These data are potentially useful for clinical situations and further researches.

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Conflict of interest

The authors declare no conflicts of interest.

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