Correlation of Anthropometry of Hand with Wrist Extensor Strength in Normal Asymptomatic Individuals

ABSTRACT

INTRODUCTION

Measurement of hand grip strength is the basic criteria for the evaluation of hand structure and function. The human hand serves various dynamic purposes in day to day activities of an individual. Infact, the entire upper limb is functional because of the hand. This study was carried out to find out if there is any relation between the anthropometric measurements of the hand and the wrist extensor strength of Indian adults.

METHODOLOGY

A data was collected of 75 individuals with no pathological abnormalities from Acharya Vinoba Bhave Rural Hospital, Sawangi Meghe, Wardha. The consent of all the individuals was taken and they were informed about the procedure. The individuals were evaluated for wrist extensor strength by using a hand-held dynamometer. Also, the hand measurements such as hand length and width using a measuring tape.

RESULT

The average wrist extensor strength of the right hand of the individuals was found to be more than that of the left hand. The length of both the hands was almost equal while the width of the left hand was greater than the right hand.

CONCLUSION

There is a slight positive Correlation between the average wrist extensor strength and the length and width of the hand which can play a vital role in the rehabilitation process

KEYWORDS

Hand Anthropometry, Wrist Extensor Strength, Indian adults, correlation.

INTRODUCTION

The entire upper limb is functional only because of hand. Any loss of function in the upper limb, regardless of the segment, ultimately affects the hand. The hand consists of five digits: four fingers and a thumb. Each digit has a carpometacarpal joint and a metacarpophalangeal joint. The fingers each have two interphalangeal joints, the proximal and distal, and the thumb has only one. There are 19 bones and 19 joints distal to the carpals that form the hand complex (Okafor et al., 2020)

Hand forms the vital organ of function. It makes it possible for an individual to reach to his/ her surroundings and manipulate objects to carry out purposeful activities. Almost all Basic ADLs like grooming, dressing and Instrumental Activities of Daily Living require use of hands by the person. Handling of an object by hand involves grasping or holding any object between any two surfaces in the hand. The thumb participates in most, but not all handling tasks. There are numerous ways that objects of varying sizes and shapes can be grasped. Handling of an object is known as prehension. Prehension can be categorized as either power grip or precision handling. Power grips include cylindrical, spherical and hook grasp and the prehension grips include pulp to pulp, tip to tip, lateral prehension ("Biomechanics of the Hand - Hand Clinics," n.d.) Power grip is generally a forceful act resulting in flexion at all finger joint and thumb being used as stabilizer to the object held between the fingers and, most commonly, the palm. Precision handling, in contrast, is the skilful placement of an object between fingers or between finger and thumb and the palm is not involved.

Muscles of hand complex work in concert to allow the person to take up various grips. Wrist and finger flexors flex the fingers and the intrinsic muscles of hand work so as to accommodate the contours of the object that is being held. Extensor muscles act on stabilization of the wrist in extension during activities of grip and pinch ("Biomechanics of the Hand - Hand Clinics," n.d.).

It has been seen that wrist extension strength is directly correlated with the grip strength (Souza et al., 2017) (O'Driscoll et al., 1992) ("Wrist extension strength required for power grip: a study using a radial nerve block model - T. Suzuki, T. Kunishi, J. Kakizaki, N. Iwakura, J. Takahashi, K. Kuniyoshi, 2012," n.d.) (Nakandala et al., 2019) Grip of a person is also dependent on Hand anthropometry Anthropometry originates from anthropology which means measurements of man (Barut, 2008) (Nicolay and Walker, 2005). It demonstrates the changeability of physical characteristics of man in time and space, particularly with race differentiation, individuals' differentiation, ontogenesis and phylogenesis (GRIEVE, 1998). Ergonomic Anthropometry is of importance to physiotherapist. It refers to the measurements of the parts of the body so as to accommodate that person into work space maintaining his optimal posture and designing tools and equipment (Bullock, 1974).

Considering a single workplace varied population work for a single job requiring similar hand positions and grips so as to accomplish the given job. The tools and equipment's that are designed and the equipment used require similar dimensions according to the varying physiological and anthropological differences among the working population. Another population at target for measurements of normal humans is the disabled. These populations require various assistive devices which if not designed appropriately present with functional, quality, usability and safety problems (Ahasan et al., 2001).

Functional position is wrist complex in slight extension of 20 degrees, slight ulnar deviation of 10 degrees and fingers moderately flexed at the MP joints at 45 degrees and PIP joints at 30 degrees and slightly flexed at the DIP joints.[2] All the functional activities of hand require wrist extension. The wrist position optimizes the power of the finger flexors so that hand closure can be accomplished with the least possible effort. Thus, as grip strength is dependent on wrist extensor strength as well as on hand anthropometry, both of them may also be correlated. Hence this study was undertaken to find out if there is any correlation between hand anthropometry and wrist extensor strength.

If a workplace is being designed or improved to suit just one person, only his individual measurements are required for the specifications. However, if the equipment or workspace is to be shared by many individuals of varying sizes and proportions, it is essential that measurements of a representative sample of the using population be taken. Wrist extension is required for maintaining any of the functional grips of the hand to carry out function. It has been seen that the grip strength is dependent on the wrist extensor strength, at the same time, grip is also dependent on anthropometric measures. Hence this study was carried out to find out the relationship of hand anthropometry with grip strength with the individual.

METHODOLOGY

Study was correlational and conducted at Datta Meghe Institute of Medical Sciences, Wardha, Maharashtra. A sample size of 75 individuals was taken. Simple random sampling method was used to collect the samples. The tools used to carry out the study are hand held dynamometer, measurement tape and soft pad.

Both males and females of age 16-30 years were taken in the study. Individuals with Neuromuscular and any other Musculoskeletal disorders were excluded. Subjects were

evaluated for wrist extension strength in sitting position using a hand-held dynamometer. Hand length and breadth was measured with the help of measuring tape.

Consent was taken from each and every individual and the procedure was also explained thoroughly. The readings of hand length and width were taken in a seated position with back supported, shoulder, elbow and wrist at neutral position and the feet completely in contact with the ground. Later, three readings of wrist extensor strength from each hand was taken, and the average of all the three was calculated. The same procedure was carried out for the rest of the individuals.

Statistical Analysis:

Statistical analysis was done by using descriptive and inferential statistics using student's paired t test and software used in the analysis was SPSS 24.0 version and $p<0.05$ is considered as level of significance Table 1 describes age wise distribution of patients. Table 2 describes Gender wise distribution of patients. Table 3 explains wrist extensor strength compared on left and right side. Table 4 compares length of hand on right and left sides. Table 5 compares the width of hand on right and left sides. The maximum individuals tested were from the age group 16-20. The average of the age wise distribution of patients was found out to be 21.65±3.87.

RESULTS:

A total number of 75 individuals were involved in this study out of which 52% were male and 48% were female. This indicates a majority of male population.A comparison of the wrist extensor strength of the right and left hands of all the 75 individuals was done. The wrist extensor strength of the right-hand hand came out to be greater than the left in

majority of the individuals. A comparison between the length of the right and the left hand was made of all the individuals.The length of both the hands came almost equal with very minute difference. A comparison between the width of both the hands was also made of all the mentioned. The measurements were approximately the same for both the hands.

DISCUSSION:

This study was carried out to see if there is a correlation between wrist extensor strength and the anthropometric measurements of hand in Indian adults. Hand measurements are important to find out if there are any anomalies in the structure of the hand from different individuals as well as from the other hand.

The results showed that the maximum number of individuals that were tested for both wrist extensor strength and hand measurements were from the age group 16-20. A total of 75 individuals were involved in the study out of which males were in majority (52%) than females (48%). the wrist extensor strength of the right hand came to be greater than that of the left hand. The comparison of the length of both the hands was made and the length of both the hand were almost the same negotiating some minute changes. The width of both the hands was approximately the same.

The study indicates that the wrist extensor strength and the anthropometric hand measurements are correlated with the age of the patients. Younger individuals had comparatively more strength than older individuals.

Another aspect found out by the study was the strength and measurements of individuals with a thin built compared to that of a well-built individual. Thin built individuals didn't possess as much power as the well-built individual. Also, males possessed much more wrist extensor strength as compared to females. This is because of the high muscle mass prevalent in males.

The position of testing is also an important factor in the course of the study. If the position of the individual is not correct, it can result in false readings. The individual should be stable and properly supported throughout the procedure.

From the study we can say that there is a notable correlation between the strength of the wrist extensors and the hand dimensions. Individuals with greater hand measurements had greater wrist extensor strength. Males had bigger hand dimensions as well as greater wrist extensor strength as compared to females. Some exception was present such as women who went to gym and worked out on a regular basis had a good wrist extensor strength ratio.

CONCLUSION

To conclude the study, there is a remarkable correlation between the arthrometric hand measurements and the wrist extensor strength of the normal Indian adults. It mainly depends on certain factors such as age, gender, body built, physical strength and body posture. Though minute, variations can be found even in the two hands of a same person.

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Table 1: Age wise distribution of patients

Age Group(yrs)	No of patients	Percentage
16-20 yrs	34	45.33
21-25 yrs	16	21.33
26-30 yrs	15	20
Total	75	100
Mean±SD	21.65 ± 3.87(16-30 yrs)	

Table 2: Gender wise distribution of patients

Gender	No of patients	Percentage
Male	39	52
Female	36	48
Total	75	100

Table 3: Comparison of wrist extensor strength on right and left side

	Mean	N	Std. Deviation	Std. Error Mean	Mean Difference	t-value
Right Side	24.11	75	7.27	0.83	2.79±3.17	7.62 p=0.0001,S
Left Side	21.32	75	7.80	0.90		

Table 4: Comparison of length of hand on right and left side

	Mean	N	Std. Deviation	Std. Error Mean	Mean Difference	t-value
Right Side	18.51	75	1.54	0.17	0.06±0.62	0.95 p=0.34,NS
Left Side	18.58	75	1.56	0.18		

Table 5: Comparison of width of hand on right and left side

	Mean	N	Std. Deviation	Std. Error Mean	Mean Difference	t-value
Right Side	8.25	75	0.91	0.10	0.009±0.42	0.19 p=0.84,NS
Left Side	8.24	75	0.85	0.09		