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EVALUATION OF RELATIONSHIP BETWEEN CARRYING ANGLE AND HAND GRIP STRENGTH IN DIFFERENT ELBOW POSITION AMONG NORMAL INDIVIDUALS

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Abstract

Background: Several activities in day to day involving upper limb require good hand grip strength. A reliable evaluation of hand grip forms an integral part of rehabilitation, not only to assess the strength muscles involves in gripping but also to apply as a tool in rehabilitating patients with variable level of hand injuries. Various sports require some degree of grip strength which improves the performance and play a key role in preventing overall injuries relevant to forearm and hand. Since the hand grip is considered to be affected by variation in carrying angle. The acute angle produced medially when the axis of the forearm deviates laterally from the long axis of the humerus, with the arm extended and palm facing forward, is referred as carrying angle. Average value of carrying angle in male is 5-10 and slightly greater in female being 10-15. If this angle is >15 it is called cubitus valgus whereas if it is <5 it is called cubitus varus.

Aim: The aim of the study is to evaluate the relationship between carrying angle and hand grip strength in different elbow position among normal individuals.

Methods: In this study, 70 individuals according to inclusive and exclusive criteria were recruited from Dr. ulhas patil college of physiotherapy. Their ages ranged from 18-30 years. The carrying of both arms were measured by using universal goniometer in anatomical position. The grip strength was assessed in in sitting in chair without arm support, with forearm extended and forearm flexed to 90^0. Best of three attempt were selected as a final reading with 5 second rest in between.

Result: The study showed that there is negative correlation existed between carrying angle and grip strength . It suggest that there is a strong relationship between carrying angle grip strength in different elbow position among normal individuals.

Conclusion: The study concluded that , there is a significant relationship between the carrying angle and hand grip strength in different elbow position (flexion, Extension) in normal individual between age group of 18-30 years.

Key words: Hand grip strength , Carrying angle , Hand held dynamometer , Universal goniometer.

INRODUCTION

The elbow joint is considered as a compound joint which functions as a loose hinge joint. At the elbow, one degree of freedom is possible that occurs in the sagittal plane around a coronal axis.

When the upper extremity is in the anatomical position, the long axis of the humerus and the long axis of the forearm form an acute angle medially when they meet at the elbow, the angle is known as carrying angle.

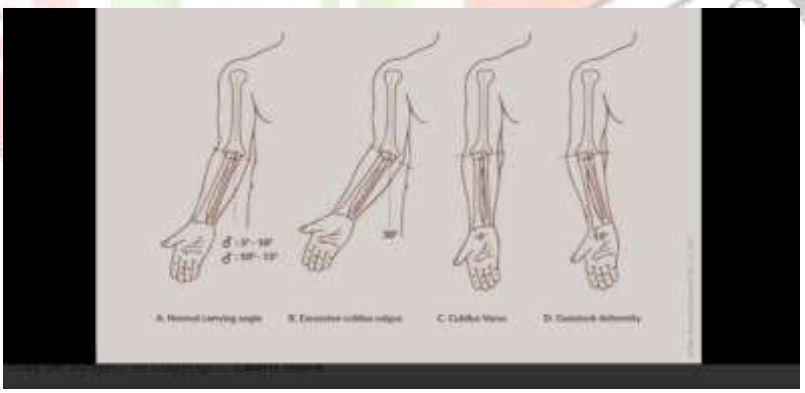
This normal valgus angulation is called the carrying angle. Average value of carrying angle in male is 5-10 and slightly greater in female being 10-15. If this angle is >15 it is called cubitus valgus whereas if it is <5 it is called cubitus varus .

Carrying angle is larger in younger adult female than male, because female has a narrower shoulder and wider hip than male which may be suitable cause for having more acute carrying angle and is therefore deemed as one of the secondary sexual character. Functional use of carrying angle results from a combination of shoulder lateral rotation, elbow extension, and forearm supination which enable a person to carry a bucket in one hand in such a manner as to avoid contact between the carried load and lower limb on the same side. This position also helps in leading the hand towards a position above the center of mass of the weight. The increase in carrying angle may lead to elbow instability and pain during exercise or in throwing activities. Wider carrying angle may reduce the function of elbow flexion, predispose to risk of elbow dislocation. Carrying angle is measured by universal goniometer with an elbow in extension and forearm in supination.

Grip strength is the integrated performances of muscles that can be produced in one muscular contraction.

Many daily functions and sporting events require high activity levels of the flexor musculature of the forearm and hands like flexor carpi radialis, palmaris longus, flexor digitorum profundus, flexor digitorum superficialis, flexor policus longus and brevis. Each of these muscles is active during gripping activity.

It is widely accepted that grip strength provides an objective index of the functional integrity of upper extremity. The purpose of testing grip strength is diverse, which include evaluating and comparing treatments, to diagnose disease, to document the progression of muscle strength.



The hand held dynamometer uses a spring to measure maximum isometric strength of the forearm and hand muscles during muscle contraction.

The American Society of Hand Therapists recommended standardized positioning for grip strength measurement which is patient in sitting position with shoulder adducted and neutrally rotated, elbow flexed at 90º, forearm and wrist in neutral position. A variety of instruments are available to measure grip strength.

This dynamometer has many useful features for routine screening as well as in the evaluation of hand, disease. In this study it is used for the evaluation of hand grip strength in different elbow position in relation to carrying angle. The hand held dynamometer uses a spring to measure maximum isometric strength of the forearm and hand muscles during muscle contraction.

METHODOLOGY

- Sample size : 70 Subjects
- Type of study : Cross sectional study
- Method of sampling : Convenient Sampling
- Study place : Dr. Ulhas Patil College of Physiotherapy
- Study population : young adult (18-30 yrs)
- Study duration : 6 months

SELECTION CRITERIA

Inclusion Criteria:

- Subject with informed consent
- Young healthy male and female adults with age of 18–30 years old.

Exclusion Criteria:

- Previous history of surgery.
- Median, Ulnar or/and Radial Nerve Palsy.
- Fracture around shoulder, elbow and wrist.
- Cervical Radiculopathy.
- Pathology around elbow and wrist joints.

Material Required: Pen, Paper, Chair, Hand held dynamometer, Universal Goniometer.

PROCEDURE

An ethical clearance was obtained from the ethical committee of Dr. Ulhas Patil Medical College of Physiotherapy. Subjects who satisfied the inclusion criteria were included in the study. The purpose of the study was explained and informed consent was obtained from subjects. A brief assessment of upper extremity was taken prior to study. The carrying angle was measured by universal goniometer in standing position with the upper extremity to be measured should be in anatomical position. The arms of the goniometer were kept in straight line and the goniometer's axis placed at fulcrum (midline of elbow joint) of the elbow. The fixed arm of the goniometer was aligned with the middle of the subject's upper arm. The movable arm of the goniometer was moved along until it lined up along the middle of subject's forearm. Grip strength was measured by hand held dynamometer with the subject sitting on a 17 chair, arm unsupported, shoulder in a neutral position, elbow at 90º of flexion and extension forearm in mid prone position. Each subject was instructed to exert their maximum grip strength for 5 seconds. The measurement was repeated 3 times and best of those three values was considered. These measurements were done for both dominant as well as the non-dominant side of the hand.

Carrying angle assessment using Universal Goniometer (ICC 0.76):

Universal Goniometer is one of the reliable and feasible tool used to assess carrying angle

Measurement of Rt CA

Measurement of Lt CA

Carrying angle was measured in anatomical position with fulcrum of goniometer at midline of elbow joint , the fix arm of the goniometer was aligned with the midline of the subjects upper arm and movable arm of the goniometer was moved along until it lined up along the middle of the subjects forearm.

Grip strength Assessment Using Hand Held Dynamometer (0.82-0.99)

Grip strength was measured by Hand Held Dynamometer with the subject sitting on a chair , arm unsupported , shoulder in neutral position , elbow at 90º of flexion and extension , forearm in midprone position (Bilaterally).

GS in in Rt elbow flexion

GS in Rt elbow extension

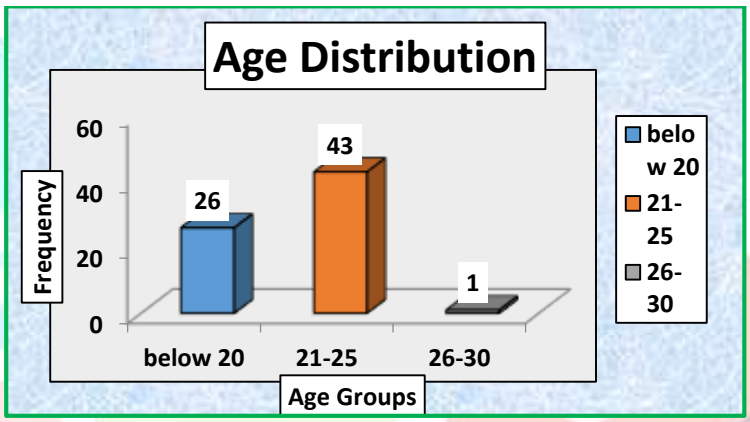
Each subject was instructed to exert their maximum grip strength for 5 sec , the measurement was repeated 3times and best of those 3 values was considered.

DATA ANALYSIS

- The collected Data i.e. Carrying angle and grip strength are quantitative in nature.
- Hence Karl Pearson's correlation coefficient movement correlation statistics was applied to the test to find whether the carrying angle significantly correlated with grip strength.
- All the statistical analysis was performed using the statistical software SPSS 28.0

Subgroups on the basis of age –

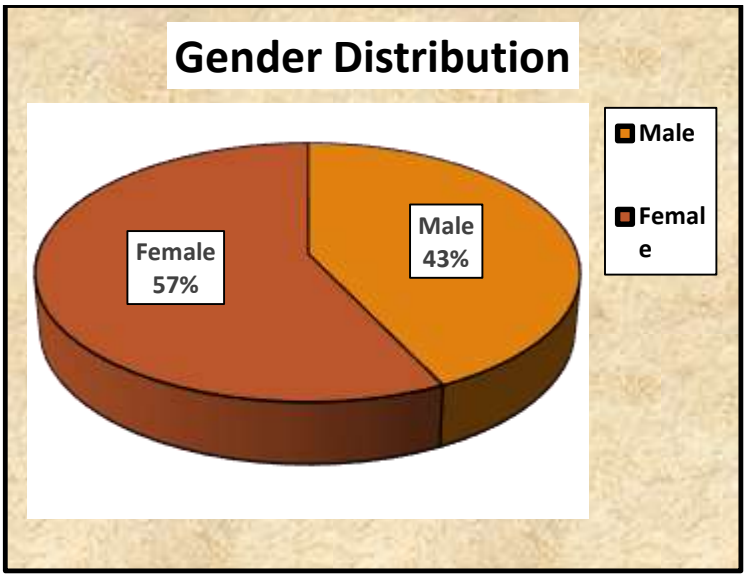
Variable	Gropus	Frequency	Percentage
Age (in years)	below 20	26	37.14
	21-25	43	61.43
	26-30	1	1.43



Inference: The bar diagram shows age wise distribution. In our study out of 70 subjects, 26 subject were between age group 18-20, 43 subject were between 21-25 whereas 1 subject between 26-30yrs of age.

Gender wise distribution :

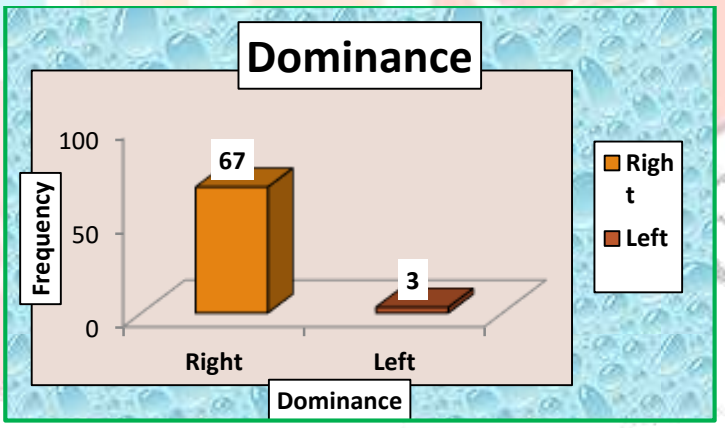
Variable	Gropus	Frequency	Percentage
Gender	Male	30	42.86
	Female	40	57.14



Inference: The pie diagram shows Gender wise distribution. In our study out of 70 subjects, 57% were females and 43% were males.

Dominance wise distribution

Variable	Gropus	Frequency	Percentage
Dominance	Right	67	95.71
	Left	3	4.29



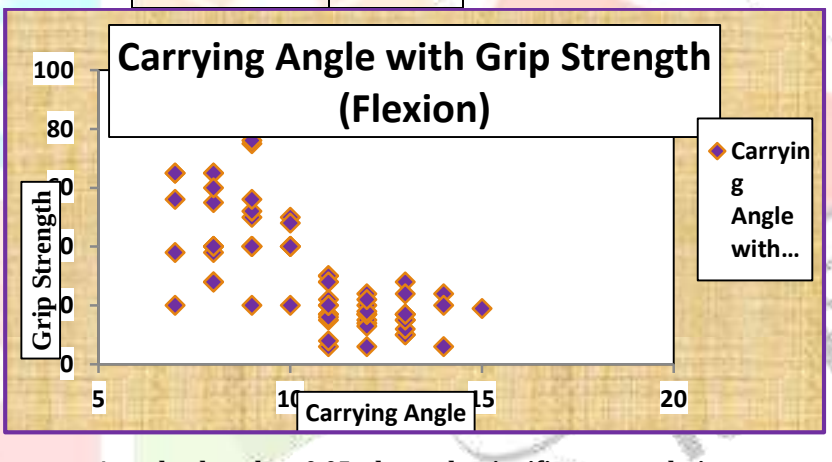
Inference: The bar diagram shows dominance wise distribution. In our study out of 70 subjects, 67 were of right dominance and 3 were left dominance.

Descriptive statistics of Carrying angle and Grip Strength

Parameter		Mean	SD	Median	Range
Carrying Angle	Right	10.50	2.06	11.0	(7.0, 15.0)
	Left	10.22	1.90	10.5	(7.0, 14.0)
Grip Strength (Felxion)	Right	31.90	19.52	26.0	(6.0, 78.0)
	Left	27.30	18.82	22.0	(4.0, 78.0)
Grip Strength (Extension)	Right	27.09	18.29	22.0	(2.0, 75.0)
	Left	21.50	17.90	14.5	(2.0, 76.0)

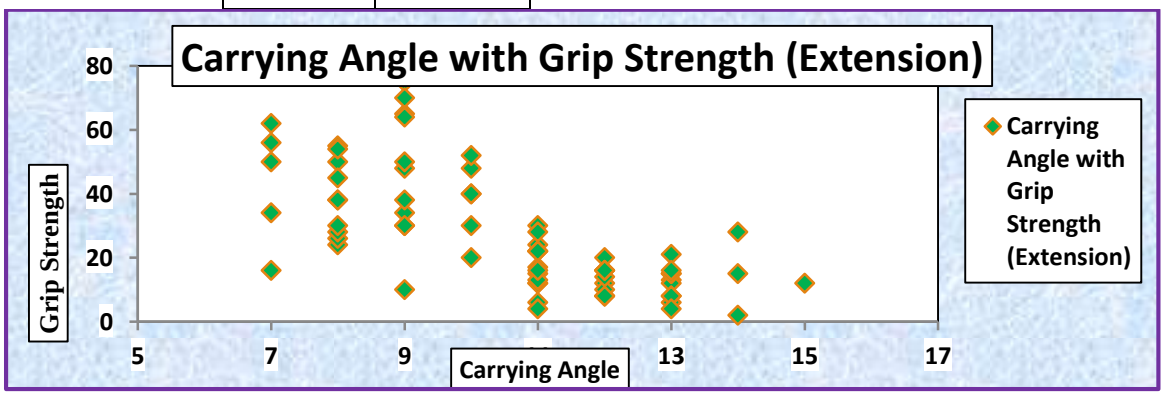
Karl Pearson's Correlation Coefficient

Right	Carrying Angle with Grip Strength (Flexion)
r value	p value
-0.70	0.00



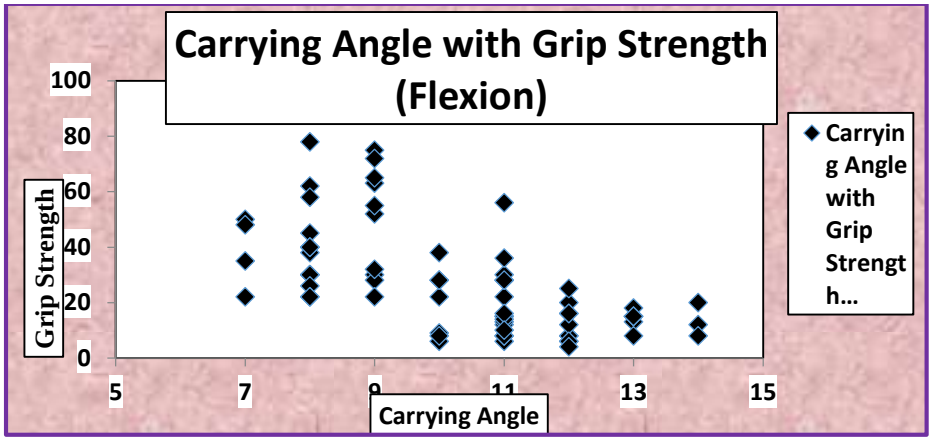
*p value less than 0.05, shows the significant correlation

Right	Carrying Angle with Grip Strength (Extension)
r value	p value
-0.69	0.00



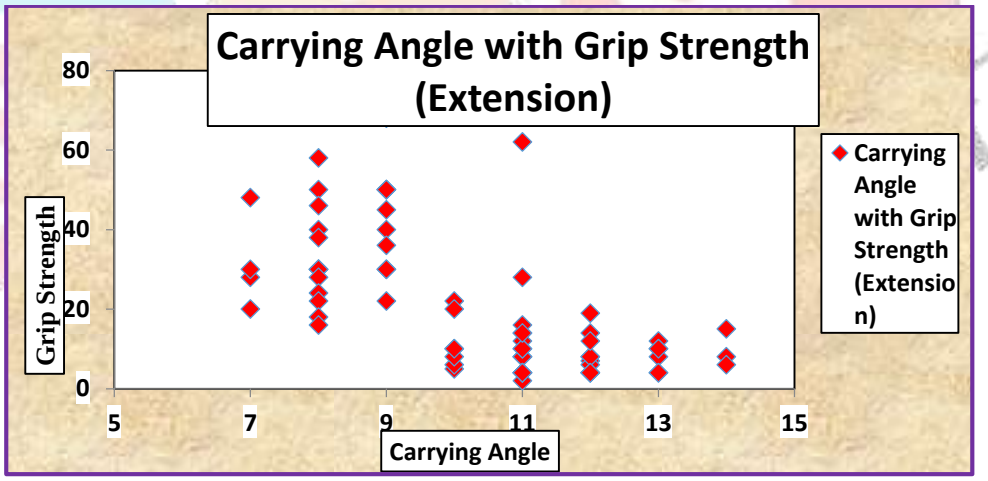
*p value less than 0.05, shows the significant correlation

Left	Carrying Angle with Grip Strength (Flexion)
r value	p value
-0.62	0.00



***p value less than 0.05, shows the significant correlation**

Left	Carrying Angle with Grip Strength (Extension)
r value	p value
-0.64	0.00



***p value less than 0.05, shows the significant correlation**

RESULT

The study showed that it was found negative correlation existed between carrying angle and grip strength . It suggest that there is a strong relationship between carrying angle grip strength in different elbow position among normal individuals.

DISCUSSION

- The present study aimed to correlate carrying angle and hand grip strength in different elbow position among normal individuals.
- The study suggest that there is a negative correlation between carrying angle and hand grip strength which means as carrying angle increases grip strength decreases and vice versa.
- This result can be attributed to active insufficiency which states that the muscles which are incapable of producing full action simultaneously at all joints on which they act are said to be actively insufficient. There are three types of insufficiency: Active, Passive and Tonic.
- Passive insufficiency means that the relaxed muscle cannot allow a full range of reverse movements in all joints under its control. Active insufficiency implies that such a muscle cannot contract to such an extent that maximum range of movement in every joint on which it acts would be possible. Tonic insufficiency means that muscular tension interferes with joint movement.
- In this particular study total 70 healthy young individuals of age group (24+-6) participated.
- This participants where evaluated as per data collection sheet.
- Initially carrying of both arms where measured by universal goniometer in anatomical position.
- It was found that out of 70 subjects 57% subjects has large carrying angle than remaining 43% subjects.
- On the other hand held dynamometer used to assess hand grip strength (quantitatively) in elbow flexion – extension in both the hands.
- It was found that hand grip strength in Right hand elbow flexion (31.90) is more than grip strength in elbow extension (27.09) and Left side elbow flexion(27.30) and elbow extension(21.50).
- It was found that carrying angle of Right hand (Mean=10.50)more than the carrying angle of Left hand (Mean=10.22).
- According to Jason Shea, [17] increase in carrying angle increases the stretch on long finger flexors near its origin. Hence, carrying angle does affect the grip strength. The synergistic action of flexors and extensors muscles and the interplay of the muscle groups is an important factor in strength of the resulting grip
- Mathiowetz et al studied the effect of elbow position on grip strength and found it to be higher with the 90 degree of elbow flexion.
- Long term forearm and hand flexors muscle strengthening stimulates nerve receptors / mechanoreceptors in the muscle, ligament as well as the joint capsule of wrist and elbow joint as demonstrated by improved muscle endurance and strength.
- Hence the effects that are established after long term forearm and hand flexor muscle strengthening on strength and endurance could be one of the rationale for hand grip strength in healthy individuals.
- In our study , it was found negative correlation existed between carrying angle and hand grip strength in elbow flexion and extension with –
- CA with Rt elbow flexion- P= 0.00, R= -0.70.
- CA with Rt elbow extension - P= 0.00, R= -0.69.
- CA with Lt elbow flexion- P= 0.00, R= -0.62.
- CA with Lt elbow extension - P= 0.00, R= -0.64.
- Hence , it suggest that there is a strong relationship between carrying angle hand grip strength in different elbow position among normal individuals.

CONCLUSION

The study concluded that there is a significant relationship between the carrying angle and hand grip strength in different elbow position (flexion, Extension) in normal individual between age group of 18-30 years.

CLINICAL IMPLICATION

- Being a normal individual it is important that the forearm and hand flexor muscle have well strength so that they can perform ADL's using his grip like carrying bucket by side, lifting object, screwing- unscrewing, etc.
- Good grip strength most important for sportsperson like cricketers, badminton players, tennis players, etc.
- By this study we can find out subject with poor hand grip strength, increase or decrease carrying angle and further strengthening activity sessions can be added to their ADL's.
- The established effect of this long term training on a grip strength could be one of the rationale for strength training performance in normal individuals.

LIMITATIONS AND RECOMMENDATIONS

Limitations:-

- Subjects included were young individuals; hence results can not apply to children, older adults and older age group populations.
- A specific forearm and hand flexor muscle strengthening program was not incorporated for the subjects in this particular study.

Recommendations:-

- Other more appropriate instruments for assessing hand grip strength can be used (jamer, digital dynamometer, hydraulic dynamometer).
- Also digital goniometer can be used for assessing carrying angle.
- Along with the elbow flexion and extension other joint position of shoulder and body position like sitting, standing can be used.

FUTURE SCOPE

- Assessment of carrying angle and hand grip strength in different elbow position may be followed by proper wrist flexor strengthening program on a large sample size.
- It may be done with respect to ADL's, recreational and sports activity.
- It may include forearm and hand flexor muscle strengthening program along with pre and post strengthening evaluation of hand grip strength.

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