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Research Article

Assess the Impact of Different Forearm Postures on Young Adults Grip Strength

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Abstract

The objective of present study is to evaluate the effects of different forearm posture on grip strength and grip endurance time in young university adults. Twenty-five healthy right-handed men volunteered to participate in this study. The grip strength and grip endurance at 50% maximal voluntary contraction (MVC) were randomly measured in three different postures (supine, pronation and neutral). MANCOVA results no significant effect of posture on strength ($p = 0.358$) and endurance ($p = 0.743$). In addition, age ($p = 0.034$), height ($p = 0.018$) and forearm length ($p = 0.032$) significantly affect the grip endurance time in supine position. Palm circumference significantly affect the grip strength ($p = 0.039$) in pronation posture only. The pronation forearm posture produces 6.5% more grip strength than a supine posture. In addition, the grip endurance time was improved in the supine position, compared to the neutral and pronation forearm posture. It can be concluded that the pronation forearm posture produces more grip strength than a supine posture and palm circumference is the most important factor that affect the grip strength.

Keywords: *Posture; Grip Strength; Endurance; Anthropometric Measurements*

Introduction

Grip strength of the hand is extensively acknowledged as a measure of maximum grip strength [1] and active contraction of the hand and forearm muscles. There are numerous factors which may significantly affect strength of hand grip, such as dominant hand, forearm posture, gender, and anthropometry variations [2]. Studies [3-7] provide more accurate estimates by measuring the forearm and/or hand and predicts grip strength better than the general anthropometric properties of the body. It had been reported in several studies that posture significantly affects hand grip strength and the hand grip endurance [2-7]. Fiebert., *et al*. [8] in an investigation concluded that the forearm supination posture was the most influential hand grip posture during measuring hand grip strength. When the elbows are fully extended and bent 180°, the shoulders show maximum grip strength, while when the shoulders at 0° and elbow flexed 90°, they show the lowest grip strength [9]. In addition, the pronation forearm posture had a weaker hand grip strength as compared to the neutral and supination forearm posture in both gender [10]. Kattel., *et al*. [6] during an investigation measured the hand grip strength and recommended that maximum hand grip strength was grasped when the wrist is neutral, the upper arm shoulder is abducted at 0°, and elbow is flexed at 135°.

Purpose of the Study

The purpose of the current investigation was to investigate the effects of forearm postures (pronation, supination, neutral) on hand grip strength and endurance of young college adults. Therefore, the null hypothesis of the investigation was "the forearm postures had no significant effect on hand grip strength".

Methods

Experimental design

Twenty-five healthy right-handed male voluntarily participated in the study. All subjects gave their written consent, and if they did not have any history of wrist, hand, and forearm dysfunction, they were included. The maximal hand grip strength and grip endurance at 50% MVC were randomly measured in three different postures (supine, pronation and neutral). Independent factors were posture and anthropometric variables. The study parameters were investigated according to the dependent variables (maximal grip strength and endurance). According to a previous study, participants' anthropometric measurements (Table 1) were recorded [4].

Anthropometry Variables	Mean ± SD
Age (years)	21.5 ± 1.9
Height (cm)	168.4 ± 6.8
Weight (kg)	62.5 ± 10.8
Length of palm (cm)	11.1 ± 0.5
Palm circumference (cm)	21.6 ± 1.5
Length of forearm (cm)	26.7 ± 1.3
Circumference of forearm (cm)	26.7 ± 1.7

Table 1: *The anthropometric characteristics of the participants.*

Experimental procedure

In the current study, all subjects were asked to sit on chairs with adjustable height options with their forearms horizontal. The platform height is accustomed according to the elbow, shoulder and torso posture. In addition, the subjects were asked to placed shoulder abducted at 0°, and to maintain the elbow angle at 90°-120°. Additionally, subjects were requested to squeeze the hand grip dynamometer with their maximum capability (two trials were taken with 120 seconds break to measure the MVC) till the subjects sensed unbearable discomfort and were unable to continue their efforts maintained to the level of target (maximum capability) [11,12]. The hand grip jammer (G100; Biometrics Ltd. UK) is connected with the laptop using Data LINK hardware and software interface. Then, after a 5-minute break, measure the endurance at 50% MVC (using reference as the maximum values of MVC for both the trials) for further analysis. In addition, forearm postures (supine, pronation, neutral) were randomly selected during the test, giving the rest of 10 minutes between each forearm posture.

Analysis of data

The brief representation of data of hand grip strength and endurance relative to all the postures were presented in table 2. To analyse the significance of dependent variable and to examine the effect of independent, dependent variables and their interaction with covariates, MANCOVA was done with SPSS 20.0. Additionally, correlations test (Spearman) was also accomplished to assess the association (linear or nonlinear) among dependent variables and covariates.

Grip Strength (Kgf) n = 25			Endurance Time (Sec.) n = 25		
Supination (Mean ± SD)	Pronation (Mean ± SD)	Neutral (Mean ± SD)	Supination (Mean ± SD)	Pronation (Mean ± SD)	Neutral (Mean ± SD)
62.24 ± 16.18	66.6 ± 11.51	59.96 ± 19.26	42.97 ± 22.37	39.0 ± 21.38	42.4 ± 19.19

Table 2: *Summary of the grip strength and endurance.*

Note: n- Numbers of participants, Kgf- Kilogram force.

Results

Effects of posture on hand grip strength and endurance

The MANCOVA results exhibited that posture had no significant effect on hand grip strength (p = 0.358) and endurance (p = 0.743). In addition, table 2 showed that MVC grip strength was found to be higher in the pronation posture (66.6 ± 11.51) followed by the supine posture (62.24 ± 16.18) (Figure 1). However, grip endurance time was highest in supine posture (42.97 ± 22.37) seconds followed by neutral posture (42.4 ± 19.19) seconds (Figure 2).

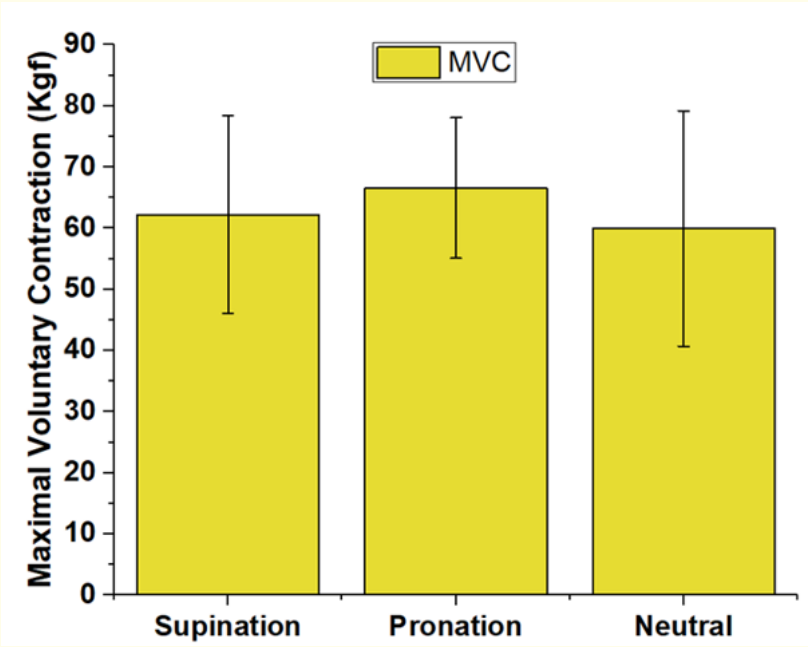

Figure 1: *MVC grip strength values in different forearm posture.*

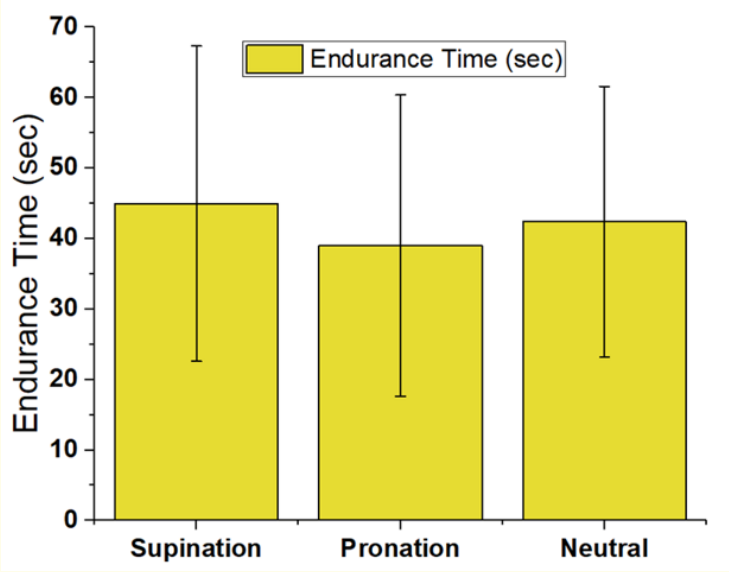

Figure 2: *Grip endurance time values in different forearm posture.*

Effects of anthropometric variation on hand grip strength and grip endurance

The age (p = 0.034), height (p = 0.018) and forearm length (p = 0.032) significantly affect the grip endurance time in supine position. However, palm circumference significantly affects the MVC hand grip strength (p = 0.039) in pronation posture only. Interestingly, palm length and forearm circumference does not significantly affects the MVC hand strength and endurance. Interestingly, the results also exhibited no significant correlation of anthropometric variations with maximal grip strength and endurance in any of the three postures (except with weight and MVC grip strength in supine position and palm circumference with MVC grip strength in all posture).

Discussion

With the forearm pronation, grip strength was significantly reduced compared to the neutral and supine forearm posture [13]. De Smet., *et al*. [10] concluded that the grip strength of the pronation posture is weaker than that of the neutral and supination forearm posture in both gender. However, Lee and Hwang [2] found highest grip strength in the neutral posture (371.90N) as compared to the pronation (363.60N) and forearm supination posture (363.30N). In contrast, current results report that MVC grip strength is higher at pronation (66.6 ± 11.51) kgf compared to supination posture (62.24 ± 16.18) kgf and neutral (59.96 ± 19.26) kgf forearm posture. Interestingly, the pronation forearm posture has 6.5% higher grip strength than the supine position. In addition, the grip endurance time in the supine position was improved compared to the neutral and pronation forearm positions.

Alam., *et al*. [4], found that anthropometric measurements such as length of the palm, circumference of the palm, and length of the forearm significantly affect the grip strength. The current study also exhibited that the palm circumference is the most significant parameter influencing hand grip strength. In addition, Lee and Hwang [2] during an investigation concluded that hand grip strength was statistically dissimilar by hand dominance, forearm posture and gender. Alam., *et al*. [3] also concluded that palm length and age significantly

affects the hand strength, with length of palm being the utmost decisive and influential parameter for hand strength ($r = 0.357$, $p < 0.001$). Fiebert., *et al*. [8] during an investigation measuring the hand grip strength recommended the length of the palm as the strongly correlated influential parameter for hand grip strength. In contrast, current results do not show a significant effect of length of palm and circumference of forearm on grip strength and grip endurance. However, the grip endurance time in the supine position had a significant effect on age ($p = 0.034$), height ($p = 0.018$), and forearm length ($p = 0.032$). In addition, Eidson., *et al*. [5] also concluded that the gender and the circumference of palm were exceptionally and had a significant association with the hand strength of both the hands, as also reported in the current results. These differences reported in various studies results could be owing to modifications in the experimental methodologies, instruments used for calculating hand strength, rest periods during testing, or methods used to measure variability in anthropometry.

Conclusion

It can be concluded that the pronation forearm posture produces more grip strength than a supine posture and circumference of palm is the utmost significant parameter influencing the maximal grip strength. In addition, the grip endurance time was improved in the supine position, compared to the neutral and pronation forearm posture.

Limitation and Future Scope

Only young college students were considered in this study. Therefore, the effects of different age groups on grip strength were not investigated. Future research may collect the grip strength of various age groups from young subjects to the elderly, and may further study the relationship between age and maximal grip strength.

Conflict of Interest

None.

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