Progressive Upper Compartment Functional Strength Training on Postural Muscle Force: In Volleyball Players

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Abstract

Objectives: Postural muscle force leads to an increase in functional movement and associated ability of strength. The author examined changes in shoulder and humerus strength, maximum isometric joint angular degree force after functional upper strength training in volleyball players. They evaluated isometric joint angular force degree as predictors of functional strength.

Materials and methods: Twenty-four participants (average age 19.03 ± 1.54) were randomized to a 4-wk upper compartment functional strength program or control group.

Results: Functional strength group increased significantly (p < 0.05) for all angular strength. Compared with controls, functional strength led to greater at 45° angular strength (p = 0.011) dominant hand, non-dominant hand angular strength (p = 0.001), greater 90° angular strength (p = 0.014) dominant hand, non-dominant hand angular strength (p = 0.001). Shoulder and humerus muscle-tendon isometric strength were good predictors of functional strength.

Conclusion: The authors concluded functional strength training in strength development is an important factor for shoulder-humerus postural force and a key target for upper compartment functional interventions.

Keywords: Functional strength training, Shoulder-humerus postural muscle force, Volleyball players

Introduction

Volleyball players, there are angular differences in postural muscle strength of the technical movement such as lifting, lowering and muscle balance [1]. Additionally, volleyball players perform individual strength in upper compartment muscle-tendon dynamics and endurance abilities, and are variant in different strength/power training such as power, stretch-shorthing cycle, and movement speed [2]. However, humerus and shoulder strength performance may decrease or increase in a periodic sequence during functional training for postural muscle force development [3]. Both injury and syndrome in which mechanical strength deficiency occurs in overactive shoulder-humerus muscle groups of the upper compartment during competition and training periods are experienced [4]. Therefore, it was necessary to progressive functional muscle strength exercises for shoulder and humerus muscle tendon complex strengthening angular activity in the training into postural muscle weakness [5].

Force energy generations in locomotive shoulder activity and their planning to provide rotational flexibility of movement are frequently mentioned in the literature [6]. However, the reason why functional training is applied in the upper compartment is to provide potential muscle mass increases and strengthening in appropriate movements in athlete [7]. On the contrary, improper functional strength training in lengthening ability of postural muscle or decrease of strength in different shoulder areas such as anterior, posterior, laterals with abnormality strength and muscle force [8]. Therefore, even in a single power cycle, a complex loss of the strength is observed overactive and protractive muscle in generally cervical region that is, when muscle-tendon weakening is seen in postural evaluations, injury is high during explosive force periods [9]. Correct force created in multiple joints in postural muscle structure caused the posterior muscles to overactive, in fact the...
Concequence of function training will be concluded whether there is weakness in the postural muscles upper compartment angular region dynamic will be analyzed in postural evaluation.

Materials and Methods
Participation
Twenty-four women were created sample group and a randomized control trial in this study. First group; functional strength training group volleyball players (FST: 12 sample size 18.59 ± 2.41 years-old, 65.20 ± 4.20 kilograms, 1.79 ± 3.54 m height, training experience 6.43 ± 3.58 years) participated in performing 4-wk functional strength training in an upper compartment. Second group; an physical active non-control group (CON: 12 sample size 19.48 ± 1.63 years-old, 69.42 ± 3.58 kilograms, 1.74 ± 2.47 m height, training experience 3.84 ± 2.45 years) voluntary participated in this study (Table 1). Participants signed an informed consent form prior to this study by Declaration of Helsinki in sport field.

Upper compartment shoulder junction postural muscle movement analysis
Postural muscle activity analysis evaluation including a shoulder junction muscles during active phases. Active flexion of shoulder abduction initial is 180° degree between scapulae raising in supine position. Stabilize scapulae passively in horizontal abduction from 90° degree extended elbow applied shoulder abduction 40-45° degree raising in prone position [16]. Resistance executed after manipulate. Therefore, obtained type I-III phase inactivity muscle and IV-V phase active muscle. Typical evaluation showed active muscle phases within 30 min in upper crossed regions. Ultimately, in muscle

Table 1: Funtional strength training program.

| Weeks | 1-wk | 2-wk |
|-------|------|------|
| **Functional training** | **Shoulder pulling** | **Latpull down high degree** | **Dumbbell broad with bar** | **Shoulder extension with bar** | **Shoulder triceps brachii machine** |
| Intensity session | 85% | 90% | 85% | 95% | 95% | 90-95% |
| Repetition | 12 rep | 10 rep | 12 rep | 12 rep | 8 rep | 12 rep |
| Set | 5 set | 5 set | 3 set | 5 set | 3 set | 2 set |
| Total repetition | 34 | 32 |
| **Weeks** | 3-wk | 4-wk |
| **Functional training** | **Prone triceps shoulder extension lunge** | **Latpull down low degree** | **Cable row crossover** | **Fly pulling machine** | **Ultimate cable shoulder workout** | **Cable row pulling** |
| Intensity session | 95% | 85% | 95% | 90-95% | 90% | 95% |
| Repetition | 15 rep | 10 rep | 8 rep | 5 rep | 5 rep | 10 rep |
| Set | 1 set | 3 set | 5 set | 3 set | 3 set | 5 set |
| Total repetition | 33 | 20 |

A previous study, shoulder-humerus postural muscle strength performance is revealed by isometric muscle contraction modeling of myofascial tendon tension and irregular localized loss of function and strength in shoulder stability, humerus head glenoid fossa tension is obtained from superior shoulder capsule connection, deltoid posterior, and supraspinatus that over time, unstable muscle shortening is known as crossover syndromes [3,8,13]. This is due to the stability of the deep shoulder muscles in the cervical junction complex and different motion stages, usually in the shoulder and humerus elevation ranges [13]. Moreover, forward head posture, rounded shoulder, myofascial separation, and pain due to deep cervical shoulder and upper cervical hyperextension are associated with weakness and shortening [4,10,14].

Other previous studies, different exercise models were obtained to evaluate functional postural dynamics in the posterior-lateral shoulder region of physical active, bodybuilding and powerlifting athletes in the upper compartment postural structure strength [11,15]. Similarly study, to evaluate strength asymmetry of shoulder in different volleyball players were obtained internal rotator injury and deficient [1,5].

The aim of this study is to examine muscle strength in different upper compartment of volleyball players.

| Weeks | 1-wk | 2-wk |
|-------|------|------|
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resistance seen multiple muscle degree III-IV phase no injury before functional strength training.

**Progressive functional strength training**

A 4-wk progressive strength program was created for functional upper compartment muscle-tendon dynamics. For pre-workout gain, a functional lunge, back squat, deadlift, and split jump consist of 8-10 repetitions. Controlled manipulation then was performed immediately after FST group performed in multi-muscular joint dynamic movements. Functional strength training was started when muscle grades were optimal. Respectively, upper shoulder and humerus movements were applied 80-95% of 1-RM intervals changes. Firstly, shoulder pull was performed as postural structure movement, a lifting performance 85-90% of 1-RM at a periodic intensity between 3-5 sets of strength and muscle power (Table 2). The high degree of latpull down and dumbbell broad shoulder binding exercises performed in muscle strength energy adaptation. But for maximal power generation 90-95% of 1-RM, therefore, cable row crossover has maximal strength with fly pulling and ultimately cable shoulder movement and cable row pulling were performed through muscle power endurance improvement in the planing method. Training periods lasted one half hours and between each set was given about one min. Total change percentage showed in the upper strength sets within a 4-wk and 3 days (Figure 1).

Functional training took place in the superficial and deep muscle activity in the full upper compartment. The upper compartment intensity periods were determined from percentages and it was progressive in the principle of correct external loading each training.

**Upper compartment strength test**

A Newton gauge isometric handgrip strength was used for absolute shoulder girdle strength and humerus longitudinal, including the best trial in 3 phases of generated force testing [12]. The external mechanic strength evaluation of triceps torque arm was concluded at 45° degree humerus raising and 90° degree shoulder joint abduction mobility. Along with humerus strength

| Strength Variables | FST group | Pre test | Post test | P-values | 95% CI | Standardize ES | Cohen’ d ES |
|--------------------|-----------|----------|-----------|----------|--------|----------------|------------|
| 45° Dominant | 27.15 ± 2.38 | 30.05 ± 2.44 | 0.001*** | 4.26-1.53 | 2.14 | 1.20 |
| 45° Non-dominant | 23.65 ± 2.08 | 25.47 ± 2.42 | 0.002** | 2.90-0.71 | 1.71 | 0.80 |
| 90° Dominant | 20.28 ± 2.88 | 24.00 ± 2.35 | 0.001*** | 4.49-2.95 | 1.21 | 1.41 |
| 90° Non-dominant | 18.77 ± 2.23 | 19.50 ± 1.93 | 0.044* | 1.57-0.12 | 1.33 | 0.35 |

*p < 0.05; **p < 0.010; ***p < 0.001

![Figure 1: Upper compartment functional strength showed in changes percentage.](image-url)
Presented graphically (Figure 2).

Study effect sizes that would affect the population were determined consequence of the pre-post comparison of the FST group. Significant differences (p < 0.001; \( d = 1.20 \) high effect) were obtained at the 45° angular degree in the dominant arm and in the non-dominant arm (p < 0.02; \( d = 0.80 \) high effect) obtained. Similarly, a significant difference (p < 0.001; \( d = 1.41 \) high effect) was found in the 90° angular degree in the dominant arm. Only the non-dominant arm showed a significant difference in force output (p < 0.044; \( d = 0.35 \) moderate effect) at the 90° angular degree.

Statistical analysis
An initial power analysis was computed with an assumed type II error rate of .05 (95% statistical power) to detect significant and medium size effect [17] by interactions. After normal distribution examined Shapiro-Wilk Test, an T-test statistic used in the study to compare the average data obtained between group differences for significant values. The effect size for difference or level of change obtained 0.20 small, 0.60 medium and ≥ 0.80 large effect as reference. All data analysis were performed using 28 SPSS (version SPPS 28 Inc Chicago, TR).

Results
FST group were performed functional 4-wk strength training periodic sequences according to training percentages and control group no training. Shoulder-humerus angular degree strength resulted in all strength measurement both dominant and non-dominant hand (Table 3). The population of the study before strength test change difference and effect size shown in the statistic (Table 4). A statistical change in all groups was presented graphically (Figure 2).

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Strength variable predictors were revealed as the consequence of the comparison of force variables in the upper compartment. It can be angular degrees with high effect sizes together in population studies. Strength variables were determined consequence of the pre-post comparison of between the FST group and CON group. Significant differences (p < 0.011; \( d = 1.13 \) high effect) were obtained at the 45° angular degree in the dominant arm and in the non-dominant arm (p < 0.02; \( d = 0.62 \) medium effect) obtained.

| Statistic variables | Test | Mean difference | Confidence interval 95% | P-values | Population ES |
|---------------------|------|----------------|-------------------------|----------|---------------|
| 45° Dominant        | PRE  | 2.76           | 0.69-4.83               | 0.011**  | 1.13          |
|                     | POST | 4.00           | 2.16-5.84               | 0.001**  | 1.84          |
| 45° Non-dominant    | PRE  | 0.11           | 1.53-1.75               | 0.88     | trivial       |
|                     | POST | 0.62           | 1.22-2.44               | 0.49     | trivial       |
| 90° Dominant        | PRE  | 1.46           | 0.54-3.47               | 0.14***  | 0.62          |
|                     | POST | 4.61           | 2.72-6.53               | 0.001**  | 2.06          |
| 90° Non-dominant    | PRE  | 0.89           | -1.94-1.77              | 0.92     | trivial       |
|                     | POST | 0.78           | -5.56-3.50              | 0.001**  | 1.78          |

*p < 0.05; **p < 0.010; ***p < 0.001.
considerable effect size in decreasing muscle activity [10]. The FST group, there was a high effect ($d = 1.20, d = 1.41$) dominant shoulder-humerus strength increases, results revealed that the muscle force affect positive the forward head and shoulder rounded [15].

The study CON group were physical individuals. However, in the CON group impact size was obtained at 45° angular degrees pre-post test results in both dominant ($d = 70$) and non-dominant ($d = 75$). Another study, extensive exercises performed in physical individuals resulted in activation in surface and deep muscles. However, functional training was included in the study without a control group, but in accordance with all individuals [11].

**Discussion**

A functional upper strength program was included for the first time in our study and examined functional angular degree isometric muscle strength difference region. Ultimately, isometric strength increases in multiple deep and superficial muscle groups of the functional strength program applied for 4 weeks were confirmed. The results revealed that flexibility in the shoulder-humerus regions and energy was obtained tendon tensions. Previous study was performed to examine strength variation in the upper compartment postural muscles during eight-week long term corrective exercise program, suggest that cervical muscles, upper trapez, lower trapezius and serrates anterior muscle significantly affect changes on the postural shoulder junction muscles strength. The main finding of this study supported our hypothesis that 45-90° angular degree intervention increased rotational strength internal changes. This data support enhance or pre-post significant results showed that sternocleidomastoid ($d = 1.51$), upper trapezius ($d = 2.11$), lower trapezius ($d = 1.52$) and serratus anterior ($d = 1.49$) observed considerable effect size in decreasing muscle activity [10]. The FST group, there was a high effect ($d = 1.20, d = 1.41$) dominant shoulder-humerus strength increases, results revealed that the muscle force affect positive the forward head and shoulder rounded [15].

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Functional training for muscular endurance, involving different muscles in a functional phase affects muscle strength in a short time, while the effects on the response of the training variables to functional movements are more important in long-term muscle strength training. Our study, isometric muscle activity work out at 4-wk functional strength highly increased and 45-90° angular degree can be isometric multiple muscle complex into postural region [8]. However, more than study has applied complex training to shortened and weakened muscles for postural muscle strength in progressive [3].

Schneider, et al. [2] reported that shoulder-humerus isometric strength response to 60-90° angular degree may be different in volleyball players. Moradi, et al. [5] examined that one threband exercise for throwing performance efficiency per week strengthening section
in volleyball players. Resistances increase arm strength, but there is a limitation in changing the working principles in frequency differences in the shoulder area. Moreover, shoulder internal rotator deficiency decreased with external 90° rotation and catching and 90° perturb scapular plan exercises. Therefore, upon upper compartment different forces can be realized that other studies in functional period squences showed 50%-70% of 1-RM intensity [18]. This study, it has been suggested that mostly percentage changes revealed to by progressive muscle strength. Although it has been studied higher or lower percentage of muscle activation our muscle training program in principle it can be used in elite athlete.

One study, changes in functional movements were found to be directly related to shoulder height and strength. Percentage changes for muscle loading were seen only in extrinsic influence. However, the principle of muscle using heat energy in similar activities is not the same. Therefore, it is appropriate to include more functional exchange exercises such as dumbbell curl and broad [7].

Cuckova, et al. [3] other studies have been compensatory in the strength development of volleyball players. Muscle functional exercises To counterbalance and imbalance were performed five times pre week. Our study applied intense training for 3 days. As for the duration, they performed 30 minutes, we applied 1.30 hours and more functional training. Consequence showed shoulder elevation may have acquired a significant range of motion. This condition has no injury and postural muscle deficiency.

Muscle memory in movements was obtained in individual percentages at stages of neuromuscular change. Hand, forearm, and elbow response results in the upper compartment varied. Because the external resistive load rejects the same working force in different regions of the force. For this reason, the athlete should awareness of heat and power changes during repetition and rest in the individual shoulder and hand-raising movements [3,5,18].

In conclusion, high-impact functional training should take place in the activity and strength of upper compartment muscles in all age and gender. Accurate periodization is essential without injury due to percentages in functional training. The study showed that functional exercises can be used in other sports branches.

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Conflict of Interest
The authors declare that the research was conduction in the absence of any commercial or financial relationships and no conflict of interest.

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