
بسم الله الرحمن الرحيم
قالوا سُبْحَانكَ لا عِلمَ لنَا إلاَّ مَا
عَلَّمْتَنَا إنَّكَ أنتَ العَلِيمُ الحَكِيمُ
صَدَقَ اللهُ العَظِيمُ
سورة البقرة : « الآية ٣٢ »

EFFECT OF HAND GRIP EXERCISE ON ELECTROMYOGRAPHIC ACTIVITY OF CONTRA LATERAL ROTATOR CUFF

By

HIND ALI MOHAMED MHMOUD

B.Sc. of Physical Therapy Cairo University (2009)

تأثير تمرين قبضة اليد على رسم العضله الكهربي للعضلات المديرة الجانبية المقابلة

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Introduction

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The Glenoheumeral Joint (GHJ) is the most mobile joint in the body, and many functional component contribute to its mobility and stability Although shoulder movement require coordination of all the shoulder girdle muscles, the rotator cuff muscles are perhaps the most important contributors to the shoulder stability **Inman et al., (1996); Veeger and van der Helm, (2007)**

- The rotator cuff muscles, especially supraspinatus (SSP) and infraspinatus (ISP), are of interest because of their key multifunctional roles in shoulder stability and movement. They are exposed to potential stress during occupational and manual work, and in a variety of sporting activities. Escamilla and Andrews, (2009)

- Training the healthy limb may induce neural adaptations that facilitate motor output with the impaired contra-lateral limb, the so-called ‘‘contra-lateral strength training effect” or ‘‘cross education” that's task specific and occurs in the opposite, homologous muscles Carroll et al., (2006) and Lee and Carroll, (2007)

- The current study was designed to examine the electromyographic activity changes in the contralateral untrained rotator cuff (SSP-ISP) during dominant ipsilateral hand grip training.

Statement of the problem:

the study may provide an answer to the following questions;

- Is there any difference in electromyographic activity of the ipsilateral rotator cuff (SSP _ ISP) pre and post hand grip training?
- Is there any difference in electromyographic activity of the contralateral rotator cuff (SSP_ ISP) pre and post hand grip training ?
- Is there any difference in electromyographic activity of rotator cuff (SSP_ISP) with regard to the ipsilateral and contralateral sides post hand grip training ?

Purpose of the Study

The purpose of this study was to investigate the effect of hand grip training on the electromyographic activity of the contralateral rotator cuff in normal individuals. In order to reach this target aim, The study was conducted to :

- Assess the electromyographic activity of the ipsilateral rotator cuff (SSP-ISP) pre and post hand grip training.

- Assess the electromyographic activity of the contralateral rotator cuff (SSP-ISP) pre and post hand grip training.
- Assess any difference in electromyographic activity of rotator cuff (SSP-ISP) with regard to the ipsilateral and contralateral side post hand grip training.

Significance of the study:

- Preservation of muscle strength after rotator cuff surgery is important for recovery of normal shoulder function and prevention of recurrent defect. Gazielly DF, et al.,(1994). Furthermore, for certain populations, such as athletes and manual laborers, this is even more important.
- Stabilization of the glenohumeral joint by the rotator cuff muscles, especially the SSP and ISP, is an essential prerequisite of hand grip activity Alizadehkhaiyat et al., (2011)

- Unilateral training may have clinical implication for patients suffering paralysis associated with stroke and other neurological disorder , It appears possible that unilateral training will induce motor irradiation in the opposite immobilized limb , which may be sufficient to maintain corticospinal excitability ,therefore minimizing the strength loss and atrophy. Likewise unilateral training of free limb may provide new approach to managing and rehabilitating musculoskeletal injury Ashlee M. Hendy et al., (2012)

SUBJECTS, MATERIALS AND METHODS

Selection of the subjects: •

- Thirty normal subject from both sexes with ages ranged from 25 to 30 years old were participated in this study.
- Subjects were normal subjects and were selected according to the following

Inclusion criteria:

- All subjects were apparently normal subjects with no cardiovascular, neurological or neuromuscular disorder.
- Subjects were required to refrain from upper body strength training outside the study and to maintain their normal daily routines.

- Subject with sufficient cognition and educated enough to understand the requirement of the study.
- The study was carried out in agreement with legal requirements and in line with the standards defined by a local ethics committee.

• Subject were right-handed according to the Edinburgh handedness questionnaire (EHQ). The EHQ includes a list of activities and tasks, the procedures go through asking the participant to indicate "which hand do he prefer for specific activity ?" and " do he ever use the other hand for that activity ?". The scale can be used by an observer assessing the person, or by a person self- reporting hand use. Oldfield, (1971), (Appendix III)

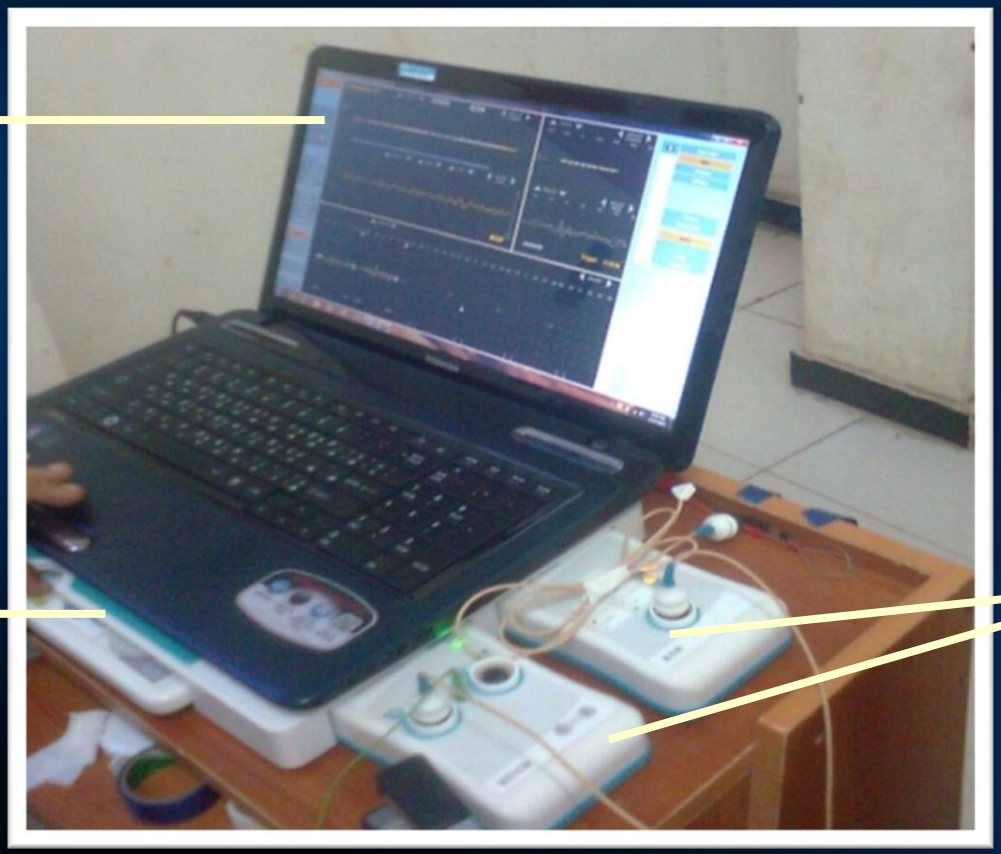
Exclusion criteria:

The current study excluded the following subject;

- Subjects with cardiovascular disease, neurological disease or musculoskeletal dysfunction of the upper quarter .
- Subjects with cardiac pacemakers or other electronic implants.

Instrumentation:

- **Instrumentation for Evaluation:**
  Electromyography apparatus



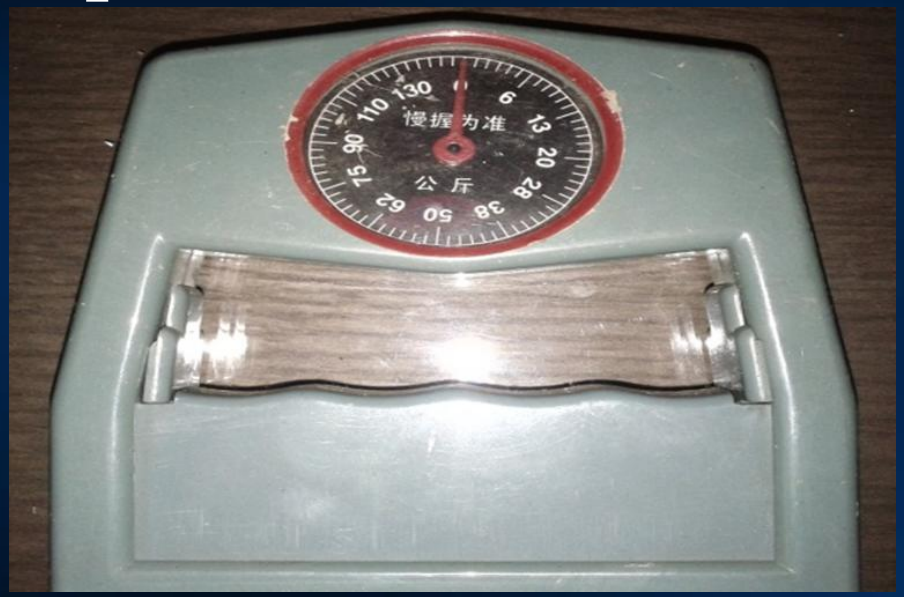
The TruTrace EMG

Stimulator headboxes

- EMG was used to measure electromyographic activities (EMG amplitude determined by calculating the root mean square RMS) of both sides pre and post hand grip training session by using surface electrodes.

b. Instrumentations for Training

Hand Grip Squeezer Tool



- It was used for hand grip training in (dominant hand only) where it was widely used for athletic training and valid for physical therapy management.

- Description: light weight plastic dynamometer, hand grip force measured with three compressible springs. The handle adjustable for different hand sizes. Its used for testing hand grip strength and for training during rehabilitation . **Robert wood,.(2008)**

Procedures

- In this study unilateral dominant hand grip training was used to examine the electromyographic activity changes in the contralateral untrained rotator cuff (SSP,ISP) .In order to reach this target aim, electromyographic activity (amplitude determined by RMS) was assessed in all subjects pre and post hand grip training session by using surface electrodes.

Electrodes placement on the supraspinatus muscle

Electrodes placement on the infraspinatus muscle

Training protocol:

- Participant was instructed to squeeze the handle of the hand grip trainer maximally (50% of MVC) for two seconds then release then repeat ten times for three sets for just one side/ dominant hand Young et al.,(2012).
- With 5 min rest period between sets which has been shown to be acceptable rest period to avoid muscle fatigue.

- At the end of hand grip training the participant was rested for 5min before the electromyographic activity was picked up. Sabbahi et al., (1979) and Stephen Minning et al., (2007)

Picking up of electromyographic activity of rotator cuff (SSP-ISP) pre and post training:

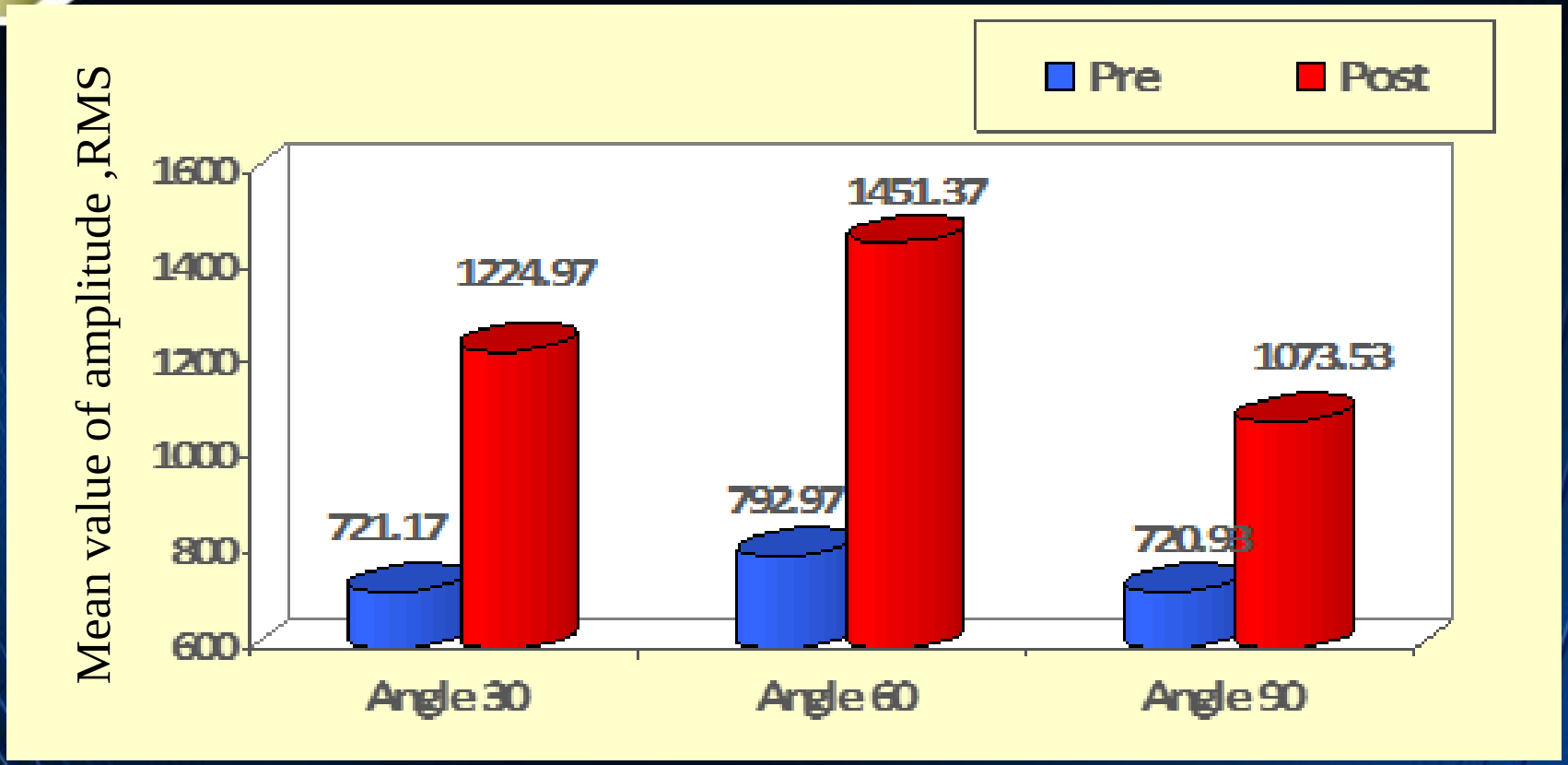
- patient instructed to perform arm abduction in scapular plane with humerus in neutral position Alpert et al., (2000) with hand grip strength 50% MVC O.Alizadehkhaiyat et al., (2011) in positions of 30, 60 and 90 degrees of arm abduction. At that time, data captures were completed and hence; electromyographic data were collected (EMG amplitude , RMS).

The 30 degrees of shoulder abduction

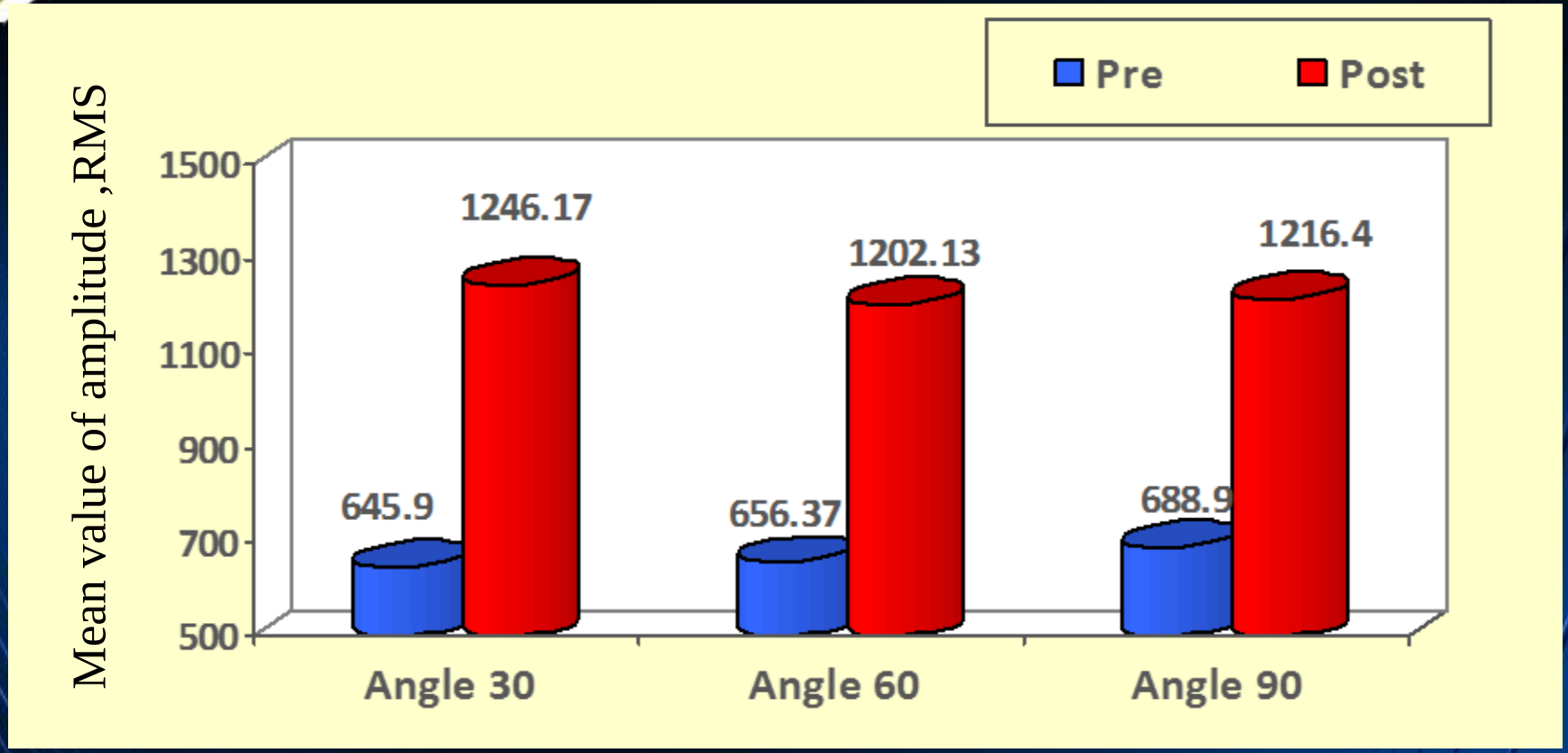
The 60 degrees of shoulder abduction

The 90 degrees of shoulder abduction

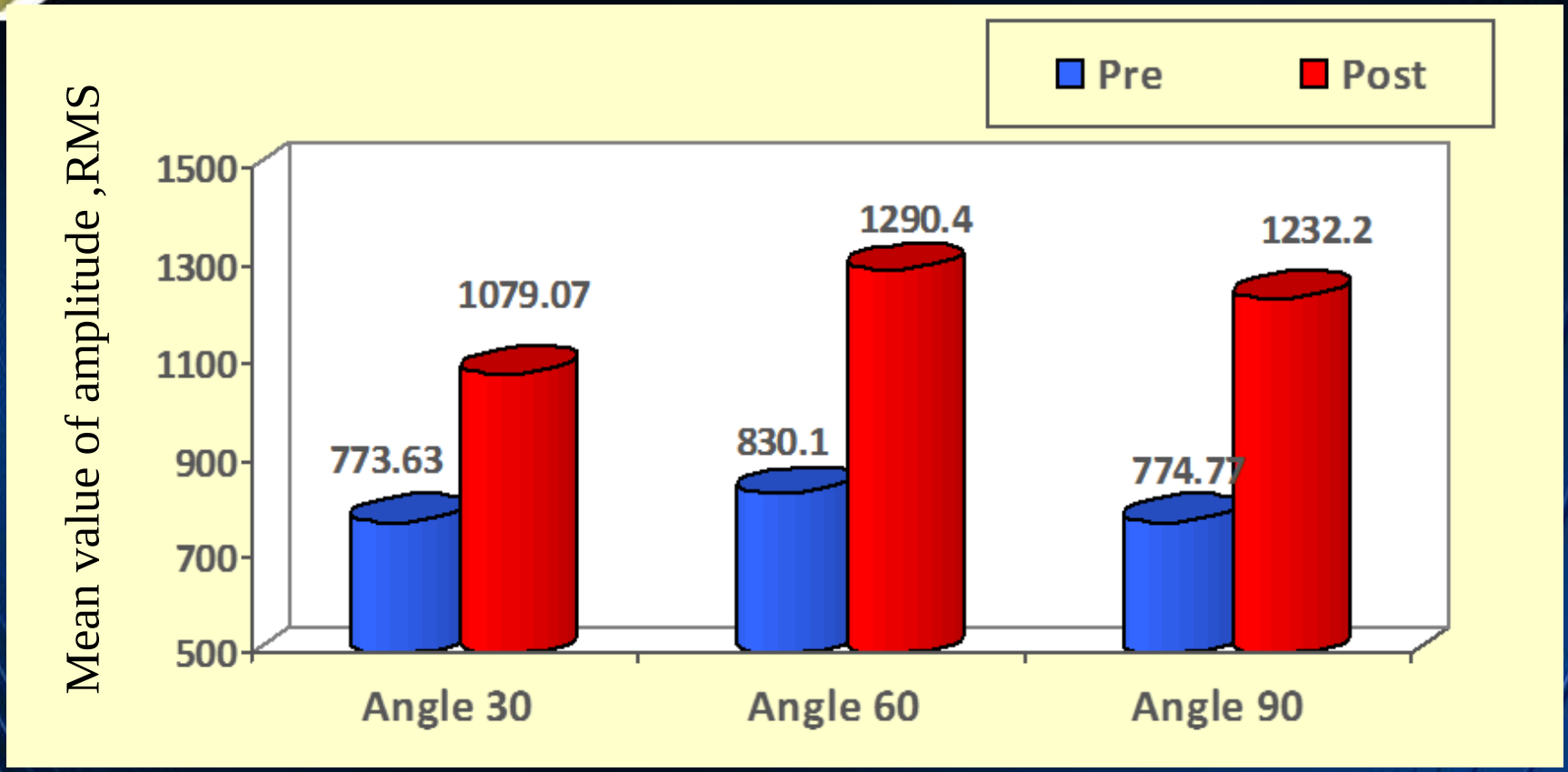
ANALYSIS OF RESULTS



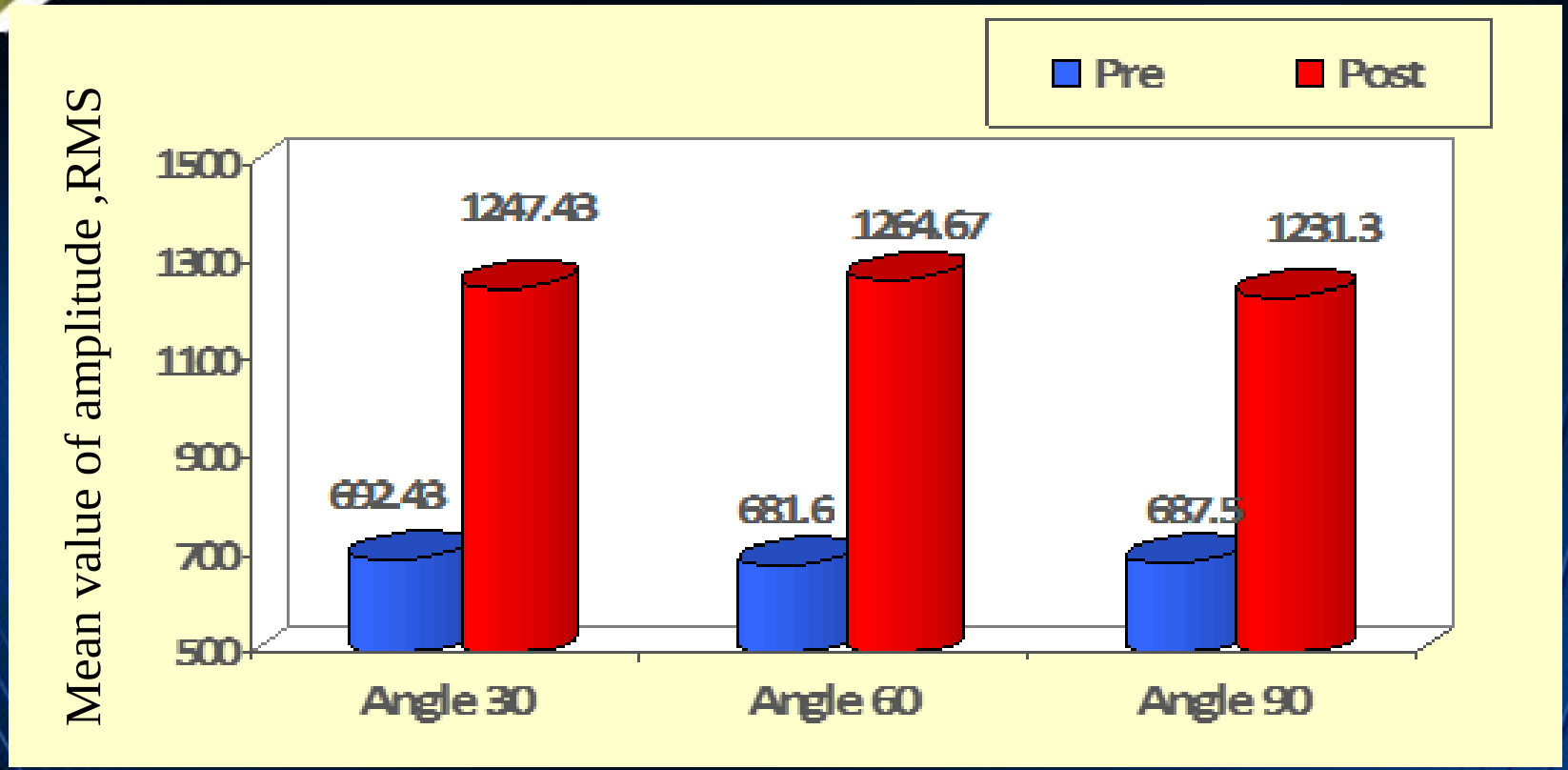
Electromyographic activity (amplitude,RMS) of supraspinatus muscle (SSP) at different angles (30º, 60º & 90º) pre and post hand grip training in dominant limb



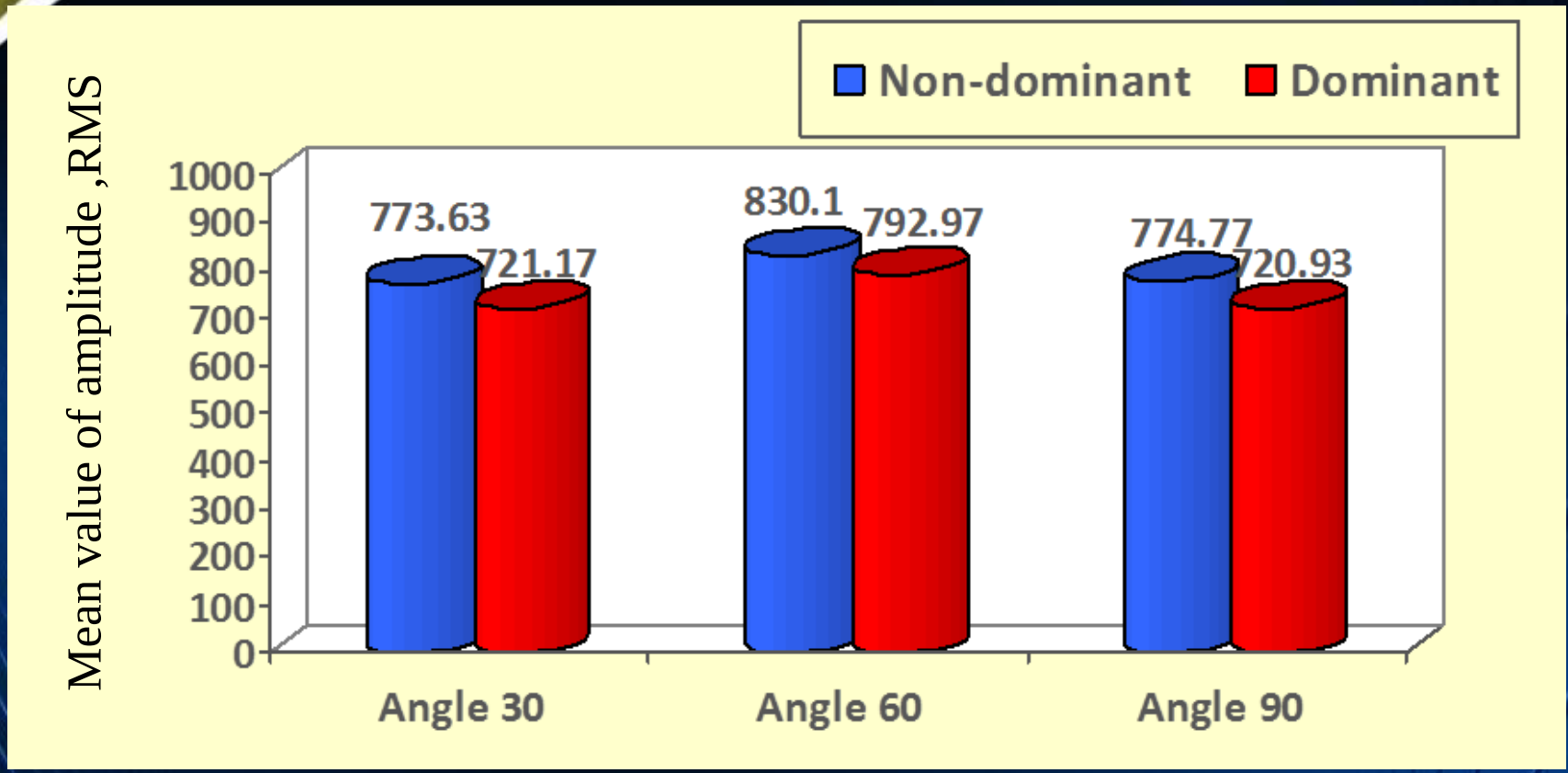
Electromyographic activity (amplitude, RMS) of infraspinatus muscle (ISP) at different angles (30º, 60º & 90º) pre and post hand grip training in dominant limb.



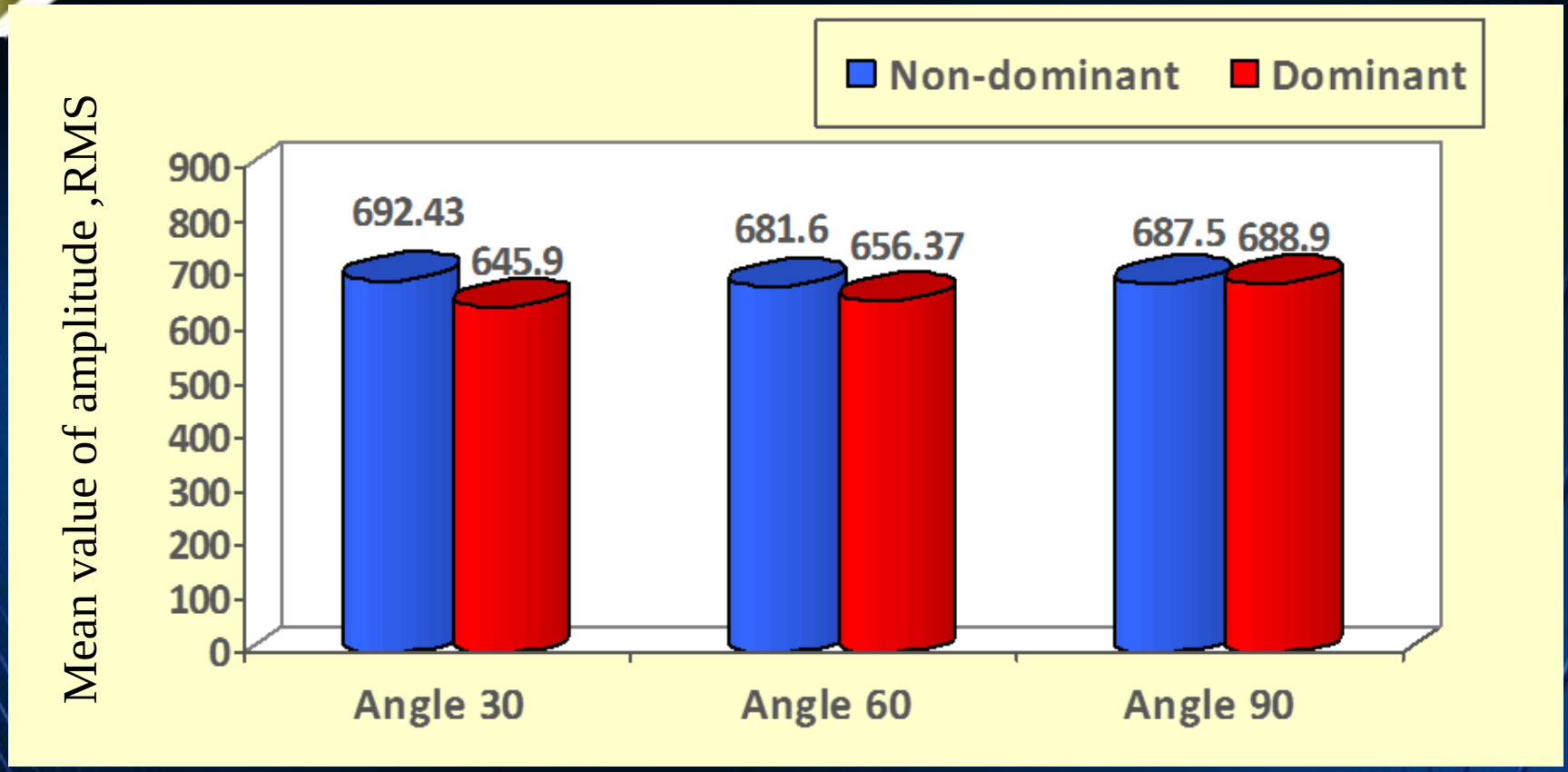
Electromyographic activity (amplitude,RMS) of supraspinatus muscle (SSP) at different angles (30º, 60º & 90º) pre and post hand grip training in non-dominant limb.



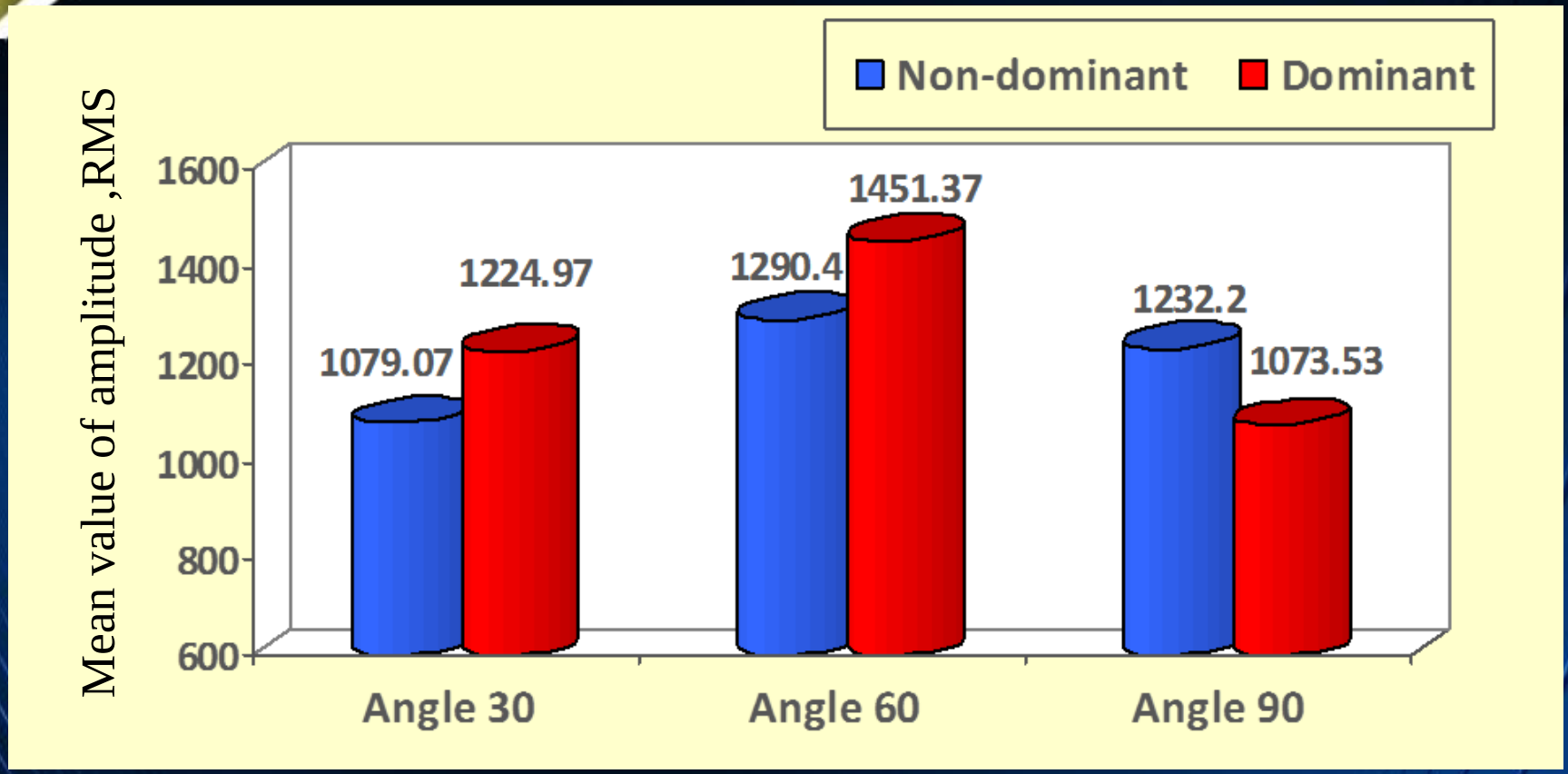
Electromyographic activity (amplitude, RMS) of infraspinatus muscle (ISP) at different angles (30º, 60º & 90º) pre and post hand grip training in non-dominant limb:



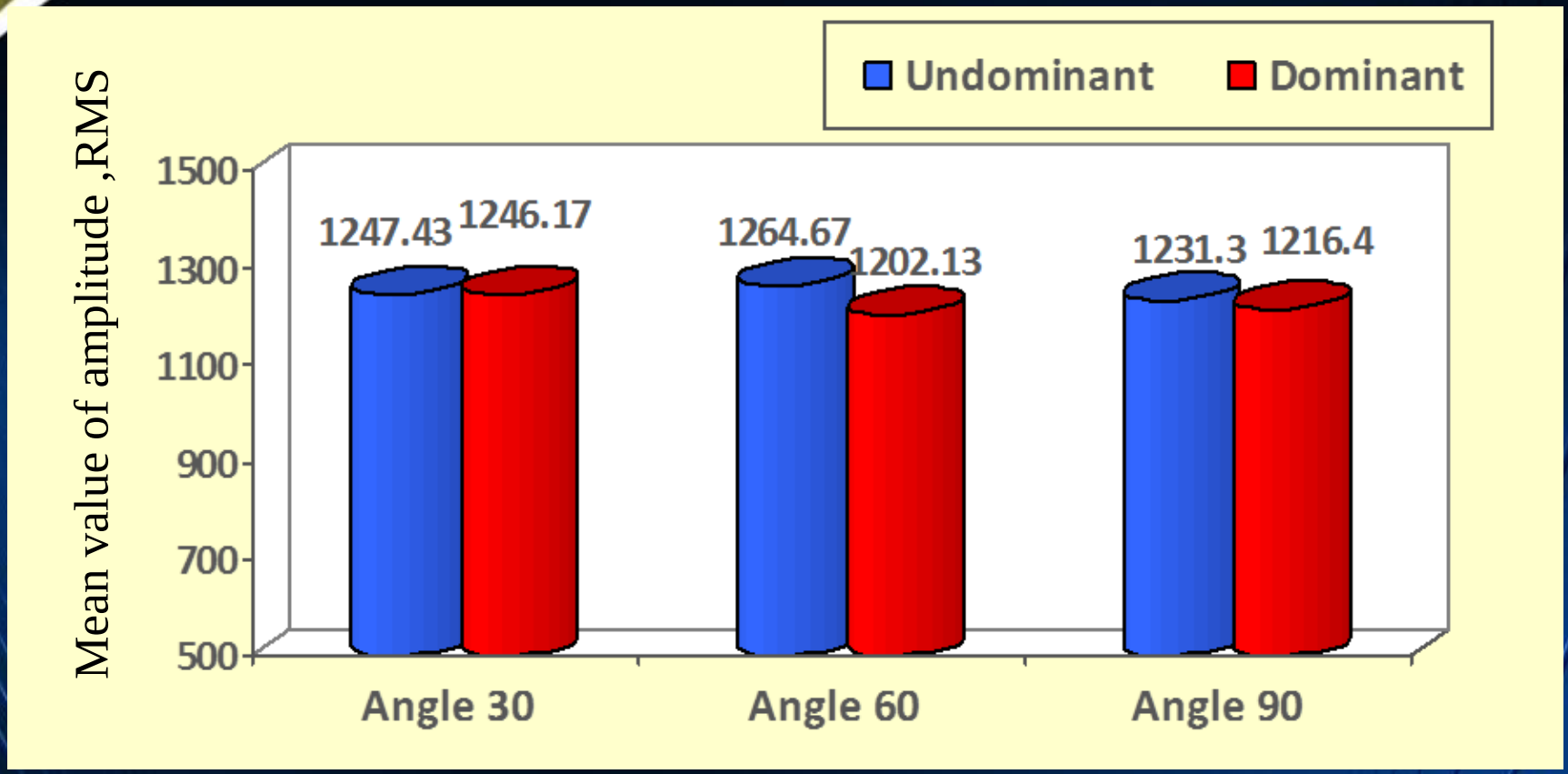
Electromyographic activity (amplitude, RMS) of supraspinatus muscle (SSP) at different angles (30º, 60º & 90º) in both dominant and non-dominant limbs pre hand grip training



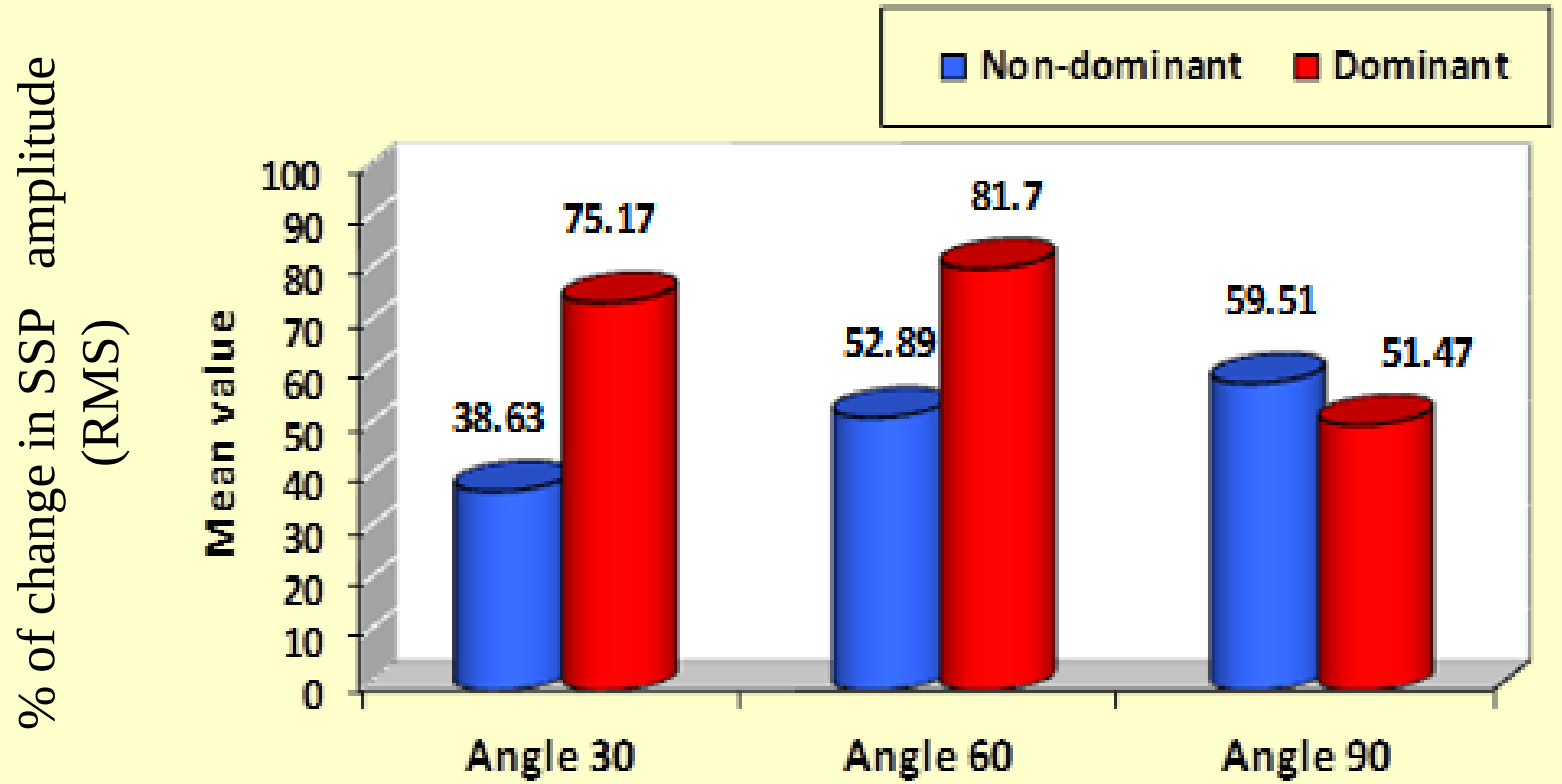
Electromyographic activity (amplitude, RMS) of infraspinatus muscle (ISP) at different angles (30º, 60º & 90º) in both dominant and non-dominant limbs pre hand grip training.



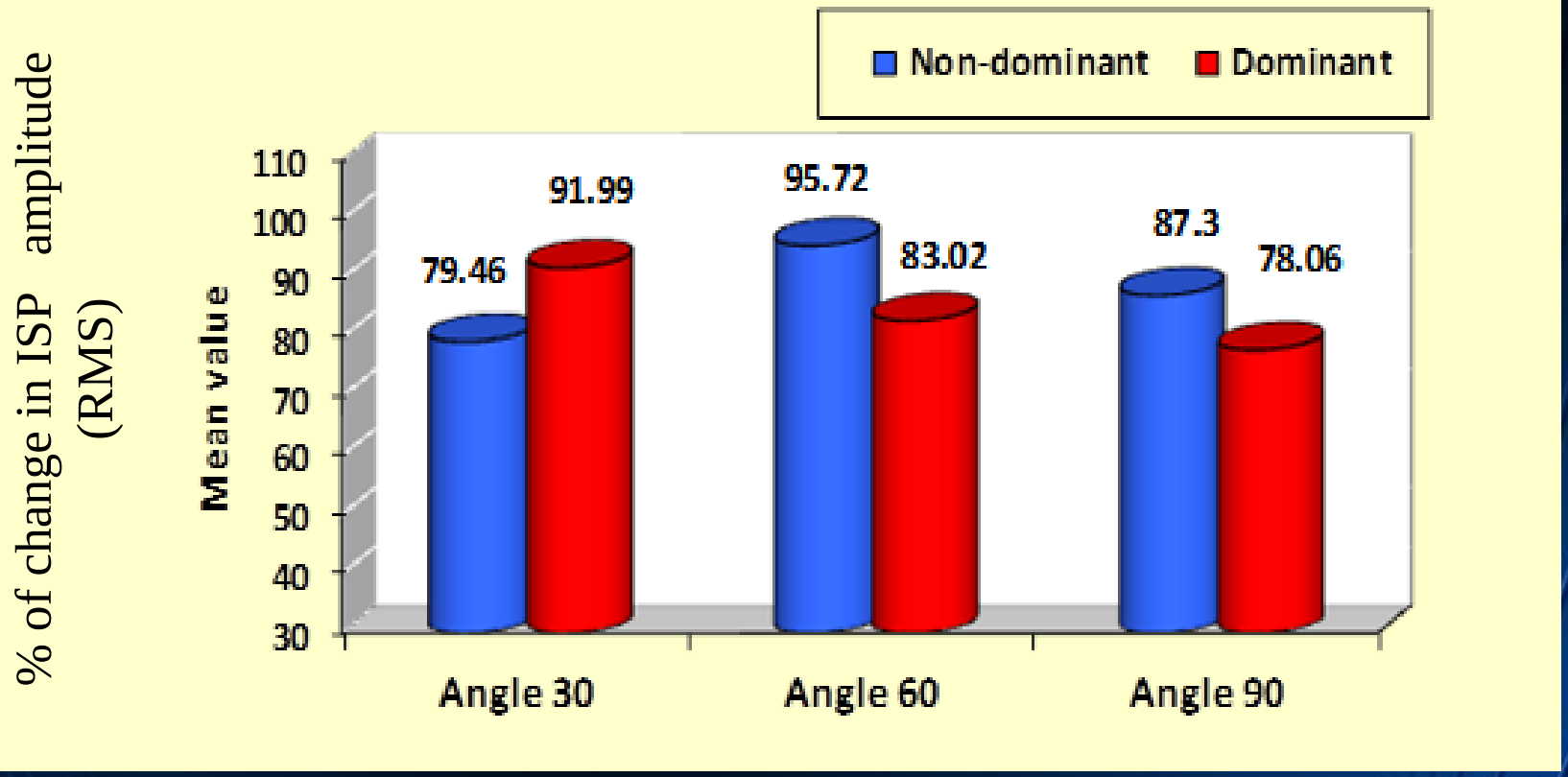
Electromyographic activity (amplitude, RMS) of supraspinatus muscle (SSP) at different angles (30º, 60º & 90º) in both dominant and non-dominant limbs post hand grip training



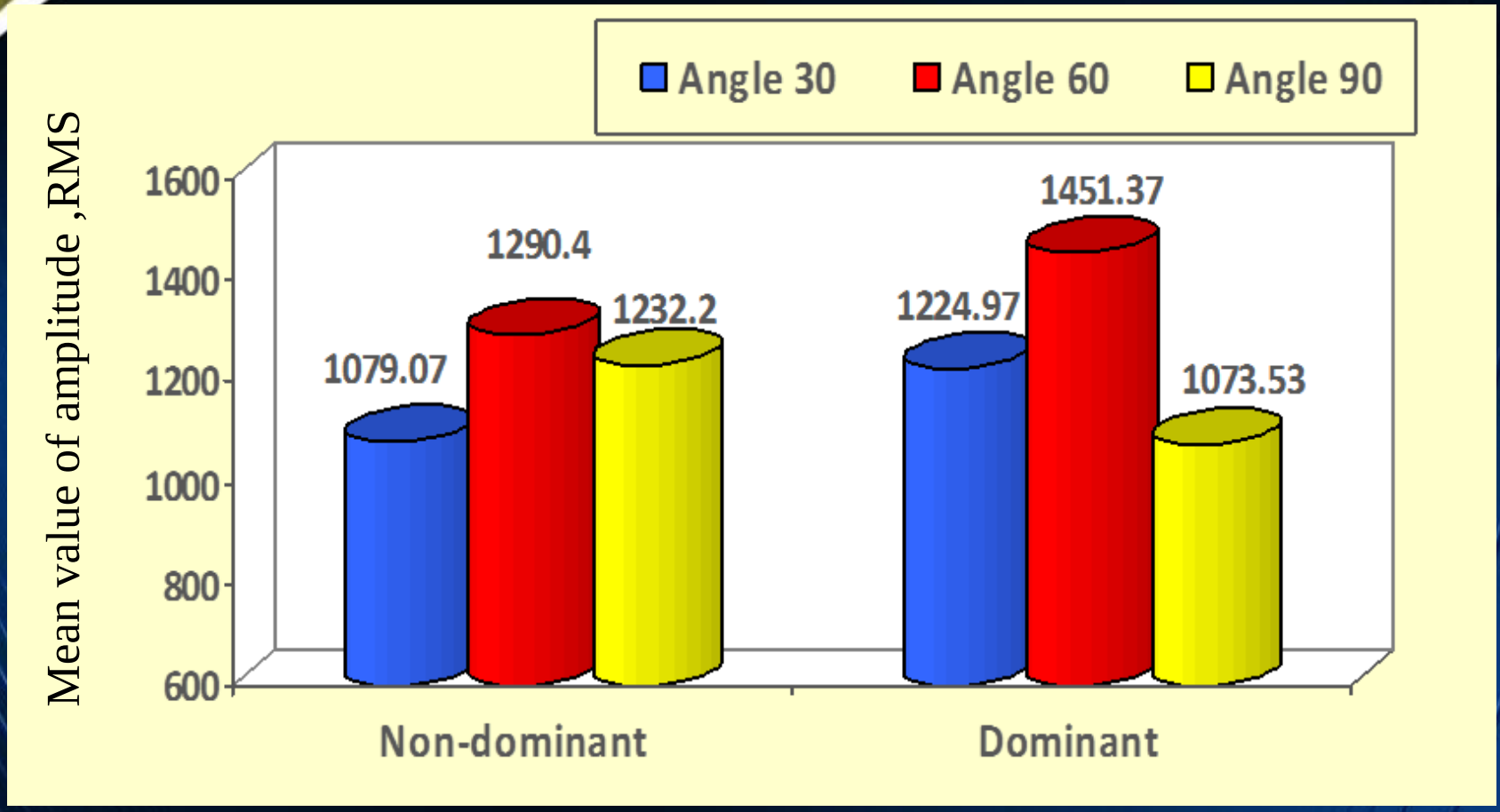
Electromyographic activity (amplitude, RMS) of infraspinatus muscle (ISP) at different angles (30º, 60º & 90º) in both dominant and non-dominant limbs post hand grip training



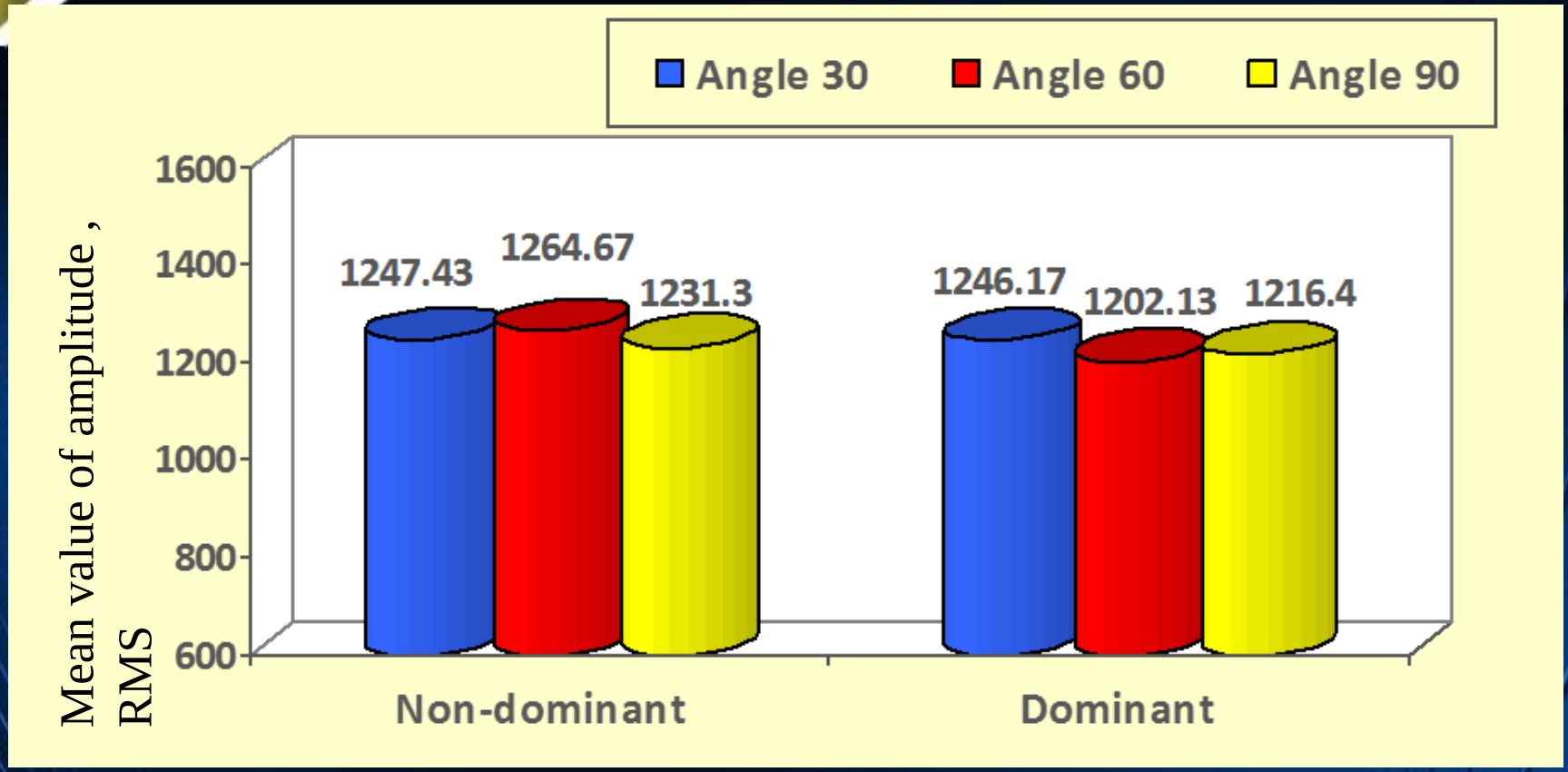
Comparison between mean values of percent of change in SSP measured at different angles (30º, 60º & 90º) in both limbs.



Comparison between mean values of percent change in ISP measured at different angles (30º, 60º & 90º) in both limbs



Comparison between mean values of EMG activity (amplitude, RMS) of supraspinatus muscle (SSP) measured at different angles (30º, 60º & 90º) in both limbs post-hand grip training.



Comparison between mean values of EMG activity (amplitude, RMS) of infraspinatus muscle (ISP) measured at different angles (30º, 60º & 90º) in both limbs post-hand grip training


Conclusion

- From the findings of the current study, unilateral handgrip training of the ipsilateral limb (dominant limb) was associated with increased EMG activity of SSP and ISP muscles of contralateral limb (non-dominant limb). This might be useful in the development and monitoring of shoulder rehabilitation strategies.

RECOMMENDATIONS

- **Further studies should be conducted to investigate the effect of hand grip training with 50% MVC as an exercise in the physical therapy rehabilitation program in patients with subacromial impingement syndrome SIS.**
- **Further researches involving the application of cross education strength training in a clinical setting are required to determine the more complex physiological and neurological response that occurs with the presence of physical muscular trauma, pain and inflammation.**

- **Additional study should be undertaken on large patients' population.**
- **Further studies should be conducted to investigate the implication of unilateral training for patients suffering paralysis associated with stroke and other neurological disorders.**


Thank you.