ORIGINAL ARTICLE

A study to compare the efficacy of Static stretching and PNF stretching on forward shoulder posture

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Abstract

Introduction: Good posture is that state of muscular and skeletal balance which protects the supporting structures of the body against injury or progressive deformity. Forward shoulder posture is considered as one of the common postural problem in normal asymptomatic young adults. Various stretching techniques and strengthening exercises play a major role to decrease the forward shoulder posture effectively. So this study was intended to find the effectiveness of Static and PNF Stretching along with strengthening techniques on forward shoulder posture. Method: Thirty asymptomatic young adults who have forward shoulder posture were selected for this study and divided into two groups. One group received Static and the other group received PNF stretching for a six week stretching along with strengthening Programme, three times per week.

Result: Both static and PNF groups showed improvement in forward shoulder posture and range of motion of both right and left shoulders. Conclusion: Although during first two weeks there was no much improvement in forward shoulder posture but from third week onwards PNF group showed marked improvement compared to other group who received static stretching

Key words: Forward shoulder posture, Static stretching, PNF Stretching, Plumb line

الملخص

يعتبر الموقف الأمامي للكتف واحدة من المشاكل الوضعية غير المتناظرة المشتركة العادية في الشباب . الموقف الجيد هو أن حالة من التوازن العضلي والهيكل العظمي الذي يحمي الهياكل الداعمة للجسم ضد الإصابة أو التشوه التدريجي.. تمتد تقنيات وتمارين التقوية المختلفة لتلعب دورا رئيسيا في انخفاض موقف الكتف إلى الأمام على نحو فعال. لذلك كان الغرض من هذه الدراسة هو العثور على فعالية ثابتة تمتد جنبا إلى جنب مع تعزيز التقنيات على موقف الكتف إلى الأمام. الطريقة: تم اختيار ثلاثين حالة للشباب الذين لديهم موقف الكتف إلى الأمام لهذه الدراسة وتقسيمها إلى مجموعتين. مجموعة واحدة ثابتة والمجموعة الأخرى تلقتPNF امتدت لستة أسابيع جنبا إلى جنب مع تعزيز البرنامج، ثلاث مرات في الأسبوع. أظهرت نتيجة المقارنة بين المجموعة الثابتة ومجموعة ال PNF تحسن في موقف الكتف إلى الأمام ونطاق الحركة من كلا الكتفين الأيمن والأيسر لمجموعة ال PNF.

الخلاصة: على الرغم من ان خلال أول أسبوعين لم يكن هناك تحسن كبير في موقف الكتف إلى الأمام ولكن من الأسبوع الثالث أظهرت مجموعة PNF تحسنا ملحوظا مقارنة مع المجموعة الأخرى.

Introduction

Good posture is that state of muscular and skeletal balance which protects the supporting structures of the body against injury or progressive deformity. Sedentary lifestyles, poor postural adaptations, activities like slouching and prolonged flexed postures have reported high incidence of forward shoulder posture [9,21]. Forward shoulder posture, defined as a sagittal plane or transverse plane scapular resting position change, is theorized to result in adaptive shortening of pectoralis minor muscle by approximating the muscles insertion sites on the coracoid process and ribs. [12,14] Forward shoulders can be described as abduction and elevation of scapula and forward position of the shoulders, giving an appearance of a hollow chest.[9, 14] These muscular imbalances have been implicated as contributing factors to upper quarter musculoskeletal dysfunction.[5,9,14,21]Forward shoulder posture may also cause decreased range of motion of shoulder mainly flexion, elevation, abduction and rotation movements because of muscle length changes and muscular imbalances. Previous researchers have described various techniques to objectively measure posture. Double square device is considered to be accurate in detecting changes in shoulder posture and would be of clinical value. This device is considered to have good reliability compared to other techniques.[9, 18] Different stretching protocols can be used for therapeutic purpose that helps to improve flexibility. Various types include passive stretching, static stretching and PNF stretching etc. Static stretching is the most common method used to lengthen the soft tissues. PNF stretching is the advanced forms which can be applied to any tightened muscle to lengthen.[26] Hold relax, contract relaxes, agonist contract etc are various forms of PNF stretching. Various studies have demonstrated that various PNF stretching techniques effectively increase flexibility and range of motion. However, there is no consensus on whether one PNF technique is consistently superior to another or whether PNF stretching is more, less or equally effective as static stretching.[26, 27] As both static and PNF stretching methods are effective methods of stretching, this study was intended to compare the efficacy of static stretching and PNF stretching in reducing forward shoulder posture by stretching of pectoralis major and minor followed by a strengthening Programme for a period of 6 weeks.

Material & Method:

METHODOLOGY

This study comprised a 6 week stretching and strengthening Programme, thrice a week. The study included 30 asymptomatic subjects who were willing to participate in the study.

SUBJECTS:

Subjects who were willing to participate in the study were screened and assessed for the presence of forward shoulder posture using a plumb line. After screening, 30 subjects with forward shoulder posture were randomly selected and divided into 2 groups. Each group comprised 15 individuals, static

group consisted of 15 subjects (10 females, 5 males). PNF group consisted of 15 subjects (11females, 4 males). Ethical clearance was taken from the ethical committee prior to the study. All the subjects were explained about the study and an informed consent was obtained from them.

INCLUSION CRITERIA:

- Asymptomatic male and female subjects of age between 18 to 25 years with forward shoulder posture.

EXCLUSION CRITERIA:

- Subjects with any surgical history to shoulder and cervical spine
- Any past or present history of injuries to shoulder and cervical and thoracic spine
- Elite level athletes or subjects.
- Presence of cervical rib, VBI, impingement syndrome, thoracic outlet syndrome.

MATERIALS USED:

Double square (Model #420 EM ,Johnson Level Tool Manufacturing)

Universal goniometer

Thera-bands

Plumb line

OUT COME MEASURES:

- Measurement of forward shoulder posture using double square device
- Measurement of shoulder range of motion using universal goniometer
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PROCEDURE:

In this study, subjects were screened for forward shoulder posture and then total members of 30 were divided into 2 groups namely group A (n=15) and group B (n=15) randomly. Group A was assigned with PNF stretch and Group B was assigned with static stretch Programmes and both the groups were given with same exercise programme for 6 weeks. Before starting the exercise Programme and stretching, forward shoulder posture was measured using a double square device by measuring the distance between wall and tip of acromion process of the subject's shoulder (both right and left). Shoulder range of motion (both right and left shoulders) was also measured using universal goniometer. Then both the groups performed same exercise Programme for strengthening, this strengthening Programme is followed by PNF stretch for pectoralis major and minor muscles in Group A and static stretch for pectoralis major and minor in Group B. This Programme was given for 6 weeks, thrice a week.

Forward shoulder posture was measured at the end of every week. Shoulder range of motion was also measured before 6 weeks and after 6 weeks Programme.

MEASUREMENT PROCEDURES:

Measurements of both the right and left shoulder of each subject were taken before and after the 6-week exercise and stretching programme and also at the end of each week. A device known as double square (model 420 EM, Johnson level and tool manufacturing) was used to quantify forward shoulder posture. shoulder range of motion was also measured

before and after 6 week programme using a universal goniometer.

DOUBLE SQUARE DEVICE:

A device known as the double square (Model #420EM, Johnson Level and Tool) was used to quantify forward shoulder posture. The double square consists of a 40-cm combination square with a second square/level added in an inverted position. This device was used to measure the distance (in millimeters) from the wall to the anterior tip of the subject's acromion process. After palpating the anterior tip of the acromion process on the subject's left and right shoulder, the location was marked on the subject's skin with a permanent marker. The subject was then instructed to place his or her heels against the wall and was verbally instructed to "assume an upright, military posture." At this point the double square was positioned over the subject's left shoulder with 1 square flush against the wall. The second square was adjusted until it touched the marked tip of the subject's left acromion. Three measurements were taken and recorded. The exact measurement process was repeated on the subject's right shoulder. The subject was then instructed to relax into his or her normal posture. At this point the entire measurement process was repeated. The military posture was incorporated in order to ensure that participants would not inadvertently alter their relaxed normal posture during the measurement process.

The mean of the 3 posture measurements was used for statistical analysis. For all subjects in both groups, measurements were taken with the same equipment and by the same investigator throughout the study to ensure accuracy and identical instructions.

UNIVERSAL GONIOMETER:

Universal goniometer can be used to measure joint position and range of motion at almost all joints of the body. Universal goniometers may be constructed of metal or plastic. Typically the design includes a body, and two thin extensions called arms- a stationary arm and a moving arm. The body of a universal goniometer resembles a protractor and may form a full or half circle. Measurement scales are located on one or both sides of the body[0 to 360 and 360 – 0 degrees].After taking the initial shoulder measurements, the subjects in both groups were assigned with a 6 week stretching and strengthening Program. The exercises were conducted 3 times per week.

At first session, the subjects were introduced to different levels of thera bands. These bands are color coded with each color representing a different resistance. The subjects were demonstrated about the exercise procedure .The subjects were given the opportunity to do 5 repetitions of each exercise with several levels of thera-bands in order to estimate which level was appropriate for themselves. The subjects then carried out 3 sets of 10 repetitions of all strengthening exercises.

EXERCISES:

Scapular retraction, External rotation, Shoulder flexion for lower trapezius

Progression of exercises:

WK 1 WK2 WK3 WK4 WK5 WK6

Repetitions: 3*10, 3*15, 3*20** 3*10 3*15, 3*20

At the end of third week the subjects progressed to next higher level of resistance using the thera-band.

PNF STRETCHING:

Group A was assigned with PNF stretching.

PECTORALIS MAJOR STRETCH:

Hold relax technique was used in PNF stretching. By changing the angle of abduction of arm different fibers of pectoralis major can be emphasized .45degrees focuses on clavicular head and 135 degrees focuses more on lower fibers of sterno-costal head. Support the right arm from the elbow to the hand using forearm and hand of one side. Ask the subject to begin slowly to attempt to bring his arm down and across his chest leading with the elbow, isometrically contracting the pectoralis major for 10 seconds. After the isometric push, the subject relaxes and breathes in. On the exhale ask the subject to lift his arm higher, keeping the forearm horizontal and his sternum to the table. This stretch is repeated 3 times bilaterally.

PECTORALIS MINOR STRETCH:

Subject lies supine on the table. Stand at the side to be stretched. Hold subject's hand with one hand allowing his or her upper arm to rest at his or side on the table. Place palm of other hand on subject's anterior shoulder. Direct the subject to pull his or her shoulder towards the table and his or her shoulder blade down his or her back towards the feet. This lengthens the pectoralis minor to its end range.

STATIC STRETCHING:

Group B was assigned with static stretching.

STATIC STRETCH FOR PECTORALIS MINOR:

Subject placed in supine position on a 5-in diameter foam roll, which runs down the center of the back. Shoulders are grasped and pressed slowly in the direction of floor until instructed to stop and hold for 30 seconds, repeated 3 times per session.

STRETCH FOR PECTORALIS MAJOR:

The subject assumes a kneeling position in front of the therapist. Then subject laced his or her fingers behind the head. Then therapist reached in front of subject's arms and back behind subject's scapulae, lacing his or her fingers together as well. Then therapist pulled in diagonal direction, both up and back from subject's trunk until instructed to stop and hold .The stretchwas held for 30 seconds, repeated 3 times per session.

STATISTICAL ANALYSIS

Statistical techniques play an extremely important role in planning of a good study In this study the analysis of effectiveness of static stretching and PNF stretching was done using ANOVA and t – test.

Initially baselines values were obtained. Mean age and height were calculated. Mean, standard deviation and standard error of the variables were calculated.

For determining the efficiency or change in posture in right and left relaxed posture in both groups ANOVA single factor was done.

For comparing the efficiency of reducing forward shoulder posture in static and PNF groups, t – test was used individually in right and left relaxed postures.

For comparing the efficiency in improvement of right and left shoulder flexion, abduction and external rotation between static and PNF groups, t- test was applied.

RESULTS:

Before starting of exercise and stretching Programme base line values of age, height, forward shoulder posture right and left, range of motion of right and left shoulders of both PNF and static group were taken. Mean, standard deviation, standard error were calculated to compare the baseline values.

(Table 1) Intra group comparison of right forward shoulder posture from 0 to 6 weeks of PNF group was done by applying ANOVA to know the significant change in forward shoulder posture .The result showed significant change in forward shoulder posture with mean score of 0.30.

VARIABLE	PNF GROUP			STATIC GROUP		
AGE	MEAN	SD	SE	MEAN	SD	SE
HEIGHT	22.4	1.05	0.27	22.9	1.10	0.28
FSP RIGHT	5.36	0.29	0.07	5.39	0.28	0.07
FSP LEFT	13.51	0.59	0.15	13.65	0.34	0.08
RIGHT FLEXION	13.27	0.47	0.12	13.45	0.32	0.08
RIGHT ABDUCTION	163.9	7.2	1.8	161.9	7.5	1.9
RIGHT E R	154.1	6.6	1.7	155.2	6.2	1.6
LEFT FLEXION	79.33	6.5	1.68	69.00	5.3	1.39
LEFT ABD	165.0	5.6	1.4	163.0	4.5	1.1
LEFT E R	158.2	4.6	1.1	155.0	5.3	1.3

(Table 2) Intra group comparison of left forward shoulder posture from 0 to 6 weeks of PNF group was done by applying ANOVA to know the significant change in forward shoulder posture. The result showed significant change in forward shoulder posture with mean score of 0.23.

Source of Variation	SS	df	MS	F-Cal	P-value	F-tab
Between Groups	223.5	6	37.249	122.602	2.77E-43	2.193
Within Groups	29.775	98	0.304			
Total	253.27	104				

(Table 3) Intra group comparison of right forward shoulder posture from 0 to 6 weeks of static group was done by applying ANOVA to know the significant change in forward shoulder posture. The result showed significant change in forward shoulder posture

Source of Variation	SS	df	MS	F-Cal	P-value	F-tab
Between Groups	226.41	6	37.734	163.830	8.66E-49	2.193
Within Groups	22.572	98	0.230			
Total	248.98	104				

(Table 4) Intra group comparison of left forward shoulder posture from 0 to 6 weeks of static group was done by applying ANOVA to know the significant change in forward shoulder posture. The result showed significant change in forward shoulder posture

Source of Variation	SS	df	MS	F-Cal	P-value	F-tab
Between Groups	49.701	6	8.283	44.411	7.74E-26	2.193
Within Groups	18.279	98	0.187			
Total	67.98	104				

(Table 5) Means of right forward shoulder posture from 0 to 6 weeks of PNF and static groups were compared and t – test was done to compare the significance. And results showed that PNF was effective

Source of Variation	SS	df	MS	F-Cal	P-value	F-tab
Between Groups	41.642	6	6.940	45.000	4.86E-26	2.193
Within Groups	15.115	98	0.154			
Total	56.757	104				

(Table 6) Means of left forward shoulder posture from 0 to 6 weeks of PNF and static groups were compared and t – test was done to compare the significance. Results showed that PNF Group is more effective.

	GroupA	GroupB
Mean	11.9676	12.9219
Variance	0.26479	0.17186
Observations	15	15
SD	0.51	0.41
SE	0.13	0.10
df	28	
t-calculated	-5.59312	
P - Value	3.1E-06	
t -tabulated	1.70329	

(Table 7) Inter group comparison of right flexion between PNF and static groups was done by applying t- test to know the significance and showed the PNF Group is more effective.

	GroupA	GroupB
Mean	11.804	12.757
Variance	0.199	0.135
Observations	15	15
SD	0.44	0.36
SE	0.11	0.09
df	28	
t-calculated	-6.383	
P - Value	3.9E-07	
t -tabulated	1.703	

(Table 8). nter group comparison of right abduction between PNF and a static group was done by applying t- test to know the significance. Results showed PNF Group is more effective.

	PNF	STATIC
Mean	176.2	167
Variance	15.1714	51.2857
Observations	15	15
SD	3.8	٧,١
SE	1.0	1.8
df	28	
t-calculated	4.3708	
P - Value	0.0001	
t -tabulated	1.7171	

(Table 9) Inter group comparison of right external rotation between PNF and static groups was done by applying t- test to know the significance. Results showed that PNF Group is more effective.

	PNF	STATIC
Mean	173	161.267
Variance	13.571	36.781
Observations	15	15
SD	3.68	6.06
SE	0.95	1.56
df	28	
t-calculated	6.4041	
P - Value	8E-07	
t -tabulated	1.7139	

(Table 10) Inter group comparison of left flexion between PNF and static groups was done by applying t- test

	PNF	STATIC
Mean	79.333	69
Variance	42.381	29.1429
Observations	15	15
SD	6.51	5.39
SE	1.68	1.39
df	28	
t-calculated	4.7322	
P - Value	3E-05	
t -tabulated	1.7033	

(Table 11). nter group comparison of Post values of left abduction between PNF and static groups was done by applying t-test

	PNF	STATIC
Mean	176.6667	168.5333
Variance	13.0952	15.8381
Observations	15	15
SD	3.61	3.98
SE	0.93	1.02
df	28	
t-calculated	5.8562	
P - Value	1.34831E-06	
t -tabulated	1.7011	

(Table 12) Inter group comparison of post values of left external rotation between PNF and static groups was done by applying- test

	PNF	STATIC
Mean	174.6667	160.8667
Variance	8.8095	26.9810
Observations	15	15
SD	2.96	5.19
SE	0.76	1.34
df	28	
t-calculated	8.9339	
P - Value	4.5E-09	
t -tabulated	1.7171	

DISCUSSION

This study was done to compare the efficiency of static stretching and PNF stretching in reducing forward shoulder posture and increase in range of motion of shoulder. Forward shoulder posture was measured using a double square device in both military posture and relaxed posture. Only relaxed posture was documented for statistical analysis. Range of motion of both right and left shoulders was also measured using a universal goniometer. On analysis of pre and post values of forward shoulder posture measurement and range of motion of both right and left shoulders, graphical representation showed marked improvement in posture and range of motion of both right and left shoulders in PNF group more than in static group. Static group showed significant change in forward shoulder posture both in right and left shoulders with p-value of 7.74E-26(for right) and 4.86E-26 (for left) at 0.05 level of significance. This is supported by the study done by Mark Kluemper et al (2006) in which static stretching and strengthening Program was given for 6 weeks, thrice a week in competitive swimmers which showed a significant improvement in their forward shoulder posture.Static stretching involves a continuous sustained stretch lasting 6 to 30 sec which is sufficient time for the golgi-tendon organ (GTO) to respond to increase in tension. The impulses from GTO can override the impulses coming from the muscle spindles, allowing the muscle to reflexively relax after the initial reflex resistance to the change in length and helps in lengthening the muscle. Also there is less danger of extensibility limits of the involved joints because the stretch is more controlled (De Wries, K, 1986).PNF group also showed significant change in both right and left forward shoulder posture with p-values of 2.77E-43(for right) and 8.66E-49(for left) at 0.05 level of significance. When static group and PNF group was compared, both right and left shoulders in relaxed posture, PNF group showed more effectiveness than static group in reducing forward shoulder posture i.e. individuals showed lesser distance of acromion tip to the wall by the end of 6 weeks. PNF group showed more effectiveness with p-value 3.1E-06 for right and p-value 3.9E-07 for left shoulders at 0.05 level of significance. PNF group also showed marked improvement in both right and left shoulder flexion, abduction and external rotation when compared to static group.In hold relax procedure, the range limiting shortened muscle is first lengthened to the point of limitation or to the extent that is comfortable for the subject .The subject then performs an isometric contraction for up to 10 sec followed by voluntary relaxation of the tight muscle. Then the limb is passively moved into the new range as the range limiting muscle is elongated (Carolyn kisner 4thed). The rationale behind this technique is that after isometric contraction there is a brief period during which the muscle is reflexively relaxed and therefore can be easily stretched. The push phase causes an increase in tension that stimulates Golgi tendon organ to affect a reflex relaxation of the antagonist even before

the muscle is placed in a position of stretch. This relaxation of antagonist muscle during contractions is referred to as autogenic inhibition. During the relaxing phase the antagonist is relaxed and passively stretched while there is a maximal isotonic contraction of the agonist muscle putting the extremity further into agonist pattern. In any synergistic muscle group a contraction of agonist causes a reflex relaxation in antagonist muscle, allowing it to stretch and protects it from injury. This phenomenon is referred to as reciprocal inhibition. Additive effects of autogenic and reciprocal inhibition of PNF stretching technique allowed the muscle to be stretched to a greater degree than is possible with static stretching and improved the flexibility and range of motion, which supports this study. It is believed that when muscle fibers are reflexively inhibited through autogenic or reciprocal inhibition, there is less resistance to elongation by the contractile elements of the muscle (Robert McAtee , Carolyn Kisner).The results showing more efficacy in PNF group is supported by the study done by Sady et al who conducted a study on 40 college men by using different stretching techniques to find out the flexibility of shoulder, trunk,and hamstrings and reviewed that PNF stretching may be the preferred technique when compared to static and ballistic stretching. Daniel C Funk et al, in his study demonstrated more efficiency of PNF stretching than static stretching in hamstrings muscle, which supports the study. As stated by Worrel T W (Sullivan MK, 1994), PNF produced greater increases in range of motion than static stretching. The exercise Programme followed in this study was appropriate protocol based on the work of Klumper et al and Wang et al whose studies showed marked improvement in strengthening of the weakened muscle. The exercise progression, followed in this study was based on the work of Wang et al in which a similar protocol produced significant strength gains. As stated by Kendall and other researchers, the tightened muscles also get weakened, hold relax technique used in PNF group helps in strengthening of the tightened muscles. Although strength of muscle was not quantified or measured, reduction in the distance from acromion tip to the wall shows indirect consequence of improvement in strength of the muscle. The results of this study have shown significant improvement in PNF group. On observing the forward shoulder measurement values in both right and left shoulders from 0 to 6 weeks, there was not much difference in the values in the initial 2 weeks, but marked significance was observed from 4th week although improvement started from 3rd week onwards. Change of next level of resistance from 3rd week of the study in every individual also shows change in strength of the muscles based on work of Wang et al. On comparing PNF and static groups, PNF group showed marked improvement in forward shoulder posture and range of motion of both right and left shoulders.

CONCLUSION: Both static and PNF groups showed improvement in forward shoulder posture and range of motion of both right

and left shoulders. Although during first two weeks there was no much improvement in forward shoulder posture, from third week onwards PNF group showed marked improvement compared to other group.

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