Analysing Postural Deviations in Swimmers: An Observational Study of Forward Head Posture, Rounded Shoulders and Scapular Dyskinesia

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Abstract

Purpose- Swimming has become one of the commonest sports around the world. There is continuous overhead activity and approximately 4000 revolutions in each training session. This continuous overuse, abuse, misuse of a particular group of muscles causes hypertrophy of shoulder muscles. These changes in the posture lead to painful conditions at shoulder like subacromial impingement, bursitis, rotator cuff pathologies and supraspinatus tendinopathy due to reduced subacromial space. The purpose of the study is to observe forward head posture, rounded shoulders and scapular dyskinesia in swimmers.
***Method**: Observational study*
***Results:** the results of the study were significant statistically for the craniovertebral angle, rounded shoulders and scapular dyskinesia were highly significant with p values of 0.001* (p*value <0.05), that is significance level was 5%. Clinically, forward head posture and rounded shoulder was highly prevalent. Conclusion- there is a high prevalence of forward head posture, rounded shoulder in swimmers, however prevalence of scapular dyskinesia was not significant.*

***Keyword:** Swimmers, Posture, Forward head posture, Rounded shoulder, Scapular dyskinesia.*

1. INTRODUCTION

Swimming has become one of the commonest sports around the world. It is an individual and a team event. Swimming consists of 4 strokes freestyle, breaststroke, butterfly and backstroke[10,11]. There is continuous overhead activity and approximately 4000 revolution in each training session[1]. The shoulder adductors, internal rotators, external rotators, and most importantly the latissimus dorsi, serratus anterior and the pectoral muscles generate the force needed for the swimmer to and overcome the forces of water and propulse forward[9,10,11]. This continuous overuse, abuse, misuse of a particular group of muscles causes hypertrophy of these muscles. This hypertrophy of muscles leads to tightness of the anterior musculature of neck, shoulder and the chest muscles. This tightness of the anterior musculature might lead to the 3 postures, forward head posture, rounded shoulder and scapular dyskinesia. These postures may also give rise to subacromial impingement, bursitis, supraspinatus tendinopathy and rotator cuff pathologies which may also cause pain[1,2].Forward head posture is defined as the anterior deviation of the head in relation to a plumb line or imaginary plumb line. The cervical extensor muscles which are the splenius capitis and upper trapezius and the sternocleidomastoid muscle become shortened in a forward head posture[4,7,8]. Forward shoulder posture is the anterior displacement of the acromion in relation to a plumb line or an imaginary plumb line and is considered a common deviation from normal posture[4,7,8]. There is lengthening of the pectoralis minor and major, serratus anterior upper trapezius and posterior shoulder muscles which are middle and lower trapezius and rhomboids which leads to rounded shoulder. These two postures in combination give rise to scapular dyskinesia. Scapular dyskinesia is defined as abnormal movement pattern of the scapula. Prominence of medial border of scapula is a characteristic feature of scapular dyskinesia. The weakness of serratus anterior and the increased activity of rhomboids causes scapular dyskinesia[3,5]. All these postures cause anterior tilting, internal rotation and downward rotation of the scapula. These changes in the posture lead to painful conditions at shoulder like subacromial impingement, bursitis, rotator cuff pathologies and supraspinatus tendinopathy due to reduced subacromial space. The need of the study arises due to dearth of literature of studies on the 3 postural deviations, hat is forward head posture, rounded shoulder and scapular dyskinesia specifically in swimmers.

2. Methodology

The study was approved by the Institutional Ethical committee. The trial was registered under CTRI with registration number (CTRI/2024/04/065894). 97 male and female swimmers within the age group 18-25 with a training experience of at least 1 year were recruited for the study. The participants with any musculoskeletal injuries in the past 6 months were excluded from participating. All participants were briefed about the purpose of the study and procedure before the commencement of testing and written informed consent was obtained for the same. The measurements for the three postures were taken were taken. Craniovertebral angle was measure by an imaginary line parallel to the C7 vertebra and the midpoint of the tragus of the ear [8,23]. The angle if measures more than 49.9 was considered as forward head posture. For the measurement of rounded shoulder the double squaring method was used[27]. The 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 (mm) from the wall to the anterior tip of the subjects acromion process. After palpating the anterior tip of the acromion process on the subjects left and right shoulder, the location was marked on the subjects 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 subjects left shoulder with 1 square against the wall. The second square was adjusted until it touched the marked tip of the subjects left acromion[27]. Three measurements were taken and recorded. The exact measurement process was repeated on the subjects right shoulder. The subject was then instructed to relax into his or her normal posture. The lateral scapula slide test[4,22] was done to check scapula dyskinesia in which the distance between the inferior angle of scapula and thoracic vertebrae (T7) in three different positions that is neutral, shoulder abducted at 90 degrees and shoulder abducted 40-45 degrees and internally rotated by keeping elbows flexed and arms resting on the waist were taken[4,22]. If the side-to-side difference between the scapula and T7 vertebrae is more than 1.5, the test is considered to be positive, or if there is a difference of more than 1.5 on either side, scapular dyskinesia is present on that side itself.

Statistical analysis- Data analysis for the research work is done using descriptive statistical analysis in which frequency, percentage, mean and SD analysis was done. Inferential statistical analysis is done using chi square goodness of fit test. SPSS version 23 and MS Excel software was used for data analysis. 5% significance level was used as a standard for the data analysis.

3. Results

The study analysed participants age, gender, height, weight, BMI, and craniovertebral angle, rounded shoulders and scapular dyskinesia. The mean age was 18.92 years (SD = 1.68, p=0.001*). Gender distribution was 51% male and 49% female (mean = 1.49, SD = 0.50, p=0.083*). Mean height was 164.28 cm (SD = 5.51, p=0.001*), and weight ranged from 39 to 77 kg (mean = 58.66 kg, SD = 8.20, p=0.001*). BMI ranged from 15.40 to 27.30 (mean = 21.61, SD = 2.65, p=0.050). The craniovertebral angle averaged 49.41 degrees (SD = 1.15, p=0.001*). Measurements for the rounded shoulders were consistent. In the lateral scapula slide test, neutral position (mean= 11.26, SD= 0.62, p=0.001*) on the right and left side. At 90 degrees shoulder abduction, on the right side (mean= 11.56, SD= 0.76, p=0.001) and on the left side (mean= 11.53, SD=0.77 p=0.001*). At 45 degrees shoulder abduction, right side and the left side (mean=11.27, SD=0.63p=0.001*). Differences across positions were under 1 cm, indicating no scapular dyskinesia.

4. Discussion

The aim of the study was to analyse the postural deviations, mainly the 3 postures the forward neck posture, rounded shoulder posture and scapular dyskinesia in swimmers and the correlation amongst the three postures. Forward head posture is defined as the anterior deviation of the head in relation to a plumb line or imaginary plumb line. The cervical extensor muscles which are the splenius capitis and upper trapezius and the sternocleidomastoid muscle become shortened in a forward head posture[4,7,8]. This study found out highly significant values for craniovertebral angle, clinically craniovertebral angle had increased than the normal values in many participants. A similar study was done by Bonnie Virag et al(25) to check for prevalence of biomechanical errors in competitive swimmers. 31 college athletes with at least 5 years of swimming experience were included in the study. The swimmers were assessed for dropped elbow during the pull-through phase and the recovery phase, an eyes-forward head-carrying angle, incorrect hand position during hand entry, incorrect hand entry angle, and an incorrect

pull-through pattern during freestyle stroke of swimming. The conclusion of the study was biomechanical errors are common in swimmers and are corelated with each other with eyes-forward-head carrying angle accounting for 46.8%. Dropped elbow during the pull-through phase (61.3%) and a dropped elbow during the recovery phase (53.2%). The incorrect hand position during hand entry occurred in 45.2%. Hence 46.8% of swimmers had forward head carrying angle.

Forward shoulder posture is the anterior displacement of the acromion in relation to a plumb line or an imaginary plumb line and is considered a common deviation from normal posture[4,7,8]. This is one of the reasons which causes pain or a common condition called swimmers shoulder[2,8,9]. There is lengthening of the pectoralis minor and major, serratus anterior upper trapezius and posterior shoulder muscles which are middle and lower trapezius and rhomboids which leads to rounded shoulder[2,8,9]. This study found that prevalence of rounded shoulders was high in swimmers typically present due to overuse of shoulder musculature. This study found that there is an increased distance between the C7 and the tip of the acromion process in most of the participants hence indicating the presence of rounded shoulder. Statistically this study showed highly significant values for rounded shoulders. This finding can be further used to develop a protocol for treatment of rounded shoulder. A similar study was conducted by Stephanie S Lynch et al (3) to check effects of exercise intervention on forward head shoulder in elite swimmers. 28 collegiate swimmers were incorporated in study and an exercise protocol was given for 8 weeks. The exercises included Y to W, L to Y, scapular protraction, chin tucks and pectoralis stretching. This intervention was successful in reducing the forward head posture and rounded shoulder.

Scapular dyskinesis is defined as abnormal movement pattern of the scapula. Prominence of medial border of scapula is a characteristic feature of scapular dyskinesia. The weakness of serratus anterior and the increased activity of rhomboids causes scapular dyskinesia[3,5]. All these postures cause anterior tilting, internal rotation and downward rotation of the scapula[3,5]. This study found out that statistically the presence of scapular dyskinesia was quite high, but clinically we couldn't find scapular dyskinesia in swimmers. The reason for absence of scapular dyskinesia may the fact that scapular dyskinesia is seen in swimmers who has more swimming experience. A study conducted by Maayan Bussiba Maor et al (29) was done previously to check scapular dyskinesia in swimmers. This study included 20 competitive swimmers, they were assessed for scapular dyskinesia during shoulder flexion and abduction, quick disabilities of shoulder and arm and hand questionnaires. There was a significant increase in scapular dyskinesis during and after the training session. Scapular dyskinesis was observed in 30% of the swimmers before training, in 70%, an hour later, and in 80%, upon completion of the training session. This study confirmed that the prevalence of SD increases throughout a training session in most swimmers. The main reason might be fatigue of the muscles which stabilize the scapula. Due to absence of scapular dyskinesia we couldn't find a corelation of scapular dyskinesia with the other two components which are forward head posture and rounded shoulders of the study. But a study was conducted by Mehmet Akif GÜLER et al (28), to find association between forward head posture and scapular dyskinesis in non-specific chronic neck pain patients. The outcome measures used were craniovertebral angle, lateral scapula slide test, neck disability index and visual analogue scale. The study found a higher risk of SD in patients with FHP compared to those with normal posture. This suggests that FHP may contribute to altered scapular movement patterns, potentially leading to shoulder problems. A systematic review of association of forward head posture, rounded shoulders and thoracic kyphosis was done by Deepika Singla et al (26), in which 4 articles were taken for review. This study found out that forward head posture, rounded shoulders and thoracis kyphosis can exist individually and in corelation with one another. Forward head posture is associated with shoulder pain, shoulder and scapular dyskinesia and many other conditions. This study also mentioned about association of rounded shoulders with scapular dyskinesis due to overuse of muscles especially in overhead athletes like swimmers, volleyball, badminton, basketball etc.

Limitations of the study was the sample size, a larger sample size could have yielded better results. Another limitation of the study was the availability of elite swimmers with a minimum swimming experience of 5 years, which could have given better results for the scapular dyskinesis component of the study.

Conclusion- there is high prevalence of forward head posture, rounded shoulder is swimmers, however prevalence of scapular dyskinesia was not significant.

Conflict of interest- The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Acknowledgement- the authors greatly appreciate the cooperation and support by swimmers, coaches and the team members at Suvarna Swimming pool JNMC, Belagavi in preparation for the study.

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Tables

Table 1: It shows the mean, standard deviation, p values for the age, gender, height, weight and BMI with p value <0.05*, that is the significance level is 5%.

Variable	Minimum	Maximum	Mean	SD	P value
Age(years)	18.00	25.00	18.92	1.68	0.001*
Gender	1.00	2.00	1.49	0.50	0.083
Height(cms)	149.00	181.00	164.28	5.51	0.001*
Weight(kg)	39.00	77.00	58.66	8.20	0.001*
BMI kg/m^2	15.40	27.30	21.61	2.65	0.050*

Variable	Minimum	Maximum	Mean	SD	P value
Craniovertebral angle(degrees)	45.00	51.00	49.41	1.15	0.001*

Table 2: It shows the mean, standard deviation and the p value for the craniovertebral angle with p value <0.05*, that is significance level is 5%.

Variable (cms)	Mean	SD	P value
Double squaring method Reading 1 Right	23.35	1.21	0.001*
Double squaring method Reading 1 Left	23.08	1.25	0.001*
Double squaring method Reading 2 Right	23.35	1.21	0.001*
Double squaring method Reading 2 Left	23.08	1.25	0.001*
Double squaring method Reading 3 Right	23.35	1.21	0.001*
Double squaring method Reading 3 Left	23.08	1.25	0.001*

Table 3: It shows the mean, standard deviation and p value for the rounded shoulders with p value< 0.05*, that is significance level is 5%.

Variable(cms)	Mean	SD	P value
Neutral Right	11.26	0.62	0.001*
Neutral Left	11.26	0.62	0.001*
S Ab 90 degree Right	11.56	0.76	0.001*
S Ab 90 degree Left	11.53	0.77	0.001*
S Ab 45 degree Right	11.27	0.63	0.001*
S Ab 45 degree Left	11.27	0.63	0.001*

Table 4: It shows the mean, standard deviation and p value for the lateral scapula dyskinesia at 3 positions, p value <0.05, that is significance level is 5%