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RESEARCH ARTICLE

MECHANICAL ANALYSIS OF SHOULDER NECK, SHOULDER, HIP AND ANKLE RANGE OF MOTION IN YOGA DYNAMIC STRETCHING

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ABSTRACT

Introduction: Increasing age people will often lose range of motion diminishing their ability to do activities of daily living. To maintain flexibility the most common method is through Dynamic Stretching, however yoga is becoming increasingly more popular with the added benefits of deep breathing and relaxation. It is important to have an understanding of the difference between range of motion and flexibility, to properly decipher the issues. Range of motion has been defined as the obtainable movement at any specific joint. Flexibility on the other hand refers to the muscles surrounding the joint and is defined as the mobility of the muscles and the length to which they extend. Range of motion within a joint is dependent on the bony structure of the joint, the surrounding connective tissues, as well as the length of the muscles spanning the particular joint. Therefore if a muscle is lacking in flexibility it may cause a reduced range of motion. **Aim**: The purpose of the study was to compare yoga Dynamic Stretching determine the improvement on Neck, Hip, Shoulder and Ankle range of motion. Hypothesis was stated that their was a significant difference between Pre and Post test means of Neck, Hip and Ankle range of motion in Yoga Dynamic Stretching. **Methodology**: Forty subjects ten each from control and Experimental group such as Yoga, Dynamic Stretching and Yoga and Dynamic stretching were given to the rehabilitation therapy for selected the randomized samples and their age was range between 18- 50 years old with recent musculoskeletal injuries. Range of motion was assessed on prior to the treatment and after the practice of experimental treatment the post test evaluation was taken in comparison with Experimental groups showed significant improvement in range of motion in yoga, Dynamic stretching and combined effect of yoga and Dynamic stretching. Analysis of variance was used with the repeated treatment and level of significance 0.05 was used to determine the difference between the means. **Conclusions:** Yoga Dynamic stretching treatment of Rehabilitation care of Experimental groups were greater effect on range of motion in the Neck, Hip and Ankle Joints. By the Results the of this study proved that the yoga Dynamic stretching was to greater therapeutic effect with joint restrictions.

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INTRODUCTION

Increasing age people will often lose range of motion diminishing their ability to do activities of daily living. To maintain flexibility the most common method is through Dynamic stretching, however yoga is becoming increasingly more popular with the added benefits of deep breathing and relaxation. This study explores the value of yoga in comparison to Dynamic stretching when related to increasing range of motion in the hip and shoulder joints. It is important to have an understanding of the difference between range of motion and flexibility, to properly decipher the issues.

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Range of motion has been defined as the obtainable movement at any specific joint (Heyward, 2010; Houglum, 2010; Reese, 2009). Flexibility on the other hand refers to the muscles surrounding the joint and is defined as the mobility of the muscles and the length to which they extend (Houglum, 2010). Range of motion within a joint is dependent on the bony structure of the joint, the surrounding connective tissues, as well as the length of the muscles spanning the particular joint (Heyward, 2010; Houglum, 2010; Reese, 2009). Therefore if a muscle is lacking in flexibility it may cause a reduced range of motion (Heyward, 2010; Houglum, 2010; Vardiman, 2010). Throughout activities of daily living, repetitive stress or overuse injuries are very common and are in part caused by restrictions in soft tissues and limitations in joint flexibility (Houglum, 2010; McAtee, 2002). Stretching is a popular method used in order to promote improvements in mobility

and range of motion (Houglum, 2010; Wyss, 2012). With regular stretching muscle tension is reduced, movements become easier helping to improve coordination. Range of motion is improved, flexibility is maintained or improved, and the likelihood of strain injuries is decreased (Vardiman, 2010; Anderson, 2010). In general stretching helps to create a general feeling of well-being (Vardiman, 2010; Anderson, 2010). Yoga uses asanas static postures due to dynamic movement to help improve muscular strength and flexibility. Specifically, hatha yoga combines a focus on asanas, pranayamas (breath control) and chanda (meditation), throughout the class to quiet the mind and to increase concentration (Sorosky, 2008). Graves, Krepcho and Mayo, did a study in which they determined that of 3000 patients treated with yoga for various chronic health problems, 98% of those surveyed proclaimed it to be useful in preventing and managing the effects of their chronic health problems. Looking specifically at flexibility it was shown to increase range of motion, which is most likely attributed to the asanas

METHODOLOGY

Forty subjects ten each from control and Experimental group such as Yoga, Dynamic Stretching and Yoga and Dynamic stretching treatment procedure were given as a form of rehabilitation therapy to given selected randomized samples and their age was ranged between 18- 50 years old with recent musculoskeletal injuries. Range of motion was assessed on prior to the treatment and after the practice of experimental treatment the post test evaluation was taken in comparison with Experimental groups showed significant improvement in range of motion in yoga, Dynamic stretching and combined effect of yoga and Dynamic stretching in relation to the Neck, Shoulder, Hip and Ankle. Analysis of variance was used with the repeated treatment and level of significance 0.05 was used to determine the difference between the means. Range of motion at the hip and shoulder was measured using a goniometer. The goniometer[1] was made of metal, had two arms and a 180-degree protractor in the center on each side. The protractor was marked off in one-degree increments and the arms of the goniometer were 12 inches long. The instrument was validated using known angles of 0, 45, 90, 135, and 180 degrees.

Measurement Procedure: Prior to any data collection participants were required to complete a PAR-Q questionnaire, a general lifestyle questionnaire, and a consent form. If they m*et a*l the required criteria they volunteered to take part in one of the three groups and were asked to attend an initial measurement session two days prior training. Standard goniometer measurements were made for shoulder flexion, extension, abduction, adduction, horizontal abduction and horizontal adduction on both the left and right side. The same examiner made two goniometer measurements for each motion. The terminal position of range of motion was determined by the examiner about subject participation in each of the three groups. When measuring shoulder flexion the subject was supine with knees and hips bent and back flat on the floor. The arm was at their side with the palm of the hand facing in and thumb pointing up (Heyward, 2010; Houglum, 2010). The axis of rotation was placed just below the acromion process on the lateral head of the humerus. The stationary arm was in line with the greater trochanter and along the mid-axillary line of the trunk. The moving arm was placed along the lateral midline of the humerus and in line with the lateral epicondyle (Heyward, 2010). Shoulder extension followed the same goniometer placement as that of shoulder flexion however the patient was in a prone position (Heyward, 2010; Houglum, 2010). For shoulder adduction and shoulder abduction the same protocol was used. The subject was placed in a supine position with their knees and hips bent and back flat on the floor. Their arm at their side with the palm facing up (Heyward, 2010). The axis of the goniometer was placed and the anterior portion of the acromion process through the center of the humerus head. The stationary arm was placed at the lateral and anterior surface of the chest, running parallel to the midline of the sternum. The moving arm was placed along the anterior surface of the arm and runs parallel to the midline of the humerus and in line with the medial epicondyle (Heyward, 2010).

Standard goniometer measurements were then performed on the hip, which included hip flexion, extension, adduction and abduction on both sides of the body. Once again the same examiner made two goniometer measurements for each motion (Houglum, 2010) and the terminal position of range of motion was determined when the participant felt tension. During hip flexion and extension the axis of the goniometer was placed slightly anterior and superior to the greater trochanter. The stationary arm was placed parallel to the long axis of the trunk and the moving arm was placed along the midline of the femur on the lateral side. The subject was in a supine position during hip flexion and in a prone position during hip extension. For hip adduction and hip abduction the subjects were lying in a supine position. The axis of rotation was placed at the hip joint in line with the greater trochanter. The stationary arm was placed bellow and parallel to level of the anterior supra iliac spine and the moving arm was placed in line with the midline of the patella on the anterior surface of the thigh.

Data Analysis

All statistical analysis was conducted in SPSS v21. Means and standard deviations for pretest and post-test measures were calculated as well as for the gain scores of the mean differences between pretest and posttest measures. A post-hoc Tukey test was used to compare between yoga participants, static stretching participants and the control group, in a Correlation statistics was used compares the test of difference between means. Independent variables included the joint, the side of the body and the motion and the dependent variable was range of motion. The changes between the pre-test and post-test values were used to examine the affects of the three groups on hip and shoulder range of motion (ROM). A p value of 0.05 was used to determine if the data is significantly different.

RESULTS

Overall both yoga and Dynamic stretching showed a significant improvement in ROM in comparison to the control group ($p<0.001$, 95% confidence interval, $\eta^2=0.214$). Yoga showed the greatest improvement in ROM with a mean difference of 1.07602 degrees ($p<0.001$, 95% confidence interval, $\eta^2=0.214$) in relation to Dynamic stretching.

Table 1. Mean difference and significance determined for the Neck

Movement			
Flexion	Yoga 1.35265 degrees > than Dynamic Stretching	Yoga 2.80087*degrees>than Control	Dynamic Stretching 3.34821*degrees>than Control
Extension	Yoga 0.35406 degrees > than Dynamic Stretching	Yoga 4.37987 *degrees>than Control	Dynamic Stretching 7.02381*degrees>than Control
Adduction	Yoga 1.21561 degrees > than Dynamic Stretching	Yoga 2.34632*degrees>than Control	Dynamic Stretching 2.91071*degrees>than Control
Abduction	Yoga 3.07955*degrees > than Dynamic Stretching	Yoga 5.34740*degrees>than Control	Dynamic Stretching 3.26786*degrees>than Control
Horizontal Adduction	Yoga 2.43144*degrees< than Dynamic Stretching	Yoga 2.50844*degrees>than Control	Dynamic Stretching 4.39858*degrees>than Control
Horizontal Abduction	Yoga 0.24545 degrees < than Dynamic Stretching	Yoga 2.36312*degrees>than Control	Dynamic Stretching 2.35857*degrees>than Control

Table 2. Mean difference and significance determined for the Shoulder

Movement			
Flexion	Yoga 1.45265 degrees > than Static Stretching	Yoga 4.80087*degrees>than Control	Static Stretching 3.34821*degrees>than Control
Extension	Yoga 0.35606 degrees > than Static Stretching	Yoga 7.37987 *degrees>than Control	Static Stretching 7.02381*degrees>than Control
Adduction	Yoga 1.43561 degrees > than Static Stretching	Yoga 4.34632*degrees>than Control	Static Stretching 2.91071*degrees>than Control
Abduction	Yoga 5.07955*degrees > than Static Stretching	Yoga 8.34740*degrees>than Control	Static Stretching 3.26786*degrees>than Control
Horizontal Adduction	Yoga 2.83144*degrees< than Static Stretching	Yoga 2.80844*degrees>than Control	Static Stretching 5.63988*degrees>than Control
Horizontal Abduction	Yoga 0.29545 degrees < than Static Stretching	Yoga 2.38312*degrees>than Control	Static Stretching 2.67857*degrees>than Control

Table 3.The mean differences and the significance of the hip motions are summarized

Movement			
Flexion	Yoga 1.60038 degrees > than Static Stretching	Yoga 7.44264*degrees > than Control	Static Stretching 5.84226*degrees > than Control
Extension	Yoga 1.09280 degrees > than Static Stretching	Yoga 5.16126*degrees > than Control	Static Stretching 4.06845*degrees > than Control
Adduction	Yoga 2.14394*degrees > than Static Stretching	Yoga 5.28680*degrees > than Control	Static Stretching 3.14286*degrees > than Control
Abduction	Yoga 0.85606*degrees > than Static Stretching	Yoga5.09416*degrees > than Control	Static Stretching 4.23810*degrees > than Control

The results were later broken down by joint and compared between the three groups. For the Neck yoga was shown to have a significant increase in hip ROM compared to both the control ($p<0.001$, 95% confidence interval, $\eta^2=0.220$) and static stretching groups ($p=0.003$, 95% confidence interval, $\eta^2=0.220$), with a mean difference of 1.3222995 degrees greater than that of static stretching. Results also showed that overall both Dynamic stretching and yoga showed the change in ROM to be significantly greater than that of the control group for the shoulder ($p<0.001$, 95% confidence interval, $\eta^2=0.165$), however neither yoga nor Dynamic stretching were significantly different from each other ($p=0.07$, 95% confidence interval, $\eta^2=0.185$). Finally results for the joints were further broken down into the individual motions. Of the six shoulder motions analyzed, two were found to be significant between the two treatment groups. Yoga had a significant increase in Neck abduction ($p<0.001$, 95% confidence interval, $\eta^2=0.275$ while static stretching had a significant increase of horizontal adduction ($p=0.016$, 95% confidence interval, $\eta^2=0.176$). Summary of the mean difference and significance for the Shoulder motions table!. Overall both yoga and Dynamic stretching showed a significant improvement in ROM in comparison to the control group ($p<0.001$, 95% confidence interval, $\eta^2=0.224$). Yoga showed the greatest improvement in ROM with a mean difference of 1.08902 degrees ($p<0.001$, 95% confidence interval, $\eta^2=0.224$) in relation to Dynamic stretching. The results were later broken down by joint and compared between the three groups. For the hip yoga was shown to have a significant increase in hip ROM compared to both the control ($p<0.001$, 95% confidence interval, $\eta^2=0.280$) and static stretching groups ($p=0.003$, 95% confidence interval, $\eta^2=0.280$), with a mean difference of 1.4232995 degrees greater than that of static stretching. Results also showed that overall both static stretching and yoga showed the change in ROM to be significantly greater than that of the control group for the shoulder ($p<0.001$, 95% confidence interval, $\eta^2=0.195$), however neither yoga nor static stretching were significantly different from each other ($p=0.07$, 95% confidence interval, $\eta^2=0.195$). Finally results for the joints were further broken down into the individual motions. Of the six shoulder motions analyzed, two were found to be significant between the two treatment groups. Yoga had a significant increase in shoulder abduction ($p<0.001$, 95% confidence interval, $\eta^2=0.376$) while static stretching had a significant increase of horizontal adduction ($p=0.016$, 95% confidence interval, $\eta^2=0.199$). Summary of the mean difference and significance for the Shoulder motions table 2. Upon completion of the hip analysis only one motion was found to show any increased improvement in ROM with respect to a comparison between treatment groups. Hip adduction had a positive mean increase for yoga ($p=0.023$, 95% confidence interval, $\eta^2=0.252$). The mean differences and the significance of the hip motions are summarized in

DISCUSSION

The results of this study confirm, in agreement with our hypothesis, that both yoga and Dynamic stretching interventions significantly increase range of motion as compared to a control group.

Further results indicate that overall there was a significant difference between the two treatment groups (yoga and Dynamic stretching). Participants in the yoga group had an overall mean increase in ROM greater than that of the other participants. These findings are in agreement with the original hypothesis. Yoga uses asanas to help improved muscular strength and flexibility. Specifically, hatha yoga combines a focus on asanas, pranayama (breath control) and Chandra (meditation), throughout the class to quiet the mind and to increase concentration. Further benefits include relaxation, deep breathing, monitored stretching and increased body awareness. As a result, the combined factors are a leading reason for the increased range of motion when compared to static stretching. There have been many studies over the years that focus on range of motion and flexibility. A number of these articles have used the same definition as that provided above which is that range of motion is the obtainable movement at any specific joint (Heyward, 2010; Houglum, 2010; Reese, 2009), while flexibility refers to the muscles surrounding the joint and is defined as the mobility of the muscles and the length to which they extend (Houglum, 2010). Other articles have used the two terms interchangeably or defined the terms in a different manner all together. This becomes an issue when comparing studies, therefore a universal definition of both flexibility and range of motion needs to be determined.

Another issue that presents itself and that has remained controversial over the years is whether or not flexibility is a benefit or detriment to health. Several articles have found that flexibility and increased ROM have little to no effect at preventing sport injuries however in opposition, many articles termed flexibility and increased ROM to be a leading treatment in rehabilitation and for maintenance of overall health (Vardiman *et al*., 2010). In general of the various studies that have been performed, there have been mixed findings, varying in quality, suggesting a need for further investigation in this area of research. Though there is still debate about joint flexibility in athletes, increasing ROM and flexibility is an important component with people suffering from various musculoskeletal injuries. Properly designed therapeutic exercise programs will put emphasis on regaining range of motion first (Houglum, 2010). The significant increase in ROM from yoga participants proves that even a 4-week program twice a week would be beneficial for those suffering from restricted ROM and decreased flexibility. Breathing is also a very important component of yoga.

An environment that is created to emphasized quiet, relaxation and trust has been found to be associated with dramatic increases in flexibility and athletic performance. As a result of the focus on breath control, yoga has been shown to have increasing value when it comes to therapy and rehabilitation. There is a need for yoga to become more widely recognized as a health care treatment along side exercise and the more traditional practices.

Conclusion

Conclusion, after 4 weeks of participation results showed participants taking part in yoga and Dynamic stretching classes had significant overall improvements in ROM in the hip and shoulder. Through past research it is evident that various styles of flexibility training will create improvements in ROM, however in a comparison of yoga to Dynamic stretching, yoga had a greater overall effect. For clientele suffering from musculoskeletal injuries a four-week yoga program would be a beneficial treatment. It is hoped that with this study yoga may start to have an increased therapeutic role with joint restrictions as well as promote future research in this field.

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