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Research Article

A COMPARISON OF THE EFFECTS OF LONG TERM CONCENTRIC VERSUS ECCENTRIC EXERCISE ON KNEE JOINT POSTION SENSE OF HEALTHY FEMALES

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ABSTRACT

The aim of the present study was that to evaluate the effects of concentric and eccentric training program on knee joint position sense. Twenty nonathletic boy students (age: 20 until 30 years) were assigned to one of the two training groups: eccentric and concentric training groups. Measurements of knee joint position sense at the beginning and at the end of 8 weeks of training executed by using a goniometer and in open chain knee extension. Training program included three sessions per week for 8 week. Data were analyzed using dependent and independent sample t-test. The results of the present study showed significant improvement in knee joint position sense for both groups ($P \leq 0.05$). However, no significant difference between groups was found ($P > 0.05$).

Keywords: *Knee Joint Position Sense, Concentric and Eccentric Exercises, Absolute Error*

INTRODUCTION

Position sense is generally defined as the ability to assess respective limb's position without the assistance of vision. Position sense is governed by central and peripheral mechanisms mainly muscular receptors, and also tendinous, articular, cutaneous and muscular receptors. Muscular receptors have the most important part in the elaboration of limb position sense (McCloskey, 1978). This role of muscular receptors indicates that modifying the functional state of the muscles can affect the precision of joint position sense. The decrease of joint proprioception could lead to abnormal joint biomechanics during functional activities which could lead to, over a period of time, degenerative joint disease (Skinner, 1993). Hence, it is important to develop and implement strategies to attenuate the decline in proprioception. So far, the only strategy that seems to retain/regain joint proprioception is regular physical exercise.

Rehabilitation professionals often focus on the concentric action of a muscle contraction and reserve exercises that isolate eccentric muscle actions for the athletic population despite compelling evidence in favor of eccentric training. Specifically, evidence exists to suggest that eccentric training induces a favorable benefit on muscle strength (Roig *et al.,* 2009), hypertrophy (Roig *et al.,* 2009), and stimulation of anabolic hormones and growth factors when compared with isometric- and concentric-based training (Heinemeier *et al.,* 2007). Moreover, the clinical efficacy of eccentric training for reversing degenerative changes in tendons (Lewis *et al.,* 2009; Ohberg *et al.,* 2004), improving function, and decreasing pain has been reported in clinical-based investigations (Jonsson *et al.,* 2006; Holmgren *et al.,* 2012; Camargo *et al.,* 2012; Bernhardsson *et al.,* 2011; Chaconas *et al.,* 2013).

Here we have not addressed the broader question of the effects of exercise on proprioception, but targeted one specific aspect of exercise, whether it is concentric or eccentric exercise. During an eccentric contraction the contracting muscle is forcibly lengthened. This compares with the more common, concentric contraction where the contracting muscle shortens. Here we have posed the question, does the long term concentric and eccentric exercise have same effect on knee joint position sense or not?

MATERIAL AND METHODS

Twenty two nonathletic healthy women served as subjects. No subject reported either a history of previous lower extremity injury or the presence of a systemic or neurological disease. At this study written informed consent was obtained from each subject before participation. Subjects were randomly assigned, to either the concentric training group (n = 11) or an eccentric training group (n = 11). The age, height, and body mass of the men in the eccentric group were, respectively, (mean ± SD) 24.9 ± 2.5yrs, 179.6 ± 6.1 cm and 69.4 ± 4.1 kg, while those of the men in the concentric group were, respectively, 25.2 ± 3.4yrs, 178.4 ± 5.2 cm and 67.9±5.7 kg. A leg press apparatus (Model: HSLLP, Life Fitness, IL, USA) was used in this experiment for training. The 1-RM was determined using a protocol suggested by Kraemer and Fry (1995). At each session we asked subjects to perform 5-min static stretching exercises (30 s and 3 sets for each of the quadriceps, hamstring, and gastrocnemius muscles).After warming up, the subjects of concentric group were seated in the starting position on the leg press apparatus at 90° of knee flexion with both feet in a shoulder-width position (Escamilla *et al.*, 2001). In this position, it was not possible for the knee to pass anterior to the subjects' feet. In this posture, all subjects were verbally encouraged to press their legs just into the foot plate and extend their knees and hips (concentric group). The subjects of eccentric group were seated in the starting position on the leg press apparatus at 180° of knee extension with both feet in a shoulder-width position (Escamilla *et al.*, 2001). In this posture, all subjects were encouraged to just slowly move their knee and hip joints into flexion angle. All subjects completed the training program. The training programs were identical other than the concentric and eccentric groups using different phase of contraction. Supervision of the workouts was maintained at all times. Each training program consisted of three sessions per week of strength training for 8 weeks. The subjects performed one warm-up set and three sets of 10 repetitions at an intensity of 60% of the 1-RM. The 1-RM was redefined after 4 weeks of training and the training resistance altered accordingly.

For evaluation of joint position sense during pre & post test, the subjects were seated in a comfortable position (with the hip at an angle of 90̊ of flexion), with the legs hanging freely, and blindfolded to block visual input. A goniometer was fixed with adhesive tape to the lateral thigh and leg at the knee joint. Then, passive positioning by the examiner was performed by extending the knee from the starting position of 90° of flexion to a flexion angle 30°. The subject maintained the position actively for 3 s without any contact from the examiner in order to identify the test position. After that, the examiner replaced the leg to the starting position. The subject was then instructed (upon the command to actively reproduce the test position. The subject then returned to the position perceived as the test position and reported to the examiner. This position was held for 3 s, and on the command ''return'' the subject returned to the initial position. Each participant performed three consecutive trials trying. The test and the response positions were recorded with a Goniometer and knee angles were determined by it. Knee joint position sense is reported as: the absolute angular error (defined as the absolute difference between the test position and the position reproduced by the subject).

All data were analyzed using SPSS version 16.0 (SPSS Inc., Chicago, IL) statistical software. Independent and paired sample t test was performed to compare the mean values of absolute angular error, and relative angular error between the two groups and between pre and post test, respectively. Statistical significance was set at a = 0.05 for all statistical comparisons.

RESULTS AND DISCUSSION

The results of this study showed that significant decrease (P=0.002) in absolute error after 8 weeks of concentric training in compared to before it (Figure 1). Same as concentric group; eccentric group showed significant improvement in knee joint position sense (P=0.001) after 8 weeks of eccentric training (Figure 2).

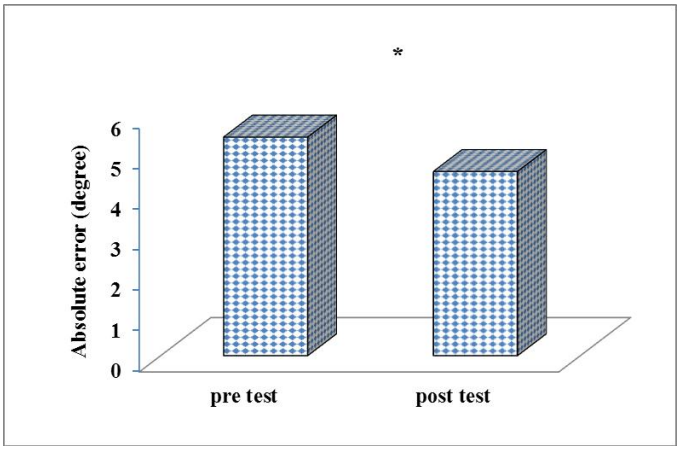

Figure 1: Comparisons of joint position sense values during pre and post test in concentric group, mean ± S.D.

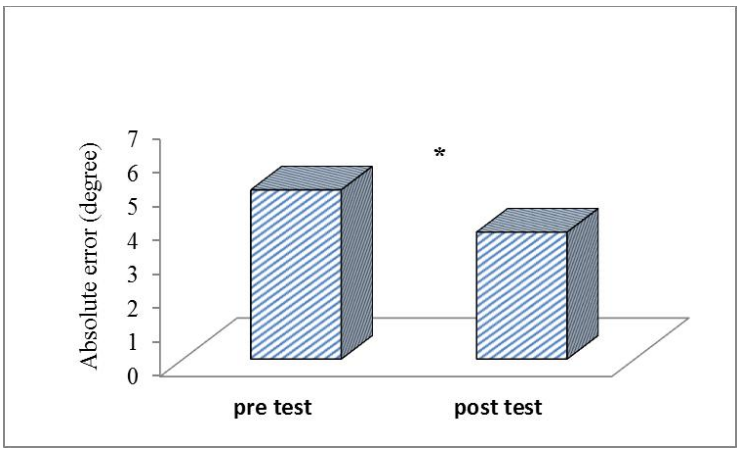

Figure 2: Comparisons of joint position sense values during pre and post test in eccentric group, mean ± S.D.

Comparisons of joint position sense changes in both group after training period showed in figure 3. Results didn't show any statistically significant differences between groups after training period (P=0.226), although eccentric group had more decrease in absolute error changes.

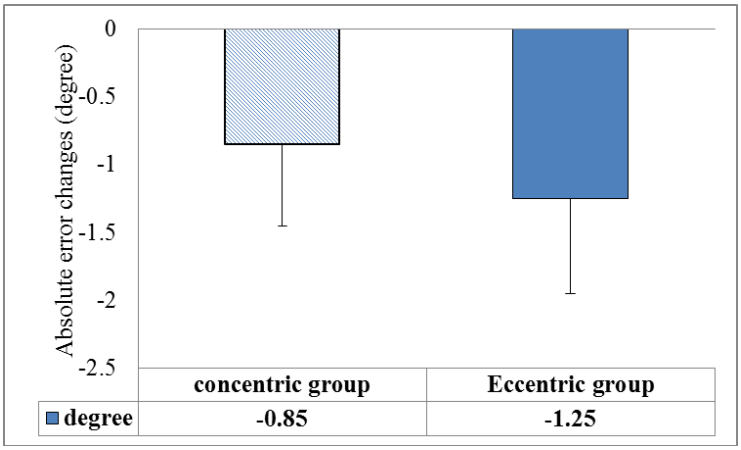

Figure 3: Comparisons of absolute error changes between two groups after training program, mean ± S.D.

The results of this study showed that significant decrease in absolute error after 8 weeks of concentric training in compared to before it (Figure 1). Same as concentric group; eccentric group showed significant improvement in knee joint position sense after 8 weeks of eccentric training (Figure 2), and that this increase in accuracy could be partly responsible for the increase in motor capabilities. Such an increase may be due to a better proprioceptive feedback but may also act indirectly by the sense of limb position, it is generally agreed, is provided by signals from skin, joint and muscle receptors. The muscle receptors responsible include the primary and secondary endings of muscle spindles, primary endings being concerned with signalling position and movement, secondary endings largely signalling position (Ribeiro and Oliveira, 2010). Results didn't show any statistically significant differences between groups after training period, although eccentric group had more decrease in absolute error changes. Muscular exercise also improves general motor capabilities, our study showed that how physical exercise may lead to changes in perception of limb position, i.e. changes in accuracy of position sense. Results of our study didn't show any differences among the effects of concentric and eccentric training on knee joint position sense.

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