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Original Research Article

Correlation between Lumbar Extensor Muscle Endurance and Lumbar Proprioception

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ABSTRACT

Background: There appears a relationship between lumbar extensor muscle strength and proprioception. No studies have yet been done to prove if there is correlation between lumbar proprioception and endurance. Therefore the objective of the study is to determine the correlation between lumbar extensor endurance and proprioception.
Methods: 60 subjects (30 females and 30 males) with mean age of 22.2 ±3.2 years were recruited for the study. The subjects were assessed for Neutral Position Sense (NPS) and Target Reposition Sense (TRS) as a measure of lumbar proprioception. The reposition errors were recorded using the bubble inclinometer in degrees. Following which the lumbar extensor endurance was recorded in seconds while the subjects were made to adapt leg prone lying and were asked to maintain the position for as long as possible.
Results: A Pearson product-moment correlation coefficient was computed to assess the relationship between the lumbar extensor endurance and lumbar proprioception. There was a moderate negative correlation between lumbar extensor endurance and lumbar proprioception in both the neutral position sense ($r = -.625$, $n=60$, $p<0.001$) and the target position sense ($r = -.567$, $n=60$, $p<0.001$).
Conclusion: There is moderate negative correlation between lumbar extensor endurance and lumbar proprioception.
Key words: Proprioception, Lumbar spine, Muscle endurance

INTRODUCTION

Proprioception is defined as the complex interaction between afferent and efferent input to control body movement and position. [1] It is a component of the somatic sense of mechano receptivity, which encompasses two aspects of position sense (static and dynamic) and allows the body to maintain stability and orientation during

both static and dynamic loads. [2] Proprioception is comprised of 3 main sensations: the sensations of position and movement of joints; the sensations of force, effort, and heaviness associated with muscular contractions; and the sensations of the perceived timing of muscular contractions. [3] It is widely recognised that proprioceptive input from muscles, joints, and other receptors is necessary for the accurate control of movement and posture. [4]

It has been shown that loss of proprioception results in large systematic errors in multi joint movements attributable, at least in part to impair motor programming.[5] Intact proprioception is essential for movement control. In the spine proprioception information is provided by structures present in the spinal ligaments, facet joint, intervertebral discs and paraspinal muscles. Muscle spindle density is high in deep paraspinal rotators. [6] It is believed that the spindles in these muscles act as kinaesthetic sensors that monitor trunk position and movement. Impaired prorioception in the lumbar spine has often been reported in people with low back pain. [7]

Muscular endurance is the ability of a muscle to contract repeatedly or generate tension, sustain that tension, and resist fatigue over a prolonged period of time. [8] Endurance testing of back extensor muscles examines the localized capability of the extensor muscles of the back to sustain activity.[9] It has been stated that people with poor muscle endurance have a higher chances of injury to the back.[9] Decreased back muscle endurance is associated with habitually adopting passive sitting posture, reduced activity levels and LBP.[10] Low levels of static endurance in the back extensor muscles are associated with higher rates of low back pain (LBP) decreased proprioceptive awareness, poor balance, and decreased productivity in the workplace.[10] However no studies have yet been done to prove if there is correlation between lumbar proprioception and endurance. Therefore the objective of the study is to determine the correlation between lumbar extensor muscle endurance and proprioception.

METHODOLOGY

Subjects:

Advertisements in the University, physical therapy department were given in the form of posters and lectures for voluntary participation of the subjects. Screening was done and the subjects were selected according to the inclusion criteria. The study included 60 asymptomatic subjects (30males and 30 females) between the age group of 18-25 (22.2 ±3.2) years. All subjects reported that they had no back pain at the time of the study. To be considered asymptomatic, a subject could not have had any previous treatment for back pain, and no current back pain. The study purpose was explained to the subjects and written consent and demographic profile was taken. Subjects were excluded if there was history of low back pain in past three months, Severe muscle tightness around hip or trunk, injury to hip or knee, Low back surgeries, Any spinal deformity, Symptoms of vertigo and dizziness or neurological deficits. All subjects had a trail practice session one day prior to the testing day so as to familiarize them with the procedural methods.

Measurement of lumbar proprioception:

We used four point kneeling method to measure the lumbar reposition sense. [11] Neutral Position Sense (NPS) and Target Reposition Sense (TRS) are measured as a measure the lumbar proprioception. The subjects were positioned in four point kneeling with hip and knee at right angles. The hands were placed shoulder width apart.

The subjects were blindfolded. The bubble inclinometer was placed at S2 region and the subjects were then asked to perform extremes of anterior and posterior pelvic tilts. To measure neutral reposition sense the subject were asked to position the pelvis in neutral. They were then asked to perform extremes of anterior pelvic tilt after which they were asked to readapt the neutral position. To perform target reposition sense the subjects were taken to fixed position blindfolded (10 degrees anterior pelvic tilt) and were asked to maintain that position for 5 seconds. They were then brought back to neutral position and asked to readapt the target position again. For both neutral and target reposition sense 3 readings were recorded and the average of the 3 readings were taken for analysis.

Measurement of Lumbar Endurance:

All these experiments were conducted in a laboratory setting. The subjects were tested during a 1-h session and were asked to undergo a body weight-dependent isometric back extension (Sorensen) test on a horizontal table.[12] Sorensen test was performed in the prone position, with the iliac crests aligned with the table edge and the lower limbs fixed by straps at the ankles and below the knees (Fig. 1). During the test, the subjects were instructed to keep their body (head, arms and trunk) unsupported, horizontal to the ground, as long as they could, with their arms crossed at the chest. To maintain the horizontal position throughout the test, the investigator gave them verbal feedback, and the test was ended when they could not hold the test position, even after investigator warnings. Verbalized encouragement was provided throughout the test. The subjects were also instructed to maintain the lumbar lordosis position as stable as possible. The endurance was recorded by investigator with the help of stopwatch in seconds. A chair with cushioned seat (or with a pillow over the seat) was place in front of the subject so that he can support himself if fatigued during the test. The stopwatch was stopped as soon as the subject gets fatigued or can no longer sustain the position.

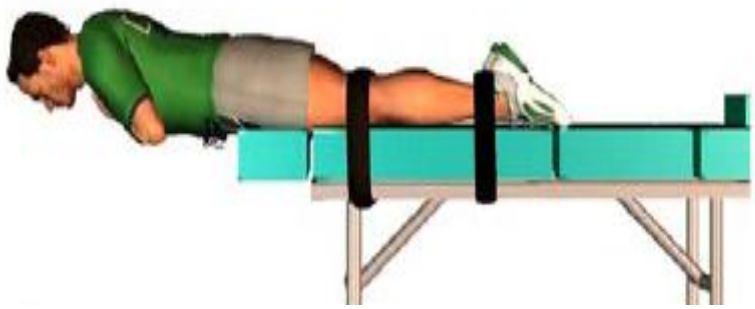

Figure 1: Test positioning of the study subjects during Sorensen lumbar extensor endurance testing

DATA ANALYSIS AND RESULTS

Data was analysed using SPSS Student Version14.0. “A Pearson product-moment correlation coefficient was computed to assess the relationship between the lumbar extensor endurance and lumbar proprioception. There was a moderate negative correlation between lumbar extensor endurance and lumbar proprioception in both the neutral position sense ($r = -.625$, $n=60$, $p<0.001$) and the

target position sense (r = -.567, n=60, p<0.001). The scatter plots summarize the results (Fig. 2 and 3).

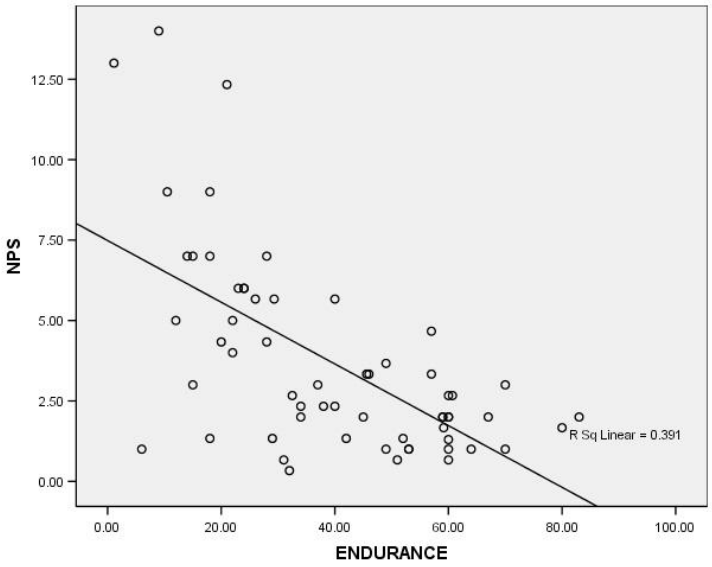

Figure 2: Scatter plot showing negative correlation between lumbar extensor endurance and Neutral Position sense (r= -.625, n=60, p<0.001)

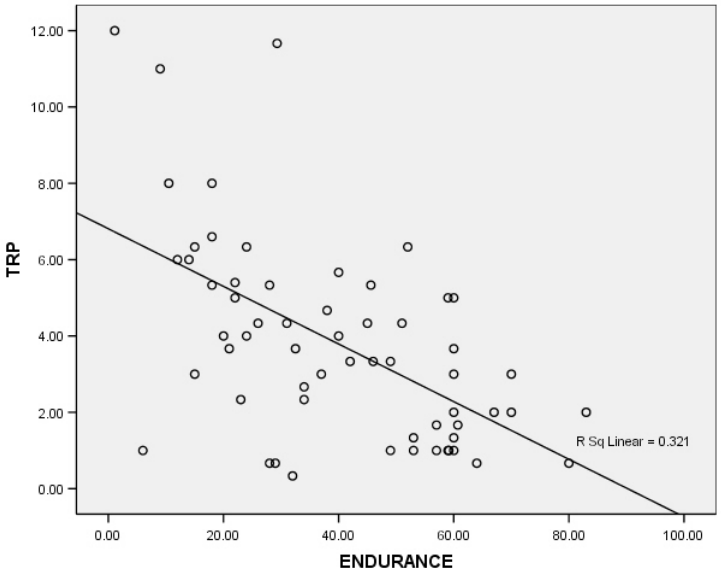

Figure 3: Scatter plot showing negative correlation between lumbar extensor endurance and Target Reposition Sense(r = -.567, n=60, p<0.001)

Gender differences:

Data from the current study revealed small gender differences in favour of females having slightly more accurate and precise lumbar proprioception in both NPS (females: r=-.662, n=30, p<0.001 and males r=-.601, n=30, p<0.001) The scatter plots summarize the results and TPS (females: r=-

.624, n=30, p<0.001 and males: r=-.579, n=30, p=0.001). The scatter plots summarize the results.

DISCUSSION

The results of this study revealed that lumbar extensor endurance is associated with lumbar proprioception. The subjects with poor endurance had greater reposition errors in both Neutral position sense and target position sense. Extensor muscle dysfunction may cause alterations in normal afferent input from the affected muscles.[13] On the other hand, proprioceptive impairment may cause different activation patterns and creates new adaptive protective mechanisms.[13,14] In subjects with poor endurance, particular muscle activation may be inhibited, thus creating abnormal movement of the pelvis and spine leading to further deteriorating in proprioception.[15,16]

Data from the current study revealed small gender differences in favour of females having slightly more accurate and precise lumbar proprioception. However, clinical significance of differences in repositioning error is smaller which is probably negligible. In the present study there was a tendency for the subjects with poor endurance (less than 30 seconds) to overshoot the target position, as evidenced during repositioning from both the anterior and posterior pelvic tilt positions to the neutral position. Several other investigators have reported a similar overshooting phenomenon occurring in patients with low back pain, patients with fewer large afferent fibers, such as patients with large-fibre sensory neuropathy or patients with deafferentation.[17,18] Thus, the overshooting phenomenon in the present study indicates decreases in proprioceptive afferent inputs, presumably from the activating lumbar muscles.

Studies have shown that spinal rehabilitation programs that focus on the strengthening of the lumbar musculature through resistance training methods have been shown to increase low back strength as well as reduce pain and improve perceived psychosocial function.[13,14] Furthermore, inefficient muscular stabilization of the low back results in an increased risk of injury to the spine. Patients with chronic LBP also have been shown to demonstrate low levels of trunk strength compared with healthy subjects. Evidence indicates that the lumbar extensor muscle group plays a primary role in trunk function and dysfunction. McGill identifies the importance of the relative endurance of a group of muscles versus the relative strength of that group in maintaining low back stability.[13,14] He also identifies proposed normal ratios of endurance times for the torso flexors relative to the extensors, as well as the lateral musculature relative to the extensors (0.98 and 0.73 respectively) to assist in the detection of endurance deficits which may cause lumbar instability and predispose a patient to low back pain.[15,16] However how lumbar extensor muscle endurance will affect the proprioception in subjects with low back pain is need to be studied.

CONCLUSION

There is moderate negative correlation between lumbar extensor endurance and lumbar proprioception. The clinical significance of this study indicates that poor lumbar extensor endurance will have an effect on lumbar proprioception. As the people with poor lumbar proprioception have increased risk of low back pain. It is necessary that we assess lumbar endurance and proprioception in our routine assessment and manage the individuals accordingly. So individual with poor lumbar extensor muscle endurance will have effect on posture,

balance as they are associated with poor proprioceptive input from the muscles which have on indirect effect on productivity in work place and increased risk of injury to the back.

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