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Full Length Research Paper

Effect of fatigue on proprioception in knee osteoarthritis

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Osteoarthritis (OA) is very common condition with advancing age affecting a wide range of population throughout the world. Proprioceptive deficits and weakness of muscles plays a key role in both developing and progression of knee OA. Above explanation establishes the role of both proprioception and strength improvement. Both the treatment is applied separately in different pathology. However strengthening exercises plays a role in fatigue hence the purpose of this study is to show the temporary effect of strengthening exercise on proprioception. To evaluate the impact of muscular fatigue on proprioception in knee OA. Forty-four patients with knee OA were taken (Mean Age= 53.25±6.09, M: F=1:1.31). For every patient joint position sense error were measured before and after exercise and after four week of strength training again before and after exercise. The Main Outcome Measure was Joint position sense error. Reposition errors did not differ significantly after fatigue. Reposition error pre and post fatigue differences varies from 6.44% to 14.86 % at three different angles. Fatigue produced by moderate exercise also has no effect on reposition error.

Key Words: Fatigue; Osteoarthritis; Proprioception.

INTRODUCTION

Osteoarthritis (OA) is a most common irreversible degenerative joint disorder affecting person older than 25 years (CDC 2010). Muscular weakness and proprioceptive error (Barrack, 1983; Garsden, 1999; Hassan 2001) are common deficit associated with knee OA. Proprioception as defined "is the ability of an organism to consciously and reflexively recognize the position of its body parts" (Enoka 1994). To protect the joint from unexpected mechanical disturbances, a quick action is required which is provided by reflex mechanism of proprioception. Proprioceptive receptors are located on joint, capsules, ligaments, muscles, tendons, and skin (Ribeiro, 2007). Proprioception protects the body via sense of resistance, sense of movement, and joint position sense (JPS). Sense of resistance represents the ability to appreciate force generated within a joint. Sense of movement refers to the ability to appreciate joint movement, including the duration, direction, amplitude, speed, acceleration and timing of movements. JPS determines the ability to perceive a presented joint angle and replicate previously perceived angle either actively or passively. All three modalities can be appreciated consciously and unconsciously, contributing to automatic control of movement, balance, and joint stability, and thus being essential to carry out daily living tasks, walking, and sports activities (Riemann, 2002).

Previous studies have shown that in knee OA there is increased JPS error in comparison to normal knee and with severity of OA this error increases. Animal studies have shown that some proprioceptive receptors are affected by muscle fatigue (Hayward,1991; Ljubisavljevic, 1994; Pedersen, 1998).

It is assumed that these receptors would be similarly affected in humans, but little is known about how fatigue actually affects human proprioception. So the objective of this study was set to investigate how muscular fatigue in knee OA affects the proprioception. In this study JPS was used to evaluate proprioception.

METHOD

The study subjects were forty four with unilateral or bilateral involvement of knee OA. Knee OA was diagnosed according to the criteria of the American College of Rheumatology (Altman, 1986). The severity of

Table 1: Demographic details

Variables	Mean(SD) N=44
Age	53.26(6.87)
Weight	62.38(5.96)
Height	155.56(3.16)
BMI	25.68(2.67)

Table2: JPS error before and after exercise

JPS Error at		Pre exercise	Post exercise	T-TEST	
		Mean±SD	Mean±SD	t	P
30^0	At baseline	7.61 ±1.94	7.12±1.26	2.58	0.99
	At week 4	4.98±2.00	4.24±2.26	2.17	0.98
45^0	At baseline	7.92±2.90	6.87±2.34	2.98	0.99
	At week 4	5.21±2.45	4.68±2.56	1.37	0.91
60^0	At baseline	6.31±2.68	5.82±2.77	1.17	0.88
	At week 4	3.59±1.52	3.28±1.32	1.56	0.94

OA in each affected knee was radiographically graded according to Kellgren-Lawrence grading systems (Kellgren, 1957; Takahashi, 2004). Subjects with grade four OA on Kellgren-Lawrence grading were excluded. Written consent was taken before participation. The ethical approval was taken from institutional ethical committee, NIOH Kolkata.

Procedure

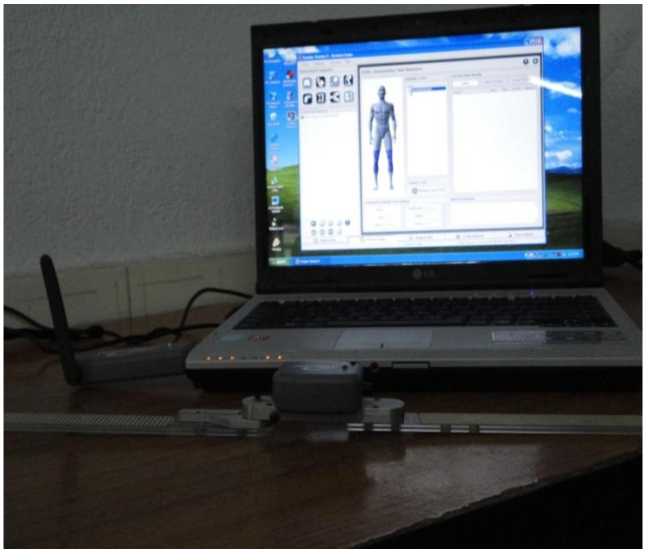
Age, sex, height, weight, body mass index (BMI) was recorded. In addition, reposition error was tested in arthritic knee before and after a customised strengthening exercise. Exercise intensity was customised according to subject's capacity of progressive strengthening exercise (Peinado, 2010). We used a computerized electronic goniometer ("Tracker Freedom Wireless Goniometer" fig. 1) to assess proprioception. The test subjects were positioned in supine lying and made to wear headphones and dark glasses to eliminate auditory and visual cues from the testing apparatus and surrounding environment. They wore shorts to negate any extraneous skin sensation. The Electrogoniometric scale was fastened to the lateral side of the knee with fixed arm pointing towards greater trochanter of femur, movable arm pointing to lateral malleolus and fulcrum at the joint line (Kumar, 2012). Skin stretch was checked while fastening the arms with adhesive tape. A trial was allowed at each angle before testing. The knee was positioned in full extension. The subject was then asked to flex the knee joint to a pre-determined target angle of 30°, 45° and 60°. Auditory feedback was constantly provided by the therapist during trial. Hold time was 5 seconds at each targeted angle. After returning to the starting position and having remained there for 10 seconds, the subject was asked to flex the knee again to reach the target angle. At every angle (30°, 45°and 60°) three readings were taken, mean was calculated and recorded as the patient's joint position sense. Reposition error was defined as the difference between the target angle and the reposition angle, and the absolute value of this error was used for statistical analysis.

RESULT

Demographic data

Forty four patients (19 male and 25 female) were evaluated for the study. Their age, weight, height, and BMI was recorded. Table 1 represents the details of the mean and standard deviation of these scores.

Fig. 1: computerized electronic goniometer (Tracker Freedom Wireless Goniometer)



Joint Position Sense Error (Jps Error)

Data for the JPS error before and after exercise was recorded. After four week of strength training data for JPS error was again recorded before and after exercise. Statistical analysis for T-distribution test had done which reveal no any significant difference between pre- versus post exercise results. The data for reposition errors before and after exercise are shown in table 2.

DISCUSSION

The purpose of this study was to show the effect of fatigue in knee OA. The results shown in table 2 indicate that reposition error difference between before and after exercise was insignificant. However mean value of post exercise JPS error was less in comparison to pre exercise value. This effect may be an effect of warm up which is supported by Subasi et al.[15] who reported that the warm up exercises improves proprioception deficit and greater improvement in proprioception when warm up period increased from 5 to 10 minutes. Other cause of difference may be increased and more presised proprioceptive receptors involvement. This is corroborated with the finding of Hurley et al.[16] who reported that in patients with knee OA, articular damage may reduce quadriceps motoneurone excitability, which decreases voluntary quadriceps activation thus contributing to quadriceps weakness and diminishing of proprioceptive acuity. Further Magalhaes et al.[17] described that since proprioception involves peripheral and central components, the observed improvement in JPS may be elucidated by exercise-related changes in both central and peripheral components. At the peripheral level, warm-up exercises may have positive impact on muscular receptors function by improving the visco-elastic properties of muscular tissue, enhancing oxygenation, increasing nerve-conduction rate, and increasing body temperature because of vasodilatation. At the central level, warm-up exercises may also contribute to better position sense accuracy by changing corollary discharges, likely involved in position sense and/or fusimotor commands and then muscle spindle sensitivity. This finding is also supported by Bartlett et al.[18] who reported that warm up exercise decreases reposition error and this may be explained by an increase in the sensitivity of the mechanoreceptors around the knee joint or a more central mechanism. We did find, however, that patient's knee OA severity on Kellgren-Lawrence grading was directly proportional to reposition error. Some of the previous studies have shown a direct relationship between knee OA and reduced proprioception (Barret, 1991; Garsden, 1999; Koralewicz, 2000; Hewitt, 2002). Our findings are also in line of a previous study Sell et al.[23] who reported more JPS error with increase in severity of OA than in patients with mild osteoarthritis.

CONCLUSION

From above study it is concluded that fatigue has no significant effect on proprioception. Training or warm up improves proprioception. Strengthening exercise contributes positively to proprioception.

Limitation

Follow up study not done, hence no long term effect of strengthening exercise studied.

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