Analyzing age related changes in Proprioceptive and Kinesthetic sensations in community dwelling elderly subjects.

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Abstract:
Aim and objective: The aim of the present study was to determine the kinesthetic and Proprioceptive changes in elderly subject and to determine the precise feedback between kinesthetic and Proprioceptive sensation in elderly group.

Methodology: Samples of convenience of thirty asymptomatic subjects were selected for three groups on the bases of age. Group A was assigned 30 subjects between the age of 20-35 years, group B was assigned 30 subjects between the age of 45-60 years and group C was assigned 30 subjects between the age of 70-85 years. After taking informed consent the subjects were assessed for their kinesthesia and Proprioceptive sensations by a wedge-shaped wooden board.

Result: Analysis of Kinesthesia and Proprioception sensation showed significant alteration in elderly group (group C) and kinesthetic sensation are maximally altered as compared to Proprioceptive sensation in elderly group.

Discussion: Alteration in proprioception and kinesthetic sensation in elderly and also Proprioceptive sensation was more accurate as compare to kinesthetic sensation in elderly group is widely believed on morphology and physiological function of the various sensory structures declined with the increase in age.

Conclusion: The study concluded that proprioception and kinesthetic sensations are altered in elderly group and also kinesthetic sensation is maximally affected as compared to Proprioceptive sensation and so training should be emphasized on cueing of Proprioceptive sensation to reduce the risk of fall in elderly.

Key words: Balance, Proprioception, kinesthesia and elderly.
Introduction:

Balance is a fundamental skill that is often compromised with advancing age. Balance impairment in older adults increases the risk for falls, which ultimately can lead to increased morbidity, mortality, and health care costs. The number of persons above the age of 60 years is fast growing, especially in India. India as the second most populous country in the world has 76.6 million people at or over the age of 60, constituting above 7.7% of total population. Falls are common, disabling and frequently fatal event affecting approximately 30-50% of older individuals annually and are a major threat to their health and independence.\(^{(1)}\)

Postural control or balance is defined as the maintenance of the body’s center of gravity within its base of support during stance or voluntary movements and in response to external perturbations. Visual, vestibular, and somatosensory signals are sent to the central nervous system, which can adjust body sway and posture by integrating this information and by controlling skeletal muscles to appropriately generate joint torques and adjust joint angles. Somatosensory system is the dominant input for maintaining balance. Impairment in any component of the postural control system can lead to instability and falls in older people.

Somatosensory system is important for generation of smooth and coordinated movements, maintenance of normal posture and regulation of balance. Impaired proprioception and kinesthesia leads to less accurate detection of body position changes and increasing the risk of fall. Their by over a period of time, altered neuromuscular control of lower limb and consequently poor balance resulting from changes in the Proprioceptive function could be related to the high incidence of harmful falls that occurs in old age subjects. Because the balance system is so complex, it can be impaired by degenerative changes due to the several alterations in function associated with aging, neural processing centers, or motor outputs. Because balance is normally an unconscious process, subjects often have difficulty articulating their symptoms; and difficulty determining the exact cause of the problem.

Fernando Ribeiro et al (2007) used different testing techniques to assess joint proprioception and kinesthesia. Joint position sense and movement measures the accuracy of position replication and can be conducted actively or passively in both open, and closed kinetic chain positions. Bouet & Gahery (2000) et al postulated that, contralateral or ipsilateral matching responses. The accuracy of joint position and movement sense has been measured directly and indirectly. Directly using
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Goniometers, potentiometers and video analysis systems, and indirectly using visual analog scales. Knee joint proprioception and kinesthesia may be assessing by an apparatus which consisted of one wedge-shaped wooden board.

This study will help in understanding of Somatosensory compromise due to aging in elderly population and will help in developing better fall prevention programs for high risk elderly. Also the precise auditory cueing between proprioception and kinaesthesia for balance rehabilitation will be identified through this study.

**Methodology:**

**Inclusion criteria:**

Both male and female subjects, asymptomatic adults’ age group between 20 to 60 years and community dwelling elderly subjects of age group 70 to 85 years.

**Exclusion criteria:**

Osteoarthritis of knee joint, lower limb fractures, peripheral neuropathy and Hearing difficulty.

**Instrumentation:**

The experimental apparatus consisted of one wedge-shaped wooden board with a radius of 63.5 cm (25 in). The wedge-shaped wooden board was separated by six dowels at a distance of 14.6 cm (5.7 in). The upper board held a padded "skate" (61 cm x 14 cm, or 24 in x 55 in), which pivoted freely on ball bearings. The skate movement described an arc from zero to 120 degrees. A pointer attached to its distal end indicated the degree of movement. Three hinged stops were inserted into the board and could be raised to stop the movement of the skate at 55, 75, and 95 degrees of knee flexion within the arc of movement.

**Protocol:**

Samples of convenience of thirty asymptomatic subjects were selected for three groups on the bases of age. Group A was assigned 30 subjects between the age of 20-35 years, group B was assigned 30 subjects between the age of 45-60 years and group C was assigned 30 subjects between the age of 70-85 years. All the subjects were dealt individually. After the collection of demographic data, the subjects were tested for their Proprioceptive and Kinesthetic sensations of knee joint.

**Procedure:**

The subjects were invited to participate in the study. A detailed explanation of the procedure was given after which the subjects signed the informed consent. Subjects were blindfolded and instructed to lie on their left side on an exercise plinth. The apparatus was placed on the floor, the subject was instructed to fully bend his right knee and maintain it during the whole procedure. The right thigh
was positioned and stabilized by another therapist to allow movement only at the knee joint. The axis of the knee joint was located by palpation and placed on a center mark at the proximal end of the skate. The right lower leg was strapped on the skate, with its long axis aligned with the midline of the skate.

Following positioning, subjects freely flex and extend their right knees to various degrees in order to become familiar with the apparatus and to establish a moderate rate of motion that was subjectively determined by the therapist.

For amplitude of 90 degree (kinesthesia):

The subject’s right knee was placed at 5 degree and stopper at 95 degree, then ask to subject bend his/her knee until the skate was stopped by the hinge on the board. This cueing was given for three times, after giving cues the subject’s limb was reposition in 20 degree, and then ask to reproduce distance which has been travelled earlier.

After getting the distance the therapist will note down the end position. Then therapist extends their knees to the starting point that is 20 degree. Each reproduction movement performed three times. Same procedure was done for 60 and 30 degree of amplitude of kinesthesia.

For amplitude of 90 degree (Proprioception):

The subject’s right knee was placed at 5 degree and stopper at 95 degree, then ask to subject bend his/her knee until the skate was stopped by the hinge on the board. This cueing was given for three times, after giving cues the subject’s limb was reposition in 20 degree, and then ask to reproduce end location of previous movement. After getting the position, therapist will note down the end position. Then therapist extends their knees to the starting point that is 20 degree. Each reproduction movement performed three times. Same procedure was done for 60 and 30 degree of amplitude of Proprioception.

Data acquisition:

Based on the performance of the individual the data for proprioception and kinesthesia was collected and recorded on data collection sheet for all the three groups. After completion of the study period the data was send for intra group and inter group analysis.

Data analysis:

Statistics were performed by using Graph pad instat software. One way ANOVA test was used to analyze and compare the score between groups A B and C. Significance level of P<0.05 was set for data analysis. Bonferroni multiple comparison post test was applied to
compare the result and paired t-test were used to analyze and compare the scores within the kinesthesia and proprioception.

**Results:**

The result obtained revealed significant alteration in proprioception and kinesthetic sensation in group C (CDES) and also significant difference between kinesthetic and proprioceptive sensation were found in group C. Kinesthetic sensation more significantly altered than proprioceptive sensation. The result presentation of data is based on the three groups including Group A (20-35), Group B (45-60) and Group C (70-80).

**Figure 1:** Comparison of mean of Kinesthesia for amplitude of 90 degree among all three groups

![](image1.png)

**Figure 2:** Comparison of mean difference, t value and p value for Kinesthesia in amplitude of 90° with group A vs. group B, group A vs. group C and group B vs. group C

![](image2.png)

**Figure 3:** Comparison of mean of proprioception for amplitude of 90 degree among all three groups.

![](image3.png)
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**Figure 4:** Comparison of mean difference, t value and p value for Proprioception in amplitude of 90° with group A vs. group B, group A vs. group C and group B vs. group C

**Figure 5:** Comparison of mean deviation of Kinesthesia and Proprioception for amplitude of 90°degree in group C.

**Discussion:**

This study analyzed Kinesthetic and Proprioceptive alteration in community dwelling subjects (CDES) and compared between kinesthetic and Proprioceptive cues in the various age groups.

The result obtained revealed significant alteration in proprioception and kinesthetic sensation in group C (CDES) and also significant difference between kinesthetic and Proprioceptive sensation were found in group C. Kinesthetic sensation more significantly altered than Proprioceptive sensation. This indicates more efficient auditory cuing of proprioception as compared to kinesthesia.

The possible explanations for less alteration in proprioception in group C, which can be attributed as follows-

Scott W Shaffer (2007) by his study that morphology and physiological function of the various sensory structures declined with the increase in age. There was preferential loss of distal large myelinated sensory fibers, axonal atrophy, declined nerve conduction velocity, neuromuscular performance and thus loss of balance.

Kararizou E et al (2005) explains that anatomical and physiological age related changes in muscle spindle can be seen in decrease in the total number of intrafusal muscle fibers and nuclear chain.
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fiber per spindle and increases in spindle capsule thickness, the conclusion drawn from this study suggest that proprioception decrease with aging is in part because of changes in muscle spindle function.

The study regarding the effects of aging on proprioception conducted by Skminner et al (1984) who investigated the knee proprioception under passive movement (threshold of detection of joint motion and the ability to reproduce passive knee positioning) and observed that older subject had poor proprioception with compared to younger subjects.

The possible explanations for significant alteration in kinesthesia in group C, which can be attributed as follows-

Montcastle VB, Powell T (1959) proved that Proprioceptive information may be more readily codable into short-term motor memory than kinesthetic information based upon this theory, Proprioceptive cues would seem to be more useful than kinesthetic cues as references for accurate, immediate reproduction of a movement.

Ms. Neufeld (1981),explained that there are no receptors in animals or humans for kinesthesia Thus, the encoding of kinesthesia would involve an additive process, which would require a greater degree of processing than the encoding of proprioception.

Conclusion:
The study concluded that significant alteration in proprioception and kinesthetic sensation in asymptomatic elderly population and also kinesthetic sensation is maximally altered than Proprioceptive sensation in asymptomatic elderly population so the main emphasis should be given to the cuing of Proprioceptive sensations, it will help the subjects to regain balance faster.

Clinical implications
For balance training of elderly population with altered somatosensory system the main emphasis should be given to the cuing of Proprioceptive sensations as they are more accurate as compare to kinesthetic cuing in elderly subjects, so it will help the subjects to regain balance faster.

Future research & Limitation
• Future research can be done on large sample size.
• Difference in male and female population can be analyzed.
• Environmental factors can be study and correlated with the changes in proprioception and kinesthesia in elderly population.
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Conflict of Interest & ethical approval

There was no conflict of interest reported among all authors. This research work is approved by ethical committee of HIPMS, HIHT University (UK) India.

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