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Association of Functional Mobility with Knee Proprioception in Knee Osteoarthritis Patients

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ABSTRACT

Background: Knee osteoarthritis (OA), the most common arthritis type, causes pain and limits daily activities, especially in older adults. Age-related declines in proprioception and joint position sense increase joint load and impair neuromuscular control. This cross-sectional study examined the relationship between functional mobility and knee proprioception in OA patients, aiming to clarify their impact on treatment and mobility outcomes.

Methods: A total of 33 participants were enrolled in this cross-sectional study based on the inclusion criteria. Functional mobility was assessed using three clinical measures: the Stair Climb Test (SCT), the 6-Minute Walk Test (6MWT), and the Five Times Sit to Stand Test (FTSST). Participants completed an initial trial of the 6MWT, and proprioception error was measured using a digital inclinometer. The FTSST and SCT were repeated three times after the first trial, with participants sitting high and holding for 5 seconds between each trial, returning to full knee extension before starting again

Results: Karl Pearson Correlation test demonstrated that there was a statistically significant moderately negative correlation was found between the FTSST and proprioception error ($r=-0.444$: $p<0.05$). There was a positive correlation between 6MWT and proprioception error ($r=+0.132$: $p>0.05$) and a low negative correlation between the SCT and proprioception errors ($r=-0.018$: $p>0.05$) but was not statistically significant.

Conclusion: The study indicated that reduced physical mobility impairs proprioception, potentially contributing to or resulting from OA. It concluded that individuals with knee osteoarthritis had greater proprioception errors, with lower physical performance correlating to more pronounced proprioceptive deficits.

Keywords: Osteoarthritis, Proprioception, 6 Minute Walk test, Stair Climb test, Five Times Sit to Stand Test, functional mobility.

INTRODUCTION

The knee, the largest synovial joint, consists of bone, cartilage, ligaments, and synovial membrane, which produces fluid for lubrication and nourishment. Due to its high use, it often develops osteoarthritis.[20]

Knee osteoarthritis is a major cause of disability and significantly reduces the quality of life.[1] Osteoarthritis of the knee increases in prevalence with age and is more common in women than in men.[18] It is known that knee OA affects almost all the other components in the knee joint including the ligaments, the menisci, the nerves, and the muscles acting on the affected joint.[24] There is a high prevalence of knee

OA (osteoarthritis) affecting 15-40% of people aged 40 and 60-70% of the Indian population older than 60 years.[17]

EULAR recommends diagnosing knee OA with persistent pain, stiffness, reduced function, crepitus, joint restriction, and bony enlargement, along with advanced symptoms like synovitis and malalignment.[19]

Osteoarthritis is classified into primary (idiopathic) and secondary (due to trauma or misalignment), with severity graded using the Kellegren–Lawrence system.[20]

Knee OA, linked to cartilage wear, aging, and weight, causes pain, stiffness, and weakness, impacting mobility, physical health, and psychological well-being.[17] Osteoarthritis leads to pain, stiffness, instability, reduced muscle function, balance issues, and functional limitations.[3]

Alterations in functional movement patterns have been noted in patients with knee OA, transitions between sitting and standing are fundamental to daily activity and identified as a key functional problem for people with knee impairment.[4]

Knee OA causes pain, limited mobility, muscle weakness, and reduced ADL tolerance, impacting daily life quality.

Lower knee extensor strength, higher body weight, and pain severity are linked to knee OA and functional limitations, particularly in high-functioning older individuals..[8] Individuals with knee OA experience progressive functional loss, impacting walking, stair climbing, and lower extremity tasks..[6] Clinicians commonly assess functional performance with simple, cost-effective tests like the 6-Minute Walk, 5-Times Sit-to-Stand, and Stair Climb, offering insights into disease severity and prognosis.[21]

Physical function relies on muscle strength, proprioception, balance, range of motion, and cortical function, with impairments contributing to disability.[21]

Proprioception is the conscious and unconscious awareness of limb position and movement, including joint position in space.[10] Age-related declines in neuromechanical factors, including proprioception, may contribute to the increased prevalence of osteoarthritis.[21]

Proprioceptors in muscles, tendons, and joint capsules provide proprioception. In knee OA, weakened muscles, tendons, and ligaments reduce proprioceptive sensation, increasing susceptibility to pain and disability.

According to Smith et al,[11] and Knoop et al,[2] articular mechanoreceptor impairment, muscle weakness, inflammation, and knee injuries, like ACL or meniscal damage, contribute to impaired proprioception in knee OA patients.[23] It has been postulated for a long time that the degeneration of knee joint proprioception increases as osteoarthritis worsens.[9] Impaired proprioception in OA may lead to slower gait, shorter stride, and slower stair walking.[5]

Knee proprioception protects against injury, aids stability, and coordinates movements; in OA, mechanoreceptor impairment and muscle weakness reduce accuracy and joint stability.

Compared to similarly aged asymptomatic individuals, deficits in knee joint proprioceptive acuity are well documented in patients with knee OA.[7] Patients with KOA experience pain and functional limitations, affecting tasks like walking, stair climbing, and sitting-to-standing.[12] Impaired proprioception disrupts walking rhythm, reducing step length, speed, and overall walking duration, worsening function.[3]

Burgess et al. showed impaired knee strength worsens degeneration, impacting function and balance in the elderly.[12]

Some studies link poor proprioception to impaired function, while others suggest deficits aren't significant. Longitudinal studies indicate impaired proprioception in knee OA may predict further decline.[13]

Improved knee proprioception may enhance mobility in OA patients, but research is limited. While some authors have demonstrated a link between proprioceptive impairment and either physical function or pain in individuals with OA, others have failed to do so.

This study explores the association between functional mobility and knee proprioception in knee osteoarthritis patients, hence this study is done to find the extent of direct relation of functional mobility with knee proprioception in knee osteoarthritis patients.

METHODOLOGY

Study design and Setting: A Cross-sectional study was carried out over a period of one year from August 2021 to August 2022. The convenience sampling technique was used to recruit individuals with knee osteoarthritis who fulfil the inclusion and exclusion criteria from a Tertiary care hospital in Karnataka.

Study participants and Sampling: On the basis of the study conducted by CL Christiansen et al., assuming r= 0.44 with 95 % confidence interval, 80 % power the sample size estimated for the study. On the basis of the study conducted by CL Christiansen et al., assuming r= 0.44 with 95 % confidence interval, 80 % power the sample size estimated for the study is 32.6 (approximately= 33).[6]

Data collection tools and techniques: Individuals with knee osteoarthritis were recruited from a Tertiary care hospital based on inclusion criteria. A brief introduction about the study procedure was explained to all the subjects. Participants was recruited on basis of the inclusion and exclusion criteria and an initial examination including demographic data will be carried out. Written consent was obtained from each subject after a detailed explanation of the procedure. After initial assessment participants were assessed using three standardized clinical measures which were used to assess functional mobility: FTSST, 6MWT, and SCT. Five Times Sit to Stand Test and the Stair Climb Test were carried out three times after one initial trial whereas one initial trial was performed by the participants for 6- Minute Walk Test and proprioception error (in degrees) was measured using a digital inclinometer in a high sitting position. This was carried out three times after the initial trial and 5 seconds hold after each trial to be maintained before getting back to the starting position (complete knee extension).

Outcome measures

Five Times Sit to Stand Test (FTSST)

The FTSST measured participants' ability to transition between sitting and standing. Seated in a chair with feet on force platforms, participants performed five transitions as quickly as possible. The fastest of three trials was recorded. If participants used their hands or armrests, this was documented, and the fastest time was analyzed.[9]

6- Minute Walk Test (6- MWT)

The second functional mobility measure was the (6MWT), assessing gait function on a level surface. Participants walked as far as possible during a 6-minute time frame. They were instructed to stop and rest if needed during the 6 minutes. The 6MWT was performed in a 30.5 m (100 ft) corridor.[9]

Stair Climb Test (SCT)

The third functional measure assessed the time required to ascend and descend one flight of stairs (12 steps, 17.1 cm height).[4] Timing was performed with a hand-held stopwatch and began when subjects lifted their foot for the first step and ended when both feet returned to the landing at the base of the stairs. The shortest time required by each participant, out of three trials, was used or the number of, stairs completed within ≤2 minutes.[9]

Measurement of knee proprioception

The knee proprioception is measured by fixing the digital inclinometer to the lateral face of the femur along the joint line with a strap.

The digital inclinometer test begins with the knee at 90° flexion in a high sitting position. Participants then extend their knee until reaching the target angle of 30°. After holding this position for 5 seconds, they return to full extension. The target angle is demonstrated three times, and participants are asked to replicate it accurately over three trials, with angles recorded.

Record the difference between the angle sensed by the participants and their reproduced angle as the absolute angular error. Then calculate the relative angular error (RAE) as the arithmetic means of the absolute angular error.

RAE= | (target angle- 1st trial) |+| (target angle - 2nd trial) |+| (target angle -3rd trial) |/3.[20]

Ethical consideration: Ethical clearance was obtained from the Institutional ethics committee. The subjects participating in the study were given a patient information sheet containing the study details and also the Inform consent was obtained from the subjects before the study. Ref. no. AJEC/REV/219/2021.

Statistical Analysis: Data were analyzed using SPSS version 23.0**.** Baseline data was summarized using mean and standard deviation. The categorical data was represented using percentages. Diagrams and graphs was used to present the data. Karl Pearson Correlation test was used to measure the correlation between functional mobility and proprioception of the knee. 'p' value less than 0.05 will be considered significant.

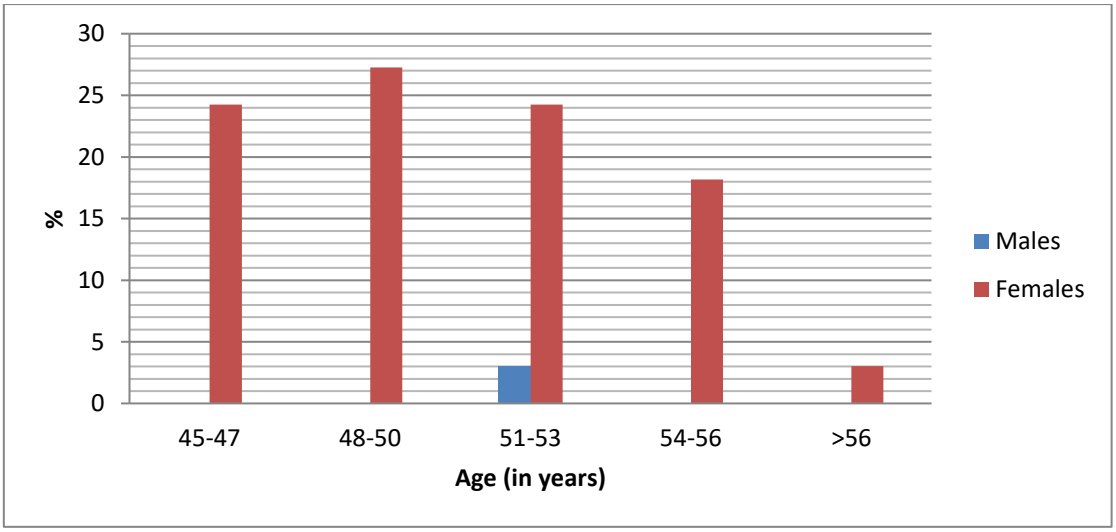
RESULTS

This study included individuals with knee osteoarthritis. The demographic data were represented as the age and gender wise distribution of the study participants.

Table 1: Age and gender wise distribution of the study participants

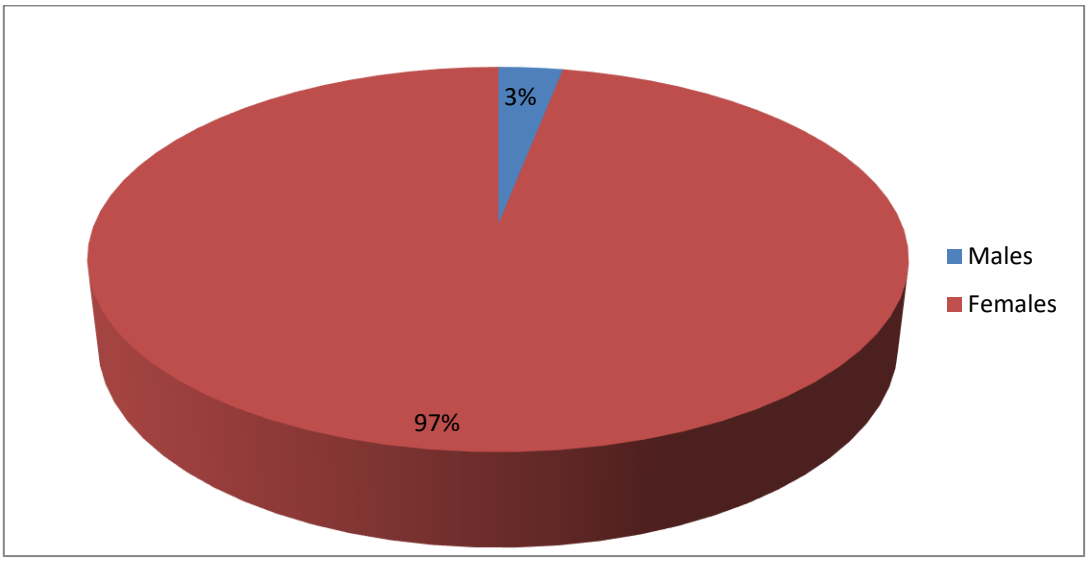
The study noted that among a t2otal of 33 individuals considered for the study, the mean age of the study participants is found to be 50.18 ± 3.5 years.

Figure 1: Age and gender wise distribution of the study participants



It is observed that 18 (54.6%) are in the age group of 48 to 53 years.

Figure.2: Gender wise distribution of the study participants



It is observed that majority of the study participants are females 32 (97%) in comparison to 1 (3%) male.

Table 2 Descriptive statistics of various parameters

	N	Minimum	Maximum	Mean	Std. Deviation
5 times Sit to Stand Test	33	13.120	16.200	14.01606	.796319
6 Minute Walk Test	33	346.00	384.00	368.0000	10.75581
Stair climb test	33	1.04	58.00	24.1470	25.60268
Proprioception Error – (Relative Angular Error)	33	22.40	29.00	26.6424	1.60799

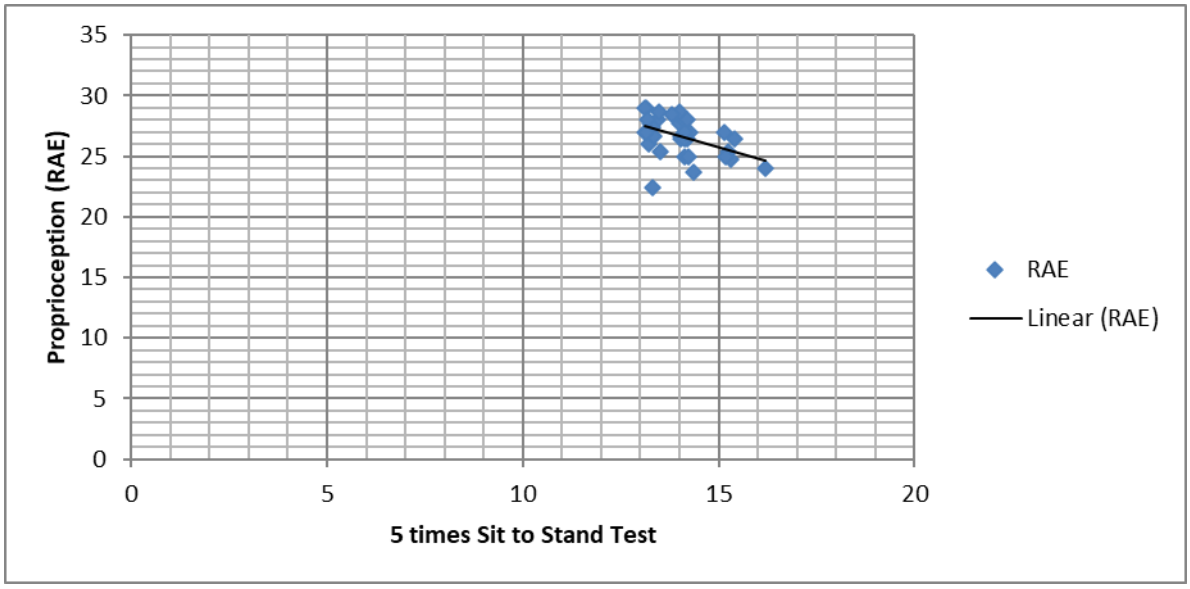
The 5 times Sit to Stand test (14.02 ± .80), 6 Minute Walk test (368.0 ± 10.8), Stair Climb test (24.15 ± 25.60) and Proprioceptive error (Relative angular error) (26.64 ± 1.61) were documented as mean and Standard deviation (SD).

Table 3: Correlation of 5 times Sit to Stand test with Proprioception Error - Relative Angular Error

		Proprioception Error - Relative Angular Error
5 times Sit to Stand Test	**Pearson Correlation**	-.444**
	Sig. (2-tailed)	.010
	N	33

Using Karl Pearson's Correlation coefficient moderately negative correlation is observed between 5 times Sit to Stand test and Proprioception Error - Relative Angular Error and is found to be statistically significant ($r=-0.444$: $p<0.05$).

Figure 3: Scatter diagrams of 5 times Sit to Stand test with Proprioception Error - Relative Angular Error



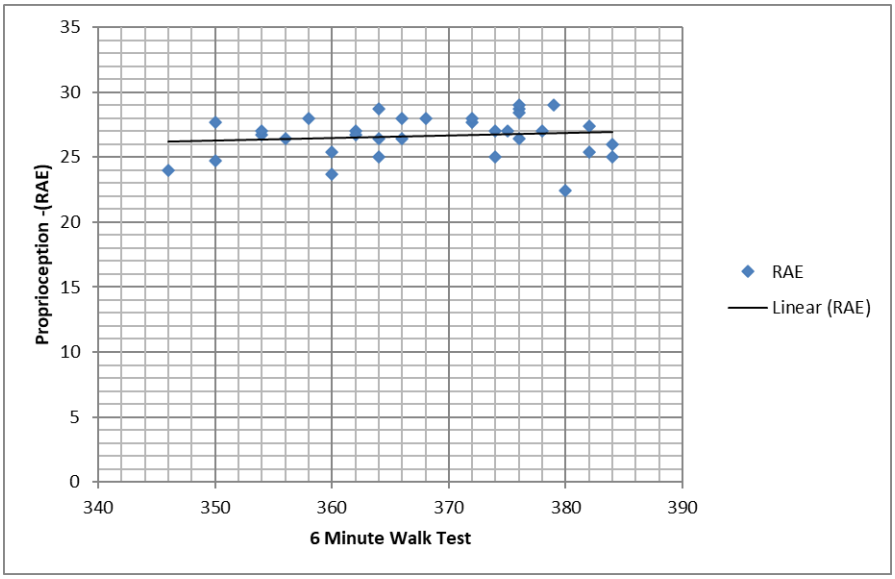
Moderately negative correlation is observed between 5 times Sit to Stand test and Proprioception Error - Relative Angular Error. X- axis= Proprioception (RAE), Y- axis= 5 times Sit to Stand test.

Table 4: Correlation of 6 Minute Walk Test with Proprioception Error - Relative Angular Error

		Proprioception Error - Relative Angular Error
6 Minute Walk Test	**Pearson Correlation**	.132
	Sig. (2-tailed)	.466
	N	33

Using Karl Pearson's Correlation coefficient positive correlation is observed between 6 Minute Walk test and Proprioception Error - Relative Angular Error (r=+0.132: p>0.05).

Figure 4: Scatter diagrams of 6 Minute Walk Test with Proprioception Error – Relative Angular Error



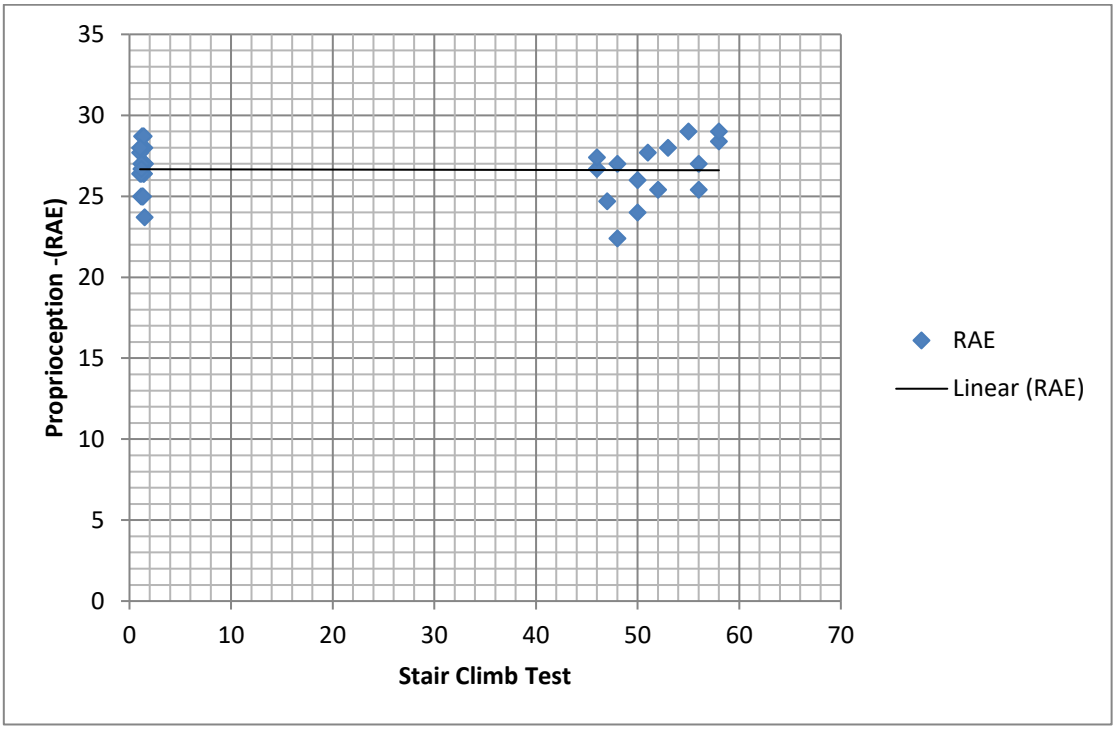
Positive correlation is observed between 6 Minute Walk test and Proprioception Error - Relative Angular Error. X-axis= Proprioception (RAE), Y-axis= 6- Minute Walk test.

Table 5: Correlation of Star Climb Test with Proprioception Error - Relative Angular Error

		Proprioception Error - Relative Angular Error
Stair climb test	Pearson Correlation	-.018
	Sig. (2-tailed)	.923
	N	33

Using Karl Pearson's Correlation coefficient low negative correlation is observed between Stair climb test and Proprioception Error - Relative Angular Error (r=-0.018: p>0.05).

Figure 5: Scatter diagrams of Stair climb Test with Proprioception Error – Relative Angular Error



Low negative correlation is observed between Stair climb test and Proprioception Error - Relative Angular Error. X- axis= Proprioception (RAE), Y- axis= Stair Climb test.

DISCUSSION

The present study was designed to determine the association of functional mobility with knee proprioception in knee osteoarthritis patients.

OA of the knee is characterized by structural joint changes, including joint space narrowing (JSN) and osteophyte formation.[14] In weight-bearing joints, especially the knee, reduces muscle function, affects sit-to-stand and gait, limits independence, and is worsened by muscle weakness and poor proprioception.[18]

Thirty-three participants with knee OA were assessed using the Kellgren-Lawrence grading with the help of X- rays and evaluated for functional limitations. Pain levels were recorded via a visual analog scale.

Functional mobility was measured using the 5 Times Sit-to-Stand, 6-Minute Walk, and Stair Climb tests. There was a statistically significant correlation observed between 5 times Sit to Stand test and proprioception error and less statistically significant correlation observed between 6 Minute Walk test as well as Stair Climb test and proprioception errors.

A study by BCL So et al. on knee OA patients under 65 examined Ai Chi's effectiveness in reducing pain, stiffness, and improving physical function, proprioception, and quality of life, but found no significant changes in range of motion, 6-minute walk test, or proprioception.[19]

Knee joint proprioception encompasses the sense of joint position and the sense of motion. These senses partially derive from neural inputs arising from mechanoreceptors in joints, muscles, tendons and associated tissue.[15]

In knee OA, muscle strength supports daily activities, often measured by timed, counted, or observed tests.[16]

IAC Baert et al. studied 45 women with knee OA to identify differences in proprioceptive accuracy between early OA, established OA, and healthy controls. The study found no knee joint position sense differences in early OA, suggesting impaired proprioception arises from degeneration, not early OA risk. Moreover, proprioception did not show a unique independent relation with functional ability, postural control, or muscle strength in knee OA patients.[10]

Conclusion:

The study concluded that those who performed 5- times Sit to Stand test and Stair Climb test showed increased proprioception error and reduced proprioception error was found in 6- Minute Walk test performance.

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REFERENCES

1. Mora JC, Przkora R, Cruz-Almeida Y. Knee osteoarthritis: pathophysiology and current treatment modalities. Journal of pain research. 2018; 11:2189.
2. Singh DK, Ying AN, Ahmad MA, Kamsan SS, Hendri EN. Knee associated problems and functional mobility among adults with knee osteoarthritis. Jurnal Sains Kesihatan Malaysia (Malaysian Journal of Health Sciences). 2018 ;16.
3. Knoop J, Steultjens MP, van der Leeden M, van der Esch M, Thorstensson CA, Roorda LD, et al. Proprioception in knee osteoarthritis: a narrative review. Osteoarthritis Cartilage. 2011 (4):381-8.
4. Felson DT. Osteoarthritis of the knee. New England Journal of Medicine. 2006 Feb 23;354(8):841-8.
5. Ganu SS, Merchant AJ. Effect of Retrowalking on Pain, Functional Disability and Functional Mobility in Patients with Chronic Knee Osteoarthritis. International Journal of Health Sciences and Research. 2018;8(11):109-15.
6. Christiansen CL, Stevens-Lapsley JE. Weight-bearing asymmetry in relation to measures of impairment and functional mobility for people with knee osteoarthritis. Arch Phys Med Rehabil. 2010 ;91(10):1524-8.
7. Ling SM, Fried LP, Garrett ES, Fan MY, Rantanen T, Bathon JM. Knee osteoarthritis compromises early mobility function: The Women's Health and Aging Study II. J Rheumatol. 2003 ;30(1):114-20.
8. Suner-Keklik S, Cobanoglu-Seven G, Kafa N, Ugurlu M, Guzel NA. The validity and reliability of

knee proprioception measurement performed with inclinometer in different positions. Journal of sport rehabilitation. 2017 ;26(6).

9. Romero-Franco N, Montaño-Munuera JA, Jiménez-Reyes P. Validity and Reliability of a Digital Inclinometer to Assess Knee Joint-Position Sense in a Closed Kinetic Chain. J Sport Rehabil. 2017 (1):jsr.2015-0138.
10. Baert IA, Mahmoudian A, Nieuwenhuys A, Jonkers I, Staes F, Luyten FP, et al. Proprioceptive accuracy in women with early and established knee osteoarthritis and its relation to functional ability, postural control, and muscle strength. Clinical rheumatology. 2013 Sep; 32(9):1365-74.
11. Romero-Franco N, Montaño-Munuera JA, Jiménez-Reyes P. Validity and reliability of a digital inclinometer to assess knee joint-position sense in a closed kinetic chain. Journal of sport rehabilitation. 2017 Jan 1;26(1).
12. Uszko-Lencer NH, Mesquita R, Janssen E, Werter C, Brunner-La Rocca HP, Pitta F, et al. Reliability, construct validity and determinants of 6-minute walk test performance in patients with chronic heart failure. International journal of cardiology. 2017 Aug 1;240:285-90.
13. Ateef M, Kulandaivelan S, Tahseen S. Test–retest reliability and correlates of 6-minute walk test in patients with primary osteoarthritis of knees. Indian Journal of Rheumatology. 2016 Oct 1;11(4):192.
14. Van der Esch M, Steultjens M, Wieringa H, Dinant H, Dekker J. Structural joint changes, malalignment, and laxity in osteoarthritis of the knee. Scandinavian journal of rheumatology. 2005 Jan 1;34(4):298-301.
15. Van der Esch M, Steultjens M, Harlaar J, Knol D, Lems W, Dekker J. Joint proprioception, muscle strength, and functional ability in patients with osteoarthritis of the knee. Arthritis Care & Research: Official Journal of the American College of Rheumatology. 2007 Jun 15;57(5):787-93.
16. Dobson F, Hinman RS, Roos EM, Abbott JH, Stratford P, Davis AM, et al. OARSI recommended performance-based tests to assess physical function in people diagnosed with hip or knee osteoarthritis. Osteoarthritis and cartilage. 2013 Aug 1;21(8):1042-52.
17. McDaniel G, Renner JB, Sloane R, Kraus VB. Association of knee and ankle osteoarthritis with physical performance. Osteoarthritis and Cartilage. 2011 Jun 1;19(6):634-8.
18. So BC, Kong IS, Lee RK, Man RW, Tse WH, Fong AK, et al. The effect of Ai Chi aquatic therapy on individuals with knee osteoarthritis: a pilot study. Journal of Physical Therapy Science. 2017;29(5):884-90.
19. White DK, Tudor-Locke C, Zhang Y, Fielding R, LaValley M, Felson DT, et al. Daily walking and the risk of incident functional limitation in knee osteoarthritis: an observational study. Arthritis care & research. 2014 Sep;66(9):1328-36.
20. Van der Esch M, Steultjens M, Harlaar J, Knol D, Lems W, Dekker J. Joint proprioception, muscle strength, and functional ability in patients with osteoarthritis of the knee. Arthritis Care & Research: Official Journal of the American College of Rheumatology. 2007 Jun 15;57(5):787-93.
21. Ganu SS, Merchant AJ. Effect of Retrowalking on Pain, Functional Disability and Functional Mobility in Patients with Chronic Knee Osteoarthritis. International Journal of Health Sciences and Research. 2018;8(11):109-15.
22. Heidari B. Knee osteoarthritis prevalence, risk factors, pathogenesis and features: Part I. Caspian journal of internal medicine. 2011;2(2):205.
23. Alencar MA, Arantes PM, Dias JM, Kirkwood RN, Pereira LS, Dias RC. Muscular function and

functional mobility of faller and non-faller elderly women with osteoarthritis of the knee. Braz J Med Biol Res. 2007 ;40(2):277-83.

24. Bennell KL, Hinman RS, Metcalf BR, Crossley KM, Buchbinder R, Smith M, McColl G. Relationship of knee joint proprioception to pain and disability in individuals with knee osteoarthritis. J Orthop Res. 2003 (5):792-7.