

Original Research Article

Radiographic evaluation of knee joint space width using fixed flexion view in knees of Indian adults

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ABSTRACT

Background: The objective of this study is to evaluate the tibiofemoral joint space width in the medial and lateral compartments of the knee using digital radiograph. The measurement of knee joint space width (JSW), in between the femur and the tibia is a way of evaluating the tibio-femoral cartilage thickness. This study is aimed at establishing normal references of joint space width for use in diagnosis and follows up of knee cartilage diseases.

Methods: This study is prospective and carried on 50 subjects at SAMC & PGI, Indore, M.P. One patient refused to sign the consent and was excluded. All subjects were healthy adults with sedentary lifestyle. All subjects underwent x-ray of bilateral knee joints. The joint space width of both medial and lateral compartments of each knee was measured using the scale in the computerized software.

Results: The average age in the study group was 44.59 years with male preponderance. The mean left medial and lateral joint space width was $5.34 \text{ mm} \pm 1.26 \text{ mm}$ and $5.21 \text{ mm} \pm 1.04 \text{ mm}$ and on right side was $5.26 \pm 1.11 \text{ mm}$ and $5.57 \pm 1.57 \text{ mm}$, respectively. No statistically significant difference was found between right and left knee joint space width compartments.

Conclusions: The values obtained after observing the radiographic references showed no significant gender variation in knee joint space width. But, it is seen that there is a decrease in joint space width with increasing age, which progresses towards osteoarthritis of knee.

Keywords: Knee, Joint space width, Radiography

INTRODUCTION

Osteoarthritis is the most common joint disorder in the body and it is responsible for considerable economic, social, psychological and functional disorder. Knee joint is a synovial joint comprising of hinge formed between the femur and tibial condyles and a saddle joint (between the patella and the patellar surface of the femur). The tibio-femoral articulation surface is separated by cartilage and menisci (medial and lateral). The measurement of the distance between the distal femur and the proximal tibia, which is known as joint space width (JSW), has become the standard tool for the assessment of osteoarthritis of knee joint.¹

The joint space width (JSW) is seen on Anteroposterior (AP) radiograph as a radiolucent area between the bony tibial and femoral condyles.² As the body grows older, there is gradual increase in the wear and tear of the cartilage and also, a gradual reduction in JSW.³ Joint space width narrowing has been reported to occur at a rate of 0.1 to 0.2 mm per year in patients with OA.^{4,5}

In India, osteoarthritis (OA) is a leading cause of knee joint space narrowing. Majority of individuals over the age of 65 years in the developed nations demonstrate radiographic evidence of OA. In India, presentation is at a much younger age. One of its earliest signs which are visible on X-ray may be narrowing of the medial

compartment of the joint. This is followed by subchondral sclerosis and cystic changes of the articular surfaces. Spur formation and osteophytes may also occur on the articulating surface. The measurement of the distance between the distal femur and the proximal tibia (joint space width), is a way of measuring cartilage thickness. It has become an important tool for the assessment of progressive degenerative knee conditions. It is also of value in the evaluation of disease modifying therapies for osteoarthritis.⁶⁻⁸

This study determines the knee joint space width on computed radiographic images of knee joint in fixed flexion view of 30 degrees in normal adults and its correlation with age and sex.

METHODS

This prospective cross sectional study of two years was carried out in the Department of Orthopaedics, Sri Aurobindo Medical College and PG Institute, commenced in February 2016 at Indore, M.P. India. The study population comprised of 49 healthy volunteers between 20 to 60 years of age with no known bone or joint disease. After prior consent, individuals were given a questionnaire which asked questions pertaining to his/her medical history, medications and exercise activity. The subjects included: consenting adults, staff, students and individuals for pre-employment medical and army examinations.

Exclusion criteria

Exclusion criteria were all patients who were currently experiencing knee pain; patients who stated they had been previously diagnosed with a bone or joint disease (i.e. rheumatoid arthritis, osteoporosis); patients who had previously sustained a knee injury and/or had undergone any knee surgery (i.e. arthroscopy, meniscectomy, etc.); patients with limping and congenital limb deformities as well as E) non-consenting individuals.

Data collection

After obtaining clearance from the ethical committee of Sri Aurobindo Medical College & PG Institute, a structured data collection check list was prepared to document the data on the age, gender and history of knee joint pain and injury/surgery, limping and congenital limb deformities. A written consent was obtained from all 49 study subjects.

Technique of computed knee radiography

The subjects underwent radiographic examination of both the knee joints in anteroposterior and lateral views in 30 degrees fixed flexion. Subjects were required to stand facing the cassette in such a way that their anterior thigh touched the cassette and their tip of great toe also touched the same plane as cassette.⁹ The postero-anterior X-ray

beam was directed parallel to the tibial plateau at a 10 degree caudal beam alignment. The position of the knee and foot was similar for all subjects. The acquisition conditions of FFV X rays were: X-ray tube voltage, 55 kV; X-ray tube current, 100 mA; time, 0.071 sec; source to image receptor distance, 100 cm; and grid (-).

The distance between the X-ray tube, the imaging plate and the knee was also kept constant in all subjects. All radiographs were obtained by the same radiographer and were done under supervision to ensure consistency of the technique.

The maximum height of the joint space width is the mid-portion of the medial and lateral compartments of each knee; in the radiolucent area between the radiopaque margins of the tibio-femoral articular surfaces (as shown in Figure 1). Measurements were made to the nearest 0.1 mm using an electronic caliper. The mean of the three measurements was recorded as JSW. Radiographs were graded according to the Kellgren–Lawrence (K–L) scoring system for features of OA.⁷ Radiographs with scores >2 on the K–L scale were excluded. These cases were there after replaced with new subjects.



Figure 1: Knee joint space.

RESULTS

The total number of subjects included in our study was 50 out of which 1 patient was left out due to non-agreement of consent. The study was finally conducted on 49 patients. Out of these, 26 subjects were males and 23 were females (Figure 2). The mean age of the subjects was 44.59 years with range 18–70 years (Figure 3).

The mean left medial and lateral joint space width measured $5.34 \text{ mm} \pm 1.26 \text{ mm}$ and $5.21 \text{ mm} \pm 1.04 \text{ mm}$. The mean right medial and lateral joint space width measured $5.26 \pm 1.11 \text{ mm}$ and $5.57 \pm 1.57 \text{ mm}$, respectively.

The right side involvement was of 52% subjects and Left side was 48% (Figure 4). The mean joint space width on right knee was $4.92 \text{ mm} \pm 1.03 \text{ mm}$ on medial side and $5.61 \text{ mm} \pm 2.06$ on lateral side in females. In males, the mean joint space width of right knee was 5.61 ± 1.12 and 5.53 ± 0.96 on lateral side.

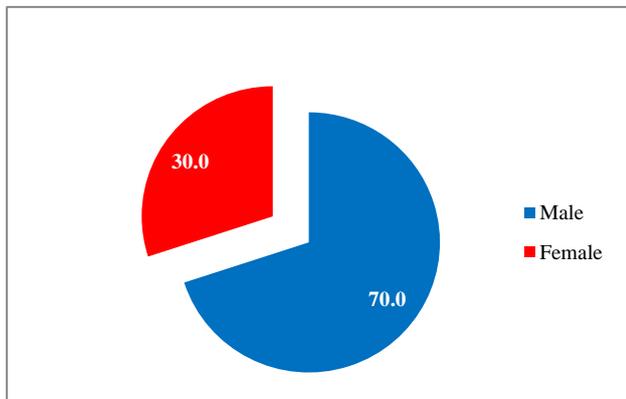


Figure 2: Distribution according to sex.

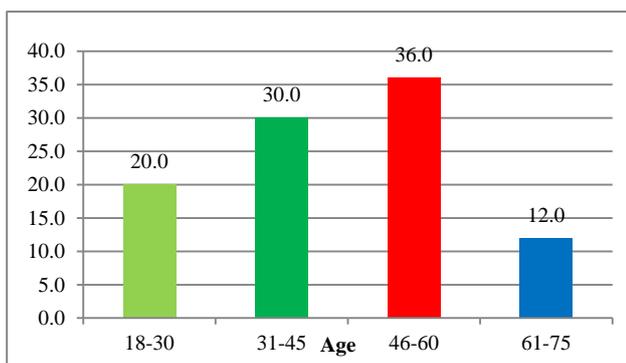


Figure 3: Distribution according to age.

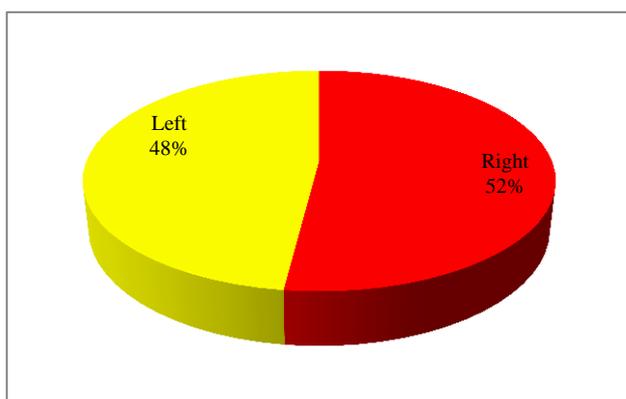


Figure 4: Distribution according to side.

The mean medial joint space width on left knee in females was $5.40 \pm 1.17 \text{ mm}$ and lateral joint space width on left side is $5.30 \pm 0.94 \text{ mm}$. In the male population, the mean medial joint space width of left knee joint was $5.30 \pm 1.37 \text{ mm}$ and lateral joint space was $5.15 \text{ mm} \pm 1.14 \text{ mm}$.

The data was analysed by t-test using SPSS 21.0 software and it was found that the data result is not significant ($p > 0.05$).

DISCUSSION

This study was able to show the normal reference value of radiographic knee JSW among adults in India. This radiographic strategy was discovered as a helpful tool in the assessment of knee cartilage of both the compartments of knee joints in order to identify various abnormalities particularly early knee cartilage degeneration, when cartilage thickness is decreasing and some degree of bone remodelling has occurred.^{8,10} Osteoarthritis is a painful disabling and impairing condition so it is important to determine the loss for costs to the community in terms of contacts with health professionals, loss of working hours, drugs used in treatment, and sometimes, operative procedures like total knee replacements etc.⁴⁻⁶

The measured knee JSW of males and females in this study is in agreement with the findings of the study of Anas et al, the mean medial and lateral JSW of left and right knee compartments had no statistically significant difference.¹¹

The measured knee JSW in this study is in agreement with the findings of Sargon et al and Dacre et al, the mean medial JSW is less than that of the lateral.^{12,13} The difference could be explained with the fact that the lateral tibio-femoral cartilage is thicker than that of the medial.^{2,3}

The knee joint space width measured by Sherwood et al show that young men have thicker articular cartilage than young women in both the medial and lateral compartments of the knee, but in this study the JSW in males and females showed no such differences.¹⁴

The medial knee JSW measured by Beattie et al, Dacre et al and Dana et al is higher than what was found in this study.^{3,13,14} They found the values of 4.8 mm for females and 5.7 mm for males. This difference could be related to differences in the study design and possible characteristics of their study subjects. The present study was based on erect radiographs while Beattie et al, Dacre et al and Dana et al used radiographs that were obtained in the supine position for knee JSW measurements.^{3,13,14}

The mean and standard deviation of the subjects age with slight female preponderance approximates the findings of Beattie et al.³ in Canada.

Furthermore, the measured JSW in this study is lower than those recorded by Lanyon et al in radiologically normal knees though their study also compared normal and osteoarthritic knees.¹⁵ This difference suggests possible lower cartilage thickness in India compared to developed countries. Possible early onset of cartilage

degeneration in our community might explain this disparity.

Although males were found to have slightly wider knee JSW than females in this study, this difference is not statistically significant, thus, allowing for local use of the uniform reference values for both sexes. However, Beattie et al found the difference in medial JSW to be statistically significant among 60 respondents, measuring 4.8 and 5.7 mm in females and males, respectively.³

The measured knee JSW show initial increase with increasing age up to 34 years; thereafter, there is a gradual reduction with advancing age especially in the medial compartments (Tables 1 and 2 and Figures 1-3). The noted decrease in JSW and cartilage thickness with increasing age corroborate the findings of Gensburger et al and Dacre et al, though the study conducted by Gensburger et al was a four-year longitudinal study, comparing the normal knees and those with OA.^{10,13} Nevertheless, Beattie et al shows fairly constant JSW with increasing age.³

Having obtained reference values for radiographic knee JSW in normal adults, there is a need for more detailed studies to examine knee JSW in other groups such as children, elderly and some disease states such as OA and other forms of arthritis.

CONCLUSION

This study shows that radiology is an important diagnostic marker for the diagnosis of early changes of osteoarthritis of knee joint, There is no significant difference in knee joint space width between males and females in urban group of population in India and there is a steady increase in JSW with an increase in age up to mid-thirties.

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REFERENCES

1. Peterfy CG. Imaging of the disease process. *Curr Opin Rheumatol.* 2002;14:590-6.
2. Ryan S, Nicholas MM, Eustace S. The knee joint. In: *Anatomy For Diagnostic Imaging.* London: Elsevier Limited; 2004: 286–289.
3. Beattie KA, Duryea J, Pui M, O'Neill J, Boulos P, Webber CE, et al. Minimum joint space width and tibial cartilage morphology in the knees of healthy individuals: a cross-sectional study. *BMC Musculoskeleton Disorder.* 2008;9:119–26.
4. Lequesne M. *Osteoarthritic Disorders.* 1st ed. American Academy of Orthopaedic Surgeons;

- Illinois. Quantitative measurements of joint space during progression of osteoarthritis: "Chondrometry"; 1995: 427
5. Sharma L, Song J, Felson DT, Cahue S, Shamiyeh MS, Dunlop DD. The role of knee alignment indisease progression and functional decline in knee osteoarthritis. *JAMA.* 2001;286:188–95.
6. Hilliquinb P, Pessisc E, Costed J, Maugetc D, Azriab A, Chevrotc A, et al. Quantitative assessment of joint space width with an electronic caliper. *Osteoarthr Cartilage.* 2002;10:542–6.
7. Kellgren JH, Lawrence JS. Radiological assessment of Osteo-Arthrosis. *Ann Rheum Dis.* 1957;16:494–502.
8. Vignona EF, Conroziera T, Piperno M, Richarda S, Carrillon Y, Fantino O. Radiographic assessment of hip and knee osteoarthritis:recommended guidelines. *Osteoarthr Cartilage.* 1999;7:434–6.
9. Peterfy C, Li J, Zaim S, Duryea J, Lynch J, Miaux Y, Yu W, Genant HK. Comparison of fixed-flexion positioning with fluoroscopic semi-flexed positioning for quantifying radiographic joint-space width in the knee: test-retest reproducibility. *Skeletal Radiol.* 2003;32:128-32.
10. Gensburger D, Arlot M, Sornay-Rendu E, Roux J, Delmas P. Radiologic assessment of age-related knee joint space changes in women: a 4-year longitudinal study. *Arthritis Rheum.* 2009;61:336–43.
11. Anas I, Musa TA, Kabiru I, Yisau AA, Kazaure IS, Abbaa SM, Kabira SM, et al. Digital radiographic measurement of normal knee joint space in adults at Kano, Nigeria *The Egyptian J Radiol Nuclear Med.* 2013;44:253–8.
12. Sargon MF, Taner D, Altinta K. Examination of joint space by magnetic resonance imaging in anatomically normal knees. *ClinAnat.* 1998;9:386–90.
13. Dacre JE, Scott DL, Da Silva JAP, Welsh G, Huskisson EC. Joint space in radiologically normal knees. *Rheumatology.* 1991;30:426–8.
14. Duren DL, Sherwood RJ, Chumlea WC, Siervogel RM, Towne B. Radiographic Joint Space of the Knee in Healthy Young Adults. *Human Biology.* 2006;78(3):353-64.
15. Lanyon P, O'Reilly S, Jones A, Doherty M. Radiographic assessment of symptomatic knee osteoarthritis in the community: definitions and normal joint space. *Ann Rheum Dis.* 1998;57:595–601.

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