**Journal of Cardiovascular Disease Research**

**ISSN: 0975-3583,0976-2833 VOL14, ISSUE 12, 2023**

## Original Research

# The functional outcome of medial compartment osteoarthritis of the knee treated with proximal fibular osteotomy: A Prospective Cohort Study

**Dr. Sanjay Kumar[1], Dr. Kumar Anshuman[2]**

[1]Senior Resident, Department of Orthopaedics, Narayan Medical College and Hospital, Jamuhar, Rohtas, Sasaram, Bihar, India.
[2]Professor and Head of Department, Department of Orthopaedics, Narayan Medical College and Hospital, Jamuhar, Rohtas, Sasaram, Bihar, India.

**Corresponding Author:** Dr.Sanjay Kumar
Senior Resident, Department of Orthopaedics, Narayan Medical College and Hospital, Jamuhar, Rohtas, Sasaram, Bihar, India
**Email:** sanjay2k10@gmail.com

Received: 20 October, 2023 Accepted: 20 November, 2023

**Abstract**
**Background:** Osteoarthritis (OA) is a polyarticular chronic degenerative disease of multifactorial aetiology, and the most common joint to be afflicted is the knee.
**Objectives:** To evaluate the clinical and functional outcomes of medial compartment OA of the knee treated with PFO with respect to pain, disability, and range of movements.
**Materials and Methods:** The present prospective cohort study consists of 60 patients with medial compartment knee OA treated by PFO of both genders who attended OPD and emergency in the orthopaedic department. The institutional ethical committee approved the study, and written informed consent was obtained from all the participants in the study.
**Results:** There were 36 (60%) females and 24 (40%) males with an M: F ratio of 1:1.5. The mean age of patients was found to be 58.72±8.29 years (P value = 0.26). Patients were followed up for range of motion at 3 months and 6 months. At the time of 3-month follow-up, 9 (15%) patients had a range of motion <80, whereas 21 (35%) patients had a range of motion between 80 and 90. 19 (31.67%) patients had ROM between 90 and 100. 11 (18.33%) patients were found to have ROM greater than 100. At the time of final follow-up at 6 months, 05 (8.33%) patients had a range of motion <80, whereas 21 (35%) patients had a range of motion between 80 and 90. 23 (38.33%) patients had ROM between 90 and 100. 11 (18.33%) patients were found to have ROM greater than 100.
**Conclusion:** PFO is a relatively easy, safe, fast, and effective procedure for the management of medial joint OA of the knee. It does not respond to conservative measures and results in improved functional and clinical outcomes, decreased knee joint pain, and an increased ML ratio.
**Keywords:** Proximal Fibular Osteotomy, Knee, Osteoarthritis, VAS Score, JOA Scores

## Introduction

Osteoarthritis (OA) is a polyarticular chronic degenerative disease of multifactorial aetiology, and the most common joint to be afflicted is the knee [1]. A community-based study that involved people above 40 years of age from five different states of India reported the prevalence of the condition to be 28.7% [1]. OA of the knee joint is associated with advanced age, a higher body mass index (BMI), female sex, and sedentary lifestyle [1]. Knee osteoarthritis (OA) is a painful and chronic condition that affects a large proportion of the population, particularly older individuals. Symptomatic OA is one of the most common causes of compromised mobility in older individuals. OA of the knee joint affects about half of the population over the age of 60 and mainly women, as it is mostly because of osteoporosis as a result of decreased bone mineral density [2]. An important feature of OA of the knee is the compartment-specific narrowing of the joint space, which is associated with clinical manifestations of the disease [3]. Medial joint space narrowing is the most common type of narrowing [3]. There are multiple options for the management of knee joint OA, both conservative and surgical. Conservative options for OA of the knee include analgesics, physiotherapy, intra-articular injections of steroid or platelet-rich plasma, and viscosity supplementation agents. Surgical options include high tibial osteotomy (HTO) and total knee arthroplasty (TKA), which can be done in intractable cases of OA of the knee. HTO is a technically demanding procedure and has specific problems associated with it, such as neurovascular injury, iatrogenic fracture, and non-union. Total knee replacement is an excellent procedure in terms of relief of pain,

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 12, 2023

correction of deformity, and improvement of function, but it is not a feasible option for young patients with mild-to-moderate OA [4]. Proximal fibular osteotomy (PFO) is an excellent treatment option for medial compartment OA in comparison to HTO, as it is associated with fewer or none of the complications that are frequently encountered in HTO [5]. PFO works on the principle that it supports the lateral tibial plateau, and by removing the wedge from the fibula, it weakens the support of the lateral tibial plateau provided by the fibula, leading to the correction of varus deformity and shifting the loading force from the medial compartment more laterally, causing the pain to decrease and an improvement in function. Comparing a HTO to a PFO is a relatively simple surgical procedure [6]. Ideal indications of PFO are predominantly medial compartment arthritis with varus knees and good lateral joint space in weight-bearing films, at least a 2 mm gap in AP stress Varus X-rays, a motivated patient who understands that this is a procedure that buys time and delays knee replacement surgery, and patients with a body mass index (BMI) <23 [7]. Compared with TKA or HTO, PFO is a simple, safe, fast, and affordable surgery that does not require the insertion of additional implants. As such, PFO is a suitable surgical option for most of the patients who lack financial and medical resources [8]. The complications related to the removal of the proximal fibula are few [9].

**Aims and objectives:** The aim of the present study is to evaluate the clinical and functional outcomes of medial compartment OA of the knee treated with PFO with respect to pain, disability, and range of movements.

**Materials and Methods**

The present prospective cohort study consists of 60 patients of both genders who attended OPD and emergencies in the orthopaedic department. The study was conducted in the orthopaedic department at Narayan Medical College and Hospital, Jamuhar, Rohtas, Sasaram, Bihar, India. 60 patients with medial compartment knee OA treated by PFO were included in this study. The study duration was 24 months, extending from January 2018 to December 2020. The institutional ethical committee approved the study, and written informed consent was obtained from all the participants in the study. Demographic details such as age and gender were noted in all the cases. The BMI of all the cases was determined. The diagnosis of medial compartment knee OA was made on the basis of history and clinical examination and was confirmed on the basis of a weight-bearing X-ray, which was done in all cases except in patients who were too frail. Patients with radiographic evidence of Kellgren Lawrence [10] Grade II to IV OA of the knee joint were included. In selected cases (in whom subchondral bone changes and chondro-calcinosis were suspected), computed tomography of the knee was done. The degree of varus deformity was determined on the basis of imaging findings. Those patients who were not responding to conservative treatment and were having pain severe enough to hamper quality of life and daily activities were selected for surgical intervention. The sample size was calculated according to the previous reference studies, when PFO was done for knee OA. Keeping power (1-beta error) at 80% and confidence interval (1-alpha error) at 95%, the minimum sample size required was 60 patients; therefore, we included 60 (the minimum required number of cases) patients in the present study. Informed written consent was obtained from all patients for surgery. All patients were electively posted for PFO after getting the anaesthetic fitness for surgery, and only ASA Grade I and II patients were selected for the surgery. PFO was done, and after surgery, full weight bearing was allowed with quadriceps drills and knee range of motion exercises from day 1 if there was no significant pain. A full-weight bearing X-ray was done on the 2$^{nd}$ day after PFO. Follow-up visits were scheduled at 1 month, 3 months, and 6 months, respectively. A follow-up X-ray was done during each follow-up visit. The functional outcome was assessed using the Japanese Orthopaedic Association (JOA) score for osteoarthritic knee [11]. During follow-up visits, the other factors assessed included range of motion, visual analogue scale (VAS) scores, and complications. Qualitative data were represented with percentages, and quantitative data were represented as the mean with SD. A paired t-test was used to compare the differences in outcome scores. The statistical analysis was done using Microsoft 16 and SSPS 22.0 software and $P<0.05$ was taken as statistically significant.

**Inclusion criteria:**

1. Age more than 40 years
2. Patients gave written consent.
3. patients with clinical OA of the knee diagnosed as per the ACR
4. Patients with medical compartment OA are treated by PFO.
5. Mild-to-moderate genu varus deformity (<15°)
6. ASA Grade I/II

**Exclusion criteria:**

1. Patients who refused to give consent
2. Patients with concomitant arthritis due to any other cause (rheumatoid, seronegative OA).
3. Patients with post-traumatic arthritis of the knee.

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 12, 2023

4. Patients with a history of a ligament or meniscus injury to the knee.
5. Patients with clinical valgus deformity of the knees as measured using a goniometer.
6. ASA Grades III and IV

**Results**

The present prospective study consists of 60 patients with medial compartment knees treated by PFO. There were 36 (60%) females and 24 (40%) males with an M: F ratio of 1:1.5 (Figure 1). The mean age of patients was found to be 58.72±8.29 years (P value = 0.26).

**Figure 1: Gender wise distribution of patients**

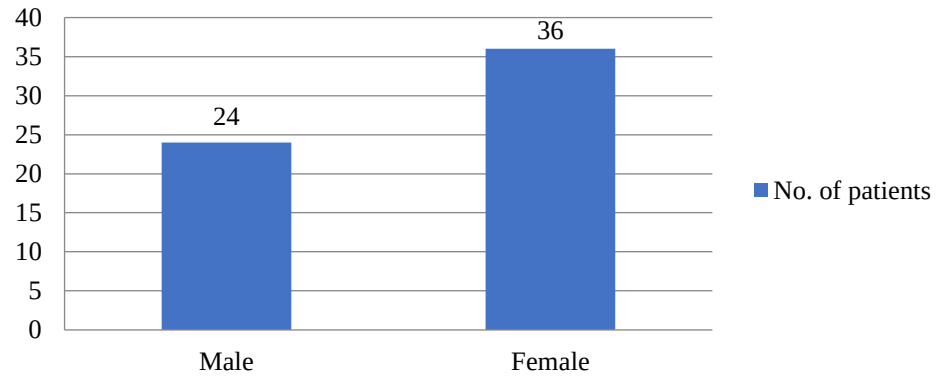
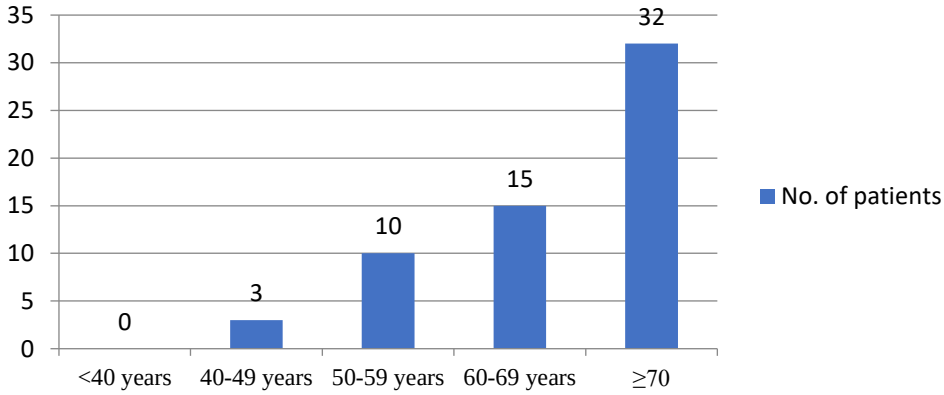



**Table 1: Age-wise distribution of the present studied patients**

| Age (years) | No. of patients | Percentage |
|---|---|---|
| <40 | 00 | 00 |
| 40–49 years | 03 | 05 |
| 50–59 years | 10 | 16.67 |
| 60–69 years | 15 | 25 |
| ≥70 | 32 | 53.33 |
| Total | 60 | 100 |
| Mean age | 58.72±8.29 years, P value= 0.26 | |

**Figure 2: Age- wise distribution of patients**




In present study, 27 (45%) of the participants had the right side affected, whereas 33 (55%) of the participants had left knee OA. The analysis of the age group of the patients showed that the most common age group affected was 70 years of age or older (53.33%), followed by 60–69 years (25%) and 50–59 years (16.67%). Only 3 (0.05%) patients were below 50 years of age, and there was no patient below 40 years. (Table 1, Figure 2).

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 12, 2023

| Table 2: Body mass index (BMI) of the present studied patients | | |
|---|---|---|
| BMI | No. of patients | Percentage |
| Normal (<25) | 15 | 25 |
| 25–30 (Overweight) | 25 | 41.67 |
| More than 30 (Obese) | 20 | 33.33 |
| Total | 60 | 100.00 |

Overweight and obesity were found to be important features in patients with knee OA. The analysis of BMI in patients showed that among 60 patients, 20 (33.33%) were obese (BMI≥30) and 25 (41.67%) were overweight (BMI≥25 but <30). 15 (25%) of the patients had a BMI <25 (Table 2).

| Table 3: The mean VAS score of the patients at presentation and during the 6-month follow-up | | |
|---|---|---|
| Mean VAS score | Mean ± SD | P-value |
| At presentation | 6.21±1.82 | P<0.0001 (Paired t-test) Highly significant |
| At 1 month | 4.10±1.50 | |
| At 3 months | 3.72±1.42 | |
| follow-up (6 months) | 1.50±0.89 | |

VAS: Visual analogue scale

At the time of presentation, all patients were experiencing moderate pain. The mean VAS score at the time of presentation was 6.21 ± 1.82. The pain reduced gradually over a period of time, and at the time of the final follow-up visit, the pain had been reduced to a considerable level, as shown by mean VAS scores of 1.50±0.89. The difference in VAS score at the time of presentation and final follow-up was found to be statistically highly significant (P<0.0001) (Table 3).

| Table 4: Range of motion at presentation and during follow-up | | | |
|---|---|---|---|
| Range of motion | No. of patients | Percentage | 95% CI (confidence interval) |
| At the time of 3-month follow-up | | | |
| <80 | 09 | 15 | 4.4–31.6 |
| 80–90 | 21 | 35 | 20.5–56.1 |
| 90–100 | 19 | 31.67 | 15.4–49.6 |
| >100 | 11 | 18.33 | 8.4–39.1 |
| At the time of 6-month follow-up | | | |
| <80 | 05 | 8.33 | 1.2–23.5 |
| 80–90 | 21 | 35 | 17.9–52.9 |
| 90–100 | 23 | 38.33 | 20.5–56.1 |
| >100 | 11 | 18.33 | 10.6–42.7 |

Range of motion (ROM) describes the extent to which a joint or muscle may be moved or stretched in your bod y. A goniometer is used to measure the range of motion of the joints of the body. Patients were followed up for range of motion at 3 months and 6 months. At the time of 3-month follow-up, 9 (15%) patients had a range of motion <80, whereas 21 (35%) patients had a range of motion between 80 and 90. 19 (31.67%) patients had ROM between 90 and 100. 11 (18.33%) patients were found to have ROM greater than 100. At the time of final follow-up at 6 months, 05 (8.33%) patients had a range of motion <80, whereas 21 (35%) patients had a range of motion between 80 and 90. 23 (38.33%) patients had ROM between 90 and 100. 11 (18.33%) patients were found to have ROM greater than 100 (Table 4).

| Table 5: Functional outcomes as assessed by JOA scores | | |
|---|---|---|
| Mean JOA score | Mean ± SD | P-value |
| At presentation | 56.50±10.31 | P<0.0001 (Paired t test) Highly significant |
| At 1 month | 76.70±12.64 | |
| At 3 months | 85.42±14.92 | |
| follow-up (6 months) | 88.69±16.75 | |

JOA: Japanese Orthopaedic Association

The patients were followed up for improvements in functional outcomes for 6 months. The functional outcome was assessed by the JOA score for osteoarthritic knee. Mean pre-operative JOA was found to be 56.50±10.31.

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 12, 2023

At the time of the final follow-up visit (at 6 months), the mean JOA score was found to be 88.69±16.75. The mean JOA scores at the time of final follow-up were found to be significantly improved as compared to JOA scores at the time of presentation and the difference was found to be statistically highly significant (Table 5). Finally, the incidence of complications was assessed in studied cases. At the time of the final follow-up, there was a significant improvement in all the cases as far as VAS scores, range of motion and joint function were concerned. There were no complications in the majority of the cases. Only 10 patients were found to have complication out of which 7 (11.67%) patients were found to have extensor halluces longus weakness and 3 (05%) patients were found to have dorsal numbness.

**Discussions**

We studied 60 patients with knee OA, who wurden treated by PFO. The analysis of the gender distribution of studied cases showed that there was a female predominance in the occurrence of OA knee. It is well established in various studies that knee OA is more common in females. Although the exact cause of female Predominance in OA Knee is not fully understood, various studies have suggested the role of oestrogen, body composition, and knee structure as the probable cause of OA in women. Several Studies have examined the role of Oestrogen in the propensity to develop OA Knee; however, the evidence is not found to be definitive. Some authors also suggested that women are more likely to have more pain, as compared to men in a similar degree of OA. Vashisht et al.[12] conducted a prospective study to evaluate the efficacy of PFO. In this study, out of 38 patients there were 36 females and 24 males with a M: F ratio of 1:1.5. Similar female preponderance was also reported by the authors such as Vina et al. [13]In our study, the majority of the affected patients was in their seventies or above. Fukui et al. conducted a study to explore the relationship between radiographic changes and symptoms or physical examination findings [14]. For this purpose, 106 OA Knees in 68 Subjects wurden followed up at 6-month intervals over 36 months. Knee radiographs wurde obtained, symptoms wurde evaluated using a validated questionnaire, and the outcome of the physical examination was thoroughly recorded using a specific chart at each visit. Correlations between the change of radiographs and clinical data wurden investigated in a longitudinal manner. The mean age of the patients in this study was found to be 58.72 years. Similar mean age of patients with knee OA was also reported by the authors such as Anderson and Loeser [15]. In this study, the BMI in patients showed that among 60 patients 20 (33.33%) patients were obese (BMI≥30) and 25 (41.67%) patients were overweight (BMI≥25 but <30). 15 (25%) of the patients had BMI < 25. Roy et al.[16] conducted a study to estimate the prevalence of knee OA among women between the age group of 46–65 years and the effect of age and BMI on knee OA. For this purpose, the authors undertook a cross-sectional study comprising of 100 patients with knee OA. The study found that patients affected by knee OA with BMI ≥25 were significantly more affected, 45 (69.2%) compared with participants with normal BMI 20 (30.2%). The study concluded that advanced age and overweight were strongly associated with OA in our population. Therefore, weight reduction and taking preventive measures can decrease the burden and help in minimizing morbidity associated with OA. Similar positive Correlation between Increased BMI and Knee OA has also been reported by the authors such as Ananda Coomarasamy et al. [17]. The choice of treatment depends on the age of the patient, the stage of the disease, and the condition of the bones. Treatment options includes arthroscopic debridement, high tibial osteotomy, PFO, uni compartmental knee arthroplasty, and total knee arthroplasty. High tibial osteotomy is indicated in young patients with medial joint OA and varus deformity of the knee [18]. In elderly patients with medial joint OA, the high tibial osteotomy is not the right choice, due to concomitant osteoporosis, causing a tibial plateau fracture [19]. In our study, we observed that there was significant pain relief in patients at three months, which continued to improve till one year. Significant pain relief following PFO, as reported by us, has been reported by several other studies [18, 19]. In our study, there was a significant improvement in functional outcome as well as VAS scores and ML ratio in patients who had undergone PFO for OA knee. The complications were seen only in 10 (16.67%) patients. A recent study by Huda et al. [20] published in 2021 has reported improvement in VAS score. Wang et al., conducted a prospective study to explore the effects of PFO as a new surgery for pain relief and improvement of medial joint space and function in patients with knee OA [21].

In this study the authors found that almost all patients experienced medial pain relief after PFO. Most patients exhibited improved walking postoperatively. Weight-bearing lower extremity radiographs showed an average increase in the post-operative medial knee joint space. In our study, there was a significant improvement in the functional outcome of the cases, as assessed by the difference in mean JOA scores at the time of presentation and final follow-up. There was a significant improvement in JOA scores at the time of final follow-up and the difference was found to be statistically highly significant. Zou et al.[22] undertook a study in which 92 patients with KOA, including 40 patients with PFO (observation group) and 52 patients with HTO (control group), who were treated with osteotomy, were included in the study. The median follow-up period was 25months.The functional outcome of the patients was assessed on the basis of JOA scores. The authors found that the pain VAS and femur–tibial angle significantly decreased and the JOA score of the knee joint significantly increased

**ISSN: 0975-3583,0976-2833 VOL14, ISSUE 12, 2023**

in the patients treated by PFO. Similar improvement in functional outcome in patients of knee OA treated by PFO was also reported by the authors such as Qin et al [23].

**Limitation(s) of the study:** A Limitation of our study is the small sample size and short duration of the study.

## Conclusions

PFO is relatively easy, safe, fast, and effective procedure for the management of medial joint OA of the knee, not responding to conservative measures, and improves functional and clinical outcomes, reduces knee joint pain, and increases the ML ratio. Minimal post-operative rehabilitative measures and minimal complication rates make it an attractive treatment choice for managing Knee OA.

**Acknowledgement: The** authors would like to acknowledge the entire faculty and residents of the Department of Orthopaedics for their valuable support, time to time suggestion in undertaking present study. Special thanks to Dr. Kumar Anshuman**,** Professor and Head of Department, Department of Orthopaedics, Narayan Medical College & Hospital, Jamuhar, Rohtas, Sasaram, Bihar, India, gave valuable suggestions during the study.

## Reference

1. Epidemiology of knee osteoarthritis in India and related factors. Pal CP, Singh P, Chaturvedi S, Pruthi KK, Vij A. *Indian J Orthop. 2016;* 50:518–522. [PMC free article] [PubMed] [Google Scholar]
2. Im GI, Kwon OJ and Kim CH. The relationship between osteoarthritis of the knee and bone mineral density of proximal femur: A cross-sectional study from a Korean population in women. Clin Orthop Surg.2014;6(4):420-425. https://doi.org/10.4055/cios.2014.6.4.420
3. Neogi T, Felson D, Niu J, et al. Association between radiographic features of knee osteoarthritis and pain: results from two cohort studies. *BMJ*. 2009;339:0. [PMC free article] [PubMed] [Google Scholar]
4. Khan M, Adili A, Winemaker M and Bhandari M. Management of osteoarthritis of the knee in younger patients. CMAJ. 2018;190(3):E72-E79. https://doi.org/10.1503/cmaj.170696
5. Utomo DN, MahyudinF, Wijaya AM and Widhiyanto L. Proximal fibula osteotomyasan alternative to TKA and HTO inlate-stage varus type of knee osteoarthritis. J Orthop.2018;15(3):858-861. https://doi.org/10.1016/j.jor.2018.08.014
6. VaishA, Kathiriya Y K and Vaishya R. Acritical review of proximal fibular osteotomy for knee osteoarthritis. Arch Bone Jt Surg. 2019;7(5):453-462.
7. Dumond H, Presle N, TerlainB, Mainard D, Loeuille D, Netter P, et al. Evidence for a key role of leptin in osteoarthritis. Arthritis Rheum.2003;48(11):3118-3129. https://doi.org/10.1002/art.11303
8. Iannone Fand Lapadula G. Obesity and inflammation—targets for OA therapy. Curr Drug Targets. 2010;11(5):586-598. https://doi.org/10.2174/138945010791011857
9. Zhang W, Doherty M, Peat G, Bierma-Zeinstra MA, Arden NK, Bresnihan B, et al. EULAR evidence-based recommendations for the diagnosis of knee osteoarthritis. Ann Rheum Dis. 2010;69(3):483-489. https://doi.org/10.1136/ard.2009.113100
10. Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthrosis. *Ann Rheum Dis.* 1957; 16:494–502. [PMC free article] [PubMed] [Google Scholar]
11. Okuda M, Omokawa S, Okahashi K, Akahane M and Tanaka Y. Validity and reliability of the Japanese orthopaedic association score for osteoarthritic knees. J Orthop Sci.2012;17(6):750-756.https://doi.org/10.1007/s00776-012-0274-0
12. Vashisht A, Menwal Gand Bhatnagar R. Aclinico-radiological evaluation of functional outcome of proximal fibular osteotomy for medial compartment knee osteoarthritis: A new emerging technique. Int J Res Orthop. 2020;6(3):515-520.https://doi.org/10.18203/issn.2455-4510
13. Vina ER, Youk AO, Quinones C, Kwoh CK, Ibrahim SA and Hausmann LR. Use of complementary and alternative therapy for knee osteoarthritis: Race and gender variations. ACR Open Rheumatol.2021;3(9):660-667. https://doi.org/10.1002/acr2.11307
14. Fukui N, Yamane S, Ishida S, Tanaka K, Masuda R, Tanaka N, etal. Relationship between radiographic changes and symptoms or physical examination findings in subjects with symptomatic medial knee osteoarthritis: Athree-year prospective study. BMC MusculoskeletDisord.2010;11:269. https://doi.org/10.1186/1471-2474-11-269
15. Anderson AS and Loeser RF. Why is osteoarthritis an age-related disease? Best Pract Res ClinRheumatol.2010;24(1):15-26. https://doi.org/10.1016/j.berh.2009.08.006

**ISSN: 0975-3583,0976-2833 VOL14, ISSUE 12, 2023**

16. Roy M K, Hossain M Z, Siddiquee A H, Alauddin M, Islam M K, Minto A K, et al. Study of relationship between age and body mass index on knee osteoarthritis in advanced aged females in a divisionalcityofBangladesh.IntJResOrthop.2021;7(4):705-708. https://doi.org/10.18203/issn.2455-4510
17. Ananda Coomarasamy A, Caterson I, Sambrook P, Fransen M and March L. The impact of obesity on the musculoskeletal system. Int J Obes (Lond).2008;32(2):211-222. https://doi.org/10.1038/sj.ijo.0803715
18. Rai AK, Saurabh A, Shekhar S, Kunwar A, Verma V: Proximal fibular osteotomy for pain relief and functional improvement in patients of osteoarthritis of knee. Int Surg J. 2019, 6:2368-72. 10.18203/2349- 2902.isj20192957
19. Prakash L:PFO—proximal fibular osteotomy in medial compartment arthritis of the knee with varus deformity. EC Orthopaedics. 2019,10:315-21.
20. Huda N, Islam MS, Kumar H, Pant A, Bishnoi S: Proximal fibular osteotomy for medial compartment knee osteoarthritis: is it worth?. Indian J Orthop. 2020, 54:47-51.10.1007/s43465-020-00160-0
21. Wang X, Wei L, Lv Z, Zhao B, Duan Z, Wu W, et al. Proximal fibular osteotomy: A new surgery for pain relief and improvement of joint function in patients with knee osteoarthritis. J Int Med Res.2017;45(1):282-289. https://doi.org/10.1177/0300060516676630
22. Zou G, LanW, ZengY, Xie J, Chen S and QiuY. Early clinical effect of proximal fibular osteotomy on knee osteoarthritis. Biomed Res.2017;28(21):9291-9294.
23. Qin D, Chen W, Wang J, Lv H, Ma W, Dong T, et al. Mechanism and influencing factors of proximal fibular osteotomy for treatment of medial compartment knee osteoarthritis: A prospective study. J Int Med Res.2018; 46(8):3114 -3123. https://doi.org/10.1177/0300060518772715.