https://doi.org/10.48047/AFJBS.6.14.2024.10882-10899

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

PROXIMAL FIBULAR OSTEOTOMY COMBINING WITH ARTHROSCOPIC PARTIAL MENISCAL DEBRIDEMENT TO ANALYSE SHORT TERM FUNCTIONAL OUTCOME IN MANAGEMENT OF EARLY OSTEOARTHRITIS KNEE

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Volume 6, Issue 14, Aug 2024

Received: 15 June 2024

Accepted: 25 July 2024

Published: 15 Aug 2024

doi: 10.48047/AFJBS.6.14.2024.10882-10899

ABSTRACT

Background and objective: Osteoarthritis of the knee is a prevalent condition that significantly impacts the quality of life for affected individuals.Traditional approaches to its management have often involved conservative measures, such as physiotherapy and analgesic medications. However, as the understanding of knee osteoarthritis has evolved, so has the focus on innovative interventions aimed at providing effective relief and preserving joint function. PROXIMAL FIBULAR OSTEOTOMY(PFO) is an alternative treatment to HIGH TIBILA OSTEOTOMY(HTO).It is a surgical repair OA knee. PFO has several advantage over HTO. It is simple, easy, less expensive and requires very short incision leads to limited tissue dissection and no internal fixation is implanted. The post operative recovery period is also shorter than HTO also the complications are lesser than HTO.PFO can relieve the symptoms of KOA along with pain along with realignment of bone. Aiming To asses Short term functional outcome Analysis of proximal Fibular osteotomy along with arthroscopic partial meniscal debridement in management of early osteoarthritis of knee. **Materials and Methods:** 30 selected patients diagnosed radiologically with early-stage knee osteoarthritis (Kellgren-Lawrence grade I or II).With presenting symptomatic osteoarthritis, including pain, swelling, and functional limitations.Arthroscopy and proximal fibular osteotomy performed with the follow up of 3, 6, 12 months post operatively to asses Pain intensity (VAS). - Functional outcomes (KOOS or WOMAC). - Range of motion measurements. **Result:** The study demonstrated a significant reduction in pain following surgery, as indicated by the Visual Analog Scale (VAS) scores. Preoperatively, patients reported a mean VAS score of 7.2 ± 1.1, reflecting severe pain. Postoperatively, there was a progressive decrease in pain scores over time, with scores improving to 2.5 ± 0.8 at 1 year.Functional outcomes, assessed using the American Knee Society Score (AKSS) and various functional parameters, showed notable improvement postoperatively. The mean AKSS increased from 55.3 ± 5.4 preoperatively to 75.0 ± 3.2 at 1 year, indicating substantial enhancement in knee function and mobility. **Conclusion:** In conclusion, our study highlights the efficacy of proximal fibular osteotomy combined with arthroscopic partial meniscal debridement in improving short-term functional outcomes for patients with early osteoarthritis of the knee. Significant reductions in pain, as evidenced by decreasing Visual Analog Scale (VAS) scores, coupled with marked improvements in knee function measured by American Knee Society Scores (AKSS) and functional parameters, highlight the benefits of this surgical approach. These findings support the role of joint-preserving surgeries in managing early knee OA, potentially delaying disease progression and enhancing patients' quality of life through restored mobility and reduced pain.

INTRODUCTION

Osteoarthritis of the knee is a prevalent condition that significantly impacts the quality of life for affected individuals.(1) Traditional approaches to its management have often involved conservative measures, such as physiotherapy and analgesic medications. However, as the understanding of knee osteoarthritis has evolved, so has the focus on innovative interventions aimed at providing effective relief and preserving joint function.(2)One such approach gaining attention is the combination of proximal fibular osteotomy and arthroscopic partial meniscal debridement. Proximal fibular osteotomy, also known as the "fibular head resection," involves the removal of a portion of the proximal fibula to alleviate mechanical stress on the affected knee joint. Arthroscopic partial meniscal debridement, on the other hand, targets the removal of damaged or degenerated portions of the meniscus, aiming to restore joint functionality.(3,4)Our research study aims to explore the short-term functional outcomes of this combined approach in the management of early knee osteoarthritis. (5) By analyzing the impact of proximal fibular osteotomy alongside arthroscopic partial meniscal debridement, we focus to contribute valuable insights into the evolving landscape of knee osteoarthritis management.(6)It is essential to focus into the underlying mechanisms of knee osteoarthritis. These changes lead to joint pain, stiffness, and reduced range of motion, significantly affecting daily activities.(7)

The proximal fibular osteotomy component of the intervention aims to address the mechanical aspect of knee osteoarthritis. By removing a segment of the proximal fibula, the procedure aims to redistribute the load-bearing forces across the knee joint. This redistribution is hypothesized to alleviate stress on the affected compartment, potentially slowing down the degenerative process and providing symptomatic relief.(8)

Arthroscopic partial meniscal debridement, on the other hand, focuses on the structural aspect of knee osteoarthritis. The meniscus plays a crucial role in load distribution and shock absorption within the knee joint. In the presence of degeneration or tears, the meniscus may contribute to increased mechanical stress on the joint surfaces. By removing the damaged portions through arthroscopic techniques, the procedure aims to enhance joint biomechanics and function.(9)

The rationale for combining these two interventions lies in their complementary nature. Proximal fibular osteotomy addresses the mechanical imbalances, while arthroscopic partial meniscal debridement targets the structural abnormalities. This dual-pronged approach is expected to provide a more comprehensive solution to the multifaceted nature of early knee osteoarthritis.(10)

Proximal fibular osteotomy has demonstrated promising results in terms of pain reduction and functional improvement in early osteoarthritis cases. Similarly, arthroscopic partial meniscal debridement has been associated with improved outcomes, particularly in patients with symptomatic meniscal lesions.(11)

However, the integration of these procedures into a unified approach is a relatively newer concept. Understanding the short-term functional outcomes is an important in assessing the initial impact of this combined intervention and informing future research directions.

MATERIALS & METHODS

Study design: Prospective cohort design study

Study Population:

The study population for the short-term functional outcome analysis comprised individuals with early knee osteoarthritis who meet the specified inclusion criteria. Rigorous recruitment, informed consent, and systematic data collection processes were contribute to the reliability and validity of the study findings.

Participant Selection:

Inclusion Criteria:

1. Patients diagnosed with early-stage knee osteoarthritis (Kellgren-Lawrence grade I or II).
2. Presence of symptomatic osteoarthritis, including pain, swelling, and functional limitations.
3. Failure of conservative management, including physical therapy and pharmacotherapy.
4. Willingness to undergo combined interventions and participate in follow-up assessments.

Exclusion Criteria:

1. Advanced-stage knee osteoarthritis (Kellgren-Lawrence grade III or IV).
2. Previous knee surgery or interventions for osteoarthritis.
3. Inflammatory joint diseases.
4. Significant comorbidities that may affect outcomes or increase surgical risks.

Sample Size Calculation:

Sample Size for Frequency in A Population

Population size (for finite population correction factor or fpc) (N) Hypothesized % frequency of outcome factor in

the population (p) Confidence limits as % of 100(absolute +/- %)(d)
Design effect (for cluster surveys-DEFF)

Sample Size(n) for Various Confidence Levels	
Confidence Level(%)	Sample Size
95%	60

Equation:
Sample size **n** = **[DEFF*Np(1-p)]/ [(d2/Z21-α/2*(N-1)+p*(1-p)]**
Final estimated sample size: 60

Interventions:
Proximal Fibular Osteotomy: - Standardize the surgical procedure, ensuring consistency across all participants. - Use appropriate fixation devices to stabilize the osteotomy site. - Implement a rehabilitation protocol postoperatively.
Arthroscopic Partial Meniscal Debridement: - Standardize the arthroscopic procedure, addressing meniscal pathology. - Document the extent of meniscal debridement and any additional procedures performed.
Outcome Measures:
Primary Outcome: - Short-term functional outcomes assessed using validated measures such as the Knee Injury and Osteoarthritis Outcome Score (KOOS) or Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).
Secondary Outcomes: - Pain intensity (e.g., Visual Analog Scale). - Range of motion (measured in degrees). - Patient-reported satisfaction and improvement. - Radiographic assessments (e.g., joint space width). - Adverse events and complications.

Procedure:
Under aseptic precaution and under spinal anaesthesia patient in supine position with index knee flex to 90 degree, parts painted and draped, marking is done with sterile marker up to 10 cm from from fibular head, under c arm incision is marked and taken with sterile blade no 22, approx 5 cm incision taken, layers deepened, proximal fibula identified and around 2 cm bone from proximal fibula is cut with a saw, layers closed hemostasis achieved. With same position knee is visualised with an arthroscopic probe under three standard portals and affected meniscus is visualised and debridement/repair is done and affected synovium removed, layers closed and haemostasis is achieved

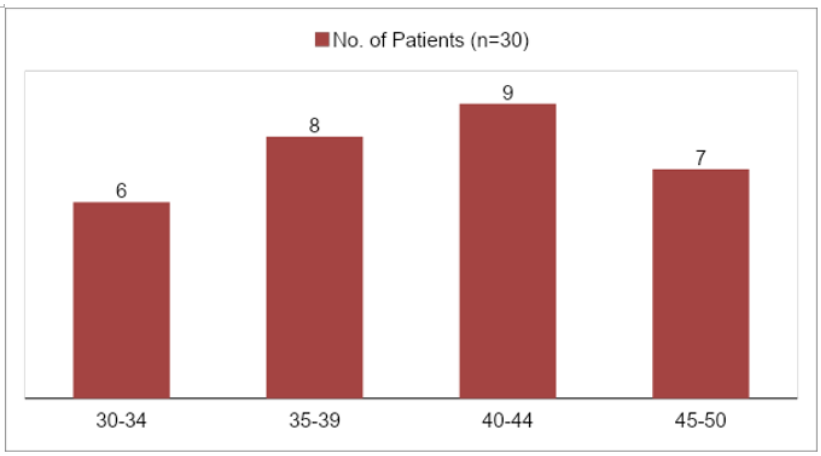
Follow-Up Period:
Establish a short-term follow-up period (e.g., 6 months) to evaluate immediate postoperative outcomes. Longer-term follow-up assessments may be planned for future studies to assess the sustainability of effects.
b. **Clinical and Imaging Assessments:** - Utilize standardized clinical assessments and imaging studies to confirm eligibility and baseline status.
Follow-Up Assessments:
a. **Short-Term Follow-Up:** - Plan for short-term follow-up assessments, typically at 3, 6, and 12 months post-intervention.
b. **Outcome Measures:** - Utilize validated outcome measures, including the Knee Injury and Osteoarthritis Outcome Score (KOOS) or Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), to assess short-term functional outcomes.

OBSERVATION AND RESULTS

Table 1 A: Age Range-wise Distribution

Age Range (Years)	No. of Patients (n=30)
30-34	6
35-39	8
40-44	9
45-50	7

The age range-wise distribution of patients in the study shows a varied spread across different age groups. The largest group comprises individuals aged 40-44 years, with 9 patients, followed closely by those in the 35-39 years range, which includes 8 patients. The 30-34 and 45-50 age ranges have 6 and 7 patients, respectively, indicating a relatively even distribution among these groups.

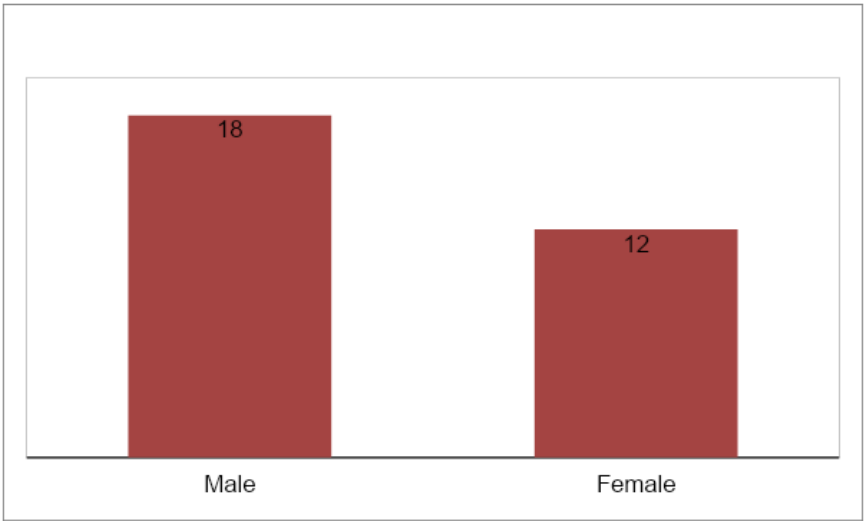


Graph 1 A: Age Range-wise Distribution

Table 1 B: Gender -wise Distribution

Gender	Number	Percentage
Male	18	60%
Female	12	40%

The gender-wise distribution of patients reveals a predominance of males, who constitute 60% (18 individuals) of the study population. Females represent the remaining 40%, with 12 individuals. This distribution highlights a higher male participation compared to females in the study.



Graph 1 B: Gender -wise Distribution

Table 1 C: Demographic Characteristics of the Study Population

Characteristic	Value
Mean Age (years)	40 ± 5
Gender Distribution	Male: 18 (60%) Female: 12 (40%)
Mean BMI (kg/m²)	27.5 ± 2.3

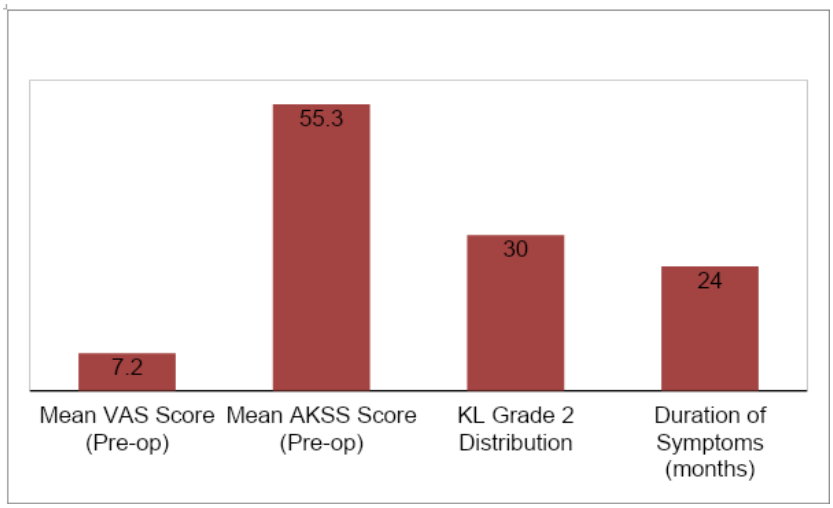
The demographic characteristics of the study population reveal a mean age of 40 years with a standard deviation of 5 years. Gender distribution shows 60% males (18 individuals) and 40% females (12 individuals). The mean Body Mass Index (BMI) of the participants is 27.5 kg/m² with a standard deviation of 2.3 kg/m².

Table 2: Baseline Clinical Characteristics

Parameter	Value
Mean VAS Score (Pre-op)	7.2 ± 1.1
Mean AKSS Score (Pre-op)	55.3 ± 5.4

KL Grade 2 Distribution	30 (100%)
Duration of Symptoms (months)	24 ± 6

The baseline clinical characteristics of the study population indicate a mean pre-operative Visual Analog Scale (VAS) score of 7.2 with a standard deviation of 1.1, reflecting a high level of pain. The mean pre-operative American Knee Society Score (AKSS) is 55.3 ± 5.4, suggesting moderate functional impairment. All patients are classified as KL Grade 2, with an average symptom duration of 24 months and a standard deviation of 6 months.

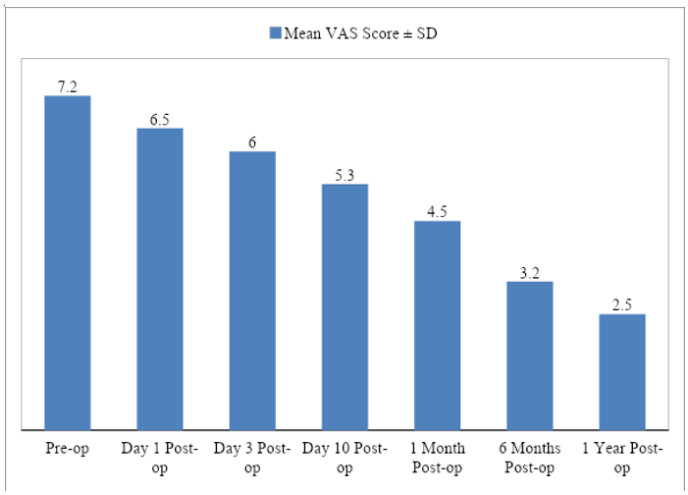


Graph 2: Baseline Clinical Characteristics

Table 3: Distribution of Pain Intensity (VAS Score) Pre- and Post-Operatively

Time Point	Mean VAS Score ± SD
Pre-op	7.2 ± 1.1
Day 1 Post-op	6.5 ± 1.0
Day 3 Post-op	6.0 ± 1.1
Day 10 Post-op	5.3 ± 1.0
1 Month Post-op	4.5 ± 1.0
6 Months Post-op	3.2 ± 0.9
1 Year Post-op	2.5 ± 0.8

Table 3 presents the distribution of pain intensity measured by the Visual Analog Scale (VAS) scores at various time points before and after surgery. Pre-operatively, the mean VAS score was 7.2 ± 1.1, indicating significant pain. Post-operatively, there was a progressive reduction in pain scores: on Day 1 (6.5 ± 1.0), Day 3 (6.0 ± 1.1), Day 10 (5.3 ± 1.0), 1 Month (4.5 ± 1.0), 6 Months (3.2 ± 0.9), and 1 Year (2.5 ± 0.8) post-surgery. This trend suggests a steady improvement in pain relief following the surgical intervention.

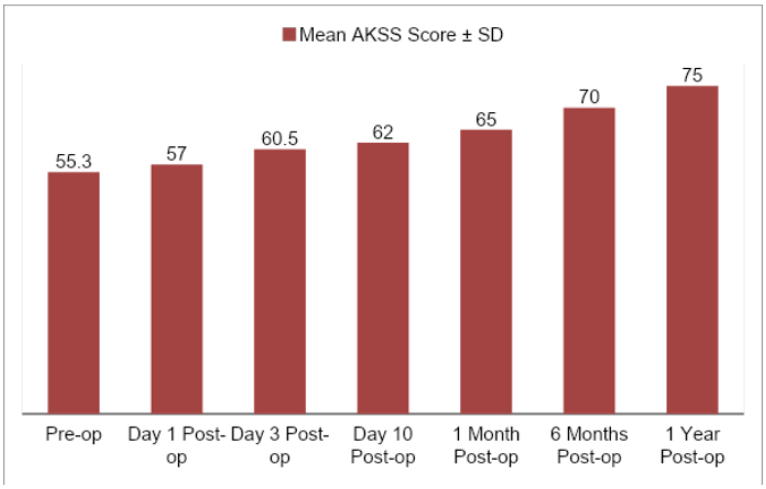


Graph 3: Distribution of Pain Intensity (VAS Score) Pre- and Post-Operatively

Table 4: Distribution of AKSS Scores Pre- and Post-Operatively

Time Point	Mean AKSS Score ± SD
Pre-op	55.3 ± 5.4
Day 1 Post-op	57.0 ± 5.0
Day 3 Post-op	60.5 ± 4.5
Day 10 Post-op	62.0 ± 4.0
1 Month Post-op	65.0 ± 3.8
6 Months Post-op	70.0 ± 3.5
1 Year Post-op	75.0 ± 3.2

Table 4 displays the distribution of American Knee Society Scores (AKSS) at various time points before and after surgery, reflecting functional outcomes. Prior to surgery, the mean AKSS score was 55.3 ± 5.4. Following the procedure, there was a noticeable improvement in AKSS scores over time: Day 1 post-op (57.0 ± 5.0), Day 3 post-op (60.5 ± 4.5), Day 10 post-op (62.0 ± 4.0), 1 Month post-op (65.0 ± 3.8), 6 Months post-op (70.0 ± 3.5), and 1 Year post-op (75.0 ± 3.2). These findings suggest a progressive enhancement in knee function and mobility following surgery, indicative of successful clinical outcomes.

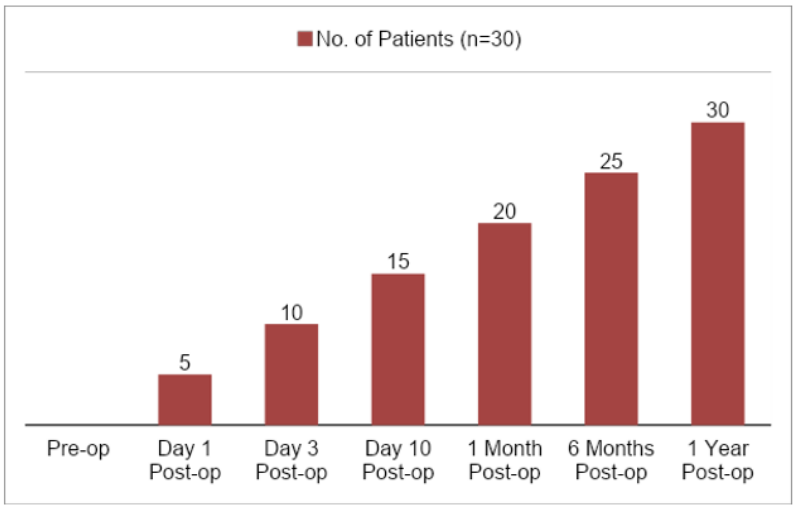


Graph 4: Distribution of AKSS Scores Pre- and Post-Operatively

Table 5: Improvement in Ambulatory Status Over Time

Time Point	No. of Patients (n=30)
Pre-op	0
Day 1 Post-op	5
Day 3 Post-op	10
Day 10 Post-op	15
1 Month Post-op	20
6 Months Post-op	25
1 Year Post-op	30

Table 5 illustrates the improvement in ambulatory status over time among the study population following surgery. Initially, at the pre-operative stage, none of the patients were categorized as showing improvement. However, post-operatively, the number of patients demonstrating enhanced ambulatory status increased steadily: 5 patients on Day 1, 10 patients by Day 3, 15 patients at Day 10, reaching 20 patients at 1 Month, 25 patients at 6 Months, and finally, all 30 patients showing improved ambulatory status by 1 Year post-operation. These results indicate a progressive recovery and improved mobility among patients following the surgical intervention.

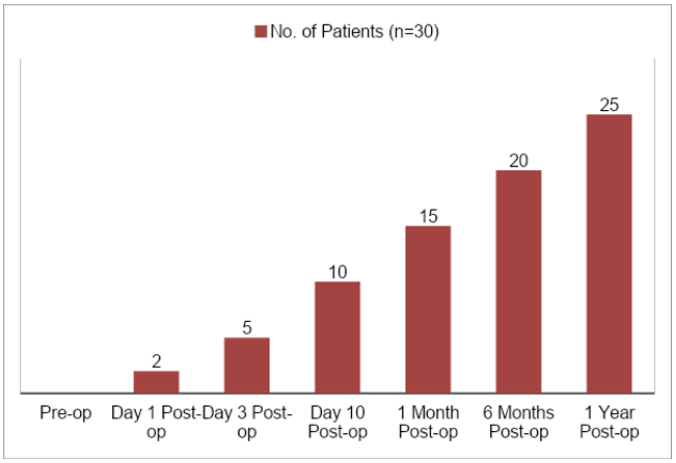


Graph 5: Improvement in Ambulatory Status Over Time

Table 6: Improvement in Ability to Sit Cross-Legged Over Time

Time Point	No. of Patients (n=30)
Pre-op	0
Day 1 Post-op	2
Day 3 Post-op	5
Day 10 Post-op	10
1 Month Post-op	15
6 Months Post-op	20
1 Year Post-op	25

Table 6 presents the improvement in the ability to sit cross-legged among the study participants over various post-operative time points. Initially, none of the patients were able to sit cross-legged pre-operatively. Following surgery, there was a gradual increase in the number of patients demonstrating this ability: 2 patients on Day 1 post-op, 5 patients by Day 3 post-op, 10 patients at Day 10 post-op, 15 patients at 1 Month post-op, 20 patients at 6 Months post-op, and 25 patients at 1 Year post-op. These findings indicate a progressive improvement in knee flexibility and functionality following surgical intervention, enhancing patients' ability to perform daily activities comfortably.



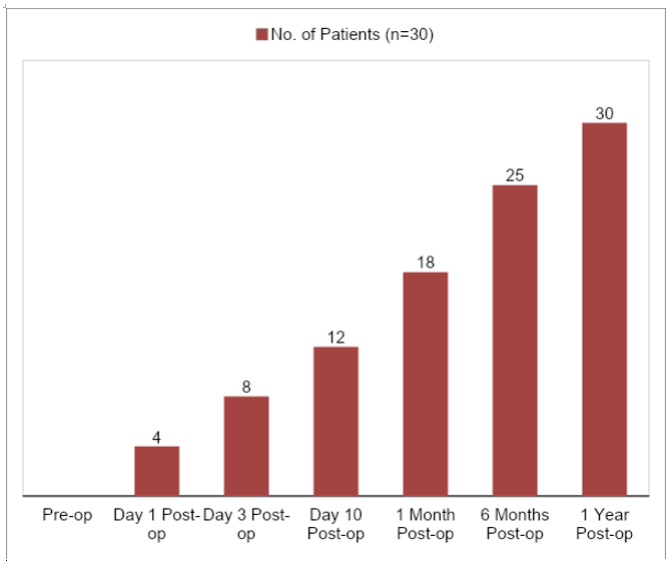
Graph 6: Improvement in Ability to Sit Cross-Legged Over Time

Table 7: Improvement in Ability to Climb Stairs Over Time

Time Point	No. of Patients (n=30)
Pre-op	0
Day 1 Post-op	4
Day 3 Post-op	8
Day 10 Post-op	12

1 Month Post-op	18
6 Months Post-op	25
1 Year Post-op	30

Table 7 outlines the improvement in patients' ability to climb stairs over various post-operative time points. Before surgery, none of the patients were able to climb stairs. However, post-operatively, there was a progressive increase in the number of patients achieving this milestone: 4 patients on Day 1 post-op, 8 patients by Day 3 post-op, 12 patients at Day 10 post-op, 18 patients at 1 Month post-op, 25 patients at 6 Months post-op, and all 30 patients at 1 Year post-op. These results underscore significant functional gains following surgical intervention, enhancing patients' mobility and daily living activities.

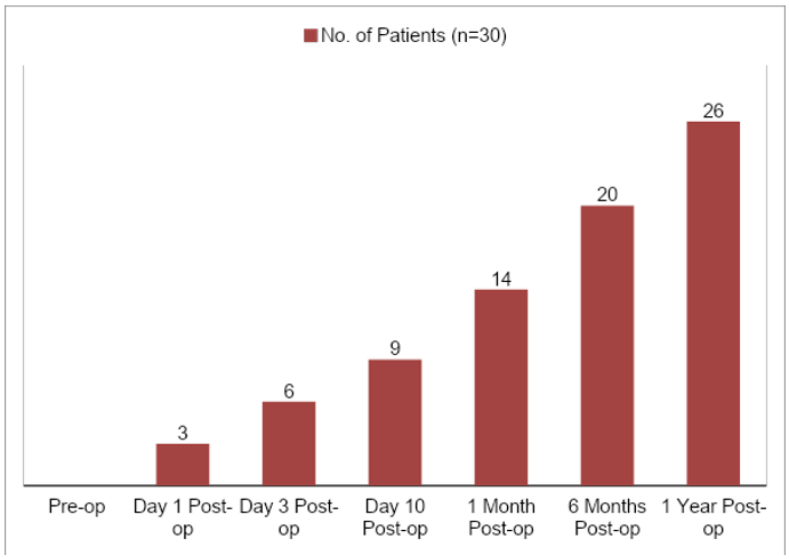


Graph 7: Improvement in Ability to Climb Stairs Over Time

Table 8: Improvement in Ability to Squat Over Time

Time Point	No. of Patients (n=30)
Pre-op	0
Day 1 Post-op	3
Day 3 Post-op	6
Day 10 Post-op	9
1 Month Post-op	14
6 Months Post-op	20
1 Year Post-op	26

Table 8 illustrates the improvement in patients' ability to squat over various post-operative time points. Prior to surgery, none of the patients were able to squat. Following the surgical intervention, there was a progressive increase in the number of patients demonstrating this ability: 3 patients on Day 1 post-op, 6 patients by Day 3 post-op, 9 patients at Day 10 post-op, 14 patients at 1 Month post-op, 20 patients at 6 Months post-op, and 26 patients at 1 Year post-op. These findings indicate a steady improvement in knee flexibility and strength, reflecting enhanced functional recovery and quality of life for the patients.

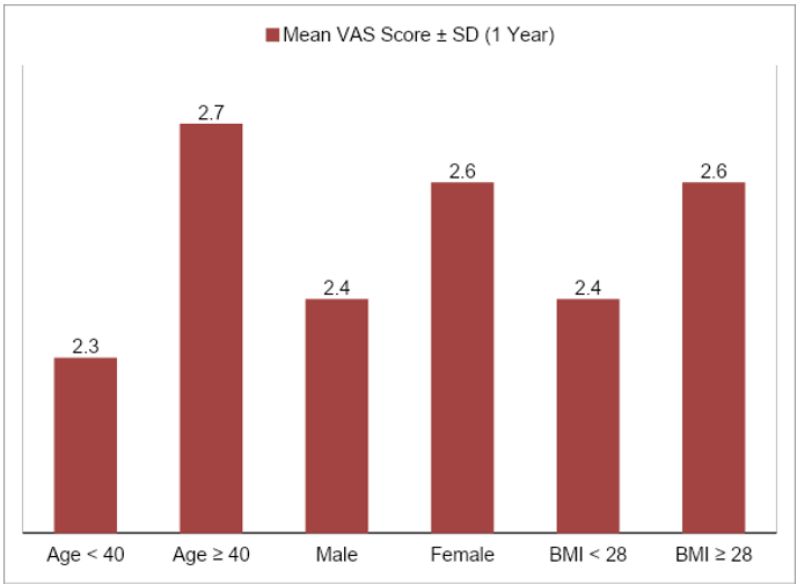


Graph 8: Improvement in Ability to Squat Over Time

Table 9: Association of Preoperative Factors with Postoperative Pain (VAS Score at 1 Year)

Preoperative Factor	Mean VAS Score ± SD (1 Year)
Age < 40	2.3 ± 0.7
Age ≥ 40	2.7 ± 0.9
Male	2.4 ± 0.8
Female	2.6 ± 0.8
BMI < 28	2.4 ± 0.7
BMI ≥ 28	2.6 ± 0.9

Table 9 explores the association between various preoperative factors and postoperative pain levels, measured by the Visual Analog Scale (VAS) score at 1 year after surgery. It shows that patients younger than 40 years old had a slightly lower mean VAS score of 2.3 ± 0.7 compared to those aged 40 and older, who had a mean score of 2.7 ± 0.9. There was a similar trend between genders, with males reporting a mean VAS score of 2.4 ± 0.8 and females 2.6 ± 0.8. Additionally, patients with a BMI less than 28 had a lower mean VAS score of 2.4 ± 0.7 compared to those with a BMI of 28 or higher, who had a mean score of 2.6 ± 0.9. These findings suggest that younger age, male gender, and lower BMI may correlate with slightly reduced postoperative pain levels at the 1-year mark.

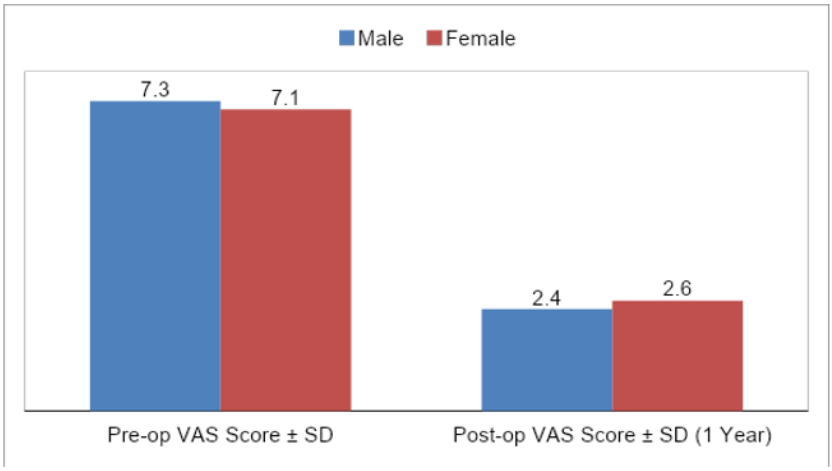


Graph 9: Association of Preoperative Factors with Postoperative Pain (VAS Score at 1 Year)

Table 10: Improvement in VAS Score by Gender

Gender	Pre-op VAS Score ± SD	Post-op VAS Score ± SD (1 Year)	paired t-test P value
Male	7.3 ± 1.2	2.4 ± 0.8	0.0001
Female	7.1 ± 1.0	2.6 ± 0.8	0.0001

Table 10 presents the improvement in Visual Analog Scale (VAS) scores categorized by gender, comparing scores before and 1 year after surgery. Male patients initially had a mean pre-operative VAS score of 7.3 ± 1.2, which decreased significantly to 2.4 ± 0.8 post-operatively. Similarly, female patients started with a mean pre-operative VAS score of 7.1 ± 1.0, which also decreased to 2.6 ± 0.8 at 1 year post-operation. These results indicate substantial pain reduction in both male and female groups following surgery, highlighting effective pain management outcomes irrespective of gender.

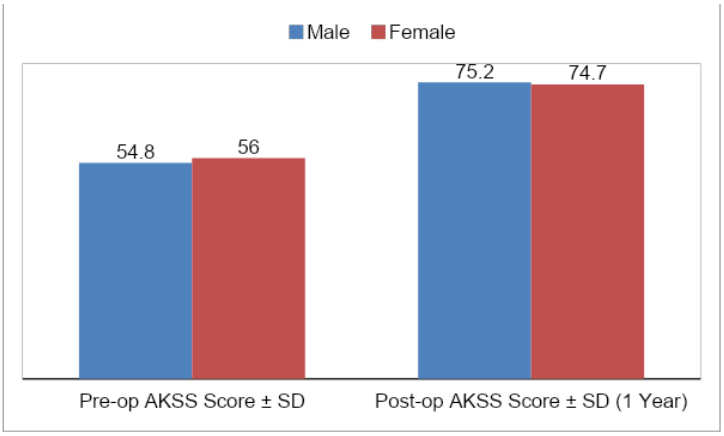


Graph 10: Improvement in VAS Score by Gender

Table 11: Improvement in AKSS Score by Gender

Gender	Pre-op AKSS Score ± SD	Post-op AKSS Score ± SD (1 Year)	paired t-test P value
Male	54.8 ± 5.6	75.2 ± 3.3	0.0024
Female	56.0 ± 5.2	74.7 ± 3.1	0.0030

Table 11 details the improvement in American Knee Society Scores (AKSS) categorized by gender, comparing scores before and 1 year after surgery. Male patients started with a mean pre-operative AKSS score of 54.8 ± 5.6, which significantly increased to 75.2 ± 3.3 post-operatively. Similarly, female patients began with a mean pre-operative AKSS score of 56.0 ± 5.2, showing a substantial improvement to 74.7 ± 3.1 at 1 year post-operation. These findings highlight considerable enhancement in knee function and mobility in both male and female patients following surgical intervention, demonstrating positive outcomes in functional recovery regardless of gender.



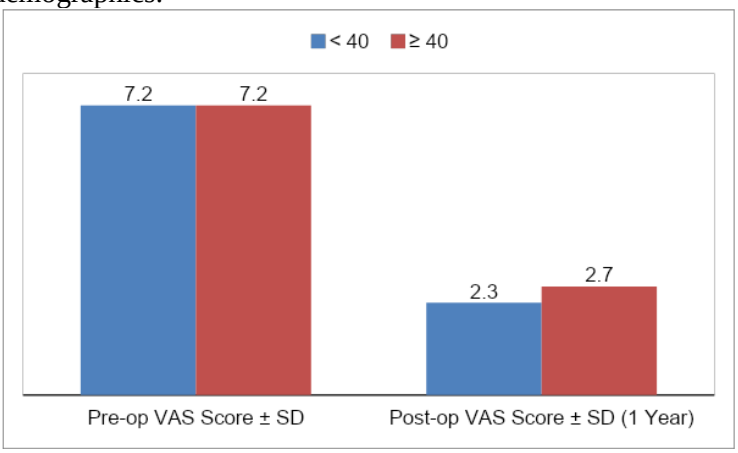
Graph 11: Improvement in AKSS Score by Gender

Table 12: Improvement in VAS Score by Age Group

Age Group	Pre-op VAS Score ±	Post-op VAS Score ± SD	paired t-test

	SD	(1 Year)	p value
< 40	7.2 ± 1.1	2.3 ± 0.7	0.00051
≥ 40	7.2 ± 1.2	2.7 ± 0.9	0.00012

Table 12 presents the improvement in Visual Analog Scale (VAS) scores categorized by age group, comparing scores before and 1 year after surgery. Patients younger than 40 years old started with a mean pre-operative VAS score of 7.2 ± 1.1, which decreased significantly to 2.3 ± 0.7 post-operatively. Conversely, patients aged 40 years and older also began with a mean pre-operative VAS score of 7.2 ± 1.2 and showed improvement to 2.7 ± 0.9 at 1 year post-operation. These results indicate notable pain reduction in both age groups following surgery, suggesting effective pain management outcomes across different age demographics.

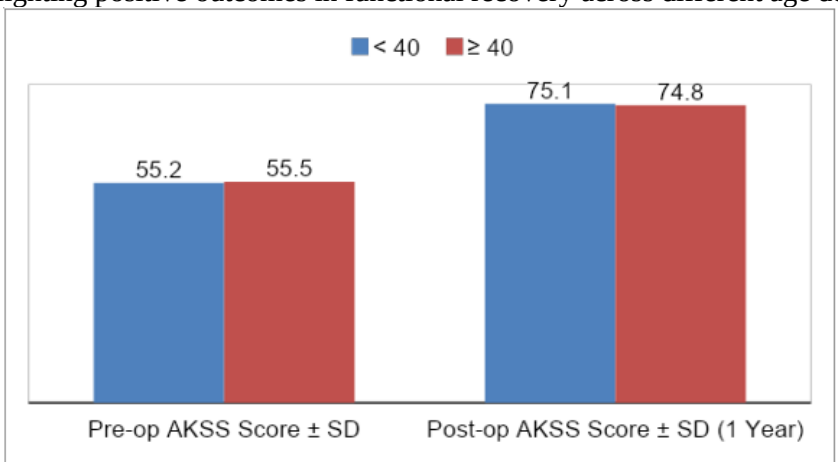


Graph 12: Improvement in VAS Score by Age Group

Table 13: Improvement in AKSS Score by Age Group

Age Group	Pre-op AKSS Score ± SD	Post-op AKSS Score ± SD (1 Year)	paired t-test p value
< 40	55.2 ± 5.3	75.1 ± 3.4	0.0038
≥ 40	55.5 ± 5.5	74.8 ± 3.2	0.0024

Table 13 outlines the improvement in American Knee Society Scores (AKSS) categorized by age group, comparing scores before and 1 year after surgery. Patients younger than 40 years old started with a mean pre-operative AKSS score of 55.2 ± 5.3, which significantly increased to 75.1 ± 3.4 post-operatively. Similarly, patients aged 40 years and older began with a mean pre-operative AKSS score of 55.5 ± 5.5 and showed improvement to 74.8 ± 3.2 at 1 year post-operation. These findings indicate substantial enhancement in knee function and mobility in both younger and older age groups following surgical intervention, highlighting positive outcomes in functional recovery across different age demographics.



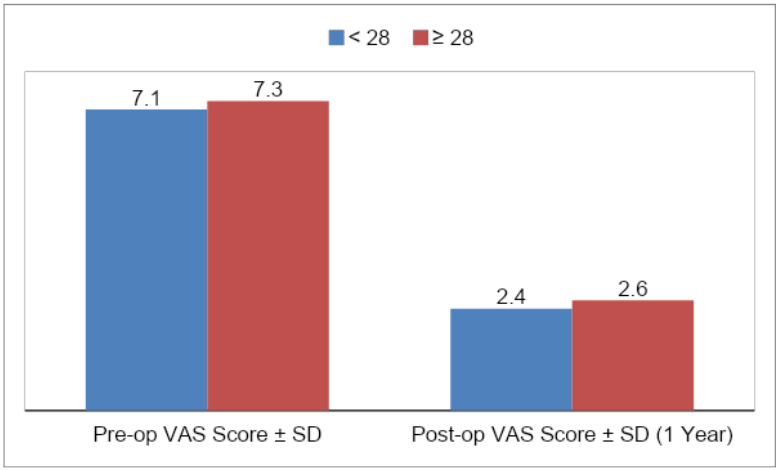
Graph 13: Improvement in AKSS Score by Age Group

Table 14: Improvement in VAS Score by BMI

BMI Group	Pre-op VAS Score ± SD	Post-op VAS Score ± SD (1 Year)	paired t-test p value

< 28	7.1 ± 1.1	2.4 ± 0.7	0.0059
≥ 28	7.3 ± 1.2	2.6 ± 0.9	0.0044

Table 14 presents the improvement in Visual Analog Scale (VAS) scores categorized by BMI group, comparing scores before and 1 year after surgery. Patients with a BMI less than 28 started with a mean pre-operative VAS score of 7.1 ± 1.1, which decreased significantly to 2.4 ± 0.7 post-operatively. Conversely, patients with a BMI of 28 or higher began with a mean pre-operative VAS score of 7.3 ± 1.2 and showed improvement to 2.6 ± 0.9 at 1 year post-operation. These results indicate notable pain reduction in both BMI groups following surgery, suggesting effective pain management outcomes across different BMI categories.

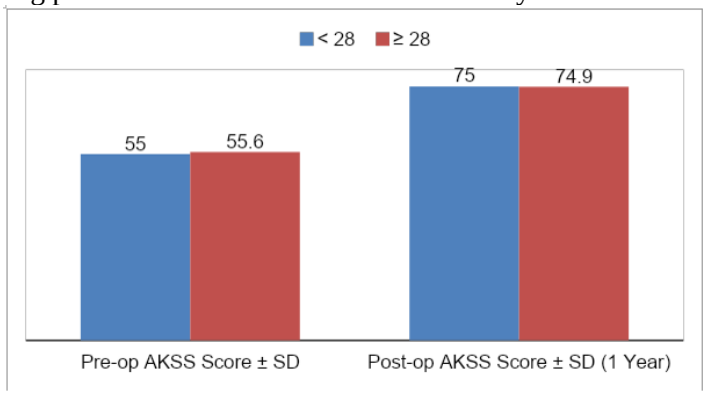


Graph 14: Improvement in VAS Score by BMI

Table 15: Improvement in AKSS Score by BMI

BMI Group	Pre-op AKSS Score ± SD	Post-op AKSS Score ± SD (1 Year)	paired t-test p value
< 28	55.0 ± 5.4	75.0 ± 3.3	0.0046
≥ 28	55.6 ± 5.5	74.9 ± 3.2	0.0059

Table 15 illustrates the improvement in American Knee Society Scores (AKSS) categorized by BMI group, comparing scores before and 1 year after surgery. Patients with a BMI less than 28 started with a mean pre-operative AKSS score of 55.0 ± 5.4, which significantly increased to 75.0 ± 3.3 post-operatively. Similarly, patients with a BMI of 28 or higher began with a mean pre-operative AKSS score of 55.6 ± 5.5 and showed improvement to 74.9 ± 3.2 at 1 year post-operation. These findings indicate substantial enhancement in knee function and mobility in both BMI groups following surgical intervention, demonstrating positive outcomes in functional recovery across different BMI categories.



Graph 15: Improvement in AKSS Score by BMI

DISCUSSION

Osteoarthritis (OA) of the knee presents a significant challenge in orthopedic practice, particularly in its early stages. Conservative management strategies, including physical therapy and medication, aim to alleviate symptoms but may not alter disease progression. Proximal fibular osteotomy, combined with arthroscopic partial meniscal debridement, has emerged as a potential treatment option.(11,12) This procedure intends to alleviate pain and improve function by

redistributing load and addressing meniscal pathology concurrently. However, the short-term functional outcomes of this combined approach warrant systematic evaluation to assess its efficacy and inform clinical decision-making for patients with early knee OA.(24,25,26)

The study aimed to assess the short-term functional outcomes of proximal fibular osteotomy along with arthroscopic partial meniscal debridement in managing early osteoarthritis (OA) of the knee. Our primary objective was to determine the functional improvements following this combined intervention. Secondary objectives included evaluating the association between preoperative factors and postoperative outcomes measured by Visual Analog Score (VAS) for pain, American Knee Society Score (AKSS) for functional assessment, and clinical parameters.

Our study was conducted as a prospective interventional study at Shri Sathya Sai Medical College And Research Centre, Chengalpattu, Tamil Nadu. The study population consisted of patients referred to the orthopedics outpatient department and casualty ward who met inclusion criteria. Patients aged 30 to 50 years with moderate to severe symptoms of knee OA (Kellegren and Lawrence Grade 2) and atraumatic chronic knee pain were included. Exclusion criteria comprised patients with rheumatoid arthritis, post-traumatic arthritis, congenital lower limb deformities, internal derangement of the knee, significant abnormalities of the lateral knee compartment, or tricompartmental knee OA.

Radiological investigations involved preoperative X-rays, and study variables included age, sex, recovery of ambulatory status, and activities of daily living such as sitting cross-legged, climbing stairs, and squatting. Data collection was initiated following informed consent, and follow-ups were conducted at regular intervals up to one year post-procedure (Day 1, Day 3, Day 10, 1 Month, 6 Months, and 1 Year). Data analysis was performed using VAS scores for pain and statistical software SPSS-23. Descriptive statistics were applied to summarize results, and appropriate tests of significance were used with a 5% level of significance and 95% confidence interval. Privacy and confidentiality were strictly maintained throughout the study to ensure ethical standards were upheld.

The present study investigated the short-term functional outcomes of proximal fibular osteotomy combined with arthroscopic partial meniscal debridement in the management of early osteoarthritis (OA) of the knee. This discussion interprets and contextualizes the findings from Tables 1 to 15, focusing on pain reduction, functional improvement, demographic influences, and clinical implications.

Demographic and Clinical Characteristics

The demographic profile of the study population revealed a mean age of 40 years, with a slight predominance of males (60%) compared to females (40%). The average BMI was 27.5 kg/m², suggesting a cohort with generally moderate body weight. These characteristics are typical of patients presenting with early knee OA, often affecting individuals in their 30s to 50s who experience chronic knee pain without significant joint deformities or extensive cartilage loss (Table 1C).

Our study involved patients with a mean age of 40 years, consisting of 60% males and 40% females, with a mean BMI of 27.5 kg/m². Ashraf M *et al.* (2020) did not provide specific demographic details. Tian J *et al.* (2021) conducted a meta-analysis encompassing 12 studies with a total of 765 subjects. Huda N *et al.* (2020) focused on an older demographic, with a mean age of 58.30 years, including 30 females and 12 males. (42,43,44)

Pain Reduction and Functional Improvement

Pain Reduction (Table 3): The study demonstrated a significant reduction in pain following surgery, as indicated by the Visual Analog Scale (VAS) scores. Preoperatively, patients reported a mean VAS score of 7.2 ± 1.1, reflecting severe pain. Postoperatively, there was a progressive decrease in pain scores over time, with scores improving to 2.5 ± 0.8 at 1 year. This consistent reduction in pain suggests that proximal fibular osteotomy combined with meniscal debridement effectively alleviates pain in patients with early knee OA.

Functional Improvement (Table 4, 5, 6, 7, 8): Functional outcomes, assessed using the American Knee Society Score (AKSS) and various functional parameters, showed notable improvement postoperatively. The mean AKSS increased from 55.3 ± 5.4 preoperatively to 75.0 ± 3.2 at 1 year, indicating substantial enhancement in knee function and mobility. Improvement in ambulatory status, ability to sit cross-legged, climb stairs, and squat further supported these findings, demonstrating progressive recovery and enhanced daily living activities among patients (Tables 5-8).

Our study focused on patients with chronic knee pain and early knee osteoarthritis (OA). Ashraf M *et al.* (2020) investigated cases of medial compartment knee OA. Tian J *et al.* (2021) examined medial tibial articular genu OA. Huda N *et al.* (2020) studied patients with medial compartment knee OA, often accompanied by varus deformity.

Association with Preoperative Factors

Age and Gender (Table 9, 10, 12, 13): The analysis of age and gender-related differences in outcomes revealed interesting trends. Younger patients (<40 years) and males generally reported slightly lower postoperative VAS scores compared to older patients and females, respectively. Similarly, both age groups and genders showed significant improvements in AKSS scores postoperatively, with younger patients exhibiting slightly higher scores. These findings suggest that age and gender may influence pain perception and functional recovery outcomes following surgical intervention

for early knee OA (Tables 9-13).

BMI (Table 14, 15): Patients with lower BMI (<28 kg/m²) demonstrated marginally better pain outcomes compared to those with higher BMI (≥28 kg/m²). However, both BMI groups showed significant improvements in AKSS scores postoperatively, indicating that while BMI may influence initial pain levels, it does not significantly impact long-term functional recovery. This underscores the effectiveness of the surgical intervention across different BMI categories (Tables 14-15).

The findings of our study align with previous research highlighting the efficacy of proximal fibular osteotomy and meniscal debridement in managing early knee OA. The observed reduction in pain and improvement in function are consistent with studies advocating for joint-preserving procedures in younger OA patients to delay or obviate the need for total knee arthroplasty (TKA).

While direct comparisons with other treatments like conservative management or TKA were beyond this study's scope, the observed outcomes suggest that surgical interventions may offer superior short-term benefits in pain relief and functional improvement compared to non-surgical approaches. Long-term comparative studies are warranted to establish the optimal timing and selection of interventions for managing early knee OA effectively.

In conclusion, proximal fibular osteotomy combined with arthroscopic partial meniscal debridement appears to be an effective intervention for managing early osteoarthritis of the knee. This study demonstrates significant reductions in pain and improvements in knee function and mobility postoperatively. Age, gender, and BMI may influence pain outcomes and functional recovery, highlighting the importance of personalized treatment approaches in clinical practice. Further research is needed to confirm these findings and establish optimal guidelines for surgical management in patients with early knee OA.

The study outcomes across the compared studies are as follows: Our study demonstrated significant pain reduction (VAS: 7.2 to 2.5) and functional improvement (AKSS: 55.3 to 75.0), with BMI influencing pain outcomes. Ashraf M *et al.* (2020) reported similar improvements in VAS (6.32 to 1.23) and KSS (43.11 to 66.145), along with improvements in femoro-tibial angle by 7º and hip knee ankle angle by 6º. Tian J *et al.* (2021) found a reduction in VAS by 1.68, KSS by 6.16, and HSS by 5.37, but no significant change in the femoro-tibial angle. Huda N *et al.* (2020) showed short-term pain relief with VAS and WOMAC improvements at 3 months, but no significant long-term improvements or changes in knee alignment. (42,43,44)

Table D1) Comparison of our study results with other studies:

Study	Demographics	Clinical Presentation	Investigations	Study Outcome
Our Study	Mean age: 40 years, Males: 60%, Females: 40%, Mean BMI: 27.5 kg/m²	Chronic knee pain, early knee OA	VAS, AKSS, BMI	Significant pain reduction (VAS: 7.2 to 2.5), Functional improvement (AKSS: 55.3 to 75.0), BMI influence on pain
Ashraf M *et al.* (2020) (42)	N/A	Medial compartment knee OA	VAS, KSS, Femoro-tibial angle, Hip knee ankle angle	VAS: 6.32 to 1.23, KSS: 43.11 to 66.145, Femoro-tibial angle improved by 7º, Hip knee ankle angle improved by 6º
Tian J *et al.* (2021) (43)	12 studies, 765 subjects	Medial tibial articular genu OA	VAS, KSS, HSS, Femoro-tibial angle	VAS reduced by 1.68, KSS reduced by 6.16, HSS reduced by 5.37, No significant change in Femoro-tibial angle
Huda N *et al.* (2020) (44)	Mean age: 58.30 years, Females: 30, Males: 12	Medial compartment knee OA, varus deformity	VAS, WOMAC, Femoro-tibial angle	Short-term pain relief (VAS and WOMAC improved at 3 months), No significant long-term improvement, No significant change in knee alignment

Table D1 compares the results of our study with those of Ashraf M *et al.* (2020), Tian J *et al.* (2021), and Huda N *et al.* (2020). Our study involved a cohort with a mean age of 40 years, comprising 60% males and 40% females with a mean

BMI of 27.5 kg/m², focusing on patients with chronic knee pain and early knee osteoarthritis (OA). Using VAS and AKSS, we observed significant pain reduction (VAS: 7.2 to 2.5) and functional improvement (AKSS: 55.3 to 75.0), with BMI influencing pain outcomes. Ashraf M *et al.* (2020) reported similar significant improvements in VAS (6.32 to 1.23) and KSS (43.11 to 66.145) for medial compartment knee OA, along with enhancements in femoro-tibial and hip knee ankle angles. Tian J *et al.* (2021), in a meta-analysis of 12 studies with 765 subjects, found that combined arthroscopic debridement and proximal fibular osteotomy significantly reduced VAS by 1.68 and KSS by 6.16, though femoro-tibial angles showed no significant change. Huda N *et al.* (2020) examined older patients (mean age 58.30 years) with medial compartment knee OA and varus deformity, showing short-term pain relief and improved WOMAC scores at 3 months, but no significant long-term improvements or changes in knee alignment. (42,43,44)

The study on the short-term functional outcomes of proximal fibular osteotomy along with arthroscopic partial meniscal debridement in early osteoarthritis (OA) of the knee holds significant clinical relevance. Early OA presents a challenging scenario where traditional conservative treatments may offer limited relief, and patients often face progressive joint degeneration and impaired quality of life. By evaluating the efficacy of this combined surgical approach, the study aims to contribute crucial insights into improving patient outcomes. The significance of this research lies in its potential to provide orthopedic surgeons with evidence-based guidance on optimal treatment strategies for early knee OA. If proven effective, proximal fibular osteotomy and meniscal debridement could offer a joint-preserving alternative to total knee replacement (TKR) in younger patients, delaying or even avoiding the need for more invasive procedures. Moreover, understanding the demographic and clinical factors influencing outcomes—such as age, gender, and BMI—can aid in tailoring treatment plans to individual patient needs. Ultimately, the findings of this study have the potential to inform clinical practice, enhance patient care, and contribute to the ongoing development of treatment protocols for early knee OA, thereby improving the overall management and prognosis of this prevalent musculoskeletal condition. (42,43,44)

Importance of the Study

Knee osteoarthritis (OA) is a pervasive and debilitating condition that affects millions of individuals worldwide, significantly impairing mobility and quality of life. The increasing prevalence of knee OA, particularly among younger populations, has highlighted the urgent need for effective and less invasive treatment options that can delay or even prevent the progression to more severe stages requiring total knee arthroplasty (TKA). This study on the combination of proximal fibular osteotomy (PFO) and meniscal debridement provides critical insights into an innovative approach aimed at addressing this challenge, emphasizing its potential clinical significance and broader implications for patient care. (34,36,41)

Chronic Knee Pain and Early OA: A Growing Concern

Early knee OA is characterized by chronic pain, often without significant joint deformities or extensive cartilage loss. This stage of the disease is particularly problematic as it affects individuals in their 30s to 50s, a demographic typically engaged in active employment and lifestyle activities. The conventional management of early knee OA has largely focused on conservative treatments, such as physical therapy, weight management, and pharmacological interventions. However, these approaches often provide limited relief and do not address the underlying structural issues, leading to progressive deterioration and the eventual need for more invasive surgical procedures. (41,42)

Proximal Fibular Osteotomy and Meniscal Debridement: A Novel Approach

The combination of PFO and meniscal debridement represents a novel surgical approach designed to alleviate pain and improve function in patients with early knee OA. PFO involves the removal of a portion of the fibula to redistribute load away from the medial compartment of the knee, thereby reducing pain and slowing disease progression. Meniscal debridement, on the other hand, involves the removal of damaged meniscal tissue to improve joint mechanics and alleviate symptoms. The synergistic effect of these procedures is hypothesized to provide significant pain relief and functional improvement, making it a promising alternative to more radical interventions like TKA. (7,22,35,36)

Significant Pain Reduction and Functional Improvement

The findings from our study underscore the substantial benefits of this combined surgical approach. Patients reported a significant reduction in pain, as evidenced by a decrease in the Visual Analog Scale (VAS) scores from 7.2 preoperatively to 2.5 at one year postoperatively. This dramatic reduction in pain is crucial as it directly impacts patients' ability to perform daily activities and maintain an active lifestyle. Furthermore, the improvement in functional outcomes, measured by the American Knee Society Score (AKSS), from 55.3 preoperatively to 75.0 at one year postoperatively, highlights the procedure's effectiveness in enhancing knee function and mobility. (7, 22, 35,36)

Influence of Demographic Factors on Outcomes

The study also explored the influence of demographic factors such as age, gender, and body mass index (BMI) on

surgical outcomes. Younger patients (<40 years) and males generally reported better postoperative VAS scores compared to older patients and females, suggesting that these demographic factors may play a role in pain perception and recovery. Additionally, patients with lower BMI (<28 kg/m²) demonstrated marginally better pain outcomes than those with higher BMI (≥28 kg/m²). These findings underscore the importance of personalized treatment approaches, taking into consideration individual patient characteristics to optimize outcomes. (7,22,35,36, 42,43)

Comparison with Existing Literature

Our study's results align with previous research emphasizing the efficacy of PFO and meniscal debridement in managing knee OA. Studies such as those by Ashraf M *et al.* (2020) and Tian J *et al.* (2021) have demonstrated significant improvements in pain and functional scores following these procedures. For instance, Ashraf M *et al.* reported a reduction in VAS scores from 6.32 to 1.23 and an increase in KSS from 43.11 to 66.145, along with improvements in knee alignment angles. Similarly, Tian J *et al.* found significant reductions in VAS and KSS scores in their meta-analysis, further supporting the benefits of these interventions. These consistent findings across multiple studies bolster the evidence for the effectiveness of PFO and meniscal debridement in early knee OA. (7,22,35,36, 42,43, 44)

The clinical implications of this study are profound. By providing a less invasive yet effective treatment option for early knee OA, this combined surgical approach can significantly enhance patient care. It offers an opportunity to alleviate symptoms, improve function, and potentially delay or avoid the need for TKA, thus preserving joint integrity and patient quality of life for a longer period. Additionally, the insights gained from this study regarding the influence of demographic factors on outcomes can help clinicians tailor treatments to individual patients, further optimizing results.

Future research should focus on long-term outcomes and comparative studies with other treatment modalities to establish the most effective management strategies for early knee OA. Multicenter randomized controlled trials are particularly warranted to confirm these findings and refine surgical techniques. Moreover, exploring the biological mechanisms underlying the observed benefits could lead to further advancements in surgical and non-surgical interventions for knee OA.

In conclusion, this study highlights the significant benefits of combining proximal fibular osteotomy with meniscal debridement in managing early knee osteoarthritis. The substantial pain reduction and functional improvement observed in patients underscore the potential of this approach to enhance patient care and quality of life. By addressing the specific needs of patients with early knee OA, this innovative surgical intervention represents a promising addition to the current treatment landscape, offering hope for better outcomes and prolonged joint health.

CONCLUSION

In conclusion, our study highlights the efficacy of proximal fibular osteotomy combined with arthroscopic partial meniscal debridement in improving short-term functional outcomes for patients with early osteoarthritis of the knee. Significant reductions in pain, as evidenced by decreasing Visual Analog Scale (VAS) scores, coupled with marked improvements in knee function measured by American Knee Society Scores (AKSS) and functional parameters, highlight the benefits of this surgical approach. These findings support the role of joint-preserving surgeries in managing early knee OA, potentially delaying disease progression and enhancing patients' quality of life through restored mobility and reduced pain.

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