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Proximal Fibular Osteotomy Vs Proximal Fibular Osteotomy with Intra-Articular Hyaluronic Acid: Difference in Terms of Pain Relief and Functional Outcome

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ABSTRACT

Background: Knee osteoarthritis (OA) is a complex, progressive illness marked by cartilage deterioration and adjacent bone enlargement, and management is challenging due to poor connective tissue self-regeneration. This study compared the effects of proximal fibular osteotomy (PFO) alone versus PFO with intra-articular hyaluronic acid injections (IAHA) among patients presenting with knee OA.

Methods: A quasi-experimental study was done at Ziauddin Hospital's orthopedics department from March 2020 to March 2021. Patients with medial compartment knee joint OA requiring surgery aged ≥40 years and BMI of <30kg/m^2 were included. All participants were assigned into two groups, PFO was done alone in group A (n=30) and with IAHA in group B (n=30). Both groups had their medial joint spaces measured and documented pre- and post-operatively, as well as their Oxford knee score and visual analog scale (VAS). SPSS version 25 was used and the normality of data was assessed using Shapiro-Wilk's test. The mean difference (post-pre) was compared using the Mann-Whitney U test. A p≤0.05 was statistically significant.

Results: A total of 60 patients were included with a mean age of 51.30±4.87 in Group A and 50.83±6.17 in Group B. Outcomes in both groups were improved considerably with a significant p<0.0001 in groups, in terms of pain and function determined using Oxford knee score, medial joint space measurement, and VAS score.

Conclusion: PFO alone and PFO with IAHA show significantly improved results in terms of functional outcomes, but the use of IAHA in combination with PFO, has considerably better results in terms of pain relief.

Keywords: Intra-Articular Injection, Knee Osteoarthritis, Osteoarthritis, Osteotomy

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INTRODUCTION

Knee osteoarthritis (OA) is a complex, progressive illness marked by cartilage deterioration and adjacent bone enlargement[1, 2]. Knee OA is expected to affect 16 percent of the global population and 203/10,000 person-years[3]. Increased BMI, advanced age, feminine gender, physical inactivity, trauma, and misalignment are all associated with it[1]. Malalignment can cause uneven load distribution inside the knee joint, exerting extra stress on a specific area of articular cartilage. An increase in breakdown products is caused by a local biochemical process involving pro-inflammatory cytokines, free radicals, and proteinases, affecting articular cartilage homeostasis and lowering synovial fluid viscosity[4].

Previously, Total Knee Arthroplasty (TKA) was the only choice for orthopedic surgeons. Even though it provides pain relief and deformity repair, it is not the therapy of choice for the young population[5]. Uni-compartment knee arthroplasty (UKA) is another option for TKA. Although this treatment is connected to a faster recovery time and fewer problems, it is also linked to a greater risk of reoperation[6]. High tibial osteotomy (HTO). is another popular procedure, especially among young patients[7]. HTO is a technically difficult operation that can result in problems such as neurovascular damage, iatrogenic fracture, and non-union. Furthermore, many individuals may require TKA correction in the future [8, 9].

Proximal Fibular Osteotomy (PFO) has gained popularity in recent years as a treatment option for individuals with medial compartment knee OA. It is far more popular in the East (China and India) than in the West.[10] Its appeal stems from the fact that it is a simpler, less costly treatment with superior functional results. It is more likely to be used than alternative procedures like UKA, HTO, and TKA in younger populations and patients with multiple co-morbidities[11]. A study revealed that pain scores dramatically decreased from 6.4 (baseline) to 2.1 (postoperatively after 1 year) among 30 patients treated with PFO[10].

Intra-articular hyaluronic acid (IAHA) injections have recently gained popularity as a therapy for knee OA.[12] Restoration of the elastic and viscous characteristics of the synovial fluid, anti-inflammatory and anti-nociceptive actions, and regulated hyaluronic acid production are all advantages of IAHA injections[8, 9]. A review of 8 meta-analyses reported, that patients with knee OA treated with IAHA treatment showed substantial improvement in stiffness, function, and pain for up to 26 weeks when compared to controls[12].

PFO and IAHA, both techniques, might theoretically be employed together to generate synergistic benefits for restoring normal architecture and delaying disease progression. As a result, we examined the effects of PFO alone versus PFO with IAHA injections in terms of pain relief and functional outcomes in this study.

METHODS

It was a quasi-experimental study conducted at the orthopedics department of Dr. Ziauddin University Hospital, Karachi over 1 year from March 2020 to March 2021. A sample size of 24≈to 30 in each group was estimated on the Open Epi sample size calculator. Statistics of mean function sub scores as 67.63 ± 13.65 in the PFO group and 54.10±10.29 in the PFO plus IAHA group (considering 20% difference between groups), 99% confidence level, and 90% power of test were considered for sample size estimation[13].

Patients with medial compartment knee joint OA who needed surgery, were age≥40 years and had a BMI of less than 30 kg/m^2 were included in the study. Patients in whom conservative management was unsuccessful were also included in this study as they were good candidates for surgery. Whereas patients with morbid obesity, tri-compartmental or bi-compartmental OA, valgus knee deformity, inflammatory joint disease, or any infection in the knee joint were not included in this study. A non-random consecutive sampling technique was applied for sample selection.

Ethical review approval of Ziauddin Hospital Nazimabad was attained for the study (ERC #3092020). All the patients, included in this study, underwent clinical and radiological evaluation. PFO alone (group A) or with IAHA (group B) was performed after receiving written informed consent.

PFO was performed by cutting a single lateral incision in the fibula that measured 3-5 cm in length. Between the peroneus and soleus muscles, fascia was incised along the septum. Using an oscillating saw and an osteotome, a 2-3 cm portion of the fibula was removed 6 to 10 cm below the caput fibulae. The surgical site was irrigated with a large amount of normal saline, and the muscles, fascia, and skin were then sutured in layers.

For IAHA injection, the patient is placed in a supine position with the knee flexed slightly by placing a towel roll in the popliteal space. The needle insertion site was marked, a lateral suprapatellar approach was chosen, and the site of injection was marked one finger breadth above the patellar edge and one finger breadth lateral to the patellar edge, and the drug was injected. Pre and postoperatively, a weight-bearing x-ray of the diseased knee was taken in anteroposterior (AP) and lateral perspectives and medial and lateral joint spaces were measured and documented. At monthly intervals, VAS and Oxford knee score values were recorded

before and after surgery.

The collected data was entered into SPSS version 25. The normality of the numeric data was assessed using Shapiro-Wilk's test. Data such as age and pre- and post-Oxford Knee Score were normally distributed and therefore presented as mean ± standard deviation. Whereas pre- and post-VAS scores and pre- and post-medial joint space followed non-normal distribution and, therefore, presented as median and interquartile range. Qualitative variable such as gender was presented in the form of frequency and percentage. Change in Oxford knee score (pre and post) in both groups was assessed using a Paired t-test. Change in medial joint space (pre and post) and VAS score (pre and post) in both groups were assessed using the Wilcoxon Rank test. The mean difference (post-pre) in Oxford knee score and medial space between both groups was compared using an independent sample t-test (as the mean difference in Oxford knee score and medial joint space across groups followed normal distribution). The mean difference (post-pre) in VAS score between both groups was compared using the Mann-Whitney U test (as the mean difference in VAS score across groups followed a non-normal distribution). A p-value≤0.05 was considered statistically significant.

RESULTS

The sixty patients were between the ages of 40 and 65, with a mean age of 51.30±4.87 years in Group A and 50.83±6.17 years in Group B. In group A, there were 18 (60%) females and 12 (40%) males, whereas in group B, there were 16 (53.3%) females and 14 (46.7%) males. (Table 1).

Table 1: Baseline characteristics of both groups.

Variables	Group A	Group B
Age (years)	51.30±4.87	50.83±6.17
Gender		
Male	12 (40%)	14 (46.7%)
Female	18 (60%)	16 (53.3%)

Significant pain relief and improved joint function were observed in all patients using the Oxford knee scoring system at 1 year post-operatively, with an average increase of 14.78-15.20 points (as compared to pre-operative evaluation), with a score of 26.23±2.75 pre-operatively improving to 41.01±2.61 post-operatively in group A (p=0.001), and a score of 27.47±4.10 pre-operatively improving to 42.70±2.57 post-operatively (p=0.001). Similarly, weight-bearing lower-limb X-rays revealed an increase in the median medial knee joint space from 3.81 mm pre-operatively to 5.14 mm post-operatively in group A and from 3.79 mm pre-operatively to 5.21 mm post-operatively in group B, both with a significant p-value of ≤0.05. In group A, the median pain score fell from 8 pre-operatively to 4 post-operatively, while in group B, the median pain score decreased from 8 pre-operatively to 3 post-operatively, with a significant p-value of ≤0.05 in both groups. (Table 2)

Table 2: Comparative analysis of pre and post of Oxford knee score, medial joint space, and VAS score in both groups

Groups	Oxford Knee Score$		p-value	Medial Space (mm)^		p-value	VAS score^		p-value
	T1	T2		T1	T2		T1	T2	
A	26.23±2.75	41.01±2.61	0.001*	3.81 (3.60-3.91)	5.14 (5.03-5.36)	0.001*	8 (7-9)	4 (4-5)	0.001*
B	27.47±4.10	42.70±2.57	0.001*	3.79 (3.30-3.89)	5.21 (5.08-5.36)	0.001*	8 (7-9)	3 (2-4)	0.001*

*T1=Pre-operatively, T2=post-operatively at one year, Data presented as Mean±SD or Median (IQR), $ Paired t-test was applied, ^ Wilcoxon Rank test was applied *Significant at 5% level of significance*

The mean difference in Oxford knee score and medial joint space was identical in both groups, according to an independent t-test. (Table 3)

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Table 3: Comparative analysis of mean difference in Oxford knee score and medial joint space between both groups.

Groups	Oxford Knee Score*	p-value	Medial Space (mm)*	p-value
	Mean difference		Mean difference	
A	-0.466	0.664	-0.11	0.303
B				

**An independent t-test was applied.*

Mann-Whitney U test revealed that the change in VAS score was significantly different between both groups (U=186, p=0.001). (Figure 1)

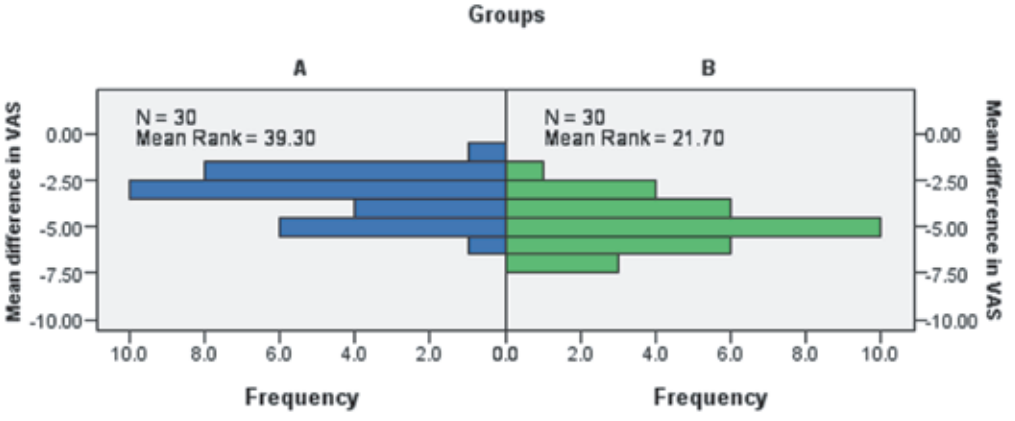

Figure 1: Comparison of change in VAS score between both groups.

DISCUSSION

PFO is based on the idea that non-uniform settling causes knee OA and accelerates its development[14]. The lateral section of the tibial plateau is supported by the fibula and associated soft tissues, but the medial side is exclusively supported by the medial tibial cortex. In light of this, the medial side experiences increased axial stress, resulting in non-uniform settlement and tibial plateau degeneration[15]. PFO is used to decrease the lateral fibular support, which subsequently shifts the stress from the medial to the lateral side, causing the varus deformity to be corrected and thereby impacting disease development[16].

Intra-articular drug administration, on the other hand, which is a concentrated therapeutic dosage that is dispersed through the joint capsule, may be regarded as an optimal route of drug delivery in OA[17]. Intra-articular drug administration provides several advantages over systemic drug delivery, including higher local bioavailability, less systemic exposure to some medications, fewer side effects, and a lower cost[10, 18, 19].

There are numerous studies and ample data about the benefits and use of PFO and IAHA individually, but there is no study has been conducted on the use of PFO and IAHA in combination. Hence, in the current study, we have compared the effects of PFO alone with PFO with IAHA injections in terms of pain relief and functional outcome. Our research demonstrates that while both PFO alone and PFO + IAHA have dramatically improved functional outcomes, the use of IAHA in conjunction with PFO has much superior pain reduction results. In individuals with knee OA, IAHA also lowers the requirement for additional analgesics such as NSAIDs, corticosteroids, and opioids, according to recent research[20].

Retrospective database analyses show a 0.6–2.2-year delay in the need for TKR with 5 or more doses of IAHA, and up to 3.6 years with 5 or more doses of IAHA[21-23]. In a prospective comparative study of PFO and HTO for unilateral varus knee OA, Zou et al. found that the PFO group had a significantly lower operating time, peri-operative hemorrhage, time to full weight-bearing, VAS score, and post-operative complications[24]. PFO improved both the radiological look and function of varus knee OA, as well as long-term pain alleviation, according to Yang et al., who performed it in 156 patients with medial compartment knee OA[25].

Both above-mentioned treatments give considerable advantages on their own, but when used together, they produce better results, particularly in terms of pain reduction. Some of the limitations were that assessing the results in the treatment of medial

compartment osteoarthritis required a bigger sample size and a longer follow-up time. Another flaw was the lack of a control group. Because the patients were assigned at random, it is impossible to say which treatment approach will provide better results in whatever grade of OA. More research should be done in the future to assess how successful and safe these treatments are on a broader sample of persons with knee OA. This would help to broaden the therapeutic applicability of these methods.

CONCLUSION

In conclusion, our study highlights the efficacy of PFO and PFO + IAHA in enhancing functional outcomes. Notably, the addition of the IAHA with PFO yields superior pain relief. These findings advocate for a nuanced approach in clinical interventions, emphasizing the potential synergies for improved patient outcomes in pain management.

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None

CONFLICT OF INTEREST

There is no conflict of interest.

ETHICAL APPROVAL

Ethical review approval of Ziauddin Hospital Nazimabad was attained for the study (ERC #3092020).

PATIENT CONSENT

All the patients, included in this study, underwent clinical and radiological evaluation. PFO alone (group A) or with IAHA (group B) was performed after receiving written informed consent.

AUTHORS CONTRIBUTIONS

NM Conceptualization, Methodology design, Manuscript writing and editing, and manuscript review. MK, MN Data collection and validation, manuscript drafting and revision, data entry and management. KA Data analysis and interpretation, manuscript review, and final approval.

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