RESEARCH

FUNCTIONAL OUTCOME OF OSTEOARTHRITIS KNEE TREATED WITH PROXIMAL FIBULAR OSTEOTOMY

Received : 11/06/2022
Received in revised form : 21/08/2022
Accepted : 30/08/2022

Keywords:
Proximal fibular osteotomy, Medial compartment osteoarthritis, TKR, Kellgren–Lawrence score.

Corresponding Author:
Dr. Sandeep Kumar A,
Email. sandeep.kumar523@gmail.com
ORCID: 0000-0002-4627-6331

DOI: 10.47009/jamp.2022.4.4.48

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2022; 4 (4); 244-249

Teenu Chandheesh Kotla[1], Sandeep Kumar A[2], Bharghav Y[3]

[1]Postgraduate Resident, Department of Orthopaedics, Narayana Medical College and Hospital, Chintharedypalem, Nellore, Andhra Pradesh, India
[2]Assistant Professor, Department of Orthopaedics, Narayana Medical College and Hospital, Chintharedypalem, Nellore, Andhra Pradesh, India
[3]Senior Resident, Department of Orthopaedics, Narayana Medical College and Hospital, Chintharedypalem, Nellore, Andhra Pradesh, India

Abstract

Background: Osteoarthritis is the most common cause of disability in the Indian population. Total knee arthroplasty, which aims to relieve pain and improve joint function and mobility, is the main surgical alternative in this patient population. To assess the functional outcome of osteoarthritis knee treated with proximal fibular osteotomy. **Materials and Methods:** 30 patients were selected who suffered from Osteoarthritis. The patient underwent Proximal fibula osteotomy. Following discharge, patients followed up at 1st, 3rd and 6th month and during which serial Xraysand clinical assessment were done of knee joint. **Result:** 30 patients were selected with medial compartment osteoarthritis knee.Out of them 2patients had paraesthesias along the course of the SPN and over the dorsum of the foot, and 2patients had EHL weakness, and all of them recovered within 3months. and none of the patients had foot drop and infection. **Conclusion:** PFO is a relatively simple, safe, and affordable surgery for pain relief, correction of varus malalignment, and to improve joint function in medial compartment osteoarthritis knee.

INTRODUCTION

Osteoarthritis is a progressive degenerative condition consisting of the retrogressive sequel of cell and matrix changes that result in articular cartilage structural loss and function accompanied by cartilage repair and bone remodelling reaction. All ethnic groups of people are affected in all geographic locations, and it is the most common cause of disability in old age.

Degenerative changes are not uniformly progressive and generally high in the medial compartment of the knee, and the rate of joint degradation varies individually. Osteoarthritis is regarded as a whole joint disease with multifactorial aetiology like alteration of biomechanical stress loading, ligament instability, cartilaginous degradation, muscular imbalance, and insufficiency.

Risk Factors of Osteoarthritis Knee

1. Age,
2. Obesity,
3. Joint incongruency
4. Increased mechanical stress
5. Ligamentous injuries sequel
6. Intraarticular fractures

The cartilage shows diminished cellularity, proteoglycan concentration, elasticity, and a decrease in breaking strength with advancing years.

Tears of ligamentous structures that protect the joints, such as the anterior cruciate ligament and meniscus in the knee and labrum in the hip, susceptibility leading to premature Osteoarthritis knee. Meniscal tears increase with age, and chronic tears are often asymptomatic but lead to adjacent cartilage damage and accelerated osteoarthrosis. Obesity and joint incongruency, and occupational repeated use can cause increased mechanical stress leading to early osteoarthritis knee.

Joint pain of OA is often described as a deep ache localized to the involved joint. Movement aggravates the pain and is relieved by rest, but as the disease progresses, it may become persistent. Articular cartilage is aneural; joint pain in OA must arise from other structures. The cardinal signs of osteoarthrosis are narrowing of the joint space, marginal osteophytes, subchondral cysts and sclerosis, malalignment and bone remodelling.

Various Treatment Strategies of Osteoarthritis Knee: Conservative Methods

1. Foot wear interventions and NSAIDs.[1]
2. Modification of gait with toe-out gait

ISSN (O): 2687-5365; ISSN (P): 2753-6556

3. Valgus knee braces
4. Muscle strengthening
5. loss of weight as obesity enhances loads during the stance phase
6. Neuromuscular rehabilitation
7. Orthobiologics and viscosupplementation.[2]
8. Platelet rich plasma therapy
9. Intra articular steroid injections

Surgical Modalities.[3]

1. High tibial osteotomies for uni-compartmental osteoarthritis knee
2. Proximal fibular osteotomy (novel surgery)
3. Unicompartmental arthroplasty (for uni-compartmental arthritis)
4. Total knee arthroplasty.

Osteoarthritis of the knee is the most prevalent form of Osteoarthritis. It occurs commonly in the medial compartment of the knee.

Proximal fibular osteotomy (PFO) is a simple and inexpensive novel procedure proposed to treat pain due to medial compartment arthritis

PFO is proposed as an alternative to high-tibial osteotomy (HTO), Uni-compartmental knee arthroplasty (UKA), and total knee arthroplasty (TKA).

PFO is a relatively safe and inexpensive treatment method.

PFO is an excellent alternative procedure for replacement surgery in young individuals suffering from medial compartment arthritis

It is relatively free from complications such as non-union at the osteotomy site, wound closure complications associated with High tibial osteotomy (HTO).

The learning curve of the PFO procedure and surgical time is relatively less in comparison to HTO and UKA, and TKA.

However, there is no consensus available at the moment regarding the mechanism of action and the outcome of this procedure. The aim of the study is to assess the functional outcome of osteoarthritis knee treated with proximal fibular osteotomy.

MATERIALS AND METHODS

This Prospective study was conducted in Department of Orthopaedics, Narayana Medical College and Hospital, Chinthareddypalem. A minimum of 30 patients will be selected with Osteoarthritis in the medial compartment arthritis. Duration of study was from June 2020 to May 2021.

Inclusion Criteria

Were OA mainly involving age from 30 years to 76 years, The isolated medial compartment of the knee joint, Medial space narrowing, patient with difficulty in walking and pain due to medial compartment knee osteoarthritis, Provision of informed and written consent to a surgical plan involving, Kellgren Lawrence grade less than.[4]

Exclusion Criteria

Posttraumatic knee OA, Genu valgus, Tricompartmental OA, Septic arthritis, inflammatory joint disease, malignant tumors. Patients who fit Into the inclusion criteria will be selected and after taking surgical fitness from the anesthesiology department, proximal fibula osteotomy is performed.

Follow-up and Clinical Evaluations

Anteroposterior and lateral radiographs of the knee joint were obtained preoperatively and postoperatively at 1, 3, 6 months. The severity of knee OA will be evaluated using the KL score.

In this study, radiological factors included tibiofemoral angle (TFA), Kellgren and Lawrence grading of OA knee 49, joint space width of both compartments, were made on AP radiographs preoperatively and postoperatively.

Pain will be Assessed Using: Visual analog scale.

Functional activity is measured by the knee society score ROM of the knee joint is used to evaluate knee function in all patients at baseline and each follow-up visit. Functional activity is assessed at immediate postoperative day, at 14th postoperative day, and six weeks, at three months, six months.

Surgical Technique

The surgery is performed with the patient in the supine position under spinal anesthesia with antibiotic cover. Tourniquet will be used routinely in our series. The fibular head is marked, and the osteotomy site is taken as 7 to 9 cm from the fibula head. The rationale for choosing this level of osteotomy is that a higher level osteotomy would be likely results in injury to the common peroneal nerve. At the same time, that there will be a loss of effect of the osteotomy on the arthritis of the medial compartment if it is done any lower down. A 5-8 cm lateral incision is made overlying the chosen site of osteotomy, and dissection is done through the skin and subcutaneous tissues. The peroneus muscle and soleus muscle are then separated to expose the periosteum of the fibula, which is then incised, and a 1.5 to 2 cm of thefibula is then osteotomised with the help of an oscillating saw after placing a few drill holes at the osteotomy site. Too much stretch of the soft tissues is avoided in order to protect the nerve from potential damage. Bone wax is used to seal the occasional profuse bleed from the fibula cut ends, which occurs after the osteotomy.

After ensuring hemostasis and giving wound wash, closure is done in layers, and sterile dressing and compression bandage applied. All patients are encouraged to stand and walk on the same evening of surgery and are discharged on the third postoperative day after the first wound inspection. Intravenous antibiotics will be given for three days and followed by oral antibiotics for a period of 5 days. The sutures are removed on the 12th postoperative day.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Postoperative X-rays are then taken, and the radiological parameters are evaluated and documented. The patients were reviewed at 1, 3, 6 months, where the VAS and the knee scores are evaluated and documented.

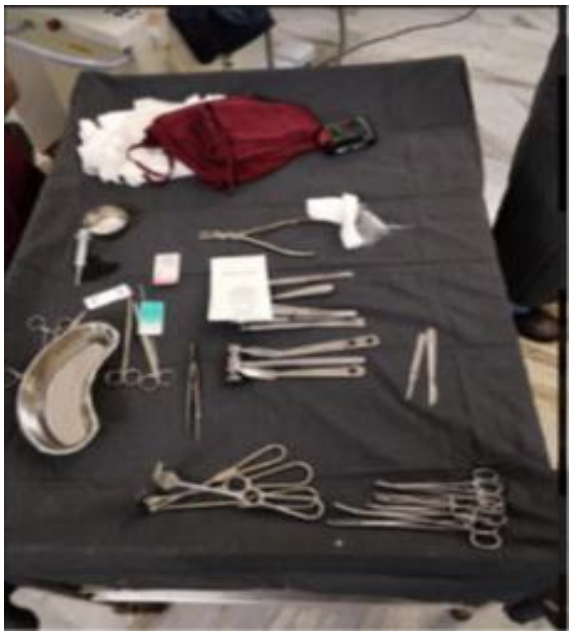

Fig.1 Instruments used for proximal fibular osteotomy

Fig.2 The fibular head is marked, and the osteotomy site is taken as 7 to 9 cm from the fibula head.

Fig.3 1.5 to 2 cm of the fibula is exposed at the determined osteotomy site and osteotomised.

Preoperative X-rays: AP and Lateral views
Evaluation parameters:
Kellgren-Lawrence (KL) grading of OA Knee:
Knee society score (KSS) was used
Grading for the Knee Society Score:

Score	Remark
80-100	Excellent
70-79	Good
60-69	Fair
Below 60	Poor

Bone wax is used to seal the occasional profuse bleed from the fibula cut ends, which occurs after the osteotomy. After ensuring hemostasis and giving wound wash, wound closure is done in layers.

Fig.4 Pre-op and Immediate Post op X-rays

Fig.5 3rd month follow-up X rays

Fig.6 6th month follow-up X-rays

RESULTS

In our study, 30 patients were selected with medial compartment osteoarthritis knee along the lines of inclusion criteria described; out of them, 17 were females, and 13 were males. Medial compartment arthritis of the knee is more prevalent in middle age groups, i.e., 35-50 years in our study.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Out of 30 patients,15 patients underwent PFO for the right knee, and 15 patients underwent surgery for the left knee.

Patients were assessed with a VAS scale for pain assessment, and KSS knee society scores for functional activity and radiological parameters were evaluated using medial joint space and lateral joint space and tibiofemoral angle TFA preoperatively and postoperatively and followed up for at least for six months duration, and baseline results were noted. Mean, the standard deviation was calculated and the same represented by the graphs. A paired t-test was used to calculate the significance between the variables. A p-value of less than 0.05 was taken as significant.

Preoperative VAS SCORE Mean ±SD 5.8±0.61and there is a significant reduction in pain postoperatively, at the final follow up, the VAS score Mean ±SD is 2.1±0.71.

Preoperative mean medial joint space 1.31±0.31and there is significant improvement postoperatively with mean medial joint space of 4.5±0.28 with widened medial joint space.

The mean preoperative lateral joint space is 7.07±0.59 and there is a significant reduction in lateral joint space postoperatively with mean lateral joint space5.65±0.62.

There is an improvement in the tibiofemoral angle TFA from the mean TFA 184±1.81preoperatively to the mean TFA 178.5±1.3 postoperatively.

The mean functional knee score was 53.6 preoperatively and improved to 74.5 postoperatively at the end follow-up.

Table 1: showing the pain VAS variation between pre-operation and a postoperative final follow up

Pain	**Preoperative mean± SD**			**Postoperative mean± SD**				
Vas score	5.8±0.61			2.1±0.71				
Paired Samples Test								
	Paired Differences					t	df	Sig.(2-tailed) P-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
(VAS)Pre-op - (VAS) Post-op	3.700	.651	.119	3.457	3.943	31.118	29	<.0005

Table 2: Medial joint space variation between pre-operation and a postoperative final follow up.

		Pre-op mean+/-SD			**Post-op+/-SD**				
Medial joint space		1.31±0.31			4.5±0.28				
Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair1	MJSPREOP–MJS POSTOP	-3.190	.263	.048	-3.288	-3.092	-66.417	29	<.0005

Table 3: Lateral joint space variation between pre-operation and a postoperative final follow up.

		Pre-Op mean+/-SD			**Post-op+/-SD**				
LATERALJOINTSPACE		7.07±0.59			5.65±0.62				
Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. ErrorMean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair1	LJSPREOP – LJSPOSTOP	1.42000	.94737	.17297	1.06624	1.77376	8.210	29	<.0005

Table 4: Tibiofemoral angle variation between pre-operation and a postoperative final follow up.

Tibiofemoralangle		**Preoperative(mean±SD)**			**Postoperative(mean±SD)**				
TFA		184+/-1.81			178.5+/-1.3				
Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair[1]	-TFAPRE0P-TFA POSTOP	5.500	2.097	.383	4.717	6.283	14.367	29	<.0005

Functional score: KSS knee society score

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 5: KSS score between pre-operation and a postoperative final follow up

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair1	KSS preop–KSS postop	-20.900	8.231	1.503	-23.973	-17.827	-13.908	29	<.0005

KSSSCORE	Preoperative	Post-operative
MEAN	53.6	74.5
SD	4.83	7

DISCUSSION

Medial compartment arthritis of the knee is a common disorder affecting lifestyle quality and functionality due to severe pain.

Although various treatments like high tibial osteotomy, unicompartmental arthroplasty,[4] and total knee arthroplasty were proposed and practiced for medial compartment osteoarthritis knee, they have significant complications following surgery relative to the proximal fibular osteotomy.

A total knee arthroplasty TKA procedure, despite relieves pain and improves function even in end stages arthritis, is very complex and expensive,[5] and may even require revisions and chances of infections are relatively high, whereas high tibial osteotomy HTO was the surgery of choice which aims in correcting the varus malalignment in medial compartment OA knee in the young individuals and delays the TKA necessity, it comes with the disadvantages like prolonged non-weight-bearing, delayed union or nonunion risks, wound infection and peroneal nerve paralysis.[6]

Proximal fibular osteotomy is a relatively easy procedure with less surgical time and low complications in relation to other procedures like HTO and UKA and TKA that were described for medial compartment osteoarthritis knee.[7]

PFO (proximal fibular osteotomy) is a novel surgery to treat medial compartment arthritis knee for pain relief and improvement of joint function. Patients who underwent PFO had significant pain relief, and their medial joint space increased. The effects were seen immediately after PFO in the majority of the patients, and the patient can be mobilized and weight-bearing can be started on the immediate postoperative day. Although the exact mechanism of action of PFO is relatively known but felt, various theories have been proposed

1. Non uniform settlement theory:

The fibula bone density is relatively higher than the medial tibial plateau. With a condition like decreased bone density, the lateral side of the Tibia is not allowed to "settle" due to the support of the fibula to the lateral tibial plateau creating a varus deformity.[8]

This theory has been called non-uniform settlement as the majority of the medial tibial plateau is unsupported, the medial side "settles" down with medial slippage of femoral condyles during playing and walking, further aggravating the non-uniform settlement.

The PFO rationale is that with proximal fibular osteotomy, this support from the fibula to the lateral tibial plateau is removed, even the lateral side settles down, leading to varus deformity correction and reducing pain and other symptoms.

Dong et al. studies settlement value and proposed that settlement to be inversely related to the hip-knee angle (HKA) and directly related to the KL grading of OA of the knee.

2. Too many cortices theory:

This theory states that only one cortex supports the medial Condyle. Still, the lateral Condyle is supported by three cortices, i.e.by, two fibular cortices, one tibial cortex, and balance loading is thus difficult when the medial side collapses in a varus-deformed knee with an intact fibula. Whereas with the PFO, the fibular strut support is removed and neutralized and load-bearing capacity becomes equal, and strut effect of the fibula is interrupted, and varus thrust is eliminated.

3. Slippage phenomenon:

Non-uniform settlement leads to varus settlement, which makes the femur to slide to the medial side. This phenomenon of sliding towards the medial side is called the slippage phenomenon. Which further tends to increase the highKnee adduction moment (kam), which further enhancing the non-uniform settlement, leading to the progression of varus deformity.

4. The theory of competition of muscles:

Huang et al. stated that following PFO, i.e., proximal fibular osteotomy, there exists a competition between biceps femoris and peroneus of muscles.[9]

He also found that there is a decrease in muscleactivity in the peroneus Longus on the side operated and increased muscle activity in the long head of biceps femoris immediately after proximal fibular osteotomy.

This could explain the immediate improvement in tibiofemoral angle from a significant varus to a more neutral alignment immediately following the high-fibular osteotomy.

5. Dynamic fibular distalization theory:

Qin et al,[10] found that after PFO surgery, the proximal fibula is not subjected to weight transmission compressive forces from the distal fibula any further. Whereas muscles attached to the

ISSN (O): 2687-5365; ISSN (P): 2753-6556

proximal fibula, like peroneus longus and soleus, exerted the distal pull over the fibular head, and there is a transmission of tensile force from the fibular head to the lateral femoral Condyle narrowing the lateralknee-joint space.

Despite the mechanism of PFO remains unclear, with many theories proposed, it has been seen that proposed theories are complementary to each in the working mechanism with the evident results.

The long-term side effects of PFO on the other joints like the ankle, knee, hips are unknown yet. Hence it requires further study on the biomechanics of the PFO knee, its mechanism of pain relief, and the widening of joint space medially.[11]

Zou et al, in their study, observed that in proximal fibula osteotomy, the fibular head is distally pulled through the peroneus longus and soleus muscle to form a lever structure, with the fulcrum being lateral tibial plateau used to pry the medial femoral Condyle to reduce the stress of medial plateau.

Hence, the load on the knee is transferred from the medial plateau to the lateral plateau, causing the rearrangement of the mechanical axis of the distal femur to relieve the lateral soft tissue tension of the knee joint and relieve symptoms. Some studies also argued that this procedure is associated with low intra-osseous pressure and pain relief.

Ideal site of osteotomy

The success of Proximal Fibular Osteotomy greatly depends on the correct level of the osteotomy. The ankle joint complex stability depends on the fibula's integrity, and well known that six centimeters of the distal fibula are essential for ankle stability. Hence, performing partial fibulectomy more proximally is preferred, avoiding complications in the ankle. With the interosseous membrane, fibers are oblique from Tibia down to fibula; on weight-bearing, the fibula is pulled towards the Tibia by the interosseous membrane resulting in load sharing between the two bones. On performing the partial fibulectomy more proximally, lesser loads are shared by the proximal fibular segment, and its support to the lateral tibial plateau becomes weaker. The most commonly reported complication of PFO is related to the injury to the peroneal nerve and its branches due to its proximity and an anatomical course about the fibula. Hence, it is mandatory to understand its anatomical location and make all the efforts to prevent neurological injury during the PFO. Close attention is needed to avoid potential peroneal nerve injury during surgery.

To reduce iatrogenic injury to the peroneal nerve postero-lateral approach is ideal, which passes between the Peroneus longus muscle and the soleus muscle to expose the proximal fibula.

CONCLUSION

PFO is a relatively simple, safe, and affordable surgery for pain relief, correction of varus malalignment, and to improve joint function in medial compartment osteoarthritis knee. It is a promising alternative procedure for medial compartment osteoarthritis. This procedure delays the requirement of TKR. Care should be taken to avoid injuries to peroneal nerves.

The postoperative vas score, KSS knee score, and medial joint space and lateral joint space and tibiofemoral angle in comparison to the preoperative vas score, KSS knee score and medial joint space and lateral joint space and tibiofemoral angle are significant as the P-value is <0.05 and hence the test is significant.

REFERENCES

1. Pendleton A, Arden N, Dougados M, Doherty M, Bannwarth B, Bijlsma JW, et al. EULAR recommendations for the management of knee osteoarthritis: report of a task force of the Standing Committee for International Clinical Studies Including Therapeutic Trials (ESCISIT). Ann Rheum Dis. 2000;59(12):936-44. doi: 10.1136/ard.59.12.936.
2. Petrella RJ, Petrella M. A prospective, randomized, double-blind, placebo controlled study to evaluate the efficacy of intraarticular hyaluronic acid for osteoarthritis of the knee. J Rheumatol. 2006;33(5):951-6.
3. McGrory B, Weber K, Lynott JA, Richmond JC, Davis CM 3rd, Yates A Jr, et al. The American Academy of Orthopaedic Surgeons Evidence-Based Clinical Practice Guideline on Surgical Management of Osteoarthritis of the Knee. J Bone Joint Surg Am. 2016;98(8):688-92. doi: 10.2106/JBJS.15.01311.
4. Parratte S, Argenson JN, Dumas J, Aubaniac JM. Unicompartmental knee arthroplasty for avascular osteonecrosis. Clin Orthop Relat Res. 2007;464:37-42. doi: 10.1097/BLO.0b013e31812f7821.
5. Migliorini F, Tingart M, Niewiera M, Rath B, Eschweiler J. Unicompartmental versus total knee arthroplasty for knee osteoarthritis. Eur J Orthop Surg Traumatol. 2019;29(4):947-955. doi: 10.1007/s00590-018-2358-9.
6. Hernigou P, Medevielle D, Debeyre J, Goutallier D. Proximal tibial osteotomy for osteoarthritis with varus deformity. A ten to thirteen-year follow-up study. J Bone Joint Surg Am. 1987;69(3):332-54.
7. Guo J, Zhang L, Qin D, Chen W, Dong W, Hou Z, Zhang Y. Changes in ankle joint alignment after proximal fibular osteotomy. PloS one. 2019;14(3):e0214002.
8. Dong T, Chen W, Zhang F, Yin B, Tian Y, Zhang Y. Radiographic measures of settlement phenomenon in patients with medial compartment knee osteoarthritis. Clin Rheumatol. 2016;35(6):1573-8. doi: 10.1007/s10067-015-3146-0.
9. ZeYu Huang YN, Xu B, Shen B, Kraus VB, Pei F. Evidence and mechanism by which upper partial fibulectomy improves knee biomechanics and decreases knee pain of osteoarthritis. J Orthop Res. 2018:10.1002/jor.23867. doi: 10.1002/jor.23867.
10. Foroughi N, Smith R, Vanwanseele B. The association of external knee adduction moment with biomechanical variables in osteoarthritis: a systematic review. Knee. 2009;16(5):303-9. doi: 10.1016/j.knee.2008.12.007.
11. Nie Y, Ma J, Huang Z, Xu B, Tang S, Shen B, et al. Upper partial fibulectomy improves knee biomechanics and function and decreases knee pain of osteoarthritis: A pilot and biomechanical study. J Biomech. 2018;71:22-29. doi: 10.1016/j.jbiomech.2017.12.004.

ISSN (O): 2687-5365; ISSN (P): 2753-6556