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Original Research Article

The Functional Outcome of Medial Compartment Osteoarthritis Knee Following Proximal Fibular Osteotomy

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Abstract:

Background: Knee osteoarthritis (O.A.) is a chronic, progressive degenerative disease that affects the articular cartilage and due to anatomy and biomechanics medial compartment osteoarthritis knee is most common. Various treatment modalities like intraarticular injections, physiotherapy, visco- supplementation, arthroscopic debridement, high tibial osteotomy, and knee replacement with uni-compartmental arthroplasty have its own complications. Hence, there is a necessity for a modest technique easily reproducible, provides decent functional outcomes. In this scenario, this study is designed to know the functional outcomes, when an osteotomy of the fibula at proximal 3rd is performed in medial compartment osteoarthritis knee.

Materials and Methods: This study is a Hospital-Based Prospective interventional study, study period between July 2019- June 2021(2 years), conducted in Department of Orthopaedics, Andhra Medical College, Visakhapatnam. SAMPLE SIZE: 36. Patients fit for surgery and fall in the inclusion criteria for high fibular osteotomy taken for surgery The primary outcome observed will be the functional outcome of the patient. Preoperative and postoperative Oxford knee score (OKS), function sub-scores of the American Knee Society score (AKSS), and Visual Analogue Score (VAS) was noted along with Preoperative and postoperative weight-bearing ratio of medial/lateral compartment. Patients were followed up on for 14 days, 3 months, and 6 months after surgery, and the results were compared to pre-surgery scores at the end of the six-month follow-up period.

Results: At 6 months, showed radiological improvement, all being statistically significant ($P < 0.001$). The average VAS score before surgery was 7.36 ± 1.04, and six months later it was 1.72 ± 0.77. The average pre-op functional sub-score of the AKSS was 50.75 ± 2.72, with a final score of 73.66 ± 2 after six months. The average preoperative OXFORD score was 24.05 ± 1.73, and the average postoperative OXFORD score was 33.94 ± 2.2. the average medial/lateral joint space was 0.36 ± 0.18, which increased in the postoperative phase, reaching 0.77 ± 0.28 after six months.

Conclusion: PFO has developed as a new procedure for people with knee osteoarthritis who want to alleviate pain and improve joint function. The study's most remarkable findings were pain alleviation and an improvement in the medial to lateral joint space ratio.

Keywords: Knee Osteoarthritis, Proximal Fibular Osteotomy, Visual Analogue Score (VAS).

Introduction

Knee osteoarthritis (O.A.) is a chronic, progressive degenerative disease that affects the articular cartilage and due to anatomy and biomechanics medial compartment osteoarthritis knee is most common.

It is commonly seen in males less than 50 years and in females older than 50 years.

Factors associated with knee osteoarthritis are increasing Age, Obesity, sedentary lifestyle, or work-related activities. The most frequent form of joint disease is osteoarthritis in the knee. Higher prevalence in females than males (11.4% vs. 6.8%) (Felson et al. 1987). The joint is constantly exposed to loading, bending, and rotation, acting in a coupled fashion. Primary Osteoarthritis of the knee is more prevalent than that of the other joints. Various treatment modalities like intraarticular injections, physiotherapy, visco- supplementation, arthroscopic debridement, high tibial osteotomy, and knee replacement with uni-compartmental arthroplasty have its own complications. Hence, there is a necessity for a modest technique easily reproducible, provides decent functional outcomes.

The fibula carries 16 percent of the body's weight. The loading via fibula is preserved with age and contributes to the support of the lateral side of the

proximal tibia, whereas the proximal tibia loses strength more quickly, therefore if the lateral support of the fibula is weakened by proximal fibular osteotomy, then it leads to a repair of the varus deformity, which can then reposition the loading strain from the medial compartment to the lateral compartment. Various theories support the rationale for performing a proximal fibular osteotomy like The nonuniform settlement concept, The "too many cortices" theory, Phenomenon of slippage, The competition of muscles concept, Theory of Dynamic fibular distalisation, Theory of Ground response vector(GRV) readjustment.

In this scenario, this study is designed to know the functional outcomes, when an osteotomy of the fibula at proximal 3rd is performed in medial compartment osteoarthritis knee.

Aim and Objectives

1. To study how high fibular osteotomy affects knee function in patients with medial compartment osteoarthritis.
2. To investigate the effects of high fibular osteotomy as a novel technique fo r reducing pain and improving the medial/lateral joint space ratio.

Materials and Methods

This study is a Hospital-Based Prospective interventional study, study period between July 2019- June 2021(2 years), conducted in Department of Orthopaedics, Andhra Medical College, Visakhapatnam.

Sample Size: 36

The Institute Ethics Committee approval was obtained; and a Written Informed Consent was obtained from the Patient.

A detailed history was taken and patients were subjected to General Physical Examination, Systemic Examination, and the neurovascular status of the lower limbs. X-ray knee the anteroposterior and lateral views were taken in standing position. The routine pre-anesthetic evaluation was done. Routine preop knee scoring was done. Patients fit for surgery and fall in the inclusion criteria for high fibular osteotomy taken for surgery.

The primary outcome observed will be the functional outcome of the patient. Preoperative and postoperative Oxford knee score (OKS), function sub-scores of the American Knee Society score (AKSS), and Visual Analogue Score (VAS) was noted along with Preoperative and postoperative weight-bearing ratio of medial/lateral compartment.

Medial knee joint space (the lowest point of the medial condyle of femur and medial condylar plateau of the ipsilateral tibia) and lateral knee joint space (the lowest point of the lateral condyle of femur and lateral condylar plateau of the ipsilateral tibia).

Patients were followed up on immediate postop period, at suture removal after 14 days, 3 months, and at the final follow-up period, 6 months postop. The final follow-up scores were compared with preop scores. Data will be recorded in a specially designed proforma and transferred to the master sheet.

Inclusion Criteria:

1. Age more than 40 years.
2. Patients who had given consent.
3. Osteoarthritis knee in medial compartment grade 1 to 3
4. Varus less than 150.

Exclusion Criteria:

1. Age less than 40 years.
2. Patients who denied consent. 3.Osteoarthritis grade IV
3. Varus angle more than 150 and fixed flexion deformity more than 150.
4. Associated tumors around the knee
5. The patient is not fit for surgery.
6. Post-traumatic arthritis, bi or tri compartmental osteoarthritis knee, inflammatory joint disease.

Surgical Technique

The surgery is performed under spinal or epidural anaesthesia without a tourniquet. The fibular head tip is marked with a skin marking pen, and the appropriate downward distance is measured.

Skin and subcutaneous tissue were cut. The incision should be more than twice the length of the resected segment. The fibular periosteum is now exposed by separating the peroneus and soleus. The periosteum is incised first in the line of skin incision and a 1.5 to 2 cm piece of fibula is resected with a narrow blade oscillating saw.

The length of the fibular segment to be resected is 1.5 to 2cm, and the distance from the fibular head is 6 to 9 cm. the idea is to cut the 2 fibular cortices and converting the knee to a more balanced joint, with unicortical support on either side, allowing Correction of the mechanical axis.

The resection should be high enough to cause a mechanical axis shift but not enough to damage the common peroneal nerve. Hence the size of the resected segment and its distance from the fibular head depends on the patient's height, while shorter patients had a 1.5 cm segment resected and 6cm below the level of the fibular head. Tall patients had a 2cm resection, some 8 to 9 cm below. The osteotomised fragment is removed and ends smoothed. The wound was washed, closed in layers, and given a light compression bandage. The

patient was mobilized as soon as tolerated in most cases within hours.

Statistical Analysis: Statistical analysis was performed using SPSS version 19.0 statistical software for the window.

Continuous variables were expressed as mean±SD, and dichotomous variables were expressed as percentages. A two-tailed t-test was applied to analyze the postoperative weight-bearing ratio of knee joint space (medial/lateral compartment) data.

In addition, the nonparametric test (Wilcoxson's signed-rank test) was applied to analyze the OKS, AKSS, and VAS scores. The chi-square test was analyzed the Comparison of qualitative variable, and Comparison of the quantitative variable was analyzed by independent samples unpaired T-test.

A P-value less than 0.05 were considered to be significant. Data was entered in Microsoft Excel, and data analysis was performed using windows MEDCALC software on a personal computer.

Results

A total of 36 patients with medial compartment O.A. underwent high fibular osteotomy. Patients were followed up on for 14 days, 3 months, and 6 months after surgery, and the results were compared to pre-surgery scores at the end of the six-month follow-up period. The average age of the patients was 55, with males (20) (55.56%) and females (16) (44.44%).

The radiological improvement was evident in all instances with an increase in medial/lateral joint space ratio during immediate postop; following six months of follow-up, the mean increase in medial/lateral joint space ratio was 41%.

At three months, showed radiological improvement, all being statistically significant ($P < 0.001$).

Table 1: Visual Analogue Scale Distribution of Patients

VAS score	preop	Post op
1	0	15
2	0	14
3	0	7
4	0	0
5	0	0
6	11	0
7	15	0
8	5	0
9	5	0
10	0	0

- The average VAS score before surgery was 7.36±1.04, and six months later it was 1.72±0.77. With a z-value is -5.2316 and p-value is <0.001. shown in table 2
- The average pre-op functional sub-score of the AKSS was 50.75±2.72, with a final score of 73.66±2 after six months. With a z-value is -5.2316 and p-value is <0.001. shown in table 2
- The average preoperative OXFORD score was 24.05±1.73, and the average postoperative OXFORD score was 33.94±2.2. With a z-value is -5.2316 and p- value is <0.001. shown in table 2

Table 2: Functional Parameters

	PREOP	POST-OP	z-value	P-VALUE
OXFORD	24.05±1.73	33.94±2.2	-5.2316	<0.001
AKSS	50.75±2.72	73.66±2	-5.2316	<0.001
VAS	7.23±1.02	1.72±0.74	-5.2316	<0.001

Preoperatively, the average medial/lateral joint space was 0.36±0.18, which increased in the postoperative phase, reaching 0.77±0.28 after six months, with a t-value is 7.39 and p-value is <0.001. Shown in table 3

Table 3: Radiological Parameters

	PREOP	POST-OP	t-value	P-VALUE
Medial/lateral joint space ratio	0.36±0.18	0.77±0.28	7.39	<0.001

There were no serious complications other than immediate post-procedure neuropraxia involving the superficial peroneal nerve in 5 patients, with one patient demonstrating full recovery at one month follow up and the remaining 4 patients re-covering after three months. The VAS score was decreased by day one itself and at final follow up it was further decreased.

The M/L space ratio was increased after immediate postop; then, it was constant up to 3months, then it further increased at the final follow-up period. The AKSS and OXFORD scores increased immediately

after postop; they remained constant until the final follow-up. Table 4

Table 4: clinical parameters throughout follow up

Time Interval	VAS	AKSS	OXFORD	M/L Ratio
Preop	7.23±1.02	50.75±2.72	24.05±1.73	0.36±0.18
Immediate postop	2.06±0.81	72.3±4.19	30.3±2.28	0.49±0.22
14 days	1.8±0.83	73.3±4.11	32.83±2.63	0.49±0.22
3 months	1.76±0.74	73.53±3.63	33.53±2.60	0.59±0.25
6months	1.72±0.74	73.66±2	33.94±2.2	0.77±0.28

Discussion

The goal of this study is to see how high fibular osteotomy in the medial compartment arthritic knee joint affects function.

When compared to other surgical techniques for early osteoarthritis, such as high tibial osteotomy and arthroscopic procedures, a significant number of patients experienced impressively rapid pain relief immediately after surgery. The average age of the patients with O.A. of the knee in this study was 55 years. The majority of the patients were between the ages of 51 and 65 years. The mean VAS improved significantly from 7.36 at preoperative to 1.72 at 6 months postoperative follow-up in the current study. Wang et al. and Prakash L et al. found comparable results in their research, as did Wang et al. [1] Table 5.

Table 5: Comparing VAS score Results with Other Studies

VAS SCORE	Study	Wang et al.	L. Prakash
PREOP	7.36±1.04	8.02±1.5	6.7
POST-OP	1.72 ±0.77	2.74±2.34	2.2
Improvement	56.4%	52.8%	45%

There is a 56.4% increase in VAS score in this study. It was compared with Wang et al (52.8% increases in VAS score). (P = 0.6801) and L. Prakash (45% increase in VAS score) (P = 0.5351). So on applying the chi-squared test, it is more than 0.05. That means the present study produced similar output as that of other studies. The mean medial/lateral knee joint space ratio and the OXFORD score both improved significantly in this study. The findings of this investigation were consistent with those of Utomo. et al. [2] Table 6

Table 6: Comparing M/L Ratio with other study

M/L Ratio	Study	Utomo et al
PREOP	0.36±0.12	0.40±0.02
POST-OP	0.77±0.29	0.57±0.04
improvement	41%	17 %

The P-value was 0.1595, which agrees with the results of this investigation. The functional sub-score AKSS was significantly improved in this study. The findings matched those of Wang et al. Table 7

Table 7: comparing AKSS score with other study

AKSS score	Study	Wang et al.
PREOP	50.75+2.72	41.24+13.48
POST-OP	73.66+2	69.02+11.12
improvement	22.91%	27.78%

The P-value is 0.5986, which means the present study output is similar to that of other studies. The OXFORD score with Utomo. et al. were compared, and P-value is 0.9021, which means the present study is inconsistent with the Utomo. et al. Table 8

Table 8: Comparing OXFORD score with other study

Oxford Score	Study	Utomo et al
PREOP	24.05+1.73	25.66+4.18
POST-OP	33.94+2.2	36.80+3.00
improvement	20%	23%

Stretching out of the common peroneal nerve is a source of concern while doing a PFO. Furthermore, the majority of patients in this trial experienced immediate pain alleviation following PFO, and postoperative ambulation (i.e., walking) was significantly improved compared to the preoperative status.

There is more room for improvement in the smaller sample size and the short- term follow-up. Furthermore, the procedure preserves the

morphology of knee joint and makes no attempt to increase the medial plateau; there should be some hidden process that results in lower limb realignment and pain relief for patients.

The probable theories explains it are too many cortices theory, The nonuniform settlement concept,[3] slippage phenomenon, The competition of muscles concept,[4] Theory of Dynamic fibular distalisation,[5] Theory of Ground response vector(GRV) [6] readjustment. Huang et al. postulated a muscular competition between the peroneus and biceps femoris followed by PFO. After proximal fibular osteotomy,

They discovered that muscle activity rose in the long head of the biceps femoris and reduced in the peroneus longus on the side that was operated on.

This explains why, soon after proximal fibular osteotomy, the hip knee ankle (HKA) angle improved from a more varus to a more neutral alignment, which is noteworthy. Because correction of the HKA angle from a rectified nonuniform settling would not be expected to be obvious immediately after a fibular resection, this explains the quick pain reduction following surgery. Qin et al. discovered that the amount of the angle of inclination of the proximal tibiofibular joint and the amount of distalisation of the fibula were linked to considerable clinical improvement following surgery.[5]

In 2015, Yang et al. described that high fibular osteotomy could significantly improve FTA angle, AKSS score, and VAS score.[7] Zou et al. In a prospective comparative study of 40 patients with PFO and 52 patients with HTO for unilateral varus knee O.A, discovered a significant reduction in operation time, perioperative bleeding, time for full weight- bearing, pain VAS score, FTA, and complications in the high fibular osteotomy cases, while the Japanese Orthopaedic Association score increased. The short and long term surgical effects of high fibular osteotomy are superior to high tibial osteotomy.[8]

In 2018, Liu et al. concluded that In terms of functional evaluation, Age, VAS score, KSS clinical and functional scores, HKA angle, and settlement values were all independent factors affecting satisfactory functional outcome.[9] In 2018, Nie et al. did a pilot study that provides objective 3D gait and plausible biomechanical evidence for improving clinical symptoms from partial upper fibulectomy.[10]

Regarding complications,3 patients got superficial peroneal nerve injury which was recovered at 3 months follow-up. Whereas other studies noted the foot drop as another complication. In this study it is avoided because of careful use of retractors and relatively long incision and careful periosteum lifting before cutting.

There is a justification, and many people believe that this proximal fibular osteotomy is effective in treating medial compartment osteoarthritis, and that the follow-up period should be extended with little changes to get quick outcomes.

Conclusion

PFO has developed as a new procedure for people with knee osteoarthritis who want to alleviate pain and improve joint function. The study's most remarkable findings were pain alleviation and an improvement in the medial to lateral joint space ratio.

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