

Midterm Functional and Radiological Results of Proximal Fibular Osteotomy to Treat Medial Compartment Osteoarthritis: A Prospective Observational Clinical Study (2-5 Years)

Shivendra Rathore, Rakesh Dhukia, Mayank Ganeshani, Kanti Lal Roat, Narendra Joshi

Abstract: *Introduction:* Osteoarthritis (OA) is a chronic degenerative joint disease of dynamic pathology with multifactorial aetiology. a wide variety of treatment options are available ranging from lifestyle modification, weight reduction, NSAIDs (oral and Topical), intra-articular steroids, autologous platelet rich plasma, hyaluronic acids and surgical interventions like arthroscopic joint lavage, high tibial osteotomy, and arthroplasty (partial or complete). Proximal fibular osteotomy can significantly improve both the radiographic appearance and function of the affected knee joint and achieve pain relief. We have studied mid-term (2-5 years) results of a proximal fibular osteotomy, previously operated in our institution to relieve the increasing loading force on the medial compartment for treatment of medial compartment osteoarthritis. *Methodology:* A Hospital based prospective observational study Department of Orthopaedics in SMS Medical College and Hospital. the Sample size was calculated to be 35 subjects. Patients were evaluated with standard anteroposterior view X-rays of both knee joints in weight bearing stance, and X-rays both knee joints lateral view to know kellgrane lawrence and ahlbach grade. Anatomical axis gives us the femorotibial angle (FTA); mechanical axis gives mechanical axis deviation. Knee rating scale for clinical evaluation of osteoarthritis is of the knee joint. *Results:* 1) Female predominant 54.29% were females while 45.71% were males. 2) Seventeen right knee (48.57%) and eighteen (51.42%) left knee were operated. 3) Preoperative range of motion was 0-124.06° and postoperatively range of motion was 0-126.40°. the change was statistically non-significant. 4) The mean preoperatively value of womac score was 45.06 with standard deviation. 3.89 and mean postoperatively value of womac score was 31.46 with standard deviation 9.35 and p value was <.0001. 5) The mean follow-up period was 48.58 months with standard deviation of 3.83 with maximum of 52 months and minimum of 44 months follow up duration. *Conclusion:* Proximal fibular osteotomy may reduce knee pain significantly in the varus osteoarthritis knee and improve the functional recovery of the knee joint. It is safe, simple and effective procedure that is an alternative to high tibial osteotomy and may delay or even negate for total knee arthroplasty for medial compartment osteoarthritis of the knee joint.

Keywords: Osteoarthritis, weight reduction, Medial opening wedge high tibial osteotomy, proximal fibular osteotomy, prospective observational study, kellgrane Lawrence, femorotibial angle

1. Introduction

Osteoarthritis (OA) is a chronic degenerative joint disease of dynamic pathology with multifactorial etiology. It involves progressive softening and loss of articular cartilage, subchondral bone sclerosis, cyst formation and the development of osteophytes. OA of the knee accounts for more dependence in walking, stair climbing and other lower-extremity tasks than any other disease. [1]

OA was once considered a degenerative, primary disorder of the articular cartilage but now it is widely appreciated that multiple structures are involved and affected in the development of OA. Because of the complex pathophysiology of OA a wide variety of treatment options are available ranging from lifestyle modification, weight reduction, NSAIDs (oral and Topical), intra-articular steroids, autologous platelet rich plasma, hyaluronic acids and surgical interventions like arthroscopic joint lavage, high tibial osteotomy and arthroplasty (partial or complete). [2]

Medial opening wedge high tibial osteotomy (MOWHTO) was first described in the 1950s for the surgical treatment of osteoarthritis of the knee with varus deformity. [3] High tibial osteotomy laterally based closing-wedge damage to the peroneal nerve and fibular pseudarthrosis, risks of development of patella infera, patella subluxation and of the loss of proximal tibial bone stock which may complicate

TKR later. [4]

High tibial osteotomy medial opening-wedge may include loss of fixation, nonunion and delayed union because of the relative instability, neurovascular injury, compartment syndrome, deep infection, nonunion, fixation failure, loss of correction, instability, tibial plateau fracture, flexion contracture. [5]

Total knee arthroplasty can correct lower extremity alignment relieve pain and improve function significantly. However, for younger, active patients or patients with moderate osteoarthritis, it may not be the treatment of choice.

The load bearing axis of the lower limb can be represented by a line extending from femoral head center to ankle joint center. In a varus knee, this line passes medial to the center of knee, increasing force across the medial tibiofemoral compartment. In recent years natural history studies of primary knee osteoarthritis have revealed a link between alignment and subsequent osteoarthritis progression. [6, 7]

Proximal fibular osteotomy, A 2-cm-long section of fibula was resected 6 to 10 cm below the fibular head. Proximal fibular osteotomy can significantly improve both the radiographic appearance and function of the affected knee joint and also achieve pain relief. [8] Joint Surg [Am] 2000; 82-A:1252-9.

Prakash et al in his studies on proximal fibular osteotomy found that it has low complication rate and is relatively easy to execute, proximal fibular osteotomy should definitely be considered in any algorithm for the treatment of medial compartment osteoarthritis of the knee. [9]

Based on previous image and clinical studies, we believe that the lateral support provided to the osteoporotic tibia by the fibula-soft tissue complex may lead to the nonuniform settlement and degeneration of the plateau bilaterally this may result in the load from the normal distribution shifting farther medially to the medial plateau and consequently lead to knee varus, aggravating the progression of medial compartment osteoarthritis of knee joint.

Using this logic, we have studied mid-term (2-5 years) results of a proximal fibular osteotomy, previously operated in our institution to relieve the increasing loading force on the medial compartment for treatment of medial compartment osteoarthritis of knee joint

Aim and Objectives

The present study was conducted to assess and compare midterm (2-5 years) preoperative and post operative radiological outcome (femorotibial angle, mechanical axis deviation, Kellgren Lawrence grade and Ahlback grade) of proximal fibular osteotomy in medial compartment osteoarthritis knee. And also to analyze midterm (2-5 years) functional outcome of proximal fibular osteotomy using knee rating scale score (JOA), visual analog scale score (VAS), WOMAC score and analgesic usage.

2. Material and Methods

A Hospital based, prospective observational study Department of Orthopaedics in SMS Medical College and Hospital. As per the reference article, the Sample size was calculated to be 35 subjects α -error 0.05 and study power 80% with minimum detectable difference mean of femorotibial angle (1 ± 2).

Inclusion Criteria:

- 1) Previously operated case of PFO those completed at least 2 years follow up.
- 2) Patients who has given informed consent to take part in study.

Exclusion Criteria:

- 1) Operated case of Proximal fibular Osteotomy less than 2 years follow up.
- 2) Operated case of PFO with ipsilateral limb injury.
- 3) Bilaterally operated case of PFO.

Plan of action

Patients were evaluated with standard anteroposterior view X-rays of both knee joints in weight bearing stance, and X-rays both knee joints lateral view to know Kellgren Lawrence and Ahlback grade. Full length X-rays from hip to ankle in weight bearing position were taken to know anatomical axis, mechanical axis and weight bearing line. Anatomical axis gives us the femorotibial angle (FTA); mechanical axis gives mechanical axis deviation; the position of weight bearing line on the tibial plateau is

assessed where 0% represents medial end and 100% represents lateral end in AP projection.

Knee Rating Scale Score System

Knee rating scale for clinical evaluation of osteoarthritis is of the knee Oapanese [Orthopaedic Association - Yasuda 1992]

Womac Scoring System

It is a self-administered questionnaire consisting of 24 items divided into 3 subscales: Pain (5 items), stiffness (2 items) and physical Function (17 items). The test questions are scored on a scale of 0-4, which correspond to: None (0), Mild (1), Moderate (2), Severe (3), and Extreme (4). Higher scores on the WOMAC indicate worse pain, stiffness, and functional limitations.

3. Observation and Results

- Female predominant 54.29% were females while 45.71% were males
- 22.86% were in 41-50 years age group and 34.29% were in 51-60 years age group and 42.86% were ≥ 61 years age group. The average age was 58.34 ± 8.47 years and range is 42 to 75.
- Seventeen right knee (48.57%) and eighteen (51.42%) left knee were operated.
- Preoperative range of motion was 0-124.06° and postoperatively range of motion was 0-126.40°. the change was statistically non significant .
- The mean preoperatively value of womac score was 45.06 with standard deviation. 3.89 and mean postoperatively value of womac score was 31.46 with standard deviation 9.35 and p value was $<.0001$.
- Preoperatively 27 out of 32 in Kellgren Lawrence grade 2 and 5 out of 32 patients in Kellgren Lawrence grade 3. Postoperatively 22 out of 32 in Kellgren Lawrence grade 2 and 10 out of 32 patients in Kellgren Lawrence grade 3.
- Maximum cases were distributed among the first and second grades of OA knee and there is no difference in postoperative Ahlback grade osteoarthritis knee. 21 out of 32 patients were in grade 1 and 11 out of 32 were in grade 2 and postoperative same as preoperative.
- The mean follow up period was 48.58 months with standard deviation of 3.83 with maximum of 52 months and minimum of 44 months follow up duration

Table 1: VAS score

| VAS score | Mean | SD | Mean difference | p value |
|-----------|------|------|-----------------|---------|
| Pre op | 7.21 | 0.65 | 4.063 | <0.0001 |
| Post op | 3.15 | 2.28 | | |

The mean preoperatively value of VAS score was 7.21 with standard deviation 0.65 and mean postoperative value of VAS score was 3.15 with standard deviation 2.28 and p value was $<.0001$.

Table 2: Knee rating scale score

| Knee rating scale | Mean | SD | Mean difference | p value |
|-------------------|-------|-------|-----------------|---------|
| Pre op | 49.31 | 4.15 | -15.40 | <0.0001 |
| Post op | 64.71 | 9.723 | | |

The mean preoperatively value of knee rating scale score was 49.31 with standard deviation 4.15 and mean postoperative value of knee rating scale score was 64.71 with standard deviation 9.72 and p value <.0001.

Table 3: Mechanical axis deviation

| Mechanical axis deviation | Mean | SD | Mean difference | p value |
|---------------------------|-------|------|-----------------|---------|
| Pre op | 10.12 | 3.51 | 1.344 | <0.0001 |
| Post op | 8.78 | 3.49 | | |

The mean preoperatively value of mechanical axis deviation was 10.12 mm with standard deviation 3.51 and mean postoperative value of mechanical axis was 8.78mm with standard deviation 3.49 and p value was <.0001.

Table 4: Femorotibial angle

| Femorotibial angle | Mean | SD | Mean difference | p value |
|--------------------|--------|------|-----------------|---------|
| Pre op | 182.21 | 1.53 | 1.844 | <0.0001 |
| Post op | 180.37 | 1.45 | | |

The mean preoperatively value of Femorotibial angle was 182.21 with standard deviation

1.53 and mean postoperative value of Femorotibial angle was 180.37 with standard deviation

1.45 and p value was <.0001.

Table 5: Analgesic use

| Analgesic use | Mean | SD | Mean difference | p value |
|---------------|------|------|-----------------|---------|
| Pre op | 8.00 | 2.67 | 4.862 | <0.0001 |
| Post op | 3.34 | 2.60 | | |

There is significant difference in preoperative and postoperative analgesic use .In preoperative patients mean value of analgesic use was 8 tablets per week while in postoperative patients mean value of analgesic use was 3.34 tablets per week.

4. Discussion

OA of the knee joint is the most common cause of arthritis and is known to cause considerable pain and loss of function. The choice of treatment depends on the age of the patient, stage of the disease, and the condition of the bones. [10, 11]

In this study average age of patients was 58.34 ±8.35 per knee with a range of 42 to 72 years. this correlates well with Zong-you yang et al (2015) [12] as 59.2 years, Xiaohu wang et al, (2017) as 63.96 years, Guoping zou et al (2017) [13] as 62.3 Years. The Framingham Study found that 27% of those aged 63 to 70 had radiographic evidence of knee osteoarthritis, increasing to 44% in the over 80 age group. [14] Other studies have found that 80% of people over the age of 65 have some radiographic evidence of osteoarthritis (although this may be asymptomatic), but that incidence

and prevalence of symptomatic osteoarthritis levelled off or declined in men and women at around 80 years of age. [15]

Male to female ratio of knees in study was 1:1.31 similar to Zong-You Yang et al (2015) as M:F ratio was 1:2.23, Guoping Zou et al (2017) as M:F ratio was 1:2.33.

In our study mean preoperative range of motion was 124.06°±6.20° which increased to 126°±9.524° postoperatively. The change was statistically non significant because most of the patients taken for evaluation were in first and second grade of knee osteoarthritis.

In our study, the mean femorotibial angle was 182.21°±1.53° preoperatively and Postoperatively mean angle was 180.37°±1.45° the decrease was statistically significant with p value<.001. In the study of Zong-You Yang et al (2015) mean femorotibial angle was 182.7°±2.0° preoperatively and postoperatively angle was 179.4°±1.8° the decrease was statistically significant with p value <.001. In the study by Guoping Zou et al (2017) mean femorotibial angle was 183°±2.5° Preoperatively and postoperatively angle was 168°±1.3° decrease was statistically significant. In the study by Bachhal et al (2011) [16] mean tibiofemoral angle was 184.97° preoperatively and postoperatively angle was 170.81°. The final tibiofemoral achieved by Weale et al (2001) [17] was 173.9°±5.1°. Werner et al (2010) achieved an average postoperative tibiofemoral angle measuring 9° of valgus.

In our study the mean mechanical axis deviation was 10.12±3.51mm preoperatively and postoperatively mean mechanical axis deviation was 8.78±3.49mm the decrease was statistically significant with p value of 0.042

In our study we prescribed same analgesic to a particular patient preoperatively and postoperatively. Mean preoperatively analgesic use was 8.00±2.67 tab per week and postoperatively after mean follow up period of 8.82 months mean value of analgesic use was 1.52 tablets per week. In the present study after mean follow up period of 48.58months analgesic use proprioception. Arthritis Rheum 1997;40:2260–5 was 3.04±2.60 tab per week with p value of 0.0003.

In our study mean preoperative VAS score was 7.21±0.65 and postoperatively after mean follow up period of 8.82 months mean value of VAS score was 1.65.In the present study VAS score was 3.15±2.28 with p value of<.0001.

In the study by Wang X et al (2017) [18] the mean visual analogue scale scores significantly decreased from 8.02±1.50 preoperatively to 2.74±2.34 postoperatively with p value <.001. In the study by Zou G et al (2017) [13] mean visual analogue scale scores significantly decreased from 4.6±1.3 preoperatively to 0.5±0.2 postoperatively. In the study by Yang Z et al (2015) [12] mean VAS score was 2.0 which was significantly lower then the preoperative value of 7.0 with p value of <.001.

Preoperative mean Knee rating scale score (JOA) was 49.31±4.15 and postoperatively knee rating scale score was of 64.71±9.72 with p value of <.0001. Preoperative mean

womac score was 45.06 ± 3.89 and postoperatively mean womac score was 31.46 ± 2.28 with p value of $< .0001$.

In the study by Zou G et al (2017) [13] uses JOA score for evaluation of functional results. Mean JOA at final follow up was 89 ± 13.6 , significant higher then the mean preoperative score 66.5 ± 10.2 . In the study by Yang Z et al (2015) [12] uses the American knee society score (KSS) for evaluation of functional results. Mean KSS at final follow-up was 92 ± 31.7 , significantly higher then the mean preoperative score of 45.0 ± 21.3 . Wang X et al (2017) [18] observed that preoperatively, the mean knee and function subscores of the American knee society score were 44.41 ± 8.90 and 41.24 ± 13.48 , respectively. Postoperatively, they significantly improved to 69.02 ± 11.12 and 67.63 ± 13.65 , respectively.

In our study out of 35 patients 2 patients lost to follow up and 1 patient was operated for total knee replacement surgery after PFO due to non improvement of knee osteoarthritis symptoms.

In the study by Yang Z et al (2015) [12] Conversion to total knee arthroplasty following PFO was observed in four cases. In the study by Liu et al, reported no conversion to total knee arthroplasty following PFO in their study.

5. Conclusion

Pxoximal fibular osteotomy may reduce knee pain significantly in the varus osteoarthritis knee and improve the functional recovery of the knee joint. It is safe, simple and effective procedure that is an alternative to high tibial osteotomy and may delay or even negate for total knee arthroplasty for medial compartment osteoarthritis of the knee joint. A long term study with rondamised control required for establishment of the procedure

References

- [1] Johnson VL, Hunter DJ. The epidemiology of osteoarthritis. *Best Pract Res Clin Rheumatol*. 2014;28(1):5-15
- [2] Guccione AA, Felson DT, Anderson JJ, Anthony JM, Zhang Y, Wilson PW, Kelly-Hayes M, Wolf PA, Kreger BE, Kannel WB. The effects of specific medical conditions on the functional limitations of elders in the Framingham Study. *Am J Public Health*. 1994;84(3):351-8.
- [3] Spahn G, Wittig R. Primary stability of various implants in tibial opening wedge osteotomy: a biomechanical study. *J OrthopSci* 2002;7:683-7
- [4] Meding JB, Keating EM, Ritter MA, Faris PM. Total knee arthroplasty after high tibial osteotomy: a comparison study in patients who had bilateral total knee replacement. *J Bone*
- [5] Brouwer RW, Bierma-Zeinstra SM, van Raaij TM, Verhaar JA. Osteotomy for medial compartment arthritis of the knee using a closing wedge or an opening wedge controlled by a Puudu plate: a one-year randomised, controlled study. *J Bone Joint Surg [Br]* 2006;88-B:1454-9.
- [6] Van den Bekerom MP, Patt TW, Kleinhout MY, van der Vis HM, Albers GH. Early complications after high tibial osteotomy: a comparison of two techniques. *J Knee Surg* 2008;21:68-74
- [7] Spahn G. Complications in high tibial (medial opening wedge) osteotomy. *Arch Orthop Trauma Surg* 2004;124:649-53.
- [8] Spahn G. Complications in high tibial (medial opening wedge) osteotomy. *Arch Orthop Trauma Surg* 2004;124:649-53.
- [9] Prakash L, Dhar SA. Proximal Fibular Osteotomy: Biomechanics, Indications, Technique, and Results. *Orthopedics*. 2020;43(6):e627-e631.
- [10] Jiang L, Tian W, Wang Y, Jiesheng R, et al. Body mass index and susceptibility to knee osteoarthritis: a systematic review and meta-analysis. *Joint Bone Spine* 2012;79:291-7
- [11] Messier SP, Leagult C, Mihalko S, et al. The Intensive Diet and Exercise for Arthritis (IDEA) trial: design and rationale. *BMC Muscul Dis* 2009;10:93
- [12] Yang ZY, Chen W, Li CX, et al. Medial compartment decompression by fibular osteotomy to treat medial compartment knee osteoarthritis: a pilot study. *Orthopedics* 2015; 38: e1110-e1114
- [13] Zou G, Lan W, Zeng Y et al. Early clinical effect of proximal fibular osteotomy on knee osteoarthritis. *Biomedical Research* 2017; 28 (21): 9291-9294
- [14] Oliveria SA, Felson DT, Reed JI, et al. Incidence of symptomatic hand, hip and knee osteoarthritis among patients in a health maintenance organisation. *Arthritis Rheum* 1995;38:1134-41
- [15] Pai Y-C, Rymer WZ, Chang RW, et al. Effect of age and osteoarthritis on knee
- [16] Bachhal V, Sankhala SS, Jindal N, Dhillon MS. High tibial osteotomy with a dynamic axial fixator: precision in achieving alignment *J Bone Joint Surg Br*. 2011 Jul;93(7):897-903
- [17] Weale AE, Lee AS, MacEachern AG. High tibial osteotomy using a dynamic axial external fixator: *Clin Orthop* 2001;382:154
- [18] Wang X, Wei L, Lv Z, Zhao B, Duan Z, Wu W, Zhang B, Wei X. Proximal fibular osteotomy: a new surgery for pain relief and improvement of joint function in patients with knee osteoarthritis. *J Int Med Res*. 2017;45(1):282-289