

Combined Approach of Proximal Fibular Osteotomy (PFO) Followed by Intra-Articular Dextrose Prolotherapy in Severe Medial compartment Knee Osteoarthritis

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Abstract

Introduction: Knee osteoarthritis (OA) is a chronic, progressive degenerative disease and a leading cause of mobility-related disability, affecting nearly half of the population. It resulted from mechanical and chemical disorders that damage the joint and the underlying bone. The management of knee OA is challenging due to poor self-regeneration of connective tissues. Surgical treatment with prolotherapy approaches was conducted to treat medial compartment knee OA. The purpose of this study was to assess the effect of proximal fibular osteotomy (PFO) followed by dextrose prolotherapy in severe medial compartment knee osteoarthritis.

Materials and Methods: The present study was conducted in Government Hospital for Bone and Joint Surgery, Postgraduate Department of Orthopaedics, Government Medical College, Srinagar Kashmir. This prospective study consisted of a total of 21 cases, who underwent Proximal Fibular Osteotomy followed by dextrose prolotherapy for medial compartment osteoarthritis of knee. The mean age of the study population was 56.7 (range 45-73) years. In this study there were 9 (42.86%) male and 12 (57.14%) female patients.

Results: All patients revealed an improvement in joint space compared to before procedure. Mean knee Rom increased from $103.33^\circ \pm 12.10^\circ$ to $114.2^\circ \pm 6.92^\circ$. The mean increase in the knee Rom was 10.87 ± 5.18 . Mean VAS scale at rest decreased from 7.9 ± 2.2 to 2.7 ± 1.3 and in activity 8.9 ± 1.9 to 3.1 ± 0.9 . Total WOMAC score and its subcategories had a continuous improvement trend in all the evaluation sessions. No side effects including infection, exacerbation of inflammation, or sustained pain related to the injection or injected fluid were seen.

Conclusion: Proximal Fibular Osteotomy followed by dextrose prolotherapy in patients having medial compartment osteoarthritis of knee showed pain relief and functional improvement as a long-term outcome.

KEYWORDS

Knee osteoarthritis, proximal fibula osteotomy, dextrose prolotherapy

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I. Introduction

Knee osteoarthritis (OA) is a slowly progressive chronic disease characterized by pain, loss of function, and deformity of the affected joints. In the past, OA was considered a normal sign of aging and it was described as a degenerative disorder that mainly causes cartilage loss^[1]. However, more recent studies have shown that OA occurs and evolves due to the interaction of multiple risk factors affecting the whole joint including the cartilage, subchondral bone, synovium, ligaments, and menisci^[2]. Adding to this, the burden of knee OA continues to grow^[3], estimated to affect between 10 and 25% of patients over 60^[4], alongside a population that is increasingly co-morbid and obese^[3, 5]. Knee osteoarthritis is a common condition associated with pain and morbidity^[6]. It is also the second leading cause of disability and a heavy economic and social burden^[7]. Knee osteoarthritis is divided into five grades (Kellgren- Lawrence (KL) grading) as normal (Grade 0), minor (Grade 1), mild (Grade 2), moderate (Grade 3) and severe (Grade 4).

Management is directed to reduce pain, improve function and limit disease progression^[8]. Currently, no disease-modifying treatment has been approved. Non-pharmacological treatments include patient education, exercises, weight reduction, walking supports, bracing, acupuncture, and electromagnetic therapy^[9, 10]. Pharmacological treatments include topical and oral NSAIDs^[11], intra-articular (IA) injections of corticosteroids, visco-supplements, platelet-rich-plasma therapy, mesenchymal stem cells, ozone therapy,

botulinum toxin type A, and hypertonic dextrose. Hypertonic dextrose can treat musculoskeletal pain under the name prolotherapy. Hypertonic dextrose injection is an accessible, low-cost, and safe procedure that gives a significant improvement. It is injected into the articular space to repair and restore the soft tissues in the joint by initiating the inflammation, proliferation, and regeneration of the damaged cartilage^[12]. Analgesics and nonsteroidal anti-inflammatory drugs (NSAIDs) have suboptimal effectiveness. A case of severe knee OA needs surgical procedures. It varies from Total Knee Arthroplasty (TKA), High Tibial Osteotomy (HTO), and Proximal Fibular Osteotomy (PFO).

PFO has become the new alternative procedure to reduce pain and to improve joint function in severe knee OA with a narrowing medial compartment. Compared to TKA, which is the gold standard, and HTO, PFO is not only a safe, simple, and quick procedure, but it also does not need additional insertion^[13]. Utomo et al reported that PFO reduced varus deformity, increased joint space ratio, and improved patient subjective scores on pain and function^[14].

In this study for management of severe medial compartment knee osteoarthritis we have used proximal fibular osteotomy (PFO) followed by dextrose prolotherapy.

II. Materials And Methods

The present study was conducted in Government Hospital for Bone and Joint Surgery, Postgraduate Department of Orthopaedics, Government Medical College, Srinagar Kashmir. This prospective study consisted of a total of 21 cases, who underwent Proximal Fibular Osteotomy followed by dextrose prolotherapy for medial compartment osteoarthritis of knee. The mean age of the study population was 56.7 (range 45-73) years. In this study there were 9 (42.86%) male and 12 (57.14%) female patients.

Inclusion criteria:

- Patients with KL Grade III and IV Knee osteoarthritis with medial joint space narrowing.
- Age >45 years
- Patients who gave written consent.

Exclusion criteria:

- KL Grade I, II
- Patients who have received intra-articular injection of HA in the past 6 months.
- Patients who had received either oral, injectable steroid during the 3 months before the study.
- Uncontrolled diabetes mellitus
- A current intake of NSAIDs or steroids, current anticoagulation therapy
- Inflammatory post-infectious knee arthritis, systemic inflammatory conditions.
- Knee flexion of less than 100 degrees, any valgus, varus of more than 15 degrees.

The grading of knee osteoarthritis was done according to the Kellgren and Lawrence radiological grading classification (Table 1).

Table 1: Kellgren and Lawrence radiological grading classification

| Grade | Parameters |
|-----------|---|
| Grade I | Doubtful narrowing of joint space and possible osteophytic lipping. |
| Grade II | Definite osteophytic with definite narrowing of joint space. |
| Grade III | Moderate multiple osteophytes with definite diminution of joint space, some sclerosis and possible deformity. |
| Grade IV | Joint space greatly impaired with severe sclerosis, large osteophytes and definite deformity. |

Procedure:

Under regional anesthesia the proximal fibular osteotomy (PFO) procedure was done by removing a little segment (1–2 cm) of fibula 7–8 cm below the fibular head by accessing the inter-muscular space between extensor digitorum longus and peroneus longus brevis. Each patient received three intra-articular injections at 1-month intervals in weeks 0, 4, and 8. During the procedure, each patient was placed in a supine position with the knee flexed at 10–15°, and the intra-articular injection landmark was determined below the superolateral part of the patella [Lento et al. 2011]. The injection site was located by a lateral approach; in patients without sufficient space on the lateral side, a medial approach was performed. Under sterile conditions, a composition of 8 ml of 20% dextrose and 2 ml of 1% lidocaine was injected using a 22 gauge needle.

Outcome measures:

Baseline demographic findings and Western Ontario and McMaster Universities arthritis index (WOMAC) values, knee ROM, and pain severity at rest (seated) and in activity (after walking 6 m) using the visual analogue scale (VAS) were recorded. The patients were evaluated for these parameters at the time of first injection, and 4, 8, and 24 weeks later.

III. Results

On the radiological evaluation at the follow-up of 6 months all patients revealed an improvement in joint space compared to before procedure (Figure 1).

At the end of the follow-up of 6 months mean knee Rom increased from $103.33^{\circ} \pm 12.10^{\circ}$ to $114.2^{\circ} \pm 6.92^{\circ}$. The mean increase in the knee Rom was 10.87 ± 5.18 .

Mean VAS scale at rest decreased from 7.9 ± 2.2 to 2.7 ± 1.3 and in activity 8.9 ± 1.9 to 3.1 ± 0.9 , ($p < 0.001$) (Table 2).

At the follow-up of 6 months total WOMAC score and its subcategories had a continuous improvement trend in all the evaluation sessions. Pain sub-score values showed decrease of 8.10 ± 2.06 (from 15.37 ± 2.93 to 7.27 ± 0.87) points, stiffness sub-score values showed decrease of 2.12 ± 2.27 (from 5.10 ± 2.87 to 2.98 ± 0.60) points, function sub-score values showed decrease of 22.18 ± 7.77 (from 43.3 ± 11.21 to 21.12 ± 3.44) points and the total mean WOMAC score had decreased by 32.4 ± 12.1 (from 63.77 ± 17.01 to 31.37 ± 4.91) points (Table 2).

During our study, no side effects including infection, exacerbation of inflammation, or sustained pain related to the injection or injected fluid were seen.

Table 2: Changes in range of motion (knee Rom), visual analog scale (VAS) and Western Ontario and McMaster Universities arthritis index score (WOMAC) and its subscales during the study periods.

| Variables | Baseline | 3-Months | 6-Months | Change | |
|----------------------|---------------|---------------|--------------|--------------|--------------|
| Mean range of motion | 103.33± 12.10 | 114.0± 7.20 | 114.2± 6.92 | 10.87± 5.18 | |
| Mean VAS Score | At rest | 7.9 ± 2.2 | 2.1 ± 1.0 | 2.7 ± 1.3 | 5.2 ± 1.2 |
| | In activity | 8.9 ± 1.9 | 2.9 ± 0.6 | 3.1 ± 0.9 | 5.8 ± 1.0 |
| Mean WOMAC Score | Pain | 15.37 ± 2.93 | 9.93 ± 2.1 | 7.27 ± 0.87 | 8.10 ± 2.06 |
| | Stiffness | 5.10 ± 2.87 | 3.29 ± 1.02 | 2.98 ± 0.60 | 2.12 ± 2.27 |
| | Function | 43.3 ± 11.21 | 25.88 ± 5.19 | 21.12 ± 3.44 | 22.18 ± 7.77 |
| | Total WOMAC | 63.77 ± 17.01 | 35.27 ± 5.3 | 31.37 ± 4.91 | 32.4 ± 12.1 |

Figure 1: A (Radiograph before procedure), B (Radiograph at the follow-up of six months)



IV. Discussion

Knee osteoarthritis is one of the most common joint disorders, and it causes severe pain and immobility. TKA is a gold standard for severe knee osteoarthritis because of its effectiveness in reducing pain and improving knee function. However, TKA is an expensive and complex procedure requiring multiple revisions in some patients^[13, 15]. HTO has been the surgical treatment of choice for young patients with osteoarthritis of the medial compartment of the knee, and it is aimed at correcting alignment and delaying the

time until TKA is required^[16, 17]. However, HTO also has some disadvantages, including a delayed time to full weight bearing and risks of nonunion or delayed union, peroneal nerve paralysis and wound infection^[18, 19].

PFO has emerged as a new surgery to relieve pain and improve joint function in patients with medial compartment knee osteoarthritis as reported by Zhang et al. in 2015. The most striking findings in the present study included medial pain relief and an increase in the medial joint space.

As people get older, the bone density of the knee tibial plateau reduces over time. The tibial plateau consists of two sides; the medial and lateral sides. Unlike the medial side, fibula supports the lateral side^[20]. A clinical study conducted by Zhang et al reported that the fibula supports one-sixth of body weight. Therefore, the stress distribution inside the tibial plateau becomes uneven. More medial-side stress in the tibial plateau can result in varus deformity. Moreover, the femoral condyle could shift to the medial during walking with transverse shear forces due to the tibial plateau slope arising from the nonuniform settlement^[21]. PFO changes the stress distribution in the knee joint and reduces the medial compartment stress by removing a little fibular segment. Pan et al, using computerized tomography (CT) and magnetic resonance imaging (MRI) for a finite element model, concluded that PFO could reduce stresses in the medial compartment of the knee joint by transferring the stress pathway from the anterior medial area to posterior medial area on the tibial plateau^[22]. In addition, an analysis of a three-dimensional gait study demonstrated that PFO could be beneficial in delaying the progression of knee OA^[23]. It can also rebalance the soft tissue around the knee. After the procedure, the lateral ligaments and muscles of the knee joint will tighten, and the medial side will relax. The lateral soft tissues will pull up the femoral condyle, thus reducing the tension of the medial tibia plateau^[24]. Utomo et al reported that the use of PFO can significantly reduce the varus deformity, improve medial joint space, and increase patient subjective and functional scores using the Western Ontario and McMaster Universities arthritis index score (WOMAC). This single-arm clinical trial found that dextrose prolotherapy could cause significant reduction in patients' pain at rest and during activity, and could enhance joint ROM and WOMAC scores. There are few reports regarding the effects of prolotherapy on OA. All these studies have shown an improvement in different pain scales between 36% and 55%, as well as improved WOMAC subscales following prolotherapy [Rabagoet al. 2012, 2013b; Hashemiet al. 2010; Reeves and Hassanein, 2003; Kim et al. 2002]. The common complication of PFO is an injury of the peroneal nerve and its branches because the procedure bypasses the lateral border of the fibula, where one-third of the deep the peroneal nerve is located. Therefore, the best site for the fibula osteotomy is 6–10 cm under the head of the fibula^[25].

WOMAC total score in our study improved by 50.81% at the end of week 24 as well as 52.70%, 41.56%, and 51.22% reduction in pain, stiffness, and function subscale scores respectively. This improvement exceeds thereported minimal clinical difference of 12–25% found in related studies [Tabachet al. 2005, 2009]. There is one possible explanation for this difference: we evaluated patients for 24 weeks, while these previous series followed their patients for 52 weeks.

Although cartilage volume increases after each prolotherapy session and will remain increased for a time, it decreases over time, which has a significant correlation with the pain subscales of the WOMAC score [Rabagoet al. 2013a]. Therefore, it is possible that with longer follow up, we would observe similar improvements to those reported by others.

As previously mentioned, the total WOMAC score was considerably improved until week 8 and then maintained throughout the study period. In other words, treatment effects reached a plateau after 8–12 weeks, similar to the results described by others [Rabagoet al. 2012]. This observation could be due to the possibility of overuse of the knee after a temporary improvement in pain and function, and ignoring the recommendations about gradual increase of pressure on the knee. Other studies have also reported that the improvements attenuate over time and sometimes the symptoms are exacerbated after several months, which indicate the short-term effects of the treatment, similar to the injections of hyaluronic acid agents [Samson et al. 2007]. Though post-treatment pain is not as severe as their experienced original pretreatment pain, this could suggest that these patients need several injections at intervals to keep the desired results.

Our cases provide clinical evidence for a new therapy for severe knee OA. We combined biomechanical advantages of PFO and hypertonic dextrose prolotherapy to treat patients with late-stage medial compartment knee OA. Both treatments are simple, quick, safe, and affordable procedures to reduce pain and increase knee function. Among the enrolled population, all of them reported meaningful improvement at long-term follow-up based on their subjective pain scores using VAS and functional scores using the WOMAC index. The patient's knee functions improved and the patient's satisfaction increased in daily life. This combined therapy can offer an alternative to treat late-stage medial compartment knee OA rather than a complex surgical procedure. However, the patient can still undergo TKA if needed. This report presents the first case series with PFO procedure followed by dextrose prolotherapy to the best of our knowledge.

There were some limitations in this study as, a small number of patients to report a strong, absence of standardization of knee X-Ray images to do radiographic measurement and limited follow-up.

V. Conclusion

Proximal Fibular Osteotomy followed by dextrose prolotherapy in patients having medial compartment osteoarthritis of knee showed pain relief and functional improvement as a long-term outcome. This study suggests that the treatment strategy may be useful to treat severe OA with varus deformity and postpone the need for TKA for those who cannot undergo HTO or TKA for various reasons.

References

- [1]. Creamer P, Hochberg MC. Osteoarthritis. *Lancet*. 1997;350(9076):503–8.
- [2]. Sanchez M, Delgado D, Sanchez P, Fiz N, Azofra J, Orive G, et al. Platelet rich plasma and knee surgery. *Biomed Res Int*. 2014;2014:890630.
- [3]. GBD2017 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet*.2018;392(10159):1789–858.
- [4]. Cross M, Smith E, Hoy D, Nolte S, Ackerman I, Fransen M, et al. The global burden of hip and knee osteoarthritis: estimates from the global burden of disease 2010 study. *Ann Rheum Dis*. 2014;73(7):1323–30.
- [5]. Felson DT, Lawrence RC, Dieppe PA, Hirsch R, Helmick CG, Jordan JM, et al. Osteoarthritis: new insights. Part 1: the disease and its risk factors. *Ann Intern Med*. 2000;133(8):635–46.
- [6]. Curl WW, Krome J, Gordon ES, Rushing J, Smith BP, Poehling GG. Cartilage injuries: a review of 31516 knee arthroscopies. *Arthroscopy* 1997; 13: 456-460.
- [7]. H. F. Zhang, C. G. Wang, H. Li, Y. T. Huang, and Z. J. Li, “Intra-articular platelet-rich plasma versus hyaluronic acid in the treatment of knee osteoarthritis: a meta-analysis,” *Drug Design, Development and Therapy*, vol. Volume 12, pp. 445– 453, 2018.
- [8]. Neogi T. The epidemiology and impact of pain in osteoarthritis. *Osteoarthritis Cartilage* 2013;21:1145-53.
- [9]. Onishi K, Utturkar A, Chang E, Panush R, Hata J, Perret-Karimi D. Osteoarthritis: a critical review. *Crit Rev PhysRehabil Med*. 2012;24(3-4):251–64.
- [10]. Lane NE, Shidara K, Wise BL. Osteoarthritis year in review 2016: clinical. *OsteoarthrCartil*. 2017;25(2):209–15.
- [11]. Bannuru RR, Osani MC, Vaysbrot EE, Arden NK, Bennell K, Bierma-Zeinstra SMA, et al. OARSI guidelines for the non-surgical management of knee, hip, and polyarticular osteoarthritis. *OsteoarthrCartil*. 2019;27(11):1578–89.
- [12]. Sit RWS, Wu RWK, Rabago D, et al. Efficacy of intra-articular hypertonic dextrose (Prolotherapy) for knee osteoarthritis: a randomized controlled trial. *Ann Fam Med*. 2020;18(3):235–242. doi:10.1370/afm.2520
- [13]. Zhang YZ. Innovations in orthopedics and traumatology in China. *Chin Med J*. 2015;128(21):2841–2842. doi:10.4103/0366-6999.168015
- [14]. Utomo DN, Mahyudin F, Wijaya AM, Widhiyanto L. Proximal fibula osteotomy as an alternative to TKA and HTO in late-stage varus type of knee osteoarthritis. *J Orthop*. 2018;15(3):858–861. doi:10.1016/j.jor.2018.08.014
- [15]. Burnett RS and Bourne RB. Indications for patellar resurfacing in total knee arthroplasty. *J Bone Joint Surg* 2003; 85: 728–745.
- [16]. Duivenvoorden T, Brouwer RW, Baan A, et al. Comparison of closing-wedge and opening-wedge high tibialosteotomy for medial compartment osteoarthritis of the knee: a randomized controlled trial with a sixyear follow-up. *J Bone Joint Surg Am* 2014; 96: 1425–1432.
- [17]. Laprade RF, Spiridonov SI, Nystrom LM, et al. Prospective outcomes of young and middle-aged adults with medial compartment osteoarthritis treated with a proximal tibial opening wedge osteotomy. *Arthroscopy* 2012; 28: 354–364.
- [18]. Sprenger TR and Doerzbacher JF. Tibial osteotomy for the treatment of varusgonarthrosis. Survival and failure analysis to twenty-two years. *J Bone Joint Surg Am* 2003; 85-A: 469–474.
- [19]. W-Dahl A, Robertsson O and Lidgren V. Surgery for knee osteoarthritis in younger patients. *ActaOrthop* 2010; 81: 161–164.
- [20]. 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(12):e1110–4. doi:10.3928/01477447-20151120-08
- [21]. Wang X, Wei L, Lv Z, et al. 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.
- [22]. Pan D, Tianye L, Peng Y, et al. Effects of proximal fibular osteotomy on stress changes in mild knee osteoarthritis with varus deformity: a finite element analysis. *J OrthopSurg Res*. 2020;15(1):1–10.
- [23]. Nie Y, Ma J, Huang ZY, 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.
- [24]. Guo J, Zhang L, Qin D, et al. Changes in ankle joint alignment after proximal fibular osteotomy. *PLoS One*. 2019;14(3):e0214002.
- [25]. Ryan W, Mahony N, Delaney M, O’Brien M, Murray P. Relationship of the common peroneal nerve and its branches to the head and neck of the fibula. *Clin Anat*. 2003;16(6):501–505.

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