

**MANAGEMENT OF KNEE DEFORMITIES USING DOUBLE LEVEL OSTEOTOMY  
TECHNIQUE**

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**ABSTRACT**

**Introduction:** Double level osteotomy was first introduced by Benjamin in 1969 for patients with disabling knee pain due to osteoarthritis or rheumatoid arthritis. This procedure is now being used to correct the deformity, realign knee joint obliquity and weight-bearing lines, and pain reduction. The purpose of this report is to express clinical experience with the use of this surgical technique and to describe the long-term follow-up of the patients who were operated on. **Methods:** During a 4-year period, 9 patients (12 knees) with the mean age of 43.5 years underwent Surgery due to genu varum. Lysholm score and KOOS score were used for functional assessment, pre and post-operatively. The mechanical tibiofemoral angle was evaluated with anteroposterior radiographs taken while the patients were standing on both legs with full extension of the knees. In the surgical procedure, we first started from closed- wedge biplanar osteotomy of femur, and following that according to X-ray determination we performed tibial open-wedge biplanar osteotomy. **Results:** All patients returned with good and acceptable performance. The mean KOOS score and Lysholm score were 91.4 and 85.6 points post-operatively. Most patients were satisfied with the results of their surgery and all the angles measured on X-rays had been corrected. **Conclusion:** In general, we can conclude that the double level osteotomy technique is an acceptable and reliable method. Although this technique is delicate and has some difficulties, finally there are good and satisfying results for patients. Our experience in using this surgical technique showed that this method could be a valid treatment option for the treatment of knee deformity.

**KEYWORD:** Double level osteotomy, knee deformities, genu varum.

**INTRODUCTION**

Osteotomies, along with total and unicompartmental knee arthroplasties have proved to be successful treatments for uni-compartmental knee arthritis.<sup>[1,3]</sup> Tibial osteotomy was first introduced in 1958 by Jackson for managing the osteoarthritis of the knee.<sup>[4]</sup> It has been established as a useful treatment for relief of pain and angular deformity resulted from osteoarthritis (OA) and in a lesser extent in rheumatoid arthritis (RA).<sup>[2,4]</sup> However, it has the possible risks of over or under correction, which can result in failure or an excessive joint line obliquity and may cause in need of a future total knee arthroplasty.<sup>[1,5]</sup> Total knee arthroplasty as a way of treatment has had successful results, but may

not be a good option in young and active patients.<sup>[1,3,6]</sup> Double level osteotomy (DLO) is a successful treatment in patients with unicompartmental knee arthritis and severe knee deformities which require angle corrections, especially in young patients and those with high level of activity.<sup>[1,3,5,11]</sup>

DLO was first introduced by Benjamin in 1969 for patients with disabling knee pain due to OA or RA, which had not responded to at least one year of conservative treatment; however, further studies of the suggestion made by him failed to prove the validity of this procedure.<sup>[1,4,12,14]</sup> DLO is a combination of high tibial osteotomy (HTO) and distal femoral osteotomy

(DFO), a way to correct the deformity and realign knee joint obliquity and weight-bearing lines.<sup>[1,15]</sup>

There are no specified statistics about the prevalence and number of double level osteotomies in other articles. Twelve double level osteotomies have been done on 9 patients with genu varum deformity in their knees (3 patients had bilateral double level osteotomy of the knee) in Milad hospital from 2012 to 2016. This study has performed to express clinical experience with the use of this surgical technique and to describe the long-term follow-up results of the patients who were operated on.

## MATERIALS AND METHODS

From 2012 to 2016, 12 DLOs were performed on 9 patients in Milad hospital. Three patients had bilateral

DLO of the knee. There were 3 men and 6 women with the mean age of 43.5 (range, from 32 to 57). They were all suffering from genu varum with a constant pain in their knees and walking problems including lateral thrust. There was no lost in the patients during the study and all patients were followed prospectively for the mean period of 36 months (range, from 18 to 60 months).

Lysholm score and KOOS score were used for functional assessment, pre and post-operatively and the mechanical tibiofemoral angle was evaluated with anteroposterior radiographs taken while the patients were standing on both legs with full extension of knees.

**Table 1: Patient demographics and characteristics.**

Mean age (year)	Mean follow-up (month)	gender	Side of injury
43.56 ± 7.299 (32-57)	36 ± 13.332 (18-60)	6(F) / 3(M)	2(Right) / 4(Left)/ 3(Both)

All the patients were evaluated before the operation for the best procedure (HTO, DFO, DLO, and TKR) based on the age, mechanical axis, and joint line angle. DLO was considered as the proper procedure based on these criteria.

All the surgeries were performed by two orthopedic surgeons in Milad hospital and the mean time of surgery was 90minutes. We used lateral closed-wedge femoral osteotomy and medial open-wedge tibial osteotomy with the biplanar method in all cases and the DFO was done prior to the HTO.

## Operative Technique

### Femoral Osteotomy

We performed lateral closed-wedge osteotomy in all cases. A longitudinal, lateral incision was used. Following that, dissection of soft tissues and the iliotibial band in line with its fibers, at its insertion on the lateral intermuscular septum was performed. The position of the osteotomy was determined before the surgery. Using the image intensifier we inserted two Kirschner wires aimed to the coincide of the hinge point, one parallel to the joint line approximately 2 cm proximal to the joint and the other one from a slightly higher point and at an angle to intersect the first wire in the hinge point. The distance between Kirschner wires at the entry point was due to the preoperative planning which was checked using a ruler. We then performed the transverse osteotomy by an oscillating saw in the lateral three fourth of the femur, parallel to the wires acted as a guide for the saw. The next step was to perform the ascending osteotomy in the anterior one fourth of the femur with the angle of between 90 to 110 degrees. After closing the osteotomy site the last stage was to position the plate under image intensifier and fix it by locking screws and removing Kirschner wires.

### Tibia Osteotomy

In all patients we performed medial open-wedge biplanar osteotomy. After a medial longitudinal incision (~6cm) and dissection of soft tissue, superficial medial collateral ligament (MCL) and the pes anserinus were completely released below the osteotomy site. Two Kirschner wires were placed in tibia parallel and aimed towards the hinge point which was defined before the operation under the image intensification. Then we positioned the knee in the 90 degrees flexion and marked the anterior ascending osteotomy, which runs at an angle of about 110 degrees to the transversal saw cut ending behind the patellar tendon. After marking the cutting depth which had been determined before the operation, we performed the transverse osteotomy with an oscillating saw below the Kirschner wires. Following that the posterior ascending with the narrow saw blade was performed. Using osteotomy chisels we opened the osteotomy and spread the osteotomy with a bone spreader until it reached to the desired angle. The final stage was to position the plate under image intensifier and fix it on the medial surface of the tibia.

## RESULTS

All the patients had been evaluated by KOOS and Lysholm score before and after the operation. KOOS score improved from 65 points (range, from 57 to 71), preoperatively to the mean of 90.6 (range from 85 to 96) at the last follow-up. Based on Lysholm score the average score before the operation was 61.2 (range, from 52 to 69) which improved to 86.5 (range, from 81 to 93) post-operatively. The mean mechanical angle of the knee was 190.5 degrees (range, 187 to 194) and it decreased to the average 180.5 degrees (range, 178 to 182) after the procedure (Table 2).

At the last follow-up, 6 patients said that they are much better and 3 of them said that they have the better condition compared to before surgery. No patients had

TKR after twenty-four months of surgery and the survival of DLO was 100%.

**Table 2: Functional and radiological assessments.**

NO	Side of injury	Mechanical angle		Lysholm score		KOOS score	
		Pre-op	Post-op	Pre-op	Post-op	Pre-op	Post-op
Patient 1	Right	190	181	66	91	61	85
Patient 2	Left	192	182	57	85	52	81
Patient 3	Right	189	178	61	88	57	84
	Left	190	182	69	94	63	88
Patient 4	Right	194	181	60	89	56	83
Patient 5	Left	191	180	71	96	69	93
Patient 6	Left	192	180	70	94	67	91
Patient 7	Right	188	181	68	92	63	87
	Left	189	180	60	88	58	85
Patient 8	left	192	182	58	87	56	84
Patient 9	Right &	189	180	69	91	66	88
	Left	190	179	71	93	67	90

## DISCUSSION AND CONCLUSION

Although the previous studies reported had different surgical methods and criteria in choosing patients, the results generally show the same pattern in most of them. Van Egmond et al reported four double level osteotomies on four patients with genu varum which all of them were uniplanar closing wedge corrections and all were fixed with angular plates. The mean scores show the improvement of knee function postoperatively.<sup>[15]</sup> Nakayama et al performed a study in 2017 on 21 patients (22 knees) with varus knee deformity. The study illustrated that DLO in these patients could accomplish satisfactory clinical outcomes by normalizing coronal alignment while avoiding joint line obliquity.<sup>[16]</sup> Kanto et al worked on the changes in leg length after double level osteotomy on 16 patients with severe varus knee deformity and reported an increase of whole leg length after the procedure.<sup>[7]</sup> Kamara et al performed a study to compare the outcomes of HTO and DLO in patients with varus knee deformity. This study showed that DLO increased physiologic torsion both on the femur and the tibia, while isolated HTO did not change the rotational alignment.<sup>[17]</sup> Inoue et al performed double level osteotomy on two patients with severe varus and valgus knee deformity. In both patients scores improved significantly; however, the patient with genu varum showed more improvement.<sup>[8]</sup> Fourteen knees with severe varus deformity were followed up before and after the double level osteotomy by Nakayama et al. The results of this study showed an improvement in both radiological parameters and KOOS scores for patients after DLO.<sup>[6]</sup> Based on Saragaglia et al's study, 91% of patients achieved the preoperative goal of  $182 \pm 2$  degrees after double level osteotomy.<sup>[18]</sup> Babis et al performed a study on 27 knees with genu varum and the follow up showed that the mean clinical and functional scores improved and only one knee had a TKR after DLO.<sup>[1]</sup> In 1987, Schuller et al performed a study to show the effect of DLO on patients with rheumatoid arthritis and severe pain which had not responded to at least one year of conservative treatment. The results showed that only half of the patients were

satisfied after one year and this number decreased to one third in 3 years.<sup>[12]</sup>

This study is not with no limitations. The sample size was limited; however, it is considered a homologous sample, since we used same criteria regarding to choosing the patients and all were operated with a similar procedure. Moreover, most of the patients were middle-aged and it is recommended that the further study is needed to evaluate more patients in the other age groups.

In our study all of the patients had good to excellent results which was comparable with former studies.

In general, we can conclude that the double level osteotomy technique is an acceptable and reliable method. Although this technique is delicate and has some difficulties, finally there are good and satisfying results for patients. Our experience in using this surgical technique showed that this method could be a valid treatment option for the treatment of knee deformity.

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