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Comparison of patient outcomes with and without graft following modified high tibial osteotomy

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ABSTRACT

Objectives. The aim of this study is to evaluate the early results of patients with and without grafting with the proximal tibia medial biplanar open wedge osteotomy technique used in the surgical treatment of varus gonarthrosis and to compare them with the literature. *Materials and Methods*. Thirty-six patients with medial gonarthrosis with varus alignment were included in the study. The proximal tibia medial biplanar open wedge osteotomy was performed on thirty-six knees. In eighteen of these patients, a tricortical graft was applied to the osteotomy site from the iliac wing being noted as Group 1. The other patients who did not receive grafts constituted Group 2. All patients were evaluated according to the Ahlbäck classification. Leg length radiographs were taken for all patients, and the osteotomy angle was calculated according to Paley's measurements. *Results*. Although the mean union-time at the osteotomy site was shorter in the Group 1, it was not statistically significant. No significant difference was observed in terms of HSS scores, and no reduction loss was observed in any patient. The hematoma was seen in three patients in Group 2 and one patient in Group 1. The donor site problems were observed in 10 patients in Group 1. *Conclusions*. With proximal tibia medial biplanar osteotomy, frontal plane and sagittal plane deformities can be corrected in patients with varus gonarthrosis, and good clinical results can be obtained without using grafts, thus avoiding donor site complications.

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Introduction

Osteotomy is known as knee joint sparing surgery to treat frontal and/or sagittal plane deformities, with or without instability. The main purpose of this method is to correct frontal and/or sagittal plane deformities, to protect the articular cartilage by changing the load distribution and to optimize the coronal and anteroposterior stabilization of the knee [1]. High tibial osteotomy is considered an ideal option for the treatment of symptomatic varus knees as a result of metaphyseal deformities caused by structural or traumatic causes [2].

Although the indications and contraindications of the high tibial osteotomy (HTO) in varus knees have not been determined with definite limits, a patient can be defined as a candidate for HTO. According to the International Society of Arthroscopy, Knee Surgery and Orthopedic Sports Medicine (ISAKOS), a candidate for HTO can be defined as follows: there is localized pain in the medial knee joint and a narrowing in the medial joint space associated with medial arthrosis and varus on direct X-ray taken by pressing, with normal lateral and patellofemoral compartments, Body Mass Index (BMI) below 30 kg/m2, 40–60 years old patient with high expectation of activity (except for running and jumping) [3].

The bone union problems in the osteotomy area and related varus correction problems are the most common complications in the HTO [4,5]. The risk of nonunion has been reported to be 4.4–19% [6]. The use of bone grafts has traditionally been recommended to prevent nonunion [7]. Autograft (iliac wing), allograft and some bone-like materials can be preferred as grafts in high tibial osteotomy [8,9]. Although obtaining autografts from the iliac wing has some complications such as pain, thigh hypoesthesia, and infection, its effect on bone union is clearly stronger than other methods [4,10]. Bone healing is a complex process and depends on ideal biological and mechanical environments. Stability has an important role in the bone union process [11].

In our study, we evaluated the clinical outcomes between the group with and without graft by performing biplane osteotomy.

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Materials and Methods

The local Ethics Committee approved the study protocol (458/2022) and the study was carried out according to the principles of the Declaration of Helsinki (2013). Written informed consent was obtained from the patients. Thirty-six patients with medial gonarthrosis with varus alignment were included in the study between March 2013 and January 2019.

The proximal tibia medial biplanar open wedge osteotomy was performed on thirty-six knees. In eighteen of these patients, a tricortical graft was applied to the osteotomy site from the iliac wing and was noted as Group 1. Other patients to whom we did not apply grafts constituted Group 2. Fifteen of the patients were female and three of them were male in Group 1, the mean age was 49 years (39– 60 years) and the mean BMI was 27.32 kg/m² (20.3 – 30 kg/m²).

Sixteen of the patients were female and two of them were male in Group 2, the mean age was 47 years (40– 60 years) and the mean BMI was 25.70 kg/m² (18.2 – 29 kg/m²). Tomofix plate with 12.5 mm wedge was applied with biplanar osteotomy in all patients. Patients with limited range of motion in the knee, over 60 years of age, over 30 kg/m BMI and with inflammatory disease were excluded from the study. All patients were evaluated according to the Ahlbäck classification [12]. Leg length radiographs were taken for all patients, and the osteotomy angle was calculated according to Paley's measurements [13,14].

Surgical Technique

The patients were placed in the supine position with a tourniquet under combined epidural spinal anesthesia. The ipsilateral iliac wing was prepared for autograft. An approximately 8 cm longitudinal anteromedian skin incision was made, extending just below the tuberositas tibia with the lower pole of the patella. The tibial periosteum and pes anserinus were removed proximally and medially.

Under the scopy control, the first Kirschner wire was sent from the medial of the tibia proximal metaphysis, approximately 2 cm below the joint line, towards the lateral cortex, 1 - 1.5 cm distal to the joint, and approximately 1 cm medial to the lateral cortex. K wires were applied in such a way that the tibial tubercle remained in the proximal fragment and the osteotomy was biplanar. The anterior wire was left in the anterior 1/3 of the tibial metaphysis. The incision in front of the tubercle was made so that the beak was at least 1.5 cm. The angle between the horizontal and vertical osteotomies was approximately 100°-110°. The line (vertical line) behind the tubercle to be osteotomy was drilled with K wires close to each other, coming out of the opposite cortex. Using the drill holes formed in the horizontal line, the osteotome was sent towards the lateral cortex. A thin osteotome was used on the vertical osteotomy line. The posterior cortex of the tibia was cut with a specially designed osteotome protecting the posterior neurovascular structures. The horizontal line of osteotomy was opened either with the triple osteotome technique or with the help of a specially designed distractor. The correction was made in the planned amount. Autograft was used in 14 cases. Fixation was achieved with specially designed 12.5 tomofix wedge plates (Figures 1-4).

An angle-adjustable knee brace was applied to all patients. CPM (continuous passive motion) was applied from the 1st postoperative day. All patients were able to perform 30-60° knee flexion before discharge. Partial weight bearing is allowed after two weeks, and full weight bearing is allowed after four weeks. The results were evaluated clinically and radiologically. We planned the same protocols during follow-up visits. Radiological evaluation was performed with anteroposterior and lateral radiographs. 3D and conventional computed tomography were additionally planned in the early postoperative first follow-up. In the final control, evaluation with orthoroentgenography was added to the study protocol. Clinically, pain and functions were evaluated with the HSS score at the last follow-up.

Statistical analysis

SPSS for Windows version 15.0 software (SPSS Inc., Chicago, Ill., USA) was used for statistical analysis. Descriptive statistics of data mean, standard deviation, median minimum, maximum, frequency and ratio values were used to describe the study population. Kolmogorov-Smirnov test was used for the distribution of variables. The $\chi 2$ test was used to compare qualitative variables. $p < 0.05$ was considered statistically significant.

Results

The mean follow-up time was 23.6 months (12-31 months) in Group 1 and 22 months (14-30 months) in Group 2. Although the mean union-time at the osteotomy site was shorter in Group 1, it was not statistically significant. No significant difference was observed in terms of HSS scores obtained in clinical evaluations at the last follow-up in both groups (Table 1).

No reduction loss was observed in any patient. The lateral cortex fracture was observed in a total of five patients, three from the 1st Group and two from the second Group. The hematoma was seen in three patients in Group 2 and one patient in Group 1. The donor site problems were observed in 10 patients in Group 1. Significant pain was observed in the early postoperative period in 9 of them, and hypoesthesia in addition to pain was observed in one patient (Table 2).

Table 1. Patient demographics and follow-up data (Group 1: grafted; Group 2: non-grafted)

	Group 1	**Group 2**	**P value**
n	18	18	
Age (years)	49 (39 – 60)	47 (40– 60)	0.782
BMI (kg/m²)	27.32 (20.3 – 30)	25.70 (18.2 – 29)	0.203
Male	3 (16%)	2 (11%)	0.500
Female	15 (84%)	16 (89%)	0.500
Tabocco use	4 (22%)	6 (33%)	0.074
Albaech 0	2 (11%)	1 (%5)	
Albaech 1	1 (%5)	3 (%16)	
Albaech 2	8 (%44)	7 (%39)	
Albaech 3	7 (%39)	7 (%39)	
Follow–up (months)	23.6 (12-31)	22 (14-30)	0.60
Union time (months)	13.3 (12-15)	13.8 (11-17)	0.69
HSS score	Excellent (17) Good(1)	Excellent (16) Good(2)	0.73

Table 2. Complications

	Group 1	**Group 2**	**P value**
Loss of reduction	None	None	
Nonunion	None	None	
Lateral Cortex fracture	3 (%16)	2 (%11)	
Hematoma	1 (%5)	3 (%16)	
Donor site problems	10 (%55)	None	

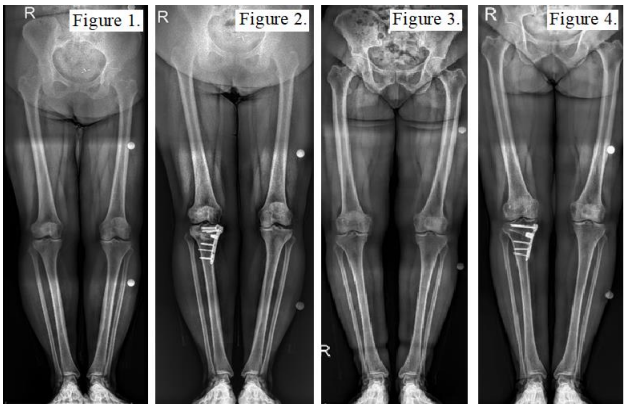

Figure 1. Preop. X-ray (patient with graft)

Figure 2. Postop. X-ray (patient with graft)

Figure 3. Preop. X-ray (patient without graft)

Figure 4. Postop. X-ray (patient without graft)

Discussion

Biplanar high tibial osteotomy is a good treatment option for young, active knee patients. Appropriate patient selection and careful surgical technique are the most important factors affecting long-term outcomes. It is preferable to apply the HTO procedure without applying an autologous bone graft to the osteotomy site. Not using bone grafts helps to reduce patient morbidity and surgical time. The use of bone grafts has recently been recommended for special cases and large angular deformities [4]. The consolidation of HTO without bone grafting is done using modern locking plates [15], but the first randomized clinical trial was performed with conventional HTO Puddu stainless steel plates [16,17]. Puddu may or may not be sufficient to maintain plate stability; to maintain stability, the lateral tibial cortex must be left intact to act as a hinge [18]. In the literature, it was found a 58% decrease in axial stability and a 68% decrease in torsional stability when the lateral tibial cortex was fractured [19]. In our series, lateral tibial fractured cortex occurred in five patients in both groups. In these patients, axial loading started 2 weeks later and the union was achieved. In our study, bone union was observed earlier in the group with autologous bone graft compared to the group without graft, but the difference was not statistically significant.

Complications in this study were similar to those described in the literature [4]. A high incidence of hematoma has been associated with not using drains in the post-surgical period [4]. In our study, we evaluated that the routine use of drains after the osteotomy is beneficial. Although not statistically significant in our study, hematoma formation was observed more frequently in the group that did not use bone grafts.

In a study of 92 patients who applied for the Tomofiks plate in the literature, they did not use grafts. Loss of correction degree was observed in 3 patients. It has been reported that this complication occurs after implant removal [20]. We used tomofix in our study, we did not remove the implant. No correction loss was observed. Puddu stated that there is no need for grafting if the amount of wedge to be opened is less than 7.5 mm [21]. In a study in which 18 patients used porous hydroxyapatite grafts following proximal tibial osteotomy to 23 knees, nonunion and recurrence were not observed in any of the patients [4,22]. Consistent with the literature, we did not observe recurrence in either group in our study. We evaluate that the type of osteotomy affects this in patients who do not use grafts.

Esenkaya et al. reported that they saw nonunion in one of their patients and attributed this to the use of allograft in their study in which they published the results of HTO applied to 58 patients [23]. In our study, nonunion was not observed in both groups.

Our study has some limitations. The number of our patients is not high, short-term follow-up and inability to be compared with other angled tomofix plates can be counted.

Conclusions

In the surgical treatment of suitable patients with varus gonarthrosis, proximal tibial osteotomies may be considered instead of prosthetic options first. These osteotomies can be performed in various ways, with various grafts and various implants. With proximal tibia medial biplanar osteotomy, frontal plane and sagittal plane deformities can be corrected in patients with varus gonarthrosis, and good clinical results can be obtained without using grafts, thus avoiding donor site complications.

Conflict of interest disclosure

There are no known conflicts of interest in the publication of this article. The manuscript was read and approved by all authors.

Compliance with ethical standards

Any aspect of the work covered in this manuscript has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

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