Orthopedic & Muscular System: Current Research

Modified Oblique Proximal Tibial Osteotomy for Deformity Correction of Tibia Vara (Blount Disease)

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Abstract

Background: In Blount's disease, there is a complex three-dimensional deformity which typically includes varus, internal rotation, and (sometimes) procurvatum. The best way to obtain correction is with simple procedure carried out as high in the tibia as possible to promote rapid union, quick remodeling, and with minimal proximal shaft deformity.

Patients and methods: 17 patients with tibia vara underwent corrections of deformity associated with tibia vara by modified Rab proximal tibial oblique osteotomy at our hospital. In twelve patients the deformity was bilateral and it was unilateral in the other five patients, with a total of 29 tibiae. They were ten boys and seven girls with a mean age at surgery of 3 years 6 months (range, 3 years 2 months to 4 years 11 months). The patients were in stage III of the Langenskiöld classification (1952) of the disease.

Results: According to Schoenecker's criteria, 100% of the patients in this study had a good result. Radiologically healing was achieved in all osteotomies with the desired correction of deformity within twelve weeks in all the 17 patients with no complication.

Conclusion: The modified Rab oblique proximal tibial has the advantage of allowing both angular and rotational correction with a high degree of success.

Keywords: Modified oblique; Tibial osteotomy; Blount's disease

Introduction

Erlacher in 1922 was the first one who described Tibia vara or Blount's disease before a more extensive review of the condition by Blount in 1937 [1]. The pathology of tibia vara was explained by repetitive, compressive injury by walking with loading of the proximal tibial growth plate medially with relative overgrowth of the lateral tibial physis resulting in a progressive varus deformity [2]. In Blount's disease, there is a complex three-dimensional deformity which typically includes varus, internal rotation, and (sometimes) procurvatum [3]. Osteotomy to correct the varus of the tibia is inadequate to obtain and maintain satisfactory correction of the deformity about the knee joint and sometimes several osteotomies may be required during the growing years of a child with Blount's disease leading to grotesque deformity of the upper tibia. The best way to obtain correction is with simple procedure carried out as high in the tibia as possible to promote rapid union, quick remodeling, and with minimal proximal shaft deformity [4]. The purpose of this study was for the evaluation of the results of modified Rab proximal tibial oblique osteotomy for the correction of tibia vara in children. All the patients gave the informed consent prior to being included into this study; the study was authorized by the local ethical committee and was performed in accordance with the Ethical standards of the 1964 Declaration of Helsinki as revised in 2000.

Patients and Methods

17 patients with tibia vara underwent corrections of deformity associated with tibia vara by modified Rab [3] proximal tibial oblique osteotomy at our hospital. In twelve patients the deformity was bilateral and it was unilateral in the other five patients, with a total of 29 tibiae. They were ten boys and seven girls with a mean age at surgery of 3 years 6 months (range, 3 years 2 months to 4 years 11 months). The patients were in stage III of the Langenskiöld [5] classification (1952) of the disease. The patients had preoperative standing roentgenograms and lateral radiographs of the affected limb segments as well as prone clinical assessment of the thigh-foot axis for assessment of internal tibial torsion. The mechanical axis was drawn on the radiograph, the mechanical axis zone, was recorded; normally this is midline, the physiologic angle includes zone 1, and zones 2 or 3 are considered to be pathologic (Figure 1) [6]. The tibiofemoral angle [7], metaphyseal-diaphyseal angle [8] were measured preoperatively and postoperatively before hardware removal, and 6 to 12 months after osteotomy. The results were graded as good, fair, or poor on the basis of

Figure 1: The knee is divided into quadrants with the mechanical axis (center hip line to center ankle) normally bisecting the knee. Medial or lateral zones 1 are considered to be normal variance, worthy of observation. Zones 2 and 3 justify surgical intervention by means of stapling or osteotomy, depending on growth remaining (Muller and Muller-Farber, 1984) [6].

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a modification of the clinical and radiographic criteria of Schoenecker et al. [9]. A good rating indicated that the patient had no pain in the knee or clinical instability and that the proximal part of the tibia was of normal contour and orientation on radiographs with the knee joint was perpendicular to the mechanical axis of the limb, and there was less than 5 degrees of difference in tibial-femoral angle from the normal side. The result was fair when the knee joint deviated 5 to 10 degrees from being perpendicular to the mechanical axis with occasional pain and poor, when there was pain restriction of activity, radiologic residual deformity (over- or under- correction), or joint-space narrowing.

Operative Technique

Rab [3] nomogram was used to calculate the angle of oblique osteotomy. The degree of valgization was found on the vertical axis, and the desired degree of rotational correction was found on the horizontal axis. The line at their intersection described the osteotomy angle drawn from the horizontal axis. An osteotomy of the fibula was performed in its middle one third or at the junction of the proximal and middle thirds through 4-cm incision. A second transverse incision at the lower pole of the tibial tubercle was done. The periosteum was incised in Y-shaped fashion, and dissected subperiosteally .Then the anteromedial and anterolateral surfaces of the proximal tibial metaphysis and diaphysis were subperiosteally exposed. Chandler retractors were introduced subperiosteally with the knee in flexion to protect the neurovascular structures posteriorly. Under image intensifier control, a smooth K-wire was drilled into the tibia at the desired angle for the osteotomy which usually was at 45 degree angle. The pin was inserted 1 cm distal to the proximal tibial tubercle and directed toward the posterior cortex to terminate at a safe distance from the growth plate. Under Image-intensifier radiographic control, the angle and the depth of the pin were determined. As the orientation of the plane of cut, we started the plane to correspond with the distal, internally rotated tibial surface, instead of starting the oblique cut from the anterior surface of the upper tibia which can lead to procurvatum with higher angles of correction and this was the first modification from the original technique (Figure 2). A power saw the tibia was osteotomized distal to the pin. As the saw was penetrated deep into the bone, with angle about 45° upward direction with frequent image intensifier radiographs were made to visualize its depth and direction. The greater part of the cut in the tibia was made from its anteromedial side because this approach was easier. When the osteotomy was completed, the osteotomized tibia was manipulated, correcting both varus and medial rotation. Care was taken during

Figure 2: A.Starting the oblique cut from the anterior surface of the upper tibia can lead to procurvatum with higher angles of correction.B this can be improved by orienting the starting plane to correspond with the distal, internally rotated tibial surface [3].

manipulation to avoid tearing the periostium on the posterior surface of the tibia. Next two K-wires were used to fix the osteotomized fragments. This was the second modification of Rab original technique as he used to fix the fragments with one screw. During surgery, the wires gave sounder fixation in the soft cancellous bone of the child and they were easier to be removed in the clinic without anesthesia. The wires should engage both tibial fragments and penetrate the posterior cortex of the distal fragment. The position of the osteotomy was verified by image intensifier. The tourniquet was released and complete hemostasis was achieved. Fasciotomy of the anterior compartment was performed to prevent compartmental syndrome. A hemovac was inserted for drainage and the wound was closed in the routine fashion. An above knee cast was applied with the knee was in complete extension [3,10].

Results

According to Schoenecker's criteria, 100% of the patients in this study had a good result. There were no transient or permanent nerve palsies or deep infection and no instances of compartment syndrome. All patients regained their preoperative knee and ankle motion. No patients complained of knee pain at follow-up. All patients had preoperative clinical medial tibial rotation ranging from 13°-18° as assessed by the prone thigh-foot axis. This improved to an average of 6°+2° postoperatively. Radiologically healing was achieved in all osteotomies with the desired correction of deformity within twelve weeks in all the 17 patients. The mean tibial varus deformity improved from an average of 17° (range, 13°-19°) preoperatively to 2.5° of valgus with a neutral mechanical axis at follow-up. The mean metaphyseal-diaphyseal angle (MDA) was 17.5°+2.5°. This improved to an average of 6.5°+3.5° at the final follow-up (Figures 3a-3e) (Table 1).

Discussion

The infantile form of tibia vara may improve by the age of 4 years, so operation should be delayed unless significant lateral thrust or symptoms develop. The progression of the deformity is monitored clinically by photography, and by both the radiographic tibiofemoral and metaphyseal-diaphyseal angles. The 'Drennan angle' is difficult to measure accurately, but suggests a pathological rather than a physiological varus when it exceeds 15° [2]. Mathematical [11] and graphical analytic [12] methods have been applied to this problem [3]. In general, osteotomy is indicated when a rapid complete correction is desired or when, for any reason, it is preferable not operate on the physis. Opening and closing wedge proximal tibial osteotomies are generally used, together with dome and cheveron-type osteotomies [13]. Opening-wedge osteotomy carries the risk of a traction injury and has potential problems of stability and consolidation. Moreover, these techniques do not always successfully correct the rotational deformity that accompanies the angular deformity in this condition [14]. Proximal tibial valgus osteotomy remains the definitive treatment of infantile tibia vara. The rationale of surgery is to unload the medial joint. Results are generally reliable; but recurrence, which is generally due to deficient medial growth, occurs more often with stage IV or higher, age 4 years or greater, and obesity [15]. Progression to advanced stages (stage 3 or 4) is an indication for osteotomy. Patients, who have persistent varus deformity without evidence of improvement after one year of orthosis use, presenting with stage 3 involvements, are treated with a proximal tibial corrective osteotomy. An osteotomy performed before age 8 on a patient with stage 4 or less Blount's is usually sufficient to correct the deformity [16]. Nine tibiae with Blount's disease were treated in Rab
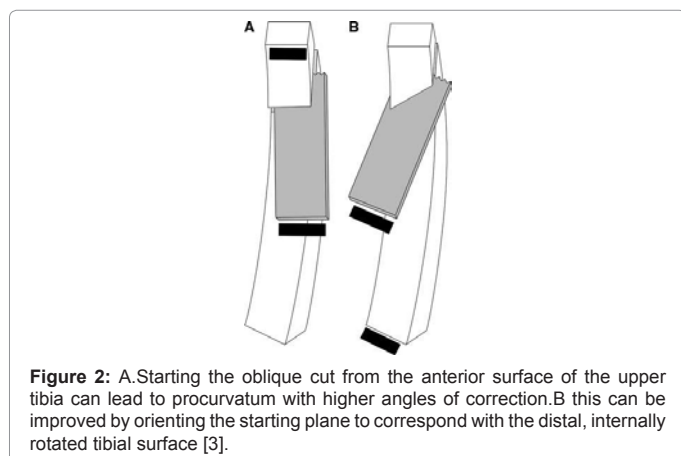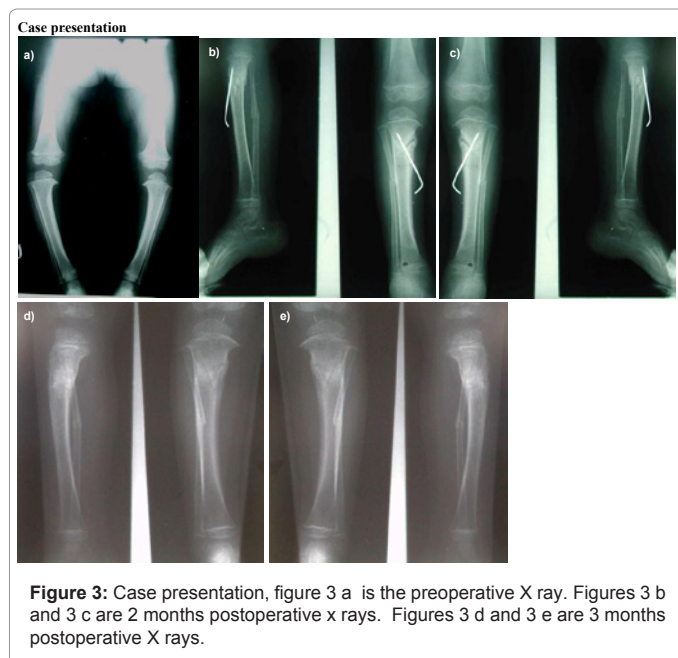
Case presentation

Figure 3: Case presentation, figure 3 a is the preoperative X ray. Figures 3 b and 3 c are 2 months postoperative x rays. Figures 3 d and 3 e are 3 months postoperative X rays.

	Preoperative	Postoperative
Clinical medial tibial rotation	13°-18°	6° + 2°
Mean tibial varus deformity	17° (range, 13°-19°)	2.5° of valgus
Mean metaphyseal-diaphyseal angle (MDA)	17.5° + 2.5°	6.5° + 3.5°

Table 1: The results of of modified Rab proximal tibial oblique osteotomy.

series, with a single-plane oblique proximal tibial osteotomy allowing simultaneous correction of varus and internal rotation. All nine osteotomies achieved the desired correction of deformity. The same results in fourteen tibiae treated with a similar technique were described by Kruse et al. [17]. Ferriter and Shapiro in their retrospective study of 74 tibial osteotomies performed for Blount disease followed for six years did not find any correlation between recurrence of deformity and preoperative deformity angle or degree of surgical correction. They found that surgery at 4 years old or younger might obviate recurrence of varus deformity in Blount disease at long-term follow-up. The concept of the osteotomy was that the correction of a pure rotational deformity requires an osteotomy in the transverse plane. If pure varus-valgus correction is desired, the osteotomy must be in frontal (coronal) plane. Flexion-extension correction requires a sagittal plane osteotomy. Because in most clinical deformities of Blount's disease varus and internal rotation must be corrected, the osteotomy should have transverse and frontal plane components. An oblique osteotomy directed from antero-distal to postero-proximal splits the difference between the transverse and frontal planes. Osteotmy cuts that are more vertical corrects greater varus deformity than internal rotation deformity; cuts that are more transverse do the opposite. Rotation with its two faces in contact corrects varus and internal rotation. The average patient with Blount's disease has approximately equal varus and internal rotation deformities. So, 45° upwards osteotomy has been appropriate for complete clinical correction. Rab [3] in his last review of his technique found that it is theoretically possible to modify the extent of angular correction in each plane by varying the angle of cut in the sagittal plane but most cases of Blount's disease have equal degrees

of tibia vara and tibial internal rotation. For this reason, variations from a 45° upward cut have not proven to be necessary. More acute angles are difficult to achieve, and the natural tendency for a surgeon is to make the cut slightly more transverse than the optimum cut. As regarding orienting the plane of cut, informal reports from surgeons following the initial publication mentioned that excessive procurvatum of the tibia (beyond that which is typical of Blount's disease) was seen with larger angular corrections while this can remodel and does not seem to be clinically troublesome, it is the result of an osteotomy plane that is started too laterally. The procurvatum can be improved by basing the approach for the plane of cut on the direction of the foot (internally rotated) and not the knee. In other words, the 45 upward cut should be made proximally, based on the coordinate system of the distal tibia, not the proximal (Figure 2). Once rotated to the corrected position, the faces of the osteotomy may shorten several millimeters; this has not proven to be a problem [3]. In all our patients we used 45° upward cut based on the distal tibia, not the proximal in the orientation of the plane of cut, correction of the deformity was achieved in all patients. Union with no excessive procurvatum, occurred in each patient. There were no deep infection, no transient or permanent nerve palsies or deep infection and no instances of compartment syndrome. All patients regained their preoperative knee and ankle motion. The oblique osteotomy has many advantages. It avoids damage to the apophysis of the tibial tubercle while allowing a very proximal cut. It corrects accurately both varus and internal rotation deformities. Its broad flat metaphyseal surface in the tibia heals quickly with limited internal fixation with key wires is adequate to control position.

Conclusion

Based on our results we found that the modified Rab oblique proximal tibial osteotomy allows maximal maintenance of length, stability, and metaphyseal contact. This procedure has the advantage of allowing both angular and rotational correction with a high degree of success.

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