

Complete Closing Wedge Osteotomy for Correction of Blount Disease (Tibia Vara): A Technique

Alex Burton, MD, and William Hennrikus, MD

Abstract

Treatment of Blount disease (tibia vara) can be daunting in adolescents because of their obesity. The goals in performing osteotomy for Blount disease are to correct the deformity, restore joint alignment, preserve leg length, and prevent recurrent deformity and other complications, such as neurovascular injury, nonunion, and infection.

In this article, we report on our treatment of 9 limbs in 8 patients (age range, 13-17 years) with Blount disease. In each case, we performed an oblique complete closing wedge osteotomy of the tibia fixed with a compression plate with oblique screw and a fibular osteotomy. Mean body mass index was 38. In 2 patients, an external fixator (instead of a cast) was used after surgery to increase stability. Mean correction was 26°. The cast was removed at 6 weeks. A hinged knee brace was worn for another 6 weeks. Return to normal activities was allowed after 4 months.

The described method, using a closing wedge tibial osteotomy and an oblique fibular osteotomy, is practical and safe and has reproducible results.

that the osteotomy was completed, we modified the Laurencin technique by using a 6-hole, 4.5-mm compression plate rather than a 5-hole semitubular plate, and added a large oblique screw from the medial side to compress the osteotomy site and to protect the plate from fracture. In addition, in 2 patients who weighed more than 250 pounds, we used an external fixator for additional stability. In this article, we report the outcomes of correcting adolescent tibia vara with a complete closing wedge tibial osteotomy and an oblique fibular osteotomy.

Materials and Methods

This study was approved by the Institutional Review Board at Pennsylvania State University. Between 2009 and 2012, we performed 9 complete oblique proximal tibial lateral closing wedge osteotomies on 8 patients (2 girls, 6 boys). In each case, the primary diagnosis was Blount disease. One patient also had renal dysplasia and was receiving dialysis. Mean age at time of operation was 15 years (range, 13-17 years). Mean preoperative weight was 215 pounds (range, 119-317 lb). Mean weight gain at follow-up was 4.39 pounds (range, -10 to 19 lb). Mean body mass index (BMI) was 38 (range, 25-48) (Table). All patients had varus angulation of the proximal tibia before surgery. Mean preoperative varus on standing films was 22° (range, 10°-36°). Because of the patients' size, we used standing long-leg radiographs, on individual cassettes, for each leg.

Surgical Technique

Before surgery, we use paper cutouts to template the osteotomy wedge. We also use perioperative antibiotics and a standard time-out. For visualization of the entire leg for accurate correction, we prepare and drape the entire leg. A sterile tourniquet is used. At the midshaft of the fibula, a 4-cm incision is made, and dissection is carefully carried down to the fibula. Subperiosteal dissection is performed about the fibula, allowing adequate clearance for an oblique osteotomy. The osteotomy removes about 1 cm of fibula, which is to be used as bone graft for the tibial osteotomy. In addition, a lateral compartment fasciotomy is performed to prevent swelling-related complications. The wound is irrigated and injected with bupivacaine and closed in routine fashion.

We then make an inverted hockey-stick incision over the

Blount disease (tibia vara) is an angular tibia deformity that includes varus, increased posterior slope, and internal rotation. This deformity was first described in 1922 by Erlacher¹ in Germany. In 1937, Walter Blount² reported on it in the United States. It is the most common cause of pathologic genu varum in adolescence and childhood.²

An oblique incomplete closing wedge osteotomy of the proximal tibial metaphysis was described by Wagner³ for the treatment of unicompartamental osteoarthritis of the knee in adults. Laurencin and colleagues⁴ applied this technique to the treatment of pediatric tibia vara with favorable results. They spared the medial cortex of the tibia in their incomplete closing wedge osteotomy technique. In each of the 9 cases we treated and describe here, we accidentally completed the tibial osteotomy when attempting the Laurencin technique. Given

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proximal tibia, centered down to the tibial tubercle. After dissecting down to the anterior compartment, we perform a fasciotomy of about 8 cm to accommodate swelling. Subperiosteal dissection is then performed around the proximal tibia. The medial soft tissues are left attached to increase blood supply and healing. During subperiosteal dissection, soft elevators are used to gently retract the lateral soft tissues along with the inferior and posterior structures. We use fluoroscopic imaging to guide the osteotomy as well as screw and plate placement. We use a 6-hole, 4.5-mm compression plate and screws for fixation. The 2 proximal screws of the plate are predrilled in place to allow for application of the plate after completion of the osteotomy. The plate is then rotated out of position on 1 screw, and the osteotomy is identified under fluoroscopy with the appropriate position distal to the second hole of the 6-hole plate.

An oscillating saw and osteotomes are used to perform the oblique osteotomy. The pre-estimated bone wedge is removed. Wedge size is adjusted, if needed. The bone wedge is morselized for bone graft. The osteotomy is then closed, correcting both varus and internal tibial torsion. Our goal is 5° valgus. After correction is obtained, the plate is placed, and the proximal screw is snugly seated. Three cortical screws are placed distally to hold the plate in place under compression mode, and a cancellous screw is placed superiorly at the proximal portion of the plate for additional fixation. The screw placed proximal to the osteotomy site is a fully threaded cortical screw with excellent compression. Correction and proper placement of hardware are verified with fluoroscopy.

The wound is irrigated and injected with bupivacaine. Bone graft is then placed at the osteotomy site. Additional bone graft is placed posteriorly between the osteotomy site and the muscle mass to stimulate additional healing. Another screw is placed obliquely from the medial side across the osteotomy site to provide additional fixation (Figure 1). A deep drain is placed and connected to bulb suction for 24 hours after surgery. The

wound is then closed in routine fashion. In 2 patients who weighed more than 250 pounds, we used an external fixator for additional stability (Figure 2).

Postoperative Care

The incisions are dressed with antibiotic ointment and 4×4-in bandages and then wrapped with sterile cotton under-cast padding. The leg is placed into a well-padded cylinder cast with the knee flexed 10°. The leg is aligned to about 5° valgus. The cast is then split on the side and spread to allow for swelling and to prevent compartment syndrome.⁵ We also use a drain hooked to bulb suction, which is removed 24 hours after surgery. Toe-touch weight-bearing with crutches is allowed immediately after surgery. The cast is removed at 6 weeks, and a hinged range-of-motion knee brace is worn for another 6 weeks. All patients are allowed to resume normal activity after 4 months. In our 2 external-fixator cases, a cast was not used, and toe-touch weight-bearing and knee motion were allowed immediately. The external fixators were removed at about 10 weeks.

Results

Mean postoperative mechanical femoral-tibial angle was 3°, and mean correction was 26° (range, 16°-43°) (Table). Lateral distal femoral angle did not show significant femoral deformity in our sample. Mean medial proximal tibial angle was 74° (range, 63°-79°). In each case, the varus deformity was primarily in the tibia. Mean tourniquet time was 88 minutes (range, 50-119 min). Our complication rate was 11% (1 knee). In our first case, in which we did not use an extra medial screw, the 4.5-mm plate fractured at the osteotomy site 2.5 months after surgery. The 250-pound patient subsequently lost 17° of correction, and valgus alignment was not achieved. Preoperative varus was 25°, and postoperative alignment was 8° varus. This plate fracture led us to use an extra medial screw for additional stability in all subsequent cases and to consider using an exter-

Table. Patient and Postoperative Information^a

Pt	Age, y	Sex	Preoperative Weight, lb	BMI	Physes	Side	Preoperative Varus, °	Postoperative Valgus, °	Correction, °	LDFA, °	MPTA, °
1	13	M	152	27	Open	R	13	7	20	89	75
2	13	M	245	45	Open	R	27	1	28	87	63
3	14	M	250	48	Open	L	25	8 (varus)	17	100	76
4	14	F	162.5	36	Closed	L	10	6	16	88	78
5	15	M	119	25	Closed	R	36	7	43	116	79
6a	16	M	272	47	Closed	R	25	3	28	104	76
6b	17	M	273	48	Closed	L	33	4	37	101	68
7	17	M	317	42	Closed	L	17	4	21	92	74
8	17	F	141	26	Closed	L	16	6	22	95	78

Abbreviations: BMI, body mass index; LDFA, lateral distal femoral angle; MPTA, medial proximal tibial angle.

^aFor each patient, the primary diagnosis was Blount disease (tibia vara).



Figure 1. Patient 4—postoperative radiograph.



Figure 2. Patient 6a—postoperative radiograph.

nal fixator for patients weighing more than 250 pounds. After the first case, there were no other plate fractures. A potential problem with closing wedge osteotomy is shortening, but varus correction restores some length. Mean postoperative leg-length difference was 10 mm (range, 0-16 mm). No patient complained of leg-length difference during the postoperative follow-up.

Eight and a half months after surgery, 1 patient had hardware removed, at the family's request. No patient experienced perioperative infection or neurovascular damage. Our overall patient population was obese—mean BMI was 38 (range, 25-48), and mean postoperative weight was 219 pounds. Three of our 8 patients were overweight (BMI, 25-30), and 5 were obese (BMI, >30). For prevention of plate failure, we recommend using an extra oblique screw in all patients and considering an external fixator for patients who weigh more than 250 pounds.

Discussion

Correction of adolescent tibia vara can be challenging because of patient obesity. The technique described here—a modification of the technique of Laurencin and colleagues⁴—is practical and reproducible in this population. The goals in performing osteotomy are to correct the deformity, restore joint alignment, preserve leg length, and prevent recurrent deformity and other complications, such as neurovascular injury, non-union, and infection.^{3,6-8} Our technique minimizes the risk for these complications. For example, the fasciotomy provides excellent decompression of the anterior and lateral compart-

ments, minimizing neurovascular ischemia and the risk for compartment syndrome. During cast placement, splitting and spreading reduce the risk for compartment syndrome as well.⁵

Wagner^{3,9} demonstrated the utility of a closing wedge proximal tibial osteotomy in adults. Laurencin and colleagues⁴ showed this technique is effective in correcting tibia vara in a pediatric population. However, they did not specify patient weight and used a small semitubular plate for fixation, and some of their patients had infantile Blount disease. We modified the technique in 3 ways. First, we performed a complete osteotomy. Second, because our patients were adolescents and very large, we used a 6-hole, 4.5-mm compression plate and screws. Third, we used an external fixator for increased stability in patients who weighed more than 250 pounds.

The reported technique, using an oblique metaphyseal closing wedge osteotomy with internal fixation in obese patients, is practical, safe, and reliable. This technique is a useful alternative to an external fixator. We used it on 9 knees with tibia vara, and it was completely successful in 8 cases and partially successful in 1 (hardware breakage occurred). An external fixator was used to prevent hardware breakage in 2 patients who weighed more than 250 pounds. This technique is a valuable treatment option for surgical correction, especially in obese patients.

Dr. Burton is a Second-Year Resident, and Dr. Hennrikus is Professor of Orthopaedics, Department of Orthopaedics, Pennsylvania State University College of Medicine, Hershey, Pennsylvania.

Address correspondence to: Alex Burton, MD, Department of Orthopaedics, Pennsylvania State University College of Medicine, 30 Hope Dr, Hershey, PA 17033 (tel, 717-531-7006; fax, 717-531-0216; email, aburton@hmc.psu.edu).

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