International Journal of Multiphysics
Volume 18, No. 3, 2024
ISSN: 1750-9548

Modified Dome Shaped Proximal Tibial Osteotomy in Management of Blount Disease

Khaled Ali Alsagheer, Emad Mahmoud Swayeb

Dr. Khaled Ali Alsagheer Specialist orthopedic of Medical Misurata center- Libya

Email : khaled.alsagier@gmail.com

Dr. Emad Mahmoud Swayeb Specialist orthopedic of Medical Misurata center- Libya

Email : eswayeb@gmail.com

Abstrac

Background: Blount's disease is commonly attributed to an intrinsic, idiopathic defect in the posteromedial proximal tibial physis resulting in progressive bowing of the leg, intoeing, and lateral knee thrust. Treatment has historically included bracing, physeal stapling, or corrective osteotomy, and was determined primarily by age at presentation.

Method: ten patients (twelve limbs) with early onset Blount's disease (infantile tibia vara) were managed between January 2015 and December 2018 by modified dome shaped osteotomy with adding cut at lateral cortex is done to twelve limb. This osteotomy is fixed by 2 k.wires and casting. The average age of children was 4.25 years and follow up time was 12 months.

Results: revision of correction and fixation done to two limb in early stage and five case after casting enter to physiotherapy program against stiffness otherwise there is no permanent complication or problem need to manage

Conclusion: Correction of Blount disease by modified dome shaped osteotomy is effective intervention in infantile type (during childhood). We added cut of lateral cortex after osteotomy to give good bone contact to correct the internal torsion. The short-term outcomes are good and promising with low complication rates and good consolidation. Long-term follow-up results of these patients are needed to observe possible long term complications.

Keywords: : Proximal, Tibial Osteotomy; Tibio-femoral angle; infantile tibia vara

Introduction

Angular deformities of the lower limbs are common during childhood. In most cases this represents a variation in the normal growth pattern and is an entirely benign condition. Blount disease, also known as tibia vara, is an acquired genu varus deformity in children caused by disrupted normal cartilage growth at the proximal medial metaphysis of the tibia. This condition develops due to excessive compressive forces on the medial aspect of the proximal tibial physis, leading to altered enchondral bone formation [(1)].

Blount disease can be either unilateral or bilateral and manifests in 2 forms infantile and adolescent distinguished by variations in age of onset and presentation. The infantile or early-onset form is commonly bilateral, typically manifests in children between the ages of 1 and 5, and tends to exacerbate after the initiation of walking [(2)].

The adolescent form manifests at a later stage and may present as either unilateral or bilateral. Blount's disease is pathology of the proximal tibial epiphysis causing outward tibial bowing in children. Physical examinations as well as several imaging modalities are used to diagnose Blount's disease and differentiate from conditions with similar appearances. [(3)]

The Langenskiöld 6-stage classification system, based on the progressive degeneration of the medial joint compartment, is used to assess the severity of the disease [4] .

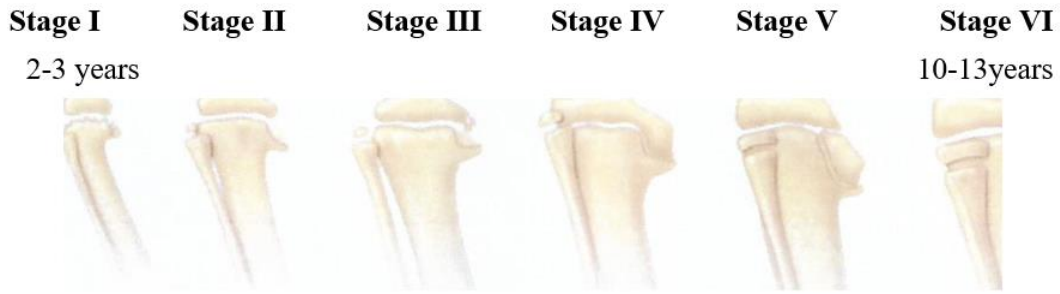

Fig (1) : Complete Restoration Restoration possible common

It is relatively rare to have a deformity occur in only one plane, Tibia vara, rarely if never produces simple varus deformity of the tibia but usually involves internal tibial torsion and the occasionally recurvatum deformity of the upper tibia [5] .

While physical exam and standard x-ray are the mainstays of assessment of Blount's disease, there may be some use in additional imaging modalities such as CT and MRI. CT may be helpful for better assessment of rotational deformities. MRI may be helpful in evaluating some associated soft tissue changes that have recently been described in patients with Blount disease[6].

Historically, they try to use of orthotic management in the correction of Blount's disease has not proven to be as successful as hoped. Due to lack correction and increased laxity of the joint capsule of the knee have been the main reasons for not continuing with orthotic management. So the treatment of choice for individuals with Stage IV or an E-M angle of greater than 30^0has mandated that the child undergo one of several types of tibial osteotomies.Due to the risk of changing with progressive angulardeformity, many cases come to require surgical intervention for correction and re-establishment of lower limb alignment[7].

The surgical correction of persisting, significant deformity can be succeeded by a variety of procedures ranging from manipulation of physeal growth by temporary physealstapling, or hemiepiphysiodesisto many types of valgus osteotomies such as the incomplete lateral closing wedge osteotomy, an oblique tibial osteotomy, the dome shaped osteotomy. and the intra-epiphyseal, or trans-epiphyseal tibial osteotomy [8] .

Aim of the work

In this prospective study we assess the dome shaped osteotomy in the proximal tibia for correction of severe varustibial deformity due to infantile tibia vara with step cut of the lateral cortex to get contact of the bone after derotation to correct the combined internal tibial torsion.

Operative technique

Under a general anesthesia, the patient in supine position. A high thigh tourniquet was used. A sub-periosteal excision of I cm of fibula was performed through a lateral longitudinal incision at the middle of the shaft of fibula to avoid damage to branches of the peroneal nerve.

The proximal tibial approach was via a vertical incision placed just laterally to the tibialtuberosity and centered on the site of the planned osteotomy. In the proximal tibia this was at or just below the tibial tubercle.

A subperiosteal exposure of the tibia was performed and the level confirmed with x ray. A dome cut was outlined on the tibial surface: the apex of the osteotomy site below the tibial tuberosity was marked with a drill hole (2.5 mm) and further medial and lateral drill holes were placed in a semicircular distribution so that the convexity of the distal fragment faced the adjacent joint. The drill holes were then connected with a small

osteotome to complete a dome osteotomy. Care was taken to ensure that the lateral and medial corners were completed.

Once the osteotomy was freely mobile, the major varusdeformity was corrected and then the distal tibia was rotated to achieve the necessary torsional correction. After rotation correction the lateral cortices found not in contact, so a step osteotomy was done to give bone contact to add stability and help union Intra-operative corrections of the deformity was assessed clinically and radio-graphically using a roller metal passing from the center of the hip to the canter of the ankle joint to identify the mechanical and anatomical axes.

The osteotomy was stabilized with crossed 2 mm Kirschner wires inserted percutaneously. During wound closure, care was taken to preserve the periosteum and the soft tissues. All wounds were sutured using an absorbable stitch. An above-knee plaster cast was applied. At 2 weeks, the plaster cast was changed under general anesthesia and the final position of the osteotomy adjusted, in two legs according to the malalignment detected on the follow up.And the K-wires were infected in two osteotomy, patient receive intravenous antibiotic for extra week,the infection disappear when k.wire removed.

The K- wires were removed at 6 weeks without a general anesthetic. The plaster cast was removed when the osteotomy was united clinically and radio-graphically. The total time in cast varied with the age of the patient. Full weight bearing was allowed at 6 weeks. Physiotherapy was commenced following cast removal.

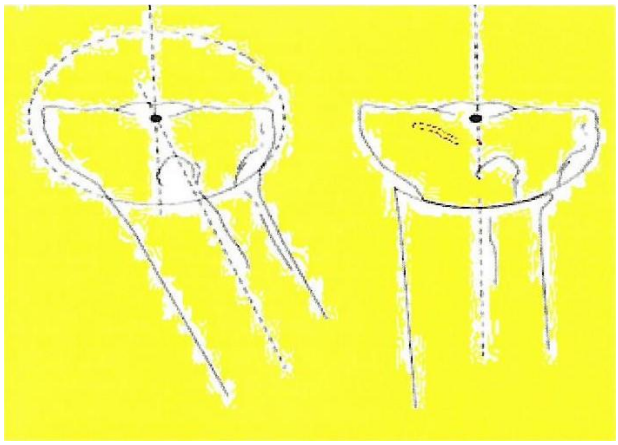

Fig (2): Operative technique

Materials and methods

The study was carried out in Aljazeera orthopedic centre ten patients (twelve limbs) with early onset Blount's disease (infantile tibia vare) were managed between January 2015 and December 2018.

Medical records were used to determine patient data, operative details, complications and functional outcomes.

Radiographs were evaluated to determine the accuracy of correction using standard metrics. Standard anterio-posterior (AP) long leg radiographs x-ray were used to calculate the mechanical axis deviation (MAD), medial proximal tibial angle (MPTA), lateral distal femoral angle (LDFA) and medial plateau angle (MPA).

X ray data was extracted and compared from pre-operative x ray. Clinically, preoperatively and postoperatively, by means of the thigh foot angle (TFA) Preoperative assessment also included measurement of the metaphysealdiaphyseal angle (MDA). The mechanical axis should normally bisect the knee. Axes that lie within the central half of the knee (medial and lateral zones l) are physiologically normal. Axes that pass through zones 2 and 3 are pathological.

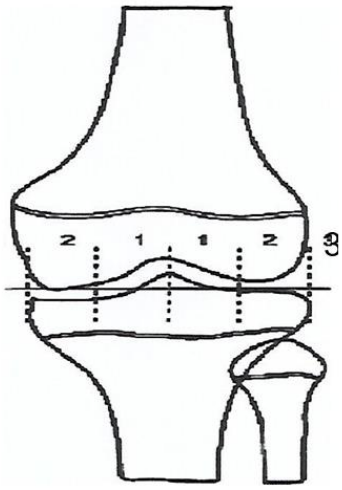

Fig. (3): R adiological Zones in Knee

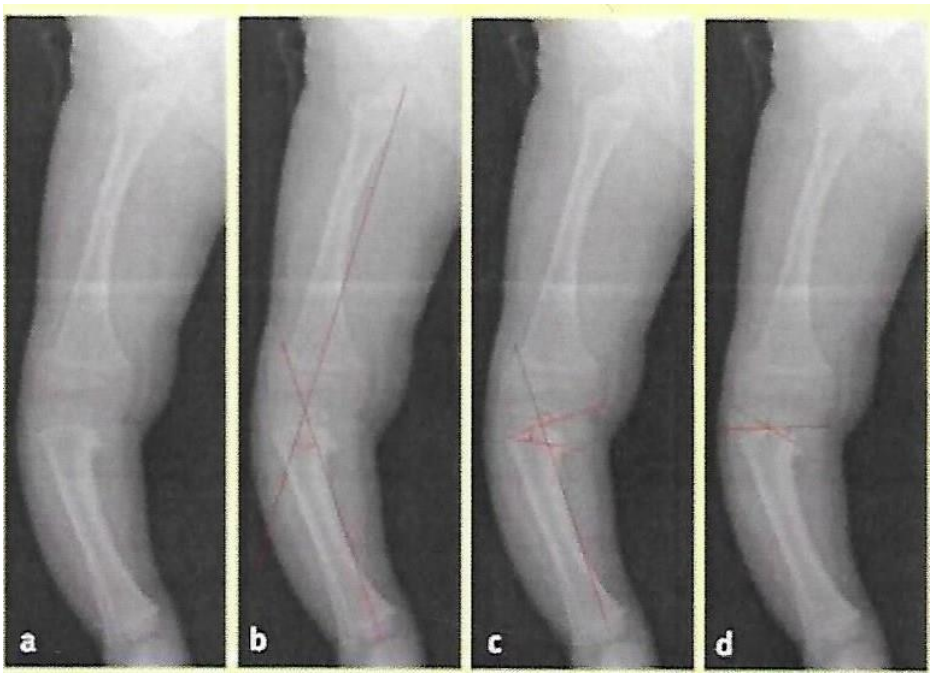

Fig (4): Various angles used in diagnosing Blount's disease. A. xray demonstratingtibial bowing deformity. B. The tibio-femoral angle measured between the tibial and femoral axis. C. The tibialmetaphysealdiaphyseal angle,. D. The epiphyseal-metaphyseal angle (EMA) measured between a parallel line along the tibialphysis and another line from its mid-point to the most distal medial beaking.

Inclusion criteria

Patients with confirmed diagnosis of Blount's disease younger than five years old at the beginning of treatment, Langenskiöld stage II to IV.

Exclusion criteria

A diagnosis other than Blount's disease, non-adherence to treatment patient's age higher than five years old at the beginning of treatment and Langenskiöld stage V or VI.

Statistical analysis:

SPSS v28 was used to conduct statistical analysis (IBM Inc., Armonk, NY, USA). The mean and standard deviation (SD) of the quantitative variables were displayed, and the two groups were compared using the unpaired Student's t-test. The Chi-square test was used to analyze the qualitative variables, which were expressed as frequency and percentage (%). According to the type of data qualitative represent as number and percentage, quantitative continues group represent by mean ± SD, the following tests were used to test differences for significance;. Differences between quantitative independent multiple by independents sample t test (for normally distributed data) and Mann Whitney test (for not normally distributed data) were used, One-way ANOVA test (F) was used to test differences when more than two independent groups were present and variances were equal, while Kruskal-Wallis test (KW) was used when equal variances were not present. there are two assumptions for ANOVA that keep showing up - homogeneity of variance and normality. Homogeneity of variance is the assumption that each population mean has the same variance The assumption of normality means that the populations that each group is drawn from have normal distributions. Together, these two assumptions assume that for ANOVA, every sample is drawn from a normal distribution with the same population variance, even if the population means aren't the same Logistic regression useful in the prediction of the presence or absence of an outcome based on a set of independent variables. It is similar to a linear regression model but is suited when the dependent variable is qualitative (categorical).. Statistical significance was defined as P value < 0.05.

Result

Two weeks postoperative during change of plaster, two limbs showed some loss of angular correction and Kwires were extracted and reinserted percutaneously after manipulation under anesthesia with application of a valgus force to correct the residual deformity.

The total time in plaster varied with the age of the patient. All osteotomies united within time ranged from 2 to 4 months. At a mean time of 12-months of follow-up, all patients had a good clinical and radiological correction of deformity with improvement of preoperative symptoms.

Radiographically, the angular correction was from a mean of 20 degrees preoperative to a mean of 3 degrees of varus angulation postoperative. TFA was corrected from a mean of 15 degrees of in-toeing preoperatively to a mean neutral position at follow-up.

In all cases the postoperative foot progression angle (FPA) was within 4 degrees of neutral and hence for each patient was within normal limits. The mechanical axis was corrected from passing outside the middle half of the knee joint

(Table 1) Measurements of deformity in our Blount cases

The angle	Pre operative	Post o erative
Meta h sealdia h seal an le	11 — 19 degree	2—5 de ee
Varus angular deformity	15 — 25 varus	3 degree valgus — 7 degee varus
Thi foot an le	10 — 20 de ee in toein	2 — 9 de ee

(Table 2) Position of mechanical axis

Side	Medial		Lateral	
zone	Zone 3	Zone 2	Zone 2	Zone 3
Pre operative	5	7		
Post operative		2		

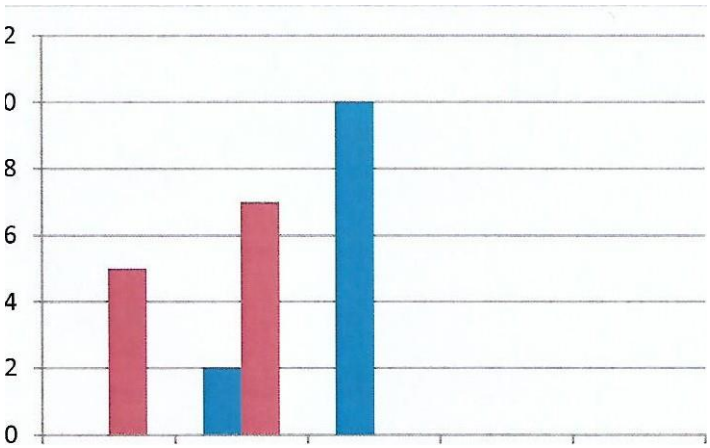

Fig.(5) Position of mechanical axis

Discussion

In our study we use Dome shaped tibial osteotomy to correct both the angular and rotational malalignment in patients with moderate to severe Blount disease. Good bony position ensured, and we added step osteotomy of lateral cortex after rotation of the distal fragment gave good bone position.in this study, a significant difference in the tibiofemoral angle was observed before and after surgery 15 — 25 varus before surgery and 3 degree valgus 7 degree varus after operation.There are contradictions in various studies on the amount of the correction of the valgus angle. Insallet al. report that an amount of post-operative valgus correction between 5 ^{0} and 14 ^{0} is acceptable[(9)], in the study of **Tabatabaei et al. [(10)]**, the average varus angle changes from 17.5 to 5.5 valgus degrees after proximal tibial osteotomy using dome-shaped method. **Ferriter and Shapiro [(11)]** conducted a study in which 37 children with Blount's disease were treated with closing wedge, opening wedge, and dome osteotomies with additional internal fixation. They corrected the varus deformity to an average of 9^{0} of valgus (range: 5—20 ^{0}). Up to 57% of the patients required one to four additional osteotomies about five of our patients presented with slightly knee stiffness after removal of cast that rapidly responses to proper physiotherapy without developing other complications like patella baja .

Pin tract infection in our study was (16 %) two cases from 12 total numbers of cases. and treated by intravenous antibiotic ceftriaxoze and finally disappeared after removal of k.wire. Risk of infection is high after using the plate compared to k.wire. **Huang et al. [(12)]** performed 46 high tibial osteotomies using a locking compression plate for internal fixation and observed two deep infections which were treated with surgical debridement and external fixation.

In our k. wire cases respond to intravenous antibiotic and the infection completely disappear after removal of that transit k.wire fixation. Several potential causes of neurovascular problems have been highlighted. Peroneal nerve palsy may be caused by traction and the anterior compartment syndrome could be related to anterior tibial artery trauma. **Andrisevic et al., [(13)]** reported peroneal nerve palsy in 10% of children undergoing tibial derotation osteotomies due to anterior compartment syndrome.

in our work, careful attention to surgical detail with gentle soft tissue dissection and manipulation, pre-drilling of the tibia by multiple holes and then completion of the osteotomy with an osteotomy to avoid vascular complications. In addition, the middle fibular osteotomy decompressed all compartments of the lower leg and to be away from common peroneal nerve and its branches.Although compartment syndromes have been reported not infrequently in the old literature, recent studies including ours have seen no such complications. However. **Payman et al [(14)]** identified a significantly increased risk of major complications such as recurrence/reoperation in one case with a comorbidity [(14)],

In our study all patients but one were corrected by remodeling and more correcting of deformity in operation after removal of k.wire then fixation again after remodeling of fracture in proximal tibia. No other

patients needed reoperation. The limited internal fixation with crossed Kirschner wires provided acceptable control of the osteotomy position in all cases, thus avoiding the need for additional surgery that occurs for extraction in plate fixation techniques.

Reference

1- **Heflin, J. A., Ford, S., & Stevens, P. (2016).** Guided growth for tibia vara (Blount's disease). *Medicine*, *95*(41), e4951.

2- **Espandar, R., Mortazavi, S. M. J., & Baghdadi, T. (2010).** Angular deformities of the lower limb in children. Asian journal of sports medicine, 1(1), 46.

3- **Mehtar, M., Ramguthy, Y., & Firth, G. B. (2019).** Profile of patients with Blount's disease at an academic hospital. *SA Orthopaedic Journal*, *18*(3), 30-35.

4- **Shinohara, Y., Kamegaya, M., Kuniyoshi, K., & Moriya, H. (2002).** Natural history of infantile tibia vara. The Journal of Bone & Joint Surgery British Volume, 84(2), 263-268.

5- **Geith, M. A., & Naggar, A. M. (2016).** Modified dome shaped proximal tibial osteotomy for treatment of infantile tibia vara. Int J Res Orthop, 2, 394-9.

6- **Sabharwal, S. (2015).** Blount disease: an update. Orthopedic Clinics, 46(1), 37-47.

7- **Sabharwal, S., & Sabharwal, S. (2017).** Treatment of infantile Blount disease: an update. Journal of Pediatric Orthopaedics, 37, S26-S31.

8- **Warme, B. A., Aalderink, K., & Amendola, A. (2011).** Is there a role for high tibial osteotomies in the athlete?. Sports health, 3(1), 59-69..

9- **Khakha, R., Abd Razak, H., Kley K., van Heerwaarden R. & Wilson, A. (2021).** Role of high tibial osteotomy in medial compartment osteoarthritis of the knee: indications, surgical technique and outcomes. Journal of clinical orthopaedics and trauma, 23, 101618.

10- **Tabatabaei, S., Narimani, A., & Mehramiri, S. (2017).** Assessment of the Treatment Outcomes of Dome-shaped Proximal Tibial Osteotomy in Patients with Genu Varum Referred to Razi Hospital. Asian Journal of Pharmaceutics, 11(3), S667-S671.

11- **Ferriter, P., & Shapiro, F. (1987).** Infantile tibia vara: factors affecting outcome following proximal tibial osteotomy. Journal of Pediatric Orthopaedics, 7(1), 1-7..

12- **Huang, Y., Gu, J., Zhou, Y., & Li, Y. (2014).** Osteotomy at the distal third of tibial tuberosity with LCP L-buttress plate for correction of tibia vara. Journal of orthopaedic surgery and research, 9, 1-9.

13- **Andrisevic E., Westberry, D., Pugh, L. I., Bagley, A., Tanner, S., & Davids, J. (2016).** Correction of tibial torsion in children with cerebral palsy by isolated distal tibia rotation osteotomy: a short-term, in vivo anatomic study. Journal of Pediatric Orthopaedics, 36(7), 743-748.

14- **Payman, K. R., Patenall, V., Borden, P., Green, T., & Otsuka, N. Y. (2002).** Complications of tibial osteotomies in children with comorbidities. Journal of Pediatric Orthopaedics, 22(5), 642-644.