Evaluation of combined high tibial osteotomy and ilizarov external fixator in the treatment of late-onset tibia vara

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Purpose
The purpose of this study was to evaluate the results of combined high tibial osteotomy in combination with gradual translation by ilizarov external fixator in the treatment of late-onset tibia vara.
Patients and methods
A total of 23 patients with a diagnosis of late-onset tibia vara, 16 (69.6%) male and seven (30.4%) female, were included in this study; in 14 (60.9%) patients the deformity was on the right side, whereas in nine (39.1%) patients the deformity was on the left side.

The etiology was Blount's disease in all patients. The mean age of the patients was 23 years, ranging from 13 to 35 years, and the mean preoperative mechanical axis deviation was 84.39 mm. The mean preoperative medial posterior tibial angle was 61.17°, whereas the mean preoperative proximal posterior tibial angle was 63.09°.
Results
The mean duration of external fixator application was 124.6 days, ranging from 90 to 170 days; the mean postoperative medial proximal tibial angle was 86.22°, with a *P* value of 0.001; the mean postoperative proximal posterior tibial angle was 79.74°, with a *P* value of 0.001; and the mean postoperative mechanical axis deviation was 10.7 mm, with a *P* value of 0.001.

Residual deformity was present in three (13%) cases, ranging from 5 to 18°; no neurovascular complication was seen in both early and late postoperative periods; and limb length discrepancy was present in five (21.7%) cases, which was between 1.5 and 2.7 cm.
Conclusion
High tibial osteotomy in combination with gradual correction by ilizarov is safe and effective in the management of late-onset tibia vara.

Keywords:
genu varum, ilizarov, tibia vara, late onset

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Introduction

Blount's disease is one of the most common etiologies of pathological genu varum in children and adolescents [1].

Two types of Blount's disease are known (early-onset and late-onset), according to whether the deformity appears before or after the age of 4 years [2].

Late-onset tibia vara always presents with a multiaxial tibial deformity, which is a combination of varus, procurvatum, and internal tibial torsion [1].

Although the way of management of tibia vara is still of controversy, corrective osteotomy is the still the best option for management [1].

Gradual correction with distraction osteogenesis has proven to be an effective means for achieving an accurate multiplanar deformity correction especially in patients with late-onset disease [2].

The aim of this study is to evaluate the outcome and the effectiveness of the circular external fixator with high tibial osteotomy in the management of late-onset tibia vara.

Patients and methods

A total of 23 patients from Benha University Hospital with a diagnosis of late-onset tibia vara, 16 (69.6%) male and seven (30.4%) female, were included in this study; in 14 (60.9%) patients the deformity was on the

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right side, whereas in nine (39.1%) patients the deformity was on the left side (Table 1). The study was approaved by ethical committee of Banha University and were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

The etiology was Blount's disease in all patients; all cases were treated by the author between April 2012 and September 2015, and the mean follow-up period was about 18 months.

Preoperative plane radiography – anteroposterior and lateral views – were performed for all patients (Fig. 1); also, computed tomography scanogram was done for the majority of the cases (Fig. 2). The analysis of the deformity was done using the methodology described by Paley [3].

The mean±SD age of the patients was 23±6.07 years, ranging from 13 to 35 years; the mean±SD preoperative mechanical axis deviation was 84.39±13.5 mm; the mean±SD preoperative medial posterior tibial angle was 61.17±8.54°; and the mean±SD preoperative proximal posterior tibial angle was 63.09±10.23° (Fig. 3).

Table 1 Summary of patients and methods

Patients	Value
Age [mean±SD (range)]	23.0±6.07 (13–35)
Sex [*N* (%)]	
Male	16 (69.6)
Female	7 (30.4)
Duration of fixation [mean±SD (range)]	124.65±21.69 (90–170)

Technique

Under regional spinal anesthesia, fibular osteotomy was done at its middle third, and then under image intensifier the proximal reference wire was inserted in the upper tibial epiphysis in skeletally immature patients parallel to the joint line, whereas in skeletally mature patients the proximal reference wire was inserted in the upper tibia 1 cm below and parallel to the joint line.

On the other hand, another distal reference wire was inserted at the distal tibia above and parallel to the ankle joint.

Assembly of proximal construct, which is one and half ring proximal to the intended site of osteotomy, where the distal construct composed of two complete rings located distal to the osteotomy site, provided that the two constructs corresponding to the two reference wires.

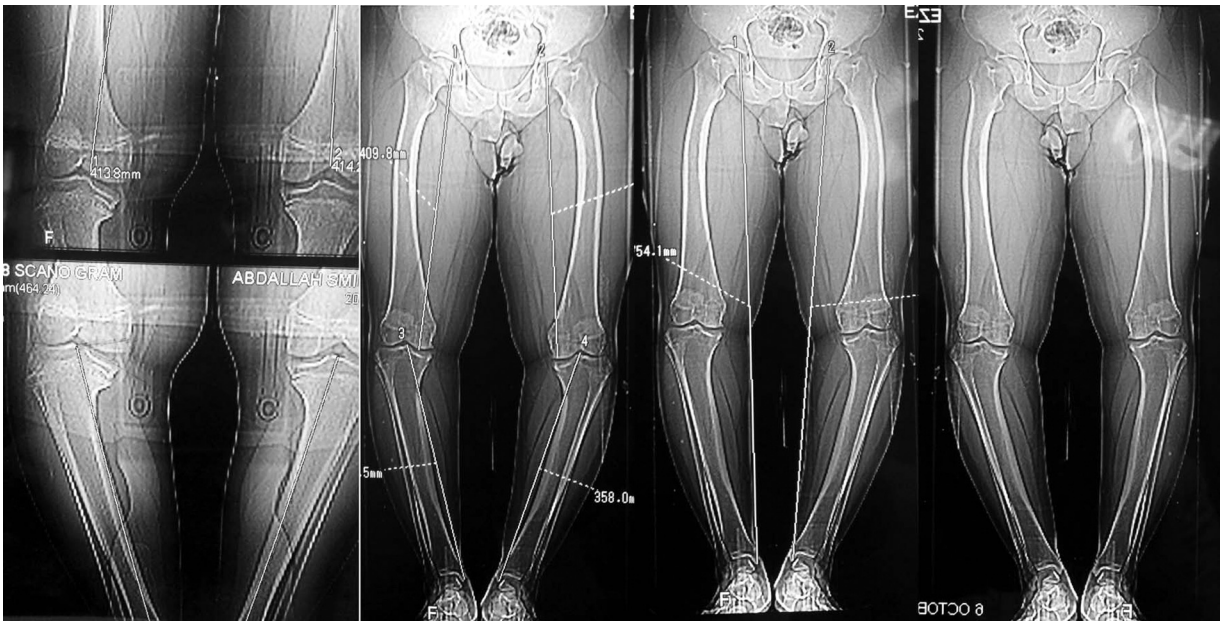
In late-onset tibia vara, the center of rotation and angulation is close to the articular surface, which makes performance of the osteotomy at the center of rotation and angulation impossible; also, it was harmful for skeletally immature patients as the growth plate lies close to the joint surface, and thus we perform oblique osteotomy just distal to the tibial tuberosity in all patients.

Acute correction of internal tibial torsion was done, and then we put a distractor on the medial side of the fixator and a unidirectional hinge anteriorly, at the center of the tibia above the site of the osteotomy that allows correction of varus deformity and decrease of translation during correction; this hinge is held by a long bolt with two nuts tightened on each other, to make the hinge move freely.

Figure 1

Pre-operative x aysanteroposterior and lateral views.

Figure 2



Pre-operative C.T.scanogram of both lower limbs.

Figure 3

Preoperative clinical photos of varus deformity.

Follow-up

The patient was discharged from the hospital on the third day postoperatively after full neurological and vascular examination, and the patient was informed of pin site care; oral antibiotics such as cephalosporins, analgesics such as ibuprofen and diclofenac sodium, and antiedematous drugs such as α-chymotrypsin were prescribed to the patients.

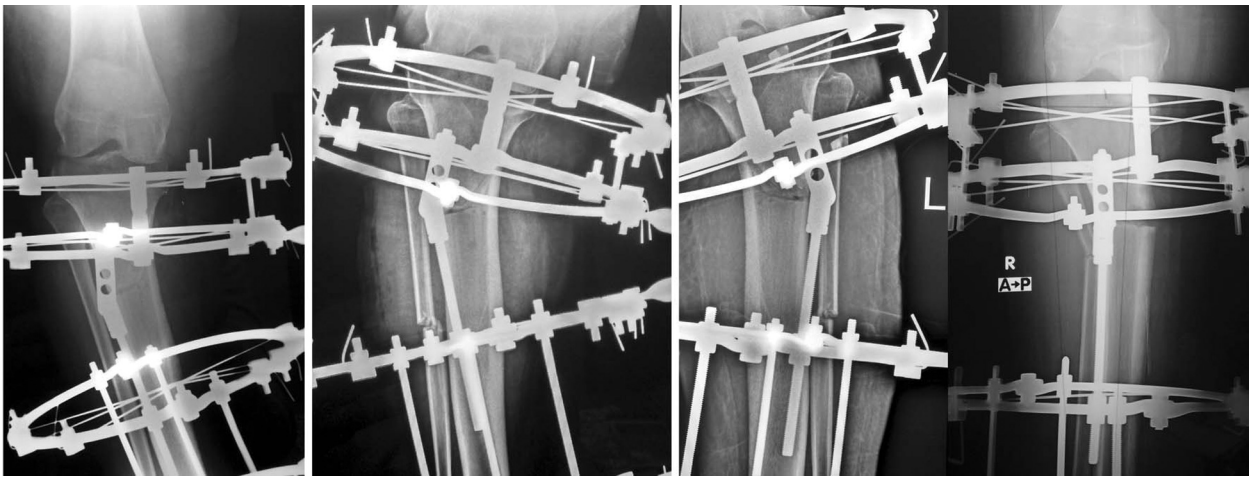
Marking of the nuts by colored pen was done at the first visit, which is 7 days postoperatively in the outpatient clinic, and the patient was informed and taught how to move the nuts. Correction of the deformity was started 7–10 days postoperatively (Figs 4 and 5).

The patients came every 2 weeks to the outpatient clinic to follow up the correction progress; radiography were performed in each visit, the pin site was examined, stability of the apparatus was assessed, and bowing of the distractor rod on the medial side was corrected.

The correction was continued until the deformity was corrected, and the mechanical axis became between 0 and 10° valgus; the correction was stopped and another connecting rod was inserted to connect the proximal and distal construct for stability.

The apparatus was removed after complete radiological and clinical signs of bone healing (Figs. 6 and 7).

Figure 4



Early and latefollow up X-Rays.

Figure 5

Early and late clinical photos ant the beginning and near full correction.

Statistical analysis

The clinical data were recorded on a report form. These data were tabulated and analyzed using the computer program Statistical Package for the Social Sciences (SPSS) (SPSS, version 16; IBM SPSS Statistics, USA) to obtain the following.

(1) Descriptive data: descriptive statistics were calculated for the data in the form of:
   (a) Mean±SD for quantitative data.
   (b) Frequency and distribution for qualitative data.
(2) Analytical statistics: In the statistical comparison between the different groups, the significance of difference was tested using paired t test (used to compare the mean of two quantitative variables).

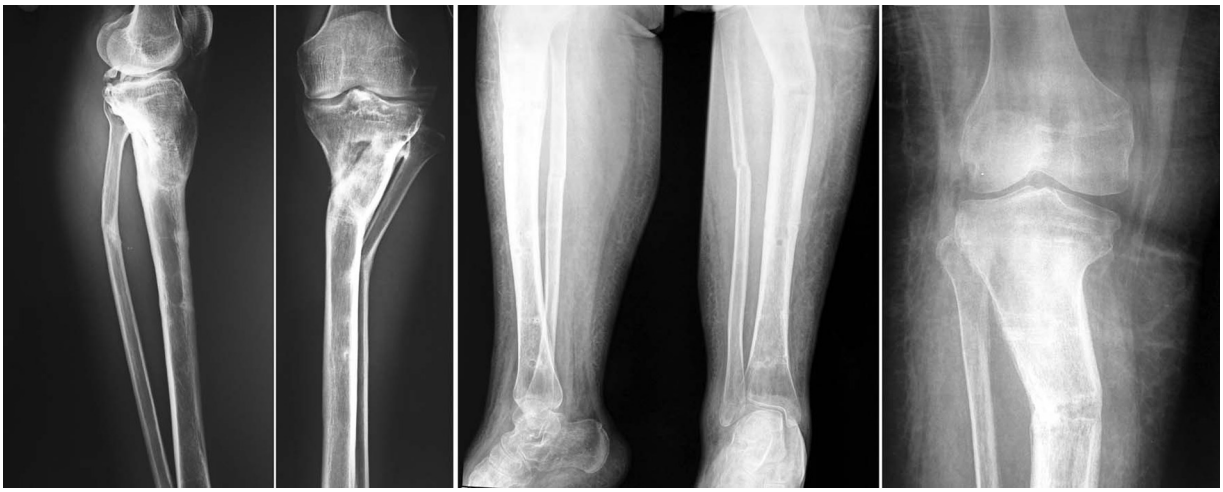
A *P* value less than 0.05 was considered statistically significant, a *P* value greater than 0.05 was considered statistically insignificant, and a *P* value less than 0.01 was considered highly significant in all analyses.

Results

The mean±SD duration of external fixator application was 124.6±21.7 days, ranging from 90–170 days; the mean±SD postoperative medial proximal tibial angle was 86.22±3.66° and a *P* value of 0.001; the mean±SD postoperative proximal posterior tibial angle was 79.74±2.09° and a *P* value of 0.001; and the mean±SD postoperative mechanical axis deviation was 10.7±7.6 mm and a *P* value of 0.001.

Pain was present in all cases especially at the beginning of correction, it was located at the medial side of the tibia mainly because of distraction, and it was controlled by mild analgesics; pin tract infection was present in about 20% of the cases, all of superficial type, mainly at the proximal medial wires because of distraction

Figure 6



X rays after removal of circular external fixator.

Figure 7

Clinical photos after full correction and fixator removal.

overload, and it was controlled by administration of oral antibiotics such as cephalosporins for 10 days. Knee range of motion was encouraged during fixator application until 90° flexion, and after removal of the fixator and during the follow-up period all patients had complete knee range of motion.

Residual deformity was present in three (13%) cases, ranging from 5 to 18°; all cases had no neurovascular complication in both early and late postoperative periods. Limb length discrepancy was present in five (21.7%) cases, and it was between 1.5 and 2.7 cm; it had no impact upon the patient gait (Table 2).

Psychological support for the patient was needed during the whole period of fixator application (Table 3).

Table 2 Summary of results

Items	Preoperative	Postoperative	Paired *t* test	*P* value
MPTA	61.17±8.54	86.22±3.66	13.52	0.001**
PPTA	63.09±10.23	79.74±2.09	7.19	0.001**
MAD	84.39±13.5	10.74±7.62	34.02	0.001**

MAD, mechanical axis deviation; MPTA, medial posterior tibial angle; PPTA, proximal posterior tibial angle. ***P* value greater

Discussion

Because of lower limb malalignment, pain and knee osteoarthritis are the end results of untreated Blount's disease [1].

Proximal tibial osteotomies and acute correction of the deformity are performed for the management of infantile tibia vara, but it was noted that it is less effective in treating late-onset tibia vara, but many complications such as neurological affection and compartmental syndrome could occur with acute deformity correction [1,2,4,5].

Gradual correction with distraction osteogenesis appears to be safe and effective in the management of multiaxial deformity [4–8].

Amer and Khanfour [1] advocated that the results of gradual angulation and translation by ilizarov external fixator in the management of 20 tibiae of late-onset tibia vara were satisfactory.

Coogan *et al.* [5] reviewed eight patients with 12 tibias of adolescent tibia vara who were treated by proximal tibial osteotomy and gradual correction by ilizarov circular fixator, and the results were encouraging as the mean varus angle decreased from 18° preoperatively to 2.5° postoperatively.

Table 3 Summary of current study and comparison of other similar studies

	References				
	This study	Amer and Khanfour [1]	Stanitski *et al*. [8]	Coogan *et al*. [5]	Alekberov *et al.* [4]
Patients and methods	23 patients, 16 male andseven female	20 patients	17 obese patients (25 tibias)	8 patients (12 tibias)	45 patients (69 tibias)
Follow-up	19 months	2.9 years			
Results	Postoperative MPTA: 86.22 deg. MAD: 10.7 mm	Mean angle of correction: 11.36 deg. (0–35)	Varus angle within 5 deg. of normal	Proximal tibial varus angle decreased from 18 to 2.5 deg.	Angle achieved within normal
Complications	Pin tract infection in 20%Limb length discrepancy less than 3 cm in five casesResidual angle deformity in three cases	Recurrence of deformity in 10 cases	One premature consolidation, one delayed uion, two residual internal tibial torsion, eight pin tract infection	One premature consolidation, one overcorrection with skin necrosis, seven pin tract infection	Six patients need revision

MAD, mechanical axis deviation; MPTA, medial posterior tibial angle.

Stanitski *et al*. [8] reviewed 17 patients with 25 tibias, managed by high tibial osteotomy and gradual correction by ilizarov external fixator; the varus angle decreased from 27° preoperatively to 5° of normal axis postoperatively.

Alekberov *et al*. [4] reported the use of ilizarov external fixator in 45 patients, 69 tibias; correction of the deformity was achieved in all patients, except in six patients.

On the other hand, Oto *et al*. [9] managed six limbs of adolescent tibia vara by lateral plate hemiepiphysiodesis of the proximal tibia, and he concluded that the use of tension band plate hemiepiphysiodesis (eight plate) is not recommended in the treatment of severe adolescent Blount's disease.

Conclusion

From our study, we concluded that correction of late onset of tibia vara by high tibial osteotomy in combination with gradual correction with ilizarov external fixator is a reliable and effective method for the management of such a type of deformity.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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