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ORIGINAL ARTICLE

Outcome of Percutaneous Tibial Osteotomy in Children with Genu Varum Deformity

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Abstract

Background: ***The pediatric bow knee (genu-varum) is a ubiquitous orthopedic presentation; different surgical procedures have been described to correct this pathological type. In this study, we evaluate the use of the percutaneous tibial osteotomy technique to correct the angular deformity of pediatric patients with genu varum.***

Aims and objectives: ***To assess the correction of the angular deformity in pediatric patients with genu varum using the percutaneous tibial osteotomy technique.***

Patients and Methods: ***We conducted a randomized controlled (closed envelope) prospective interventional study to assess the effectiveness of the percutaneous osteotomy technique in treating pediatric genu varum. This study had 20 cases (35 limbs): 14 males and 6 females, 15 bilateral and 5 unilateral. All patients underwent surgery at Al-Azhar University or Mansoura Health Insurance Hospitals between August 2022 and August 2023.***

Results: ***Post-operatively, the study showed significant radiological improvement in mLDFA, MPTA, and mechanical axis deviation. The patient showed significant clinical improvement, according to the Böstman knee score.***

Conclusion: ***This surgical procedure is a reliable method of correcting genu-varum deformity in children before maturity, with some precautions to reduce the rate of complications reported about their children. Bow legs, or genu-varum.***

Keywords: Percutaneous; Tibial Osteotomy; Genu Varum Deformity

1. Introduction

Parents often worry about their children's bow legs or genu varum, a frequent problem. The malformation makes the lower leg and thigh look like an archer's bow from the outside. [1]

While a varus angle of 10–15 degrees is typical for newborn knees, the femorotibial joint eventually remodels to a neutral position between 18 and 20 months. [2]

When a child ages one to three has genu varum, both normal and abnormal genu varum should be considered. These include rickets, infantile tibia vara, infection, trauma, and metaphyseal chondrodysplasia. [1]

Most pediatric varum cases are physiologic and resolve spontaneously without any intervention. Pathological bowlegs are defined as femorotibial varus angulation that is greater than 10 degrees and persists after the age of 2 years. [2]

On radiographs, the symmetrical relationship between the proximal tibia and distal femur, the typical appearance of the growth plate, and the medial bending of both bones identify physiological bowlegs. In children younger than two, radiographic findings and the tibiofemoral angle are the same in the physiological bow leg and infantile tibia vara. [3]

Average growth and development spontaneously resolve the physiological genus varum. Nevertheless, in pathological genu varum, the condition generally worsens over time, predisposing to mechanical lower limb issues and joint disorders. [4]

Angular deformity around the knee can be fixed surgically, such as through proximal tibial osteotomy, hemi epiphysiodesis, medial tibial plateau elevation, and asymmetric physical distraction. The surgery's primary goal is to restore the mechanical axis of the limb. [4]

This study aimed to assess the results of percutaneous tibial osteotomy in children with genu varum deformity.

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2. Patients and methods

We conducted a randomized controlled (closed envelope) prospective interventional study to assess the effectiveness of percutaneous osteotomy technique in treating pediatric genu varum. In this study, there were 20 cases (35 limbs): 14 males and 6 females, 15 bilateral and 5 unilateral. All patients underwent surgery at either Al-Azhar University or Mansoura Health Insurance Hospitals between August 2022 and August 2023.

Cases with pathological genu varum, such as those with Blount disease or nutritional rickets (rickets, infantile tibia vara, infection, trauma, and metaphyseal chondrodysplasia) following medical treatment for their active form, vitamin D-resistant rickets, and renal osteodystrophy, met the inclusion criteria. The tibio femoral angle (deformity angle) was above 15 degrees, the age group was between 3 and 13 years, and both genders were included.

The exclusion criteria included cases with physiological genu varum. The criteria for nutritional rickets included whether there was still an active form of calcium or vitamin D deficiency. Persistent infection, Surgical contraindications, The age range falls between 3 and 13 years old.

2.1.METHODS

The diagnosis methods include taking a history, conducting a physical examination, conducting laboratory tests, and taking a long, standing full-length anteroposterior radiograph of both lower extremities, with the patellae facing forward, which is crucial for a detailed analysis of frontal plane alignment. We evaluated the results after surgery using a modified Böstman knee score, radiographic evaluations, and patient-reported measures of improved knee function. 5

Operative technique: We performed the operation in a sterile environment while the patient was under general anesthesia. The patient lies supine on a radiolucent table so that the image intensifier can see the ipsilateral hip, knee, and ankle. We followed standard procedures for preparing and draping the operating extremities. Preoperatively, antibiotics were administered. We applied and tightened the sterile tourniquet before making the incision. The surgeon stationed himself on the same side and raised the C-arm on the contralateral side. (Figure a), The surgeon made a small incision one finger breadth below the tibial tuberosity. We inserted a 5 mm Shanz pin through the incision in Figure b to create a hole in the near cortex. (Figure c), Next, the surgeon directed the pin towards the posterior, posteromedial, medial, and posterolateral cortices. We manually completed the osteotomy by applying a valgus-directed force distal to the osteotomy site with one hand, while holding the part of the tibia proximal to the osteotomy site in place with the other hand. We corrected the deformity using an image intensifier (Figure e). In Figure f, we applied the knee cast mentioned above to uphold the correction. We counted the number of images captured by the image intensifier in each case (Figure g). The technique does not necessitate a fibular osteotomy that has been associated with neurovascular complications.

Percutaneous drilling using manual osteoclasis, open drilling, or an oscillating saw with irrigation can create an osteotomy and prevent heat necrosis. Crossed K wires, Steinmann pins, plaster pins, staples, plating, and external fixation are also possibilities.

Figure 1. Showed steps of percutaneous corrective osteotomy of genu varum

Postoperative management and follow-up: The patient was kept in the hospital for 24 hours after the operation under observation, and the patient's mothers were instructed to keep their children's lower limb elevated above the heart level to prevent the development of compartment syndrome, as well as for early detection and intervention if compartment syndrome had developed. The patient was released from the hospital the next day. We administer intravenous antibiotics based on the child's weight for 24 hours post-operatively, and prescribe oral antibiotics, analgesics, and antipyretics after discharge, which we continue for only one week post-operatively. Following the operation, we perform a post-operative X-ray and conduct follow-up. We perform X-rays after 3 weeks and 6 weeks, and if necessary, after 9 weeks. We assess the correction by measuring the limb mechanical axis before and after the operation. What are the acceptable angles after corrective osteotomy? The medial proximal tibial angle (MPTA) should be 87° (range 85°–90°), the mechanical axis deviation (MAD) should be 8±7 mm medial, and the tibio-femoral angle should be between 5° and 7° of valgus.

Methods of statistical analysis: We evaluated and statistically analyzed the collected data using the arithmetic mean, standard deviation, t-test, and chi-square. We considered the difference significant when P was less than 0.05.

3. Results

Table 1. Relation between Bostman knee score and demographic data of the studied patients

		POST BOSTMAN KNEE		TEST VALUE	P-VALUE	SIG.
		Good 20-27 No. = 8	Excellent 28 - 30 No. = 12			
AGE	Mean ± SD	4.13 ± 0.64	5.67 ± 2.50	-1.694•	0.107	NS
	Range	3 – 5	4 – 13			
SEX	Female	2 (25.0%)	4 (33.3%)	0.159*	0.690	NS
	Male	6 (75.0%)	8 (66.7%)			
UNILATERAL / BILATERAL	Unilateral	1 (12.5%)	4 (33.3%)	1.111*	0.292	NS
	Bilateral	7 (87.5%)	8 (66.7%)			
SIDE AFFECTED	Right	8 (53.3%)	9 (47.4%)	0.119*	0.730	NS
	Left	7 (46.7%)	10 (52.6%)			
CASTING DURATION (WKS)	Mean ± SD	7.53 ± 0.64	7.37 ± 0.76	0.672•	0.506	NS
	Range	6 – 8	6 – 8			
WB STARTED (WKS)	Mean ± SD	3.67 ± 0.72	3.89 ± 0.57	-1.031•	0.310	NS
	Range	3 – 5	3 – 5			
TIME TO HEAL (WKS)	Mean ± SD	6.53 ± 0.52	6.37 ± 0.76	0.718•	0.478	NS
	Range	6 – 7	5 – 7			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS) *:Chi-square test; •: Independent t-test

Table 1: showed that there was no statistically significant relation observed among Bostman knee score & age, sex or laterality of the studied patients with p-value = 0.107, 0.690 and 0.292; respectively. Also, the table revealed that there was no statistically significant relation observed among Bostman knee score and side affected, casting duration, WB started and time to heal with p-value = 0.730, 0.506, 0.310 & 0478; respectively.

Table 2. Relation between Bostman knee score and inter-condylar distance (cm) of the studied patients

INTER-CONDYLAR DISTANCE (CM)		POST BOSTMAN KNEE		TEST VALUE‡	P-VALUE	SIG.
		Good 20-27 No. = 15	Excellent 28 - 30 No. = 19			
PRE	Mean ± SD	7.93 ± 0.80	8.79 ± 1.44	-2.065	0.047	S
	Range	7 – 9	7 – 12			
POST	Mean ± SD	0.00 ± 0.00	0.08 ± 0.19	-1.627	0.114	NS
	Range	0 – 0	0 – 0.5			
MEAN DIFFERENCE		-7.93 ± 0.80	-8.71 ± 1.55	-1.768	0.087	NS
WILLCOXON RANK TEST		-3.453	-3.853			
P-VALUE		0.001 (HS)	0.000 (HS)			

‡: Mann Whitney test

Table 2. showed that while there was statistically significant variance observed among good group & excellent group concerning inter-condylar distance with p-value = 0.047 but there was no statistically significant variance observed among both groups concerning postoperative inter-condylar distance and also regarding mean difference with p-value = 0.114 and 0.087 respectively. The table also revealed that there was statistically significant reduction in inter-condylar distance postoperative than preoperative in both groups with p-value = 0.001 for good group & <0.001 for excellent group.

Table 3. Relation between Bostman knee score and mLDFA pre and postoperative

MLDFA		POST BOSTMAN KNEE		TEST VALUE•	P-VALUE	SIG.
		Good 20-27 No. = 15	Excellent 28 - 30 No. = 19			
PRE	Mean ± SD	108.87 ± 1.77	110.00 ± 3.51	0.065	0.077	NS
	Range	106 – 111	106 – 117			
POST	Mean ± SD	99.53 ± 3.42	100.47 ± 3.49	0.112	0.451	NS
	Range	96 – 104	96 – 105			
MEAN DIFFERENCE		-9.33 ± 2.26	-9.53 ± 2.46	-0.244	0.809	NS
PAIRED T-TEST		-16.014	-16.895			
P-VALUE		0.000	0.000			

Table 3. Displayed that there was no statistically significant variance observed between good group and excellent group concerning mLDFA with p-value = 0.077; also, there was no statistically significant variance observed among both groups concerning postoperative mLDFA & also concerning mean difference with p-value = 0.451 & 0.809 respectively. The table also showed that there was statistically significant reduction in mLDFA postoperative than preoperative in both groups with p-value <0.001 for both groups.

Table 4. Relation between Bostman knee score and MPTA pre and postoperative

MPTA		POST BOSTMAN KNEE		TEST VALUE•
		Good 20-27 No. = 15	Excellent 28 - 30 No. = 19	
PRE	Mean ± SD	80.07 ± 3.10	79.47 ± 3.45	0.519
	Range	74 – 86	74 – 91	
POST	Mean ± SD	95.93 ± 1.94	96.95 ± 2.30	-1.366
	Range	92 – 98	92 – 101	
MEAN DIFFERENCE		15.87 ± 4.31	17.47 ± 2.97	1.280
PAIRED T-TEST		14.267	25.648	
P-VALUE		0.000	0.000	

Table 4. Displayed that there was no statistically significant variance observed among good group and excellent group concerning MPTA with p-value = 0.607; also, there was no statistically significant variance observed among both groups concerning postoperative MPTA and also regarding mean difference with p-value = 0.182 & 0.210 respectively. The table also revealed that there was statistically significant increase in MPTA postoperative than preoperative in both groups with p-value <0.001 for both groups.

Table 5. Relation between Bostman knee score and MAD (cm) pre and postoperative

MAD (CM)		POST BOSTMAN KNEE		TEST VALUE•	P-VALUE	SIG.
		Good 20-27 No. = 15	Excellent 28 - 30 No. = 19			
PRE	Mean ± SD	4.77 ± 0.37	4.83 ± 0.44	-0.418	0.679	NS
	Range	4.5 – 5.5	4 – 5.5			
POST	Mean ± SD	0.43 ± 0.16	0.44 ± 0.16	-0.277	0.784	NS
	Range	0.1 – 0.6	0.1 – 0.7			
MEAN DIFFERENCE		-4.34 ± 0.37	-4.38 ± 0.41	-0.295	0.770	NS
PAIRED T-TEST		-45.675	-46.159			
P-VALUE		0.000	0.000			

Table 5. displays that there was no statistically significant variance observed among the good group and excellent group concerning MAD with a p-value of 0.679; also, there was no statistically significant variance observed among both groups concerning postoperative MPTA and also regarding the mean difference with a p-value of 0.784 and 0.770, respectively. The table also revealed that there was a statistically significant reduction in MAD postoperatively compared to preoperatively in both groups, with a p-value <0.001 for both groups.

CASE PRESENTATION

Case 1: A 4-year-old male with bilateral genu varum post-rickets. Calcium, phosphorus, and alkaline phosphatase are within the normal range. Intercondylar distance: 12 cm. Right limb: mLDFA: 110 °, MPTA: 79 °, mechanical axis deviation medial: 5 cm. Left limb: mLDFA: 111 °, MPTA: 79 °, mechanical axis deviation medial: 5.5 cm. Böstman knee score: 15. Figure 2

Figure 2: long film standing radiograph showing angles and mechanical axis pre-operative.

Immediate post-operative x-rays: Figure 3

Figure 3. X-rays showed both lower limbs osteotomy sites immediate post-operative.

Osteotomy site consolidation after 2 months: Figure 4

Figure 4. X-rays showed osteotomy sites consolidation 2 months post-operative.

7 months post-operative: Figure 5

Figure 5. clinical picture of the patient after full correction.

4. Discussion

In children, lower-limb coronal angular abnormalities are common. The majority of instances, however, are physiological in nature and go away spontaneously. [6] In most cases, varus alignment of the lower extremities corrects itself to valgus by early infancy. The average degree of varus at birth is around 15 degrees, and after about 24 months, the alignment begins to shift to valgus. At around 3–4 years of life, valgus alignment reaches its maximum of 8–10 degrees and then gradually decreases to 6-7 degrees by the time a child is 5–6 years old. [7] We should thoroughly check children with bowlegs after the age of two, as they are considered abnormal. It is also abnormal to have persistent lower limb valgus after the age of eight. The treatment for a pathological malformation differs greatly from that of a purely physiological one. While benign neglect and parental reassurance can manage physiological deformity expectantly, progressive pathological deformity often requires surgical treatment. [8]

The mean age of cases at the time of presentation was 5.05±2.09 years. The mean follow-up time was 9.21±3.07 months. The mean preoperative mLDFA was (109.71±3.12), and the mean postoperative mLDFA was (100.17±3.45). The mean preoperative MPTA was (80.06±3.74), and the mean postoperative MPTA was (96.86±3.01). The mean pre-operative mechanical axis deviation was 4.78±0.42 cm, and the mean post-operative mechanical axis deviation was 0.44±0.16 cm.

All patients had satisfactory Böstman post-operative follow-up scores, except for one case, which developed over correction. This percutaneous technique demonstrated the advantages of a more cosmetic scar, a very small surgical wound, a shorter operative time, and the ease of performing it.

Although the natural history of untreated infantile Blount's illness is not well established, the spontaneous resolution of the varus deformity is unusual. [9]

According to Hofmann et al.'s research, 37% of the knees were asymptomatic, despite the fact that the vast majority of them had early degenerative arthritis. [10]

Perform tibial osteotomies before the age of four years, as this reduces the risk of recurrence and late complications, as soon as it becomes evident that the deformity is not correcting spontaneously. [11] Ferriter and Shapiro found that metaphyseal proximal tibial osteotomies, such as closing- or opening-wedge and dome osteotomies with internal fixation, had 57% recurrence and 13% complications in a retrospective study of 37 cases with infantile tibia vara. [12]

Martin et al. state that the opening-wedge osteotomy requires a more thorough dissection and a second surgery to achieve the same secure fixation and predicted alignment. But in two of their cases, they had to have more surgery to fix the deformity. In addition, one patient with infantile Blount's disease needed a distal tibial rotational osteotomy because an internal tibial torsion wasn't treated properly. [13]

In contrast to hemi-epiphysiodesis, which required a second stage of surgery to remove the eight plates, single-stage surgery allows for a comparison of the benefits and drawbacks of percutaneous osteotomy correction. Another advantage of percutaneous osteotomy is that we used a percutaneous technique with no reported wound infection or ugly scar. We observed over-correction in percutaneous osteotomies due to poor surgical methods, erroneous casting, and the upkeep of correction following the osteotomy.

Payman et al. analyzed the genu varum osteotomy outcomes. We looked at the outcomes of 129 tibial osteotomies performed between 1990 and 1999 to see if any had any unwanted side effects. A total of 35 patients experienced wound problems, with six experiencing a recurrence and five experiencing a delayed union. There were two reports of temporary paralysis of the peroneal nerve, one instance of nonunion (1%), and one instance of malunion (1%). No case reported compartment syndrome (0%). [14]

In this study of percutaneous osteotomy, there were no reported cases of wound infection because we used the percutaneous technique and no fixation devices. On the other hand, Payman et al. used external fixation and pins and discovered that 45 percent of the 96 patients treated with pins had wound complications after surgery, whereas only 11 percent of the 24 patients treated with external fixation had wound complications. [14]

The short follow-up duration in this study limited our ability to define the rate of recurrence in percutaneous osteotomies. This study's percutaneous osteotomy did not experience any delayed union or non-union because it took place in the highly vascularized metaphyseal region of the proximal tibia.

This study of percutaneous osteotomy did not report any cases of peroneal nerve palsy, despite Payman et al. identifying the use of external fixation in both cases of transitory nerve palsy. [14]

Robbins recommends an osteotomy of the proximal tibia if a child receives therapy for the first time after the age of three. [11] There are a variety of methods for carrying out this treatment on youngsters. [15] We perform an osteotomy by positioning the incision distal to the tibial tubercle to prevent damage to the tibial apophysis and subsequent genu recurvatum. In order to properly treat the genu varum and internal tibial torsion, a concomitant osteotomy of the fibula is required. [15]

5. *Conclusion*

All surgical procedures are reliable methods of correcting genu-varum deformity in children before maturity, with some precautions to reduce the rate of complications reported with each technique. With the advantages of more cosmetic scars, a shorter operative time, and a single-stage surgical procedure with a percutaneous osteotomy technique.

Disclosure

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Authorship

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References

1. Aly, Tarek. Open Versus Closed Wedge Proximal Tibia Osteotomy In Children with Genu Varum. JSM Orthoped Rheumatol. 2019;5(2):1–7.
2. Coppa V, Marinelli M, Procaccini R, Falcioni D, Farinelli L, Gigante A. Coronal plane deformity around the knee in the skeletally immature population: A review of principles of evaluation and treatment. World J Orthop. 2022;13(5):427-443
3. Maré P, Thompson D. Infantile Blount's disease. SA Orthopaedic Journal. 2020;19(3):173–182.
4. A. El-Hak AH, Shehata EM, Zanfaly AI, Soudy ESE. Genu Varum in Children; Various Treatment Modalities for Bowleg's Correction: Review article. Egypt J Hosp Med. 2022;87(1):1858–1863.
5. Ranjan R, Sud A, Kanojia RK, Goel L, Chand S, Sinha A. Results of Supracondylar "V" Osteotomy for the Correction of Genu Valgum Deformity. Indian J Orthop. 2019;53(2):366-373.
6. Ghanem I, Karam JA, Widmann RF. Surgical epiphysiodesis indications and techniques: update. Curr Opin Pediatr. 2011;23(1):53-59.
7. Goldman V, Green DW. Advances in growth plate modulation for lower extremity malalignment (knock knees and bow legs). Curr Opin Pediatr. 2010;22(1):47-53.
8. Keppler P. Behandlung von Torsionsabweichungen am Unterschenkel [Treatment of rotational malalignment of the lower leg]. Unfallchirurg. 2018;121(3):191-198.
9. Shinohara Y, Kamegaya M, Kuniyoshi K, Moriya H. Natural history of infantile tibia vara. J Bone Joint Surg Br. 2002;84(2):263-268.
10. Hofmann FC, Neumann J, Heilmeier U, et al. Conservatively treated knee injury is associated with knee cartilage matrix degeneration measured with MRI-based T2 relaxation times: data from the osteoarthritis initiative. Skeletal Radiol. 2018;47(1):93-106.
11. Robbins CA. Deformity Reconstruction Surgery for Blount's Disease. Children (Basel). 2021;8(7):566.
12. Ferriter P, Shapiro F. Infantile tibia vara: factors affecting outcome following proximal tibial osteotomy. J Pediatr Orthop. 1987;7(1):1-7.
13. Martin SD, Moran MC, Martin TL, Burke SW. Proximal tibial osteotomy with compression plate fixation for tibia vara. J Pediatr Orthop. 1994;14(5):619-622.
14. Payman KR, Patenall V, Borden P, Green T, Otsuka NY. Complications of tibial osteotomies in children with comorbidities. J Pediatr Orthop. 2002;22(5):642-644.
15. Coppa V, Marinelli M, Procaccini R, Falcioni D, Farinelli L, Gigante A. Coronal plane deformity around the knee in the skeletally immature population: A review of principles of evaluation and treatment. World J Orthop. 2022;13(5):427-443.