

Treatment of Genu Varum by Medial Open-Wedge High Tibial Osteotomy Without Bone Graft

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Abstract

Background: Genu varum (tibia vara) is a varus malformation identified by outward knee bending that implies the lower leg is bent inside with relation to the thigh's axis, giving the limb the image of an archer's bow.

Objective: To assess the treatment of genu varum by medial open-wedge high tibial osteotomy without bone graft.

Patients and method: The study was done at the period from the beginning of Oct 2019 to the end of December 2021, A sample of 18 patients, 13 males and 5 females with 24 knee joints (15 in left joints and 9 in right joints) with mean age (25.28±6.24) years old and age ranging between (18-40) years old, (6 patients with bilateral deformity, other 12 with unilateral deformity). These patients underwent medial open wedge high tibial osteotomy for genu-varum correction and followed for 2 years to evaluate the outcome of surgery were included in this study.

Results: The mean preoperative and postoperative Lysholm scores were mean (65.3±3.8) range (58–68), and mean (90.5±5.3) range (84–96), respectively with highly significant association. The mean preoperative and postoperative HSS score were mean (65.1±2.7) (range 58-68) and mean (87.5±1.5) range (82-92) respectively with highly significant association.

Conclusion: Highly significant differences were found between pre-op and post-operative study for all type of wedge size correction, this indicate that our intervention was excellent in correction of the varum deformities

Keywords: Genu varum, high tibial osteotomy, bone graft.

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1. INTRODUCTION

Genu varum (GV) is a Latin term used to describe Bowlegs. It's one of the most prevalent lower-limb misalignments linked to pain and dysfunction. However, minimal attention has been paid to limb position and muscle actions while doing tasks in patients with GV. (1) This condition can appear at any age, from infancy to maturity, and it can be caused by a variety of factors. As the condition worsens, the patient may develop lateral knee thrust and a waddling gait. There may be in toeing as well as subsequent consequences on the hip and ankle. (2)

GV (tibia vara) is a varus malformation identified by outward knee bending that implies the lower leg is bent inside with relation to the thigh's axis, giving the limb the image of an archer's bow (**Figure 1**). The femur and tibia are typically angled medially. (3). Underlying causes for development of this deformity includes; Physiological / developmental may be sequale to childhood deformity, old trauma to the lower part of femur or upper tibia with mal-union, rarefying diseases of the bone (softening bone) such as; rickets (vitamin D deficiency during childhood) or osteomalacia. Other bone disease such as osteitis deforms, congenital factors, calcium and phosphorus metabolism diseases, infection and bony dysplasia. (4)

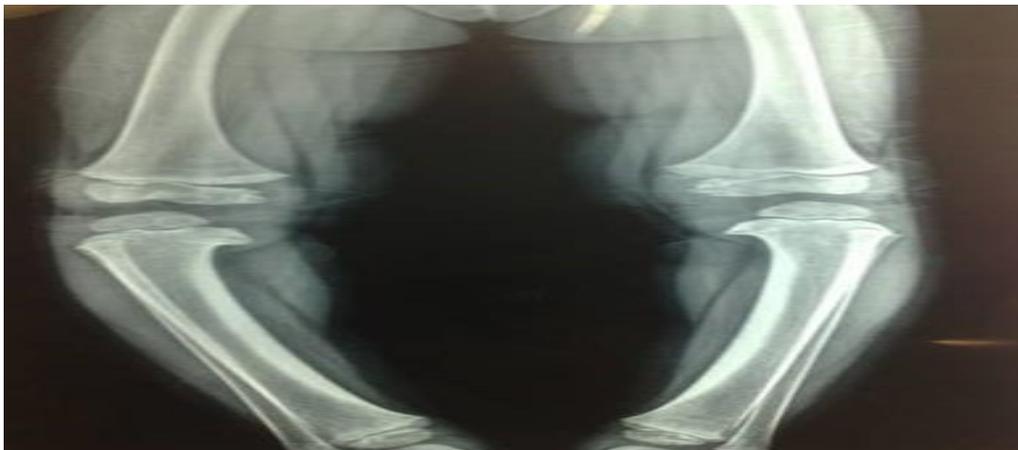


Figure 1. Preoperative anteroposterior X-ray view of both lower limbs with GV. ⁽³⁾

2. METHODOLOGY

The study were done at the period from the beginning Oct 2019 to the end of December 2021 and mean time of follow up post op. of patients was (22.5±3.2) months range from (18-25 month)

Sampling technique:

A sample of 18 patients,13 males and 5 females with 24 knee joints (15 in left joints and 9 in right joints) with mean age (25.28±6.24) years old and age ranging between (18-40) years old, (6 patients with bilateral deformity, other 12 with unilateral deformity). These patients underwent medial open wedge high tibial osteotomy for geno-varum correction and followed for 2 years to evaluate the outcome of surgery were included in this study.

Depend on radiological assessment along this period with clinical evaluation according to:

1. The Hospital for Special Knee Surgery (HSS) is based on a total of 100 points. The score is divided into seven categories, which include pain, function, range of motion, muscle strength, flexion deformity, instability, and subtractions, and
2. The Lysholm score is a 100-point scoring system for examining a patient's knee-specific symptoms including mechanical locking, instability, pain, swelling, stair climbing, and squatting. In bilateral knee deformity we begin the surgery on worse one and if bilateral equal severity; we begin in surgery on dominant side.

Inclusion criteria:

- (1) Genu varum with full weight bearing view measure not less than 165° on standing film (varum14 degree at upper limit)
- (2) Age (18_40)years old
- (3) Some level of pain tolerance.
- (4) A moderately active demand (but not jumping or running),

Exclusion criteria:

1. Compartmental osteoarthritis and\or patella femoral involvement.
2. Pre-diagnosed osteoporosis
3. varus malalignment >15 degrees.
4. Obese patients (BMI >30).

5. Flexion deformity >15 degrees.
6. Generalized ligamentous laxity that was have more than 5/9 score of ligamentous laxity score (beighton score).
7. ROM < 90 degree.
8. Patient with Diagnosed inflammatory arthritis or infection status.
9. Heavy smokers
10. Diabetic patients or immunocompromised patient
11. Patient with ligamentous injury (ACL, MCL, LCL) or instability diagnosed on MRI.

Ethical considerations:

The purpose and procedures were explained to all participants and they were given the right to participate or not, verbal consent was taken with reassurance that interpret gained will be kept confidentially.

Data analysis:

- Data were analyzed by using SPSS IBM program version 23.
- Data are presented as means \pm variance compared using an unpaired t-test.
- Chi-square or Fisher s exact 'tests compared means and percentages when appropriate.

Probability values < 0.05 were considered statistically significant in all analyses.

3. RESULTS

The current study was included 18 patients in which 13 (72.2%) of them were male and 5 (27.8%) were female with (2.6:1) male/female ratio with the mean age (25.28 \pm 6.24) years of the group (20 \pm 1.58 for female and 27.3 \pm 5.66 for male). The most common etiological cause of the disease was developmental 7/18 (38.9%) then childhood rickets 4/18 (22.2%), post trauma 4/18 (22.2) and bone dysplasia 3 (16.7%) as shown in (**Table 1 & Figure 2**). The distribution of the joint's involvement was in 24 knee joints (15 in left joints and 9 in right joints): 4 joints were in post trauma, 6 joints were found in childhood rickets, 4 joints in bone dysplasia, and 10 joints in developmental. 6/18 patients with bilateral and 12/18. Highly significant differences were found between pre-op and post-operative study for all type of wedge size correction, this indicate that our intervention was excellent in correction of the varum deformities as shown in (**Table 2**). A significant association were found between

osteotomy opening size (7, 10, and 12) and healing time after 12 weeks of post-operative follow-up as shown in **(Table 3)**. Regarding to the radiological results; it was found that there is a highly significant increase in post-operative finding for HKA (weight bearing Hip-Knee-Ankle angle) and the outcome of the surgery than that in pre-operative. No significant difference found in patellar tendon length (insall-savati ratio) in pre op and post op results, also No significant difference found regarding posterior tibial slope **(Table 4)**. the mean union time was (17.1 ± 3.5) weeks (range: 12–21 weeks), and the mean time of surgery is (93.8 ± 5.2) minute with the range (85-100 minutes) as shown in **(Table 5)** . The mean preoperative and postoperative Lysholm scores were mean (65.3 ± 3.8) range (58–68), and mean (90.5 ± 5.3) range (84–96), respectively with highly significant association. The mean preoperative and postoperative HSS score were mean (65.1 ± 2.7) (range 58-68) and mean (87.5 ± 1.5) range (82-92) respectively with highly significant association **(Table 6)**.

Table 1: distribution of studied group according to gender and etiology

Variable		No.	%	
Gender(n=18)	Female	5	27.8%	
	Male	13	72.2%	
Etiology(n=18)	Developmental (n=7)	Bilateral	3	42.9%
		Unilateral	4	57.1%
	Rickets (n=4)	Bilateral	2	50.0%
		Unilateral	2	50.0%
	Post trauma (n=4)	Unilateral	4	100.0%
	Bony dysplasia (n=3)	Bilateral	1	33.3%
		Unilateral	2	66.7%

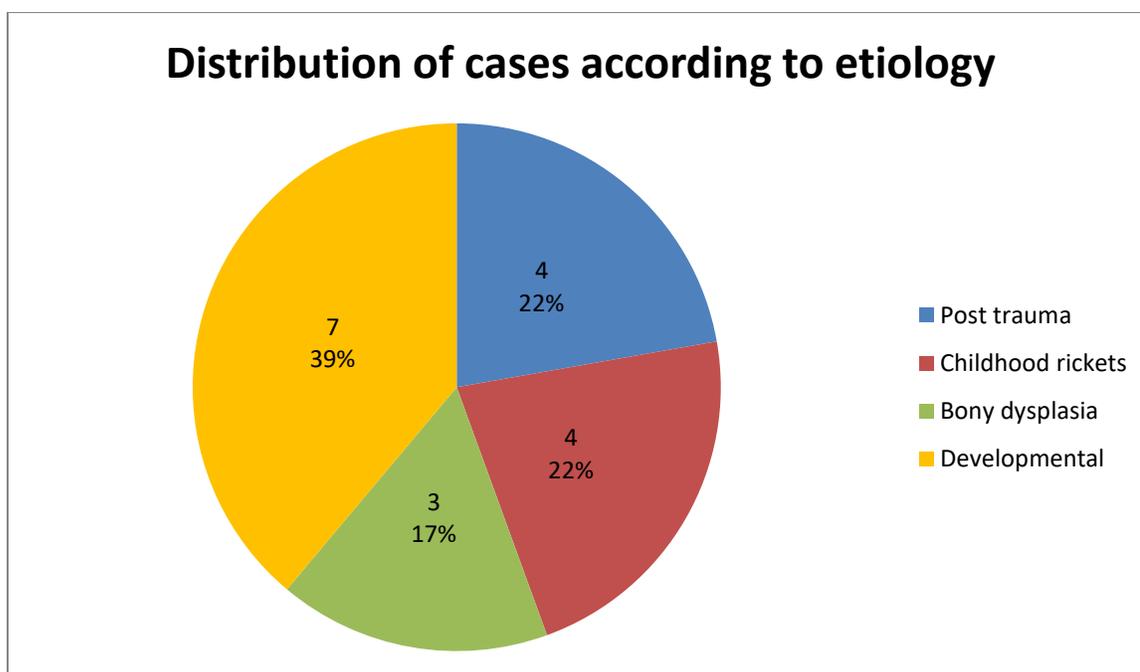


Figure 2: Distribution of cases according to etiology

Table 2: Association between pre op HKA and post-operative HKA varum deformity size according to radiological result

Varum deformity size	Pre Op.	Post Op.	P-value
	HKA		
7	173±1.03	184.25±0.7	<0.001
10	169.4±1.34	184.2±1.09	<0.001
12	168±0	183±1.87	<0.001
14	166.4±0.54	182.4±2.07	<0.001

Table 3: The correlation between osteotomy opening size and healing time after 12 weeks of post-operative follow-up

Osteotomy opening size in millimeters	Number of patients	Number of osteotomy united at 12 weeks	P value (comparing healing time of each with that of 14 mm)
7	8 (33.4%)	8 (100%)	0.004
10	6(25%)	6 (100%)	0.003
12	5 (20.8%)	4 (80%)	0.03
14	5(20.8%)	3 (60%)	0.2 NS
Total number	24	21	–

Table 4: Radiological results

index	Pre op	mean±SD	Post op	mean±SD	p. value
(HKA)(Weight bearing HIP-KNEE-ANKLE ANGLE)	166-173	169.70±2.67	179-186	183.58±1.529	<0.001
Posterior tibial slope	7.40-9.60	8.37 ± 1.62	8.30-9.85	8.08 ± 1.80	0.5 NS
Patellar tendon length (insall-savati ratio)	0.9-1.2	1.23 ± 0.01	0.8-1.2	1.15 ± 0.87	0.6 NS

Table 5: operative and union time.

Variables	Range	Mean±SD
Time of surgery/ minutes	85-100	93.8±5.2
The average union time/weeks	12-21	17.1±3.5

Table 6: Association between scores and operative time.

Variables	Preoperative (range, mean±SD)	Postoperative (range, mean±SD)	P value
Lysholm scores	(range:58–68), 65.3±3.8	(range:84–96), 90.5±5.3	< 0.001
HSS score	(range;58-68), 65.1±2.7	(range;82-92) 87.5±1.5	< 0.001

4. DISCUSSION

Opening-wedge high tibial osteotomy is a valuable treatment option for young and active patients with good long-term results associated with proper patient selection and careful surgical technique. The possibility of performing the procedure without autologous grafting is very attractive as it reduces patient morbidity and duration of surgery, the lateral tibia is left intact to act as a hinge, giving the structure stability. (5) The gender distribution of the current study shows that male was more than female, that is similar to that found by Tabrizi A. (4) But it is apposite to that found by Faisal W et al, (6) when the female were more. This may be due to difference in sample size collection between both studies. The results of current study are similar to published data regarding the functional results. (7-9) In which overcorrection of coronal valgus alignment was important to obtain satisfactory result after HTO. Our study aimed to do open wedge high tibial osteotomy that had mechanical HKA angle of 183°–186°. Which is same that done by Heringou et al, who mentioned that best

results were obtained in 20 cases of OW-HTO in this range (183° – 186°) of angle correction and they found there is a significant association between anatomical valgus alignment at consolidation between 8° and 15° with the best result. (10) The knee range of motion was not changed significantly after HTO, whereas the function and Knee Scores were significantly improved. Our goal was a correction of 3° valgus to be consistent with published data and a study of ranges by Thomine et al. (11,12) Our results also show that the healing time in small osteotomy spaces of 7 mm is significantly shorter than in spaces of 14 mm (P value 0.004). Which is in concordance with that found by El-Assal M et al, who mentioned that small osteotomy deformity was union in short period than that in wider deformity with significant association. (13) Bone union in the current study was occurred on average (17.1 weeks=4.2 months), which is less than that that found by Brosset T et al, when the average time of union was 4.5 months. (14) However, it is similar to the results reported by Koshino et al, found that the osteotomy site joined after 4 months using porous hydroxyapatite as a filler (non-absorbent ceramic substitute) after osteotomy of the wedge of the medial opening. (15) Mohamed E. Attia, also supports the same study without bone graft with average union time was 15 weeks (range: 8–24 weeks). (13) Brinkman et al. (16) Bonneville et al., who used a macroporous tricalcium phosphate substitute to fill this opening, with an average binding time of 3.7 months. (7) Bove used a porous inert alumina ceramic spacer to achieve an average of 3 months; a plate was used for fixing and no loss of correction was observed in all 50 cases. However, around this inertia, a radio-beam supply was observed, and in a quarter of cases, a non-absorbable spacer was detected. (17) Staubli et al. did not use grafts or bone replacers to fill the void, and reported that complete remodeling of the medial cortex could take up to 1 year. They reported a case of non-union in 92 patients. (18) Regarding to the time for operation in the current study, it was found that it takes (90 ± 10.9) minutes that is similar to that found in Iranian study carried by Tabrizi A to compare between two types of treatment of high tibial osteotomy. (4) The complications that occurred in this study were similar to those described in previous studies, the overall complication rate of the current procedure was (37.5%). (19,20) As mentioned previously the overall complication rate for HTOs varied in many studies. For example, Wu et al. in their study reported that the

complication rate of 5.6%, whereas Naudie et al. report a rate of 34.0%. Other studies have described complications of tibial osteotomy in 10-20% of patients with osteotomy. (21,22) In Tabrizi A study, (4) there were no cases of delay or absence of union and no infection was observed. Previous study found that the infection rate was between 0.8 and 10.4% for HTO. (23,24) According to HSS and Lysholm scores and operative score, it was found that highly significant increase in postoperative score than that in preoperative. Which is same that revealed by El-Assal MA et al, when according to HSS score recorded the average pre-operative score was 84 and improved to 97 post-operative. Overall, the results in all 58 knees were excellent in 51 knees (88%), good in seven knees (12%) and without fair and poor results. (25) The results of the Insall Salvati index for patellar height in the current study do not show significant differences in patella height between pre and post-operative. Which is similar to Wright et al, study that mentioned that the height of the patella was reduced in all patients who received High tibia osteotomy. (26) This due to an increase in the articular surface of the relatively tibial tubercle with open wedge osteotomy. While Noyes et al, study argue that there is indeed a decrease in the height of the patella in 80% of open wedge cases. (27) In the present study the complication was happened in (37.5%) of the patients and the most common complication was hematoma that found in 4/24 (16.7%) patients, then loss of correction in 2/24 (8.3%) patients. then in superficial wound infection 2/24 (8.3%) and delay union 1/24 (4.2%). This may be attributed to the small sample size and short period of follow up in comparison to the other study in which some of them follow up the patients for many years. Our choice in the current study to do the procedure without bone graft is based on many previous studies that found there is no significant difference regarding the reunion time or less complication. Zorzi et al, have compared grafted and non-grafted osteotomies in their prospective randomized clinical trial. There were no significant differences about bone union between the two groups. However, they used spacers with plates. The difference of our study is that we did not use any spacers. The size of the healthy bone surface area is an important factor for bone healing. According to this classical knowledge, we support that any material like spacers that placed into the osteotomy site decreases the size of healthy bone surface area and so the union. (13)

5. CONCLUSIONS

Highly significant differences were found between pre-op and post-operative study for all type of wedge size correction, this indicate that our intervention was excellent in correction of the varum deformities

Limitation of the study:

1. Small sample size with short period of the study
2. Study was done for non-obese only
3. Selection bias as we selected group of patients.

Ethical Approval:

All ethical issues were approved by the author. Data collection and patients enrollment were in accordance with Declaration of Helsinki of World Medical Association , 2013 for the ethical principles of researches involving human. Signed informed consent was obtained from each participant and data were kept confidentially.

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