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THE EFFECTIVENESS OF CLOSED WEDGE FEMORAL OSTETOMY IN CORRECTION OF GENU VALGUM DEFORMITY IN ADOLESCENT.

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ABSTRACT

Background: Various types of corrective osteotomies of the distal femur have been described in the literature for genu valgum deformity such as lateral opening wedge, medial closing wedge, dome osteotomy, wedgeless spike osteotomy, and wedgeless "V" osteotomy. **Objectives:** We aimed this study to evaluate the effectiveness of medial closing wedge osteotomy in correction of deformity. **Methods:** In this study, after recording history and physical examination, appropriate radiographs were taken. We did varus distal femoral osteotomy by standard medial subvastus approach then followed the patients clinically and radiographically. **Results:** This study was done on 32 knees (18 patients) age was ranged from 10 to 18 years with mean average of (15.61±1.28) years. Operation time was distributed as 139.72±42.4 minutes, with minimum 90 minutes and maximum 170 minutes. The mean time to union of osteotomy was 8.9weeks ranged (7-11 weeks). The mean preoperative tibiofemoral angle (TFA) was 16.5° (range, 12°–19°) that improved after surgery to a mean postoperative value of 2.57° (range, 1.3°–4.7°) which was statistically significant ($P < 0.001$). **Conclusion:** Distal femoral varus osteotomy can be a reliable procedure for the treatment of valgus knee deformity. In this procedure, with more tibiofemoral angle correction, more congruence angle correction can be achieved. Therefore, along with genu valgum correction, the patella should be stabilized simultaneously.

Key words: Genu valgum, pathological, Femur, osteotomy. ·

INTRODUCTION

Genu valgum involves medial angulation of the knee and outward deviation of the longitudinal axis of both the tibia and femur. Persistent genu valgum in adolescents induces abnormal gait and functional disturbances (including difficulty in running, knee discomfort, patellar malalignment, lateral patellar instability, and ligamentous instability) [(1)]. Angular knee alignment changes according to the age of the child. It is genu varum with internal tibial torsion at birth and then aligns to straight legs by the eighteenth month to the twenty-fourth months. Further drifts into valgus with about 12 degrees around five years. This genu valgum spontaneously correct by age of seven years to that of normal adult values of around 8 degrees. [(2)] After seven years old, correction of excessive physiologic genu valgum may be indicated. [(3)]

Nutritional rickets is the leading cause of these deformities in developing countries. The deformity may originate from the distal femur, proximal tibia, or the knee joint. [(4)]Genu valgum usually originates from the distal femur that may be confirmed by various angle measurements on standing radiographs of both lower limbs including hips, knees, and ankles[(5)]

The advantages of medial closing wedge are: Direct bony contact leads to inherent stability and reliable bony healing compared to the need for bone grafting of an opening-wedge technique. There is less hardware irritation because of the plate not being directly under the iliotibial band.[(6)] Corrective osteotomy for excessive genu valgum is appropriate when the patient presents near or after skeletal maturity. [(7)] Young patients with valgus alignment and lateral compartment disease including isolated lateral compartment arthritis, lateral meniscal deficiency, and/or focal chondral or osteochondral lateral compartment defects are excellent candidates for a distal femoral osteotomy. [(8)]

SUBJECTS AND METHODS

This prospective clinical study was conducted on 18 adolescents aged between 10 and 18 years presenting with a genu valgum deformity were admitted to Orthopaedic Department Zagazig University in Egypt Hospitals, during the period from April 2020 to April 2021.

Written informed consent was obtained from all patients and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University (International review board IRB#:6365-l-4-2020). The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Inclusion criteria: At skeletal maturity. Patients with genu valgum deformity having a tibiofemoral angle more than 15 degree. Pathological genu valgum. Non-traumatic etiology. Desire to participate in activities with heavy functional loading

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(b) Exclusion criteria: Before skeletal maturity. Instability of the knee. End stage OA. Bi and Tri-compartmental OA. Flexion deformity. Osteonecrosis. Hematological or rheumatological diseases. Presence of infection

The patients having genu valgum deformity who were selected after qualifying inclusion criteria were clinically assessed and underwent radiological and biochemical investigations. Patients having a TFA ranged 12-15°, intermalleolar distance (IMD) of more than 10 cm, origin of the deformity in the distal femur, were considered for inclusion in the study. Patients who had.Instability of the knee. End stage osteoarthritis. Bi and Tri-compartmental osteoarthritis. Flexion deformity. Osteonecrosis. Hematological or rheumatological diseases were excluded from the study.

The origin of the deformity was clinically assessed by the knee flexion test. Measurement of the IMD was done while in standing position with the knee extended and the medial surface of both the knees touching each other and patella facing forward. Measurement of the radiological TFA was done as the angle formed between the anatomical axis of the femur and tibia. The lateral distal‑femoral angle (LDFA) was measured as the lateral angle between the mechanical axis of the femur and the articular surface of the distal femur. Evaluation was done on the basis of pre and postoperative radiological (TFA and LDFA) parameters.

Functional assessment was done using The Hospital for Special Surgery Knee - rating Score (HSS). The standing anteroposterior (AP) radiograph was taken including both hips, both knees with patella facing forward, and both ankles to measure the angles to quantify the deformity.

Preoperative assessment:

The patients were managed according to age, severity of deformity, cause of deformity. The patient should be assessed clinically, laboratory and radiologically.

Clinically: Examine limb length, deformity (unilateral or bilateral), oigin of deformity (Tibial or femoral or both and another associated deformity as external tibial torsion.

Laboratory: Serum calcium, phosphate, alkaline phosphatase.

All laboratory investigations were done at Zagazig University Hospitals.

Radiological: Long film x-ray showing from both hips to ankles, showing angles and mechanical axis deviation .

Operative procedure

The operation is performed under anaesthesia (general/ spinal) with the patient supine on a radiolucent operating table under tourniquet control. The knee is flexed to 60^{o} during the surgery to avoid pressure in the popliteal area by keeping a large bolster under it. During draping care is taken to expose the ankle so that the center of the ankle could be determined easily.

A medial longitudinal skin incision of approximately 8–10 cm long was made extending from the level of the medial joint line to 5 cm above the adductor tubercle. The deep fascia was incised in line with the incision. The vastus medialis was identified and elevated anteriorly. The epiphyseal vessels traversing transversely were identified just proximal to the adductor tubercle . The periosteum was incised and elevated anteriorly and posteriorly to expose the femoral metaphysis and to protect the popliteal vessels. The adductor tubercle was identified.

A transverse medial incision through the periosteum is extended along the anterior and posterior femur using electrocautery. A malleable retractor is placed anteriorly to protect the quadriceps and posteriorly to protect the neurovascular structures. The osteotomy is outlined by placing 2 K-wires from medial to lateral corresponding with the planned osteotomy angle. The wedge osteotomy is created using an oscillating saw between the 2 K-wires preserving approximately 5 mm of lateral femoral cortex. The bone cut must be parallel to the K-wire and the articular joint line. Copious irrigation is used to avoid thermal injury from the saw. The wedge of bone is then removed. The 2 K-wires are then removed. Closing the wedge must be performed gradually by gentle compression of the lower leg laterally.

The osteotomy may temporarily stabilized by crossed K-wires. Leg alignment is checked radiologically after closing with a rigid alignment bar positioned between hip and ankle center. Once confirmed, the osteotomy was then stabilized by internal fixation. We used in this study distal femoral plate and proximal tibial plate (T-plate). Plate position is then verified with AP and lateral fluoroscopy. Insert vacuum drain and closure the vastus medialis was fastened back to medial septum with interrupted sutures. The subcutaneous tissue and skin were closed in routine fashion, and compression dressing was applied. High above knee cast was applied in all patients.

Postoperative treatment:

The drain is removed at 24-48 hours after surgery and the amount of blood collected in the drain was less than 50 cc. All patients received intravenous 500 mg of third generation cephalosporin for 48 hours post operatively followed by oral antibiotic capsules for 5 days. Analgesic (Intramuscular 75 mg of diclofenac sodium) in first 48 hours then mild analgesic belonging to NSAIDs were given as required for 5 day postoperatively. Immediate postoperative radiographs including the knee (AP and lateral views) were taken. The patients are kept non-

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weight bearing for 3 weeks to be followed by partial weight bearing with 2 crutches as tolerated. removal of the cast after 3 weeks and , active assisted exercises are started. The patient is allowed full weight bearing and more demanding activities as his or her muscle strength and symptoms allows. Patients were reviewed at 3 weekly intervals. Standing radiographs both AP and lateral views were taken at 4 weekly intervals. Follow up period was 6 months.

RESULTS

Table (1): Age distribution of the studied group.

Variable	The studied group(18) mean ± SD (Range) median	
Age (years):	15.61±1.28 (14-18) 15.5	
Variable	**NO(18)**	**%**
Age grouping ≤ 15.5 years >15.5 years	8 10	44.4% 55.6%

Table (1), showed that the the mean age for studied patients was 15.61±1.28 years with range (14-18).

Table (2):Comparing pre & postoperative change on tibiofemoral angle among study group

Variable	Pre-operative mean ± SD	Post-operative mean ± SD	p-value
Tibiofemoralangle	16.5°±1.9	5.6°±1.3	< 0.001*

Table (2), showed that the mean preoperative Tibiofemoral angle was 16.5° (range, 12°–19°) that improved after surgery to a mean postoperative value of 2.57° (range, 1.3°–4.7°) which was statistically significant (P < 0.001).

Table (3): Intermalleolar distance before and after correction

Variable	Pre-operative mean ± SD (Range)	Post-operative mean ± SD (Range)	p-value
Inter-malleolar distance	14.77±1.95 (12-17)	5.11±1.2 (4-7)	0.001**

Table (3), showed that the The mean preoperative IMD was 14.77 cm (range, 10–18 cm) that improved to a mean postoperative value of 5.11 cm (range, 1–7 cm) and that was statistically significant (P < 0.001).

Table (4): The change on pre & postoperative of mLDFA among studies group

	Pre-operative mean ± SD Range	Post-operative mean ± SD Range	p-value
mLDFA (º)	77±3.5 73°–83°	88.4±1.3 87°–91°	< 0.001*

Table (4), showed that the The mean preoperative LDFA was 77.3° (range, 73°–83°) that improved significantly after corrective osteotomy to a mean postoperative value of 88.1° (range, 87°–91°) with P < 0.001.).

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 03, 2021

Table (5): Pre and post-operative change on HSS scores among the studied group

	Pre-operative mean ± SD	Post-operative mean ± SD
HSS score	61.78±6.041	84.15±6.9

Table (5), showed that the mean preoperative of HSS scores was 61 that improved significantly to a mean postoperative value of 84.15 ($P < 0.001$) and that falls in the good and excellent outcome category.

DISCUSSION

Coronal plane deformities such as genu valgum are a frequent cause of outpatient clinic visit in the orthopedic department, especially among adolescent females and young adults. Malalignment in coronal plane increases the risk of development and progression of osteoarthritis. [9]

The altered biomechanics and lateral shifting of mechanical axis in genu valgum deformity may lead to anterior knee pain, patellofemoral instability, abnormal gait, and difficulty in running. Severe genu valgum deformity needs surgical intervention to restore biomechanics and improve cosmesis, gait, and function. [10] A large number of corrective distal femoral osteotomies have been described for genu valgum deformity because the most common site of deformity is distal femur. Femoral osteotomies work well for realignment of the limb with a valgus deformity. The degree of correction may vary depending on the progression of disease at the time of treatment. [11]

A total of 18 patients included in the study underwent surgical correction of genu valgum deformity with medial closed wedge femoral osteotomy and were followed up for 6 months. The mean age of the patients was 15.16 years (range, 14–18 years). There were 11 males and 7 females.14 patients' bilateral lesions and 4 patients had unilateral lesions so the total number of limbs affected was 32limbs.

The current study showed that the mean tibiofemoral angle was 19.8^o (range, 16^o to 29^o) before surgery, that improved to a mean postoperative value of 5.3o (range, 0o to 10o) .Agreed with the results of **Gupta, et al** [12] whom their study included 30 adolescent or young adults presenting with a genu valgum deformity. that reported the mean tibiofemoral angle was 22.2^o (range, 16^o to 29^o), that improved to a mean postoperative value of 5.1o (range, 0^o to 10^o). **Ranjan et al** [13] where a total of 30 patients, the mean age of the patients was 17.4 years (range, 13–23 years). The mean preoperative clinical TFA was 23.4° (range, 18°–28°) that improved after surgery to a mean postoperative value of 5.8° (range, 4°–7°) .These two studies were similar to ours results.

The current study showed that the mean preoperative intermalleolar distance was 14.7cm (range, 12-19cm) decrease significantly from to 5.11cm (range, 2–6 cm). With little differences in the results compared to study of **Ranjan et al** [13] that reported the preoperative IMD was 13.5 cm (range, 13–21cm) that improved to a mean postoperative value of 2.3 cm (range, 1–5 cm).

Regarding clinical results which assessed in the current study by the hospital for special surgery (HSS) scoring system. The HSS score for these patients improved from a mean was 62 points preoperatively. This score increased to a mean of 84 points postoperatively more than have of the studied groups 20 limbs(65.16%)had excellent clinical results, 9 limbs (28.08%) had good clinical results and 3 limbs(9.36%) had fair clinical results. This in agreement with the study of **Stähelinm, et al.,** [14] found that 21 knees improved in average HSS score from 65 points preoperatively to 84 points. Results were rated as excellent in 11 knees, good in 8 knees, and fair in 2 knees. We are disagree with the study **Buda et al.** [15] Retrospectively reviewed 32 valgus knees (mean age: 41.4±11.2) which recorded improved in HHS score with mean range of post-operative about 84-88.

From the results obtained in this study and from the review of literature we find that, closed wedge osteotomy when done for proper indication with thorought preoperative planning could offer a satisfactory and a more successful results than other methods mentioned of operative correction of genu valgum deformity.

Conclusion

Distal femoral varus osteotomy can be a reliable procedure for the treatment of valgus knee deformity. In this procedure, with more tibiofemoral angle correction, more congruence angle correction can be achieved. Therefore, along with genu valgum correction, the patella should be stabilized simultaneously.

Recommendations: Further studies with a larger number of sample size are recommended which can shed more light on the current results.

Abbreviations:

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 03, 2021

IMD: intermalleolar distance; TFA : tibiofemoral angle; OA: osteoarthritis; The LDFA sidelong distal femoral point; HSS : Knee - rating Score; AP : anteroposterior.

-Authors' contributions

KMH, RHA, EMS and MSA collected patients' samples and clinical data. MSA prepared sample for laboratory investigations and wrote the paper. Statistical analysis, interpretation of data, and preparation the paper for submitting international was done by KMH. Critical revision of the manuscript was performed by all of the authors. All authors have read and approved the final manuscript.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request

Conflicting Interest (If present, give more details): No Conflict of Interest

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Declarations

-Ethics approval and consent to participate

Written informed consent was obtained from all patients and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University (International review board IRB#:6365-1-4-2020). The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

-Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 03, 2021

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