

MODIFIED CHEVRON OSTEOTOMY FOR TREATMENT OF HALLUX VALGUS

Tanveer Haider,¹ Muhammad Zafar Iqbal Shahid,² Muhammad Khalid,³ Muhammad Siddique Hamid,⁴ Muhammad Khalid Syed,⁵ Asim Islam⁶

Abstract

Background & Objective: Hallux valgus is the most common forefoot deformity in adults, especially in females. Almost 150 different procedures have been described for the treatment of Hallux valgus deformity. Modified distal metatarsal Chevron osteotomy with distal soft tissue release is one of the most effective procedures for the correction of mild to moderate Hallux valgus deformity.

Methods: This is a prospective observational study conducted at Department of Orthopedic Surgery Services hospital Lahore from Jan 2018 to Jan 2019 after taking permission from the hospital ethical review board. A total number of 20 patients of age between 25-65 years were included in the study. Informed written consent was obtained from each patient. Each patient underwent X-rays in dorsoplantar and lateral views in weight-bearing position including axial sesamoid view of the foot. Hallux valgus angle (HV), inter-metatarsal angle (IMA) were measured on x rays while clinically each patient was assessed for American orthopedic foot and ankle society score (AOFAS) pre-operatively. In all these patients, we performed the Modified chevron osteotomy with lateral soft tissue release and medial eminence excision with capsular repair. Post-operative follow-up was done at two weeks, six weeks, 3 months and at one year for the radiological assessment of HV angle and IMA along with AOFAS score on clinical examination.

Results: Total no of patients enrolled in our study were 20 with 16 females and 4 males. Four patients had mild Hallux valgus while 16 patient had moderate Hallux valgus. Pre-operative mean AOFAS score was 56.50 ± 3.54 . Six patients had B/L Hallux valgus deformity. Thus a total no. of 23 feet in 20 patient underwent Modified Chevron osteotomy with distal soft tissue release. Before surgery the mean HV angle was $31.52^\circ \pm 6.44^\circ$ while mean IMA was $18^\circ \pm 1.10^\circ$. The AOFOS score improve from 56.50 ± 3.54 pre-operatively to 85.95 ± 6.15 after 06 weeks post-operatively. It further improved to 94 ± 1.25 after 01 year at the final follow up. The mean HV angle was improved from $31.52^\circ \pm 6.44^\circ$ pre-operatively to $6.4^\circ \pm 1^\circ$ after 06 weeks and $6.42^\circ \pm 1^\circ$ after 01 year post operatively. The mean IMA improved from 18 ± 1.10 pre-operatively to 5.4 ± 1.30 after 06 weeks post-operatively and $5.6^\circ \pm 1.1^\circ$ at the end of 01 year. The osteotomy union time was 10-16 weeks after the surgery. There was no recurrence of the deformity, Infection, stiffness of the joint and avascular necrosis of metatarsal head noted post-operatively at the end of one year. The mean first metatarsal shortening was 3.6 ± 1.2 mm at the final follow up. The patient satisfaction was also good (90.5%).

Conclusion: Modified chevron osteotomy with distal soft tissue release is a good procedure for correction of mild to moderate Hallux valgus. It allows a significant lateral displacement of distal fragment (4.5mm). This osteotomy improves the foot biomechanics, has got durable functional and cosmetic result.

Key words: Hallux valgus, modified chevron osteotomy, inter-metatarsal angle (IMA), Hallux valgus angle (HV).

How to cite: Haider T, Shahid MZI, Khalid M, Hamid MS, Islam A, Syed MK. Modified Chevron osteotomy for treatment of Hallux valgus. JAIMC 2023; 21(1): 24-28

1. Department of Orthopedic Surgery, Khawaja Safdar Medical College, sialkot

2-6 Department of Orthopedic Surgery, Ameer-ud-Din Medical College

Submission Date: 13-01-2023
1st Revision Date: 28-01-2023
Acceptance Date: 10-03-2023

Correspondence:

Dr. Muhammad Zafar Iqbal Shahid, Assistant Professor Department of Orthopedic and Spine Surgery, Ameer ud Din medical college/PGMI, Lahore. Email: drzafar2014@gmail.com

Hallux valgus is one of the most disabling and complex fore-foot deformity. It is not an isolated disorder but a complex pathogenesis is involved with a combination of deformities and symptoms in the lesser toes.^{1,2,3}

Hallux valgus is a progressive deformity of first metatarsal joint which causes not only the anatomical changes but also causes the biomechanical effects in foot on weight bearing. It causes a variety of problems like pain at first metatarsophalangeal joint, difficulty in wearing the shoes and tendency to fall especially in the elderly population.⁴⁻⁶

Proximal phalanx is deviated laterally while the first metatarsal is deviated medially and is adducted. Mostly it occurs in between age of 18-65 years of age in 23% of adults. The angle between first and second metatarsal is 8°-9° while Hallux valgus angle is 15°-20°. Pronation of the great toe results when the angle of first metatarsophalangeal joint exceeds above 30°-35°. When pronation occurs, the abductor hallucis becomes more plantar ward.⁷⁻⁹

In this way the medial capsular ligament with its capsule-phalangeal portion is the only force which causes resistance to the development of this deformity.^{8,9,10}

Adductor Hallucis pulls the great toe further into valgus and stretch the medial capsular ligament. The capsule become attenuated and pulls the metatarsal head medially from the plantar sesamoids. The four tendons flexor Hallucis brevis, flexor Hallucis longus, extensor Hallucis longus and adductor Hallucis further causes valgus pull at the level of metatarsophalangeal joint.^{10,11,12}

As a result of these forces the sesamoid cristae becomes flattens at the plantar surface of first metatarsal. When these forces exert more pressure the fibular sesamoid is displaced either partially or completely into first inter-metatarsal space which further results in development of callosities, metatarsalgia and stress fracture in the region of lesser metatarsals on weight bearing.¹¹⁻¹³

The articular surface of first metatarsal becomes further deformed resembling the scoop of ice cream with further derangement of distal metatarsal articular

angle. As the deformity progresses the articular angle at the base of proximal phalanx of the great toe also become deranged (phalangeal articular angle).¹⁴⁻¹⁶

While considering the hallux valgus angle, both these angles should be taken into account specially the distal metatarsal articular angle.

Hallux valgus also causes the hammer toe deformity of second toe. There is difficulty in wearing the shoes as result of splaying the toes. It is recommended that shoes with wide toe box should be used as shoes with narrow toe box result in dorsal bunion formation. With further progression of the deformity corns develop and bursal hypertrophy occurs at the medial eminence of first metatarsal head and ultimately it results in osteoarthritis of first metatarsophalangeal joint.

The exact cause of hallux valgus is unknown but other factors can cause hallux valgus. These are the genetic factors, flat foot, abnormal first metatarsal dorsiflexion, short first metatarsal, fore foot varus, abnormal foot biomechanics and gastrocnemius equinus deformity. In addition to these causes ligamentous laxity such as Ehlers-danlos syndrome, Down syndrome and Marfan syndrome are also the other contributing factors for hallux valgus. Moreover certain arthropathies like gouty arthritis, psoriatic arthritis and rheumatoid arthritis also can cause hallux valgus deformity.

The females are affected twice than the males. The individuals who wear shoes with narrow toe box or with high heels are also the most common sufferers.

The Hallux valgus is classified as mild, moderate and severe according to Mann & Coughlin classification. This classification based upon the weight bearing X Rays (dorso-plantar and lateral x rays of the foot). In mild form, HVA ranges from 15°-30° and IMA from 9°-13°. In moderate form, HVA ranges from 30°-40° and IMA from 13°-20°. While in severe form, HVA is >40° and IMA >20°.

Many treatment options are available to treat hallux valgus. Conservative treatment is available in the form of hallux valgus splint, shoe modification i.e. using shoes with wide toe box, exercise, physiotherapy and activity modifications.

Almost 150 different surgical procedures have been devised for hallux valgus deformity correction, all having its own merits and demerits. Ideal procedure should correct the hallux valgus angle, Intermetatarsal angle should eliminate the pain and maintain the joint congruity.

One of the most commonly performed operation is Modified distal metatarsal chevron osteotomy combined with distal soft tissue release is an effective procedure for the correction of mild to moderate hallux valgus deformity.^{17,18}

METHODS

After permission from hospital ethical review board, this prospective observational study was carried out at Services institute of medical sciences Lahore. A total number of 20 patient of age between 25-65 years were included in the study.

A written consent was obtained from each patient.

Each patient underwent dorsoplantar and lateral views x rays in weight bearing position including Axial Sesamoid view of the foot. On x-rays we measured the Hallux valgus angle (HVA), inter-metatarsal angle (IMA) while clinically each patient was assessed for American orthopedic foot and ankle society score (AOFAS) pre-operatively.

Patients having severe or recurrent hallux valgus deformity, with marked degenerative changes at metatarsophalangeal joint, with neuropathic foot and patients with associated ankle and foot deformity were excluded from the study.

In all these patients, we performed the Modified chevron osteotomy with lateral soft tissue release and medial eminence excision with capsular repair under regional anesthesia.

After making the longitudinal incision over the medial eminence, a long plantar and short vertical arm, 60° V-Shaped Chevron osteotomy was done with an oscillating saw, 1-1.3 Cm proximal to the articular portion of metatarsal head. After osteotomy the metatarsal head portion was displaced laterally up to 4-5mm with minimal pressure and then it was fixed with Herbert's screw. The extra medial portion of the osteotomy was

excised.

Post-operative follow up was done at 02 weeks, 06 weeks, 03 months and at 01 year. At each follow up these patients was assessed radiologically for HV angle and IMA.

Clinically each patient was assessed for AOFAS score.

All data were assessed by using SPSS Version 25. Demographic data, HV angle, IMA, AOFAS and operative time were assessed pre and post operatively by using student t-test. P-value of <0.05 was considered significant.

RESULTS

Total number of patients enrolled in our study were 20 with 16 females and 4 males. The mean age was 37.5 ± 5.6 . Four patients had mild Hallux valgus while 16 patient had moderate Hallux valgus.

Pre-operative mean AOFAS score was 56.50 ± 3.54 with a range of 50-70. Six patients had B/L Hallux valgus deformity. Thus a total of twenty three feet in 20 patient underwent Modified Chevron osteotomy with distal soft tissue release. Before surgery the mean HV angle was $31.52^\circ \pm 6.44^\circ$ while mean IMA was $18^\circ \pm 1.10^\circ$.

The AOFAS score improved from 56.50 ± 3.54 pre-operatively to 85.95 ± 6.15 after 06 weeks post-operatively. It further improved to 94 ± 1.25 after 01 year at the final follow up.

The mean HV angle was improved from $31.52^\circ \pm 6.44^\circ$ pre-operatively to $6.4^\circ \pm 1^\circ$ after 06 weeks and $6.42^\circ \pm 1^\circ$ after 01 year post operatively.

The mean IMA improved from 18 ± 1.10 pre-operatively to 5.4 ± 1.30 after 06 weeks post-operatively and $5.6^\circ \pm 1.1^\circ$ at the end of 01 year. The osteotomy union time was 10-16 weeks after the surgery.

There was no recurrence of the deformity, Infection, stiffness of the joint and avascular necrosis of metatarsal head noted post-operatively at the end of one year. First metatarsal shortening was 4-6 mm at the final follow up.

DISCUSSION

Table 1: Results of pre-operative and post-operative assessment of Hallux valgus

Parameters	Pre-Operative	Post-operative at 06 weeks	Post-operative at 01 year
. HV angle	31.42°±6.44°	6.4°±1°	6.42°±1°
. IMA	18°±1.10°	5.4°±1.30°	5.6°±1.1°
. AOFAS	56.50±3.54	85.95±6.15	94±1.25

Hallux valgus is a complex deformity of forefoot. Both intrinsic and extrinsic factors are responsible for it and these cause a significance impact on the fore-foot biomechanics.^{7,8,9} These are flat foot, female gender, ligamentous laxity and connective tissue disorders. Modified chevron osteotomy is an excellent procedure for correction of mild to moderate hallux valgus with addition of distal soft tissue release.^{19,20} It provides the improved stability, reduces the pain and correct the foot biomechanics ultimately ending up in improved early mobility and rehabilitation.^{10,11,12}

In our study we performed the Modified Chevron osteotomy in thirteen feet in 20 patients with mild to moderate hallux valgus. The HV angle, IMA and AOFAS score improved post operatively at six weeks and at the end of final follow up at one year.

Seo et al. analyzed the outcome of distal metatarsal chevron osteotomy in 54 patients with 77 consecutive feet with hallux valgus. They came to the conclusion that distal chevron osteotomy with lateral soft tissue release was a safe procedure in old patients.¹

Giotis et al carried out the 42 cases of Modified Chevron osteotomy in 33 patients. They came to the conclusion that Modified Chevron osteotomy offers an excellent clinical outcome of HV deformity in young female athletes.⁵

Zhang et al carried his studies regarding the effect of Modified Chevron osteotomy in 20 patients with hallux valgus. They came to the conclusion that Modified Chevron osteotomy can achieve successful correction of moderate to severe hallux valgus with excellent outcomes with 4 years follow up. There was no recurrence of deformity during the post op follow up.²

Chen XQ et al carried out their studies in 26 patients with mild to moderate hallux valgus deformity. They performed the Modified Chevron osteotomy with lateral soft tissue release. They came to the conclusion that Modified Chevron osteotomy is a simple procedure with good exposure and provides the stable fixation with excellent recovery.⁴

Mannder et al conducted a systemic review and meta analysis on hallux valgus deformity. They performed the minimally invasive and open distal metatarsal chevron osteotomy. They came to the conclusion that both of these techniques provide equal radiological outcomes but the functional outcomes were good in open metatarsal osteotomy than in minimal invasive technique.²¹

Similarly study conducted by Kim et al. Regarding the modified chevron osteotomy with lateral soft tissue release in moderate to severe hallux valgus also reveals that modified chevron osteotomy is an excellent procedure for correction of moderate to severe hallux valgus.³

All these studies suggest that a significant patient satisfaction in patients who underwent Modified Chevron osteotomy for mild to moderate hallux valgus.¹³⁻¹⁵ It provides the stability, improve the functional and radiological status of the foot and has got excellent recovery and rehabilitation.¹⁶⁻¹⁸

CONCLUSION

Modified chevron osteotomy with distal soft tissue release is a good procedure for correction of mild to moderate Hallux valgus. It allows a significant lateral displacement of distal fragment (4-5mm). This osteotomy improves the foot biomechanics, has got durable functional and cosmetic result. The patient satisfaction was also good (90.5%).

Limitations of the Study

Number of cases in our study were small. Moreover, in our study the follow up of the cases was also of short duration. It should include a study with large number of cases with follow up of longer duration.

Conflict of interest: *None*

Funding Source: *None*

REFERENCES

1. Seo JH, Lee HS, Choi YR, Park SH. Distal Chevron Osteotomy with lateral release for moderate to severe Hallux valgus patients age sixty years and over. *Int. Orthop* 2020; 44:1099-105
2. S Zhang et al, the effect of a modified Chevron osteotomy for Hallux valgus patients: A five year follow up study. *Research square* 2021; Doi; [https://doi.org/ 10.21203/rs.3.res929642/v1](https://doi.org/10.21203/rs.3.res929642/v1)
3. Kim HN, et al. Distal Chevron osteotomy with lateral soft tissue release for moderate to severe Hallux valgus decided using intra operative varus stress radiographs *Foot Ankle Surg* 2013;52(3): 303-10.
4. Chen xQ, WU QF, Dong WQ et al. Clinical effect modified Chevron osteotomy combined with lateral soft tissue loosening in treating mild to moderate Hallux valgus through internal signal approach. *China J orthop and trauma* 2018; 31(3): 213-216.
5. Giotis D Paschos NK, Zampeli F et al. Modified Chevron Osteotomy for Hallux valgus deformity in female athletes. A two years follow up study. *J Foot & Ankle surg* 2017; 22(3) : 181-185.
6. Kaufmann G, Mortlbauer, Hofer et al. Five years follow up of minimally invasive distal metatarsal Chevron Osteotomy in comparison with open technique. *JBJS* 2020; 102: 873-879.
7. Kaufmann G, Dammerer D, Heyenbrock F et al. Minimally invasive versus open Chevron Osteotomy for Hallux Valgus correction; a randomized controlled trial *Int. orthop* 2019;43(2) ; 343-50.
8. Clemente P, Manscal G & Barrios C. Distal Chevron osteotomy vs different operative procedures for Hallux valgus correction: a metaanalysis. *J orthop surg Res* 2022;17(80): Doi.org/10.1186/s 13018-22-02914-0.
9. Ray J, Friedman A, Santrock R; Hallux valgus. *Foot Ankle Orthop* 2019:1-12.
10. Guo C-J, LiC-G, LiX-C, et al. Hallux valgus correction comparing percutaneous oblique osteotomy and open Chevron Osteotomy at two years follow up. *Othop Surg* 2021;13(5):1546-1555.
11. Chen JY, Ang BF, Jiang L et al. Pain resolution after Hallux valgus surgery. *Foot Ankle Int*; 37(10): 1071-1075.
12. Nery C, Coughlin MJ, Baufield D, Ballerini FJ, Kobata S. Hallux valgus in males-part 1: demographics, etiology and comparative radiology, *Foot Ankle Int* 2000;5:485-98.
13. Gribbin Ck, Ellis SJ, Nguyen J, Williamson E, Cody EA. Relationship of radiographic and clinical parameters with Hallux valgus and second ray pathology. *Foot Ankle Int.*2017;38:9-14.
14. Zhu M, Chen JY, Yeo NEM et al. Health related quality of life improvement after Hallux valgus corrective surgery. *Foot ankle surgery: official journal of the European society of Foot ankle surgeons* 2021;27:539-42.
15. Verdu-Roman C, Sanz-Reig J, Martinez-Gimenez E, Carralata-Munuera C, Lopez-Pineda A, Quesada JA, Gil-Guillen VF, Orozco-Beltran D. Plantar Pressure improvement in moderate hallux valgus with modified chevron osteotomy. *Clinical and Radiographic outcomes. Foot ankle Surg; official J. Eur Soc of Foot ankle Surg* 2020;26:205-8.
16. Van Graningen B, Vander Steen MC, Reijman M, Bos J, Hendriks JG. outcomes in Chevron Osteotomy for Hallux Valgus in a large Cohort. 2016;29:18-24.
17. Synth NA, Aiyver AA Introduction: why are there so many Surgeries for Hallux valgus. *Foot and ankle Clinic* 2018; 23:171-182.
18. Kraus T, Singer G, Svehlik M et al; Longe term outcome of Chevron – Osteotomy in Juvenile Hallux Valgus *Acta Orthop Belg* 2013;79(5):552
19. Ma Q, Liang X, Lu J. Chevron Osteotomy versus Scarf Osteotomy for Hallux Valgus correction; A meta analysis. *Foot ankle surg: Official Journal of the European Society of Foot and Ankle Surgeon*; 2019; 25:755-60.
20. Matsumoto T, Gross C E, Parekh SG. Short term radiographic outcome after Distal Chevron osteotomy for Hallux Valgus Intra medullary plates with an amended Alogrithm for surgical management of Hallux valgus. *Foot ankle specialist*;2019;12:25-33.
21. Singh MS, Khaurana A, Kapoor D et al. Minimally invasive vs open distal meta tarsal osteotomy for hallux valgus- A systematic review and meta analysis. *J clin orth trauma* 2020;11,348-356.