New Modification of Chevron Osteotomy in the Treatment of Hallux Valgus

Ammar Talib Noah AL-Yassiri[*], *Mohammed Hatem Salal*[**], *Sinan Urabee Ibrahim*[***]

ABSTRACT:

BACKGROUND:

The Corless original chevron osteotomy is a 60 degree V shaped cut which had been described in 1976 to address some of the drawbacks in Mitchell's procedure, several modifications since there had been added both to extend the indications and to improve the stability of the cheveron osteotomy. In our study, we used the 90 degrees angle cut but kept the original Corless V shaped osteotomy in order to retain the stability.

OBJECTIVE:

To evaluate the mechanical and the clinical results of these modifications.

PATIENTS AND METHODS:

From January 2016 until June 2018, 15 patients (16 feet) have undergone new modification of chevron osteotomy in medical city teaching hospitals, their ages were (25-50) year, the median age±SD was (40±8.3), 2 male (3 feet), and 13 female, the patients included in this study have intermetatarsal angles 12-20 and hallux valgus angle 23-46 degree all of them complaining of pain or bursitis at the bunion site or discomfort in shoe wear, and followed clinically and radiologically for at least 1 year.

RESULTS:

The 15 patients included in this study have completed at least 6 months of follow up, the point at which the final assessment was done, two of them were male (3 feet)(13.3%) their ages (43,45 y) median 44.0 ± 1.4y , and 13 female (86.7%) their age range (23-50y) the median 38.0 ± 8.7y. Significant improvements were noted in HVA (P- value 9.7x10-12 and IMA (P-value 1.6x10- 10) measurements, also similar improvement were obtained about the functional outcome represented by the AOFAS score results (P-value 6.4 x 10-9).

CONCLUSION:

Modified chevron osteotomy was useful and safe to address mild to moderately severe cases of hallux valgus, our new modification render it more stable with a high union rate.

KEYWORDS: Chevron osteotomy, new modification, hallux valgus, treatment

INTRODUCTION:

When Corless described his chevron osteotomy for the first time in 1976[1,2], it was a modification of Mitchell's osteotomy in order to overcome the main drawbacks of this operative procedure which are the instability of the Mitchell's cut and the most important problem which is the shortening of the first ray or the extension malunion of the distal fragment or both which result in redistribution of the weight bearing to the adjacent rays and thence a forefoot metatarsalgia as a complication of this surgery[2,3].

Corless make his cut -giving it the V shape- more stable and he avoid the shortening resulted from Mitchells' step cut, however, many modifications have been made since the original intracapsular chevron osteotomy one of them is that of Horne from which we have inspired our cut by using right angle cut instead of the 45-60 degrees cut using 2-mm drill hole to mark the apex of the V[2-6].

Another modification from which we have got benefit is that of Murwaskiand Beskin (2008) by which they increase the lateral displacement by more than 50% and displacing the apex of the chevron to a point slightly proximal to the center of the head in order to correct more severe deformity[2].

* College of Medicine, University of Baghdad, Iraq
**The Iraqi Board for Medical Specializations
*** Ghazi AL-Hariri Hospital for Specialized Surgery, Medical City, Baghdad- Iraq

Chevron osteotomy is used for patients less than 40 years old with hallux valgus angle < 30 degree and intermetatarsal angle <13 degrees but it also used in older people with good results when the first MTP joint is in good condition[1,2].

Our study used the 90 degrees angle but kept the direction of the angle similar to the original Corless osteotomy in order to retain the stability that has been sacrificed by Horne modification and we put the apex of the cut in 10 to13 mm from the articular surface so as to address more severe cases.

The aim of this study is to evaluate the mechanical and the clinical results of these modifications.

PATIENTS AND METHODS:

From January 2016 until June 2018, 15 patients (16 feet) have undergone new modification of chevron osteotomy in medical city teaching hospitals, their ages were (25-50) year, the median age±SD was (40±8.3), 2 males (3 feet), and 13 females.

The patients included in this study had intermetatarsal angles 12-20 and hallux valgus angle 23-46 degree all of them complaining of pain or bursitis at the bunion site or discomfort in shoe wear because of widening of the forefoot and rubbing of the bunion with footwear. Patients with osteoarthritic metatarsophalangeal joint are excluded from the study. The patients followed clinically and radiologically for at least 1 year

Surgical technique: Under either general anesthesia or spinal anesthesia, with the use of pneumatic tourniquet at the level of the thigh, starting midline medial incision from the middle of the proximal phalanx curving it slightly dorsomedial over the bunion and end at the mid shaft of the 1st metatarsal in the midline again, the capsule of the MTP joint then incised in the medial midline exposing the medial eminence, the most important point is to avoid stripping of the capsule off the neck of the 1st metatarsal as it may jeopardize the blood supply to the head leading to avascular necrosis, the eminence is removed with oscillating saw then we use a 2 mm k-wire and we drill it at the apex of the proposed chevron cut which usually chosen to be 10-13 mm from the articular surface at the midline axis this will help to avoid overcut of one limb more than the other we usually mark the cut of the limb with cautery making the angle 90 degree but keeping the original orientation of the 60 degree cut of Corless then we used towel clip to hold the proximal piece and using thumb or finger pressure to push the distal piece laterally which then fixed with crossed k-wire from medial to lateral and from proximal to distal to improve the stability we checked their position by exploring the articular surface to avoid intra-articular penetration and we use the fluoroscopy if we are in doubt, the k- wire then cut short just out of the medial cortex to be left embedded after closure which is done after keeping the hallux in corrected position tucking the capsule like a vest in pant and then skin closed with interrupted mattress suture, after that dressing done with gauze cotton rap and a light pop cast holding the big toe in its corrected position until stiches removed after two weeks then either a walking pop cast is done with a toe spacer in between 1st and 2nd toes or hallux valgus splint is used. The patient instructed to avoid weight bearing until signs of union appear usually by 6 weeks, the patient x-rayed post operatively to ensure the correction and exclude any intraoperative complication then another x-ray done after 6 weeks to evaluate union and to start gradual weight bearing thence, and to be followed after 3 months, then every 6 months for a year.

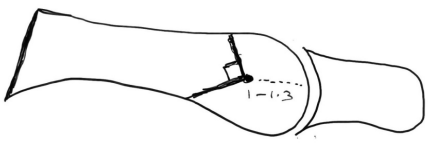

Fig.1: shows the site, the direction and the configuration of the modified osteotomy

Assessment: All patients were evaluated preoperatively using AOFAS scorefor the hallux (MTP & IP joints) which evaluates pain, activity modification, footwear requirements, motion and stability of MTP and IP joints of the hallux, presence of corn or callus, in addition to the alignment, all patients were re-evaluated using the same score in 6months postoperatively after complete union and rehabilitation, also IMA & HVA measured using standing AP view pre and post operatively.

Statistical analysis: The data were expressed as median ± standard deviation; the probability was calculated by T-test (two tailed). The test is calculated using computer IBM SPSS version 25.0.

RESULTS:

All the 15 patients included in this study have completed at least 6 months of follow up, the point at which the final assessment was done, two of them were male (3 feet) (13.3%)their ages (43,45 y) median44.0 ± 1.4y , and 13 female(86.7%) their age range (23-50y) the median 38.0 ± 8.7y.

The measurements of the IMA before and after surgery showed significant improvement in postoperative measurements (P- value <0.05) as illustrated in table 1

Table 1: IMA median ± standard deviation in the studied groups

	No.	Median ± SD	Probability
Preoperative	15	15.5 ± 2.2	$1.6x10^{-10}$
Postoperative	15	8.0 ± 1.1	

Also we got significant improvement in the postoperative measurements of HVA compared to the preoperative measurements as shown in table2.

Table 2: HVA median ± standard deviation in the studied group

	No.	Median ± SD	Probability
Preoperative	15	40.0 ± 6.4	$9.7x10^{-12}$
Postoperative	15	13.5 ± 2.0	

Regarding the functional outcome, the AOFAS score shows that there is a significant improvement in results postoperatively as compared to the preoperative results.

Table 3:the median ± standard deviation between AOFAS preoperatively and postoperatively groups

	No.	Median ± SD	Probability
Preoperative	15	20.0± 18.3	6.4×10^{-9}
Postoperative	15	92.0 ± 6.8	

We didn't have any case of nonunion, avascular necrosis or infection; however, we have one case with migration of k-wire into the MTP joint for whom surgery was done to remove the k-wires.

DISCUSSION:

Many modifications have been added to the original chevron osteotomy since its first description by Corless, most of them aiming to improve the stability and magnitude of correction in order to extend the indications for which this osteotomy can be used, and the result of most of these modifications has been proved to improve the functional and radiological results[1,2,4,6].

Our new modification in this study results in significant improvement in both radiological and functional results as both IMA and HVA has been corrected from (15.5 ± 2.2) preoperatively to (8.0 ± 1.1) postoperatively and from (40.0 ± 6.4) preoperatively to (13.5 ± 2.0) postoperatively respectively. Improvement in the functional outcome as assessed by AOAFS score is also significantly well established, this proves that this modification allows greater amount of lateral displacement of the distal piece to improve the magnitude of angles correction without jeopardizing the stability [2].

It is well known that hallux valgus deformity more common in females than males, with the greater angles correction achieved in male[2, 15]. In this study we agree with this finding, however, we found that the most severe cases were males. The most severe IMA (18°) was corrected to (8°) the patient was a male and the most severe HAV (46°) was corrected to (16°) and the patient again was male. We think that this is because of the of sex differences in bone morphology which allows us to perform lateral displacement of the distal fragment in some cases more than 5 mm and still we can have 50 % apposition between the fragments or even less opposition, owing to the stability of our cut these findings can explain the greater correction of angles that can be achieved in male patients [2].

Nonunion wasn't a complication in this series, we believe that is because of one or more of the followings; the morphology of the 1st metatarsal bone of our patient possesses a good diameter which allow about 50% apposition between the fragments , the site and direction of the angle of the cut which provides stability and put the cut in the metaphyseal region of the bone and avoid the extension of the lower arm to the diaphysis may be good justifications, also the crossed k-wire fixation which adds much to the stability and the use of non-walking cast postoperatively for about 6 weeks by which all of our cases show clinical and radiological signs of union.

Neither avascular necrosis nor infection has been encountered as complications in these cases owing to the sharp delicate dissection that we have used in performing surgery, and avoiding disturbing the blood supply especially by avoiding stripping of the capsule off the neck of the first metatarsal bone and avoiding violating the soft tissues at the lateral side of the bone as we didn't do lateral soft tissue release in this series.

One case with k-wire migration has been encountered in or study which is thought due to inadvertent penetration of the articular surface during its insertion which was corrected intraoperative but left the track open for later migration, this case required reoperation– fortunately after union- to remove the k-wires.

CONCLUSION AND RECOMMENDATION:

Modified chevron osteotomy was useful and safe to address mild to moderately severe cases of hallux valgus, our modification renders it more stable with high union rate, however our sample size is small and the follow up period is relatively short.

So, our recommendation is to perform a study with larger sample size and a longer period of follow up.

REFERENCES:

1. Schneider W, Aigner N, Pinggera O, Knahr K. Chevron osteotomy in hallux valgus. The Journal of Bone and Joint Surgery British volume. 2004;86-B(7):1016-1020.
2. Campbell W. Campbell's Operative Orthopaedics. 13th ed. Philadelphia: Elsevier; 2017.
3. Oh I, Kim M, Lee S. New Modified Technique of Osteotomy for Hallux Valgus. Journal of Orthopaedic Surgery. 2004;12(2):235-238.

4. Vasso M, Del Regno C, D'Amelio A, Schiavone Panni A. A modified Austin/chevron osteotomy for treatment of hallux valgus and hallux rigidus. Journal of Orthopaedics and Traumatology. 2015;17(1):89-93.
5. Baig M, Baig U, Tariq A, Din R. A Prospective Study of Distal Metatarsal Chevron Osteotomies with K-Wire Fixations to Treat Hallux Valgus Deformities. Cureus [Internet]. 2017 [cited 6 September 2019];9(9):e1704. Available from:https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5698042/
6. Matzaroglou C, Bougas P, Panagiotopoulos E, Saridis A, Karanikolas M, Kouzoudis D. Ninety-Degree Chevron Osteotomy for Correction of Hallux Valgus Deformity: Clinical Data and Finite Element Analysis. The Open Orthopaedics Journal. 2010;4(1):152-156.
7. Wülker N, Mittag F. The Treatment of Hallux Valgus. Deutsches Aerzteblatt Online [Internet]. 2012 [cited 6 September 2019];109(49):857–868. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3528062/
8. Donnelly R, Saltzman C, Kile T, Johnson K. Modified Chevron Osteotomy for Hallux Valgus. Foot & Ankle International. 1994;15(12):642-645.
9. Giotis D, Paschos N, Zampeli F, Giannoulis D, Gantsos A, Mantellos G. Modified Chevron osteotomy for hallux valgus deformity in female athletes. A 2-year follow-up study. Foot and Ankle Surgery. 2016;22(3):181-185.
10. Trnka H, Hofstaetter S. The chevron osteotomy for correction of hallux valgus. Interactive Surgery. 2007;2(1):52-61.
11. Guler Y, Buyukkurt C, Ayanoglu S, Gurbuz H, Tekin A, Karslioglu B et al. High intermetatarsal angle hallux valgus: does modified chevron osteotomy solve the problem?. Int J Clin Exp Med. 2019;12(3):2973-2979.
12. TRNKA H, ZEMBSCH A, EASLEY M, SALZER M, RITSCHL P, MYERSON M. The Chevron Osteotomy for Correction of Hallux Valgus. The Journal of Bone and Joint Surgery-American Volume. 2000;82(10):1373-1378.
13. Sanhudo J. Correction of Moderate to Severe Hallux Valgus Deformity by a Modified Chevron Shaft Osteotomy. Foot & Ankle International. 2006;27(8):581-585.
14. Crosby L, Bozarth G. Fixation Comparison for Chevron Osteotomies. Foot & Ankle International. 1998;19(1):41-43.
15. Choi G, Kim H, Kim T, Lee J, Park S, Kim J. Sex-Related Differences in Outcomes after Hallux Valgus Surgery. Yonsei Medical Journal. 2015;56(2):466.
16. Park Y, Lee K, Kim S, Seon J, Lee J. Lateral Soft-Tissue Release with Medial Transarticular or Dorsal First Web-Space Approach Combined with Distal Chevron Osteotomy for Moderate-to-Severe Hallux Valgus. JBJS Essential Surgical Techniques. 2014;4(4):e24.
17. Free online AOFAS Hallux score calculator - OrthoToolKit [Internet]. Orthotoolkit.com. 2019 [cited 14 September 2019]. Available from: https://www.orthotoolkit.com/aofas-mtp-ip/
18. Nguyen U, Hillstrom H, Li W, Dufour A, Kiel D, Procter-Gray E et al. Factors associated with hallux valgus in a population-based study of older women and men: the MOBILIZE Boston Study. Osteoarthritis and Cartilage. 2010; 18(1):41-46.