

Comparison between dome and wedge osteotomy in management of hallux valgus deformity

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الهدف

المقارنه بين طريقه القبه والإيقاع في علاج ابهام القدم الاروح
الطريقة

تم دراسه 36 قدم ل 28 مريض معدل اعمارهم 50.3سنة مصابون بابهام القدم الاروح.معدل وقت المتابعه 8 اشهر 19 قدم تم معالجتها بواسطة القبه و 17 بواسطة الايقاع.ثم تم دراسة النتائج حسب مقياس AOFAS الامريكي.الذي يعتمد على ثمانى عوامل منها حساب الزوايا حسب الرقائق الشعاعيه.

الاستنتاج

كلا الطريقتين متساوية الفعالية سريريا وشعاعيا في النتائج

Abstract

Background: the condition of hallux valgus is considered as the most common deformities affecting females more than males, characteristically manifested as lateral deviation of the big toe and widening of first and second inter -metatarsal angle with a deformity of second toe in some severe cases.

Objective: to make a radiological and clinical assessment of two surgical methods of osteotomy used in treatment of hallux valgu and to compare between them: first one is the distal dome osteotomy, and second one is a distal wedge metatarsal osteotomy.

Patients and methods: a total of 36 feet of 28 patients suffer from hallux valgus, with mean age of 50.3 years were included in this study, followed for 6- 30 months (mean follow-up of 8.8 months). Nineteen feet treated by dome osteotomy and seventeen feet treated by wedge osteotomy. All the cases were evaluated by the american orthopedics foot and ankle society (aofas) score, also, through the hallux valgus angle and intermetatarsal angle, both before and after surgery.

Results: by dome osteotomy, the preoperative mean result of aofas score was about 45.7, with hallux valgus angle (hva) of 33.2° and intermetatarsal angle (IMA) of 11.7°. Postoperatively, the mean result of AOFAS score was 82.8, with HVA of 14.3° and IMA of 7°, with about 94.7% satisfactory results. In the other hand, the method of wedge osteotomy showed a preoperative mean result for AOFAS score of 45.2, with HVA of 34° and IMA of 12.8° , compared with postoperative mean result of AOFAS score of about 80.7, with HVA of 15.8° and IMA of 7.7°, with about 82.8 % satisfactory results.

Conclusions: the two methods of osteotomy were used with very good outcome in radiological and clinical treatment of hallux valgus.

Keywords: Hallux valgus, osteotomy, dome, wedge.

Introduction

The condition of Hallux valgus is considered as the most common deformities affecting females more than males, characteristically manifested as lateral deviation of the big toe and widening of first and second inter -metatarsal angle with a deformity of second toe in some severe cases. The degree of the hallux valgus angle of the first metatarso -phalangeal joint is usually up to [15 to 20] regard as normal, whereas the inter-metatarsal angle between

first and second metatarsal bones is about oftenly 8 to 9 degrees to consider normal. (1).

A pronation of the big toe occurs if the angle of the first metatarso-phalangeal joint is above 30 to 35 degrees. This abnormality in rotation will lead to make the abductor hallucis and moves further to plantar direction, which is usually plantar to the flexion- extension axis of the first metatarso- phalangeal joint. As seen in figure [1]. (2)

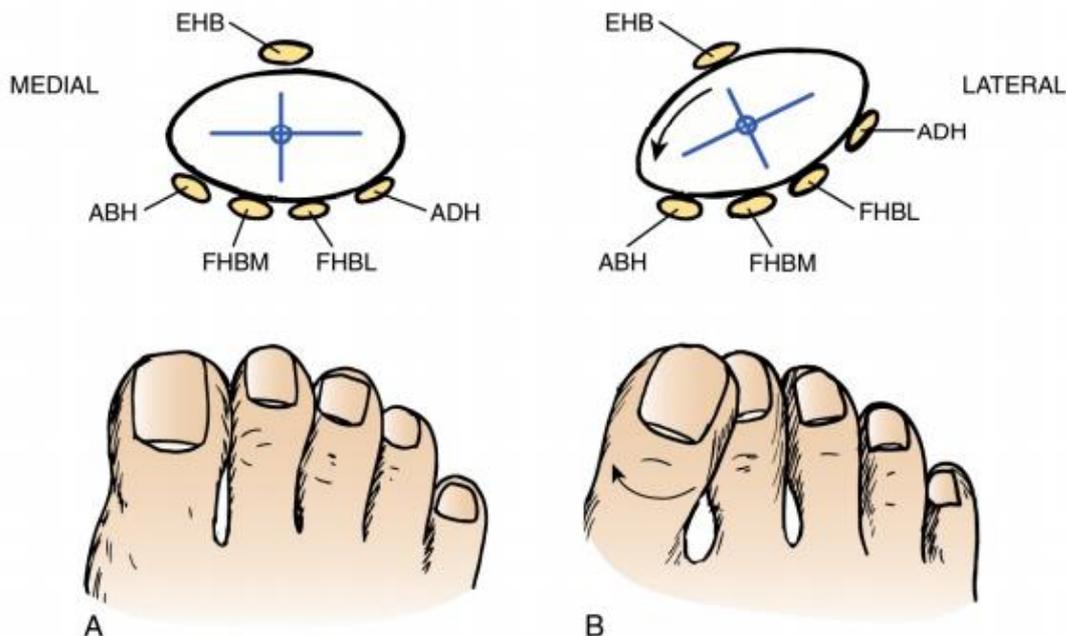


Fig.1= the normal hallux B= the hallux valgus.

The pathology of this deformity is a matter of intrinsic and extrinsic factors. Most cases due to intrinsic factors such as hereditary factors, 1st metatarsal varus deformity, ligaments laxity, variance of length of 1st metatarsal and fallen arches.

A narrow front shoes with triangular toe box accompanied with high heel are the main extrinsic factors that attributed to changes of metatarsal heads position- thus making closer, leading to big toe lateral deviation.^(2,3,4)

Heredity is the main attributer for intrinsic factors, which are: varus deviation of 1st metatarsal, length abnormality of 1st metatarsal bone, format of 1st tarso-metatarsal joint, collapsed arches with laxity of the ligament.

The conservative therapy is usually considered in a symptomatic cases, but do not correct the deformity, so the operative treatment is advised for symptomatic cases. There are many articles of operative procedures, but with no universal surgical method with perfect outcome for all cases, thus, the orthopedic surgeons make their choice for treatment according to the structural abnormalities of the 1st metatarsal bone and the degree of deformity. If there is metatarso-phalangeal joint arthrosis or not

and 1st metatarso-phalangeal hypermobility.^(2,5,6,7)

This study aims to compare and evaluate the results of the operative approach of the symptomatic hallux valgus condition treated with both surgical techniques of osteotomy. The first procedure is distal 1st metatarsal dome osteotomy of and the second one by wedge osteotomy.

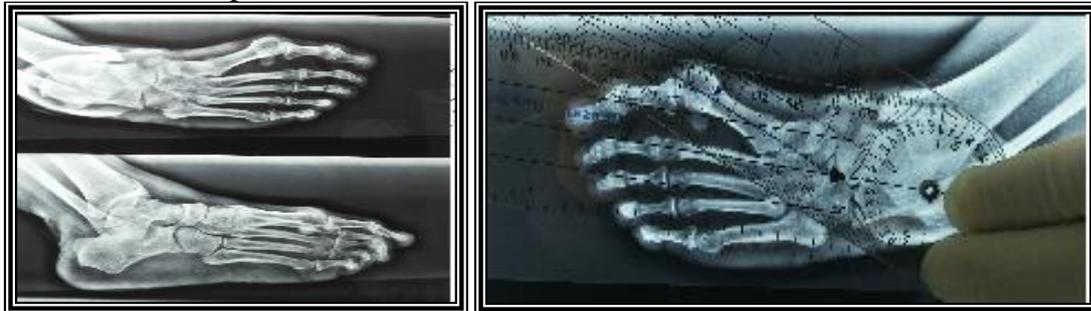
Material and methods

The current study was performed between January 2011 and July 2014, where 36 feet of 28 patients with hallux valgus angle between 28 and 38 degrees (with mean of 36) and inter-metatarsal angle between 8 and 13 degrees (with mean of 12), all cases have corresponding metatarso-phalangeal joint with osteoarthritis or rheumatoid arthritis. The cases of hallux valgus were prepared to surgery, and most of the patients were treated at the teaching or private hospitals. Female cases were commonest compared to male cases (i.e. about 25 patients -six of them have bilateral feet, while the male cases are 3 patients -two of them have bilateral feet).

In current study, the age of patients at time of surgery was in between 32 and 65years, with average age around (50.3) years. The left side (i.e. 20 feet) was affected more than the right side (16 feet). The Dome surgical

procedure was performed for 19 feet and the wedge procedure for 17 feet.

The follow up time for postoperative period was (6) months- up to (30) months, with average (8.8) months. In the first group treated by dome osteotomy, the mean follow up was (12.1) months while in the second group that was treated by wedge osteotomy, the mean followup was (6.5) months.



(Fig 2): Plain X-ray for deciding osteotomy site and size.

Surgical techniques

Dome osteotomy;

Retraction of the extensor hallucis longus was performed after dorsal incision (i.e. about 2.5-3 cm was applied to skin and fascia), then via opening of the joint capsule with resection of bunion, tenotomy of the abductor hallucis, then by soft tissue release and exposing of the distal area of 1st metatarsal bone to correct the varus deformity by making multiple holes as a

curve of dome (about 1- 1.3 cm from the distal 1st metatarsal bone).

The second step is by using small osteotome after several small holes at the osteotomy site in order to make a dome shape, correction of the deformity, then doing fixation using 2mm k-wire, washing by normal saline. The operation then finished with removal of tourniquet and good hemostasis, then capsuloraphy with one zero proline (Figure 3).



(Fig.3) : using 2mm k-wire for fixation.

The skin was sutured with proline or silk (i.e. two- zero) then the final step is by dressing with short backslap, at 90° ankle position, for protection (Figure 4).



(Figure 4). The short platform backslaps.

Wedge osteotomy ;

Preoperative radiological planning to assess osteotomy site and size on plain x-ray was done with strict antiseptic technique and the limb bloodless by tourniquet above the knee, scraping by povidone iodine, at supine position, medial incision around 3.5-4 cm was applied to skin and fascia .

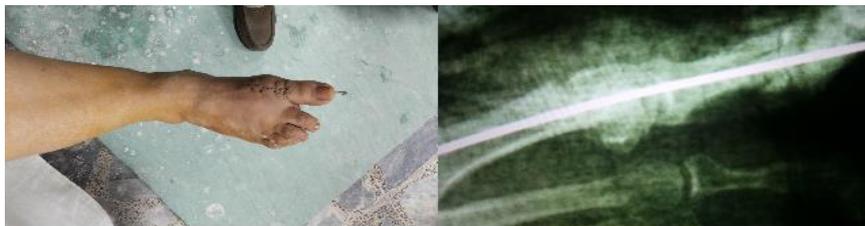
The capsule was opened with resection of bunion, soft tissue release, then exposing the first metatarsal bone for correcting the deformity by closed wedge osteotomy of about 1-1.3 cm from distal 1st metatarsal bone via small osteotome , then

fixation using 2mm k-wire, wash by normal saline, then lastly, removal of tourniquet and good hemostasis and performing capsuloraphy by one zero proline .

Finally, Suturing of skin by silk or proline (i.e. two zero) with dressing and short backslap with toe protection, at 90 degree ankle position (figure 4&5).

In both technique;

A radiographic assessment of hallux valgus angle and inter- metatarsal angle in the antero- posterior view was performed preoperatively and postoperatively (Figure 5).



(Figure 5). Postoperative x-rays, 2weeks sutures removed

After these angles were measured before and after the operation, sutures were removed at the second weeks, and backslab removed at the fourth week ,the k-wire was removed at sixth week. The questionnaire score of clinical satisfaction of the American Orthopedics Foot and Ankle Society (AOFAS) was applied ⁽⁸⁾. Figure (6) shows eight factors score from 0 to 100 points

such as: pain, activity and movement limitation, the type of footwear applied, the presence first ray alignment and calluses. We considered satisfactory results if values ≥ 70 points , while values < 70 points are unsatisfactory results .The statistical analysis was used for both data were analysed by statistical method with assessing the efficacy of the therapy.

Hallux Metatarsophalangeal-Interphalangeal Scale

Pain (40 points)	
None	40
Mild, occasional	30
Moderate, daily	20
Severe, almost always present	0
Function (45 points)	
<i>Activity limitations</i>	
No limitations	10
No limitation of daily activities, such as employment	7
Limited daily and recreational activities	4
Severe limitation of daily and recreational activities	0
<i>Footwear requirements</i>	
Fashionable, conventional shoes, no insert required	5
Comfort footwear, shoe insert	3
Modified shoes or brace	0
<i>MTP joint motion (dorsiflexion plus plantarflexion)</i>	
Normal or mild restriction (75° or more)	10
Moderate restriction (30°-74°)	5
Severe restriction (less than 30°)	0
<i>IP joint motion (plantarflexion)</i>	
No restriction	5
Severe restriction (less than 10°)	0
<i>MTP-IP stability (all directions)</i>	
Stable	5
Definitely unstable or able to dislocate	0
<i>Callus related to hallux MTP-IP</i>	
No callus or asymptomatic callus	5
Callus, symptomatic	0
Alignment (15 points)	
Good, hallux well aligned	15
Fair, some degree of hallux malalignment observed, no symptoms	8
Poor, obvious symptomatic malalignment	0
	Total= 100

American Orthopaedic Foot and Ankle Society

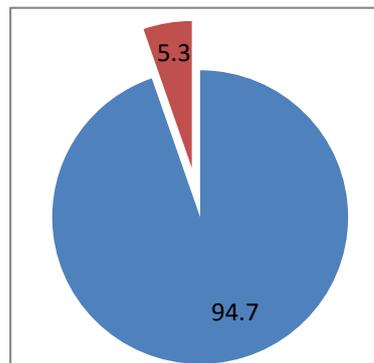
(Figure

6):- AOFAS Score

Results :

By dome osteotomy we have 94.7% satisfactory or good results (18 out of 19 feet) and 5.3% of not good results i.e unsatisfactory (1 foot). (Figure .7) , the mean AOFAS score in dome

osteotomy was increased from 45.7 points to 82.83 points in comparison between pre and postoperative period. (Table 1).



(Figure.7) satisfactory percentage of dome technique

Table 1:- AOFAS Score in dome technique

No. of order	preoperative	postoperative
1	46	90

2	65	88
3	78	95
4	65	88
5	52	76
6	54	78
7	25	84
8	30	82
9	25	73
10	32	50
11	29	92
16	61	83
22	44	78
26	46	88
27	52	95
29	34	88
31	38	78
32	42	86
36	51	83
	mean	mean
AOFAS	45.7	82.8

The preoperative mean IMA and HVA were 11.7° and 33.2°, dropping to 7° IMA and 14.3° HVA , respectively, in the postoperative period. (Table2)

Both data showed a significant improvement in the radiological and clinical

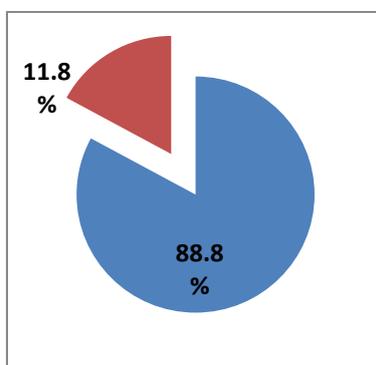
aspects of (AOFAS) with this procedure . (p<0.05).

In the group of wedge osteotomy , the percentage of satisfactory or good results was 88.2% (15 feet) out of 17 while unsatisfactory or not good results represented 11.8% (two feet). (Figure .8).

Table2:- Radiographic evaluation in dome technique

No. of order	intermetatarsal		Metatarsophalangeal	
	pre	post	Pre	Post
1	13	6	36	15
2	11	7	28	13
3	13	5	34	16
4	12	6	35	13
5	13	10	32	13
6	12	8	35	15
7	8	8	35	18
8	11	9	31	12
9	13	9	38	17
10	10	4	29	12
11	13	10	33	13
16	12	6	32	16
22	12	8	34	12
26	11	6	31	13
27	11	7	36	14
29	13	7	34	13
31	10	6	32	15

32	12	5	33	15
36	13	6	33	16
	mean	mean	Mean	Mean
	11.7	7	33.2	14.3



(Figure .8):- satisfactory percentage in wedge technique

In this group of selected feet ,the mean AOFAS score was increased from 45.1 points to 80.7 points in comparison between pre and postoperative period. (Table 3)

Table 3:- AOFAS score of wedge technique The preoperative mean IMA

No. of order	Pre operative	Post operative
12	57	60
13	52	83
14	62	95
15	34	83
17	32	40
18	29	70
19	60	73
20	20	88
21	30	82
23	34	95
24	53	83
25	54	70
28	50	74
30	60	92
33	44	83
34	46	80
35	52	84
	mean	Mean
AOFAS	45.2	80.7

The HVA were 12.8° and 34°, dropping to 7.7° IMA and 15.8° HVA, respectively, in the postoperative period. (Table 4)

Table 4:- Radiographic evaluation in wedge technique

No. of order	Intermetatarsal		Metatarsophalangeal	
	pre	post	Pre	Post
12	13	9	31	13

13	13	8	36	14
14	12	8	32	13
15	13	8	32	14
17	11	7	35	17
18	13	9	30	17
19	10	6	34	15
20	13	8	30	16
21	12	7	28	16
23	11	6	28	17
24	13	5	37	15
25	12	9	32	13
28	12	8	32	17
30	13	8	34	15
33	11	7	30	12
34	11	7	28	15
35	12	6	32	16
	mean	mean	Mean	mean
	12.8	7.7	34	15.8

There is a significant clinical improvement in AOFAS score and also there is an improvement in radiological assessment with the use of wedge operation ($p < 0.05$) for both data showed.

So, the two types of operations have similar clinical (AOFAS) score and radiological outcome during analytic comparison.

In the dome osteotomy group, about 21% of foot complications were found, like wound dehiscence in 1 patient, over-correction (i.e. hallux varus) in 1 patient, and delay union in 2 patients- with one foot for each complication. For the case of over-correction occurred (no. 10, Table 1); we plan for revision by chevron (inverted V) osteotomy to correct hallux varus deformity, and good result was obtained, while in wedge osteotomy group, there were only few complications and one patient developed a postoperative pain

There is no wound infection or decreased movement of the metatarso- phalangeal joint in both of the two operative procedures.

Discussion

Many surgical procedures were developed for the management of symptomatic hallux valgus, but still with no fixed universal surgical method for all cases. In severe deformity conditions of hallux valgus, surgery usually require osteotomy of

the 1st metatarsal bone to correct these deformities, but in mild cases, a soft tissue surgery is fair enough (i.e. McBride procedure).

Females recorded higher incidence of hallux valgus compared with the male patients, with a ratio of 9.5:1, which agreed with many studies^(1,5,7,9).

In current study, both surgical procedures have similar results in the clinical and radiological outcome with nearly similar p value. Current study showed 88.8% of satisfactory or good results, has the same findings of other studies.^(4,5,9,10,11). The dome osteotomy had higher satisfactory results (i.e. around 94.7%), while that of the wedge osteotomy showed lower results (i.e. around 82.8 %). Both procedures showed a significant increase in the mean AOFAS score, with higher outcome for dome osteotomy.

On statistical settings, a comparison between these results implies no significant differences, which is similar to the findings of Klosok⁽¹¹⁾ and Tonbul.⁽¹²⁾

An increase of the AOFAS score mean from 45.2 to 80.7 points was noticed for the wedge osteotomy group, but still under the results obtained from the data of Thomas et al⁽⁹⁾ and Walther et al⁽¹⁴⁾. The HVA and IMA was lower for the feet treated by both types of osteotomy, but with no

normal values in the all selected sample, which is similar to the results obtained from other literatures^(10,15,16)

Although improvement is better in the proximal osteotomy compared with the distal one of the 1st metatarsal regarding the IMA in relation to the HVA, yet- in most of conditions, and although there is a decrease of IMA, but it doesn't reach the normal levels. This probably is due to failure in making additional distal osteotomies in the proximal phalanx and/or 1st metatarsal bone, which ends with better correction of hallux valgus condition.

Only one case showed delayed bone healing submitted by dome osteotomy, in contrast to Smith et al,⁽¹⁶⁾ who performed the procedure by internal fixation (screws with plate) which still have the similar complications in 6 cases. We should understand that several surgeons perform the fixation with addition wedge^(10,14,15,16) with the advantage of this procedure over dome osteotomy alone, also, we can help the patient to start walking earlier. This is due to the greater stability gained by osteotomy fixation, as explained by Walther et al.⁽¹⁴⁾

CONCLUSION

The two methods of osteotomy seem to be more clinically effective for the management of hallux valgus deformity. The radiological measurements of HVA and IMA was reduced after surgery, which is significant in two operative procedures.

There's significant increased in the mean of the AOFAS score in the postoperative period in two types of osteotomy.

As above facts so the results gained by the both operative procedure are equivalent, with no significant differences in both of them.

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