Outcomes of Surgical Management of Hallux Abductovalgus with Concomitant Metatarsus Adductus Deformity: A Systematic Review

Joseph R Brown, DPM,[1] Nevin Joseph, DPM,[1] Bryan R Blacka, BS,[2] Ian Barron, DPM, FACFAS[3]

1. Resident, OhioHealth Grant Medical Center, Columbus, OH 2. Medical Student, Scholl College of Podiatric Medicine, Chicago, IL 3. Teaching Faculty, OhioHealth Grant Medical Center, Columbus, OH

Grant Medical Center
OhioHealth

STATEMENT OF PURPOSE

The purpose of this study was to evaluate the literature on the outcomes, complications, and treatment strategies of hallux abductovalgus (HAV) with concomitant metatarsus adductus (MA) deformity.

INTRODUCTION

Hallux abductovalgus is a prevalent foot deformity commonly treated by foot and ankle surgeons. Severe MA is a common factor that influences the difficulty of HAV correction. MA can be a risk factor for HAV,[1-3] with some authors suggesting patients with MA are 3.5 times more likely to develop HAV.[3] Additionally, MA can make the operative management of HAV more difficult with reduced space between the first and second metatarsals.[4] Several systems and instrumentation devices have been developed to address the combination of HAV and MA. However, no concise treatment strategies have been identified in the literature and limited data is available on clinical outcomes. We performed a comprehensive systematic review to evaluate trends of clinical and radiological outcomes of surgically managed HAV with concomitant MA to further add to the literature.

METHODOLGY

A systematic review of studies published in PubMed, Medline, Cochrane, and OVID databases between January 2002-June 2023 was performed. Publications evaluating the outcomes of surgical management of HAV with concomitant MA deformity were identified. Standard Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines were followed.

The inclusion criteria were as follows:

- Discuss surgical management of HAV with MA deformity.
- Include reported outcome measures and/or radiographic evaluations.
- Report complications, including recurrence rates.
- Article published in English.
- Patients 18 years or older.
- Minimum of 1 year follow-up.

The mean radiographic outcomes, patient reported outcome measure scores, and complication rates were calculated. Independent t-test was performed for radiographic outcomes with a p value set at <0.05 for statistical significance.

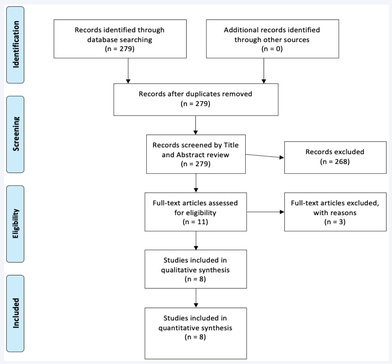

Figure 1: Systematic review methodology according to PRISMA guidelines.
Abbreviations: PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses

RESULTS

Article	Level of Evidence	# of Feet	Mean Age	Gender (M:F)	Procedures Performed	Mean Follow-Up, months
Shima et al, 2019[5]	Level 4	21	60.1	1:16	Crescentic, POMO 2nd/3rd	114.4
Burg et al, 2022[6]	Level 3	21	66	4:16	PCWO 2-4, DMO, Akin. PCWO proximal phalanges.	12
Choi et al, 2021[7]	Level 3	42	48.8	3:39	PCMO, Akin	29.5
Wu et al, 2022[8]	Level 3	32	47.1	6:17	"Syndesmotic" procedure	20.4
Conti et al, 2021[9]	Level 3	41	51.9	N/A	Lapidus	12.3
Bofelli et al, 2022[10]	Level 4	34	55.2	3:31	Lapidus	12.6
Okuda et al, 2002[11]	Level 4	1	55	1 (F)	Crescentic. POMO 2nd/3rd	34
Lee et al, 2021[12]	Level 3	45	57.9	2:36	Chevron DMO	20.5
Total	**Level 3: 5 Level 4: 3**	**237**	**54.3**	**19:156**	**Crescentic (2), POMO 2nd/3rd metatarsals (2), PCWO 2-4 (1), DMO (2), Akin (2), PCWO proximal phalanges (1), PCMO (1), "Syndesmotic" procedure (1), Lapidus (2)**	**27.2**

Table 1: Demographic data for the included articles. 8 articles met the inclusion criteria, for a total of 237 feet. 5 studies were level 3, while 3 studies were level 4 evidence. Note a lack of a standardized surgical approach, revealing substantial heterogeneity across the studies.
Abbreviations: DMO, distal metatarsal osteotomy; PCMO, proximal chevron metatarsal osteotomy; PCWO, percutaneous closing wedge osteotomy; POMO, proximal oblique metatarsal osteotomy.

Article	IMA (Pre)	IMA (Post)	HVA (Pre)	HVA (Post)	MAA (Pre)	MAA (Post)
Shima et al[5]	14.9	4.8	47.2	14.4	24.6	14.4
Burg et al[6]	8.19	4.33	44.1	12.52	28.1	13.5
Choi et al[7]	15.4	5.9	29.2	12.3	N/A	N/A
Wu et al[8]	12.7	5.9	37.2	25.3	N/A	N/A
Conti et al[9]	13.2	4.5	32.6	10.8	23.8	21.3
Bofelli et al[10]	19.4	10	31.1	17	27.4	22.9
Okuda et al[11]	14	4	62	12	37	20
Lee et al[12]	14.4	7.1	35.1	10.6	21.5	21.2
Total	**14.3**	**6.2***	**36.9**	**14.3***	**24.3**	**19.7***

Table 2: Summary of preoperative and postoperative radiographic angular measurements.
Abbreviations: HVA, hallux valgus angle; IMA, intermetatarsal angle; MAA, metatarsus adductus angle.
*Significant findings (P <0.05)

Article	AOFAS (Pre)	AOFAS (Post)	VAS (Post)
Shima et al[5]	48.6	89.9	2.0
Burg et al[6]	41.6	86.1	N/A
Choi et al[7]	60.2	90.2	1.1
Wu et al[8]	55.7	87.5	N/A
Okuda et al[11]	44	100	N/A
Lee et al[12]	N/A	N/A	1.5
Total	**53.4**	**88.8***	**1.4**

Table 3: Preoperative and postoperative patient reported outcome measures. No other outcome measures were consistently reported and thus were excluded from this chart.
Abbreviations: AOFAS, American Orthopaedic Foot & Ankle Society; VAS, Visual Analog Scale.
*Significant findings (P <0.05)

Measurement/Scoring System	Preoperative Value	Postoperative Value	*P* Value
IMA	14.3	6.2	<0.0001*
HVA	36.9	14.3	<0.0001*
MAA	24.3	19.7	0.007*
AOFAS	53.4	88.8	<0.00001*

Table 4: Mean total radiographic and clinical outcomes with statistical significance.
Abbreviations: AOFAS, American Orthopaedic Foot & Ankle Society; HVA, hallux valgus angle; IMA, intermetatarsal angle; MAA, metatarsus adductus angle.
*Significant findings (P <0.05)

Article	Complications (Excluding Recurrence)	Recurrence	Revision
Shima et al[5]	1 transfer lesion	4	1
Burg et al[6]	1 nonunion, 2 symptomatic HW	0	0
Choi et al[7]	1 hallux varus, 1 neuralgia, 3 pin irritation, 1 superficial infection	12	0
Wu et al[8]	3 stress fracture 2nd metatarsal	1	0
Conti et al[9]	3 non-unions, 1 sub-1st metatarsal head pain	7	3
Bofelli et al[10]	0	0	0
Okuda et al[11]	0	0	0
Lee et al[12]	0	5	0
Total	**17 (7.2%)**	**29 (12.2%)**	**4 (1.7%)**

Table 5: Overall complication rates, including recurrence and revision rates. Abbreviations: HW, hardware.

ANALYSIS & DISCUSSION

To our knowledge, there has not been any previously published systematic reviews with meta-analysis that have specifically examined the radiological outcomes, clinical outcomes and complications of surgically treated HAV deformities with concomitant MA. There is currently no gold standard in the treatment of hallux abductovalgus deformities with concomitant metatarsus adductus deformities. This systematic review with meta-analysis examined 8 articles that exhibited substantial heterogeneity across the procedures performed which confirms the lack of standard approach. Surgical approach ranged from procedures addressing the first ray in isolation versus a combined approach of addressing the first ray and the metatarsus adductus component.

An important strength of this study is the statistically significant improvement of the associated IM, HV, and MA angles from preoperative to postoperative measures across the included articles. Additionally, there was a statistically significant difference was found between the preoperative and postoperative AOFAS scores in 6 studies. It can be inferred that given the lack of standardization of procedures performed in the included studies, HAV with concomitant MA can be treated with a combination of arthrodesis and osteotomy procedures with favorable clinical and radiological outcomes.

The complication rate across all studies was 7.2% with non-union being the most common complication (1.7%). Recurrence rate was found to be 12.2%. This is lower than previously reported data which found the recurrence rate of HV with concomitant MA to be as high as 30%.[2] Furthermore, it should be mentioned that although the recurrence rate was 12.2%, the revision rate in the studies we examined was only 1.7%.

There are certain limitations with this systematic review. First, the articles that met inclusion criteria were lower level of evidence studies, mainly consisting of level 3 or 4 evidence with no randomized control trials. The clinical and radiographic inferences could be limited because of this. Additionally, the included studies had a mean follow-up of 27.2 months. More longitudinal studies with longer follow-up can further demonstrate the long-term complications, functional outcome scores and radiographic maintenance of the associated deformities.

CONCLUSION

No “gold standard” treatment exists for surgical management of HAV with MA. However, favorable functional outcomes with low complication and reoperation rates can be expected. HAV with concomitant MA can be successfully treated with a combination of arthrodesis and osteotomy procedures, either isolated at the first ray or in combination with procedures at the lesser rays.

REFERENCES

1. Aiyer AA, Shariff R, Ying L, Shub J, Myerson MS. Prevalence of metatarsus adductus in patients undergoing hallux valgus surgery. Foot Ankle Int. 2014 Dec;35(12):1292-7.
2. Aiyer A, Shub J, Shariff R, Ying L, Myerson M. Radiographic recurrence of deformity after hallux valgus surgery in patients with metatarsus adductus. Foot Ankle Int. 2016;37(2):165-171.
3. La Reaux RL, Lee BR. Metatarsus adductus and hallux abducto valgus: their correlation. J Foot Surg. 1987;26(4):304-308.
4. Loh B, Chen JY, Yew AKS, et al. Prevalence of metatarsus adductus in symptomatic hallux valgus and its influence on functional outcome. Foot Ankle Int. 2015;36(11):1316-1321
5. Shima H, Okuda R, Yasuda T, Mori K, Kizawa M, Tsujinaka S, Neo M. Operative Treatment for Hallux Valgus With Moderate to Severe Metatarsus Adductus. Foot Ankle Int. 2019 Jun;40(6):641-647.
6. Burg A, Tal Frenkel R, Nyska M, Ohana N, Segal D, Palmanovich E. Treating Hallux Valgus Associated Metatarsus Adductus by Minimally Invasive Surgery: A Simple Solution for a Difficult Problem. J Foot Ankle Surg. 2022 Sep- Oct;61(5):1091-1097.
7. Choi SM, Lee JS, Lim JW, Im JM, Kho DH, Jung HG. Effect of Metatarsus Adductus on Hallux Valgus Treated With Proximal Reverse Chevron Metatarsal Osteotomy. Foot Ankle Int. 2021 Jul;42(7):886-893.
8. Wu DY, Lam EKF. The Syndesmosis Procedure Correction of Hallux Valgus Feet Associated With the Metatarsus Adductus Deformity. J Foot Ankle Surg. 2022 Mar- Apr;61(2):339-344.
9. Conti MS, Caolo KC, Ellis SJ, Cody EA. Radiographic and Clinical Outcomes of Hallux Valgus and Metatarsus Adductus Treated With a Modified Lapidus Procedure. Foot Ankle Int. 2021 Jan;42(1):38-45.
10. Boffeli TJ, Sorensen T, Gorman C, Messerly C, Chang HC. A Novel Manipulation Technique for Lapidus Fusion in Correction of Hallux Valgus Deformity With Underlying Metatarsus Adductus: A Case Series. J Foot Ankle Surg. 2022 Mar-Apr;61(2):222-226.
11. Okuda R, Kinoshita M, Morikawa J, Jotoku T, Abe M. Adult hallux valgus with metatarsus adductus: a case report. Clin Orthop Relat Res. 2002 Mar;(396):179-83.
12. Lee J, Lee HS, Jeong JJ, Seo DK, Kee T, So S, Choi YR. Distal chevron metatarsal osteotomy is a viable treatment option for hallux valgus with metatarsus adductus-multi centre retrospective study. Int Orthop. 2021 Sep;45(9):2261-2270.