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Predictors of Outcome in Hallux Valgus Surgery

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Abstract

Introduction: Hallux valgus (HV) is the most common forefoot deformity, and is known to be a debilitating disease, causing pain and reduced social function. There are various established surgical treatments for HV, with patient satisfaction up to 85% after surgery. In this paper, we aim to identify the pre-operative factors that may serve as predictors to patient outcome after surgery, to help surgeons select suitable candidates for surgery in the clinic. **Methods:** A prospective study was done on patients who underwent scarf and akin osteotomy for symptomatic HV between October 2015 and March 2018. Five patient factors were collected pre-operatively, including osteoarthritis grade of first metatarsophalangeal joint, severity of HV, presence of osteoarthritic or sesamoid pain, and presence of flat foot. Patient's self-reported outcomes was assessed pre- and post-surgery, using the Manchester-Oxford Foot Questionnaire (MOXFQ) and Visual Analogue Score (VAS). Pre- and post-surgery outcome scores were compared, and changes in scores analysed with numerous patient factors to identify any significant association. **Results:** 41 feet of 36 patients were included after implementation of exclusion criteria. Both MOXFQ and VAS showed a significant reduction in scores (improvement in outcomes) after surgery. None of the pre-operative patient factors examined was found to be significantly associated with the reduction in MOXFQ score. However, the results suggested that high pre-surgery MOXFQ score was associated with a greater MOXFQ score reduction post-surgery, with p-value of <0.001. **Conclusion:** Our study found that none of the factors looked at significantly correlated with reductions in MOXFQ and VAS scores post-surgery, other than high pre-surgery MOXFQ scores. This suggests that surgeons should counsel as such in clinic. Nonetheless, as this study had a small study size, further studies should be done to support the findings of this research.

Keywords: Hallux valgus; Predictive factors; Patient outcomes; Surgical treatment; Scarf and akin osteotomy; MOXFQ.

INTRODUCTION

Hallux valgus (HV) is the most common forefoot deformity, with an associated prevalence of 23-35% [1]. It is characterised by a laterally deviated and subluxed hallux, in relation to the first metatarsophalangeal joint (MTPJ). HV is well known to be a debilitating disease, causing pain as well as reduced social function and mental health subscale scores [2]. There are various established surgical treatments for HV ranging from bunionectomy to corrective osteotomies, arthroplasty and arthrodesis [3]. These methods have proven to be effective, with overall patient satisfaction reported at up to 85% after surgery [3].

In this paper, we aim to identify the pre-operative factors that may serve as predictors of outcome post-surgery to help the surgeon better select suitable candidates in the clinic.

METHODS

Study design

We prospectively collected data on all patients who underwent scarf and akin osteotomy for symptomatic hallux valgus between October 2015 and March 2018. Exclusion criteria included patients with hallux rigidus alone, gout or rheumatoid arthritis, patients who required fusion of 1st MTPJ, and patients with lesser toe or MTPJ deformities.

Each patient's self-reported outcomes was assessed both pre- and post-surgery, using the Manchester-Oxford Foot Questionnaire (MOXFQ) and Visual Analogue Score (VAS) [4]. The MOXFQ score is a 16-item patient reported outcome measure developed and validated for use in studies assessing outcome following foot and ankle corrective surgery; it has a total score of 64, with a higher score indicating a worse outcome [4]. Using SPSS 23.0, the outcome scores pre- and post-surgery were compared, and the changes in scores

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were analysed with reference to numerous patient factors (see below). The pre-operative factors were analysed to see whether they significantly affected the surgical outcomes, with p-value of <0.05 considered as significant.

Pre-operative factors

Multiple pre-operative factors were assessed. These factors, alongside their definitions, are listed in Table 1. Severity of hallux valgus was assessed using intermetatarsal angle (IMA) and metatarsophalangeal angle (MTPA) taken on standardised weight-bearing X rays. These patients were clinically assessed by the same consultant orthopaedic surgeon specialising in foot and ankle surgery to ensure consistency.

Table 1: Pre-operative factors assessed in this study alongside their definitions. MTPJ – metatarsophalangeal joint; IMA – intermetatarsal angle; MTPA – metatarsophalangeal angle.

Pre-operative factors	Assessment and definition
Osteoarthritis grade of first MTPJ	Coughlin and Shurnas classification based on radiographic findings Grade 0 – normal Grade 1 – mild dorsal osteophyte, normal joint space Grade 2 – moderate dorsal osteophyte, <50% joint space narrowing Grade 3 – severe dorsal osteophyte, >50% joint space narrowing Grade 4 – same as grade III
Severity of hallux valgus	Radiological assessment using IMA and MTPA Mild – <15° IMA / <26° MTPA Moderate – 15-18° IMA / 26-45° MTPA Severe - >18° IMA / >45° MTPA
Presence of clinical osteoarthritic pain	Clinical assessment, based on pain on palpation of osteophytes, pain or catching on movement of 1st MTPJ, positive impingement sign on joint dorsiflexion
Presence of sesamoid pain	Clinical assessment, on palpation of the sesamoid whilst at rest and upon movement
Flat foot	Clinical assessment, presence of flat foot on weight bearing

Surgical technique

All patients underwent Scarf-Akin osteotomy using the senior author's standard operative technique.

Prophylactic broad-spectrum antimicrobial prophylaxis is first administered according to hospital protocol prior to application of an above knee tourniquet, which is inflated according to the patient's systolic blood pressure.

An incision is made over the 1st web space to allow for a lateral soft tissue release to reduce the 1st MTPJ and the sesamoids. A medial incision is made to provide access to the 1st metatarsal and proximal phalanx with care to preserve the dorsomedial sensory nerve. The capsule is opened, the joint exposed and sub-periosteal flaps raised to allow for the phalangeal and metatarsal osteotomies. All medial, dorsal and lateral osteophytes are cleared using an oscillating saw. Scarf osteotomy is performed in standard fashion. The plantar fragment is lateralised and fixed in position using 2 cannulated variable pitch screws passed in a dorsal-planar orientation. Overhanging bone is trimmed and used as bone graft laterally. Residual deformity is corrected via an opening wedge osteotomy of the proximal phalanx which is held with a single 2 monocryl suture. After thorough washout and closure, the patient is placed in a plaster side slab which is removed after 2 weeks and wears a heel weight bearing shoe for 6 weeks in total.

Statistical analysis

The authors obtained help from an external statistician. The first set of analyses examined the changes in MOXFQ and VAS scores from pre- to post-surgery. The changes in scores were found to be approximately normally distributed for both outcomes. Therefore, the paired t-test was used to examine changes between timepoints (pre- and post-surgery).

The next analyses examined factors associated with the change in MOXFQ score from pre- to post-surgery. Due to the continuous nature of the outcome, the analysis was performed using linear regression. Initially the separate association between each factor and the outcome was examined in a series of univariable analyses. If required, the joint association between factors showing some association with the outcome were examined in a multivariable analysis.

RESULTS

Demographic data

240 patients with hallux valgus were seen in clinic throughout the duration of this study. 41 feet of 36 patients, with 5 patients having had bilateral hallux valgus surgery, were included in the study following implementation of the exclusion criteria. These included 31 females and 5 males, with a mean age of 53.83 (23 - 78). With the post-op data being collected in March 2020, the follow up duration ranged from 10 months to 84 months, with an average of 44.53 months. Of these patients, the overall findings of pre-operative patient factors are as listed in Table 2.

Table 2: Number of patients in each category of pre-operative factors assessed in this study.

Pre-operative patient factors	Grade/Category	Number of patients
Osteoarthritis grade of first MTPJ	Grade 0	2
	Grade I	4
	Grade II	23
	Grade III	10
	Grade IV	2
Severity of hallux valgus	Mild	9
	Moderate	18
	Severe	14
Presence of osteoarthritic pain	Present	11
	Absent	30
Presence of sesamoid pain	Present	8
	Absent	33
Presence of flat foot	Present	21
	Absent	20

Pre- and Post-Surgery Outcome Scores

The first analyses examined the changes in outcome scores from pre- to post-surgery. The results suggested that there was a highly significant change in both after surgery. Both scores showed a significant reduction between timepoints. The MOXFQ score reduced by a mean of 27 units (out of 64 units), whilst the VAS score reduced by an average of 5 points (out of 10 points). A summary of the analysis results is reported in Table 3.

Table 3: Difference in outcome pre- and post-surgery is reported along with a corresponding confidence interval. P-values indicate the significance of the change in score between timepoints.

Outcome	n	Pre-surgery Mean ± SD	Post-surgery Mean ± SD	Change Mean (95% CI)	P-value
MOXFQ	41	41.3 ± 17.2	14.3 ± 17.2	-27.0 (-33.3, -20.7)	**<0.001**
VAS score	41	7.4 ± 1.9	2.5 ± 3.0	-4.9 (-5.9, -3.9)	**<0.001**

Association of Pre-Operative Factors with Changes in Outcome Scores

The next analyses examined factors associated with changes in the MOXFQ score. As most of the patients saw an improvement in their scores between the two time points, the outcome considered was the reduction in MOXFQ score pre- and post-surgery. The separate association between each factor and MOXFQ reduction were examined, and no statistically significant correlations were established. However, the results suggest that high pre-surgery MOXFQ score are associated with a greater MOXFQ reduction post-surgery. The positive regression coefficient suggested that patients with higher scores pre-surgery underwent greater reductions in score. Every 5-unit increase in the pre-surgery value was associated with an additional 3.8-unit reduction in score. None of the other variables examined was found to be to be significantly associated with the reduction in MOXFQ score. A summary of the results is shown in Table 4.

Table 4: Pre-operative factors and their association with reduction in MOXFQ – Univariable analyses. P-values indicating statistical significance

Pre-operative patient factors	Category	Reduction Mean ± SD	Coefficient (95% CI)	P-value
Osteoarthritis Grade of First MTPJ	None or I	30.0 ± 18.6	0	0.89
	II	27.1 ± 17.7	-2.8 (-21.7, 16.1)	
	III or IV	25.2 ± 25.6	-4.8 (-25.5, 15.8)	
Severity of Hallux	Mild	29.4 ± 12.3	0	0.52
Valgus	Moderate	22.9 ± 22.2	-6.5 (-23.1, 10.1)	
	Severe	30.6 ± 21.1	1.2 (-16.2, 18.6)	
Presence of Osteoarthritic Pain	No	26.3 ± 16.8	0	0.72
	Yes	28.9 ± 27.6	2.6 (-11.7, 17.0)	
Presence of Sesamoid Pain	No	26.2 ± 16.0	0	0.59
	Yes	30.5 ± 32.8	4.3 (-11.7, 20.4)	
Presence of Flat Foot	No	27.5 ± 17.2	0	0.88
	Yes	26.5 ± 22.6	-1.0 (-13.7, 11.8)	
Pre-surg MOXFQ (*)	-	-	3.8 (1.8, 5.8)	**<0.001**

A graphical illustration of the fitted relationship between these variables is shown in Figure 1.

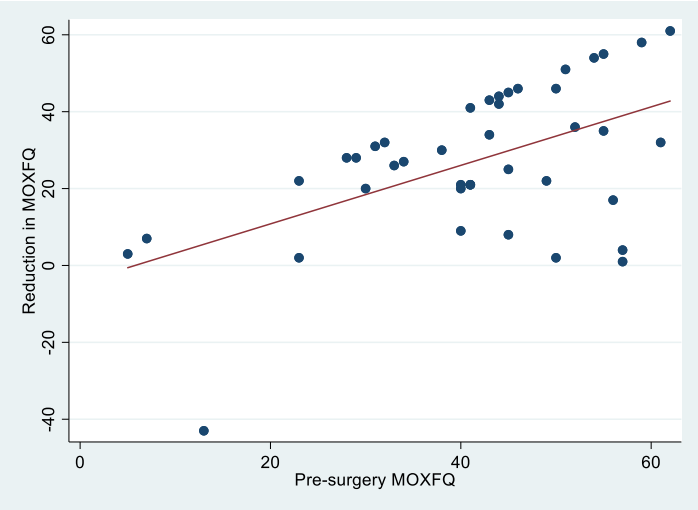

Figure 1: Association and fitted relationship between pre-surgery MOXFQ and reduction in MOXFQ from pre to post-surgery.

A multivariable regression analysis indicated similar results to the univariable analyses. That is only the pre-surgical score was found to have any association with the reduction in score.

DISCUSSION

Current literature indicates that demographic factors such as gender, obesity and age do not affect surgical outcomes[5–7]. This study aimed to assess whether it is possible to predict post-operative outcome (as judged by MOXFQ score) after scarf and akin osteotomy based on numerous other pre-operative variables, that were selected after identifying gaps in literature. Our results show that majority of patients see an improvement in MOXFQ score post-surgery. They do not however demonstrate any statistically significant link between the degree of improvement and any of the variables tested:

Flat Feet

No link was established between concurrent pes planus deformity and the change MOXFQ score pre- and post-surgery. While this is a useful finding, the authors acknowledge that the presence of deformity has been treated as a binary variable with no reference to objective grading limiting the data somewhat. Based on the authors' knowledge, there is no other studies in literature looking at flat feet as a predictive factor to surgical outcome, although a retrospective comparative series has found that flat feet was unrelated to the presence of symptoms or degree of deformity in juvenile hallux valgus [5]. Another study has found that hindfoot misalignment is not associated with worse outcomes [6].

Severity of OA

Multiple studies have shown the severity of HV to be correlated with the severity of OA [7–9]. The authors thus wondered whether the severity of OA would affect patient surgical outcomes, as this has not been previously looked at. Our study does not establish a link between the severity of OA and change in MOXFQ score, but it is important to take note of certain limitations. The distribution across the 4 grades of OA is uneven and heavily skewed toward mild/moderate disease with only 2/41 cases classified as Grade IV. We may reasonably conclude therefore that our data should not be extrapolated to draw conclusions about patients with severe OA. Indeed there is evidence that arthroplasty or fusion surgery is performed more in advanced hallux rigidus [10].

OA Pain and Sesamoid Pain

Our results do not appear to demonstrate that post-operative outcome is influenced by the presence of clinical pain due to OA, as determined by pain on palpation of osteophytes, pain or catching on movement of 1st MTP joint, positive impingement sign on joint dorsiflexion or pain on grind test. The authors acknowledge that such a finding is highly subjective and subject to inter-observer variation. As clinical examination however forms a cornerstone of pre-operative assessment, we consider OA pain relevant to include here as a binary variable.

Similarly, no correlation was established between the presence of clinical sesamoidal irritability and the post-operative MOXFQ score. This we consider of relevance as numerous studies have pointed to the satisfactory reduction of the sesamoido-metatarsal joints as a means of ensuring good post-operative outcome [8, 11].

Pre- and Post-Op MOXFQ scores

Of great interest though is that a higher pre-operative MOXFQ score correlates with a greater post-operative reduction and hence serves as a useful pre-operative predictor of outcome.

This finding may be of reassurance to the surgeon faced with significant deformity and concurrent OA disease burden and reinforces the age old medical adage: 'treat the patient'. Conversely, those with progressed disease, but nonetheless a low MOXFQ score may see less of a benefit post-surgery and should be counselled as such; this is the senior author's current practice.

Severity of HV

This study does not demonstrate that the severity of HV is significantly correlated to surgical outcomes. Indeed, there is conflicting evidence in the literature on whether the severity of HV is correlated to surgical outcomes and risk of recurrence [6, 12–16].

CONCLUSION

Our study has found that none of the variables looked at significantly correlated with reductions in MOXFQ and VAS scores post-surgery, other than high pre-surgery MOXFQ scores. This suggests that there is better post-surgery outcome in this group of patients, and the surgeons should counsel as such in clinic. Most of the variables included in this study has not been explored before in literature, as far as the authors are aware. Nonetheless, as this study had a small study size, further studies should be done in this field to support the findings of this research.

Conflict of Interest

The authors declare no conflict of interest in the write up and submission of this paper.

Authors' Contribution

1. Wan Wei Ang – main write up, data analysis
2. Maria Charalambides – data collection, data analysis
3. Alexander Overton – write up, proofread
4. Charalambos Charalambides – generated idea of the paper, data collection

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REFERENCES

1. Nix S, Smith M, Vicenzino B. Prevalence of hallux valgus in the general population: A systematic review and meta-analysis. J Foot Ankle Res 2010. https://doi.org/10.1186/1757-1146-3-21.
2. Menz HB, Roddy E, Thomas E, Croft PR. Impact of hallux valgus severity on general and foot-specific health-related quality of life. Arthritis Care Res 2011. https://doi.org/10.1002/acr.20396.
3. Wülker N, Mittag F. The Treatment of Hallux Valgus. Dtsch Aerzteblatt Online 2012. https://doi.org/10.3238/arztebl.2012.0857.
4. The Manchester–Oxford Foot Questionnaire (MOXFQ): Development and validation of a summary index score. Bone Joint Res 2013. https://doi.org/10.1302/2046-3758.24.2000147.
5. Kim HW, Park KB, Kwak YH, Jin S, Park H. Radiographic Assessment of Foot Alignment in Juvenile Hallux Valgus and Its Relationship to Flatfoot. Foot Ankle Int 2019. https://doi.org/10.1177/1071100719850148.
6. Ginés-Cespedosa A, Pérez-Prieto D, Muñetón D, González-Lucena G, Millán A, De Zabala S, *et al*. Influence of Hindfoot Malalignment on Hallux Valgus Operative Outcomes. Foot Ankle Int 2016. https://doi.org/10.1177/1071100716645403.
7. Lee KT, Park YU, Jegal H, Young KW, Kim JS, Lim SY. Osteoarthritis of the second metatarsophalangeal joint associated with hallux valgus deformity. Foot Ankle Int 2014. https://doi.org/10.1177/1071100714552478.
8. D'Arcangelo PR, Landorf KB, Munteanu SE, Zammit GV, Menz HB. Radiographic correlates of hallux valgus severity in older people. J Foot Ankle Res 2010. https://doi.org/10.1186/1757-1146-3-20.
9. Bock P, Kristen KH, Kröner A, Engel A. Hallux valgus and cartilage degeneration in the first metatarsophalangeal joint. J Bone Jt Surg - Ser B 2004. https://doi.org/10.1302/0301-620X.86B5.14766.
10. Goldberg A, Singh D, Glazebrook M, Blundell CM, De Vries G, Le ILD, *et al*. Association Between Patient Factors and Outcome of Synthetic Cartilage Implant Hemiarthroplasty vs First Metatarsophalangeal Joint Arthrodesis in Advanced Hallux Rigidus. Foot Ankle Int 2017. https://doi.org/10.1177/1071100717723334.
11. Chen JY, Rikhraj K, Gatot C, Lee JYY, Singh Rikhraj I. Tibial Sesamoid Position Influence on Functional Outcome and Satisfaction after Hallux Valgus Surgery. Foot Ankle Int 2016. https://doi.org/10.1177/1071100716658456.
12. Barg A, Harmer JR, Presson AP, Zhang C, Lackey M, Saltzman CL. Unfavorable outcomes following surgical treatment of hallux valgus deformity: A systematic literature review. J Bone Jt Surg - Am Vol 2018. https://doi.org/10.2106/JBJS.17.00975.
13. Deenik AR, De Visser E, Louwerens JWK, Malefijt MDW, Draijer FF, De Bie RA. Hallux valgus angle as main predictor for correction of hallux valgus. BMC Musculoskelet Disord 2008. https://doi.org/10.1186/1471-2474-9-70.
14. Law GW, Tay KS, Lim JWS, Zhang KT, Seng C, Yeo NEM, *et al*. Effect of Severity of Deformity on Clinical Outcomes of Scarf Osteotomies. Foot Ankle Int 2020. https://doi.org/10.1177/1071100720907387.
15. Kaufmann G, Giesinger JM, Hofer P, Braito M, Biedermann R, Dammerer D. Does preoperative deformity diminish radiographic outcome after hallux valgus correction with scarf osteotomy?: A retrospective study of 102 cases. Foot Ankle Surg 2019. https://doi.org/10.1016/j.fas.2019.05.007.
16. Matthews M, Klein E, Youssef A, Weil L, Sorensen M, Weil LS, *et al*. Correlation of Radiographic Measurements With Patient-Centered Outcomes in Hallux Valgus Surgery. Foot Ankle Int 2018. https://doi.org/10.1177/1071100718790255.