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Original Research

A Modified Foot and Ankle Score for Assessing Patient Outcomes After First Metatarsophalangeal Arthrodesis

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ABSTRACT

First metatarsophalangeal (MTP) arthrodesis is commonly used to treat many end-stage first MTP diseases. The most widely used scale for measuring the clinical outcomes after this procedure, the American Orthopaedic Foot and Ankle Society Hallux Metatarsophalangeal–Interphalangeal scale, has not been adequately validated and does not measure specific foot functions. Another outcome measure, the patient-reported Foot and Ankle Outcome Score (FAOS) has acceptable construct validity but poor content validity. The FAOS scale has 42 questions, many of which are unrelated to the hallux. We designed a short-form FAOS (sf-FAOS) consisting of 11 questions that are more relevant to first MTP arthrodesis. The sf-FAOS includes a pain subscale and a function subscale, and the score of each subscale ranges from 0 (worst outcome) to 100 (best outcome). Our study has shown that the sf-FAOS scale has acceptable validity, reliability, and responsiveness. In 21 feet (16 patients) with hallux valgus after >1 year of follow-up, the mean sf-FAOS pain score had improved by 44.9 points after surgery (from 51.2 to 96.0; $p < .001$), and the mean sf-FAOS function score had improved by 22.5 points (from 47.3 to 69.8; $p < .001$). The improvement in the function score for running and jumping was limited.

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First metatarsophalangeal (MTP) arthrodesis was introduced in 1852. The procedure can relieve first MTP pain, restore the length and stability of the medium column, and reestablish the weightbearing pattern of the forefoot (1,2). It is currently the first choice for treating severe hallux rigidus (3). In a systematic review (in preparation) of studies reported from 2000 to 2017, we found that the pooled fusion rate of first MTP arthrodesis for treating hallux rigidus was 96% (95% confidence interval [CI] 93% to 99%; $I^2 = 77%$; $n = 598$ feet in 18 studies), and the pooled patient satisfaction rate was 97% (95% CI 91% to 100%; $I^2 = 72%$; $n = 225$ feet in 7 studies). The pooled fusion rate for first MTP arthrodesis to treat hallux valgus (including in the setting of rheumatoid arthritis) was 96% (95% CI 93% to 98%; $I^2 = 31%$; $n = 454$ feet in 15 studies), similar to that for hallux rigidus. However, the pooled patient satisfaction rate was only 83% (95% CI 77% to 87%; $I^2 = 0%$;

$n = 211$ feet in 6 studies). This difference in satisfaction rates implies that the indications for first MTP arthrodesis in patients with hallux valgus, the effectiveness of the surgery, and the accuracy of the outcome score, alone or in combination, should be addressed.

The most commonly used scale for measuring the outcomes of first MTP arthrodesis to treat hallux valgus is the American Orthopaedic Foot and Ankle Society Hallux Metatarsophalangeal–Interphalangeal (AOFAS-HMI) scale. The scale includes both subjective and objective variables (Table 1). Ibrahim et al (4) demonstrated acceptable reliability and validity in the subjective component; however, the full scale has not been adequately validated (5,6). Moreover, the AOFAS-HMI scale does not address specific foot functions, such as standing, walking, and jumping. To better measure patients' experience, several patient-reported outcome measures have been proposed. The Foot and Ankle Outcome Score (FAOS) has been used several times to measure the clinical outcomes after hallux surgery (2). However, it has also not been adequately validated (7). The FAOS scale includes 42 questions, many of which are not relevant to the first MTP joint, making the scale less desirable for assessing procedures used to treat first MTP joint issues. In our experience, most patients have been unwilling to spend ≥ 10 minutes to complete the questionnaire.

H.G. and H.-L.X. contributed equally.

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Table 1
Modified American Orthopaedic Foot and Ankle Society Hallux Metatarsophalangeal-Interphalangeal scale

Item	Score
Subjective component	
Part I—pain (40 points)	
None	40
Mild, occasional	30
Moderate, daily	20
Severe, almost always present	0
Part II—function (45 points – 10 points = 35 points)	
Activity limitations (10 points)	
No limitations	10
No limitation of daily activities, limitation of recreational activities	7
Limited daily and recreational activities	4
Severe limitation of daily and recreational activities	0
Footwear requirements (10 points)	
Fashionable, conventional shoes, no insert required	10
Comfort footwear, shoe insert	5
Modified shoes or brace	0
Objective component	
MTP joint motion (dorsiflexion plus plantarflexion) (10 points)*	
Normal or mild restriction ($\geq 75^\circ$)	10
Moderate restriction (30° to 74°)	5
Severe restriction ($<30^\circ$)	0
IP joint motion (plantarflexion) (5 points)	
No restriction	5
Severe restriction ($<10^\circ$)	0
MTP-IP stability (all directions) (5 points)	
Stable	5
Definitely unstable or able to dislocate	0
Callus related to hallux MTP-IP (5 points)	
No callus or asymptomatic callus	5
Callus, symptomatic	0
Part III—alignment (15 points)	
Good, hallux well aligned	15
Fair, some degree of hallux malalignment observed, no symptoms	8
Poor, obvious symptomatic malalignment	0

Scores range from 0 (worst outcome) to 90 (best outcome).

Abbreviations: IP, interphalangeal; MTP, metatarsophalangeal.

* MTP joint motion was not included in our study, reducing the maximum score to 90.

We designed and evaluated the performance of a short-form FAOS (sf-FAOS) scale targeted to assess patient outcomes after first MTP arthrodesis. The primary aim of the present study was to validate the sf-FAOS scale. The secondary aim was to measure the clinical outcomes of first MTP arthrodesis to treat hallux valgus.

Table 2
Short-form Foot and Ankle Outcome Score scale

Item	Score				
	None (0)	Mild (1)	Moderate (2)	Severe (3)	Extreme (4)
Pain subscale*					
What amount of first metatarsophalangeal pain have you experienced in the past week during the following activities?					
Walking on flat surface	0	1	2	3	4
Going up/down stairs	0	1	2	3	4
Standing upright	0	1	2	3	4
Function subscale†					
For each of the following activities, indicate the degree of difficulty you have experienced in the past week due to your foot.					
Descending stairs	0	1	2	3	4
Ascending stairs	0	1	2	3	4
Rising from sitting	0	1	2	3	4
Standing	0	1	2	3	4
Walking on flat surface	0	1	2	3	4
Getting in/out of car	0	1	2	3	4
Running	0	1	2	3	4
Jumping	0	1	2	3	4

* Pain score: 100 minus the sum of the 3 questions multiplied by 100 and divided by 12.

† Function score: 100 minus the sum of the 8 questions multiplied by 100 and divided by 32.

Patients and Methods

Short-Form FAOS

The primary purpose of first MTP arthrodesis is to restore the normal gait and relieve pain. Thus, the most important measurement criteria for the clinical outcomes are foot function and pain (8). Thus, we kept the function and pain subscales of the FAOS and combined the activities of daily living and sports activity subscales. We also deleted questions that were irrelevant to the hallux (e.g., twisting the ankle, lying in bed). The sf-FAOS scale includes 3 questions from the FAOS pain subscale and 8 from the FAOS function subscale. Just as with the full FAOS scale, the sf-FAOS has no overall score, and the score of either subscale is normalized to 100 (best outcome; Table 2). In 2011, our department began administering the sf-FAOS scale to measure the clinical outcomes after first MTP arthrodesis.

Modified AOFAS-HMI Scale

The modified AOFAS-HMI scale does not include the MTP joint motion score (an objective variable) (9) because first MTP arthrodesis eliminates first MTP joint motion. Thus, the remaining maximum score is 90 (Table 1). The modified AOFAS-HMI scale has also often been used to measure the clinical outcomes after first MTP arthrodesis (10,11). Because the subjective component of the AOFAS-HMI scale has been validated, it was used as the reference to validate our sf-FAOS scale.

Patient Satisfaction Measurement

We measured patient satisfaction using a single question on a 5-point Likert response scale, with 1 indicating unsatisfied and 5, very satisfied.

Content Validity Measurement of the Sf-FAOS

Content validity is the accuracy with which a scale represents patients' perceptions of the relevance or importance of the questions. To measure content validity, patients rated each question as 1 (not relevant), 2 (somewhat relevant), or 3 (very relevant) (7). The average score for each subscale was calculated.

Study Design

From our hospital's electronic medical record system, we identified patients who had undergone first MTP arthrodesis from January 1, 2011 to December 31, 2015. Patients were included in the present study if hallux valgus had been the indication or part of the indication for surgery, they had completed both the preoperative sf-FAOS scale and the modified AOFAS-HMI scale, the surgery had been performed by the same senior author (H.-L.X.), and the follow-up period had been ≥ 12 months. The patients' demographic information, preoperative sf-FAOS and modified AOFAS-HMI scores, and operative techniques were obtained by a review of the medical records. The postoperative sf-FAOS and modified AOFAS-HMI scores and patient satisfaction scores were obtained at the most recent follow-up clinic visit. The patients were asked to complete the sf-FAOS scale a second time 1 month after their final follow-up examination

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