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A review of surgical outcomes of the Lapidus procedure for treatment of hallux abductovalgus and degenerative joint disease of the first MCJ

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Abstract

Background: The modified Lapidus procedure has been used to treat hallux abducto valgus and degenerative joint disease of the first metatarsocuneiform joint for many years. Historically, the Lapidus has been associated with poor satisfaction due to complications such as non-union. The aim of this study was to review the surgical outcomes of 18 patients using the validated Foot Health Status Questionnaire (FHSQ). The four domains within the FHSQ were all investigated. Pre and post operative angular measurements were also reviewed.
Results: The results of the FHSQ were positive for all four domains, with foot pain having the greatest change. Only two complications were recorded: one poor pain control and one post operative bleed and all 18 patients went to osseous union. Radiographically the mean intermetatarsal angle improved by 7.8° and HAV angle by 22.9. A positive association was also demonstrated between validated 'Minimal Important Difference' (MID) scores.
Conclusion: The Lapidus is a valuable procedure that can have few complications and high levels of patient satisfaction.

Keywords: Lapidus; First MCJ fusion; FHSQ; HAV

1. Introduction

In 1911, Albrecht first described arthrodesis of the first metatarsal cuneiform joint (MCJ) as treatment for hallux valgus [1]. This was followed by Truslow in 1925 who favoured a wedge resection etc. to correct the metatarsus primus varus, which he advocated the hallux abducto valgus (HAV) came secondary too. Kleinberg revisited the procedure thereafter and proposed that the obliquity of the first metatarsocuneiform joint and transverse alignment of the remaining tarsometatarsal joints must be considered. Therefore, to correct the HAV, the tarsometatarsal joints must be addressed. Kleinberg undertook a double wedge resection to allow the first and second metatarsals to be orientated parallel to one another [2]. The procedure was eventually popularised by Lapidus in 1934 following his publication on the aetiology and surgical technique, and further articles discussing the rationale for the procedure. He believed that certain types of HAV deformity occur due to an atavistic trait, whereby the metatarsal is adducted due to an arrest of ontogenic development. Lapidus described fusion of the first MCJ and fusion of the base of the first metatarsal to the base of the second metatarsal [1]. Since the work by Lapidus there have been numerous modifications to the procedure, primarily by omission of the arthrodesis of the first and second metatarsals, and although historically the procedure has been considered technically demanding with high complication rates, particularly non and delayed union, modified fixation techniques have been successful in reducing such complications [3–5].

Lapidus is indicated for the treatment of moderate/severe HAV, an intermetatarsal angle of 15° has been an arbitrary level deemed appropriate. However, patients with lower intermetatarsal angles and concomitant metatarsus adducts or a long first metatarsal, hypermobility of the first ray and degenerative joint disease (DJD) of the first metatarsocuneiform joint (MCJ) may also benefit from this procedure [2]. Several studies have been undertaken to investigate the effectiveness of the Lapidus, but few have used validated outcome measurement tools [3,5,6]. The purpose of this study was to

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undertake a review of the surgical outcomes of the Modified Lapidus procedure using a validated outcome measurement tool—the Foot Health Status Questionnaire (FHSQ). The FHSQ is a self-reporting questionnaire specifically designed to measure foot health related quality of life [7]. Developed in Australia in 1996, the FHSQ has been validated (content, criterion, construct validity) across an extensive range of foot pathologies. It covers eight domains, with four foot specific domains; Foot Pain, Foot Function, Footwear and General Foot Health. Each domain has a series of questions, with a succession of responses (e.g. none, very mild, mild, moderate, and severe); the participant circles the most appropriate response. The score for each question is then entered into a computer program, which transforms the raw results into the scores ranging from 0 to 100 with 100 representing the best scenario and 0 the worst [8,9]. Although an increase in the score of a domain following surgical intervention represents a mathematical improvement, which can be used for statistical analysis, it may not directly correlate as a perceived benefit by the patient. Therefore, it is possible that a statistically significant change may be directly incorrectly correlated with a clinically relevant change to the patient. The amount of change necessary to be interpreted as of significance to the patient, and therefore establish whether results have clinical importance is known as the 'minimally important difference' (MID). Until recently the MID within each of the FHSQ domains had not been quantified and thus the clinical significance of changes in domain scores was unknown. Landorf and Radford with regards to the FHSQ found minimal important differences for pain of 14 points, i.e. an improvement in pain of 14 points, foot function 7 points and general foot health of 9 points. These values represent those that the participants of Landorf's study indicated as being significant enough for them to detect, and thus allow more meaningful interpretation of data obtained from the FHSQ tool [10].

2. Materials and methods

Between July 2002 and April 2007 18 patients underwent a Lapidus for correction of HAV deformity and 1st MCJ DJD. The same principal surgeon SAM etc. performed all surgery. Indications for surgery were based on failure of conservative management, symptomatic moderate or severe HAV deformity, first ray instability or symptomatic degenerative joint disease at the 1st MCJ. DJD was diagnosed following clinical and radiological examination. Clinically these joints were painful through range of motion, often with palpable dorsal or medial osteophytes present; this was supported radiologically by features indicative of DJD such as joint space narrowing, osteophytes and subchondral sclerosis. Eleven patients underwent ancillary procedures (Table 1). Six patients had general anaesthesia; the remainder eleven patients had local anaesthesia by ankle blocks. For post operative pain control all patients had a popliteal block, and standard analgesia. Patients had a mean follow-up of 29 weeks. None of the patients within the study had undergone previous HAV or first ray procedures.

Table 1
Additional surgical procedures

Procedure	Number of patients
IPJ fusion of hallux + digital arthroplasty	1
Akin	5
Akin + digital arthroplasty	1
Akin + multiple arthroplasties	1
Tailors bunion by lesser metatarsal osteotomy	1

The methods used for data collection included the FHSQ, and a patient satisfaction survey, clinical examination and plain weight bearing radiographs. The patient satisfaction survey used is the third part of the Podiatric Audit of Surgery and Clinical Outcome Measurement System (PASCOM). This system has been implemented nationally since 1997. The survey is divided into four domains, covering patient understanding, post operative service delivery, improvement in the foot condition and patient critical assessment. An overall score is obtained which gives an indication of satisfaction [11]. Approval from the institutional review board—Solihull NHS Care Trust and clinical governance for data collection, including FHSQ, Pascom and radiographic measurements, has been obtained for all surgical practices within the department. For security measures collated data are stored on double password protected NHS computers, patient anonymity is preserved by use of patient identification number and date of birth. Patients were asked to complete the FHSQ pre operatively (on the day of surgery) and post operatively. The patient satisfaction survey was completed post operatively. The questionnaires are handed out and collected by the nursing team, at the time of completion patients are given the opportunity to offer verbally informed consent for the collected data to be utilised in future studies such as this one. The following radiographic measurements were taken: Hallux abductovalgus angle (HAV), Intermetatarsal angle, Proximal articular set angle (PASA) and Metatarsal distance. The bisection of the first metatarsal was obtained using the method as approved by Schneider et al., whereby the longitudinal axis is defined by a line drawn from the centre of the metatarsal head, through the base of the first metatarsal, as this method has been found to be least dependant on all anatomic variations and surgical alterations of the first metatarsal and therefore provides the most accurate form of measurement [12].

3. Surgical procedure

The patient was placed supine with an ankle tourniquet. A medial incision was made over the first metatarsophalangeal joint (MTPJ) extending proximally over the MCJ. The 1st MTPJ was exposed and a lateral release was undertaken. The 1st MCJ was exposed and the articular cartilage was removed from the opposing surfaces of the 1st MCJ. The first metatarsal was re-aligned reducing the intermetatarsal

Table 2
FHSQ scores

	Pre operative mean, median, (range), S.D.	Post operative mean, median, (range), S.D.	No of patients exceeding MID ($n = 18$)	Statistical significance (P-value)
Foot pain score	44.3, 48.1, (6.25–78.75), 19.6	74.6, 78.1, (31.25–100), 17.6	17	0.0001
Foot function	51.2, 50, (12.5–87.5), 22.2	71.2, 75, (12.5–100), 25.2	12	0.01
General foot health	29, 25, (12.5–75), 27.3	56.5, 60, (25–100), 30.7	13	0.01
Shoe score	22.2, 25, (16.7–50), 15.9	38, 25, (8.3–100) 28.3		Not significant

angle, care being taken to ensure correction occurred in both the transverse and sagittal planes. Once the preferred alignment was achieved, to facilitate arthrodesis the joint surfaces were fenestrated. The first metatarsal and medial cuneiform were then repositioned and provisional fixation was applied. Once the MCJ fusion had been completed the medial eminence from the head of the first metatarsal was resected. Only once the metatarsal has been re-aligned can the surgeon accurately determine the amount that needs to be removed from the head, undertaking this prior to the Lapidus risks over zealous removal. Different methods of compression fixation for the 18 cases were achieved by several techniques including cannulated lag screws, staple and plates (Fig. 1). The wound was closed in layers. Post operatively the patient was maintained non-weight bearing with a below knee cast until radiographic evidence of osseous union, but for minimum of six weeks. The patient was reviewed regularly until completion of healing and to point of discharge.

4. Results

A total of 18 patients were reviewed for this study. Of these 15 were female and 3 male. The average age at surgery was 39 years (range, 17–66 years, S.D. ±17.7). Peri operative complications included one poor pain control and one post operative bleed, on the patient satisfaction questionnaire; these had been recorded by the patients as minor problems. The mean post operative period was 29 weeks (range, 15–94 weeks, S.D. ±17). At 12 weeks post operation all 18 patients had osseous union. No correlation was found between type of fixation used and outcome of FHSQ or patient satisfaction survey.

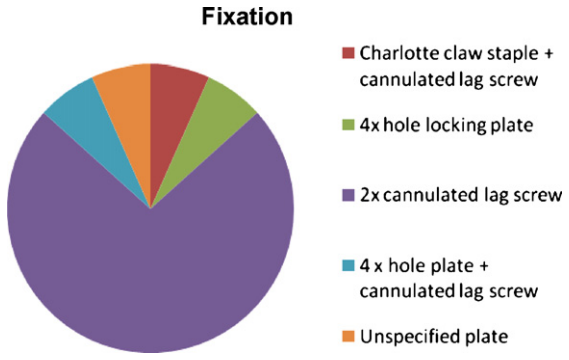

Fig. 1. Fixation for Lapidus.

Table 3
Would you be prepared to have surgery again?

Question answers	Number ($n = 18$)	%
Yes	14	77.8
No	0	0
Not answered	4	22.2

4.1. Results of FHSQ

The results of the FHSQ for the four-foot-specific domains are shown in Table 2. The MID was identified for the foot pain, foot function and foot health domains, by comparing the values obtained in this study against the threshold values set by Landorf (Table 2). Foot pain had the greatest increase in score, with a mean increase of 30.3, 17 out of the 18 patients in this domain had MIDs greater than 14 points, which represents the MID for this domain. General foot health improved by an average of 27.6, from this domain 13 of the 18 patients had improved by 9 points, which represents the MID for this domain. Foot function had an average improvement of 20 points, with 12 out of the 18 having increased scores by more than 7, which represents the MID for this domain. The lowest change in mean score was in the footwear with an average difference of 15.8, there is no MID for this domain. The scores relating to physical activity also improved from the pre operative scores whereby the mean score was 61.4 increasing to 71.9 post operatively, an average increase of 10.5. The pre and post operative scores were assessed for significance using Mann–Whitney test, which is appropriate for non-parametric data (Table 2).

4.2. Patient satisfaction results

From the patient satisfaction survey 14 patients (77.8%) would be prepared to have the same surgery again, the remaining 4 failed to complete and left blanks (Table 3). Regarding whether expectations were met, 11 (61%) answered yes, 2 only in part and 1 answered no, again 4 patients failed to complete (Table 4). The question relating to improvement in

Table 4
Were your expectations met?

Question answers	Number ($n = 18$)	%
Yes	11	61
No	1	5.6
In part	2	22.2
Not answered	4	11.1

Table 5
Results of radiographic measurement

Radiographic measurements	Pre operative mean score, (range), S.D.	Post operative mean score, (range), S.D.	Statistical significance (*P*-value)
HAV angle (°)	36.6, (13–54), 12	13.7, (4–26), 5.8	0.01
Intermetatarsal angle (°)	16.1, (9–20), 3.8	8.3, (5.5–13), 2.6	0.003
Metatarsal distance (mm)	13.2, (7–17), 3.4	6.9, (4–12), 2.3	0.0003
PASA angle (°)	29.5, (1–48), 14.5	7.1, (−5–19), 7.2	0.1

foot condition resulted in 7 patients responding 'better', 5 'much better', 1 the same and 1 worse.

4.3. Radiographic results

The mean intermetatarsal angle preoperatively was 16.1° (range, 9–20), and post operatively 8.3° (range, 5.5–13). The mean hallux valgus angle preoperatively was 36.6° (range, 13–54), and post operatively 13.7° (range, 4–26). The mean metatarsal distance improved from 13.2 to 6.9 mm. A marked improvement in the PASA was found from a mean of 29.5° pre operatively to 7.1° post operatively; however, unlike the other angular measurements this was not found to be statistically significant (Table 5, Fig. 2).

5. Discussion

Whilst the results of the Lapidus procedure, either through prospective, retrospective or critical evaluation studies have been well reported in the literature, few studies have been undertaken using a validated outcome measurement tool. In addition more meaningful data were obtained by using the MID, which no paper has yet to report in relation to results of the Lapidus procedure. The FHSQ has many advantages including it being sensitive to change, patient focused and an independent tool which reduces bias.

The results of the FHSQ were all positive, with each domain showing an increase in score post operatively compared to the pre operative score. Of the four domains foot pain had the greatest change in score, followed by general foot health, and foot function. The lowest change was footwear with a difference of 15.8 points. Despite the average follow-up being 29 weeks the results from this study have significance and are of value, due to the fact that even at this relatively early stage the results of the MID calculations showed that the majority of patients within this study were all able to perceive a clinically important and beneficial difference.

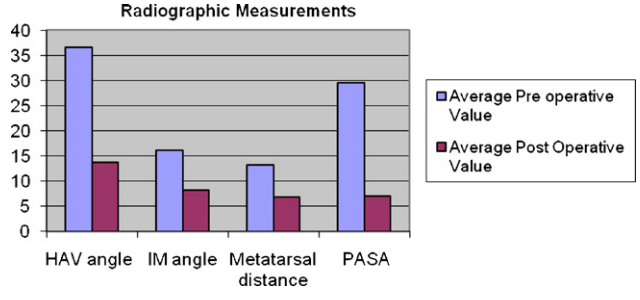

Fig. 2. Radiographic measurements average pre and post operative values.

Radiographically our study revealed a mean correction of IM angle of 8.3°, and average improvement of the HAV angle of 13.7°. In comparison to the literature whereby the method and its validity for taking the radiographic IM and HAV angles was not declared, this study used a tried method which in comparison to four other methods was found to be most accurate [12]. The critical evaluation of the modified Lapidus undertaken by McInnes et al. reviewed results of eight publications. The results from this study compare favourably regarding angular correction. McInnes found the average post operative IM angle to be 8.2, with the range being 2.1–17°, from this study the mean post operative angle was 8.3 with a range of 5.5–13°.

Comparison of patient satisfaction is difficult to undertake due to the various methods utilised. However, the results from the patient satisfaction survey used within this study were extremely favourable with the patients from all completed responses (14 out of 18) answering positively to the question 'being prepared to have the same surgery again'. A question by its nature certainly identifies level of patient satisfaction. The Lapidus has historically been associated with non-union levels ranging from 3.3% to 12% [3]. Our results revealed no non-unions and only two post operative complications, one being poor pain control and the second post operative bleed.

The modified Lapidus procedure provides significant correction and stability to the first ray. It results in satisfactory clinical outcomes, and therefore has a valuable place in the foot surgeons' armamentarium. The combination of meticulous operative technique, rigid internal fixation and post operative weight bearing restrictions minimises complications and ensures high patient satisfaction.

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