SERVICE EVALUATION:

A COMPARISON OF OUTCOMES OF FIRST METATARSOPHALANGEAL JOINT ARTHRODESIS IN A COMMUNITY NHS TRUST

Worldwide, osteoarthritis (OA) is a leading cause of disability (1). The prevalence of symptomatic radiographic first metatarsophalangeal (MTPJ) OA has been reported to be 7.8% (2). It has been demonstrated to decrease general health-related quality of life (HRQOL) (3), but successful treatment strategies are available

The aim of first MTPJ arthrodesis is to resolve the pain associated with end-stage arthritis at the first MTPJ (4). First MTPJ arthrodesis is recommended where conservative measures, such as orthoses and cortisone injections, have failed to provide sufficient pain relief, and where the arthritis is too extensive for salvage procedures, such as cheilectomy or decompressive osteotomy (5-7).

Many authors consider that fusion is the gold standard for joint destructive procedures (8, 9), and implant or resectional arthroplasty are measured against this (10, 11). That said, there is no standard arthrodesis operation technique (12). Debate exists regarding the best bone preparation or fixation technique, with the current literature providing no overriding evidence of an optimum procedure with regard to complication rates, patient-reported outcome measures (PROMs) or patient satisfaction (13, 14). Some studies have advocated immediate weight-bearing after first MTPJ arthrodesis (15, 16).

Northamptonshire Foundation NHS Trust (NHfT) utilises a neutralisation plate and compression screw for first MTPJ arthrodesis, which, coupled with the use of plantar padding and a surgical walking shoe, is felt sufficient to facilitate early weight-bearing. This is done to minimise the inherent risks of prolonged immobility, such as VTE, stiffness, compartment syndrome and pressure sores (17-19).

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METHODS

Service evaluation

The authors present a service evaluation that compares outcomes of first metatarsophalangeal joint (MTPJ) arthrodesis at NHfT against national podiatric surgery data (20), including complication rates (see Table 1), and two different PROMs: the Manchester–Oxford Foot Questionnaire (MOXFQ) (21) and the Patient Satisfaction Questionnaire (PSQ-10) (22).

The MOXFQ is a well-validated questionnaire that assesses the outcomes of foot and ankle surgery in three domains – Walking-Standing (WS), Social Interaction (SI), and Pain (P) (21). It comprises 16 questions divided over the three domains, and constitutes a reliable means of comparing surgical outcomes from the patient perspective (23). The PSQ-10 takes a more comprehensive approach to patient-reported

outcome evaluation, covering a range of topics including initial expectation, quality of communication, post-operative services, surgical outcome, and their overall assessment (24). This is less comprehensively studied than the MOXFQ (1, 23, 25), but may yield information on aspects of treatment that the MOXFQ does not address.

SURGICAL TECHNIQUE

The basic arthrodesis procedure that is undertaken at NHfT is described below. The surgery was undertaken by the consultant podiatric surgeon, podiatric surgery registrar or trainee podiatric surgeon under supervision.

A dorsal incision approach is employed. A full-thickness arthrotomy is undertaken, with release of the collateral ligaments and the sesamoid apparatus with the McGlamry elevators, if required, to allow full exposure of the joint (9).

Osteophytes surrounding the first MTPJ are removed. The articular cartilage is meticulously denuded from the head of the first metatarsal and the base of the proximal phalanx and cancellous bone exposed using Coughlin-style reamers. No bone graft is employed as standard (26); however, any minor local defects or cyst are filled with bone taken from the reamers (14). The arthrodesis is angled at roughly 10-15 degrees of dorsiflexion and 5-10 degrees of abduction, to suit the patient's anatomy, in order to avoid impingement on the adjacent toe (5, 27). A guide wire is inserted from medial proximal phalanx to lateral metatarsal head in order to stabilise the joint, whilst fixation is achieved.

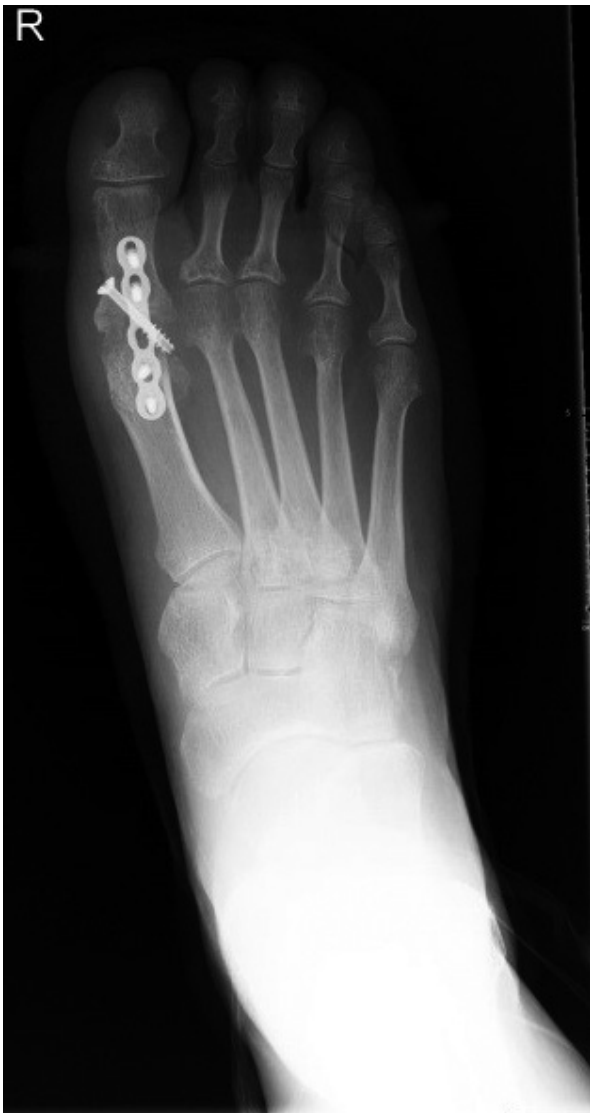

Figure 1. Neutralisation plate with 4.0 mm lag screw. AP view

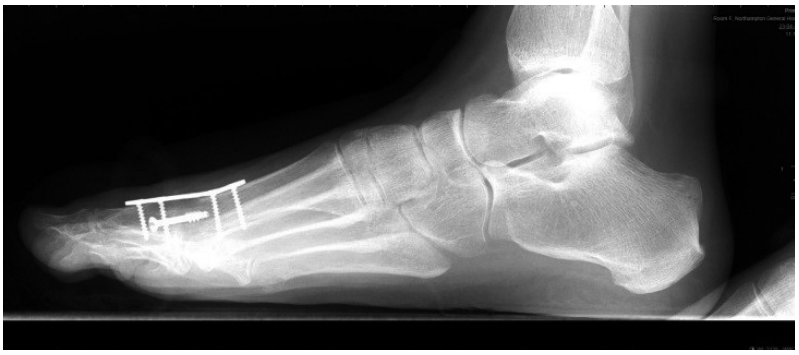

Figure 2. Neutralisation plate with 4.0 mm lag screw. Lateral view.

Fixation is achieved with a 4.00mm cannulated lag screw and a neutralisation plate (M3X). The plate protects the phalanx from rotational and shear forces, whilst the screw offers interfragmentary compression across the fusion site (22,28), (see Figures 1 & 2). It is felt the plate adds strength and allows for the early weight-bearing employed within NHfT. Stability of fixation is confirmed peri-operatively, by passively stressing the fixation prior to wound closure (12). The wound is then irrigated with saline and closed in layers (12). Fluroscopy guidance is used to confirm the fixation position post-operatively.

POST-OPERATIVE MANAGEMENT

Standard wound dressings are utilised with the addition of plantar metatarsal head padding to offload the hallux, with suture removal at 14 days. Patients are allowed immediate mobilisation without casting in a stiff-soled post-operative shoe (Benefoot) with full weight-bearing. Standard post-operative advice regarding post-surgical complications, including VTE prevention advice is issued (29).

NHfT provides post-operative analgesia via Patient Group Directive for first-ray surgery dependent on the patients' medical history and current prescribed medications (29). The standard post-operative analgesia regime is co-codamol 30/500mg 1-2 QDS and diclofenac 50mg TDS (PRN).

POST-OPERATIVE REVIEW

A six-week review is undertaken, with repeat anterior-posterior and lateral view weight-bearing plain films, to assess for progression of fusion. The consultant podiatric surgeon at the service evaluation unit confirms fusion, which is considered achieved if there is an absence of tenderness at the arthrodesis site, both on palpation and upon passive stress testing of the fixation site – in combination with radiographic evidence of trabeculae traversing the arthrodesis site on both X-ray views (30). Patients are then reviewed and discharged at six months, after a final review and noting of PROMs, if all is satisfactory.

DATA COLLECTION AND ANALYSIS

PASCOM-10 (Podiatric and Surgical Clinical Outcome Measurement) is a web-based database of podiatric procedures and outcomes, which allows retrospective report generation. Participation is mandatory among podiatric surgery units.

Following approval from the NHfT NHS Research and Development Office, reports on the outcomes of first MTPJ arthrodesis at NHfT via the PASCOM-10 database from 1 January 2013 to 31 December 2015 were analysed. The outcomes reported included complication rates and two patient-reported outcome measures (PROMs); the Manchester Oxford Foot Questionnaire (MOXFQ), and Patient Satisfaction Questionnaire (PSQ-10). The PROMs were completed pre-operatively, on the day of surgery, and post-operatively at 6-month review. Complications/sequelae were recorded by the

Complication/Sequela	National (%)	Trust (%)	Fisher's Exact Test p-value	Bonferroni corrected
Callus formation or intractable plantar keratosis	16 (0.42%)	0 (0%)	1.00	1.00
Footwear return <3/12	1 (0.02%)	0 (0%)	1.00	1.00
Sensory loss small	10 (0.26%)	1 (2.17%)	0.13	1.00
Post-operative nausea and vomiting	9 (0.23%)	0 (0%)	1.00	1.00
Transfer metatarsalgia	33 (0.87%)	0 (0%)	1.00	1.00
Healing: wound dehiscence	98 (2.59%)	3 (6.52%)	0.12	1.00
Infection: suspected/not proven	96 (2.54%)	2 (4.34%)	0.33	1.00
Pain: excessive post-treatment pain (first 72 hours)	28 (0.74%)	0 (0%)	1.00	1.00
Healing: scar line hypertrophy may not be painful	65 (1.72%)	4 (8.69%)	0.01	0.26
Metatarsal fracture	17 (0.45%)	0 (0%)	1.00	1.00
Fixation problem: fracture of fixation, failure or implant rejection	19 (0.5%)	0 (0%)	1.00	1.00
Fixation problem: removal required	20 (0.53%)	2 (4.34%)	0.03	0.82
Swelling	70 (1.85%)	1 (2.17%)	0.58	1.00
Pain: surgical site beyond six weeks	51 (1.35%)	2 (4.34%)	0.13	1.00
Healing: stitch abscess or suture reaction	32 (0.84%)	0 (0%)	1.00	1.00
Healing: necrotic damage requiring secondary intervention	1 (0.02%)	0 (0%)	1.00	1.00
Healing: avascular necrosis	0 (0%)	0 (0%)	1.00	1.00
Healing: wound breakdown, surgery may be required	6 (0.15%)	1 (2.17%)	0.08	1.00
Healing: bone union delay	11 (0.29%)	0 (0%)	1.00	1.00
Deep vein thrombosis proven	6 (0.15%)	1 (2.17%)	0.08	1.00
Surgery failed or reoccurrence	58 (1.53%)	0 (0%)	1.00	1.00
Haematoma	13 (0.34%)	1 (2.17%)	0.16	1.00
Iatrogenic toe deformation following surgery, e.g. hallux varus	11 (0.29%)	0 (0%)	1.00	1.00
Infection: proven	29 (0.76%)	1 (2.17%)	0.31	1.00
Infection: osteomyelitis	1 (0.02%)	0 (0%)	1.00	1.00
Healing: skin necrosis	4 (0.1%)	0 (0%)	1.00	1.00
Pain: complex regional pain syndrome (type I or II)	5 (0.13%)	0 (0%)	1.00	1.00
Pulmonary embolism	4 (0.1%)	0 (0%)	1.00	1.00
Healing: ischaemia/necrosis	1 (0.02%)	0 (0%)	1.00	1.00

Table 1. Complication rates across National and Trust datasets, and statistical analysis

PROMs	Average (Standard deviation)		Difference (95% CI)	p-value (t-test)
	Trust	National		
Walking-standing pre-treatment scores (MOXFQ)	59.39 (19.02)	54.13 (24.99)	5.26 (-2.42 — 12.94)	0.18
Walking-standing post-treatment scores (MOXFQ)	14.12 (18.80)	17.50 (23.57)	-3.38 (-10.63 — 3.86)	0.36
Social Interaction pre-treatment scores (MOXFQ)	48.91 (22.42)	48.77 (24.26)	0.14 (-7.32 — 7.60)	0.97
Social Interaction post-treatment scores (MOXFQ)	11.10 (16.49)	13.21 (19.86)	-2.11 (-8.22 — 4.00)	0.50
Pain pre-treatment scores (MOXFQ)	59.76 (16.12)	55.94 (20.66)	3.82 (-2.53 — 10.17)	0.24
Pain post-treatment scores (MOXFQ)	18.05 (19.00)	21.24 (21.82)	-3.19 (-9.90 — 3.52)	0.35
PSQ-10 scores	86.57 (9.75)	87.23 (12.97)	-0.66 (-4.51 — 3.18)	0.73

Table 2. PROMs across National and Trust datasets, and statistical analysis.

reviewing clinician at 6-month review. All sets of data were then inputted onto PASCOM-10.

The lead author utilised national aggregated PASCOM-10 data (2013–2015) for all podiatric surgery procedures as a baseline for service efficacy (20). These data are available publicly via the PASCOM-10 National Data Reports, whilst national procedure-specific data require 'webmaster' access, which the lead author did not have (31). This practice was adopted by Rothwell *et al* in their audit of complication rates for Chevron and Akin osteotomies, supporting the validity of this method (32).

Complication rates for first MTPJ arthrodesis at the Trust were compared with complication rates for podiatric surgery in general nationally using Fisher's Exact Test. Correction for multiple testing was done by the Bonferroni method (33). The aggregated data from 2013-2015 were analysed together as one dataset to enhance statistical power, as the authors had no reason to believe that there has been a significant change in practice in this time. Analysis was performed in R3.3.0, through the RStudio 0.99.902 Integrated Development Environment.

MOXFQ and PSQ-10 scores at the Trust were aggregated over the 2013–2015 period, and compared with published summary statistics of national data over the same period. The comparison was performed using a T-test. This analysis was performed using the web-based tool GraphPad QuickCalcs, accessed 25 May 2017.

RESULTS

There were 57 procedures of first MTPJ arthrodesis carried out between 2013 and 2015.

Complication rates

Complication rates were compared across a range of different complications collected by PASCOM-10 in first MTPJ arthrodesis (Table 1). After correction for multiple comparisons by the Bonferroni method, there was no statistically significant difference in complication rates between the national data from 2013 to 2015, and Trust data over the same period. It should be noted that none of the following serious complications were observed at NHfT: surgery failure, bone healing delay, avascular necrosis, osteomyelitis or skin necrosis.

Patient-reported outcome measures

There were 41 responses at the Trust for the MOXFQ and PSQ-10 between 2013 and 2015. Nationally, there were 7402 responses for the pre-treatment MOXFQ questionnaire, but only 7291 responses post-treatment. There was no statistically significant difference between the post-treatment MOXFQ scores of the National and Trust datasets, across all three domains of the questionnaire (Table 2). There was also no statistically significant difference in the pre-treatment scores, indicating a comparable baseline.

Nationally, there were 8281 responses for the PSQ-10 questionnaire (31). There was also no statistically significant difference in PSQ-10 scores between the two groups (Table 2). PSQ-10 distribution score results of 86.29 were achieved, with 95.4% episodes of care being reported by patients as having made their original foot problem better or much better, indicating excellent patient satisfaction.

DISCUSSION

This service evaluation demonstrated not only low complication and high patient satisfaction via patient-reported experience measures (PREMs) and PROMs for first MTPJ arthrodesis at NHfT, but also nationally for podiatric surgery across all the procedures (see Tables 1 & 2). This concurs with the Maher and Metcalfe consecutive case audit of first MTPJ arthrodesis for severe hallux rigidus, which reported no post-operative complications, albeit it was a small sample (n=29) (34).

It should be noted that there is a trend for the NHfT pre-treatment MOXFQ scores to be higher and post-treatment MOXFQ scores to be lower than the PASCOM-10 dataset (see Table 2). This does not reach statistical significance, but could be considered to suggest that adoption of the NHfT practices, as outlined in the Methods, could enhance outcomes nationally. It is acknowledged that this service evaluation has several limitations. PASCOM-10 is run by the College of Podiatry on a goodwill basis, due to the need for podiatry to equip itself with the tools to demonstrate to the commissioners our service efficacy. However, on a national basis, PASCOM-10 currently lacks the ability to undertake procedure-specific analysis, as the invasive domain includes procedures such as steroid injections, which are not going to cause complications, such as delayed

non-union that may occur with first MTPJ arthrodesis. This could have skewed the current findings.

It should be noted that NHfT only had a 72% and 77% response rate for the MOXFQ and PSQ-10 respectively. It is acknowledged that, due to the anonymous nature of PASCOM-10, loss to follow-up information cannot be accurately determined and, as such, self-selection response bias may occur.

Further, PASCOM-10 is currently only a short-term clinical analysis tool, with patients being discharged at 6 months. It does not provide a facility to undertake long-term follow up that may demonstrate issues, such as first interphalangeal and metatarso-cuneiform osteoarthritis, which has been purported to be an issue (5). As such, our next service evaluation will be a longer term follow up of a cohort of patients comparing early (six month) and later MOXFQ and PSQ-10 outcomes.

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