

Podiatric surgery and the diabetic foot: a retrospective cohort study of community-based diabetic foot surgery

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Key words

- Community
- Diabetic foot
- Local anaesthetic
- Multidisciplinary team
- Outcomes
- Podiatric surgery

Article points

1. Integrating podiatric surgery into an established diabetic foot MDT improved patient outcomes and halved the minor amputation rate.
2. The use of local antibiotic carriers shows promise in reducing diabetic foot infections but requires further research.
3. Day case podiatric surgery for people with non-acute, non-ischæmic, diabetic foot ulceration and/or infection can be performed safely under a local anaesthetic in a community setting.

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Diabetic foot multidisciplinary teams (MDT) have been shown to improve incidence and risk reduction in foot ulceration and decrease major lower-limb amputation. This Podiatric surgery team is part of a community-based foundation trust offering day-case foot surgery under a local anaesthetic. It has recently been integrated into an established diabetic foot MDT. Aims: To compare the outcomes from two cohorts who received diabetic foot surgery for the treatment or prevention of diabetic foot ulceration and/or infection before and after integration into an established diabetic foot MDT. Methods: A retrospective cohort study comparing outcomes between April 2014–November 2016, and January 2022–August 2023. A Microsoft Excel database was used to record the outcomes of interest, which included the number of referrals, demographics, surgical procedures, ulcer healing rates, complications, and whether the patient was subsequently discharged from the diabetic foot MDT clinic. Results: There was a 72% increase in referrals received in 2022/23 (179) compared to 2014/16 (104). A total of 253 procedures were performed compared to 74 in 2014/16. 92% of wounds healed in 2022/23, compared to 85.9% in 2014/16. 83% were discharged from the MDT compared to 70% in 2014/16. 73.4% of admissions resulted in healing without complication, compared to 67.5% in 2014/16 and the minor amputation rate halved over the 6-year period. Conclusion: The integration of a podiatric surgery team into an established diabetic foot MDT has improved surgical outcomes and increased the number of patients discharged from the MDT.

In 2013, a community-based podiatric surgery department was invited to join an established outpatient diabetic foot multidisciplinary team (MDT). During the initial wave of the COVID-19 pandemic in 2020, in-patient diabetic foot care changed, with vascular surgeons taking the lead role in their management and establishing the diabetic foot MDT as it stands today, with consultant endocrinologists, consultant vascular surgeons, specialist diabetes podiatrists, and a specialist vascular nurse who meet weekly via Microsoft Teams. There is a separate weekly radiology meeting to discuss imaging. Microbiology and orthopaedic opinions are available on request.

Since January 2022, a consultant podiatric surgeon has been attending the diabetic foot MDT clinic. This results in surgical referrals to the podiatric surgery team to assist with the management of patients with chronic infection, necrosis, and ulceration who are ultimately at risk of below-knee amputation and early death (Armstrong et al, 2017).

Diabetic foot MDTs have been shown to improve incidence and risk reduction in foot ulceration and decrease major lower limb amputation (Khan and Sapsed 2017).

People at risk of diabetic foot problems are offered prompt podiatric surgery with the intention of improving outcomes, minimising in-patient

hospital admissions, supporting wound healing, and subsequently discharging these people from the diabetic foot MDT onto the foot protection team.

Materials and methods

The first cohort originates from a previous study by Maher and Bond (2017), who published an audit of referrals from the diabetic foot MDT to the podiatric surgery department between April 2014 - November 2016. This study has recruited a second cohort from the referrals received from the same diabetic foot MDT over a comparable 18-month period between January 2022 – August 2023. See *Table 1* for referral criteria.

A secure password-protected Microsoft Excel spreadsheet held on an encrypted drive was used to log all referrals from the diabetic foot MDT by a single researcher and included NHS number, age, gender, referral date, and foot problem. Additional data was added to the spreadsheet throughout the perioperative period, such as duration of ulcer, procedure, complications, wound healing, weeks to wound healing, toe pressure from the operated foot, and whether the patient was subsequently discharged from the diabetic foot MDT.

Results

Over the 18-month audit period (January 2022 to August 2023), the Podiatric Surgery team received 179 referrals for high-risk people with diabetes compared to 104 in the first cohort, a 72% increase.

Of the 104 referrals in 2014/16, 64 patients attended on 74 occasions compared to 86 patients attending for surgery on 113 occasions. *Table 2* outlines the reasons for patients not going ahead with surgery in 2022/23 following referral.

50 of the 64 patients (78%) in the first cohort were male, compared to 59 of the 86 patients (69%) in the second cohort. The average age was 60 (32–89) years in the first cohort compared to 61 (range 30–86) years in the second. A total of 109 procedures were performed in 2014/16 compared to 253 procedures in 2022/23 (*Table 3*), with a mean of 1.47 procedures per patient compared to 2.9 per patient, respectively.

Using Armstrong and Frykberg's (2003) definition, 4 (3.7%) procedures were classed as elective surgery in the first cohort and 5 (1.8%) in the second, 4 (3.7%) versus 51 (20.2%) prophylactic, and

Table 1. Referral criteria.

• Failed to respond to conservative care
• Non-healing neuropathic ulceration of the foot
• Infected foot ulceration / osteomyelitis
• Foot deformity
• Patient amenable to surgery under a local anaesthetic
• Patient can arrange own transport to and from appointments
• Toe pressure above 60mmHg
• Adequate home support
• Systemically stable
• Ambulatory
• No infection beyond the site of surgery
• Elective, prophylactic, or curative surgery (non-emergent)

Table 2. Reasons for not going ahead with surgery.

Reasons	Patients (n)
Declined/continuing conservative care	18
Ulcer healed/significant improvement	13
Did not attend	10
Treatment deferred	7
No home support	3
General anaesthetic requested	1
Deceased	2
Peripheral arterial disease	5
Unstable health/significant deterioration	7
Total	66

66 (60.6%) versus 197 (77.9%) curative. 25 of the 109 (22.9%) procedures in the first cohort and 30 of the 253 (11.9%) procedures in the second cohort were full or partial toe amputations, an 11% reduction.

The mean duration of ulceration was 52.8 weeks (range 2–534) in the first cohort and 36.1 weeks (range 3–129 weeks) in the second. 85.9% of patients who attended with ulceration healed in 2014/16 and 92% in 2022/23, and 44 (70%) and 71 (83%), respectively, were subsequently discharged from the Diabetic Foot MDT Clinic. 50 (67.5%) admissions resulted in healing without complication in the first cohort and 83 (73.4%) in the second. Four patients were lost to follow-up in 2014/2016 and two in 2022/2023. *Table 4* summarises the post-operative complications.

Table 3. Surgical procedures.

Procedure	2014–2016	2022–2023
Digital amputation	25	30
Ulcer debridement excision	21	30
Lesser toe arthroplasty	12	12
Hallux arthroplasty	11	5
Local antibiotic carriers	11	43
Exostectomy	9	4
Soft tissue excision	6	0
Isolated bone biopsy	4	21
Metatarsal resection	3	22
Osteotomy	2	0
Nail avulsion	2	5
Hallux IP joint arthrodesis / Jones suspension	1	0
Sesamoid excision	1	4
Tenotomy	1	57
Distal metatarsal minimally invasive osteotomy	0	7
Achilles tendon lengthening	0	4
Forefoot tendon lengthening/transfer	0	3
1st MTP joint arthrodesis	0	2
Hallux varus repair	0	1
Incision and drainage	0	1
Fixation removal	0	1
Peroneal tendon transfer	0	1
Total	109	253

Table 4. Post-operative complications.

Complication	2014–2016	2022–2023
Ulcer at new location	10	11
Revision surgery to achieve wound healing	2	8
Post operative infection	7	5
Recurrent ulcer	3	5
Prolonged swelling of hallux	0	1
Immune reaction to flucloxacillin	1	0
Total	23	30

Discussion

Diabetes and integrated care

Diabetes is a major public health problem that has reached epidemic proportions globally, with an estimated 537 million adults living with diabetes

in 2021, a three-fold increase over the last 20 years, and this upward trend is predicted to continue (IDF Diabetes Atlas, 2021). To tackle large-scale problems like this in the UK, the government has introduced new legislation, the Health and Care Act (2022), to bring about significant changes to how the NHS in England is organised. Progressing integration is at the heart of this act, moving away from the previous legislative framework that promoted competition to a new framework that supports collaboration. The current economic climate dictates the need for judicious use of the current resources and creating smarter and more cost-effective ways of working. It is well recognised that community-based podiatric surgery has the potential to reduce reliance on hospital beds, in-patient stays, and costly acute sector operating theatres (Kings Fund, 1997). Triaging surgical patients to ensure those with lower medical needs are treated in the community, in turn, releases hospital specialists to concentrate on medical emergencies, such as critical limb-threatening ischaemia (Maher, 2016) and post-COVID-19 recovery (Mathew, 2021).

Integration into the diabetes MDT

Over the last 6 years, between the two cohorts of this study, the podiatric surgery team has worked hard to integrate themselves within the diabetic foot MDT with a Podiatric Surgeon attending the MDT clinic bi-monthly, the weekly MDT online meeting and consistent communication regarding patient care via clinic letters, discharge letters, emails, and telephone calls. The improved integration is likely one of the reasons for the increase in referrals (72%) from the diabetic foot MDT to the podiatric surgery team. Another explanation for the increased number of referrals could be the increased prevalence of diabetes, 6.5% (2017/17) to 7.2% (2021/22) in NHS Nottingham and Nottinghamshire ICS and the subsequent increase (estimated 2.2%) in diabetic foot ulcers (RCOP 2023).

Demographics

The average age (60 and 61 years) and gender ratio between the two cohorts was comparable and echoed those elsewhere in the literature, with the incidence of diabetic foot ulceration being at least 1.5 times higher among men than women

(Rossboth et al, 2021) likely due to underlying risk factors, access to care, screening, and adherence to treatment (McDermott et al, 2023).

Surgical procedures

There were nearly twice as many surgical procedures performed in 2022, mainly in the curative surgery category, due to the increase in needle flexor tenotomies and local antibiotic delivery systems. In the first cohort, we were keen to perform more flexor tenotomies; however, the patients were referred with more advanced changes, with a longer duration of ulceration (52.8 weeks in 2014/16, compared to 36.1 in 2022/23), necessitating full or partial toe amputation. This is reflected in the amputation rate which reduced by 11% (22.9% in 2016 to 11.9% in 2022). Due to methodological differences and inconsistent reporting of minor amputations in epidemiological studies, there is wide variation (1.2–362.9 per 100,000) in the reported prevalence of minor amputation in people with diabetes in England (Bowling, 2024); it is therefore difficult to compare our amputation rate to those reported nationally.

The number of lesser toe surgeries nearly trebled, but the number of lesser toe arthroplasties stayed the same, which suggests the low-risk flexor tenotomy procedure could be delaying the need for digital amputation. The IWGDF (Bus et al, 2023) recommends a digital flexor tenotomy to promote and sustain healing of neuropathic plantar or apical ulcers on digits two to five secondary to a flexible toe deformity.

Local antibiotic delivery carriers

The IWGDF (Bus et al, 2023) highlights the theoretical advantages of local antibiotic carriers, such as requiring a small dose at the site of infection in a higher concentration than can be achieved with systemic antibiotic therapy, thus potentially limiting issues of cost, adverse events, and antibiotic resistance. Within podiatric surgery, Morley et al (2022) conducted a retrospective cohort study of 127 consecutive cases of osteomyelitis and 10 cases of significant soft tissue infection, all including surgical debridement and application of local antibiotic-loaded calcium sulphate. They found the treatment to be safe and effective in managing complex foot infections,

with 88.3% of infections resolving. Our infection rate did reduce with increased use of local antibiotic carriers between the two cohorts, 9% down to 4%.

Complications

More patients who attended with ulceration in 2022/23 healed without complication, and more were subsequently discharged from the Diabetic Foot MDT Clinic.

The most common complication in both cohorts was an ulcer at a new location. Tenotomies can increase the prominence of adjacent toes, resulting in transfer ulcers; this risk can be eliminated by simultaneous tenotomising of all lesser toes. At the start of the 2022 study, we performed several tenotomies in isolation; we recognised the incidence of transfer ulcer early and subsequently changed our practice to treat any adjacent flexible and semi-rigid hammer, mallet, and claw toe deformities routinely.

The reoperation rate was 4% in each cohort, with 18–65% reported in the literature (Skoutas et al, 2009; Anwander et al, 2023; Seçkin et al, 2022). Anwander et al (2023) identified five risk factors for failure (defined as reoperation within 60 days) after debridement or amputation at the lower extremity in patients with diabetic foot syndrome. These included the presence of more than one ulcer, peripheral arterial disease, C-reactive protein >100mg/L, peripheral neuropathy, and nonpalpable foot pulses. The low rate in comparison to those reported nationally is likely due to the referral criteria, with a toe pressure less than 60mmHg not being suitable for surgery in a community setting as per local guidelines and the relatively short follow-up period.

Conclusion

This study has demonstrated that the integration of a podiatric surgery team into an established diabetic foot MDT has increased referrals, improved ulcer healing, lowered the amputation rate, and increased the number of patients discharged from the diabetic foot MDT clinic. The low number of complications and absence of any adverse events shows that day-case diabetic foot surgery for non-acute, non-ischæmic, neuropathic foot ulceration can be

performed safely under a local anaesthetic in a community setting. ■

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