The level of training in microbiological sampling for toe amputations in diabetic foot disease: a survey of UK vascular trainees

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Article points

1. Vascular surgery trainees report significant variation in training and usual clinical practice in tissue sampling during minor amputations for diabetic foot disease.
2. Consensus is required to ascertain the optimum microbiological sampling techniques to improve targeted antimicrobial therapy.
3. Changes in the curriculum may help to address training issues and perceived unimportance of toe amputation in vascular surgery.

Key words

- Diabetic foot disease
- Education
- Microbiology
- Toe amputation

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Foot-related complications of diabetes mellitus are a significant cause of morbidity and mortality globally. In the UK, there is significant variation in the outcomes for patients with diabetic foot infection. Management of the diabetic foot is a complex process involving many specialists and the combination of therapies including revascularisation, appropriate surgical debridement, targeted antimicrobial therapy and relieving the pressure on the foot with altered biodynamics, is crucial to reduce the risk of major lower-limb amputation and mortality. Vascular surgeons play an important role within the context of the multidisciplinary team; revascularisation, appropriate surgical debridement and minor amputation of diabetic foot infection in combination with appropriate tissue sampling to aid targeted antimicrobial therapy are all important steps to reduce the risk of lower-limb amputation and mortality. Foot debridement and toe amputations, which provide the source for most tissue samples, are not currently recognised as index procedures in the UK vascular surgery curriculum. This national survey of vascular surgery trainees identified significant variation in microbiological sampling techniques and a lack of continuing education in toe amputations. Standardisation of sampling techniques and increasing the visibility of toe amputations in the vascular surgery curriculum has the potential to improve outcomes in these patients.

Diabetes mellitus is a significant cause of morbidity and mortality, with an estimated global annual prevalence of 451 million people in 2017, which is predicted to rise to 693 million by 2045 (Cho et al, 2018). Foot-related complications affect 2–2.5% of people with diabetes, equating to a point prevalence of approximately 58,000 people in England alone (Kerr, 2019).

There is significant regional variation in outcomes for patients with diabetic foot disease within the UK (Jeffcoate et al, 2017). The National Diabetes Foot Care Audit aims to quantify these variations at an organisational level so that markers of an effective service can be identified. However, low levels of participation have so far made it difficult to draw any consensus on this (Jeffcoate at al, 2020).

The management of diabetic foot disease is complex, involving input from a foot protection team and multidisciplinary team of professionals (National Institute for Health and Care Excellence [NICE], 2019). Surgical debridement of infected tissue and antimicrobial therapy to manage infection are the two mainstays of therapy for acute foot infections. The surgical aspect of the management of diabetic foot disease and the importance of appropriate training for vascular surgeons has been acknowledged by the Vascular Specialty Advisory Committee (SAC) and

Table 1. Demographics of trainees.

Grade	Frequency	Deanery	Frequency
ST3	4	East Midlands	1
ST4	2	East of England	2
ST5	6	North West	3
ST6	5	Northern	2
ST7	7	Republic of Ireland	1
ST8	5	South West	4
		Thames Valley and Wessex	1
		Wales	2
		West Midlands	11
		Yorkshire and the Humber	1
		London	1

the General Medical Council (GMC). The management of fulminant diabetic foot sepsis is now one of three critical conditions on the new vascular surgery syllabus, which will be implemented from August 2021 (McCarthy et al, 2020). Alongside surgical debridement, antimicrobial therapy for managing residual infection should be guided by microbiology sampling and cultures (NICE, 2019), although few papers report sampling and processing techniques.

Aims

This study aims to determine the level of training and supervision that UK vascular surgery trainees currently have in toe amputations for diabetic foot disease and assess their practice of tissue sampling techniques for microbiological analysis.

Methods

A prospective online data collection tool consisting of 17 questions was created using Google Forms. Questions included information on trainee demographics, local diagnostic and sampling techniques, the use of the National Vascular registry (NVR) to record toe amputation rates and the level of training and supervision in toe amputation. The questionnaire was distributed nationally to vascular surgery trainees via the Rouleaux Club email newsletter and via social media trainee networks. The questionnaire was open for 9 weeks. Non-National Training Number (NTN) trainees were excluded to ensure all respondents had equivalent curriculum requirements. Data were analysed using Microsoft Excel 10.

Results

Demographics

There were 35 responses over the 9-week period, of which six were excluded as they were not current vascular NTN trainees. 29 responses were included in the analysis. *Table 1* shows the demographics of the trainees.

Experience, supervision and training

Figure 1 shows the number of toe amputations trainees had performed at the time of the study. *Figure 2* shows the frequency that each grade performs toe amputations.

Twenty-two respondents (76%) reported that they are supervised during toe amputations. *Figure 3* shows how often the consultant is in theatre supervising the trainees.

Twenty-four trainees (86%) reported having been taught how to perform a toe amputation as a registrar. Twenty-six (90%) report having no regular training reviews on toe amputation with senior colleagues. Nineteen (66%) report that they have never been taught what samples to send from toe amputations as part of their training.

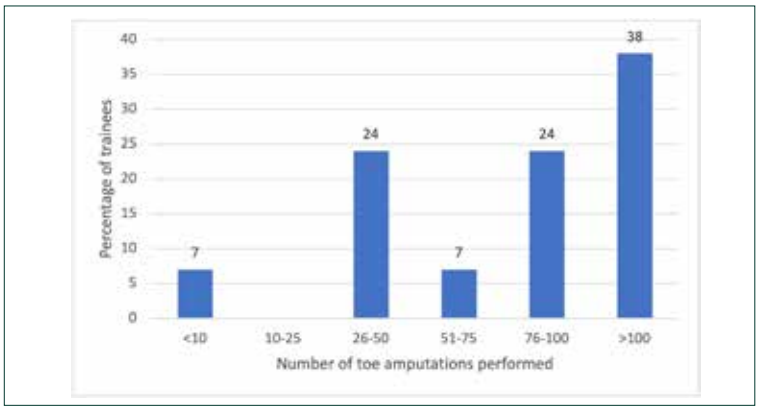

Figure 1. Number of toe amputations performed by each trainee at the time of the study.

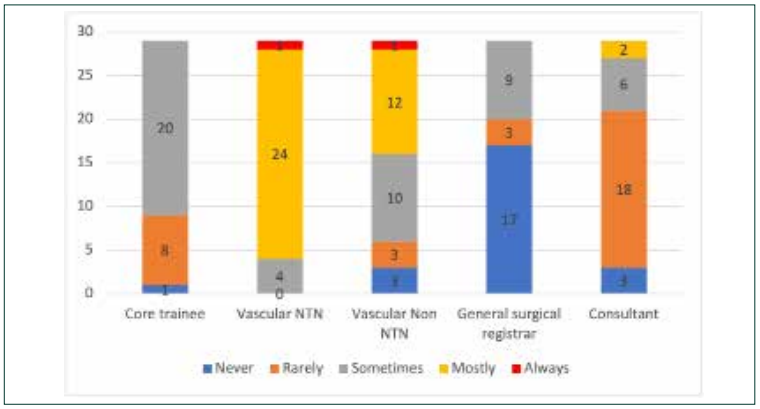

Figure 2. Frequency of toe amputations being performed by each grade.

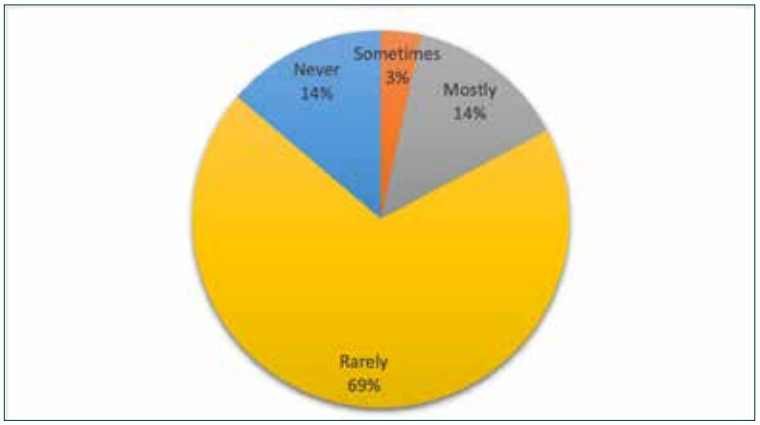

Figure 3. Frequency that supervising consultant is present in theatre during toe amputations.

Tissue sampling techniques and quality assurance

Figure 4 demonstrates the list and location in which toe amputations are taking place. *Figure 5* shows the proportion of trainees performing pre- and post-operative radiographs.

Twenty-six trainees (90%) reported that they never record their toe amputations on the NVR. One trainee each (3%) reported recording their amputation rarely, mostly, or always.

Figure 6 shows the proportion of microbiological sampling techniques used routinely by trainees. Proximal bone was the most common specimen sent for microbiological analysis (79%). *Figure 7* shows the medium in which trainees send their samples to the laboratory.

Figures 8 and *9* show the timeframes that trainees think samples take to reach the laboratory on weekdays and weekends, respectively. Twenty-five trainees (86%) did not know how their sample is processed once it reaches the laboratory.

Discussion

Five-year mortality for diabetic foot disease following toe amputation may be as high as 44.1% (Yammine et al, 2020). The burden of diabetic foot disease is significant and appropriate surgical debridement and antimicrobial therapy is crucial to its management. All recent guidance on diabetic foot disease is aimed at early and appropriate intervention to prevent major lower-limb amputation (NICE, 2019). As with any procedure, appropriate training and knowledge of processes are required to optimise performance and achieve best patient outcomes.

There were 214 vascular NTN trainees in the UK at the time of the survey. Only 14% responded to this survey. Although this is comparatively low, trainee engagement in surveys is notoriously poor; a survey of vascular surgery registrars by the Vascular Society of Great Britain and Ireland for the purpose of long-term workforce planning achieved a response rate of 35% (Vascular Society for Great Britain and Ireland, 2018). The Joint Committee for Surgical Training (JCST) Survey, which is reportedly compulsory, had a 58% response rate in vascular surgery in 2019. Lack of engagement in this study could reflect a degree of "survey fatigue" (O'Reilley-Shah, 2017).

Antimicrobial resistance is an increasing problem in the healthcare setting. Inappropriate and broad-spectrum use increases resistance (Fair and Tor, 2014). An appropriate microbiology sampling technique is imperative to enable accurate cultures and tailored antimicrobial therapy to help reduce resistance and appropriately treat residual

infection and prevent further amputation. After toe amputation, duration of antimicrobial therapy is usually determined by the presence or absence of infection in the residual bone. There is little evidence and no standardised technique for taking such samples. It makes sense that to obtain a true culture of residual bone all instruments should be clean and sterile and any visibly infected tissue or contaminated instruments, swabs, drapes should be removed from the area. The surgeon and scrub nurse should change gloves and fresh sterile instruments should be used.

Once the samples have been taken, preservation, storage and transportation of the samples are essential for appropriate culture. This survey demonstrated that trainees usually send specimens in a dry specimen pot, however, this practice risks losing information about anaerobic organisms that may have been present in tissues. When culturing blood there are separate mediums for aerobic and anaerobic cultures, yet no such medium exists for tissue samples. If trainees are not aware of the samples that should be sent or the technique for obtaining them, and there are suboptimal techniques for transportation and storage, then there is little hope for appropriate culture and targeted antimicrobial therapy.

According to the NVR, only 70% of major amputations were recorded for the 2016–18 audit period. Toe amputations do not feature in the NVR report (Walton et al, 2019). This survey demonstrates that toe amputations are poorly recorded on the NVR and the NVR does not report on the numbers being performed. If toe amputations are underreported, then there may be a misconception that the current preventative strategies for the management of diabetic foot disease are sufficient. This removes the incentive for commissioners and the NHS to invest further in preventative strategies for a disease that we know has an increasing burden on the healthcare service.

Toe amputations are also not currently recorded as index cases in surgical training logbooks, and there is no procedure-based assessment for formally assessing a trainee's ability to perform the procedure. In a time when training opportunities are increasingly restricted due to the European Working Time Directive (EWTD) and the impact of COVID-19, without an objective measure of competence and a summative method of feedback, toe amputations may be deemed to be of much lower priority to trainees than the index procedures.

Toe amputations are often deemed the simplest procedure that a vascular trainee performs prior to progressing to more complex procedures, similar to an appendicectomy or hernia repair in general

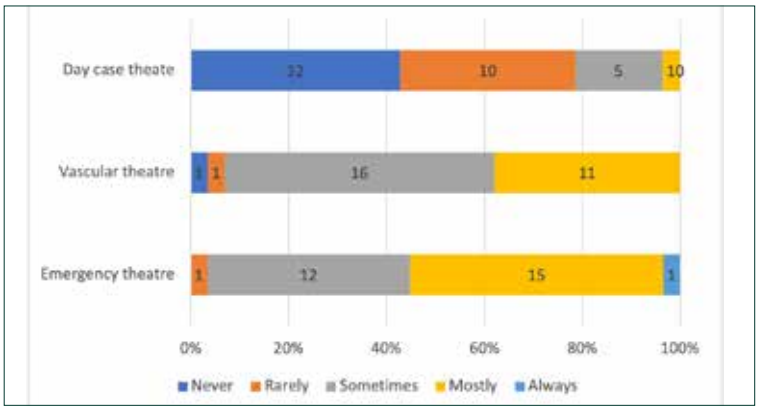

Figure 4. Location where toe amputations are being performed.

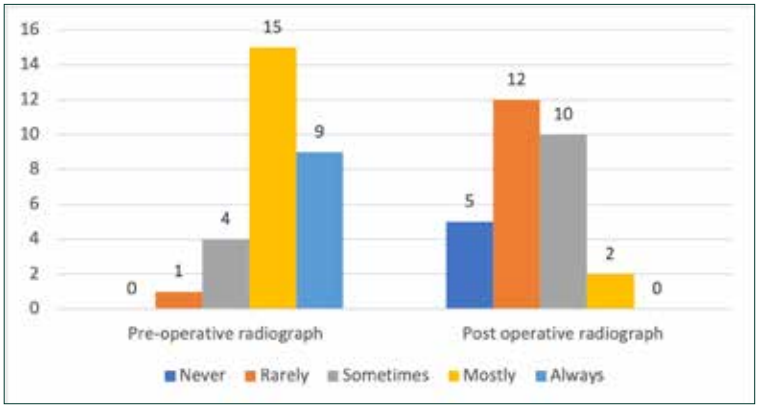

Figure 5. Number of trainees performing pre- and post-operative radiographs.

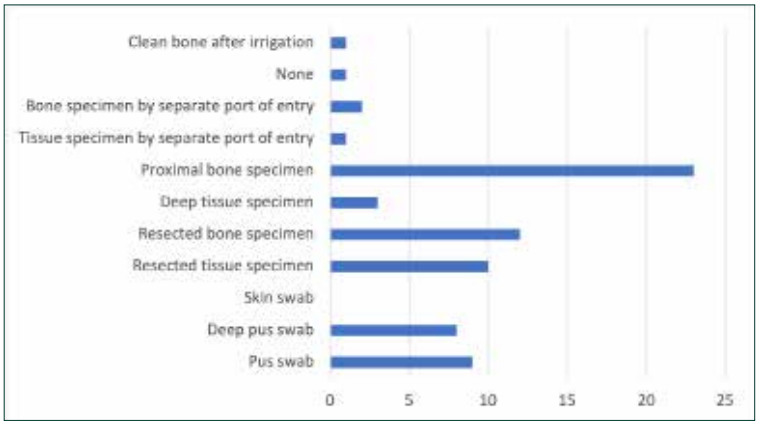

Figure 6. Frequency of microbiological sampling techniques used by trainees.

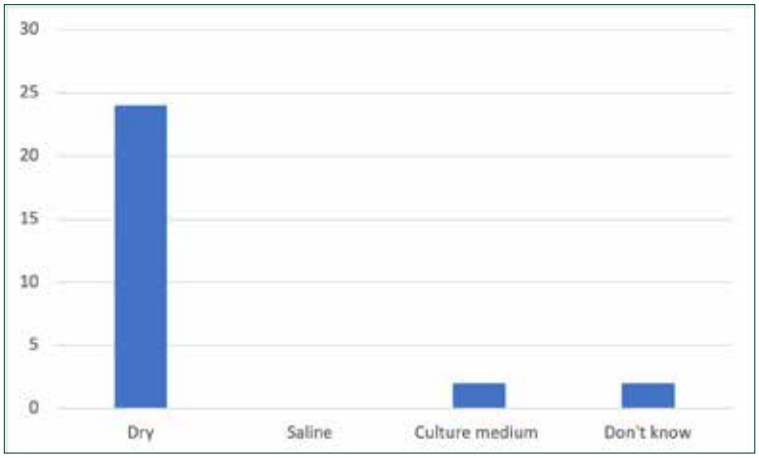

Figure 7. Frequency of different media used for transporting specimens.

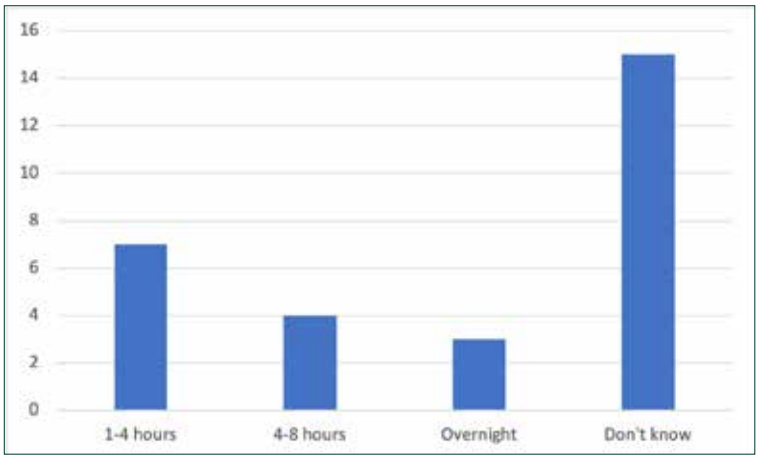

Figure 8. Time taken for specimens to reach the laboratory on a weekday.

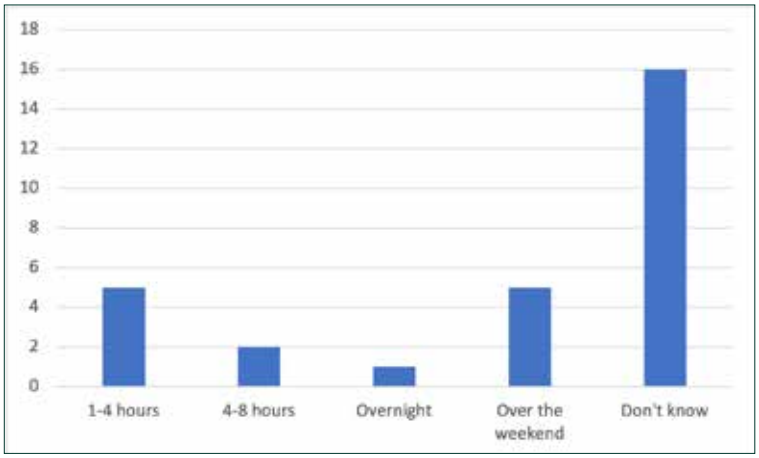

Figure 9. Time taken for specimens to reach the laboratory on a weekend.

surgery. Although few major complications occur at the time of surgery and, to the untrained, toe amputation seems a relatively safe procedure, removal of a toe or soft tissue from the foot is not an operation without consequence. The weight-bearing capabilities of the foot are complex and the altered biomechanics following foot debridement and toe amputation are complicated and can lead to further problems, particularly in the insensate foot. Residual infection in both soft tissue and bone can lead to further necrosis and tissue loss due to the pathophysiology of diabetic foot infections, resulting in more extensive debridement and increased major lower-limb amputation. Residual infection also results in the need for prolonged antimicrobial therapy, with the associated risk of antibiotic resistance or antibiotic-related complications.

This study demonstrates that once initial teaching is completed, many registrars do not receive ongoing review of their technique or supervision while performing toe amputations. There is a risk that trainees will develop bad habits if they do not regularly receive supervision and feedback on their operative skills.

The study also raises the question as to whether those performing the amputations understand the clinical importance and potential consequences of the procedure. The introduction of the new curriculum, and fulminant diabetic foot sepsis featuring as a critical condition, will hopefully act as an incentive to improve training and understanding of this complex disease process.

Conclusion

This study suggests that there is significant variation in trainee understanding of toe amputations, the processes involved, and the level of training and supervision trainees receive. Significant variation exists in tissue sampling techniques and this has the potential to hugely impact on appropriate antimicrobial therapy. This combination of factors hugely increases the risk of suboptimal therapy, increased potential for developing the need for major limb amputation, and threatens life expectancy of this cohort of patients.

Development of national standard operating procedures for sampling techniques, transportation and processing of antimicrobial specimens is required to ensure optimal targeted antimicrobial therapy. A greater emphasis on training in the management of diabetic foot disease and surgical

debridement to minimise the risk of repeated procedures and, ultimately, major lower-limb amputation, is required, with accurate recording of procedures and outcomes to ensure continued service development and optimal patient care. ■

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