Photo mapping foot deformity: a picture speaks a thousand words

KEY WORDS
- Deformity
- Neuropathic foot
- Photo mapping

The use of photography in podiatry is well established within wound care practice, the benefits of which are also widely documented. In recognising the role that photography plays in documenting ulceration, it became clear that the benefits need not be limited to this area of podiatry practice and that its use would be a valuable tool in the mapping of deformity of the foot. The use of photography has therefore been expanded into this area. The aim of these photographs is to support the written documentation within the Musculoskeletal (MSK)/High Risk assessments, including non-weight-bearing and weight-bearing assessment of the feet. Mapping deformity is key to being able to accurately monitor foot changes and potential deformity. Although patients' notes have a written description of the foot, the use of supporting photographs help to map small and important changes over time and give an immediate visual comparison.

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For many years, photography has played an important role as part of the assessment of wounds, with a number of professionals advocating the benefits of this (Hampton and Kilroy-Findley, 2016). It is clear that the use of photography within podiatry can be implemented across a wider scope of practice and not just limited to wound care, specifically for the purposes of mapping foot deformity.

There is no single definition of what exactly constitutes a foot deformity and as is explored later, there are mixed and competing views on this as evidenced in various publications (Abbott et al, 2002; Baker and Kenny, 2014; Lavery et al, 2003; Tang et al, 2005.)

Here we document the difficulties faced when seeking to map foot deformities in written form, particularly in view of the absence of a single common definition of such conditions and identifying the clear benefits in introducing photography into clinical practice as a way of remedying these challenges.

Foot deformities

Unfortunately, there is little evidence to clarify how one defines foot deformity, with Tang et al (2005) stating that there is no global accepted definition of the term 'foot deformities'. The descriptions are highly variable, as is seen comparing Abbott et al (2002) and Lavery et al (2003) definitions of deformity. Abbott and colleagues' classification describes foot deformity as displaying three or more of the following: hallux valgus, bony prominences, prominent metatarsal heads, charcot arthropathy, hammer toes, small muscle wasting or limited joint mobility. Conversely Baker and Kenny's (2014) less descriptive and what appears to be a more vague description, states that foot deformity can be quantified with the 'inability for a foot to be adequately accommodated by a high street shoe'. *Figure 1* shows the anatomy of the foot .

Neuropathy and foot deformity

Motor neuropathy significantly affects the intrinsic muscles of the foot; instability occurs resulting in clawed and hammer toe deformities with secondary metatarsal head prolapse and subluxation of the lesser digits (Jacobs, 2008; Bus et al, 2002). Both diabetes and rheumatoid arthritis can predispose you to having peripheral neuropathy. In the diabetic foot, limited joint range of motion and function is found as a result of chronic hyperglycaemia damaging the sensory, motor and autonomic nerves. Non-enzymatic glycosylation of the skin and

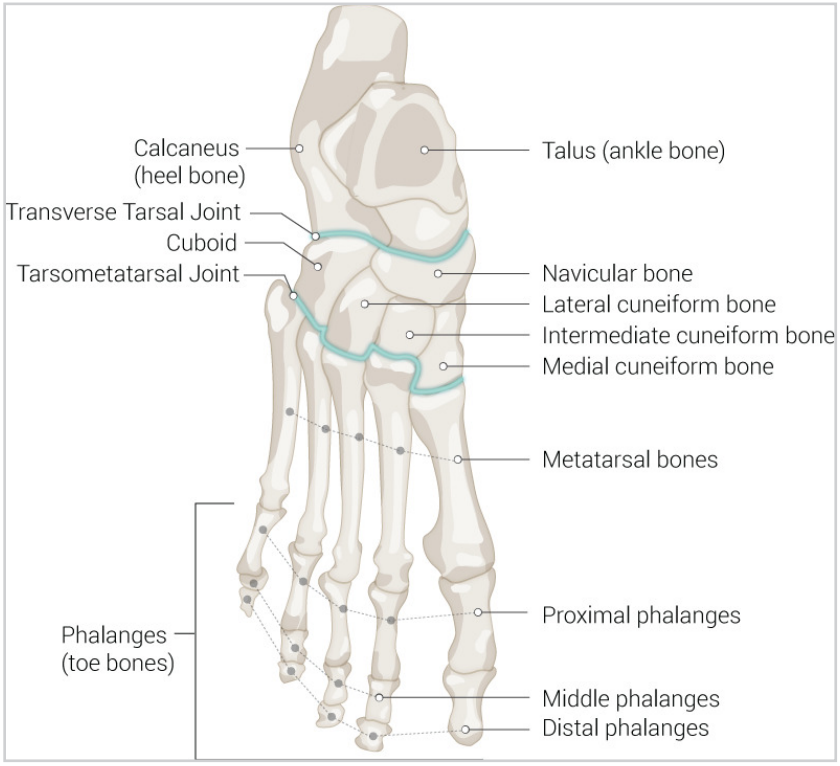

Figure 1. Anatomy of the foot. Foot Bones, Talus (ankle bone), Navicular bone, Lateral cuneiform bone, Intermediate cuneiform bone, Medial cuneiform bone, Metatarsal bones, Proximal phalanges, Middle phalanges, Distal phalanges, Phalanges (toe bones), Tarsometatarsal Joint, Cuboid, Transverse Tarsal Joint, Calcaneus (heel bone).Taken from MacGregor and Byerly. (2020) Illustration by Beckie Palmer

connective tissues results in increased stiffness in the feet and reduced collagen production (Brownlee, 1992). Cheuy et al (2016) found in the neuropathic diabetic foot, a combination of lean muscle tissue volume in the intrinsic foot muscles and limited ankle dorsiflexion were directly associated with the severity of forefoot metatarsophalangeal joint (MTPJ) deformity. Firth (2005) suggests that, with rheumatoid arthritis and complication of secondary neuropathy, comes foot deformity placing individuals at greater risk of developing callus and ulcerations.

It is noted that neuropathic foot deformities are not just associated with the rheumatoid and the diabetic foot but present in varying pathologies that may lead to neuropathic foot changes. Hereditary motor sensory neuropathic pathologies, including Charcot-Marie-Tooth disease (CMT) is one such example (Joo, 2011).

National guidelines and foot deformity.

According to the National Institute for Health and Care Excellence (NICE) monitoring and accurately documenting foot deformity is an imperative part of fully assessing the foot and also establishing risk (NICE 2015 Guideline [NG19]; NICE 2018 Guideline [NG100]). Unfortunately, there is little clear evidence to guide health professionals to be able to clinically assess foot deformity. Moreover these guides/tools are highly variable with questionable evidence underpinning their development (Crossland and Forss 2020). As previously highlighted, the lack of deformity classification also exacerbates the difficulty in determining how to describe the deformity in a standard way. In light of little evidential support, this often leads to the clinician's judgement being used to describe deformity in the foot. Evidence suggests that this results in poor reliability, description differences, poor replication and comparison (Monterior-Soares et al, 2011). An example of the inconsistency when measuring foot deformity is evident within Crawford and colleagues 2018 systematic review relating to developing a multivariable prognostic model for diabetic ulcerations. It was found that the description was so variable by different health professionals that the paper was unable to include deformity in their analysis, deeming it impossible to make comparisons due to lack of standardisation.

NICE Guidelines NG19 for managing the diabetic foot and NG100 managing the rheumatoid foot stipulate assessing the foot for any deformities which helps to determine foot risk. The NG19 guidelines help health professionals identify the level of risk of developing foot ulceration in the foot of a person with diabetes. The presence or absence of foot deformity is a determining factor in classifying the appropriate level of risk deemed. It is thought that inconsistencies in classification has the potential to affect patient's care (Crossland and Forss, 2020). NICE Guideline NG100 indicates that all adults with rheumatoid arthritis and foot problems should have assessment and periodic review of their foot health needs by a podiatrist. Health screening for deformities and callus is vital part of risk assessing (NICE, 2018).

Objectives of implementation

Due to the limitations and subjectivity in mapping foot deformities in written form, the supplemental use of photography as part of this process should seek to achieve the following;

Figure 2. Front of the feet /legs, April 2016 (a) and November 2018 (b). *TIP: Take the photograph at a lower level to get a frontal view and include the patient's leg(s), which can help to assess leg atrophy. This allows for a comparison of the feet and also understanding ankle position.*

Figure 3. Front of the left forefoot, April 2016 (a) and November 2018 (b). *TIP: Crouch down in front of the patient and take the photograph to get a clear line of sight of the forefoot. This shot will evidence the position of the toe in relation to the ground.*

- Increase accuracy in mapping foot changes/deformity
- Allow for comparison of the foot over a period time more effectively
- Save time in clinic — a picture speaks a thousand words!
- Allow for photographic evidence to be shared with colleagues
- Reduce subjectivity associated with describing foot deformity

Practical guide

It is essential while taking photographs of patients' feet over a period of time, that the format of each photograph is accurately repeated so that direct comparison can occur in order to give a more accurate long-term assessment of foot deformity and to monitor those subtle changes that are not easily conveyed in written form. The foot needs to be photographed in weight-bearing and non-weight-bearing positions.

A set of photographs need to be taken at the first presentation into the Musculoskeletal (MSK)/high risk clinic. Photographs should be repeated with any foot changes such as surgery, amputation or within a 12–18 month period, as part of the patient's annual review.

By way of example, the photographs presented in this article represent a small sample of those that were taken in an NHS Podiatry clinic showing a patient in a weight-bearing position in April 2016 and again in November 2018.

Significant changes have occurred for this patient over a two-year period. When looking at *Figure 2a* compared with *Figure 2b* this patient has undergone a left transmetatarsal amputation (TMA).

Very subtle changes can be seen at the left anterior ankle from *Figure 3a* to *Figure 3b*. *Figure 3b* shows the front of the ankle to have a very slight increase in diameter.

Figure 4. Left medial arch, April 2016 (a) and November 2018(b). *TIP: Take the photograph of the arch and crouch down to get the truest angle. This allows good medial ankle position to be captured, looking at the profile of the arch.*

As is shown in *Figures 4a* and *Figure 4b* subtle changes can be seen at the left anterior ankle. The images show that the arch position has not dropped following the left transmetatarsal amputation (TMA).

There is no change from *Figure 5a* to *Figure 5b* in the left heel following the amputation of the forefoot. In *Figure 5b* compared with *Figure 5a* the right heel shows small changes. The heel is very slightly rolling in (everted) and as a consequence you can see more toes in *Figure 5b*.

As can be seen, the photographs provide a clear record of the changes that have occurred to the foot over a period of time, which can be far more informative than a written report. This is particularly beneficial in circumstances where the changes are more acute than those shown in *Figures 3–6* as subtle deformities can be difficult to convey in written form and therefore this is best supplemented with visual reminders.

Benefits of foot-mapping photography

The impact of this process has highlighted a number of potential benefits in clinical practice. This includes;

- Photographic evidence that a patient's foot is deteriorating, enabling treatment in a timely manner, preventing diabetic/high-risk foot ulcerations and helping to prevent lower limb amputations
- Photography has proven particularly helpful in mapping through the stages of progressive conditions such as Charcot neuroarthropathy
- Acts as a baseline with which to compare any future deterioration
- Training needs, helping colleagues. Being able

Figure 5. Back of the heels, April 2016 (a) and November 2018 (b). *TIPS: Crouch down to get directly behind the heels so they can both be seen together. This angle allows the clinician to establish the rear foot position and also to map the relationship to the forefoot*

to remotely look at the photographs taken by colleagues and offer clinical support
- Allows for easier duplication and comparison and more accurate deformity mapping
- Allows the discussion of more complex cases with the multidisciplinary team/orthopaedic surgeon, both in person or remotely by sending pictures using a secure email
- NICE Guidelines NG19 1.3.13: '*Patient information about the risk of developing a diabetic foot problem*'. Managing the risk of developing a diabetic foot problem suggests the use of pictures to provide information to the patient. Visual aids help with patient education. Helping to offer a clearer explanation into what is happing with the patient's foot over time in a picture format
- NICE Guidelines NG100 1.10: '*Timing and referral for surgery*'. Photograph mapping foot deformity in the rheumatoid foot helps to provide longer-term evidence of slow progressive deformity that may occur. Supporting referrals to Orthopaedics to occur in a timely manner, with photographic evidence of progressive foot deformity.

Limitations

It has been recognised that one of the main limitations is the infancy of this project. This is reflected in some of the quality of the photographs taken. Even though a standardised approach has been attempted as a new initiative this could be further developed and refined, aiming to ensure high-quality photographs, along with standardisation.

Practical limitations should be considered. The quality of the images may be dependent on the skills of the photographer (Swann, 2010). In-house training could be expanded to include photography of foot mapping deformity. Variation will occur if the photographer does not follow an agreed protocol to achieve specific views. Appointment time limitations may be a challenge, although if photographs are taken, this should reduce the need for long written descriptions, which are often subjective. IT support and the availability of cameras is also recognised as a potential limitation. It should also be recognised that photo mapping as a visual tool for deformity will not provide a full biomechanical picture (Khan, 2018).

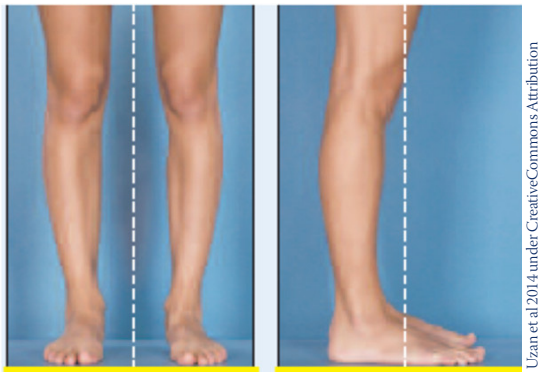

Figure 6. Optimal knee, leg, and foot viewing and framing. Taken from Uzan et al, 2014

DISCUSSION AND FUTURE WORK

It is recognised that the majority of the literature for carrying out best practice and clinical photography appears to be given around taking photographs of wounds and in dermatology. This is recognised in Uzan et al (2014) study looking at the medical photography and the principles for orthopaedics. They claim that there is little to no guidance on how to take a clinical photograph within orthopaedics and suggest optimal conditions, including positions for viewing and framing the lower limb (***Figure 6***).

As highlighted, replication and standardisation are key. As a new initiative and as part of future progression of this project, the methods on how to achieve this in practice need to be explored further. Uzan et al (2014) suggest that to improve the quality of an orthopaedic clinical photograph certain aspects should be considered:
- Background of the photograph
- Patient preparation, the extremities should be presented without clothing or accessories
- Anatomic landmarks — image technique.

As a department we also discussed other techniques that may allow for a more streamlined approach. These include:
- Stipulate the height from the floor and the camera
- Use a scale identifier
- Develop suitable tool, such as laminated template for the patient to stand on.

Carrying out photo mapping deformity in clinical practice has highlighted the significant benefits to both patient and health professional. To maximise these potential benefits, this needs to be rolled out across the wider team. This can be done through

presentations and demonstrations on how to take the specific photographs. Engagement from the wider team will ensure that photographs are taken at patient annual reviews as part of normal clinical practice. The photographs should be uploaded and attached onto the patient records in the deformity section with a standardised departmental/organisational approach being required for accuracy and consistency. Periodic auditing of the photographs across the department/organisation is recommended to ensure that standardisation is maintained.

Virtual-sharing of photo-mapping supports a multidisciplinary team approach and allows for peer review of clinical decisions across different locations.

Encouraging other health professionals to photo map deformity will aid in maximising care potential. Consideration of rolling out photo mapping deformity as part of education in deformity in the screening section of the Capability Framework For Integrated Diabetic Lower Limb Care should be given. This could include a concise practical user-guide on how to correctly photograph foot deformity. This framework aims to ensure that all people with diabetes in the UK have their feet cared for by health professionals with appropriate skill sets to improve patient outcomes (Short-life Working Group, 2019).

CONCLUSIONS

It has long been recognised that clinical photographs are there as a tool to support and aid treatment (Jacob 2019). Swann (2000) indicates that a visual reference with the right interval times and of the same area cannot be matched by either memory or written description. It is also noted that most benefit is achieved by taking a series of photographs over an extended time scale (Swann, 2000). Opportunity to be able to maximise the benefits that photographing mapping deformity brings to clinical practice will potentially improve patient care. This could be especially helpful with screening of foot deformities for less experienced podiatrists and non-foot specialists (Crossland and Forss, 2020). Taking photographs of the foot deformities helps mitigate against poor written description, variability and enables health professionals to report accurately on clinical findings. However, it is recognised that further research and guidance is needed into deformity classification and assessment to help clinical practice (Formosa et al, 2016) and to allow for greater unified standardisation to enable best practice. WUK

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