A clinical review of Dermatonics Once Heel Balm to assess its impact on callus associated with neuropathy and podiatry workloads

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Key words

- Callus
- Neuropathy
- Podiatry workload

Article points

1. Improving outcomes for people with diabetes foot ulcer risk.
2. Reducing Podiatry workloads.
3. Efficacy of urea cream.

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Foot ulceration in people with diabetes is a global problem (Boulton, 2004). The human and financial costs within the UK are significant and increasing with a calculation of £900m for the year 2014–15 (Kerr, 2019). On average, an episode of ulceration costs the NHS £14,600 to treat (Kerr, 2017). Ulcerations increase 5-year morbidity by almost 2.5 times (Walsh, 2016). The presence of callus and neuropathy occur commonly and are a recognised high predicator of foot ulceration (International Working Group on the Diabetic Foot, 2019; NICE, 2019). National and international guidelines recommend the use of emollients and the reduction of callus as important preventative actions. Most people with diabetes are likely to have their first interaction with professional advice on ulcer prevention within the community in a primary care setting. Patients with callus and neuropathy are most likely to be prescribed non-keratolytic emollients or, on rare occasions, low-concentration urea creams by their GP to treat callus. This paper assesses the effectiveness of these creams in treating callus in patients referred to diabetic foot clinics, and compares their efficacy to that of a high-concentration keratolytic (25% urea) cream prescribed or recommended by podiatrists.

One of the most effective strategies to prevent foot ulcers in patients with diabetes is prevention of callus formation (Hamatani, 2016). The development of a diabetic ulcer is usually in three stages. The initial stage is the development of a callus as set out in *Figure 1* (Armstrong, 2017).

Using an emollient with urea content helps to prevent or treat callus formation by reducing the severity of, or fully treating, the callus build up and maintaining skin quality. Urea content is an important efficacy factor. It has been reported that after treatment there was significantly greater skin hydration for feet treated with the 25% cream compared with the 10% cream (Baird et al, 2003). There seems to be general agreement that in the treatment of anhydrosis, moisturisers containing urea maintain the skin's flexibility and reduce the development of fissuring, thereby ensuring the integrity of the skin as a barrier is not broken (Baird et al, 2003; Bristow, 2016).

On the basis of available evidence, it seems likely that close to 80% of initial neuropathic ulcerations occur on sites of callus (Sage, 2001). Furthermore, it has been established that patients who have a first ulceration are then at much higher risk of having subsequent ulcerations (Leese et al, 2006); a corollary of this is that measures aimed at prevention of the initial ulceration should be fully explored. By removing the callus in neuropathic patients, the risk factor for ulceration is substantially reduced, as set out in *Figure 2*.

As a result of the link between callus and ulceration, clinical assessment of Dermatonics Once Heel Balm has been conducted at NHS Highland and NHS Whittington; in this article, the data from NHS Highland are analysed and the main conclusions are presented.

Methods

In 2018, people with diabetes presenting at NHS Highland diabetic foot clinics had their feet assessed

by a capable independent prescribing podiatrist using the Young Townson FootSkin Scale (Young et al, 2014) (*Figure 3*), which is the accepted skin scale for practitioners in the UK for assessment of callus and its associated impact on the risk of ulceration in the diabetic foot (Murray, 1996). Patients were asked what, if any, emollient had been prescribed previously. If their foot skin was assessed as being level 3 or 4, they were given a tube of Dermatonics Once Heel Balm, instructions on its application, and then asked to report back to the clinic 2 weeks later, at which point their foot skin was reassessed.

Eighty-three people were identified at the clinics and data collected comprised: age, sex, emollient used, risk factor, previous ulceration, debriding, skin scale before treatment, skin scale after treatment, cycle at beginning of trial and cycle at end of trial. One person was excluded from the analysis because he was already using the Dermatonics product.

Of the remaining 82 people, 58 were already using emollient creams, 30 of these being non-keratolytic; 24 patients had not previously used emollient cream. Three of these were eventually lost to follow up. Each person was asked to apply Dermatonics Once Heel Balm once a day then invited to attend for review of their skin scale.

Results

There had been no pre-trial measure against the skin scale for the 58 patients using keratolytic creams, non-keratolytic creams or other treatments to know if these had been efficacious on areas of callus.

Following daily treatment with Dermatonics Once Heel Balm for 2 weeks, over 91% of patients showed a significant improvement in skin scale factor; over 82% of callused patients at initial skin scale factors 3–4 went to skin scale factors 1–2 (*Figure 4a & b*).

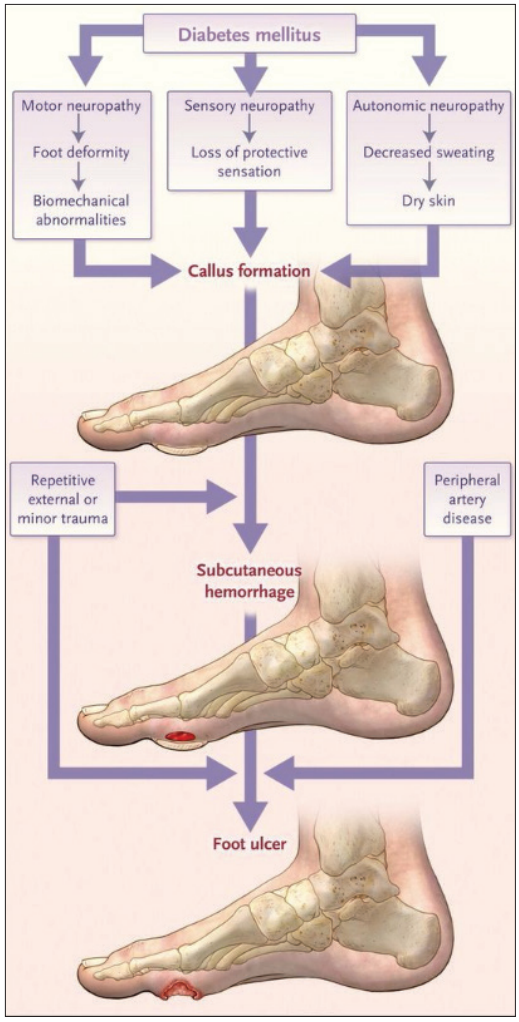

Figure 1. Common pathway of diabetic foot ulceration.

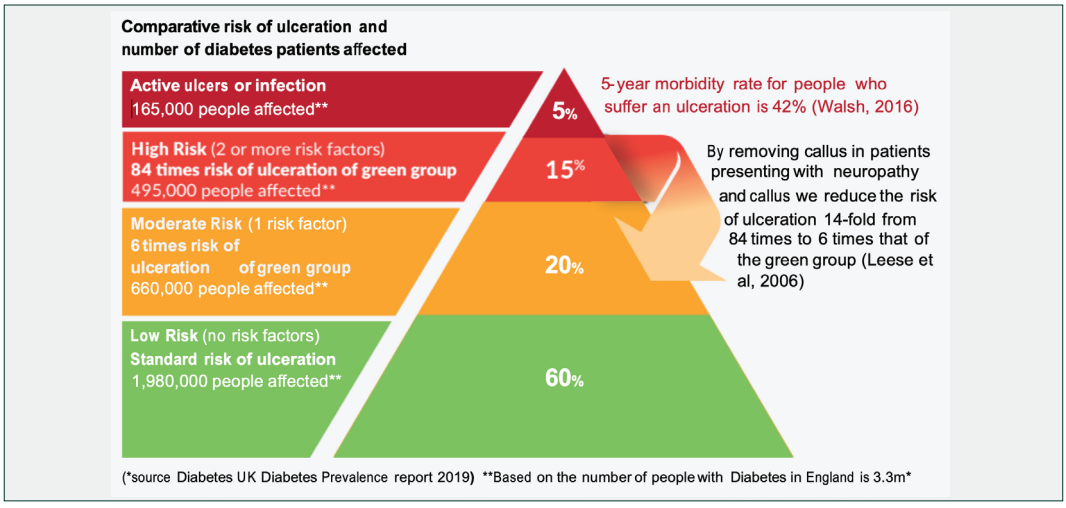

Figure 2. Pyramid of foot care for a population of people with diabetes (Boulton, 2006)

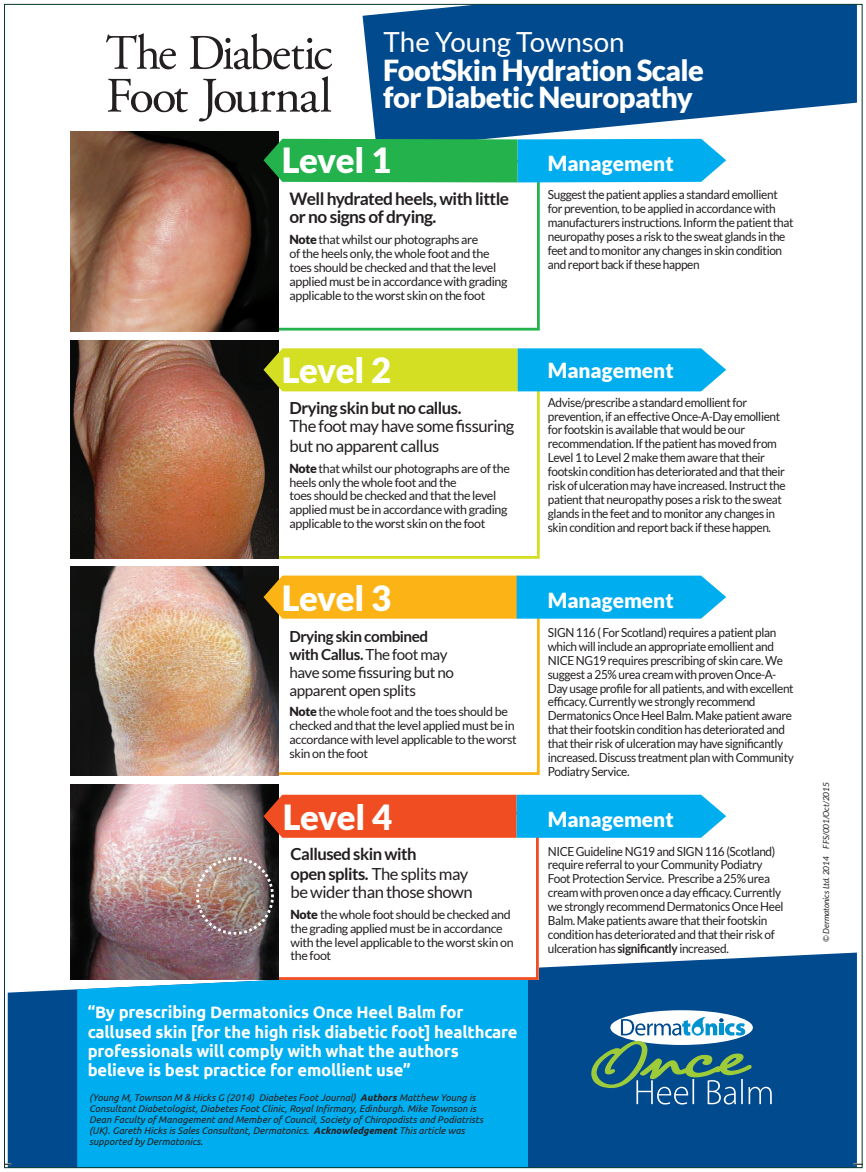

Figure 3. Foot skin scale.

The Dermatonics treatment was equally successful for patients already being treated with keratolytic and non-keratolytic creams, in fact, no distinction was found between its success on patients treated with emollient creams and those who were previously untreated.

There was a significant increase in the treatment cycles of all patients. The interval between required clinic attendance was increased with the post-treatment cycles more than doubling the pre-treatment cycles.

A second trial using the same protocol was conducted at NHS Whittington Hospital, London. The results from this site were more impressive with 47 of the 49 participants (96%) moving from level 3 or level 4 callus to level 1 or level 2 (NCL Joint Formulary, 2018), therefore significantly reducing their risk of ulceration.

Table 1. Distribution of foot skin scale before the trial for those who had been prescribed nothing and those who were using a cream.

Scale	No cream	Cream
1	0	1
2	4	5
3	6	31
4	14	22

Table 2. The distribution of foot skin scale before and after the trial for the 80 patients who completed the trial.

Scale	Before	After
1	1	28
2	9	39
3	37	12
4	34	1

Results from statistical analysis

Due to the expected values under the null hypothesis of independence being small and well below the accepted value for the asymptotic chi-squared approximation to the Pearson statistic to be valid (i.e. <5), a simulation test of independence of pre-trial treatment and skin scale was carried out.

This involves using simulation to obtain an empirical distribution for the Pearson statistic under the null hypothesis, which was constructed via 30,000 simulations. The calculated value of the Pearson statistic was 9.458 and the *P*-value obtained was 0.530, leading to the conclusion that there was no evidence of any kind of a relationship between pre-trial treatment and foot skin scale (*Table 1*). There was no evidence of a difference in the distribution across the initial foot skin scale grades (Pearson statistic = 5.786, *P*-value = 0.527), thereby confirming there was no distinction between those who were prescribed a cream and those who were not. *Table 2* shows the distribution of foot skin scale before and after the trial for the 80 patients who completed the trial; there was significant improvement across the board.

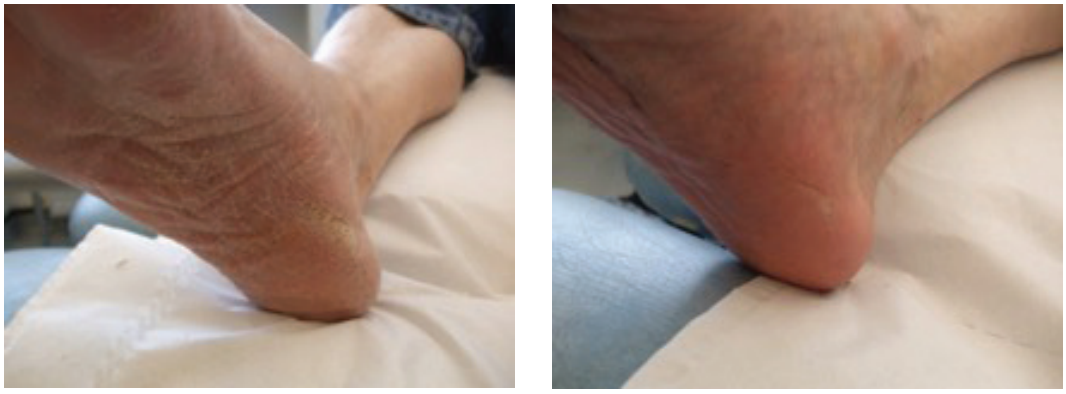

Figure 4. Before and after use of Dermatonics Once Heel Balm.

Was such a change significant?

Formal testing for equal proportions before and after treatment is clearly superfluous here but, for the sake of completeness, carrying out a 2 test of Before/After proportions results in the obvious overwhelming rejection of their equality (Pearson statistic 87 on 3 degrees of freedom, *P*-value = 0.0000), and the conclusion is that the improvement in skin scale is hugely significant. It should be noted that only one patient remained at skin scale 4.

Scale is, of course, an ordered categorical variable and it is not, strictly speaking, meaningful to assess improvement in terms of average scale grades. Even so, one might like to have an intuitive grasp of the size of individual scale improvement by considering the average change in individual 'Scale after Scale before' by looking at a bootstrapped 95% confidence interval for this difference; this produces an average shift towards scale 1 with magnitude 1.46 in the range (1.29, 1.63) with 95% confidence.

What proportion of patients showed improvement?

Out of a total of 80 patients who completed the trial, 73 showed improvement in their skin scale. Of those who did not improve, one patient started and finished with skin scale 1.

What proportion went from skin scale level 3 or 4 (callused) to level 2 or 1, which is defined as Success?

Of the 71 patients with skin scale 3 or 4, 58 (81.6%) went to skin scale 1 or 2; in other words, the trial showed a success rate of nearly 82%.

A more formal approach would be to compare the proportions of skin scale 1–2/3–4 before and after the trial with Fisher's exact test of equal proportions. This produces a *P*-value of 0.0000 and an odds-ratio of 32.58, which may be informally interpreted as a randomly selected patient being almost 33 times as likely to be found with skin scale 1–2 after the trial as they would have been before.

Table 3. What factors significantly affected Success?

Variable	Estimate	Std. Error	*P*-value
(Intercept)	1.9739-	2.7126	0.4668
Start cycle	0.5075	0.5594	0.3643
Risk factor 2	2.3909	0.9904	0.0158
Age	0.0621	0.0303	0.0400
Previous	1.2869-	0.9221	0.1628
Debriding	1.0246	1.1243	0.3621
Sex - male	0.5461	0.7237	0.4505

What factors significantly affected success?

A binary Generalised Linear Model (GLM) was fitted with 'Success-No success' as the response; the explanatory variables were 'Cycle at beginning of trial' (transformed to symmetry with a folded transformation), 'Risk factor', 'Previous ulceration' and 'Debriding'. The results are shown in *Table 3*. Diagnostic tests (Collett, 2003). There are two significantly low *P*-values and the conclusion is that Risk factor and Age affect the probability of Success. The odds-ratio for 'Risk factor 2' versus 'Risk factor 1' is exp(2.3909) = 10.92 — this means that an

Table 4. Length of time between visits changes.

Variable	Estimate	Std. Error	*P*-value
(Intercept)	3.4620	0.4940	0.0000
Start cycle	3.8753	0.3233	0.0000
Start cycle^2	0.6751	0.0817	0.0000
Success	0.1050	0.1579	0.5084

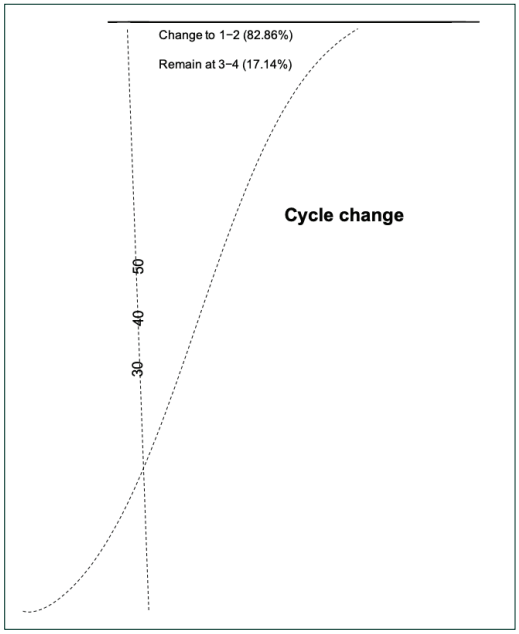

Figure 5. Change in patient cycle following improvement in foot skin.

individual with Risk factor 2 is more than 10 times as likely to register a success than a person who has Risk factor 1. Although significant, the effect of age is comparatively small; a 5-year age difference resulted in an odds-ratio of 1.3.

Were any types of treatment of patients prior to the trial significant factors affecting Success?

Statistical models were applied, both with and without the emollient used prior to the trial as a covariate, and compared with a chi-squared test of difference between residual deviances. There was no evidence that prior treatment had any effect upon 'Success' (*P*-value = 0.374).

In terms of Success was there any difference between previous keratolytic and previous non-keratolytic cream users?

Table 5. Risk factor, Age and Sex are not significant explanatory variables for End cycle changes.

Variable	Estimate	Std. Error	*P*-value
(Intercept)	3.08431	0.33843	0.0000
Start cycle	3.88026	0.31500	0.0000
Start cycle^2	0.67959	0.08011	0.0000
Success	0.44326	0.15290	0.0051

Patients for whom no previous treatment had been prescribed were removed from the data set and the model was re-fitted with an indicator variable specifying whether a keratolytic or non-keratolytic cream had been prescribed prior to the trial. There was no evidence of any difference in terms of effect upon the probability of 'Success' (*P*-value = 0.427)

Had the length of time between visits changed significantly by the end of the trial?

The 'Cycle start' and 'Cycle end' variables were first transformed to normality with folded transformations before fitting linear models; both variables are on a scale 0–52, so that the appropriate transformations were of the form ...

$$f(y) = \log\left(\frac{y}{52 - y}\right)$$

Referring to the transformed variables as 'Start cycle' and 'End cycle', End cycle was modelled as a linear function of 'Start cycle', 'Success', 'Risk factor', 'Age' and 'Sex' (*Table 4*). All diagnostic tests confirmed the fit of the model and a formal Shapiro-Francis test confirmed the folded transformation's success in ensuring normality of the model residuals.

The overwhelming significance of the positive coefficients of 'Start cycle' and 'Start cycle^2' means that, whether or not 'Success' is achieved, the cycle length will be increased and, of course, 'Success' also increases the cycle length as might be expected.

If so, by how much had the length of time changed?

Figure 5 shows the dependence of 'Cycle end' on 'Cycle start' for those who went from skin scale 3–4 to 1–2 and for those who remained on 3–4.

The graphs clearly show that the time between visits is significantly increased by the use of Dermatonics Once Heel Balm. Even for those who do not change to scale 1–2, there is an increase in cycle time, which is small for a start cycle of 5 weeks, has almost doubled for a start cycle of 15 weeks; it more than doubled for 20 weeks. For those who succeed in changing from 3–4 to 1–2, the start cycle had doubled at 10 weeks and more than doubled for longer start cycle.

Conclusion

The results of the trial show that Dermatonics Once Heel Balm can be extremely successful in the management and reduction of callus, a known risk factor in first and subsequent foot ulceration. There is a lack of published evidence on the effectiveness of emollient creams in ulcer prevention, however, this study shows that Dermatonics made impressive improvements, which had not been demonstrated by other treatments patients had used. The authors have not seen evidence of any other cream working this effectively in people with diabetes at high risk of foot ulceration. The identification of increased return periods for sharp debridement because of the improvement of Dermatonics cream had upon callus is exciting and is worthy of further exploration. At a time when NHS podiatry workforce numbers are challenged to meet increasing demand, Dermatonics could prove to be an important tool in the prevention of ulceration. The potential human and financial benefits for a low-cost prevention strategy by using Dermatonics on neuropathic callus are significant with savings to the NHS estimated to be as much as £120m (Lunn, 2018) and should be explored by commissioners, prescribers and clinicians across all areas of the foot care pathway. ■

Acknowledgements

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