

## Evidence for the link between healing time and the development of hypertrophic scars (HTS) in paediatric burns due to scald

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Accepted 13 February 2006

### Abstract

The relationship between burn depth, healing time and the development of hypertrophic scarring (HTS) is well recognised by burn surgeons but is seldom mentioned in the published literature. We studied 337 children with scalds whose scars were monitored for up to 5 years. Overall HTS rates were found to be: under 10 days to healing = 0%, 10–14 days = 8%, 15–21 days = 20%, 22–25 days = 40%, 26–30 days = 68% and over 30 days = 92%. In the conservatively treated group the HTS rates are: under 10 days = 0%, 10–14 days = 2%, 15–21 days = 20%, 22–25 days = 28%, 26–30 days = 75% and over 30 days = 94%. If skin grafting is undertaken there is a much higher incidence of HTS in the 10–14 days group: 10–14 days = 33%, 15–21 days = 19%, 22–25 days = 54%, 26–30 days = 64% and over 30 days = 88%.

We conclude that there is a low risk of HTS formation in scalds healed before 21 days, and that surgery should be reserved for scalds likely to take more than 21 days to heal.

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**Keywords:** Paediatric; Scald; Hypertrophic scar; Hypertrophy; Healing time; Burn; Outcome; Laser Doppler imaging; Evidence

### 1. Introduction

Few burns surgeons would disagree that the major burn, with deep extensive injury requires early aggressive excision and skin grafting to obtain favourable morbidity and mortality outcomes. However, the management of less extensive burns especially those of intermediate depth is more controversial. Advocates of early excision and grafting, or conservative dermal preservation strategy, will argue that their favored technique produces better results. The link between burn depth and wound healing has been known by burn surgeons for many generations, and healing after the three week point is recognised as an important predictor of hypertrophic scar development. Engrav et al. [1] suggest that an assessment of the healing facial burn should be made at 10 days post injury, so that any areas that are not expected to heal by 3 weeks can be excised and split skin grafted. The

principle paper cited as evidence for the relationship between healing time and scar formation was written by Deitch et al. [2]. They analysed variables associated with development of hypertrophic scars (HTS) and keloids in burns. He stated that the best predictor of the development of HTS was healing after 21 days. A number of other authors have studied the incidence, treatment and prevention of hypertrophic scarring but the link between healing time and HTS development is seldom mentioned [3–5].

Current practice aims to minimise healing time, through the use of dressings that provide the ideal healing environment, and by early excision and grafting of deeper burns. Clinical assessment of burn depth is notoriously difficult. Laser Doppler Imaging (LDI) is a helpful tool to assist in the assessment of burn depth, and this has been correlated with healing time [6], although not directly with scar formation. With the development of increasingly expensive wound healing products and tissue engineering (e.g. cultured keratinocytes) it is important that we justify their use. In order to do this we need to establish evidence

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that shorter healing times actually equate to better scarring.

During a small clinical audit of outpatient follow-up of paediatric burns, the first author noted a link between healing time and HTS formation. We wondered whether this association would allow us to predict which patients would develop HTS and which could be discharged from follow-up at an earlier stage. We decided to study a larger number of children with a scald injury to compare healing time with HTS formation.

Scald injuries are usually superficial partial or deep partial thickness injuries. There are three principle ways to manage them. Some burns surgeons have an aggressive approach to intermediate depth scalds, grafting them early because they believe that this will prevent HTS. Some surgeons have a dermal preservation strategy, allowing the scald to heal and then treating any hypertrophic scarring with pressure garments, massage and silicone. Others treat the scald conservatively initially and graft only those areas that are not healed at 21 days. We audited all paediatric scalds, irrespective of their treatment, to investigate the effect of overall healing time on HTS formation.

## 2. Methods

Ethical approval was obtained for carrying out an audit project involving a retrospective review of patient records. The names of all scalded children admitted to the Newcastle Upon Tyne and East Grinstead Burn Centres between 1 January 1997 and 31 December 1999 were obtained from computerised databases and admission registers. These included any hot liquid injury (bath water, kettle spills, beverages, liquid foods such as hot fat, soups etc.) but excluded injuries from ignition of volatile fluids. The hospital records were reviewed and information about the aetiology of the scald, age of child, extent of burn, type of treatment, healing time, duration of outpatient attendance and comments about the quality of scarring was recorded.

We previously studied a group of 100 children treated in East Grinstead who had been scalded by tea between 1998 and 2003. We decided to include this group of patients but in order to exclude any bias we analysed the data for all tea scalds separately and compared them with a sub group of 240 patients from the main cohort who had sustained scalds from hot water with no additives. We did this to assess whether the reported possible anti-inflammatory properties of tea would influence the outcomes [7,8]. Thirty-six of these 100 tea scald children were already included in the main cohort and 64 of the children had been scalded after the 31 December 1999 cut of period for the main study and were therefore added (Fig. 1).

The normal practice of both centres was to excise and graft burns that were clearly full thickness. Superficial injuries were treated conservatively. Intermediate depth burns were treated conservatively in East Grinstead and

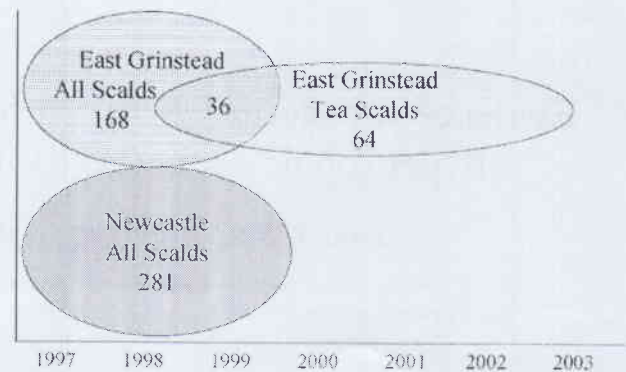


Fig. 1. Groups of children identified for inclusion in the study.

excised and grafted in Newcastle. This assessment was done on purely clinical grounds by experienced burns surgeons, as Laser Doppler imaging (LDI) was not readily available at the time of this study. The management plan for each child was determined by a clinical depth assessment and the personal preferences of the clinicians involved, and this study simply reviewed the healing process and final outcomes that resulted from this choice.

Healing time was taken from the nurse dressing clinic records as the point where the scald was described as fully healed and/or dressings were discontinued. Healing time was classified into similar groups to those used by Deitch et al. [2]: less than 10 days, 10–14 days, 15–21 days, 22–30 days, and we added a further category of over 30 days. The quality of scarring was determined by reading the outpatient clinic records. Two groups were identified: hypertrophic scars (HTS) and never hypertrophic scars (NHTS). Scars were defined as hypertrophic if this term had been used anywhere in the clinic records at any time or if treatments such as silicone gel, steroid injections or pressure garments were prescribed (unless these were clearly used prophylactically). Pigment changes alone were allocated to the never hypertrophic group.

A minimum follow-up time of 4 months from healing was chosen to reflect the time that it takes for HTS to develop and to ensure that erythema associated with normal scar development was not confused with early HTS. However, due to the normal practices of both units to discharge superficial burns early, a large number of patients do not have a 4-month follow-up duration. Therefore, we analysed the total cohort and the over 4 months follow-up group separately.

Of the 281 children treated at the Newcastle Burn Centre, 188 had sustained their injury more than 5 years previously and their home address given in their hospital records was within our local catchment area. We therefore decided to invite them to attend special clinics so that we could assess their long-term outcomes.

We assessed their scars using the Vancouver scar scale, took photographs and asked the children and their families to complete questionnaires.

Table 1  
Aetiology of the scald injury

Aetiology	Number of children	Percentage (%)
Water	240	47
Tea	162	32
Coffee	53	10
Oil	24	5
Other drinks	12	2
Food	12	2
Cooking water	5	1
NAI	1	0.2

### 3. Results

There were 281 paediatric patients admitted to the Royal Victoria Infirmary Newcastle Upon Tyne with scald injury between 1 January 1997 and 31 December 1999, and 241 sets of notes were available. There were 204 patients admitted to the Queen Victoria Hospital East Grinstead during the same period and all of their notes were reviewed. There were 64 additional children in the East Grinstead tea scald cohort (2000–2003). The total number of children in the study group was therefore 509. Fifty-eight percent of the patients were male. The average age at time of injury was 27 months (median 19 months and range 11 days to 16 years). The aetiology of the burns is shown in Table 1. They sustained scalds of an average body surface area of 5.5% with median 4% and range of less than 1–34%. One hundred and six children (21%) were skin grafted and 403 children were treated conservatively. The healing time was available in 469 cases (some were transferred to other units for follow-up and others did not attend or the dressing clinic documentation was missing).

The quality of scars could be assessed in 337 patients of the total 509. The other patients did not attend even one outpatient review, and some were transferred to different hospitals for outpatient follow-up. Of the 337 patients, 170 had been seen more than 4 months after their healing date, and these were analysed as a subgroup (Table 2). Analysing the total group of 337 patients, there was an overall HTS rate of 35%. All the 55 patients that healed in less than 10 days healed without HTS. In the patients taking 10–14 days to heal 8% had a HTS. Scalds taking 15–21 days to heal had a

Table 3  
Detailed analysis of incidence of HTS in group who healed between 22 and 30 days

	22–25 days			26–30 days		
	n	HTS	%	n	HTS	%
Conservative	14	4	28	8	6	75
Grafted	11	6	54	11	7	64
Total	25	10	40	19	13	68

20% HTS rate. Scalds healing in 22–30 days had a 52% incidence of HTS. Those that took more than 30 days to heal developed HTS in 92% of cases. We conducted a more detailed analysis of the group who healed between 22 and 30 days (Table 3). We found a HTS rate of 40% if healed between 22 and 25 days compared with 68% if healed between 26 and 30 days.

We compared the rate of HTS formation between those patients treated conservatively and those who were grafted. Scalds treated conservatively and healed between 10 and 14 days had a 2% HTS rate. Those who took 15–21 days to heal had a 20% HTS rate. Scalds taking 22–30 days to heal developed HTS in 45% of cases. Ninety-four percent of those taking more than 30 days to heal developed HTS. When the group who healed between 22 and 30 days were analysed in more detail we found a HTS rate of 28% (22–25 days) and 75% (26–30 days).

Of the surgically treated patients, those taking 10–14 days to heal had a 33% HTS rate, scalds taking 15–21 days to heal developed HTS in 19% of cases. Scalds healing in 22–30 days had a 59% HTS rate. Eighty-eight percent of those taking more than 30 days to heal developed HTS. When the group who healed between 22 and 30 days were analysed in more detail the HTS rate was 54% (22–25 days) and 64% (26–30 days).

By 4 months after injury, the majority of patients treated conservatively, who healed in less than 30 days and who had no signs suggesting the development of HTS, had been discharged from follow-up. However, almost all of the grafted patients were still under follow-up regardless of whether or not they developed HTS. Almost all of the conservatively treated group with HTS were also still under follow-up at 4 months. Patients who developed signs of

Table 2  
Incidence of HTS by healing time and method of treatment

	<10 days			10–14 days			15–21 days			22–30 days			Over 30 days		
	n	HTS	%	n	HTS	%	n	HTS	%	n	HTS	%	n	HTS	%
Over 4 months follow-up															
Conservative	4	0	0	8	1	13	20	11	55	7	6	86	47	46	98
Grafted	1	0	0	15	5	33	15	2	13	21	13	62	32	28	88
Total	5	0	0	23	6	26	35	13	37	28	19	68	79	74	94
All sample															
Conservative	54	0	0	64	1	2	59	12	20	22	10	45	52	49	94
Grafted	1	0	0	15	5	33	16	3	19	22	13	59	32	28	88
Total	55	0	0	79	6	8	75	15	20	44	23	52	84	77	92

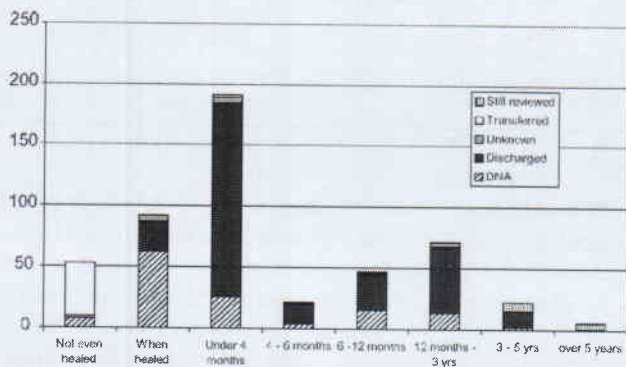


Fig. 2. Time between burn and the last time that the patients were seen. Patients were either discharged at the time stated or did not attend (DNA) the next appointment.

problems with their scars that may require further treatment such as pressure garments, silicone, aggressive physiotherapy or surgical scar revision were followed up for a longer period often over many years.

Two hundred and ninety-seven patients were formally discharged from follow-up at a mean of 8.4 months from injury (range 2 days to 5 years 1 month, median 2 months). One hundred and thirty-three patients did not attend their last follow-up appointment and were last seen on average 4.7

months after injury (range from the day of injury to 45 months, median 22 days). Forty-eight patients were transferred to other hospitals for follow-up and 13 patients were still under review. There were 18 patients for whom follow-up data was not available (Fig. 2).

Out of the 188 children invited for long-term follow-up, 28 patients and their families attended the clinic at least 5 years after the scald. Eight children treated conservatively healed within 21 days and all felt that they had no scars. This group had an average Vancouver Scar Score (VSS) of 0 and there were no apparent scars. The three children who were treated conservatively and healed in more than 21 days all had a palpable mark or pigment change and an average VSS of 1.3. The remaining group (17) were treated with skin grafting and all had scars with a VSS 1.75, (average VSS of 1.43 in the group healing before 21 days and VSS of 1.98 in those taking 21 days or more to heal). The appearance of their scars at long-term follow-up correlated well with that expected from the information held in the hospital notes (Table 4).

There were 110 tea scalds and 153 pure water scalds in the final group of 337 patients. We analysed their outcomes in the same manner as the main group (Table 5). We observed that for the same healing times the children with tea scalds have consistently higher HTS rates.

Table 4  
Details of patients reviewed at greater than 5 years

Age at injury	Sex	Days to healing	Days to skin graft	Duration of follow-up (months)	Outcome from records	Long-term review (years)	Vancouver Scar Score	Outcome at 5 years+
17 months	Female	N/A	2	28	Settled grafts	5	1	Pale mesh pattern
3 years	Female	2	C	0	Erythema only	6	0	Nothing to see
7 years	Female	7	C	0	No problems	7	0	Nothing to see
15 months	Female	7	C	0	No problems	7	0	Nothing to see
3 years	Female	8	C	0	Well settled	6	0	Nothing to see
19 months	Male	8	C	1	No problems	6	0	Nothing to see
17 months	Female	10	C	1	No problems	6	0	Nothing to see
5 years	Male	10	1	6	SSG soft pliable	7	1	Dark mesh pattern
3 years	Female	10	C	1	No problems	7	0	Nothing to see
2 years	Male	11	C	1	No problems	7	0	Nothing to see
22 months	Male	11	3	13	Settled grafts	5	1	Dark mesh pattern
16 months	Female	12	3	11	Settled grafts	6	1	Pale mesh pattern
2 years	Male	12	2	17	Well settled HTS	7	3	Pale mesh pattern
14 months	Female	16	3	22	Settled SSG	6	1	Pale mesh pattern
13 months	Male	17	4	30	Settled grafts	6	2	Pale mesh pattern
17 months	Male	22	C	1	Mild scarring	6	1	Pigment at elbow
14 months	Male	24	3	18	Mature prev HTS SSG	6	1	Dark mesh pattern
14 months	Male	25	3	20	Settled grafts	6	1	Pale mesh pattern
16 months	Male	25	C	3	HTS shoulder	5	2	Mild HTS shoulder
15 months	Female	25	6	8	Settled SSG	7	2	Dark mesh pattern
8 months	Female	26	4	40	Settled grafts	7	1.25	Pale mesh pattern
17 months	Female	27	8	36	Mature prev HTS SSG	5	1	Pale mesh
8 months	Female	29	6	27	HTS left forearm	7	1	Small areas HTS
11 months	Male	30	3	33	Soft supple prev HTS	5	3.5	Pale lumpy
3 years	Male	32	4	36	Mature prev HTS SSG	6	1	Dark mesh pattern
14 months	Male	33	5	74	Scar revision surgery	6	5	Prominent scars
4 years	Female	34	C	2	Unknown	6	1	Pigment changes
2 years	Female	55	3	63	Scar revision surgery	6	3	Lumpy mesh hand

N/A = not available, C = conservative management, SSG = split skin grafting.

Table 5  
Comparison between tea and pure water injuries

	<10 days			10–14 days			15–21 days			22–30 days			Over 30 days		
	n	HTS	%	n	HTS	%	n	HTS	%	n	HTS	%	n	HTS	%
All conservative	54	0	0	64	1	2	59	12	20	22	10	45	52	49	94
Tea conservative	21	0	0	24	1	4	24	7	29	6	5	83	17	17	100
Water conservative	24	0	0	25	0	0	23	4	17	10	4	40	23	21	91
All grafted	1	0	0	15	5	33	16	3	19	22	13	59	32	28	88
Tea grafted	0	0	0	4	2	50	3	0	0	4	3	75	7	7	100
Water grafted	1	0	0	7	1	14	8	2	25	12	7	58	16	14	87
Total cohort	55	0	0	79	6	8	75	15	20	44	23	52	84	77	92
All tea	21	0	0	28	3	11	27	7	26	10	8	80	24	24	100
All water	25	0	0	32	1	3	31	6	19	22	11	50	39	35	88

#### 4. Discussion

Patients with major burns and deep extensive injuries require early aggressive excision and skin grafting to obtain good morbidity and mortality outcomes. Establishing rapid wound closure is vital to minimise wound infection, thereby preventing life-threatening systemic sepsis, and for these patients the final appearance of their scars is not the first priority. Decisions about the wound management of patients with superficial burns are seldom difficult because the wounds are treated conservatively. However, extensive superficial burns can be life threatening and require careful fluid resuscitation, particularly at extremes of age.

The management of intermediate depth burns is more controversial and some surgeons routinely perform early excision and grafting. Others advocate a trial of conservative treatment with dressings. Each group will argue that their favoured technique produces better functional and aesthetic results.

For all burns the goal is effective wound healing. Our study has clearly demonstrated that healing time is strongly linked to ultimate scar formation. Our data has shown that healing time is related to quality of scarring whichever treatment strategy is chosen.

The link between burn depth and wound healing has been known by burns surgeons for many generations, and healing after the three week point is recognised as an important predictor of hypertrophic scar development. In 1983, Deitch et al. [2] analysed 100 patients (including 59 children) to determine the factors associated with hypertrophic burn scars. Thirty-eight percent of all his patients developed hypertrophic scars (41% of the children and 34% of the adults). He concluded that the most important indicator for future scar problems was the time required for the burn to heal. If healing occurred between 14 and 21 days then one-third of anatomical sites became hypertrophic. However, if the burn healed after 21 days then 78% of the sites developed hypertrophic scars. He felt that healing time was more important than the other variables. Our study group is purely paediatric scalds. Therefore, it can only be compared with the paediatric subgroup of Deitch et al.'s [2] patients, in

whom the aetiology of the injury is not stated. Deitch et al.'s [2] figures for children demonstrated a 64% HTS rate in black children and 28% in white children. The majority of our children were white and this could explain the lower overall HTS incidence. Our results correlate well with Deitch et al.'s [2] paper and add weight to the general concept that healing after 3 weeks is associated with raised scar formation.

Spurr and Shakespeare [4] studied hypertrophic scarring in the United Kingdom paediatric population in 1968 and 1984 and reported HTS rates of 51 and 63%. In their series the healing time is not reported and follow-up duration is not clear. Spurr and Shakespeare's patients are more similar to our group of children but only 82% of their patients had scalds. Our overall HTS rate of 35% is lower than that for these children.

Bombaro et al. [5] performed a retrospective review of 110 major burns and reported an overall HTS rate of 67%. The healing time was not mentioned. Unlike our study group, Bombaro's patients are predominantly adults (60% white) with much larger burns.

Scar development and maturation, in the paediatric age group, after sheet split skin grafting, has been studied prospectively by Schwanholt et al. They reported that a rapid peak of scarring occurs at 1–2 months after skin grafting and that the scar matures at 9–13 months.

Chen et al. have recently suggested that ingested green tea might have anti-inflammatory properties and similar properties have been described by Nag Chaudhuri et al. for Indian black tea [7,8]. It could be proposed that the topical application of tea could be in itself anti-inflammatory. However, our results refute this suggestion.

Our study is limited by its retrospective nature, the information available in the clinical notes and the length of follow-up in some cases. The assessment of HTS is difficult retrospectively as neither centre records formal scar measurements routinely. The use of a description of HTS in the medical records has been used by other authors [4,5] and this was felt to be a reasonable outcome measure, although the Vancouver Scar Score (VSS) was used when we had the opportunity to examine the patients. Scarring can be

assessed in a variety of ways, from simple clinical inspection to complex technical assessments [9]. Hypertrophy can be quantified by measurements: scar thickness/volume measured with ultrasound, colour determined by spectrophotometry and assessment of vascularity by laser doppler flowmetry. More complex techniques have also been described in a research setting such as anisotropy (stiffness) and profilometry (contour). However, these have yet to be fully evaluated and as the group of children that we reviewed had mature scars (rather than severe HTS) at the time of assessment we limited our measurements to simple methods. A number of clinical scoring systems have been described and validated, and some are easier to apply than others in the clinic setting [10–12]. The most commonly applied scar scoring system is the VSS and this is used in the scar review clinic in Newcastle to assess treatment progress. Some authors have shown that VSS is reliable when the assessors are familiar and experienced with the technique. As the Newcastle therapists were accustomed to using this technique we believed that they would be able to use it to provide a reliable objective assessment. When the information given about the quality of scarring in the patient records was compared with that assessed by the VSS there was good correlation (Table 4).

It takes time to develop raised scars and in the Deitch et al. [2] paper a minimum of 9 months follow-up was used so that transiently raised normal scars could be excluded. Schwanholt's findings suggest that as peak scarring in sheet grafts occurs by 1–2 months a shorter follow-up duration might be acceptable. In an earlier study we found that all scars that went on to become hypertrophic had done so by 4 months of healing [13]. We therefore used the 4-month figure to determine an ideal minimum follow-up duration. This length of follow-up was not always available, as it is the normal practice of both the units to discharge patients with superficial scalds reasonably early. Many of the families offered longer follow-up appointments did not attend these, with 133 patients (26%) not attending the final appointment given. One could assume that this reflects families' lack of concern about the scarring. However, more information about these patients would have been of benefit. Early discharge did not seem to be a problem, with only one patient being re-referred by the general practitioner for scar management after non-attendance to clinic. When the small group (28) of the Newcastle children were assessed at 5-year follow-up clinics, their outcomes were exactly as predicted from reviewing the medical notes. This justifies our assumption that there were no problems after discharge if none were reported before discharge. Therefore, it seems reasonable to accept that an early discharge with good results can be considered non-hypertrophic unless the patient was re-referred with scarring concerns.

We decided to include the large group of patients with superficial scalds who were discharged within 4 months of healing. We felt that if we excluded them from the study this would significantly skew the data, as it would result in an

over representation of patients with problems. This study therefore reflects the total cohort as seen in normal clinical practice, rather than a group that has been artificially altered by exclusion criteria. The raised scar rates in the over 4 month follow-up group show a similar trend to the complete group although as expected they show a higher complication rate in the more superficial injuries (Table 2).

When the group that healed between 21 and 30 days is broken down further, healing by 25 days is the critical point that determines whether HTS occurs or not, although the numbers are small. Patients are not seen on a daily basis near the end of healing, therefore the actual healing time may be shorter than that recorded, as wounds could have healed at any time between the last two dressing changes. So the true predictive figure could be nearer 21 than 25 days. Some patients were skin grafted early and others were only grafted if they had not healed after a trial of conservative treatment, which reflected the practice of individual consultants. We chose to calculate the healing time for this group from the time of burn rather than from the date of the operation, as this reflects the chronicity of wound healing rather than the timing or take of the skin graft.

From this study we confirmed that it is important that healing has occurred by 25 days to achieve optimal scarring. We noticed that the incidence of raised scars in the grafted group also correlated well to the healing times but in the 10–14 days group it was higher than the conservative group (33%), although the numbers are small. What this suggests is that a better outcome can be expected with conservative management if an accurate prediction can be made that the burn will heal before 25 days. However, if the burn is clearly deep and skin grafting will be required, it is better to perform this early so that the resulting scars are more favorable. There is still an incidence of problem scars even in the patients who were grafted and healed before 14 days. It is necessary therefore that the decision to carry out early surgery can be justified. This means that an accurate prediction of healing time is vital so that burns that would have healed by 25 days are not grafted. Clinical assessment of burn depth is notoriously difficult even for very experienced clinicians but the Laser Doppler Imager is a useful adjunct for this [6,14–17].

The recently developed MoorLDI BDA palette identifies which burns have a healing potential of less than 14 days, 14–21 days and greater than 21 days. We believe that use of the MoorLDI will allow burn clinicians to distinguish between burns with a healing potential of less than 21 days (low risk of HTS) and those with a healing potential of more than 21 days (high risk of HTS) [18] (Table 6).

We hope that the future of scald management will include treatment modalities that can modify the wound healing process so that all burns should be healed by 25 days. All the evidence to date suggests that this is the single most important factor in the prevention of HTS. On this basis scar outcome measurements must include healing time as well as an indication of scar quality so that proper comparisons can

Table 6  
Recommended treatment guidelines

Clinical impression of scald	Laser Doppler result at 48 h	Scald management
Clearly superficial	LDI may not be necessary	Conservative ± biological dressings
Depth less clear, likely to progress, intermediate or deep	Healing potential under 21 days (HP 14 or HP 14–21) Healing potential over 21 days (HP > 21)	Conservative ± biological dressings Early split skin grafting

be made. For the moment we must focus on accurate prediction of healing time, by use of LDI where necessary. This will allow us to identify which patients will benefit most from early excision and grafting and which would be best treated conservatively. We now have strong evidence on which to base our decision to operate or not. We believe that it is no longer acceptable to insist on a blanket policy of early excision and grafting for intermediate depth burns. We may be guilty of committing the perfect crime by excising viable tissue and grafting the defect, and in doing so we may sentence some of our patients to the development of HTS when they would not have done so had they been treated conservatively. For mixed depth burns with small areas of deeper injury a staged approach may be appropriate. The patient is initially treated conservatively, accepting that the deeper patches will take longer to heal and therefore form HTS. Scar revision is then planned to excise the small HTS areas once the inflammatory process has reduced, as the resulting linear scars give a better cosmetic result than conventional split skin grafts.

Each and every patient requires a thorough and considered decision in order to choose the best option for each part of their burn, and these plans may need to be revised if other factors intervene. The LDI scan assesses the healing potential of a burn wound at the time it was performed, and subsequent events such as the prolonged use of inotropes or significant infection will affect the final healing time. All these factors highlight the difficulty of managing even small burns in these patients, and emphasize the need for experience. Protocols and algorithms have a place in certain areas of medicine, and can be a guide to our practice. They are particularly helpful when important decisions have to be made quickly by unfamiliar staff. However, scald injuries are seldom a life-threatening emergency, and after initial resuscitation there is time to make a considered judgement about the management of each individual. These children and their families have a long future ahead of them, and they should look forward to this with the best outcome that a specialist multidisciplinary burns team can give them, regardless of the size, depth or location of their injury.

## 5. Conclusion

Our study has further demonstrated that there is a definite link between the time to healing of a scald wound and the

development of hypertrophic scarring, with healing time being a good predictor of scar outcome. This further justifies attempts to speed up the healing process, for even if the products are expensive the cost of treating problem scars is considerable in resources and time, as well as cosmetic outcome for the patient.

## Acknowledgements

The authors thank Miss Carolyn Reid and Mr. Philip Gilbert for their support of this project and for allowing us to include their patients in the study. We also thank Dr. Elizabeth James and Miss Alexandra Edwin for their input and enthusiasm.

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