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Prospective, randomised controlled trial comparing Versajet™ hydrosurgery and conventional debridement of partial thickness paediatric burns☆

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ABSTRACT

Introduction: Conventional surgical debridement of burn wounds consists of tangential excision of eschar using a knife or dermabrasion until viable dermis or punctate bleeding occurs. The Versajet™ (Smith and Nephew, St. Petersburg, FL, USA) hydrosurgery system has also been advocated for burn wound debridement, with the suggestion that enhanced preservation of dermal tissue might reduce subsequent scarring.

Methods: A prospective randomised controlled trial was undertaken comparing Versajet™ to conventional debridement. After excluding those with facial burns, 61 children ≤16 years of age undergoing debridement and skin grafting for partial thickness burns were recruited. Adequacy of debridement was assessed by 2 mm punch biopsies taken pre- and post-debridement. Surgical time, percentage graft take at day 10, time to healing, post-operative infection and scarring at 3 and 6 months were assessed.

Results: Thirty-one children underwent conventional debridement and 30 debridement using Versajet™. There was a significant difference in the amount of viable dermal preservation between the two groups ($p = 0.02$), with more viable tissue lost in the conventional group (median 325 μm) versus the Versajet™ group (median 35 μm). There was no significant difference between graft take at day 10 ($p = 0.9$), post-operative wound infection ($p = 0.5$), duration of surgery ($p = 0.6$) or time to healing after grafting ($p = 0.6$). Despite better dermal preservation in the Versajet™ group, there was no significant difference between scarring at 3 or 6 months ($p = 1.0$, 0.1).

Conclusions: These findings suggest that Versajet™ hydrosurgery appears a more precise method of burn wound debridement. Although dermal preservation may be a factor in reducing subsequent hypertrophic scarring, there were no significant differences found between scarring at 3 or 6 months after-injury.

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Abbreviation: TBSA, total body surface area.

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1. Introduction

Conventional surgical debridement of acute burn wounds prior to skin grafting commonly consists of sharp tangential excision of non-viable burn eschar with hand-held knives such as the larger Braithwaite or Humby knife, the smaller Goulian or Weck knife, scalpel blades, dermatomes or via dermabrasion [1]. Adequate debridement of these wounds has generally been determined by the presence of punctate bleeding and/or the presence of viable dermis or subcutaneous tissue [1–3].

The Versajet™ hydrosurgery system (Smith and Nephew, St. Petersburg, FL, USA) was developed in 1997 for the purpose of debriding many types of wounds, including burns prior to skin grafting [4,5]. The original system was superseded by the Versajet II™ (Smith and Nephew) hydrosurgery system in 2011 [5]. This system uses a high-pressure jet of sterile normal saline to debride wounds, drawing tissue debris and fluid into a chamber via the Venturi effect created by the normal saline jet [4,6–8]. The single-use, 45 degree angled, Versajet II Exact™ (Smith and Nephew) handpiece, commonly used to debride burn wounds, attaches to a console, which is then operated by a foot pedal [6,9]. Normal saline executes a 180-degree turn in the handpiece and is forced out of a narrow nozzle. This focused jet-stream passes parallel to the wound and is captured by an evacuator port which is located 8 or 14 mm from the nozzle. This jet of pressurised normal saline functions like a knife and the handpiece allows debridement and aspiration of debris to occur simultaneously [10]. Pressure can be adjusted (between 1787 and 11,535 psi) to facilitate the desired depth of debridement [9,10].

Using the cutting effect of the high-pressure jet of normal saline, tissue may theoretically be excised in a tangential manner, with maximal dermal preservation [6–8,11]. This preservation of dermal tissue, which may have been excised by conventional means, suggests that subsequent scarring might be reduced [12,13]. There are three known prospective randomised controlled trials published in the medical literature that have been undertaken comparing Versajet™ with conventional debridement in acute and chronic wounds [8,14,15], and one of which has been undertaken in burns [15]. Currently, there appear to have been no prospective randomised controlled studies published in the peer-reviewed scientific literature comparing Versajet™ (Smith and Nephew) with conventional debridement for paediatric burns.

We performed a prospective, randomised controlled trial to compare conventional tangential burn wound debridement with Versajet™ (Smith and Nephew) in children with partial thickness burns to assess whether there were statistically significant differences in dermal preservation, duration of surgery, wound infection rates, healing times and scarring outcomes.

2. Methods

2.1. Ethical considerations

Sydney Children's Hospitals Human Research Ethics Committee approval was obtained prior to commencement of this study. Signed consent was obtained from parents or guardians prior to patient enrolment.

2.2. Inclusion criteria

Children ≤16 years of age, attending the Burn Unit at The Children's Hospital at Westmead, Sydney, Australia for acute partial thickness burns undergoing debridement and split thickness skin grafting were considered for this study.

2.3. Exclusion criteria

Children with full thickness burns were excluded from recruitment as our primary outcome was reliant on the amount of dermal preservation. There is also some evidence that the Versajet™ (Smith and Nephew) hydrosurgery system may be less effective for excision of full thickness burns [16]. Children with facial injuries undergoing skin grafting were excluded from the study due to the requirement for two punch biopsies to be taken at the operative site. Patients who underwent delayed or staged grafting of their injuries, either due to significant pre-debridement infection or delayed presentation (beyond 14 days) were also excluded from the study.

2.4. Randomisation

Subjects were randomised in a 1:1 ratio to conventional debridement versus Versajet™ (Smith and Nephew) hydrosurgical debridement using permuted blocks of size four and six. Randomisation was to be stratified by the amount of total body surface area (TBSA) of the child receiving skin grafting (<10% TBSA versus ≥10% TBSA) in an attempt to maintain balance between the treatment groups, however no children with burns underwent skin grafting of ≥10% TBSA met inclusion criteria. Randomisation was computer generated and accessed following enrolment. Given the nature of this surgical intervention, it was not possible to blind the surgeons performing the procedure. It was possible, however, to blind the burns nursing staff, microbiologists, physiotherapists and pathologist involved to the treatment received by each participant.

2.5. Power calculation

An estimate of the required sample size was determined using results from similar studies [8,15]. The estimated sample size calculated using the available data was approximately 60 patients. The final number of eligible children recruited was 61.

2.6. Surgical technique and specifications

All subjects underwent standard general anaesthesia and received anti-septic povidone–iodine operative site preparation prior to sterile draping. A 2 mm punch biopsy was then taken at the site of the unhealed partial thickness burn to be grafted (Fig. 1). Subjects were then randomised into receiving debridement using the Versajet II Exact™ (Smith and Nephew) hydrosurgical system or conventional tangential burn wound debridement using a Goulian knife (6–8 thousandths of an