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Live sibling skin allografts for severe burns in a paediatric patient: A viable option in developing countries[☆]



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ABSTRACT

Severe burns in the paediatric population are associated with high mortality and morbidity in any developing countries. Children with more than 40% total body surface area burns in Fiji will succumb from complications and as a direct result of inadequate treatment and lack of resources. The surgical treatment of any severely burnt patient is not only laborious but very costly to the Fiji health system and depletes existing resources with few options for skin coverage. This is the first case report of live sibling skin allograft for severe paediatric burns and one of only few patients to have survived more than 50% burns in Fiji. We describe the technique and the role of using live sibling skin allograft as an option to improve survival in patients with severe burns in a developing country.

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1. Case report

A 12 year old Fijian girl was admitted with 65% total body surface area (TBSA) open flame burns from a kerosene stove explosion. More than 50% of the burnt surface was full thickness burns to the trunk and circumferentially involving both upper and lower limbs. She was initially resuscitated with intravenous fluids using the Parkland formula and remained hemodynamically stable but we lack the provision of the appropriate surgical treatment. She was fortunate to have acquired the assistance of a visiting paediatric burns surgeon from Australia with generous donations from overseas organizations whose contributions included a dermatome, a skin mesher, skin staples, crep bandages and Acticoat burns dressing. She required multiple burns excision and skin autografts from her remaining skin and scalp which were auto grafted with meshed skin to a ratio of 1:8. Given the lack of donor skin and after

much deliberation over the ethical dilemma of allografts, ethical approval was granted from the hospital administrators for live sibling skin allograft from her two older brothers to be grafted on top of her meshed autografts. Her allografts skins were meshed to a 1:4 ratio and were secured with staples and protected with Acticoat dressings. She also required multiple blood transfusions given the numerous burns excisions and skin grafts and she was nutritionally supported with nasogastric tube feeds. As demonstrated in Figs. 1–4, the various stages of healing of the autograft and the allograft skin had allowed for adequate and successful temporary burns cover and healing without any infection. She has remained well since and has had release of her contractures but she will require further rehabilitation and surgery if needed.

2. Discussion

In Fiji, burns injuries are common and the outcome are usually poor with significant morbidity and high mortality. Fiji's population is around 900,000 with a reported annual incidence of burns of 17.8 per 100,000 [1], such an alarming rate in a small population. As with previous reports, the majority of burns (90%) occur in the low to middle income countries like Fiji who not only have limited infrastructure to reduce the incidence but also lack the resource to treat severe burns [2,3]. More than 50% of these severe burns were children under the age of 14 years and 15% were young adults from 15 to 29 years [1]. Similarly, any adult with more than 60% total

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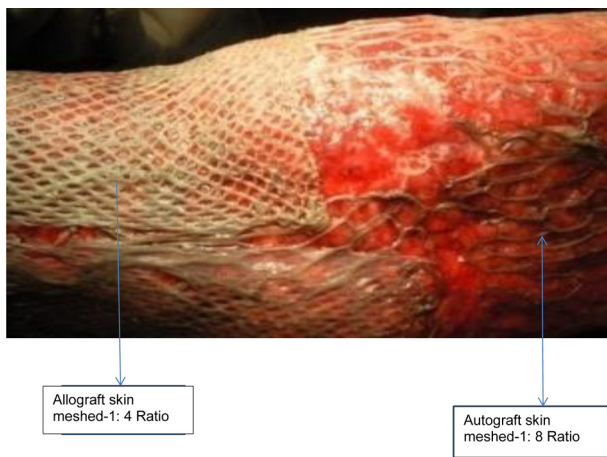


Fig. 1. The patient's available skin was harvested with an electric Dermatome and meshed into a ratio of 1:8 which was then auto grafted onto the debrided burns surface (double arrow). The live siblings' allograft skin was then meshed into 1:4 ratio and grafted (single arrow) above the auto grafted skin followed by Acticoat dressings.



Fig. 3. Day 20 Post-operative: Demonstrated that the autograft and allograft skin have remained intact apart from the edges of the allograft skin which have begun to peel off (see arrows). She has otherwise remained well.

body surface area (TBSA) burns in Fiji, despite adequate acute resuscitation, has a mortality rate between 85 and 95% [1,4].

Burns has a high mortality rate, with over $\frac{1}{4}$ million deaths being reported worldwide each year [5]. As it was found in Fiji, majority of these deaths would occur in low to middle income countries compared to high income countries [5]. Apart from the lack of resources and inadequate management of burns in these developing countries, malnutrition and infection would contribute significantly to these deaths. Children under the age of 5 years were 3 times more likely to die from burns in the African Region due to these reasons [5]. Those that do survive burns often have to live with the long-term emotional and physical disfigurement. These burns survivors have to endure multiple surgeries, significant contractures and prolonged rehabilitation which can affect the entire family and social structure. Burns injuries have remained as the fourth most common type of trauma world-wide following accidents, falls and interpersonal violence [6,7] and everyone should have a role in trying to reduce the incidence. Open fire as with burst kerosene stoves as in our case or house fire is still the commonest cause of burns in our paediatric population.

The paediatric cases should have a high mortality rate in any developing country, given their total body surface area to volume ratio as compared to adults. This was the findings in Fiji that any paediatric patient under 14 years who is admitted with greater than 30–40% TBSA burns (much less as in adults) has a mortality rate of

80% [1,4]. This is an alarming figure and despite the training of doctors and nurses in the management of paediatric burns, most often succumb to infection from lack of appropriate skin substitute and/or severe malnutrition. This high mortality rate would be deemed unacceptable in any developed countries as they have the resource to appropriately treat any child with severe burns. Very few paediatric patients from Fiji with severe burns that have survived were fortunate to have received treatment abroad, either in New Zealand or Australia. Despite Fiji being a renowned tourist location in the Pacific, the overall mortality of burns contributes to 36% of the total deaths recorded over a 12 month period [1] and these could be reduced significantly if the resources are available locally.

Treating burns locally, as in any developing country like Fiji can be very costly to the health system. Despite the local surgical and nursing teams being trained in the management of burns, the economic costs of treating burns patients often adds to the poor outcomes [2,3]. The estimated cost of the Acticoat dressings alone used in this case report including other expenses like travel, blood products and other consumables was more than \$50,000 AUD. This is equivalent to more than \$100,000 Fijian dollars, which will be enough to cater for medical consumables for any divisional hospital to run its operating theaters for several months. Due to high costs, the burns dressings in Fiji have therefore been limited to the use of Gladwrap (Cellophane) in the acute presentation followed by Silver Sulphur Diazine (SSD) cream and gauze materials to cover the



Fig. 2. Day 10 Post Autograft and Allograft: demonstrated that both layers of skin grafts have taken well with some exposed bones surface (arrow) and she was clinically well.



Fig. 4. Day 30 Post-operative: Demonstrated that the allograft skin layer have now necrosed and peeled off leaving a thin, transparent layer of new epidermis on the burns surface. There is evidence of neo-vascularization (see arrow) which blanches with pressure. These healed well with excellent skin coverage.

burns. However, this amount is still cheaper than if she was to be transferred to Australia where it would have cost the Fiji health system more \$150,000 AUD for the acute treatment only. We do not have the resources to provide appropriate temporary burns cover dressings that are available in developed countries to manage severe burns in Fiji.

Skin debridement and escharectomy is critical in the treatment of burns which can be done locally. Those that require skin grafting would have the burns excised followed by skin harvesting using a Humby knife with a scalpel blade handy to create multiple fenestrations on the auto-grafted skin. Less severe burns that have adequate normal skin would get the appropriate treatment of early skin debridement and grafting. Failure of debridement and early skin grafting in severe burns patients often precedes wound sepsis and death. With limited funding, lack of any other treatment options in Fiji and given the severity of the burns in our child, her family was informed of her expected grave outcome. Even if we were to start debriding her burns, we would not have enough skin to cover the entire burns surface and it would have been appropriate in our health system to consider palliative treatment. Her family did not accept the option of palliative treatment so they were then informed to consider the use of skin allograft from family member's as a substitute or assist her own autograft skin. Ethical approval was obtained from the senior hospital administrators as this technique of skin allograft to our knowledge had never been done before in Fiji or in the Pacific. Allograft skin from family members is not widely accepted worldwide and hence raises the ethical dilemma and medico-legal implications of this technique. The family were given time to consult and were allowed to make an informed choice given the circumstances, prior to consenting for the older male siblings to be live allograft skin donors. Both the siblings were more than 18 years old which is the legal age of independent decision in Fiji and both had consented individually to be the allograft skin donors, which had allowed the parents to be available to be with the patient in the hospital.

The use of live sibling skin allograft for severe burns in the paediatric population is not the conventional management in any developed countries. This is not the ideal treatment of skin graft in burns and to our knowledge; there is no current literature available on its use. Taking into account the religious and ethical considerations [8], improvements and major developments in burns treatment and the availability of cadaveric, porcine or synthetic skin substitutes [9–11] the option of using live sibling allograft has been long abandoned. In any developing country, synthetic skin options are either not available or are very expensive and would be a huge burden of cost to the health system. The use of cadaveric donor skin in developing countries like Fiji is not acceptable due to religious and cultural beliefs, and relatives would not consent to skin harvesting from cadavers. We also lack the facilities for storage and screening of cadaveric skin, hence the option of live siblings' allograft was considered as a viable option despite the limited literature available [12]. The possibility of allograft skin graft rejection and potential for disease transmission was also articulated to the family but it would at least allow temporary skin coverage.

As demonstrated in Figs. 1–4, the allografts and autograft skin took quite well for a month and had provided adequate skin cover which had allowed re-epithelialization of own skin to heal. She has not required any further skin grafting and this technique, in our opinion, is a viable and safe option in any developing countries that lacks the resources for advanced burns management. Since this case report, we have considered this form of temporary dressings using allograft skin from close family members in any paediatric patient

with severe burns if the family agrees. This patient has recovered well from the acute burns and has had ongoing rehabilitation with release of contractures of her lower limbs with great success in Australia. She is an inspiration to everyone that were involved in her care given her strong will and positive attitude to survive and we believe that the use of live sibling allograft skin have contributed to that success.

3. Conclusion

Live sibling skin allograft with autograft skin we believe is an effective and safe option to be considered for providing temporary skin cover in severe burns in developing countries with limited resources. The financial assistance and support of overseas sponsors is paramount for these children to survive. For our patient, she is one of the few paediatric cases with severe burns of more than 40% to have survived in Fiji and we believe that this is the first case of live allograft to be done in Fiji or in the Pacific region. We would, however, advise caution as there are ethical dilemmas and it is a technique that has not been widely accepted or previously reported in the current international literature.

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