

Advanced management of facial burns with cultured keratinocyte dressings in the pediatric patient.

A case report

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Case Report

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Background

Facial burns are a major public health issue in Mexico due to the morbidity and mortality they cause in this age group. Facial burns account for about 17% of morbidity in patients with immediate complications and long-term sequelae, while 18% will develop permanent disability. Pediatric facial burns are a challenge for the reconstructive surgeon since it is difficult to predict the progression of the scar in a patient who will continue to grow. The treatments must help prevent disability or permanent limitation as well as aesthetic alterations that could have psychosocial repercussions for the patient. The case of a 1-year-old patient with superficial and deep second-degree facial burns managed with cultured keratinocyte patches is presented. The procedure can be considered a reproducible technique with a short learning curve and an effective tool in special areas. It does not generate morbidity with respect to donor areas and offers an alternative when their use is limited. The purpose of this article is to describe the results and advantages of this innovative therapy in relation to hospitalization time as well as the cost-benefit ratio.

Keywords: Burns, pediatric burns, burns reconstruction.

Pediatric burns represent a public health issue in Mexico, as they are an important cause of morbidity and mortality in this age group. Every year, about 13 thousand people suffer burn injuries in our country, of whom between 5 and 8% are children. In this population, scald burns are the main burn mechanism; however, fire injuries represent 13% of every pediatric burn, a number that is highly relevant if we consider that due to their association with CO inhalation, they may represent higher mortality^[1]. Moreover, it is associated with about 17% of morbidity in patients with immediate complications and long-term sequelae, while 18% will develop permanent disability^[2]. Another point to consider are the epidemiological and clinical characteristics of the patients involved, who often require at least one surgical procedure during hospitalization. This significantly increases the cost of care, particularly for patients who require intensive care unit management and the high cost of supplies required for the management of skin lesions^[3].

Despite the advances made in the management of burn patients, pediatric facial burns are still a challenge for the reconstructive surgeon since it is difficult to predict the scar evolution in a patient who will continue to grow, as well as the disability or permanent limitation that it might present.

When discussing facial burns in pediatric patients, it is imperative to take into account the heightened complexity of reconstruction as well as the need for satisfaction, taking into account the aesthetic subunits. The disruption of even one of these subunits can completely disrupt the facial anatomical harmony, resulting in psychological and social repercussions for the burned patient. As a result, the management of the pediatric patient with burns focuses not solely on preserving the patient's life and achieving adequate functionality but also on doubling the facial aesthetic subunits^[4].

Epifast® is a sheet of in vitro-cultured human keratinocytes that is mounted on a sterilized and vaselined cloth and placed between two grids. It consists of three to five layers of living keratinocytes mounted on a vaselined cloth whose dimensions are seven by eight centimeters. It is a biologically active dressing that produces growth factors and can accelerate the formation of tenascin by hydroblasts as well as blood vessel formation in granulosal tissues. This specific product has demonstrated its efficacy in the management of patients with chronic wounds and re-epithelialization in diabetic foot patients^[5-6]. Additionally, it joins the group of products that utilize cultured human keratinocytes, whose efficacy has been demonstrated in the treatment of burn patients, accelerating the speed of epithelialization, reducing

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Age	1 year old
Sex	Male
Weight	11,5 kg
TBSA	13,5%
Burn mechanism	Direct fire burn
Depth	Superficial and deep 2 nd degree burn
Attention time	Less than 24 hours
Hospitalized days	10
Epithelialization time	1 st degree - 3 days Superficial 2 nd degree - 5 days Deep 2 nd degree - 8 days

*TBSA total body surface area

Table 1. Patient characteristics.

the duration of hospital stay, and reducing the number of surgical procedures ^[7].

Case report

A 1-year-old male patient who is brought by a family member to the emergency room at the South Central Hospital of High Specialty of Petróleos Mexicanos due to burns calculated at 13.5% of the total body surface by direct fire mechanism. Upon arrival, he did not present laryngeal stridor, perioral or vibrissae burns, or other data suggesting immediate or short-term compromise of the airway or CO inhalation poisoning. Consultation with the plastic and reconstructive surgery service was requested, finding deep second-degree facial burns on both cheeks and superficial second-degree burns on the rest of the face, in the right thoracic-abdominal region (superficial second-degree), elbow and right hand (superficial second-degree), and left-hand phalanges (superficial second-degree).

The patient was hospitalized for 10 days, during which two surgical procedures were performed. On day 1, mechanical washing and surgical debridement were performed. Approximately 5 patches of cultured human keratinocytes (Epifast®) were placed in the facial region, which were fixed with non-absorbable sutures to prevent their detachment, followed by the placement of an absorbent foam dressing on the extremities. The second procedure on day 5 was a mechanical washing and removal of Epifast® from the facial region since it was found to have 95% epithelialization. The patient evolved favorably, achieving epithelialization after 10 days and being discharged home with NSAID-type analgesics and facial moisturizing gel.

Follow-up was given in the outpatient clinic. Seven days later, burns were identified in the facial region in the process of epithelialization without signs of infection or other complications. The following visit was 14 days later, with complete re-epithelialization 24 days after the first surgical procedure (Figure 1).

Our 1-year-old male patient was diagnosed with superficial and deep second-degree burns of 13.5% total body surface area. In the facial region, he presented deep second-degree facial burns on both cheeks and superficial second-degree burns on the rest of the face. Patches of cultured human keratinocytes were placed on the facial region for 5 days. After 10 days, he was discharged from the hospital. Epithelialization time was obtained in first-degree burns of 3 days, superficial second-degree burns of 5 days, and deep second-degree burns of 8 days. (Table 1). Subsequently, follow-up was given by an outpatient clinic, where complete healing was found 24 days after the first procedure.



Figure 1. Satisfactory evolution with early, functional and esthetic discharge from day one to day 24th.

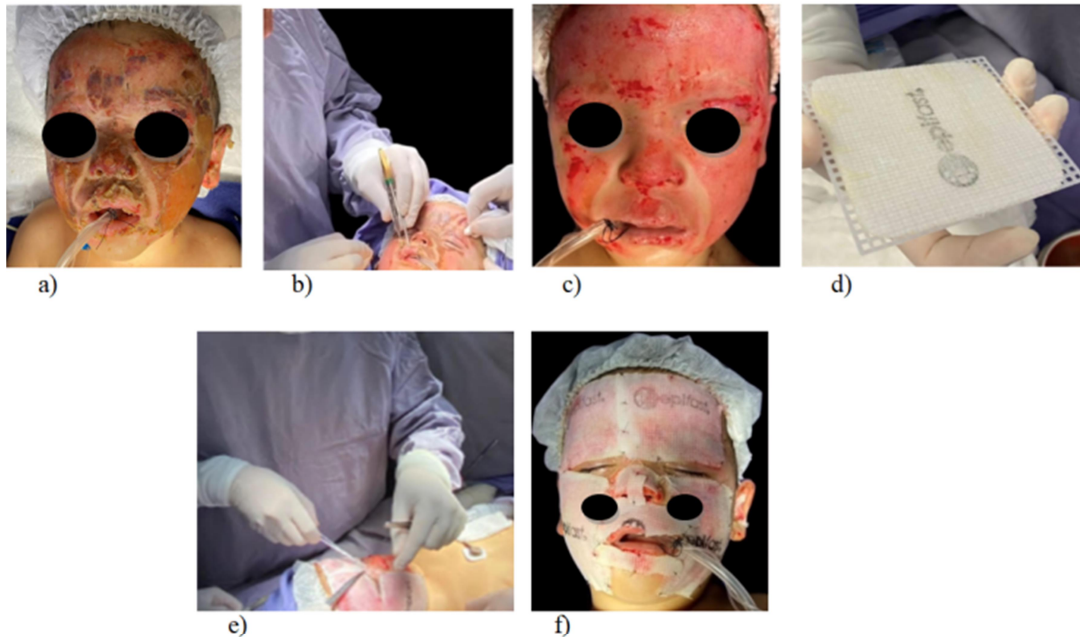


Figure 2. Technique of application of the cultured keratinocyte sheets. Patient prior to surgical treatment (a). Washing and debridement (b). Bed prepared for application of cultured keratinocytes (c). Opening of the dressing of cultured keratinocytes (d). Application of cultured keratinocytes (e). Complete facial coverage with cultured keratinocytes (f).

Discussion

The use of autografts of skin is currently the gold standard for the treatment of burns and to replace skin loss; however, this resource is limited in extensively burned patients due to a lack of donor areas, special areas, or limited surfaces, as in the case of pediatric patients^[8-10].

A bibliographic review was carried out in the pubmed medical search engine, considering works that included the terms "cultured keratinocytes", "burn", "children" where we found different series from the year 2000 to 2023 of patients with burns that are managed by means of patches of cultured keratinocytes, it is identified that the hospital stay is similar in all the series, reporting a shorter time when compared to the series with conventional management, in the same way the number of procedures necessary before the final result is reduced in patients treated with keratinocytes cultured 4 ± 2 when compared with other therapeutic alternatives 7 ± 2 ^[11-13]. The parameter with much higher evidence is epithelialization time, which was presented with a clear reduction in all the series whose patients were treated with patches of cultured keratinocytes for 4 ± 2 days vs 18 ± 2 days in management considered the gold standard^[14-15], which in turn is reflected as a decrease in care costs. Despite the price of Epifast® patches, the reduction in the number of procedures as well as the days of hospital stay and therefore the lower risk of complications such as nosocomial infections, represent a positive cost-benefit ratio for the use of patches of cultured keratinocytes.

Conclusion

This paper corroborates the information obtained from previous studies on the use of Epifast® as a therapy for the management of facial burns, in this case applied to a pediatric patient, since a favorable and measurable result was achieved in various aspects: less time of epithelialization in superficial and deep second-degree burns, length of hospital stay, patient without complications, reduction in care costs, and short- and medium-term sequelae. The procedure can be considered a reproducible technique; with a short learning curve and short application, it is an effective tool in special areas; it does not generate morbidity with respect to donor areas; and it offers an alternative when their use is limited. It is necessary to continue using this technique in our service and with other methodological designs that establish the scope of these measures.

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Conflicts of interest

No conflicts of interest

References

1. World Health Organization [Internet]. Burns; 2018 [cited 12 July 2023]. Available at: <https://www.who.int/news-room/fact-sheets/detail/burns>.
2. Gobierno de Mexico, Secretaria de Salud [Internet]. Cuenta México con centro de alta especialidad para atender quemaduras graves; 2021 [cited 12 July 2023]. Available at: <https://www.gob.mx/salud/prensa/170->

- cuenta-mexico-con-centro-de-alta-especialidad-para-atender-quemaduras-graves#:~:text=En%20México%2C%20cada%20año%20cerca,y%20en%20v%C3%ADas%20de%20desarrollo
3. De-Luna-Gallardo D, Cahuana-Quispe AI, García-Espinoza JA, Arámbula-Sánchez BY, Navarro-Delgadillo CI, Dávila-Díaz R, Erazo-Franco MA, Costa-Dulche A, Mena-Garza AA, Morales-De-La-Cerda R, Flores-Soto D, Cuervo-Vergara MA, Reyes-Ibarra PA, Márquez-Espiella C. Use of Cultivated Epidermal Allograft in Chronic Wounds: A Novel Therapeutic Alternative. *J Cutan Aesthet Surg*. 2022 Jul-Sep;15(3):237-243.
 4. Martínez-De Jesús FR, Frykberg R, Zambrano-Loaiza E, Jude EB. Re-Epithelialization of Neuropathic Diabetic Foot Wounds with the Use of Cryopreserved Allografts of Human Epidermal Keratinocyte Cultures (Epifast). *J Clin Med*. 2022 Dec 10;11(24):7348.
 5. Bannasch H, Unterberg T, Föhn M, Weyand B, Horch RE, Stark GB. Cultured keratinocytes in fibrin with decellularised dermis close porcine full-thickness wounds in a single step. *Burns*. 2008 Nov;34(7):1015-21.
 6. Inoue S, Kijima H, Kidokoro M, Tanaka M, Suzuki Y, Motojuku M, Inokuchi S. The effectiveness of basic fibroblast growth factor in fibrin-based cultured skin substitute in vivo. *J Burn Care Res*. 2009 May-Jun;30(3):514-9.
 7. Castellanos-Ramirez Diana Karina, Gonzalez-Villordo David, Gracia-Bravo Laura Josefina. Manejo de heridas. *Cir. gen*. 2014; 36(2): 112-120
 8. Barret JP, Wolf SE, Desai MH, Herndon DN. Cost-efficacy of cultured epidermal autografts in massive pediatric burns. *Ann Surg*. 2000 Jun;231(6):869-76
 9. Arámbula H, Sierra-Martínez E, González-Aguirre NE, Rodríguez-Pérez A, Juárez-Aguilar E, Marsch-Moreno M, Kuri-Harcuch W. Frozen human epidermal allogeneic cultures promote rapid healing of facial dermabrasion wounds. *Dermatol Surg*. 1999 Sep;25(9):708-12.
 10. Cienfuegos MR, Sierra ME, Juárez AE, et al. Aloinjertos de epidermis cultivada para áreas donadoras de piel y lesiones de espesor total en pacientes politraumatizados. *An Med Asoc Med Hosp ABC*. 2003;48(2):84-88
 11. Alvarez-Díaz C, Cuenca-Pardo J, Sosa-Serrano A, Juárez-Aguilar E, Kuri-Harcuch W. Controlled clinical study of deep partial thickness burns treated with frozen cultured human allogeneic epidermal sheets. *J Burn Care Rehabil*; En prensa.
 12. Cuenca-Pardo J, Álvarez-Díaz C. Costo-beneficio de la cirugía precoz del paciente quemado comparado con cirugía tardía. *Cir Plast* 2000; 10(1): 5-7
 13. Alvarez-Díaz C, Cuenca-Pardo J, Sosa-Serrano A, Juárez-Aguilar E, Marsch-Moreno M, Kuri-Harcuch W. Controlled clinical study of deep partial-thickness burns treated with frozen cultured human allogeneic epidermal sheets. *J Burn Care Rehabil*. 2000 Jul-Aug;21(4):291-9.
 14. Bolívar-Flores J, Poumian E, Marsch-Moreno M, Montes de Oca G, Kuri-Harcuch W. Use of cultured human epidermal keratinocytes for allografting burns and conditions for temporary banking of the cultured allografts. *Burns*. 1990 Feb;16(1):3-8
 15. Yanaga H, Udoh Y, Yamauchi T, Yamamoto M, Kiyokawa K, Inoue Y, Tai Y. Cryopreserved cultured epidermal allografts achieved early closure of wounds and reduced scar formation in deep partial-thickness burn wounds (DDB) and split-thickness skin donor sites of pediatric patients. *Burns*. 2001 Nov;27(7):689-98

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