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Reconstruction of skin defects on the penis after severe burns

Reconstrucción de defectos cutáneos en pene después de quemaduras severas

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ABSTRACT

Genital burns have a variable clinical presentation and, when not treated promptly, can increase the risk of morbidity and mortality. The most affected anatomical area in the male is the shaft of the penis; these patients require extensive surgical debridement once the tissue affected by the burn has been delimited, subsequently presenting with complex and irregular skin defects. To reduce secondary tissue necrosis, penile skin defects after a severe burn should be treated early to minimize secondary tissue necrosis, preserve functional tissues, and recover the elastic texture of the skin. Regarding the experience of our surgical team with the use of thin partial thickness skin grafts and, in some cases, a scrotal flap with modification in the tip design, the results show that they can be helpful tools, provide a definitive skin coverage, sensitive function, and elasticity by using local tissue with similar characteristics, regarding the technique can be performed with minimal technical difficulty and minimal morbidity resulting, we always recommend long-term follow-up, to evaluate the functional aesthetic results and complications that may occur.

RESUMEN

Las quemaduras en genitales tienen una presentación clínica variable cuando no son tratadas oportunamente pueden aumentar el riesgo de morbilidad y mortalidad. El área anatómica comúnmente afectadas en el varón es el cuerpo del pene, estos pacientes requieren un desbridamiento quirúrgico extenso una vez delimitado el tejido afectado por la quemadura, presentando posteriormente defectos de piel complejos e irregulares. Los defectos de piel en el pene después de una quemadura severa deben tratarse tempranamente con el objetivo de reducir la necrosis tisular secundaria, preservar los tejidos funcionales y recuperar la textura elástica de la piel. Respecto a la experiencia de nuestro equipo quirúrgico con la utilización de injertos cutáneos de espesor parcial fino y en algunos casos un colgajo de escroto con la modificación en el diseño de la punta, los resultaron muestran que pueden ser herramienta útiles, proporcionar una cobertura cutánea definitiva, función sensitiva y elasticidad al emplearse tejido local con características similares, respecto a la técnica se puede realizar con mínima dificultad técnica y mínima morbilidad resultante, siempre recomendamos llevar un seguimiento a largo plazo, para evaluar los resultados estéticos funcionales y complicaciones que puedan presentarse.

INTRODUCTION

Genital burns have a variable clinical presentation and, when not treated promptly, can increase the risk of morbidity and mortality.[1] The anatomical area commonly affected in males is the penile shaft; this group of patients requires extensive surgical debridement once the tissue affected by the burn is delimited, presenting with complex and irregular skin defects.[2]

The goals for successful reconstruction in patients with penile shaft burns require tension-free surgical repair to allow sufficient

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length, adequate skin for unrestricted erections to allow acceptable sexual function, protective sensitivity to prevent chronic skin degeneration, ability to empty the corpora cavernosa spontaneously while standing, minimize tissue loss, maintain adequate penile shaft thickness, preserve voluntary urination, avoid scar retraction and present a good aesthetic appearance.[3]

The penile shaft is composed of skin, Colles' fascia, Buck's fascia, dorsal superficial vessels and nerves, tunica albuginea, and erectile tissue composed of paired corpora cavernosa and the corpus spongiosum around the urethra; burns in this anatomical area cause severe functional and aesthetic sequelae.[4] The plastic surgeon faced with this clinical scenario must be clear about the reconstructive goals and focus on achieving successful reconstruction with the skin and tissue available after debridement.[4,5] He or she must also consider that the burn promotes an inflammatory reaction that, depending on its extent, can be localized or systemic. Deep burns will transform the skin into eschar; this presents bacterial invasion to healthy tissue, causing greater release of proinflammatory elements such as tumor necrosis factor, interleukins, and cytokines, which causes damage to deep anatomical planes.[6]

Penile skin loss can occur after a variety of pathological processes, such as severe genital burns, genital lymphedema, soft tissue infection, and excessive skin removal after debridement.[7] This results in severe functional and aesthetic disability for the patient, which can have a significant impact on their quality of life, requiring an individualized reconstructive surgical technique focused on the particular conditions of each patient.[4] Skin coverage options include partial or full-thickness skin grafts, fascio-cutaneous flaps, pedicled flaps, microsurgical reconstruction, or a combination of these.[2]

We aim to demonstrate our expertise in treating penile skin defects after severe burns and the surgical techniques to provide successful skin coverage with acceptable aesthetic and functional results.

Figure 1: *A full-thickness graft with manual fenestrations covers a defect in the anterior aspect of the penile shaft.*

Case 1

A 19-year-old patient presented with a third-degree scald burn on the skin of the penile shaft. Physical examination revealed necrosis of the skin of the penile shaft, with no signs of hematuria or difficulty urinating. Debridement of the necrotic tissues was performed, presenting a cutaneous loss of the penile shaft, leaving the tunica albuginea and glans intact. In this case, the inner skin of the foreskin was preserved, and a full-thickness skin graft with fenestrations was performed to cover the defect immediately after debridement; the donor site was the left groin, which was managed with a primary closure. The patient had an uneventful postoperative course. A follow-up examination showed an integrated and sufficiently mobile skin graft with great flexibility *(Figure 1)*.

Case 2

A 36-year-old male patient presented with a scald burn, and within a few hours, he showed local edema and necrotic skin on the shaft of the penis, accompanied by changes in color and temperature. He was diagnosed with a third-degree scald burn on the shaft of the penis. Urgent surgical debridement was performed, and once the necrotic tissue

was delimited, the resulting skin defect was evaluated. Physical examination documented a skin loss with irregular edges of 6 cm in length × 4 cm in the base in the penile shaft and granulation tissue in Buck's fascia, with no evidence of an active infectious process. The reconstructive technique selected for skin coverage of the resulting defect required the design of a scrotal flap with modification of the distal part *(Figure 2)*, of a scrotal skin longitudinal 12 cm in length × 8 cm in the base, subsequently advanced to allow skin coverage of the anterior and lateral aspect of the penile shaft *(Figure 3)*. The vascularization of the flap comes from the external pudendal artery, which provides adequate vascular supply to the skin and subcutaneous tissue in the most distal region of the flap *(Figure 4)*. The laxity of the scrotal skin allowed coverage of the entire skin defect without the need to mobilize the proximal third of the flap *(Figure 5)*. He did not require splinting of the penis, only the placement of a jockstrap in the scrotal region *(Figure 6)*. The patient started physical therapy 48 hours after surgery and was discharged from the hospital 14 days postoperatively. In the plastic surgery office follow-up, the patient presented stable skin coverage and sensitivity in the flap's skin, referring normal erections, and no functional limitation.

Figure 2: *36-year-old male patient with residual skin defect on the shaft of the penis following extensive surgical debridement for scald.*

DISCUSSION

This paper describes two surgical techniques employed by our surgical team for reconstructing skin defects on the penile shaft, the technical advantages, and long-term results. In our center, patients with penile skin defects after a burn require an individualized surgical technique that considers the integrity of anatomical structures after surgical debridement, the detailed evaluation of the patient's characteristics, the resulting defect, and the available resources and infrastructure. The vascularity of this region

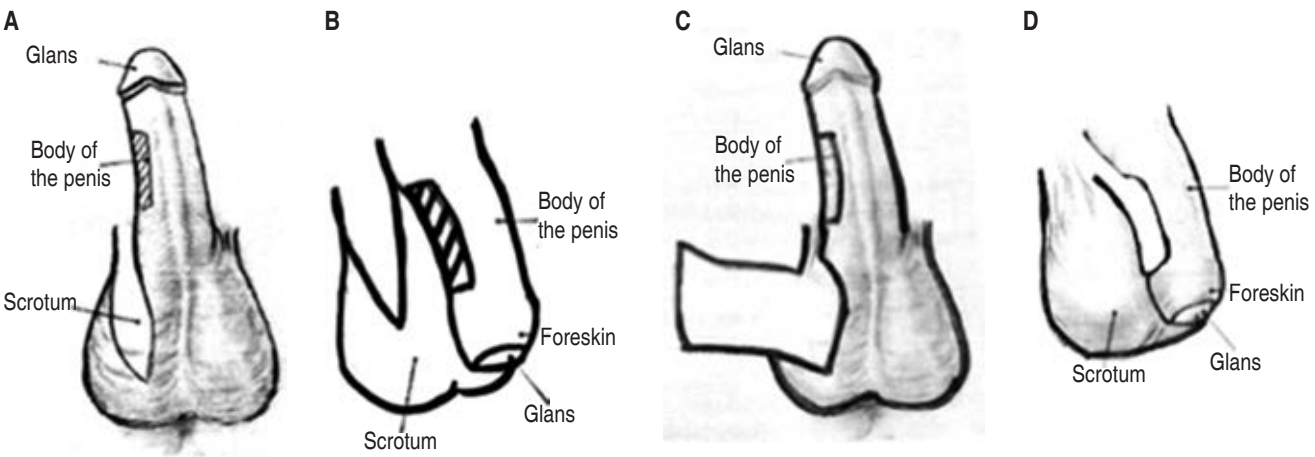

Figure 3: ***A)*** *Initial design of the scrotal flap and delimitation of the defect with the penis in extension.* ***B)*** *Scrotal flap design in the usual penile situation.* ***C)*** *Movement of the scrotal flap to evaluate tension-free advancement.* ***D)*** *Resultant of the flap.*

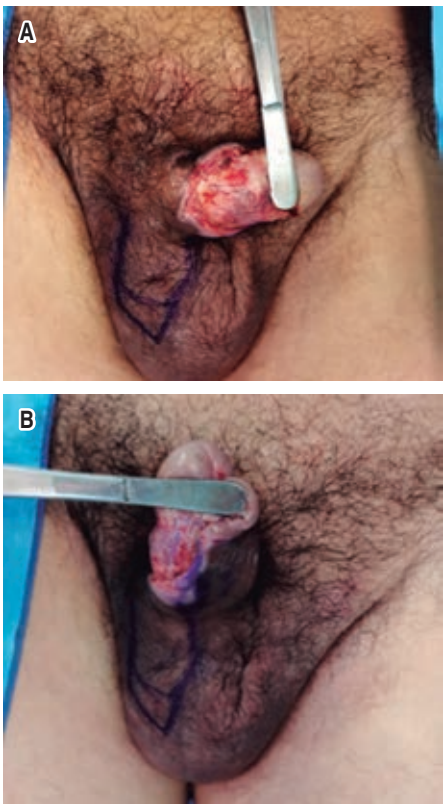

Figure 4: A) *Scrotal flap design with modification of the distal part to end in a tip, allowing advancement.* ***B)*** *Evaluation of scrotal skin laxity to cover the penile shaft and its ability to return to its initial position.*

allows the design of several local flaps to cover the penile skin defects, based on the principle that the blood supply system reduces the risk of necrosis. Thus, multiple surgical techniques can achieve acceptable aesthetic and functional skin coverage.[1]

In the first clinical case, a full-thickness graft with fenestrations was performed to cover an important extension of the penile shaft without using tissue from the foreskin or scrotum, showing good postoperative evolution without complications in the donor area. This approach correlates with that reported by Chertin and collaborators regarding the application of laminated partial thickness skin grafts in children from 2 to 18 years of age with satisfactory functional and esthetic results.[2] Some other surgical groups report 15 years of experience in the performance of partial thickness skin grafts for male genital reconstruction with successful results for lesions of multiple etiology.[3] We must remember that partial or full-thickness skin grafting is a simple surgical technique frequently related to secondary graft contraction and erection difficulty.[4]

In the second clinical case, a scrotal flap was performed, which allowed adequate skin coverage with skin identical to the injured skin and without leaving a residual skin defect.[5] A base was designed with vascular

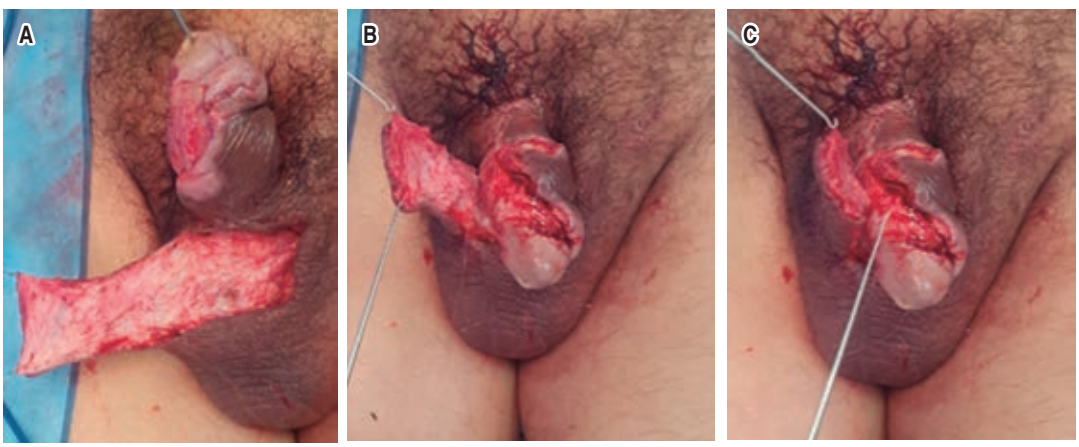

Figure 5: A) *Residual skin defect in the scrotum after flap lifting.* ***B)*** *Final position of the penile shaft in the scrotum, evaluating tension-free stretching.* ***C)*** *Advancement of the scrotal skin flap for skin coverage of the anterior portion of the penile shaft.*

contribution from the external pudendal artery; subsequently, the dissection of the flap was performed, which allowed the advancement in the form of a book page over the resulting skin defect in the penile shaft; mummification of the most distal part of the flap was performed so that it ended in a point, this configuration allowed skin coverage with tissue of similar diameter, color and sensitivity to the defect, and avoided the appearance of scar contracture.[6] In the literature review, we have not found any reported cases of scrotal flaps with modifications of the tip design.[7] Scrotal flaps provide a similar reconstruction with donor tissue, and a tension-free repair can be performed without increasing days of hospitalization and with minimal sequelae in the donor area.[8] Compared to skin grafting, the scrotal skin flap has several advantages, such as skin texture, less shrinkage, and better elasticity during an erection. However, little has been published on scrotal skin flaps covering severe skin defects. Pedicled flaps from adjacent areas, such as the groin, represent a reconstructive option with good sensory function and adequate vascularization. These characteristics allow the penis to regain its strength and elasticity but report drawbacks with scarring of the donor site and excessive bulging of the tissue in the recipient site.[9]

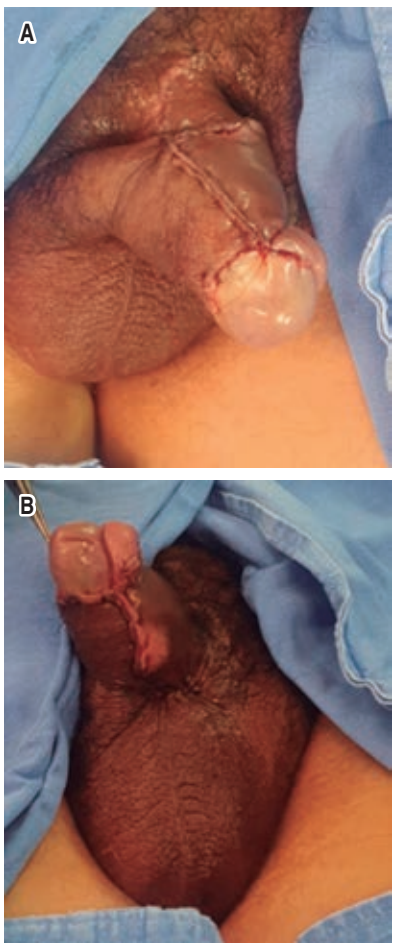

Figure 6: A) *Resulting scrotal flap, achieving tension-free skin coverage, preserving the shape of the penile shaft and glans penis.* ***B)*** *Resultant after closure of the donor area of the flap.*

It is essential to point out that the study and detailed description of the anatomical characteristics of the genital region allow the performance of free microsurgical flaps, with the disadvantage of requiring a team of trained microsurgeons, specialized instruments, and infrastructure, close monitoring of the evolution of the flap, and follow-up of the morbidity generated in the donor area.[10] High voltage electrical burns in the genitalia and perineum are very rare; there are only some case reports found in the literature. The devastating damage triggered by electrical injury to the penile skin, subcutaneous tissue, corpus cavernosum, and urethra requires treatment focused on preserving tissue and structures as much as possible and seeking the earliest possible skin coverage with tissue and abundant vascular supply to improve healing in conjunction with the use of adjuvant therapies such as hyperbaric chamber to improve local blood circulation and promotion of angiogenesis.

CONCLUSIONS

To reduce secondary tissue necrosis, penile skin defects after severe burns should be treated early to minimize secondary tissue necrosis, preserve functional tissues, and recover the elastic texture of the skin. Regarding our surgical team's experience, we suggest using tissue with similar characteristics and rich vascular supply and trying to carry out long-term follow-ups. We recommend individualizing the selection of the surgical technique and keeping in mind that inadequate choice for skin coverage may result

in unwanted and difficult-to-treat complications such as penile contracture, limitation of sexual function, and changes in self-esteem and self-perception of the patient.

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