Adequate debridement and pie-crusting technique in the management of traumatic injuries

Luis A. Beraún Coronel,[*] Manuel O. Becerra Orrego,[**] José G. Quispe Juárez[**]
[*]Department of Orthopedics and Traumatology, Hospital II-2 Tarapoto (Tarapoto, Perú)
[*]Department of Orthopedics and Traumatology, Hospital Nacional Dos de Mayo (Lima, Perú)

ABSTRACT
Chronic wounds of traumatic origin, with tissue exposure, require adequate debridement, lavage and prompt coverage to prevent infection and desiccation. Wounds may even require to be enlarged in order to perform an adequate surgical debridement. Enlarged wound attempts to perform a complete coverage may result in tension wound closures, which are complicated by inflammation, infection, and dehiscence and aggravated when located on flexure areas, such as on the knee. We report the case of a 28-year female patient, who presented to the Emergency Department with a history of traumatic wound in the right knee and signs of delayed healing, friable granulation tissue, exposed patella, increased serous drainage, and painful limited range of motion. She underwent a single surgical time procedure with debridement, irrigation, and complete coverage of the wound using the pie-crusting technique.
Key words: Pie-crusting, ulcerative traumatic wound; skin incisions; debridement; wound closure.
Level of Evidence: IV

Desbridamiento apropiado y técnica de "pie crusting" en el manejo de la herida traumática

RESUMEN
Las heridas crónicas de origen traumático, con exposición de tejidos, requieren de un desbridamiento adecuado, lavado y una pronta cubierta para evitar la infección y la desecación. A veces, incluso deben ser ampliadas para realizar un adecuado desbridamiento quirúrgico; por lo que, al intentar una cobertura completa, el resultado es una herida a tensión, que se complica con inflamación, infección y la dehiscencia que se acentúa aún más si está en una zona de flexión, como la rodilla. Se presenta el caso de una paciente de 28 años, que acudió a emergencias con un antecedente de herida traumática en la rodilla derecha, signos de retraso de la cicatrización, tejido de granulación friable, exposición de la rótula, abundante secreción serosa y dolor al movimiento con rango limitado. Se la trató en un solo tiempo quirúrgico con desbridamiento, irrigación y cobertura completa de la herida mediante la técnica de "pie crusting".
Palabras clave: "Pie-crusting"; herida ulcerativa traumática; incisiones cutáneas; desbridamiento; cierre de la herida.
Nivel de Evidencia: IV

INTRODUCTION

Traumatic injury treatment requires a thorough cleansing and a tension-free closure to achieve optimal wound healing. Inadequate wound management can lead to ulceration and exposure of bone and musculotendinous tissue, hindering treatment and limiting the patient's activities.[1] The first step when treating an ulcerated wound associated with a traumatic injury is debridement[2,3] of all nonviable tissue as well as the enlargement of the wound to allow for adequate exploration. Then lavage is performed with normal saline solution with or without antiseptic,[4,5] which allows for a favorable environment for wound healing. Following this procedure, the possibility of new surgical cleansing or of performing the coverage in the first surgical time has to be assessed, considering the recommendation of a prompt coverage to prevent potential desiccation and infection of exposed tissues.[1] Such events warrant

Received on May 23rd, 2019. Accepted after evaluation on July 30th, 2019 • L. A. BERAÚN CORONEL, MD • langel_15@hotmail.com http://orcid.org/0000-0002-9965-4332
How to cite this paper: Beraún Coronel LÁ, Becerra Orrego MO, Quispe Juarez JG. Adequate debridement and pie-crusting technique in the management of traumatic injuries. *Rev Asoc Argent Ortop Traumatol* 2020;85(3):XXXX. https://doi.org/10.15417/issn.1852-7434.2020.85.3.992

the implementation of specific techniques, such as the use of flaps and grafts, which require time to be fully integrated.[3] One of such approaches is the pie-crusting technique[6-9], which has been described in studies although not widely used. The pie-crusting technique consists of multiple transdermal incisions, 3-5 mm long, performed using a No. 15 scalpel blade parallel to the wound edge and perpendicular to the lines of tension, at 5- to 10-mm intervals between incisions. The number of incisions should be as much as necessary such that the tension surrounding the wound is abolished. It is a simple and useful technique, as it relieves tension and enables the expansion of skin, reduces the area of exposed tissue, and may even enable for complete coverage.[6,7] The wound is then dressed with a nonadherent dressing and a splint is applied to protect and prevent movement and wound distension.

CLINICAL CASE REPORT

Woman of 28 years of age, who suffered a motor-vehicle accident while riding as a motorcycle passenger. The patient indicates that as she fell her right knee hit the pavement directly, resulting in a deep wound with bone exposure (Figures 1-3). She was treated in a hospital, where she underwent topical cleansing and wound closure. Wound dressing changes were performed every two days, and the wound progressively developed into an ulcer.

Figure 1. Wound progression toward ulceration. Tension and inflammation are evident. The patient applied home-made poultice.

Figure 2. With time, wound showed signs of necrosis and decreased inflammation.

Figure 3. The patient came to the hospital with an ulcer wound, friable granulation tissue, increased serous drainage, and patella exposure.

Four weeks later, the patient presented to the Emergency Department of the Hospital de Tarapoto with moderate to severe pain in the injured knee. Physical examination revealed no fever, stable vital functions, and evidence of undernutrition. The patient presented with a transversal, sutured wound in the right knee, 20 cm long, with ulceration in the central third, 7 cm wide and 8 cm long, with unhealthy margins, increased serous drainage, necrotic and friable granulation tissue, as well as exposure of the patella anterior surface, which was desiccated. She experienced moderate knee pain, which worsened during flexion, hindering her ability to walk. X-rays revealed no evidence of joint involvement.

Surgical debridement of unhealthy tissue was performed, the exposed bone surface was cleaned, margins were removed until bleeding was seen, and the wound was enlarged to enable a better evaluation, which facilitated the detection of dust particles adhered to the lateral and medial patellar retinaculum. Mechanical debridement was performed with 10 cc of 10% povidone-iodine plus 1000 cc normal saline solution, and 10 cc hydrogen peroxide and 9 L of normal saline solution.

Following a new evaluation, patellar coverage was decided. First, only one-third of the surface was covered and then the pie-crusting technique was applied, performing small incisions of 0.5-1 cm, some parallel to the wound and others perpendicular to the lines of tension; wound synthesis was performed with simple and Blair-Donati sutures. In this way, the procedure achieved little tension and complete coverage of the wound. Finally, the wound was dressed with paraffin gauze and protected with a long-leg splint for 14 days.

Wound dressing change was performed 4 days after surgery (Figure 4), finding minor serous drainage and no inflammation.

Figure 4. Forth-day postoperative evolution. Minor serosanguinous drainage.

On day 6 (Figure 5), necrosis was detected on the tip of the flap of approximately 2 cm x 2 cm; wound dressing treatment with saline solution was continued and the necrotic area began to separate showing signs of granulation.

Figure 5. Sixth-day postoperative evolution. Necrosis was detected on the tip of the flap.

The patient was assessed by a plastic surgeon who suggested a skin graft, but the patient declined to undergo any new surgical procedure. Given her adequate course, she continued with the wound dressing with Prontosan® solution and gel.

On day 10, she was discharged on antibiotics for 6 weeks. Two weeks later, the splint was removed; a month following surgery, pie-crusting incisions had completely healed (Figure 6).

Figure 6. One-month postoperative evolution. Area evidencing granulation signs.

By week 7, the wound had completely closed, the patient had mild pain, full flexion and extension range of motion, a Visual Analogue Scale score of 2 (Figures 7 and 8), no signs of instability, and no difficulty walking. Patient indicated on some follow-up controls a slight increase in volume.

The current state, 9 months after surgery, includes full joint range of motion and no signs of recurrent infection.

Figure 7. Seventh-week postoperative evolution. Complete wound closure.

Figure 8. Postoperative assessment. The patient is able to walk, experiences mild pain, and has full flexion range of motion.

DISCUSSION

The management of ulcer wounds of traumatic origin requires adequate debridement. There is no consensus on lavage agent: normal saline solution or antiseptic solutions, which are bactericide-bacteriostatic agents, but also cytotoxic.[4] In our case, we used a significant amount of a 9°/$_{000}$ sodium chloride, povidone-iodine and hydrogen peroxide combination, after applying antiseptic agents. This procedure prevented recurrent infection and, in combination with the antiseptic therapy, an excessive cytotoxic damage.[10]

Performing a thorough debridement requires the subsequent coverage of bone tissue. The pie-crusting technique was performed to prevent potential desiccation and infection.[6-9] The technique consists in performing small transdermal incisions which, by means of skin elasticity and the principle of meshing a skin graft, allows for complete coverage of the wound with little tension as the incisions work as drainage areas.[7-9] Although this technique has already been described, mostly for areas other than joints, it is not widely used. The pie-crusting technique produces satisfactory outcomes.

CONCLUSIONS

The first step in this wounds treatment must include adequate wound cleansing and debridement, which also prevent closure associated with tension of the wound. The adequate mechanical debridement together with the help of the pie-crusting technique prevented wound tension and achieved a successful outcome, in a single surgical time, with no need for further interventions or the use of flaps to cover de defect with bone exposure.

Conflict of interests: Authors claim they do not have any conflict of interests.

M. O. Becerra Orrego ORCID: http://orcid.org/0000-0001-8828-5618
J. G. Quispe Juárez ORCID: http://orcid.org/0000-0003-1531-2712

REFERENCES

1. Kouros I, Parham G. Chronic wounds. *Clin Plastic Surg* 2005;32:209-22. https://doi.org/10.1016/j.cps.2004.11.011
2. Kellam J. Musculoskeletal injury. En: Smith WJ, Stahel PF (eds). *Management of musculoskeletal injuries in the trauma patient*. New York: Springer; 2014:198-200. https://doi.org/10.1007/978-1-4614-8551-3
3. Moran SL, Sems A. *Master technique in orthopaedic surgery: soft tissue surgery*. 2nd ed. Philadelphia: Lippincott William & Wilkins; 2016:14-8. https://doi.org/10.1016/j.jhsa.2008.09.009
4. Bishara SA, Saad AD, Shady NH. Wound cleansing, topical antiseptics and wound healing. *Int Wound J* 2009;6(6): 420-30. https://doi.org/10.1111/j.1742-481X.2009.00639.x
5. Kramer A, Dissemond J, Kim S, Willy C, Mayer D, Papke R, et al. Consensus on wound antisepsis: update 2018. *Skin Pharmacol Physiol* 2018;31:28-58. https://doi.org/10.1159/000481545
6. Singh D, Lomax A. Piecrusting to facilitate skin closure. Case report. *Foot Ankle Spec* 2016;9(4):367-71. https://doi.org/10.1177/1938640015620635
7. Dunbar RP, Taitsman LA, Sangeorzan BJ, Hansen ST. Technique tip: use of "pie crusting" of the dorsal skin in severe foot injury. *Foot Ankle International* 2007;28(7):851-3. https://doi.org/10.3113/FAI.2007.0851
8. Motley RJ, Holt PJ. The use of meshed advancement flaps in the treatment of lesions of the lower leg. *J Dermatol Surg Oncol* 1990;16:346-8. https://doi.org/10.1111/j.1524-4725.1990.tb00046.x
9. DiStasio AJ 2nd, Dugdale TW, Deafenbaugh MK. Multiple relaxing skin incisions in orthopaedic lower extremity trauma. *J Orthop Trauma* 1993;7(3):270-4. https://doi.org/10.1097/00005131-199306000-00012
10. Lu M, Hansen EN. Hydrogen peroxide wound irrigation in orthopaedic surgery. *J Bone Jt Infect* 2017;2(1):3-9. https://doi.org/10.7150/jbji.16690