A Gustilo Type IIIB Open Forearm Fracture Treated by Negative Pressure Wound Therapy and Locking Compression Plates : A Case Report

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Case Report

A Gustilo Type IIIB Open Forearm Fracture Treated by Negative Pressure Wound Therapy and Locking Compression Plates: A Case Report

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Abstract A 91-year-old female sustained injuries to her left forearm while walking across a crosswalk.
X-rays showed left radial shaft and ulna shaft fractures, and the injury was a type IIIB open fracture. On the day of admission, irrigation and debridement of the open wound, and temporary fixation of the radius and ulna using an external fixator and a Kirschner wire were peformed. Six days after the surgery, we used negative pressure wound therapy (NPWT) using the V.A.C.ATS® system for the open wound. Thirteen days after the first surgery, definitive fixation was performed by using locking compression plates, and full thickness skin grafting was undertaken for the open wound. NPWT is a treatment that accelerates the wound healing process through the delivery of continuous subatmospheric pressure within a closed environment. In our case, we could reduce the healing period of the soft tissue and could convert to the definitive fixation in a timely fashion. NPWT is thought to be a useful adjunct in the management of the soft tissues of open fractures.

Key words : Negative pressure wound therapy (NPWT), V.A.C.ATS® system, Open fractures, Locking compression plates

Introduction

Open fracture remain a challenging injury for orthopaedic surgeons. We experienced a severe open forearm fracture treated by negative pressure wound therapy and locking compression plates.

Case report

A 91-year-old female was struck by a motorcycle while walking across a crosswalk. She sustained injuries to her left forearm and head. She was transferred to the emergency department of our hospital. Her vital signs were stable, and her consciousness was normal. Her left forearm was severely deformed, and an open wound was present on the dorsal side of the forearm. The size of the open wound was 18 × 4 cm (Fig. 1). The fascia of the extensor carpi radialis muscle was partially injured, however, the major vessels and nerves were uninjured. The movement and sensation of her left fingers were intact. X-rays showed left radial shaft and ulna shaft fractures (AO 22-B3.3) (Fig. 2).

On the day of admission, thorough irrigation and debridement of the open wound, and temporary fixation of the radius and ulna using an external fixator and a Kirschner wire were peformed (Fig. 3). The open wound could not be closed completely, therefore, we used Terudermis™, (Olympus Terumo Biomaterials Corp, Tokyo, Japan) to cover the open wound. The injury was a type IIIB open fracture according to the classification of Gustilo and Anderson[1]. She was given a first-generation

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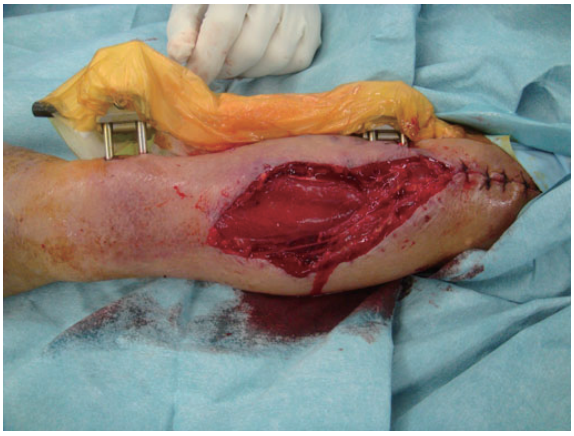
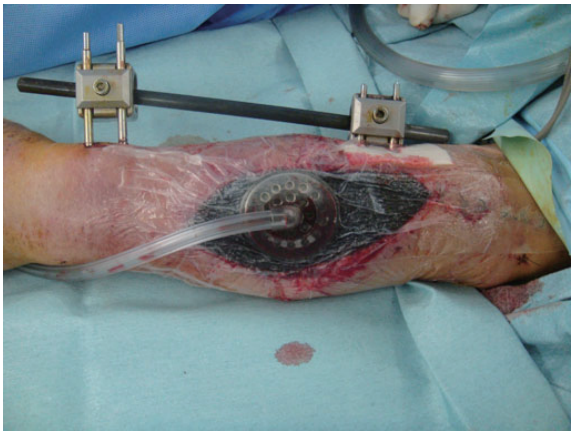
Fig. 1 The open wound on the day of admission. The open wound was located at the dorsal side of the left forearm. The size of the open wound was 18 × 4 cm.

Fig. 2 An X-ray photograph of the left forearm on the day of admission. The X-ray showed left radius shaft and ulnar shaft fractures.

Fig. 3 An X-ray photograph of the left forearm after the surgery on the day of admission. An external fixator was applied on the radius, and a Kirschner wire was inserted into the ulna.



(a)



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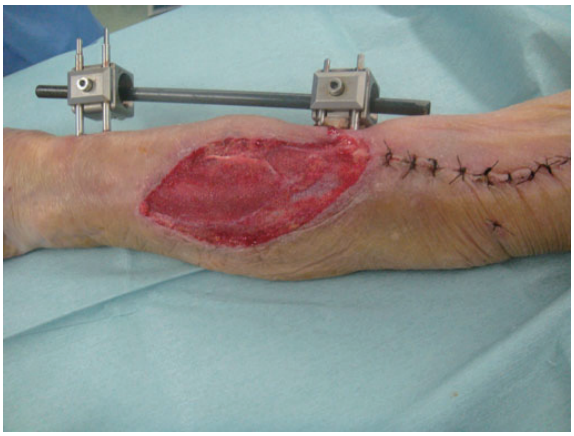

(c)

Fig. 4 a. The open wound at the beginning of using the V.A.C.® system The size of the open wound was 11 × 4cm, and the fascia of the extensor carpi radialis muscle was exposed.
b. The V.A.C.ATS® system. 125mm Hg continuous subatmospheric pressure was applied on the open wound.
c. The open wound one week after using the V.A.C.ATS® system. The granulation of the open wound had improved.

Fig. 5 The X-ray photograph taken after the definitive fixation. The radius was fixed by a LC-LCP, and the ulna was fixed by a LCP reconstruction plate.

Fig. 6 A photograph of the left forearm 11 weeks after the admission. The condition of the grafted skin was good.

cephalosporin and an aminoglycoside antibiotic for prophylaxis. We checked the open wound 48 hours after the first surgery, and slight skin necrosis around the open wound was detected, however, there was no sign of infection. Six days after the surgery, we used negative pressure wound therapy (NPWT) using the V.A.C.ATS® system (KCI, San Antonio, Texas, USA) for the open wound (Fig. 4a, b). The method entails placing a sterile, open-cell polyurethane foam dressing into the wound defect, sealing the site with an adhesive drape, then applying controlled subatmospheric pressure to the wound. We changed the polyurethane foam every 48-72 hours, and continued NPWT for one week. The granulation of the open wound improved (Fig. 4c). Thirteen days after the first surgery, we performed definitive fixation using a LC-LCP and a LCP reconstruction plate (Synthes GmbH, Oberdorf, Switzerland) on the left radius and ulna. At the same time, full thickness skin grafting was undertaken for the open wound using skin from the inguinal region (Fig. 5). The patient was discharged from our hospital 35 days after admission.

Eleven weeks after the injury, the graft skin had healed well (Fig. 6) and the patient had no superficial or deep infections, or wound dehiscence. The range of motion was flexion 140 degrees, extension 0 degrees, internal rotation 70 degrees, external rotation 70 degrees at the elbow joint, and the volarflexion was 40 degrees, dorsiflexion was 40 degrees, the radial deviation was 25 degrees, and the ulnar deviation was 35 degrees at the wrist joint.

Discussion

Severe open fractures remain a challenging injury for orthopedic surgeons because of the occurrence of infection. The risk of a clinical infection depends on the severity of the injury and ranges from 10% to 50% for type III open fractures[2]. The management of open forearm fractures depends on the severity of the soft tissue injuries. Immediate plating can be performed in type I, II, and IIIA open forearm fractures. For types IIIB and IIIC, irrigation and debridement of open wounds, and a temporary external fixator are generally applied to stabilize the fracture, followed by secondary internal fixation when the soft tissues are stabilized. In our case, there was doubt about the feasibility of soft tissue coverage, so we fixed the fracture using an external fixator.

Conversion to definitive fixation should be performed in a timely fashion. The reason is that pin-site contamination was more common where

an external fixator was in place for more than two weeks[3]. However, open wounds sometime cause infection, therefore, a delay in the healing of the open wound is often an obstacle preventing the definitive fixation. Early coverage of an open fracture wound is important to protect against infection.

In the management of soft tissue defects, there are various methods that can be used, such as an artificial dermis, fix and flap[4], and negative pressure wound therapy (NPWT)[5)~8)]. The concept of fix and flap is to support coverage of open fracture wounds as early as possible with rotational flaps or free-tissue transfers. However, this technique is not always possible because of multiple factors, including the patient condition, and the availability of surgeons skilled in rotational flaps and free tissue transfer[8].

Negative-pressure wound therapy (NPWT) is a treatment that accelerates the wound healing process through the delivery of continuous subatmospheric pressure within a closed environment. Application of NPWT leads to the removal of the third space fluids from the area immediately adjacent to the wounds, and increases the local functional blood perfusion, leading to an accelerated rate of granulation tissue formation, a decrease in tissue bacterial levels, and an increase in nutrient blood flow[5)6)].

NPWT was newly established as a reimbursement item by the Japanese medical health insurance system in April 2010. At present, only the V.A.C.ATS® system has been approved as a NPWT system in Japan, but this wound closure treatment by negative pressure is now covered by the medical insurance system. The V.A.C.ATS® system is an easy to use and reliable therapy for accelerating wound healing, reducing the medical care costs and improving quality of life for patients. In our case, we could reduce the healing period of the soft tissue and could convert to the definitive fixation within 2 weeks by using the V.A.C.ATS® system.

In conclusion, NPWT is thought to be a useful adjunct in the management of the soft tissues of open fractures.

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（和文抄録）

局所陰圧吸引療法とロッキングプレートを用いて治療した前腕開放骨折の一例

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松下昌史，見明　豪，口石倫太朗，野口康男

我々は，局所陰圧吸引療法とロッキングプレートを用いて治療した前腕開放骨折（Gustilo IIIB）の一例を経験したので報告する．症例：91 歳女性．横断歩道を歩行中にバイクと衝突し受傷した．左前腕の変形と左前腕背側に 18 × 4 cm の開放創を認めた．レントゲンにて左橈尺骨骨幹部骨折（AO 22-B3.3）と診断した．受傷当日に洗浄・デブリドメント，橈骨創外固定，尺骨髄内固定（K-wire）を行った．受傷 6 日目より V.A.C.ATS® system による局所陰圧吸引療法を開始した．開放創の肉芽形成は良好で，受傷 13 日目にロッキングプレートを用いた橈尺骨骨接合術ならびに全層植皮術を行った．術後 11 週の時点で感染徴候は認めなかった．

Gustilo IIIB 開放骨折の一般的な治療は，徹底的なデブリドメントと創外固定による一時的固定，軟部組織の修復，そしてプレートなどの内固定材料による最終的な固定である．一時的な固定から最終的な固定に時期を逸せずに移行するためには，開放創が感染を合併させずに，開放創を早期に被覆する必要がある．V.A.C.ATS® system による局所陰圧吸引療法を用いることで，良好な肉芽組織の形成を促進することができた．局所陰圧吸引療法は開放骨折の軟部組織治療に有用な補助療法であることが示唆された．