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Original Research Article

Surgical Bone Coverage for Open Leg Fractures in Bamako: Therapeutic Aspects and Evolutionary Aspects

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Abstract: ***Introduction****:* The surgical bone-covering technique is used to cover and protect exposed bone in cases of open fractures. The objective of this research was to explore the therapeutic dimensions and the evolution of surgical bone-covering procedures for open leg fractures in adults in Bamako. ***Methodology*****:** A retrospective study, conducted from January 2023 to December 2025 in the Department of Orthopedic and Trauma Surgery at the Gabriel Touré University Hospital (Mali), examined 20 cases of tissue loss in the leg, with a follow-up period of at least 10 months. ***Results***: We recorded 20 patients with open fractures of the leg, with a sex ratio of 9. The mean duration of hospitalization was 17.6 days (range: 7–33 days). The mean time to soft-tissue coverage was 18.43 days (range: 0–36 days). The mean size of the skin defect following debridement was 12.5 centimeters. Outcomes were favorable in 18 cases (90%), resulting in skin healing. Bone consolidation was achieved in 17 cases (85%). Complications consisted primarily of flap necrosis, which occurred in 3 cases (15%). ***Conclusion*****:** Surgical bone coverage is an important step in the treatment of open leg fractures, with encouraging results in our series.

Keywords: Open Fracture, Leg, Surgical Flap, Bamako.

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INTRODUCTION

A flap consists of a high-quality tissue transfer (skin, subcutaneous tissue, and muscle) harvested as a single unit and vascularized by a distinct pedicle originating from an area proximal to the site requiring reconstruction [1]. Flap coverage represents a major advancement in the treatment of open tibial fractures involving significant skin loss. Nevertheless, the management of severe tissue injuries remains a subject of controversy within the surgical community [1–4]. Addressing tissue loss resulting from open leg trauma poses a major challenge in the field of traumatology, necessitating the use of reconstructive plastic surgery to ensure tissue viability [5, 6].

PATIENTS AND METHODS

This retrospective study, conducted from January 2023 to December 2025 in the Department of Orthopedic and Trauma Surgery at the Gabriel Touré University Hospital (Mali), focused on 20 cases of soft-tissue loss in the leg. We included all patients admitted or hospitalized for Gustilo-Anderson type IIIB open leg fractures who underwent flap coverage and were followed up for at least 6 months. Demographic, clinical, radiological, therapeutic, and outcome-related data were collected and analyzed using an individual case report form.

RESULTS

This descriptive study included 20 patients (18 men, 2 women; male-to-female ratio of 9) with 20 cases of open leg fractures. The mean age of the patients was 33.45 years (range: 15–75 years). The injuries resulted from a road traffic accident (RTA) in 19 cases (95%) and from a fall in 1 case (5%). Regarding the patients' underlying health status, several comorbidities were noted: 2 patients had diabetes, 1 was being treated for hypertension, 5 were smokers, 8 were tea consumers, and 2 consumed alcohol. The left side was most frequently affected, observed in 13 cases (65%). According to the Gustilo and Anderson classification, the injuries were predominantly high-energy, characterized by extensive soft-tissue (skin and muscle) damage (type IIIB) in 19 cases (95%). The middle section of the leg was the most commonly affected area, accounting for 13 cases (70%).

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Regarding clinical management, a standard radiographic assessment (anteroposterior and lateral views) was performed in all cases. Additionally, a pneumatic tourniquet was applied to the mid-thigh of the affected limb in 19 cases (95%).

Surgical debridement of the recipient site was carried out for all patients, involving the careful and conservative excision of infected or necrotic tissue—as well as tissue destined for necrosis—extending from the superficial layers to the deeper structures. This debridement was preceded by thorough irrigation of the lower limb and the wound using an isotonic saline solution, allowing for a comprehensive assessment of the extent of the injury. Bone stabilization was achieved surgically: via a uniplanar external fixator in 18 cases (90%), a T-shaped plate in 1 case (5%), and K-wire fixation in 1 case (5%). The flaps used were muscular in 12 cases (soleus in 9 cases; medial gastrocnemius and soleus in 2 cases; medial gastrocnemius alone in 1 case), fasciocutaneous in 5 cases (neuro-sural in 2 cases; supramalleolar rotational flap in 1 case), and cutaneous-adipose in 3 cases. More than half of the patients—65%—presented with no loss of bone substance.



Figs. 1 and 2: Intraoperative images showing the harvesting of a soleus and medial gastrocnemius muscle flap and the coverage of the defect



Fig. 3: Complete healing of an open leg fracture following a flap procedure using the soleus and medial gastrocnemius muscles



Figs. 4 and 5: Image of a lateral supramalleolar fasciocutaneous flap before and after healing

After measuring the defect to be filled, the flap was raised via careful dissection. It was then rotated without placing tension on the vascular pedicle. The flap was sutured to the site of the tissue loss using interrupted non-absorbable sutures. In 12 cases (60%), a secondary bone graft was performed to fill the defect. The mean duration of hospitalization was 17.6 days (ranging from 7 to 33 days). The mean follow-up period was 13.3 months (ranging from 6 to 25 months). The mean size of the cutaneous defect following debridement was 12.5 cm. Complications included flap necrosis in 3 cases (15%): two cases of partial necrosis and one case of total necrosis. Reoperation was required in 3 cases—twice for sequestrating osteitis and once for a surgical site infection. A pathogen was isolated in 3 cases: *Proteus hauseri*, *Staphylococcus aureus* (one case), and *Escherichia coli* (one case). Healing was achieved 2 months later, following sequestrectomy and targeted antibiotic therapy.

DISCUSSION

Bone coverage is a crucial step in the management of open leg fractures [7]. It significantly improves the clinical outcome by reducing complications and the time required for bone union. The loss of skin and soft tissue is a recurring issue, observed across patients of all genders and ages—both in our setting and in most other published series [8–10]. In a study by Monka *et al*., [11], bone coverage was not performed immediately; instead, the authors opted for healing by secondary intention following bone stabilization. This approach resulted in bone union in 36 out of 38 patients, with a mean time to union of five months (ranging from 1 to 13 months). Hospital stays in that study were extended, lasting between 24 and 330 days. Delaying coverage significantly prolongs the duration of hospitalization, as it necessitates ongoing local wound care. In our series, the mean length of hospital stay was 17.6 days (ranging from 7 to 33 days). Although this represents a relatively short period of care, the process remains complex in our context, as the full financial burden of treatment falls upon the patients and their families. The high cost of surgical interventions, combined with the lack of social health coverage for the majority of our patients, often leads to delays in both hospital admission and the initiation of treatment. Current recommendations for reducing the time required for skin healing and bone consolidation in the treatment of open fractures—in addition to bone stabilization via external fixation—emphasize the need for interventions to cover the fracture site using tissue flaps [11]. The timing of therapeutic interventions is a key factor in the clinical course of open fractures [12]. If conditions are not suitable for immediate, comprehensive treatment, it is essential—within the first few hours following the open fracture—to at least perform surgical debridement and stabilize the injury using non-surgical orthopedic

methods [13]. Bone stabilization facilitates the healing process, while the local condition of the tissue significantly influences the success of any subsequent coverage procedure.

High-velocity trauma can exacerbate the initial skin injury, potentially leading to skin necrosis [14]. Attempting immediate coverage carries a risk of necrosis if the local vascular status is compromised; conversely, delaying coverage increases the risk of both infection and necrosis of the bone exposed to the external environment.

Our team has opted for immediate bone coverage in Gustilo-Anderson type I, II, and IIIA fractures, provided there is no significant contamination, crushing, or contusion. For type IIIB and IIIC open fractures, or in cases where there is a risk of secondary necrosis, we recommend delayed bone coverage following a five-to-seven-day period of appropriate local wound care. In all instances, it is essential to perform an initial assessment and management of the injuries through well-executed, minimal intervention designed to ensure the stability of the traumatic lesions—a strategy known as "damage control" [15–17]. This therapeutic principle aims to limit the progression of the injuries and preserve the local vascular supply to the tissues. This initial treatment is recommended within the first six hours following the trauma [18]. It may be repeated—notably for surgical debridement—to reduce the risk of infection and better prepare the site for surgical bone coverage. Delayed bone coverage, particularly through the use of a flap, has also been advocated by numerous authors [19–21]. The size of the skin defect remaining after debridement is a key factor in the success of the bone coverage procedure. In our series, the mean defect size was 12.5 cm; this figure varied across other studies: 10 cm in Belmahi's series, 13 cm in Zhu's, and 13.3 cm in Abdessamad's [22–24]. The therapeutic outcomes in our series were predominantly favorable. The success of a surgical bone coverage procedure depends on the surgeon's experience, adherence to appropriate clinical indications, the local vascular status, and whether or not an infection occurs [25]. The two cases of sequestrating osteitis had been treated via sequestrectomy and antibiotic therapy tailored to the antibiogram. The surgical site infection had been managed with local wound care and antibiotic therapy.

CONCLUSION

Open fractures of the leg involving soft-tissue loss are common and remain a therapeutic challenge for the orthopedic surgeon. Road traffic accidents are the predominant etiology in our study.

To address these defects, reconstruction using flaps has emerged as a preferred strategy, yielding highly satisfactory clinical outcomes.

Conflicts of Interest: No conflicts of interest have been reported by the authors.

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