

**Combination of muscular and cutaneous flaps in the management of a tibial wound in a dog: case report**

Combinação de retalhos muscular e cutâneo no manejo de uma ferida tibial em um cão: relato de caso

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ABSTRACT: Muscular and cutaneous axial pattern flaps are described in veterinary medicine as adjuncts in the management of extensive injuries; however, there are few reports demonstrating their use in tibial injuries in dogs. This report aims to describe the use of a caudal sartorius muscle flap and a caudal superficial epigastric axial cutaneous flap for the coverage of a tibial wound in a dog. The animal was a 1-year-old, 25 kg, spayed female Golden Retriever that was presented after being attacked by a Pitbull, showing an extensive wound on the tibia of the right pelvic limb. Blood tests, X-rays, and ultrasound were performed, all of which were normal. The dog was managed for the trauma and the wound was cleaned until the appropriate time for surgical intervention. After 4 days, the caudal sartorius muscle flap and the caudal superficial epigastric axial cutaneous flap were used to cover the defect. Two months after the procedure, complete healing was achieved, and the animal was discharged from the hospital.

Keywords: orthopedics; sartorius; reconstruction; canine.

RESUMO: Retalhos musculares e cutâneos axiais são descritos na medicina veterinária como adjuvantes no manejo de lesões extensas; no entanto, há poucos relatos demonstrando seu uso em lesões tibiais em cães. Este relato tem como objetivo descrever o uso de um retalho muscular do sartório caudal e de um retalho cutâneo axial da artéria epigástrica superficial caudal para a cobertura de uma ferida tibial em um cão. O animal era uma cadela Golden Retriever, castrada, de 1 ano de idade e 25 kg, que foi atendida após ser atacada por um Pitbull, apresentando uma ferida extensa na tíbia do membro pélvico direito. Foram realizados exames de sangue, radiografias e ultrassonografia, todos com resultados normais. A cadela foi tratada pelo trauma e a ferida foi higienizada até o momento adequado para a intervenção cirúrgica. Após 4 dias, foram utilizados o retalho muscular do sartório caudal e o retalho cutâneo axial da artéria epigástrica superficial caudal para cobertura do defeito. Dois meses após o procedimento, foi observada cicatrização completa, e o animal recebeu alta hospitalar.

Palavras-chave: ortopedia; sartório; reconstrução; canino.

INTRODUCTION

Wound management in dogs is a crucial aspect of clinical practice, especially when dealing with open wounds (Davidson, 2015). These wounds often require ongoing treatment for days or weeks until they can either be closed or heal by secondary intention, both in veterinary medicine (Buote, 2022; Aisa; Parlier, 2022) and in human medicine (Jiang *et al.*, 2023). Although most wounds heal without complications, some may present significant challenges due to limited tissue coverage availability and an increased risk of complications (Hupples *et al.*, 2015; Gaudio *et al.*, 2023).

Reconstruction techniques have proven effective in managing extensive wounds, facilitating healing and functional restoration (Ciepluch; Séguin; Worley, 2022; Siegelmayr; Gradner, 2023). Muscular flaps are a versatile strategy in wound treatment, as they provide reliable coverage due to their vascular supply, improving the viability of the wound bed and promoting adequate healing (Cronin; Hall, 2019; Ciepluch; Séguin; Worley, 2022). Among the numerous muscular flaps described in the veterinary literature (Bitton *et al.*, 2020; Simpson; Hall, 2021; Ciepluch;

Séguin; Worley, 2022), the caudal sartorius muscle flap was described by Weinstein, Pavletic and Boudrieau (1988) as a satisfactory technique for covering medial tibial lesions, enhancing the vascular supply to the injured area, promoting tissue healing, and minimizing associated complications.

Similarly, cutaneous flaps, especially axial pattern flaps, also have adequate blood supply, contributing to the management of extensive wounds. These flaps are designed to preserve the structure and function of the skin while providing a protective barrier over injured areas (La Puerta *et al.*, 2021; Katarwala; Buote, 2022; Gaudio *et al.*, 2023). Thus, the combination of muscular and cutaneous flaps in the treatment of complex wounds can enable a more effective and comprehensive approach to managing open wounds in dogs.

To date, the authors are not aware of any description of a wound reconstruction that combined the caudal sartorius muscle flap with the caudal superficial epigastric axial cutaneous flap. Therefore, this study aims to report a unique case of reconstruction that utilized both flaps for an extensive and open lesion on the medial portion of the tibia in a dog.

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Received: 11/25/2024

Accepted: 01/02/2025

CASE REPORT

A 1-year-old, 25 kg, spayed female Golden Retriever was presented to the Veterinary Hospital after being attacked by a Pitbull. According to the owner, the dog was not bearing weight on the affected limb and had not eaten, urinated, or defecated since the trauma. After the anamnesis, the patient underwent a general physical examination, during which an extensive open wound was observed on the right pelvic limb, involving the medial portion of the tibia and extending along the entire diaphysis, resulting in bone exposure (Figure 1A).

The dog was hospitalized for stabilization, receiving fluid therapy with Lactated Ringer's solution (50 ml/kg over 24 hours, IV), Methadone (0.3 mg/kg, QID, IM), Dipyrone (25 mg/kg, TID, IV), and Cefalotin (25 mg/kg, TID, IV). The dog was then referred for blood tests (complete blood count, albumin, ALT, creatinine, urea), AFAST, and TFAST, which showed no abnormalities. After 24 hours, a radiographic examination of the tibia and fibula in simple orthogonal projections was performed under sedation with Dexmedetomidine (5 mcg/kg, IM) and Ketamine (2 mg/kg, IM), which also revealed no abnormalities.

During hospitalization, the wound was cleaned aseptically four times a day with saline solution and covered with hydrogel and polyhexamethylene biguanide (PHMB), combined with bandage protection, to promote autolytic debridement. After four days of cleaning, the patient was prepared for surgery, where surgical debridement was performed, followed by delayed primary wound closure.

The dog was premedicated with Methadone (0.3 mg/kg, IM), and after ten minutes, it was induced with Propofol to effect (IV) and intubated with an 8 mm endotracheal tube. During the procedure, the patient was maintained under Isoflurane and 100% Oxygen in a closed system. The animal was positioned in dorsal recumbency, and a wide area was shaved on the right pelvic limb and abdominal region, followed by conventional antiseptis.

The surgical drapes were placed, and the surgical debridement began with the removal of all necrotic and devitalized tissue using a 24 scalpel blade and a curette. Additionally, the area was thoroughly irrigated with 0.9% saline solution using a 40/12 needle attached to a sterile three-way stopcock system (Figure 1B). Next, an incision was made on the medial aspect of the thigh, and the subcutaneous tissue was dissected to carefully identify and isolate the caudal sartorius muscle. The muscle was transected proximally, approximately 3 cm distal to its origin on the ilium, and the blood vessels were ligated. The muscle insertion was maintained at the proximal tibia (Figure 1C). The muscle was rotated over the defect and sutured with 3-0 nylon in simple interrupted sutures at its edges, covering 50% of the bone exposure (Figure 1D).

The skin was then incised along the mammary chain on the same side as the limb lesion, from the third to the fifth mammary gland. The subcutaneous tissue was dissected, releasing the mammary chain while preserving the caudal superficial epigastric artery. The axial pattern flap was then rotated caudomedially over the defect. Afterward, the subcutaneous tissue was sutured using a simple continuous pattern, and the skin was closed with simple interrupted sutures (Figure 2A).

At the end of the procedure, ice was applied to the surgical wound on the tibia for 15 minutes, followed by the application of a compressive bandage on the limb and abdominal region, which was maintained for 48 hours.

The patient was hospitalized for seven days, receiving Methadone (0.3 mg/kg, IM, TID), Dipyrone (25 mg/kg, IV, TID), Carprofen (2.2 mg/kg, PO, BID), Amoxicillin with Clavulanate (25 mg/kg, PO, BID), and the surgical wound was cleaned twice daily with saline solution. The dog was then discharged with instructions for wound care at home and returned ten days later for suture removal, at which point adequate healing was observed (Figure 2B-C). The patient returned two months after the procedure, and no surgical complications were noted (Figure 2D).

DISCUSSION

In this report, we present a case of an open wound with bone exposure on the medial aspect of a dog's tibia, treated clinically with autolytic and surgical debridement, combined with a muscle flap from the caudal sartorius muscle and a skin flap from the caudal superficial epigastric artery. The treatment of extensive and complex wounds in dogs often requires multimodal approaches to ensure adequate coverage and promote effective healing (Aisa; Parlier, 2022). Thus, the combined therapy used in this patient proved to be an effective approach for wound management, allowing for the preservation of the limb.

In our case, managing the wound over a four-day period with hydrogel resulted in an improvement of the wound bed, evidenced by the maintenance of bone viability and adequate tissue preparation for subsequent surgical intervention. This brief period of hydrogel treatment was crucial in preventing dehydration of the exposed tissues and halting the progression of necrosis (Firlar et al. 2022), factors we believe could have compromised tissue viability and, consequently, the surgical procedure. Additionally, the use of PHMB in conjunction with hydrogel treatment was a well-founded choice, aimed at effectively and safely managing an infected wound, given that PHMB has broad antimicrobial activity without host-associated cytotoxicity and is also effective against biofilms (Davis et al., 2017; Aisa; Parlier, 2022).

Due to the presence of bone exposure, we opted for delayed primary closure of the wound. This therapeutic approach aimed to quickly cover the lesion, minimizing bone exposure to the environment, which was important for reducing the risk of infection and bone necrosis (Chan et al., 2022). Additionally, delayed closure allowed time for autolytic debridement and proper preparation of the wound bed for the placement of the flaps.

The choice of the muscle flap for wound coverage aimed not only to cover the defect but also to optimize the healing environment. Although the caudal superficial epigastric axial skin flap might have been sufficient to cover the lesion, muscle flaps offer additional advantages by promoting angiogenesis and providing a robust source of growth factors and immune cells (Dermisiadou et al., 2023). Moreover, they are effective in cases of osteomyelitis (Buono et al., 2018), which we believe contributed to the positive wound outcome by reducing complications.

By using the caudal superficial epigastric axial

flap, we achieved complete closure of the lesion, which facilitated the outpatient management of the wound by minimizing fluid loss, reducing pain, and increasing protection against external pathogens. Although complications such as dehiscence, necrosis, and infection are described in the literature regarding the use of this flap (Forster *et al.*, 2021), we did not observe such complications in our patient throughout the healing process. We believe this is related to the combination of therapies used, the absence of a neoplastic association with the lesion, and the establishment of the third mammary gland as the cranial limit of the flap. In cases where the incision extends more cranially or there is a neoplastic association, there is a tendency to observe complications related to the flap (Forster *et al.*, 2021).

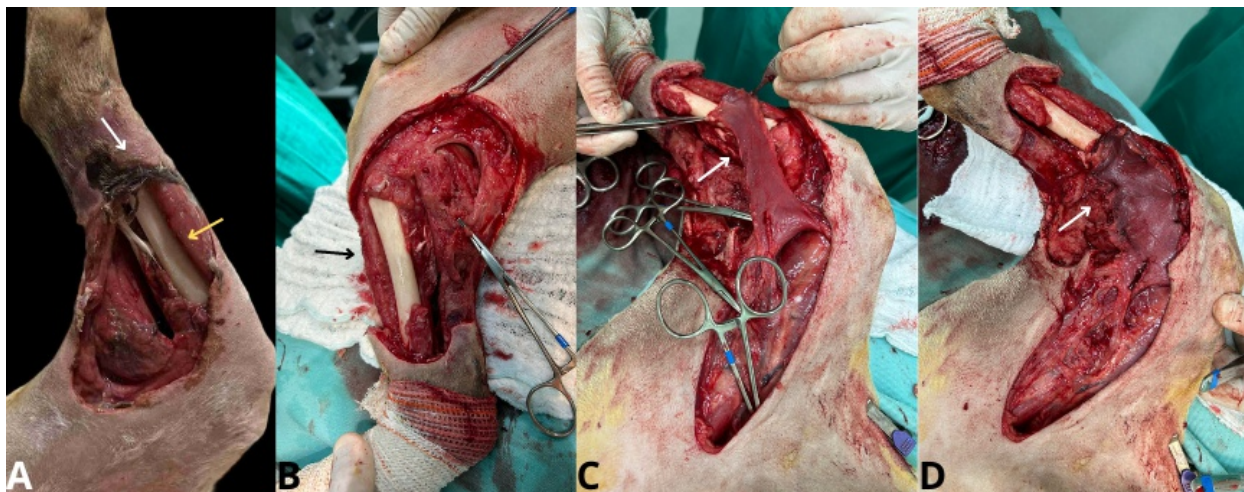
Although this report demonstrated a satisfactory outcome with the combined use of muscle

and skin flaps in managing a tibial wound in a dog, certain limitations should be considered when interpreting the results. Firstly, this is a single case report, which limits the generalization of the findings to other cases and species. Additionally, individual variability, such as the patient's response to treatment and underlying clinical conditions, may influence the results, and thus it cannot be guaranteed that the same approach would be equally effective in all similar cases.

CONCLUSION

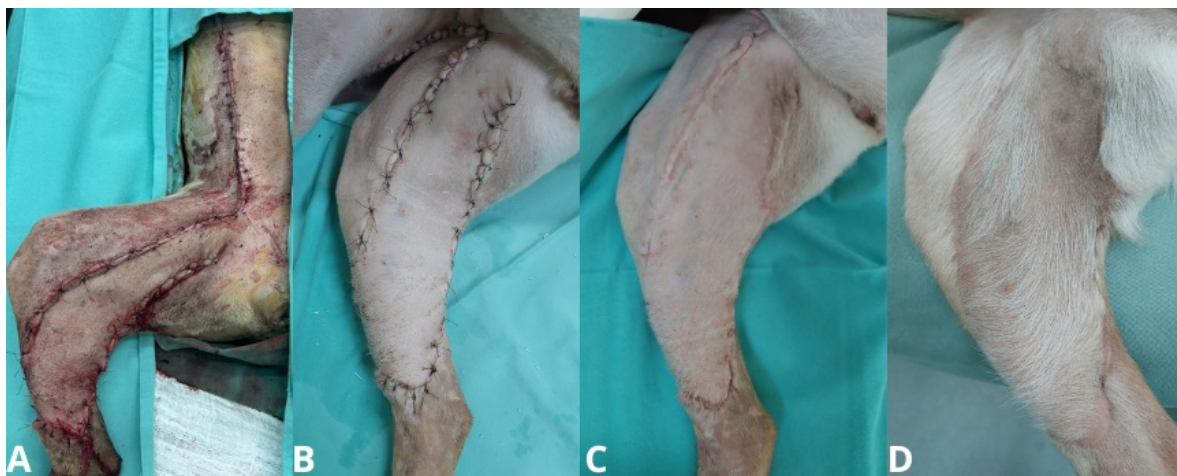
The combination of the caudal sartorius muscle flap with the caudal superficial epigastric axial skin flap provided adequate wound coverage and satisfactory healing, allowing for the preservation of the animal's limb function.

Figure 1 – Open bite wound on the medial aspect of the tibia of a dog. Areas of necrosis (white arrow) and bone exposure (yellow arrow) are observed before clinical management (A). In "B," the wound post-surgical debridement (black arrow) with removal of necrotic tissue is visible (B). The caudal sartorius muscle flap with proximal release and rotation to the medial aspect of the tibia (white arrow) (C). Coverage of 50% of the wound with the caudal sartorius muscle (white arrow) (D).



Source: author's collection.

Figure 2 – Coverage of a wound on the medial aspect of a dog's tibia with a caudal superficial epigastric axial skin flap. In "A," the rotation of the flap to the medial aspect of the tibia covering the entire defect is noted. Post-operative evaluation at 17 days and removal of skin sutures from the surgical wound without evidence of complications (B-C). Evaluation of the wound after 2 months showing hair regrowth and complete healing (D).



Source: author's collection.

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