

# Replantation dilemma: lessons learned from managing a dog bite forearm amputation in a sixteen-year-old girl

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**ABSTRACT. – BACKGROUND:** Bite injuries, particularly those involving the hands, present a significant medico-legal challenge, often leading to complications and frequent emergency department visits. Dog and cat bites, especially among children, are major contributors to infections due to the complex anatomy of the hand, which predisposes it to severe infections even from minor bites. *Capnocytophaga canimorsus*, found in the oral cavity of dogs and cats, is particularly concerning due to its potential to cause severe infections. Prompt and appropriate treatment is essential to mitigate these risks. Managing such injuries poses significant challenges, necessitating clear guidelines for reporting and safety measures. This article highlights the urgent need for additional research, support, and education, particularly focusing on children, along with the development of international guidelines to improve outcomes for patients.

**CASE REPORT:** A case study of a sixteen-year-old girl who had her left forearm amputated due to a rottweiler bite is presented. Despite initial attempts at replantation, complications led to the decision for amputation.

**CONCLUSIONS:** This case underscores the challenges in managing severe dog bite injuries, emphasizing the importance of prompt assessment, thorough debridement, and proper wound management to minimize complications. Additionally, psychological evaluation and treatment are crucial for patients and parents following such traumatic events.

From a medical standpoint, this case highlights the importance of monitoring inflammatory markers, appropriate surgical priorities, and the need for psychological support. Prevention of dog bites is crucial, requiring increased awareness among public authorities and dog owners. Clear guidelines for reporting dog bites are essential, but further research is needed to improve their comprehensiveness and effectiveness.

*Key Words:*

Dog bite, Replantation, Forearm amputation, Psychological evaluation, Children, Microsurgery.

## Introduction

Bite injuries are common and constitute an emerging medico-legal problem and frequent emergency department visits, often leading to complications, particularly when involving the hands<sup>1-3</sup>. Dog and cat bites are the primary cause of infections due to their frequent occurrence, with children being especially vulnerable<sup>3-5</sup>. The complexity of the hand's anatomy, with multiple compartments and minimal soft tissue coverage, predisposes it to infections even from minor bites. Consequently, hand bite injuries have the potential to develop into severe infections, sometimes leading to death<sup>6-8</sup>.

According to the National Institute for Health and Care Excellence (NICE), in 2015, dog bites made up 60-90% of all recorded mammalian bites. They are frequently encountered in emergency departments (EDs). Recent data<sup>5</sup> indicates a rising trend, with a 76% increase in hospital admissions due to dog bites.

The pathogens responsible for these infections are derived from the oral flora of the biting animal or person and include a variety of aerobic and anaerobic bacterial strains. Complications are more likely to arise with delayed medical consultation, lack of proper medical care, and inadequate wound management.

The most frequent pathogens are *Flavobacteriaceae* family (*Capnocytophaga* genus: *C. ochracea*, *C. gingivalis*, *C. haemolytica*, *C. sputigena*, *C. granulosa*, *C. canimorsus*, *C. cynodegmi*). Among these pathogens, *Capnocytophaga canimorsus*, a gram-negative, capnophilic rod found in the oral cavity of dogs and cats, is particularly noteworthy. It can cause severe infections in humans, including sepsis, endocarditis, and meningitis, highlighting the importance of prompt and appropriate treatment<sup>8</sup>.

Managing bite injuries poses a significant challenge for both patients and physicians<sup>9,10</sup>.



**Figure 1.** Pre-operative condition of avulsion amputation.

Clear guidelines are essential for reporting dog bites and ensuring safety. However, current guidelines may lack comprehensiveness or effectiveness, indicating a need for further research and development.



**Figure 2.** Pre-operative evaluation of multi-tissue loss of substance.



**Figure 3.** Synthesis with percutaneous Kirschner wire of shortened radius and ulna.

This article emphasizes the urgent need for additional research, support, and education on dog bites, particularly in children, along with the development of international guidelines. By addressing these needs, we can mitigate the physical and psychological impact of dog bite injuries and improve outcomes for patients.

### **Case Presentation**

A sixteen-year-old girl was briefly left unattended when she approached an enclosure housing a rottweiler. The circumstances leading to the incident are unclear, but it appears that the girl intended to pet a known dog that belonged to neighbors. Upon hearing the girl's screams, her mother promptly arrived at the scene. The girl was promptly brought to a first aid facility but arrived at our Hand Center's emergency room six hours after the traumatic incident and was immediately transferred to the operating room. Her mother requested replantation and provided consent after being informed of the procedure.

The wound assessment revealed that the left forearm had undergone avulsion amputation (Figure 1), resulting in significant loss of soft tissue. Both muscle and skin tissue were severely damaged in the anterior, posterior, and radial parts of the forearm. The loss of tissue affected the radial and ulnar arteries, the median, ulnar and radial



**Figure 4.** Resolved venous crisis.

nerves, as well as all flexors and extensors (Figure 2). Additionally, there was a fracture of both the radius and ulna, with dislocation of the radial head.

A thorough irrigation with saline solution was performed before preparing the surgical site.

Following this, a forearm replantation procedure was carried out, involving shortening of both the radius and ulna and percutaneous synthesis with 2 mm diameter Kirschner wires (Figure 3).

After thorough debridement of all tissues and repair of the arterial, venous, and nerve stumps under microscopy, arterial repair of the radial and ulnar arteries, as well as nerve repair (neurorrhaphy) of the median and ulnar nerves, and tendon repair (tenorrhaphy) of the flexor tendons were performed.

Upon release of the tourniquet, successful blood flow to the fingers was confirmed. Considering the ischemic time, it was decided to postpone nerve repair (neurorrhaphy) of the radial nerve, tendon repair (tenomyorrhaphy) of the extensor tendons, and dorsal skin coverage until the risk of replantation failure and infection had been minimized.

Another rationale has been the historical acceptance that specific types of dog bite injuries should be left as open wounds for easier monitoring of infection signs, allowing exudates or purulent infection to flow freely to reduce the risk of systemic infection<sup>4-7,9</sup>.

The patient was closely monitored, with inflammatory and infectious markers assessed twice daily. Although there were no changes in these markers, an odor suggestive of infection

was noted. The girl was undergoing antibiotic therapy, and if swabs of the wound and a culture test had been conducted, they would likely have shown a negative result.

Seven days post-replantation, following the resolution of the venous crisis (Figure 4) and maintaining adequate perfusion of a functional portion of the hand (Figure 5), we faced a dilemma: whether to continue with the dorsal reconstruction despite the functional limitations associated with forearm replantation or to counsel the parents on prosthetic advancements and consider amputation. However, due to the elevated risk of infection, and after informing the patient's mother about this and the potential for prosthetic options, the decision was made to proceed with amputation.

A good range of movement was recovered<sup>11</sup>. The neuropathic discomfort was treated with nutraceuticals<sup>12</sup>, and the patient followed the process of prosthesization (Figure 6).

## Discussion

Canine bites are emerging as a significant public health issue<sup>1-3,10</sup>, and despite being a concern for public health authorities, little action seems to have been taken to mitigate these incidents. The severity is particularly notable because it primarily affects young children, who are often bitten around the neck and facial region. Limb injuries are less common, with literature documenting only two cases<sup>13,14</sup> of upper limb amputations that were not replanted.





**Figure 5.** Hand vascularization seven days after replantation.

Any breed of dog can bite, although certain breeds, like rottweilers, appear to have a higher predisposition. Studies<sup>14-16</sup> show that children are frequently bitten by dogs they are familiar with, such as family pets or those owned by friends or neighbors.

The reasons behind why children are more susceptible to dog bites are not fully understood. Some suggest<sup>3,4,14</sup> that a playful child might be seen as threatening by a dog. However, a study by Sack et al<sup>16</sup> revealed that 11 children were fatally attacked by dogs while sleeping, challenging this theory.

Factors such as breed, training, hunger, or lack of exposure to children can increase the likelihood of a dog biting. Young children should always be supervised around dogs, especially large ones or in groups.

From a medical standpoint, several lessons can be learned from this case.

Nowadays, monitoring inflammatory markers can help detect sepsis and vascular complications<sup>17-20</sup>.

Replantation is generally indicated for young age and extensive injuries, but contamination of the amputated part is a significant contraindication<sup>21,22</sup>.

Surgical priorities should focus on saving the patient's life first, then preserving function, and finally considering aesthetics<sup>21</sup>.

In cases of severe injuries, particularly those involving specialized areas like the face or hand, thorough examination in the operating room is crucial. Early irrigation and debridement are essential, and antibiotic prophylaxis is essential, especially for deep wounds or extensive tissue damage. Preserving as much normal tissue as possible enhances functional outcomes.

Psychological evaluation and treatment should be used in the management of severe dog bites.

After such traumatic injuries, children and parents are likely to experience emotional symptoms. Therefore, psychological evaluation and treatment are crucial aspects of management<sup>5</sup>.

In medical and psychological contexts, understanding the profound changes a young patient undergoes following a significant traumatic event is crucial. This process, often described as a "vital metamorphosis", encompasses both physical and emotional transformations that fundamentally alter the patient's existence<sup>23</sup>. This exploration aims to illustrate these changes graphically, emphasizing the stark contrast between the pre- and post-event phases.

The primary objective is to depict the emotional and sensitive dimensions of the trauma experienced by the patient. By visualizing these changes, we aim to highlight the subjective essence of the harm, providing a clear distinction between the patient's life before and after the traumatic event.

To achieve this, psychologists commonly use a combination of graphical representations, including timeline diagrams, emotional spectrum charts, and life phase comparison graphics comparing the pre-event phase, traumatic event, and post-event phase<sup>24</sup>.

This approach not only provides a clear distinction between the pre- and post-event phases but also emphasizes the subjective essence of the harm experienced. Through these visualizations, we aim to foster a deeper discussion and awareness of the emotional and sensitive dimensions of trauma.

Further research and graphical analyses can enhance our understanding of these transformations. By incorporating patient narratives and detailed case studies, we can continue to explore the complex interplay between emotional, physical, and social factors in the aftermath of trauma<sup>23</sup>.

Counseling and understanding the consequences of the trauma are easier after a few days rather than immediately following the incident. In this instance, it was easier to have a discussion with the parents seven days after the event rather than a few hours later to help them understand the consequences of the trauma, the functional outcomes of the replantation, and the options for prosthetic treatment.

The prevention of dog bites is an increasingly important public health topic as the incidence of serious injury continues to rise<sup>1,2</sup>.

Bite injuries, particularly those involving the hands, present a significant medico-legal challenge due to the known severe complications, with the one mentioned being particularly significant. From a strictly medico-legal perspective, it is crucial to differentiate cases where the injury represents a foreseeable but not concretely preventable adverse event (“complication”) from those where the iatrogenic phenomenon results from incongruent surgical conduct. In jurisprudence, the prevailing view excludes the legal relevance of the term “complication” in its strictest sense.



**Figure 6.** Post-amputation conditions. **A**, Frontal view. **B**, Lateral view in extension. **C**, Lateral view in flexion. **D**, Distal view.

This is because, even in the case of a foreseeable event, the healthcare provider bears the burden of proving the exact fulfillment of their obligation, and it is insufficient for a cause of exclusion of guilt to be merely theoretically conceivable<sup>25</sup>.

## Conclusions

Despite being a concern for public health authorities, little action seems to have been taken to prevent these dog bite accidents. Increased awareness among public authorities and dog owners is necessary, as legislation to prevent such incidents is progressing slowly.

Developing clear guidelines for reporting dog bites and ensuring safety is crucial, but current guidelines may lack comprehensiveness or effectiveness, indicating a need for further research. From a medical perspective, cases illustrate many lessons.

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### Conflict of Interest

The authors declare that they have no conflict of interest.

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### Authors' Contributions

De Vitis R. and Cruciani A. performed the limb replantation and following amputation; De Vitis R. and Cannella A. wrote the manuscript; Caruso L., Cruciani A., Cannella A. and Bocchino G. participated in the clinical evolution, acquisition, analysis, and interpretation of the data; Taccardo G. revised the article critically for important intellectual content.

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### Ethics Approval

Not applicable due to the design of the study.

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### Informed Consent

The authors declare that the patient and parents provided consent for their data and figures to be published in this case report.

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Data and materials are available for consultation. No additional data are available.

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Authors disclose that have not used any form of generative artificial intelligence was used for writing the manuscript.

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### CARE Guidelines

The authors have read the CARE guidelines, and the manuscript was prepared and revised according to the CARE guidelines.

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