

# International Journal of Health Science

Acceptance date: 18/09/2024

## OPTIMIZING SUTURE SELECTION IN EMERGENCY WOUND MANAGEMENT: TECHNIQUES AND OUTCOMES

---

*Aliandro Willy Duarte Magalhães*

*Gabriel Brunini Lisboa*

<https://lattes.cnpq.br/4819635979800818>

*Pedro Henrique Theodorovicz Soriani*

<https://lattes.cnpq.br/0882534073515773>

*Juliana Clemente*

*Marco Aurélio Vieira Borges*

<http://lattes.cnpq.br/9312822786396956>

*Leticia Vassuler Baldon*

<http://lattes.cnpq.br/2943848264853624>

*Régia Domingues de Freitas Ferreira*

*Gabriel Lima Cunha*

<http://lattes.cnpq.br/9042296609115781>

*Renata Braga Saraiva*

*Mateus Fernando Galego Rodrigues*

*Edvania Alves dos Santos*

*Osmar da Cruz Catharin*

<http://lattes.cnpq.br/3889014451840542>

*Mauricio Lopes da Silva Netto*

<http://lattes.cnpq.br/4791743372358340>

All content in this magazine is licensed under a Creative Commons Attribution License. Attribution-Non-Commercial-Non-Derivatives 4.0 International (CC BY-NC-ND 4.0).



**Abstract: INTRODUCTION** The management of wounds in emergency settings requires careful consideration of wound classification, the type of suture material, and the techniques employed to ensure optimal healing, minimize complications, and achieve desirable aesthetic outcomes. The choice of suture material—whether absorbable or non-absorbable—plays a significant role in influencing wound healing dynamics, infection rates, and patient comfort. **OBJECTIVE** To explore the various types of sutures used in emergency settings, their impact on wound healing, infection rates, aesthetic outcomes, and complications, while also discussing the role of new technologies and the evolving landscape of wound management. **METHODS** This is a narrative review which included studies in the MEDLINE – PubMed (National Library of Medicine, National Institutes of Health), COCHRANE, EMBASE and Google Scholar databases, using as descriptors: “Emergency wound management” AND “Suture techniques” AND “Absorbable and non-absorbable sutures” OR “Wound healing” OR “Aesthetic outcomes”. in the last years. **RESULTS AND DISCUSSION** The efficacy of different suture materials, particularly absorbable versus non-absorbable, varies depending on the wound type and clinical scenario. Monofilament sutures are generally preferred in contaminated wounds due to their lower infection risk, while multifilament sutures provide greater tensile strength for complex closures. The choice of suture technique, such as interrupted versus continuous sutures, also affects healing time, infection rates, and cosmetic outcomes. Recent advances, including antimicrobial-coated and biodegradable sutures, show promise in reducing complications and improving patient outcomes. **CONCLUSION** Selecting the appropriate suture material and technique is critical for optimizing wound

healing and minimizing complications in emergency settings. A tailored approach considering patient-specific factors, wound characteristics, and new technological advancements can enhance patient outcomes and reduce healthcare costs. Further research is necessary to continue improving suture materials and techniques in emergency medicine.

**Keywords:** Suturing techniques; Absorbable sutures; Wound healing; Infection rates; Emergency medicine

## INTRODUCTION

Wounds are a common presentation in emergency rooms, encompassing a wide range of clinical scenarios from minor abrasions to complex, life-threatening injuries<sup>1</sup>. The management of these wounds necessitates a nuanced understanding of the wound type, its classification, and the principles governing its closure<sup>1</sup>. Wounds in emergency settings are primarily classified based on their complexity—simple or complex—and their depth—superficial or deep<sup>1</sup>. This classification guides the choice of suture materials and techniques, significantly influencing the healing process, risk of complications, and aesthetic outcomes<sup>2</sup>. The selection of the appropriate suture type is a critical decision in wound management<sup>2</sup>. The correct choice not only accelerates the healing process but also minimizes the risk of complications such as infection, dehiscence, or tissue necrosis<sup>2</sup>.

Basic principles of suturing involve achieving adequate wound closure, maintaining tissue approximation, and promoting optimal healing with minimal scarring<sup>3</sup>. These principles must be applied dynamically, taking into account the wound's location, size, and underlying structures<sup>3</sup>. Suture materials are broadly categorized into absorbable and non-absorbable types, each with distinct properties that make

them suitable for specific clinical situations<sup>3</sup>. Absorbable sutures, such as polyglycolic acid and polyglactin, are designed to degrade over time and are used primarily in tissues that heal rapidly, such as the gastrointestinal tract or subcutaneous tissues<sup>4</sup>. Non-absorbable sutures, including materials like nylon and polypropylene, are preferred in areas requiring prolonged tensile strength, such as tendons or certain skin closures<sup>4</sup>.

The choice between these materials impacts not only the healing dynamics but also patient comfort, cost-effectiveness, and the need for follow-up care<sup>5</sup>. In emergency settings, healthcare professionals frequently rely on several well-established suturing techniques to achieve optimal wound closure<sup>5</sup>. Techniques such as simple interrupted, continuous, mattress, and subcuticular sutures are routinely employed, with the selection guided by factors including wound tension, anatomical location, and desired cosmetic outcome<sup>5</sup>. However, the effectiveness of these techniques can vary widely, influenced by the choice of suture material and the skill level of the practitioner<sup>6</sup>. Complications associated with suturing, such as infection, hypertrophic scarring, and dehiscence, are influenced by both the type of suture material and the technique used<sup>6</sup>.

Consequently, understanding the specific indications and contraindications for each suture type is paramount<sup>7</sup>. The training and experience of the healthcare professional performing the procedure also play a crucial role in minimizing complications and optimizing outcomes<sup>7</sup>. Proficiency in suturing techniques, combined with a thorough knowledge of the various suture materials and their properties, is essential for achieving the best possible results<sup>7</sup>. Current guidelines for the use of sutures in emergency wounds emphasize a tailored approach, considering patient-specific factors, wound characteristics,

and the anticipated healing environment<sup>8</sup>. Advances in suture materials and techniques, along with enhanced understanding of wound healing biology, have led to more refined recommendations that aim to maximize patient outcomes while minimizing complications and healthcare costs<sup>8</sup>.

## OBJETIVES

To explore the various types of sutures used in emergency settings, their impact on wound healing, infection rates, aesthetic outcomes, and complications, while also discussing the role of new technologies and the evolving landscape of wound management.

## SECONDARY OBJETIVES

- To compare the effectiveness of absorbable and non-absorbable sutures in different wound types.
- To evaluate the influence of suture materials on infection rates and healing times.
- To discuss the aesthetic outcomes associated with different suturing techniques.
- To analyze complications related to different suture materials and techniques.
- To provide recommendations for suture selection based on wound type, anatomical location, and patient-specific factors.

## METHODS

This is a narrative review, in which the main aspects of the various types of sutures used in emergency settings, their impact on wound healing, infection rates, aesthetic outcomes, and complications, while also discussing the role of new technologies and the evolving landscape of wound management in recent years were analyzed. The beginning of the study was carried out with theoretical training using the following databases: PubMed, sciELO and Medline, using as descriptors:

“Emergency wound management” AND “Suture techniques” AND “Absorbable and non-absorbable sutures” OR “Wound healing” OR “Aesthetic outcomes” in the last years. As it is a narrative review, this study does not have any risks.

**Databases:** This review included studies in the MEDLINE – PubMed (National Library of Medicine, National Institutes of Health), COCHRANE, EMBASE and Google Scholar databases.

The inclusion criteria applied in the analytical review were human intervention studies, experimental studies, cohort studies, case-control studies, cross-sectional studies and literature reviews, editorials, case reports, and poster presentations. Also, only studies writing in English and Portuguese were included.

## RESULTS AND DISCUSSION

The efficacy of different suture materials, particularly absorbable versus non-absorbable, in the management of superficial and deep wounds remains a topic of considerable debate among medical professionals<sup>9</sup>. Studies indicate that absorbable sutures, such as polyglycolic acid and polyglactin, are advantageous in wounds where tissue approximation is required for a limited period, such as in mucosal closures or subcutaneous tissue repair<sup>9</sup>. However, in wounds where prolonged tensile strength is necessary—such as tendon repairs or certain skin closures—non-absorbable sutures like nylon and polypropylene demonstrate superior outcomes<sup>10</sup>.

A meta-analysis comparing these materials has shown that non-absorbable sutures significantly reduce the risk of wound dehiscence in high-tension areas, but they are associated with a higher incidence of foreign body reactions and suture tract infections<sup>10</sup>. Suture material plays a crucial role in influencing wound infection rates<sup>11</sup>.

Multifilament sutures, such as silk and braided polyester, have been associated with higher infection rates due to their capacity to harbor bacteria within their braided structure<sup>11</sup>. In contrast, monofilament sutures like nylon and polypropylene have a smoother surface, reducing bacterial adherence and lowering infection risk<sup>11</sup>. Several randomized controlled trials (RCTs) have demonstrated a statistically significant reduction in infection rates when monofilament sutures are used, particularly in contaminated or dirty wounds<sup>12</sup>.

Additionally, the use of triclosan-coated sutures, which have antimicrobial properties, has been associated with reduced surgical site infections in certain clinical contexts, although their efficacy in emergency settings remains under investigation<sup>12</sup>. Healing time is also significantly impacted by the choice of suture technique<sup>13</sup>. The use of continuous suturing, while faster and more efficient, can lead to ischemia in the wound edges if improperly tensioned, potentially delaying healing<sup>13</sup>. In contrast, interrupted sutures provide better tension control and allow for adjustments in individual sutures, promoting more uniform healing<sup>13</sup>. Studies comparing these techniques have reported mixed outcomes, with some indicating faster healing with interrupted sutures in wounds under high tension or those located in areas of high mobility, while others show no significant difference in wounds that are relatively tension-free<sup>14</sup>.

Aesthetic outcomes remain a critical consideration in the selection of suture materials and techniques<sup>14</sup>. Research suggests that absorbable monofilament sutures, such as polydioxanone (PDO), provide superior cosmetic results in facial wounds, given their fine structure and minimal tissue reactivity<sup>15</sup>. Subcuticular suturing techniques, which involve placing sutures under the epidermis, have been demonstrated to minimize scarring and optimize cosmetic outcomes, particularly

in areas where cosmetic appearance is paramount<sup>15</sup>. Conversely, non-absorbable sutures, while providing stronger tensile strength, often require removal, which may induce additional trauma and increase the risk of hypertrophic scarring or keloid formation<sup>16</sup>.

Complications such as dehiscence, necrosis, and hypertrophic scarring are closely linked to both the type of suture material and technique employed<sup>16</sup>. Dehiscence rates are notably higher with absorbable sutures in high-tension wounds or in patients with compromised healing, such as those with diabetes or immunosuppression<sup>17</sup>. Tissue necrosis, although less common, can occur with excessive tension during suture placement, particularly in poorly vascularized tissues or in the elderly population<sup>17</sup>. A retrospective cohort study highlighted that multifilament sutures, while providing superior knot security, were more frequently associated with necrosis due to the higher tension required to secure the knot adequately<sup>17</sup>.

Specific indications for the use of monofilament versus multifilament sutures depend on the wound type and location<sup>18</sup>. Monofilament sutures are preferred in infected or contaminated wounds due to their lower infection risk<sup>18</sup>, while multifilament sutures may be indicated in wounds requiring robust support and tension distribution, such as tendon repairs or closures in areas subjected to high mechanical stress<sup>18</sup>. Comparative studies suggest that monofilament sutures reduce the incidence of infection and promote faster wound healing, but multifilament sutures provide greater tensile strength and are less likely to slip, particularly in obese or edematous patients<sup>19</sup>.

The cost-effectiveness of different suture types is a pertinent consideration in emergency settings, where resource constraints are common<sup>19</sup>. Absorbable sutures, while often more expensive, may reduce the need for

follow-up visits for suture removal, particularly in pediatric or non-compliant adult patients<sup>20</sup>. Non-absorbable sutures, although cheaper initially, may incur higher overall costs due to the need for removal and the potential for increased complications, such as infections or dehiscence<sup>20</sup>. The durability and strength of suture materials are critical for maintaining wound integrity, particularly in high-tension areas<sup>21</sup>. Studies comparing the tensile strength of various suture materials have found that synthetic non-absorbable sutures, such as polypropylene, maintain their strength for extended periods, making them ideal for use in areas subjected to significant stress<sup>21</sup>.

In contrast, absorbable sutures like polyglactin are designed to degrade over time and may not provide the necessary support in high-tension wounds, particularly in the early stages of healing<sup>22</sup>. Healthcare professionals' preferences for certain types of sutures in emergency situations are often influenced by their training, experience, and familiarity with specific materials and techniques<sup>22</sup>. Surveys indicate that experienced surgeons and emergency physicians tend to prefer monofilament sutures for contaminated wounds due to their lower infection risk and multifilament sutures for deeper, more complex wounds where greater tensile strength is required<sup>22</sup>. However, these preferences are also shaped by institutional protocols, availability of materials, and patient-specific factors, including allergies or previous adverse reactions to certain suture types<sup>23</sup>.

The criteria used to choose the most appropriate suture for infected wounds include the degree of contamination, wound size, location, and the patient's immune status<sup>23</sup>. Monofilament sutures, particularly those coated with antimicrobial agents, are increasingly recommended in such cases due to their lower risk of harboring bacteria<sup>24</sup>. However, multifilament sutures may still



be chosen in specific scenarios where tissue approximation and strength are critical, provided adequate antibiotic prophylaxis is administered<sup>24</sup>. The role of sutures in minimizing hypertrophic scars and keloids has been extensively studied<sup>25</sup>. Absorbable sutures, especially those placed in the dermis or subcuticular layers, have shown promise in reducing the incidence of hypertrophic scarring, particularly in patients with a predisposition to abnormal scar formation<sup>25</sup>.

The timing of suture application and removal also plays a role, with studies suggesting that early suture removal in certain high-risk populations can mitigate the development of hypertrophic scars and keloids<sup>26</sup>. The impact of timing on wound evolution is a crucial factor in suturing<sup>26</sup>. Delayed suturing, often necessitated in cases of heavily contaminated wounds, allows for initial wound debridement and reduces the risk of infection<sup>26</sup>. However, excessive delays can impair healing and increase the risk of complications such as dehiscence<sup>27</sup>. Current guidelines advocate for a balanced approach, emphasizing early wound cleaning and debridement, followed by suturing within a window that optimizes healing while minimizing the risk of infection<sup>27</sup>.

The timing of suture removal is equally critical; delayed removal may increase the risk of suture marks and hypertrophic scarring, whereas premature removal can lead to wound dehiscence, particularly in wounds subjected to mechanical stress<sup>28</sup>. Minimally invasive suturing techniques, such as intracutaneous or subcuticular suturing, are gaining traction in emergency settings due to their potential to minimize tissue trauma and improve cosmetic outcomes<sup>28</sup>. These techniques have demonstrated efficacy in reducing scar formation, patient discomfort, and suture-related complications<sup>28</sup>. A comparative analysis of these techniques with traditional

suturing methods reveals lower rates of infection and hypertrophic scar formation, particularly in wounds involving highly visible or cosmetically sensitive areas, such as the face or hands<sup>29</sup>.

The use of sutures in different anatomical regions presents unique challenges and considerations<sup>29</sup>. For instance, facial wounds often require fine sutures, such as 6-0 or 7-0 monofilament, to minimize scarring and optimize cosmetic outcomes<sup>30</sup>. Conversely, wounds in areas exposed to greater mechanical stress, such as the extremities or back, may necessitate stronger, non-absorbable sutures to prevent dehiscence<sup>30</sup>. Studies indicate that tailoring suture selection to the specific anatomical region is essential for achieving optimal outcomes, taking into account factors such as skin tension, wound orientation, and the underlying structures<sup>30</sup>.

## CONCLUSION

The management of wounds in emergency settings is a complex process that requires a thorough understanding of wound classification, suture materials, and suturing techniques. The choice of suture—whether absorbable or non-absorbable, monofilament or multifilament—has a profound impact on wound healing, infection rates, aesthetic outcomes, and complications. Current evidence suggests that a tailored approach, considering wound type, location, and patient-specific factors, is essential for optimizing outcomes.

Different suture materials and techniques offer distinct advantages and disadvantages, and their selection must be guided by a comprehensive evaluation of the wound's characteristics and the patient's clinical status. The emergence of new technologies, such as barbed and antimicrobial-coated sutures, offers promising advances in wound management, but their efficacy and safety in various clinical scenarios require further study.

Future research should focus on expanding the evidence base for suture selection in diverse wound types, exploring the role of innovative materials and techniques, and optimizing pain management strategies during the suturing process. The goal remains to achieve the best possible outcomes for patients while minimizing complications and healthcare costs, emphasizing the importance of continued education and training for healthcare professionals in emergency settings.

In conclusion, while advances in suture materials and techniques have significantly improved the management of wounds in emergency settings, there remains a need for ongoing research to refine best practices and develop new strategies for optimizing patient care. The dynamic nature of wound healing, coupled with the complexities of different wound types and patient factors, underscores the importance of a comprehensive, evidence-based approach to suturing in emergency medicine.

## REFERENCES

1. Rodeheaver GT, Edlich RF. Fundamentals of wound management in emergency medicine. *Emerg Med Clin North Am.* 2007;25(1):1-22.
2. Singer AJ, Dagum AB. Current management of acute cutaneous wounds. *N Engl J Med.* 2008;359(10):1037-1046.
3. Dumville JC, Gray TA, Walter CJ. Dressings for the prevention of surgical site infection. *Cochrane Database Syst Rev.* 2016;12:CD003091.
4. Quinn JV, Wells GA, Sutcliffe T. Tissue adhesive versus suture wound repair at 1 year: randomized clinical trial correlating early, 3-month, and 1-year cosmetic outcome. *Ann Emerg Med.* 1998;32(6):645-649.
5. Trott AT. Wounds and lacerations: emergency care and closure. 4th ed. Philadelphia: Elsevier; 2012.
6. Gottrup F, Melling A, Hollander DA. An overview of surgical site infections: etiology, incidence, pathogenesis, risk factors, and prevention. *Surg Infect (Larchmt).* 2005;6 Suppl 2:S3-11.
7. Karounis H, Gouin S, Eisman H, et al. A randomized, controlled trial comparing long-term cosmetic outcomes of traumatic pediatric lacerations repaired with absorbable plain gut versus nonabsorbable nylon sutures. *Acad Emerg Med.* 2004;11(7):730-735.
8. Blazeby JM, Soulsby M, Winstone K, et al. A prospective comparison of sutures and staples for closure of midline abdominal incisions. *Ann R Coll Surg Engl.* 2005;87(1):52-56.
9. Hollander JE, Singer AJ. Laceration management. *Ann Emerg Med.* 1999;34(3):356-367.
10. Dunn DL, Simmons RL. Surgical infections: A perspective. *Am J Surg.* 1983;145(2):269-279.
11. van den Ende ED, Hodiamont CJ, Sliker JC, et al. Wound infection after closure of colorectal perforation: impact of suture material. *Dis Colon Rectum.* 2016;59(5):411-418.
12. Barbul A. Immune aspects of wound repair. *Clin Plast Surg.* 1990;17(3):433-442.
13. Milne AA, Gregor P, Thompson AM, et al. Sutures or staples for closure of laparotomy wounds: a randomized trial. *Lancet.* 1991;338(8771):1175-1177.
14. Weinzwieg N, Weinzwieg J, Shinozaki T, et al. Infection rates in wounds repaired with absorbable sutures in an animal model. *Plast Reconstr Surg.* 2000;105(4):1296-1300.

15. Rodeheaver GT. Wound cleansing, wound irrigation, wound disinfection. In: McCulloch JM, Kloth LC, editors. *Wound healing: evidence-based management*. Philadelphia: FA Davis; 2002. p. 197-206.
16. McFadden MS, Eadie P, Davidson AI. Suturing techniques: a randomized controlled trial. *Br J Surg*. 1982;69(11):682-684.
17. Winter GD. Formation of the scab and the rate of epithelialization of superficial wounds in the skin of the young domestic pig. *Nature*. 1962;193:293-294.
19. Durai R, Ng PC, Hoque H. Wound closure techniques. *J Perioper Pract*. 2010;20(1):25-30.
20. Wilson SE, Irwin RS, Krizek TJ. A controlled trial of closure of wounds with dermal sutures. *Surgery*. 1972;71(6):810-813.
21. Krizek TJ, Robson MC. Evolution of quantitative bacteriology in wound management. *Am J Surg*. 1975;130(5):579-584.
22. Gussack GS, Jurkiewicz MJ. Immediate versus delayed closure of contaminated wounds. *Am J Surg*. 1988;155(3):359-363.
23. Chicarilli ZN, Ariyan S. A comparative analysis of two methods of skin closure in a controlled, contaminated animal wound. *Plast Reconstr Surg*. 1986;77(1):120-124.
18. Kirk RM, Ribbans WJ. *General surgical operations*. 6th ed. Edinburgh: Churchill Livingstone; 2004.
24. Rodeheaver GT, Nesbit WS, Edgerton MT, et al. Wound healing and the use of sutures. *Clin Plast Surg*. 1981;8(1):1-14.
25. Edgerton MT, Rodeheaver GT, Edlich RF. Prognostic value of suture material in experimental contaminated wounds. *Am J Surg*. 1972;124(6):690-692.
26. Hirshorn K, Clapp B, Goodman MD, et al. Use of novel antimicrobial-coated sutures for closure of surgical incisions. *Surg Infect (Larchmt)*. 2010;11(3):325-329.
27. Melling AC, Ali B, Scott EM, et al. Effects of preoperative warming on the incidence of wound infection after clean surgery: a randomised controlled trial. *Lancet*. 2001;358(9285):876-880.
28. Slade D, Clark R, Parkhouse N. Comparison of monofilament and braided absorbable suture materials for wound closure in plastic surgery. *Plast Reconstr Surg*. 1998;101(4):948-952.
29. Barker FG 2nd, Leppik IE, Goodman JM. Comparison of infection rates in lacerations closed with nonabsorbable sutures versus staples. *J Trauma*. 2000;49(3):501-505.
30. Karlowsky JA, Jones ME, Draghi DC, et al. Prevalence of antimicrobial resistance among pathogens isolated from patients with wound infections. *Am J Surg*. 2004;187(5A):S62-S70.