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THERAPEUTIC APPROACH TO ACUTE PAIN IN POLYTRAUMA PATIENTS: AN INTEGRATIVE REVIEW

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Abstract: Introduction: Trauma is a serious global public health problem, with high morbidity and mortality rates. Acute pain is a frequent experience in polytrauma victims, but its clinical management remains inadequate, characterized by undertreatment, variability in approaches, and significant organizational barriers. This gap between guidelines and practice, accentuated in contexts of limited resources, negatively impacts patient stabilization and clinical outcomes. **Methods**: An integrative review was conducted with a search of the PubMed, BVS, SciELO, and ScienceDirect databases, considering the period from 2015 to 2025 and including clinical trials that addressed the management of acute pain in polytrauma patients in emergency services. After a screening process, eight studies were eligible for final analysis. **Results**: The synthesis of the studies confirmed the prevalence of undertreatment and inconsistent pain assessment. Organizational strategies, such as the implementation of standardized protocols combined with staff training, have been shown to significantly improve the quality of analgesic management. Pharmacologically, multimodal analgesia has proven effective, with combinations such as nalbuphine and paracetamol standing out. Inhaled methoxyflurane emerged as a promising, effective, and safe alternative. At the same time, outdated practices, such as resuscitation with synthetic colloids, were identified as being associated with an increase in complications. **Conclusion**: It is concluded that effective pain management in polytrauma patients is a multifactorial challenge that transcends simple pharmacological choices. It is imperative to integrate standardized clinical protocols, continuously invest in team training, and adopt a care culture that prioritizes early, evidence-based analgesia as an essential component of resuscitation, adapting to local realities to optimize patient prognosis.

Keywords: Pain Management; Multiple Trauma; Analgesia; Acute Pain.

INTRODUCTION

Trauma represents one of the greatest challenges to public health, given its high morbidity and mortality rates and significant socioeconomic impact, especially as it affects individuals of working age. In the Brazilian context, studies characterize the magnitude and epidemiological profile of trauma care in emergency services (1). On an international scale, cohorts show the growing incidence of trauma in the elderly population and associate the reduction in mortality and length of hospital stay with the existence of specialized trauma centers and the implementation of improved treatment algorithms (2).

Trauma-related pain is an unpleasant sensory and emotional phenomenon, whose pathophysiology involves peripheral and central mechanisms, such as central sensitization, capable of amplifying and prolonging the painful sensation and impacting clinical outcomes (3). Tissue injury activates nociceptors and triggers an inflammatory response with the release of mediators (such as prostaglandins and cytokines), which increase neuronal excitability and transmit pain impulses to the central nervous system. Furthermore, persistent afferent input can induce CNS sensitization and painful hypersensitivity (3-5). Therefore, early assessment and treatment of pain in trauma is essential not only for comfort but also to reduce complications and improve prognosis.

In urgent and emergency settings, the literature shows that pain is highly prevalent and that failures in assessment and treatment (oligoanalgesia) remain frequent. In a Brazilian study conducted in an emergency department, inadequate pain management and great variability in the time to first analgesia were observed (6). In low- and middle-income countries, such as Rwanda and Ethiopia, studies also describe gaps in analgesia and pain management practices in trauma patients, reinforcing the influence of structural factors, therapeutic availability, and work processes (7,8).

Despite recognition of its importance, pain management in trauma still faces significant barriers, such as the underuse of analgesics and the fear that pain relief may mask important clinical signs. In low- and middle-income countries, the fragility of clinical record systems and the shortage of professionals trained in acute pain protocols aggravate the problem, compromising the effectiveness of analgesia and care safety (7,8). Organizational factors, such as high demand and lack of uniform protocols, hinder the standardization of care and generate variability in conduct, with significant delays in treatment; the average time for first analgesia can exceed 90 minutes in some contexts (7). This scenario contributes to inadequate management, in which almost half of patients may receive insufficient pharmacological treatment for the intensity of their pain (8).

This reveals a significant gap between the recommended guidelines and the practice observed in the initial management of pain in trauma. Although early analgesia is recommended, studies in referral emergency services show that this goal is often not achieved. In an Ethiopian context, for example, less than 10% of patients received their first analgesia within 30 minutes, and almost half received pharmacological treatment considered inadequate for their reported level of pain (8). This disconnect indicates that failures in the initial assessment and decision-making process perpetuate undertreatment from admission onwards.

The introduction of new analgesic therapies, however promising, faces the critical challenge of practical implementation. The efficacy demonstrated in studies does not always translate into reality in healthcare settings, especially in places with limited resources. The adoption of an innovation depends not only on its effectiveness, but also on its logistical feasibility, cost, and the training capacity of teams (7,8). Therefore, pain management strategies should be evaluated not only for their potency, but also for their adaptability to different operational and economic realities.

Given this complex landscape, marked by undertreatment, unjustified variability, and barriers to implementation, it is essential to consolidate evidence that supports pain management strategies that are simultaneously effective, practical, and adaptable (7,8). Identifying approaches that can be integrated in a standardized manner into emergency workflows is a crucial step toward improving the quality of care. Thus, this study aims to identify, in the scientific literature, the main strategies employed in the management of acute pain in polytrauma patients treated in emergency services.

METHODOLOGY

This study consists of an integrative review of the literature on acute pain management in polytrauma patients, focusing on

the relationship between pharmacological and non-pharmacological treatment.

The methodology applied was based on the analysis of recently published studies, allowing the identification and classification of different types of management for the cessation or attenuation of acute pain in polytrauma patients. It provides a comprehensive view of the topic, favors the synthesis of knowledge, and enables the application of relevant findings from the literature in clinical practice, aligning with the principles of evidence-based practice. Thus, it enables a methodological approach capable of generating more consistent results regarding complex concepts, theories, and practices, contributing to improving the quality of care provided to patients (9).

The guiding question of this study was formulated based on the PICO (Population, Intervention, Comparison, and Outcome) strategy, which guides the development of the research question, directs the literature search, and assists in the efficient identification of the most relevant scientific evidence. As shown in **Table 1**, P (population) refers to polytrauma patients; I (intervention) refers to acute pain management strategies; C (comparison) considers pharmacological and non-pharmacological approaches; O (outcome) involves effective pain control and clinical impact.

Thus, after using the PICO strategy, the question was structured as follows: What strategies have been described in the literature for the management of acute pain in polytrauma patients in emergency services?

Data collection was performed in the following databases: PubMed, BVS (Virtual Health Library), SciELO (*Scientific Electronic Library Online*), and ScienceDirect. The search was based on the analysis of descriptors found in DeCS (Health Science Descriptors): Acute pain, Multiple trauma, and Emergency Medicine, and MeSH (*Medical Subject Headings*): *Acute pain*, *Multiple trauma*, *Emergency Medicine*, using Boolean operators such as AND and OR to combine terms and optimize the search for relevant studies.

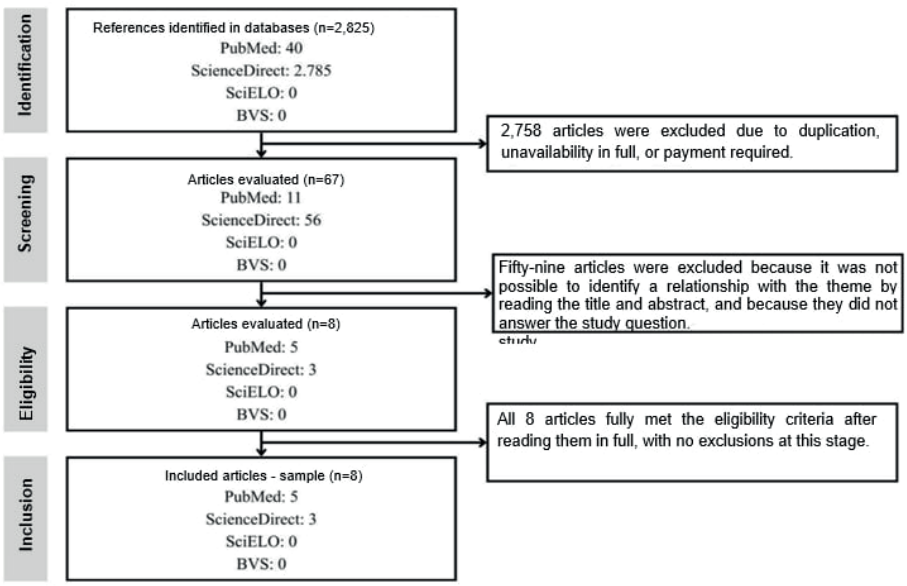
Articles published in the last 10 years (2015-2025), available in full (free full text), in Portuguese/English/Spanish, of the clinical trial/randomized clinical trial type, addressing acute pain management in polytrauma patients in an urgent and emergency context, were selected. The exclusion criteria were systematic, integrative, narrative, or meta-analysis reviews, studies without methodological rigor, experimental studies in animals or non-human models, and articles focused exclusively on chronic pain.

In the study selection process, screening was performed by (1) title, (2) abstract, and (3) full text. PubMed: of the 40 clinical trials identified, 29 were excluded by title and abstract because they were not directly related to the management of acute pain in polytrauma patients. Eleven articles remained for full-text reading, of which six were excluded because they did not adequately answer the guiding question or were of low thematic relevance, leaving five eligible studies. ScienceDirect: of the 2,785 studies filtered as clinical trials/randomized trials, 2,729 were excluded by title and abstract because they did not address acute pain management in polytrauma patients or because they dealt with other clinical conditions. Fifty-six articles remained for full-text evaluation, of which 53 were excluded for not adequately answering the guiding question or for being of low thematic relevance, leaving

Description	Question Component
P (population)	Polytrauma patients
I (intervention)	Acute pain management strategies
C (comparison)	Pharmacological and non-pharmacological approaches
O (outcome)	Effective pain control and clinical impact

Table 1: Construction of the guiding question using the PICO strategy

Source: Prepared by the authors, 2025.



VHL: Virtual Health Library; PubMed: U.S. National Library of Medicine; SciELO: Scientific Electronic Library Online; n: Sample number.

Figure 1: Flowchart of the selection of studies for this integrative review.

Source: Prepared by the authors, 2025.

Author, year, and country	Type of study	N	Intervention	Main results	Study conclusions
Jean Pierre Hagenimana et al., 2024, Rwanda. [11]	Intervention study	261	Implementation of the Essential Pain Management (EPM) course combined with mentoring to use the protocol based on the WHO analgesic ladder.	Significant improvement in pain management: documentation scores increased (absence of records reduced from 58% to 24%); increase in patients with mild pain (37% to 62%); patient satisfaction rose from 42% to 80%. Persistent barriers : lack of staff experience, documentation failures, patient reluctance to report pain.	The implementation of a structured training program in pain management combined with mentoring in the use of the WHO ladder-based protocol is effective in improving the quality of acute pain management in polytrauma patients.

Hilbert Carius et al., 2018, Germany. [12]	Retrospective observational cohort study (Trauma Register DGU)	48,484	Analysis of resuscitation with synthetic colloids (mainly HES) versus crystalloids.	Administration of >1,000 ml of synthetic colloids associated with an increase in the rate of renal replacement therapy (OR 1.42) and renal failure (OR 1.32). Use of colloids associated with a higher incidence of multiple organ failure. No difference in hospital mortality between colloids and crystalloids. The use of colloids decreased over the period (2002–2015).	The choice of resuscitation fluid may affect the safety of the analgesic regimen. It is recommended to integrate safe fluid resuscitation with analgesic strategies that avoid aggravating renal failure or coagulopathy.
Jean Muragizi et al., 2023, Rwanda. [13]	Retrospective cross-sectional study	1,329	Administration of analgesia (opioids, non-opioids, and ketamine)	Opioids predominated (tramadol: 35% of administrations). Ketamine underutilized (1%). Profile: young men (72%, median age 32 years), traffic accidents (51.8%), majority without serious injuries (60.8%). About half of the patients received analgesia.	Predominance of opioids; disparity in access (men, traffic accident victims, and those with serious injuries are more likely to receive analgesia). Need for standardized protocols and clinical audit.
Segni Kejela, Nebyou Seyoun, 2022, Ethiopia. [14]	Prospective observational study	74	Administration of analgesia (diclofenac or tramadol)	79.7% of patients had severe pain in the emergency department; 59.5% in the emergency room. All received analgesia, only diclofenac (12.2%) or tramadol (87.8%).	Disconnect between pain intensity and analgesic potency. Inadequate pain control in ~2/3 of cases, with excessive use of WHO level I/II analgesics.
Jonas Lohmann et al., 2025, Germany. [15]	Multicenter retrospective observational study (historical cohort)	1,241	IV paracetamol, IV nalbuphine + paracetamol, IV piritramide	Analysis of 1,241 prehospital interventions. The combination of nalbuphine + paracetamol had a higher probability of effective analgesia (OR 3.25) and a greater mean reduction in pain (ΔNRS 4.6). Complications were rare (5.5%), with no difference between opioids.	The combination of nalbuphine + paracetamol was more effective than opioid monotherapy with piritramide or paracetamol, with comparable safety. Supports use in prehospital protocols.
Lvovschi et al., 2020, France. [16]	Organizational modeling study (MCDA) with expert panel	0	Methoxyflurane	Methoxyflurane (MEOF) alone: positive organizational impact (59/100). Trauma care pathway without MEOF: 66/100. MEOF + structured pathway combination: best result (75/100), with positive effects on all criteria.	MEOF has a positive organizational impact, especially when integrated into trauma protocols. MCDA is useful for evaluating innovations in complex contexts.

Brichko et al., 2021, Australia. [17]	Phase IV, open-label, randomized clinical trial with parallel groups (RAMPED)	120	Comparison between methoxyflurane screening and standard analgesic treatment	Inhaled methoxyflurane (3 mL) vs. standard care for severe pain (NRS ≥ 8). Did not achieve a ≥ 50% reduction in 30 minutes, but had greater reductions at all times (15–90 min) and a favorable safety profile.	Methoxyflurane provides clinically significant reductions in pain for up to 90 min, making it a viable non-opioid option for initial management, but it may be insufficient alone in very severe pain.
Hartshorn et al., 2025, United Kingdom and Ireland. [18]	Randomized, double-blind, placebo-controlled, multicenter clinical trial	192	Comparison between methoxyflurane and placebo administered via the same inhaler device	Methoxyflurane was superior to placebo in reducing pain within 15 minutes in children with trauma, with a tolerable safety profile.	Methoxyflurane is effective and safe for acute traumatic pain in pediatrics and may reduce the need for opioids in initial care.

Table 2. Studies on acute pain management in polytrauma patients.

Source: Prepared by the authors, 2025.

three eligible studies. In the other databases (SciELO, BVS), no articles advanced to this stage due to the initial zero number or because they did not fit the defined filters.

RESULTS

For the analysis of the eight selected articles, a summary table (**Table 2**) was prepared, structured in a systematic and standardized manner. This instrument was constructed based on a previously defined script, covering the following essential information from each study: author and year of publication, title, methodological design, and objective. This organization enabled a comparative visualization of the included studies, facilitating understanding of the methodological approaches and investigative purposes of each article.

DISCUSSION

The comparative analysis of the included studies shows that the management of acute pain in polytrauma patients remains insufficient and heterogeneous, even in structured emergency services. There is a consistently high prevalence of moderate to severe pain from admission, contrasting with suboptimal rates of early and adequate analgesia, especially in low- and middle-income settings (11,12,16). These findings corroborate the existence of a persistent gap between evidence-based recommendations and everyday clinical practice.

Studies conducted in African services show that less than half of patients receive analgesia compatible with the intensity of their pain, often with significant delays until the first administration (11,12,116). In comparison, investigations conducted in high-income countries show greater access to structured analgesic strategies, especially in the prehospital setting, even though severe pain is not fully controlled in all cases (13,15). This discrepancy suggests that organizational and systemic factors exert as much influence as pharmacological availability.

The organization of care flows emerges as a central determinant of the quality of pain management. Evidence shows that the implementation of standardized protocols and educational interventions is associated

with improved pain documentation, more appropriate analgesic prescribing, and reduced time to the first dose (11). In contrast, settings characterized by a lack of protocols and high care overload show greater variability in conduct and persistence of oligoanalgesia (12,16). These findings reinforce that systematic pain assessment should be incorporated as an essential component of screening and clinical reassessment in trauma.

With regard to pharmacological strategies, studies indicate that multimodal analgesia performs better than monotherapy. Data from prehospital care show that the combination of non-opioid analgesics with intermediate-potency opioids results in greater reduction in pain scores, without a significant increase in adverse events, when compared to the isolated use of paracetamol (13). In contrast, in services with limited resources, the predominant use of lower-potency analgesics is observed even in the face of severe pain, characterizing therapeutic inadequacy (12,16).

The introduction of innovative therapies, such as inhaled methoxyflurane, has proven effective in reducing acute traumatic pain in different settings and age groups, including pediatric populations (13,15). Although it does not always produce significant reductions in a short period of time when used alone in cases of very severe pain, this strategy has relevant operational advantages, such as ease of administration, rapid onset of action, and less dependence on venous access (13). In children and adolescents, it was observed to be more effective than placebo, with an acceptable safety profile, expanding the potential for clinical application of this resource (15).

However, analyses incorporating organizational criteria show that the impact of these innovations is maximized when integrated into structured lines of care. Evaluations based on multiple criteria indicate that the reorganization of care flows produces broader benefits than the isolated introduction of new drugs (14). This finding converges with the results observed in this study, in which structural differences between the services evaluated were directly reflected in the time to analgesia and the quality of pain management.

Additionally, therapeutic practices that are not aligned with current evidence, such as the use of synthetic colloids in the volume resuscitation of severely traumatized patients, remain present in some contexts and are associated with worse clinical outcomes, including renal dysfunction and organ failure (18). Although not directly related to analgesia, these data reinforce the need for an integrated and evidence-based approach t y care for polytrauma patients, since inappropriate interventions can aggravate the clinical course and negatively impact pain control.

In summary, the studies analyzed indicate that undertreatment of pain in trauma results less from the isolated unavailability of drugs and more from systemic failures related to service organization, professional training, and the absence of clear protocols. The integration of systematic pain assessment, standardization of procedures, team training, and careful incorporation of new technologies represents the most effective strategy to ensure early, safe, and effective analgesia, with a positive impact on clinical outcomes and the experience of polytrauma patients.

CONCLUSION

Pain in polytrauma patients remains undertreated in different healthcare settings, especially those with less infrastructure. The findings of this review reinforce the urgent need for standardization of protocols, training of teams, and incorporation of effective analgesic therapies, both traditional and innovative. Organizational and educational strategies are as essential as the pharmacological arsenal, as they determine the ability of services to offer early, adequate, and safe analgesia. The integration of scientific evidence and clinical practice is fundamental to reducing morbidity and mortality and improving the experience and prognosis of trauma victims.

REFERENCES

1. Santos LFS, Fonseca JMA, Cavalcante BLS, Lima CM. Estudo epidemiológico do trauma ortopédico em um serviço público de emergência. Cad Saúde Colet. 2016;24(4):397-403. doi:10.1590/1414-462X201600040128. Disponível em: https://www.scielo.br/j/cadsc/a/q5qSWC-5QgVhy8j3gygGSVSP/?lang=pt SciELO Brasil

2. Kalbas Y, Lempert M, Ziegenhain F, Scherer J, Neuhaus V, Lefering R, et al. A retrospective cohort study of 27,049 polytraumatized patients age 60 and above: identifying changes over 16 years. Eur Geriatr Med. 2022;13(1):233-241. doi:10.1007/s41999-021-00546-9. Disponível em: https://pubmed.ncbi.nlm.nih.gov/34324144/ PubMed

3. Ji RR, Chamessian A, Zhang YQ. Pain regulation by non-neuronal cells and inflammation. **Science.** 2016 Nov 4;354(6312):572-577. doi:10.1126/science.aaf8924. Disponível em: https://pmc.ncbi.nlm.nih.gov/articles/PMC5488328/ PMC

4. Ji RR, Nackley A, Huh Y, Terrando N, Maixner W. Neuroinflammation and central sensitization in chronic and widespread pain. **Anesthesiology.** 2018 Aug;129(2):343-366. doi:10.1097/ALN.0000000000002130. Disponível em: https://pmc.ncbi.nlm.nih.gov/articles/PMC6051899/ PMC

5. Donnelly CR, Andriessen AS, Chen G, Wang K, Jiang C, Maixner W, et al. Central nervous system targets: glial cell mechanisms in chronic pain. **Neurotherapeutics.** 2020;17(3):846-860. doi:10.1007/s13311-020-00905-7. Disponível em: https://pmc.ncbi.nlm.nih.gov/articles/PMC7609632/ PMC

6. Silva JS, Cruz TAF, Ribeiro CJN, Santos VS, Alves JAB, Ribeiro MCO. Dor em pacientes atendidos na classificação de risco de um serviço de urgência. Rev Dor. 2016;17(1):34-38. doi:10.5935/1806-0013.20160009. Disponível em: https://www.scielo.br/j/rdor/a/x7xYfGntHd4LnVLQJxpSDHv/

7. Rosenberg A, Uwitonze E, Dworkin M, Guidry JPD, Cyuzuzo T, Banerjee D, et al. Pain in the Prehospital Setting in Rwanda: Results of a Mixed-Methods Quality Improvement Project. Pain Res Manag. 2020;2020:3284623. doi:10.1155/2020/3284623. Disponível em: https://pubmed.ncbi.nlm.nih.gov/33014213/

8. Ayano WA, Fentie AM, Tileku M, Jiru T, Hussen SU. Assessment of adequacy and appropriateness of pain management practice among trauma patients at the Ethiopian Aabet Hospital: A prospective observational study. BMC Emerg Med. 2023;23:92. doi:10.1186/s12873-023-00869-9. Disponível em: https://pmc.ncbi.nlm.nih.gov/articles/PMC10433567/

9. Souza MT de, Silva MD da, Carvalho R de. Integrative review: what is it? How to do it?. einstein (São Paulo) [Internet]. 2010Jan;8(1):102–6. Available from: https://doi.org/10.1590/S1679-45082010RW1134

10. Hagenimana JP, Banguti PR, Anderson RLC, Tuyishime J de D, Nyirigira G, Tuyishime E. Improving pain management for trauma patients at two Rwandan emergency departments. African Journal of Emergency Medicine. 2024 Dec;14(4):258–62.

11. Hilbert-Carius P, Schwarzkopf D, Reinhart K, Hartog CS, Lefering R, Bernhard M, et al. Synthetic colloid resuscitation in severely injured patients: analysis of a nationwide trauma registry (TraumaRegister DGU). Scientific Reports [Internet]. 2018 Aug 1 [cited 2021 Aug 2];8. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6070577/?fbclid=IwAR3oEs58b-xczpTQRoyptYyKpdS6gHfJhhpe3XhO7n7-Lefvy46I3XXMPkw

12. Muragizi J, Guptill M, Bogdan Dumitriu, Henry M, Aluisio AR, Jean Paul Nzabandora, et al. Analgesia use in trauma patients at a university teaching hospital in Kigali, Rwanda. African Journal of Emergency Medicine. 2023 Sep 1;13(3):147–51.

13. Kejela S, Seyoum N. Acute pain management in the trauma patient population: are we doing enough? A prospective observational study. Journal of Trauma and Injury. 2022 Jun 3;35(3).

14. Lohmann J, Deicke M, Deslandes M, Grannemann JJ, Johnson L, Jochen Hinkelbein, et al. Prehospital analgesia for trauma-related pain by paramedics: a comparative retrospective observational study of paracetamol, nalbuphine plus paracetamol, and piritramide. Scandinavian Journal of Trauma Resuscitation and Emergency Medicine. 2025 Oct 2;33(1).

15. Lvovschi VE, Maignan M, Tazarourte K, Diallo ML, Hadjadj-Baillot C, Pons-Kerjean N, et al. Multiple criteria decision analysis approach to consider therapeutic innovations in the emergency department: The methoxyflurane organizational impact in acute trauma pain. Ashkenazi I, editor. PLOS ONE. 2020 Apr 15;15(4):e0231571.

16. Brichko L, Gaddam R, Roman C, O'Reilly G, Luckhoff C, Jennings P, et al. Rapid Administration of Methoxyflurane to Patients in the Emergency Department (RAMPED) Study: A Randomized Controlled Trial of Methoxyflurane Versus Standard Care. Miner J, editor. Academic Emergency Medicine. 2020 Oct 28;28(2).

17. Hartshorn S, Barrett MJ, Bloom B, Lyttle MD, Walton E, Steel K, et al. Treatment of acute trauma-related pain in children and adolescents with methoxyflurane (Penthrox®) compared to placebo (MAGPIE): a randomised clinical trial. Injury [Internet]. 2025 Oct 20;112830. Available from: https://www.sciencedirect.com/science/article/pii/S0020138325006886