

TEMPLATE

RQ [##]: In Gustilo Grade III injuries, is it acceptable to delay debridement beyond six hours in order to await an experienced surgical team?

Section 1: Background (<300 words):

Known and Unknown Facts

It is widely known that Gustilo-Anderson Grade III open fractures carry high risks of deep infection, non-union, and limb loss, and that combined ortho-plastic surgical management drastically improves clinical outcomes. Historically, the "six-hour rule" mandated emergent debridement to prevent infection [Powell-Bowns MFR, Keating JF. *Timing of debridement: When to do it, and who should perform it. Injury. 2024;55:111604*]. However, the exact safe time limit for delaying surgery to await an experienced team remains unknown, as obtaining Level I randomized controlled trials assigning patients to delayed treatment may be considered unethical [Powell-Bowns MFR, Keating JF. *Timing of debridement: When to do it, and who should perform it. Injury. 2024;55:111604*].

Current Evidence, Gaps, and Clinical Relevance

Current observational evidence presents a conflict. Large registry data suggests a cumulative 0.23% increased infection probability for every six-hour delay in Grade III injuries [Cortez A, et al. *Delays in Debridement of Open Femoral and Tibial Fractures Increase Risk of Infection. J Bone Joint Surg Am. 2023;105(20):1622-1629*]. Conversely, multiple clinical cohorts demonstrate no significant increase in infection rates when debridement is delayed (e.g., >12 hours) under controlled conditions [Hendrickson SA, et al. *Time to Initial Debridement and wound Excision (TIDE) in severe open tibial fractures and related clinical outcome: A multi-centre study. Injury. 2018*].

A major clinical gap lies in balancing surgical urgency against specialist availability. Rushing a patient to theatre out-of-hours simply to meet an arbitrary target often leads to inadequate debridement by junior staff, compromising flap options and increasing revision rates [Naique SB, Pearse M, Nanchahal J. *Management of severe open tibial fractures: the need for combined orthopaedic and plastic surgical treatment in specialist centres. J Bone Joint Surg Br. 2006;88-B(3):351-357*]. Clinically, modern BOAST and NICE guidelines recognize that the quality of the initial debridement is arguably more important. Delaying surgery for 12 to 24 hours is highly relevant and recommended to ensure the procedure is performed concurrently by an experienced, multidisciplinary ortho-plastic team during

scheduled daylight lists [Powell-Bowns MFR, Keating JF. Timing of debridement: When to do it, and who should perform it. *Injury*. 2024;55:111604].

Section 2: Data extraction table

See Attached Excel Table

Section 3: Results summary write-up (up to 500 words)

6-Hour Rule vs. Cumulative Delay Risk & Determinants of Outcome Registry data reports that infection probability increases by 0.17% to 0.23% for every 6-hour delay in debridement, with the highest risk recorded in Grade III injuries [Cortez A, et al. Delays in Debridement of Open Femoral and Tibial Fractures Increase Risk of Infection. *J Bone Joint Surg Am*. 2023;105(20):1622-1629.]. Clinical cohorts report no statistically significant difference in infection rates when comparing debridement before or after 6, 12, or 24 hours [Hendrickson SA, Wall RA, Manley O, Gibson W, Toher D, Wallis K, Ward J, Wallace DL, Lamyman M, Giblin AV, Wright TC, Khan U. Time to Initial Debridement and wound Excision (TIDE) in severe open tibial fractures and related clinical outcome: A multi-centre study. *Injury*. 2018.]. When debridement averages 8 hours, patient factors and overall injury severity are the primary determinants of poor outcomes [Enninghorst N, McDougall D, Hunt JJ, Balogh ZJ. Open tibia fractures: timely debridement leaves injury severity as the only determinant of poor outcome. *J Trauma*. 2011;70(2):352-357.]. In low-grade (Grade I/II) fractures, surgical delays over 24 hours do not correlate with increased infection rates [Rotman D, Atlan F, Shehadeh K, Ashkenazi I, Gurel R, Rosenblatt Y, Pritsch T, Factor S. Timing of Debridement in Low-Grade Open Forearm Fractures Does Not Affect Infection Risk: A Retrospective Study. *J Clin Med*. 2025;14:2878.].

Orthoplastic vs. Conventional & Quality vs. Urgency Single-stage orthoplastic care reports deep infection rates of 4.2%, compared to 34.6% when definitive fixation and soft-tissue coverage are staged separately in conventional orthopaedic care [Mathews JA, Ward J, Chapman TW, Khan UM, Kelly MB. Single-stage orthoplastic reconstruction of Gustilo-Anderson Grade III open tibial fractures greatly reduces infection rates. *Injury*. 2015;46:2263-2266.]. Multicentre data demonstrates that waiting for optimal surgical conditions to perform high-quality radical debridement results in fewer secondary interventions compared to prioritizing urgent time targets [Boriani F, Ul Haq A, Baldini T, Urso R, Granchi D, Baldini N, Tigani D, Tarar M, Khan U. Orthoplastic surgical collaboration is required to optimise the treatment of severe limb injuries: A multi-centre, prospective cohort study. *J Plast Reconstr Aesthet Surg*. 2017;70(6):715-722.].

Junior vs. Senior Teams Emergency debridements performed out-of-hours to meet strict time targets by junior or general orthopaedic staff without plastic surgery support were associated with higher rates of inadequate initial management; 47% of tertiary transfer patients required revision of their initial skeletal fixation [Naique SB, Pearse M, Nanchahal J. Management of severe open tibial fractures: the need for combined orthopaedic and plastic surgical treatment in specialist centres. *J Bone Joint Surg Br.* 2006;88-B(3):351-357.]. Debridements scheduled on daytime lists led by senior orthopaedic and plastic surgery consultants are associated with fewer deep infections [Hendrickson SA, Wall RA, Manley O, Gibson W, Toher D, Wallis K, Ward J, Wallace DL, Lamymann M, Giblin AV, Wright TC, Khan U. Time to Initial Debridement and wound Excision (TIDE) in severe open tibial fractures and related clinical outcome: A multi-centre study. *Injury.* 2018.].

Upper vs. Lower Limb Upper limb open fractures experience longer surgical delays (mean 31 hours for elbows, median 47 hours for forearms) but record low deep infection rates (0% to 1.6%) due to rich soft-tissue vascularity [Bano C, Coffey D, Al-Tawil K, Tavakkolizadeh A, Rose V, Tahmassebi R, Karuppaiah K, Colegate-Stone T. Management of open elbow fractures: experiences and outcomes from a UK major trauma center. *J Shoulder Elbow Surg.* 2022;31:461-468.], [Rotman D, Atlan F, Shehadeh K, Ashkenazi I, Gurel R, Rosenblatt Y, Pritsch T, Factor S. Timing of Debridement in Low-Grade Open Forearm Fractures Does Not Affect Infection Risk: A Retrospective Study. *J Clin Med.* 2025;14:2878.]. Severe open lower limb fractures lack this vascularity and require prompt orthoplastic soft-tissue coverage [Powell-Bowns MFR, Keating JF. Timing of debridement: When to do it, and who should perform it. *Injury.* 2024;55:111604.].

Paediatric vs. Elderly Median time to initial wound excision (1 day) and definitive reconstruction (2 days) was similar between paediatric and elderly populations [Khadim MF, et al. A comparison between the Major Trauma Centre management of complex open lower limb fractures in children and the elderly. *Injury.* 2019;50(5):1376-1381.]. In a national adult registry, patients ≥65 years waited longer for initial debridement than those <65 years but received definitive soft-tissue cover sooner. The ≥65 cohort recorded an amputation rate of 12% versus 7% for the <65 cohort, and a mortality rate of 6% versus 2% [Wilson E, Young K, Kwasnicki R, Hettiaratchy S. An evaluation of the management of severe open tibial fractures in the United Kingdom's major trauma centres. *Injury.* 2024;55:111475.].

Section 4: Discussion (<1000 words)

Timing of Debridement in Grade III Injuries

The historic doctrine mandating emergency surgical debridement of open fractures within six hours has been increasingly challenged, particularly for severe Gustilo-Anderson Grade III injuries [Powell-Bowns MFR, Keating JF. Timing of debridement: When to do it, and who should perform it. *Injury*. 2024;55:111604]. Large registry analyses indicate that delays carry a cumulative, time-dependent risk, increasing the probability of infection by 0.23% for every six-hour delay in Grade III injuries [Cortez A, et al. Delays in Debridement of Open Femoral and Tibial Fractures Increase Risk of Infection. *J Bone Joint Surg Am*. 2023;105(20):1622-1629]. However, numerous observational cohorts have failed to demonstrate a consistent increase in infection rates using 6- or 12-hour thresholds when high-quality debridement and soft-tissue coverage are ultimately achieved. For example, deep infection rates for Grade IIIB tibial fractures debrided before 12 hours (4.5%) versus after 12 hours (5.6%) showed no statistically significant difference [Hendrickson SA, et al. Time to Initial Debridement and wound Excision (TIDE) in severe open tibial fractures and related clinical outcome: A multi-centre study. *Injury*. 2018]. Similarly, when debridement is performed in a timely manner (averaging 8 hours), injury severity and patient factors, rather than the exact timing of surgery, become the primary determinants of outcome [Enninghorst N, et al. Open tibia fractures: timely debridement leaves injury severity as the only determinant of poor outcome. *J Trauma*. 2011;70(2):352-357]. The consensus emphasizes that while unnecessary delays should be avoided, waiting for optimal surgical conditions is preferable to hasty intervention.

General Orthopaedic/Junior Staff vs. Specialised Orthoplastic Teams The paradigm shift away from the strict "six-hour rule" is driven heavily by the dangers of out-of-hours surgery performed by inexperienced personnel. Rushing a patient to the operating theatre simply to meet a time target often means the initial debridement is performed by junior or general orthopaedic staff without plastic surgery support. Such emergency debridements performed in peripheral hospitals by less experienced surgeons often result in inadequate excision of devitalized tissue and compromised local flap options, leading to revision of initial skeletal fixation in nearly half (47%) of transferred cases [Naique SB, Pearse M, Nanchahal J. Management of severe open tibial fractures: the need for combined orthopaedic and plastic surgical treatment in specialist centres. *J Bone Joint Surg Br*. 2006;88-B(3):351-357].

Conversely, the literature overwhelmingly supports a combined orthoplastic approach, ideally performed during scheduled daylight lists by senior consultants. Implementing a dedicated orthoplastic approach allows for radical debridement and immediate obliteration of dead space with vascularized tissue. A single-stage, combined "fix and flap" approach reduced deep infection rates to 4.2%, compared to a 34.6% infection rate when definitive fixation and soft-tissue coverage were staged separately [Mathews JA, et al. Single-stage orthoplastic reconstruction of Gustilo-Anderson Grade III open tibial fractures greatly reduces infection rates. *Injury*. 2015;46:2263-2266]. Furthermore, multidisciplinary orthoplastic care significantly accelerates soft-tissue healing and bone union while lowering

infection rates compared to traditional orthopaedic-only care [Boriani F, et al. Orthoplastic surgical collaboration is required to optimise the treatment of severe limb injuries: A multi-centre, prospective cohort study. *J Plast Reconstr Aesthet Surg.* 2017;70(6):715-722].

Paediatric vs. Elderly Populations When managing severe open fractures, timing and treatment strategies differ notably across age extremes. Interestingly, there was no difference in the median time to initial wound excision (1 day) or definitive "fix and flap" reconstruction (2 days) when comparing paediatric (median age 12) and elderly (median age 76) cohorts, although injury mechanisms diverged heavily from high-energy pediatric trauma to low-energy elderly fragility fractures [Khadim MF, et al. A comparison between the Major Trauma Centre management of complex open lower limb fractures in children and the elderly. *Injury.* 2019;50(5):1376-1381]. However, in a larger national registry analysis, older adults (≥ 65 years) experienced longer delays to their initial debridement than younger patients, likely due to the need for perioperative medical optimization [Wilson E, et al. An evaluation of the management of severe open tibial fractures in the United Kingdom's major trauma centres. *Injury.* 2024;55:111475]. Interestingly, this older cohort achieved definitive soft-tissue coverage faster than younger patients but still suffered significantly higher rates of infection, amputation, and a mortality rate three times higher than the younger cohort [Wilson E, et al. An evaluation of the management of severe open tibial fractures in the United Kingdom's major trauma centres. *Injury.* 2024;55:111475].

Upper vs. Lower Limb Fractures The anatomic location of the open fracture heavily influences both the urgency of debridement and the ultimate clinical outcome. Upper limb open fractures generally experience longer delays to debridement but tolerate them well. A study on open elbow fractures reported a mean time to first debridement of 31 hours, primarily because these injuries often occur in polytrauma patients where life-threatening systemic conditions take precedence, yet no deep or chronic infections were recorded [Bano C, et al. Management of open elbow fractures: experiences and outcomes from a UK major trauma center. *J Shoulder Elbow Surg.* 2022;31:461-468]. Similarly, for low-grade open forearm fractures, 69% of patients were operated on more than 24 hours after presentation (median time to surgery 47 hours), with an overall infection rate of only 1.6% [Rotman D, et al. Timing of Debridement in Low-Grade Open Forearm Fractures Does Not Affect Infection Risk: A Retrospective Study. *J Clin Med.* 2025;14:2878]. This tolerance to surgical delay is attributed to the upper extremity's robust blood supply and richer soft-tissue envelope. In stark contrast, the lower limb—particularly the tibial diaphysis—lacks this protective soft-tissue cover and has a precarious blood supply. Consequently, severe open tibial fractures are far less forgiving of inadequate or delayed definitive management and require the strict, timely intervention of a specialized orthoplastic team to prevent catastrophic infections and non-union [Powell-Bowns MFR, Keating JF. Timing of debridement: When to do it, and who should perform it. *Injury.* 2024;55:111604].

Section 5: Risk of bias of included studies

Overall Risk of Bias: MODERATE TO HIGH

Brief Justification:

The evidence base relies mostly on observational designs, which introduces several distinct types of bias across the studies:

- **Selection Bias and Unmeasured Confounding:** The heavy reliance on retrospective cohort studies and large database registries means patients were not randomly assigned to early versus delayed surgery. This inherently introduces selection bias, as surgeons naturally tend to operate on more severe or highly contaminated injuries sooner, while patients requiring medical optimization or transfers are delayed [Al-Hourani K, Fowler T, Whitehouse MR, Khan U, Kelly M. Two-Stage Combined Ortho-Plastic Management of Type IIIB Open Diaphyseal Tibial Fractures Requiring Flap Coverage: Is the Timing of Debridement and Coverage Associated With Outcomes? *J Orthop Trauma*. 2019;33(12):591-597.].
- **Attrition Bias (Loss to Follow-up):** While massive global databases offer high statistical power, they suffer from significant attrition. For example, the SIGN database study had a follow-up rate of only 27.3%, introducing a high risk that patients lost to follow-up had different outcomes than those who remained [Cortez A, et al. Delays in Debridement of Open Femoral and Tibial Fractures Increase Risk of Infection. *J Bone Joint Surg Am*. 2023;105(20):1622-1629.].
- **Measurement and Information Bias:** Clinical trauma audits frequently note that missing, incomplete, or illegible paper documentation (especially regarding prehospital care and precise operative timings) limits data accuracy [Lacey H, Bernard K, Syed L, O'Rourke E, Calvert-Ford Y, Bovis J, Guryel E, King I. Orthoplastics Management of Open Lower Limb Fractures at a Major Trauma Centre: Audit of Adherence to BOAST4 Guidelines. *JPRAS Open*. 2024;42:133-145.]. Furthermore, large registries often rely on non-standardized, self-reported definitions of infection [Cortez A, et al. Delays in Debridement of Open Femoral and Tibial Fractures Increase Risk of Infection. *J Bone Joint Surg Am*. 2023;105(20):1622-1629.].
- **Observer and Performance Bias:** Several single-center studies advocate strongly for their own established orthoplastic protocols. This enthusiasm can introduce observer bias that overestimates the treatment effect [Mathews JA, Ward J, Chapman TW, Khan UM, Kelly MB. Single-stage orthoplastic reconstruction of Gustilo-Anderson Grade III open tibial fractures greatly reduces infection rates. *Injury*. 2015;46:2263-2266.]. Additionally, multi-center prospective studies acknowledge performance bias introduced by differences in surgical resources, hygiene, and rehabilitation protocols across different geographical regions (e.g., UK vs. Italy vs.

Pakistan) [Boriani F, Ul Haq A, Baldini T, Urso R, Granchi D, Baldini N, Tigani D, Tarar M, Khan U. Orthoplastic surgical collaboration is required to optimise the treatment of severe limb injuries: A multi-centre, prospective cohort study. *J Plast Reconstr Aesthet Surg.* 2017;70(6):715-722.].

- **Non-response and Recall Bias:** Cross-sectional surveys used to assess standard practices suffer from low response rates (e.g., 24%) and rely on surgeons self-reporting their collaborative practices, which may skew results toward more favorable answers [Oliveira IS, Finelli CA, Ribeiro TC, Cunha CC, Durigon TS, Vargas RP, Tuma RB, Klautau GB, dos Reis FB, Salles MJ. The impact of a multidisciplinary team on the management of fracture-related infections: A surveillance study in Brazil. *Braz J Infect Dis.* 2025;29:104576.].

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Section 6: Response/Recommendation

Yes. It is reasonable to delay the initial debridement beyond six hours (typically within 12 to 24 hours) to ensure the procedure is performed concurrently by an experienced, multidisciplinary ortho-plastic team, as the quality of the surgical excision is a greater determinant of successful outcomes and infection prevention than strict adherence to the historic six-hour rule. This is provided there is no vascular compromise, compartment syndrome, or other indication for earlier emergency intervention.

Section 7: Level/ strength of Evidence:

The overall strength of evidence guiding the management and timing of debridement in severe open fractures is **MODERATE**.

Study Design There is a fundamental lack of Level I evidence (Randomized Controlled Trials or meta-analyses of RCTs) in this clinical area because randomizing patients with severe open fractures to delayed versus early debridement is deemed unethical [Powell-Bowns MFR, Keating JF. Timing of debridement: When to do it, and who should perform it. *Injury.* 2024;55:111604]. Consequently, the highest tier of available evidence relies on Level II prospective comparative cohorts, alongside a large volume of Level III retrospective comparative cohorts and database registries.

Number of Studies and Sample Size The evidence base is supported by a robust number of studies (28 sources included in this review), which encompass highly variable sample sizes. The overall power is bolstered by large-scale national and international registry analyses.

For instance, the SIGN database study by Cortez et al. analyzed 10,651 fractures across 61 countries [Cortez A, et al. *Delays in Debridement of Open Femoral and Tibial Fractures Increase Risk of Infection. J Bone Joint Surg Am. 2023;105(20):1622-1629*], and the TARN registry study by Wilson et al. evaluated 3,359 severe open tibial fractures [Wilson E, Young K, Kwasnicki R, Hettiaratchy S. *An evaluation of the management of severe open tibial fractures in the United Kingdom's major trauma centres. Injury. 2024;55:111475*]. Conversely, the strength of evidence is slightly diluted by the inclusion of several smaller, single-center retrospective cohorts and case series with sample sizes ranging from 20 to 120 patients [Lim JA, Thahir A, Zhou AK, Girish M, Krkovic M. *Definitive management of open pilon fractures with fine wire fixation. Injury. 2020.*].

Risk of Bias The overall risk of bias across the literature is **moderate to high**. Retrospective observational designs inherently suffer from selection bias and unmeasured confounding variables. The large registry studies, while statistically powerful, face significant methodological limitations, such as a high loss to follow-up (e.g., only a 27.3% follow-up rate in the SSDB database study) and a reliance on self-reported, non-standardized infection criteria [Cortez A, et al. *Delays in Debridement of Open Femoral and Tibial Fractures Increase Risk of Infection. J Bone Joint Surg Am. 2023;105(20):1622-1629*]. Furthermore, missing, incomplete, or illegible documentation regarding prehospital care and exact timings of interventions is a prevalent issue in trauma audits [Lacey H, Bernard K, Syed L, O'Rourke E, Calvert-Ford Y, Bovis J, Guryel E, King I. *Orthoplastics Management of Open Lower Limb Fractures at a Major Trauma Centre: Audit of Adherence to BOAST4 Guidelines. JPRAS Open. 2024;42:133-145*]. Single-center studies advocating for protocols developed at their own institutions also carry a risk of observer bias.

Key Outcomes Consistency Despite the lack of Level I RCTs and the inherent biases of retrospective databases, the key outcomes across these diverse settings are relatively consistent, which elevates the overall strength of the evidence to moderate. The data suggests that adopting a multidisciplinary orthoplastic approach and prioritizing thorough, radical debridement over rushing to meet an arbitrary six-hour target significantly reduces deep infection rates, non-union, and amputations [Mathews JA, Ward J, Chapman TW, Khan UM, Kelly MB. *Single-stage orthoplastic reconstruction of Gustilo-Anderson Grade III open tibial fractures greatly reduces infection rates. Injury. 2015;46:2263-2266*]. Multi-center prospective data suggests that this collaborative care model yields better soft-tissue healing and fewer secondary interventions compared to traditional, isolated orthopedic care [Boriani F, Ul Haq A, Baldini T, Urso R, Granchi D, Baldini N, Tigani D, Tarar M, Khan U. *Orthoplastic surgical collaboration is required to optimise the treatment of severe limb injuries: A multi-centre, prospective cohort study. J Plast Reconstr Aesthet Surg. 2017;70(6):715-722*]. This common consensus among the available moderate-level evidence provides a foundation for modern clinical practice guidelines.

S. no	source (file name)	Author, year of publication, Country	vancouver style reference
1	A comparison between the Major Trauma Centre management of complex open lower limb fractures in children and the elderly.pdf	Khadim MF, et al., 2019, United Kingdom	Khadim MF, Emam A, Wright TC, Chapman TWL, Khan U. A comparison between the Major Trauma Centre management of complex open lower limb fractures in children and the elderly. Injury. 2019;50(7):1376-1381.
2	An evaluation of the management of severe open tibial fractures in the United Kingdom's major trauma centres.pdf	Wilson E, et al., 2024, United Kingdom	Wilson E, Young K, Kwasnicki R, Hettiaratchy S. An evaluation of the management of severe open tibial fractures in the United Kingdom's major trauma centres. Injury. 2024;55:111475.
3	Definitive management of open pilon fractures with fine wire fixation.pdf	Lim JA, et al., 2020, United Kingdom	Lim JA, Thahir A, Zhou AK, Girish M, Krkovic M. Definitive management of open pilon fractures with fine wire fixation. Injury. 2021;51(12):2946-2952.
4	Ganga hospital open injury score in management of open injuries.pdf	Rajasekaran S, et al., 2015, India	Rajasekaran S, Sabapathy SR, Dheenadhayalan J, Sundararajan SR, Venkatramani H, Devendra A, et al. Ganga hospital open injury score in management of open injuries. Eur J Trauma Emerg Surg. 2015;41:3-15.
5	Implementing an orthoplastic treatment protocol for open tibia fractures reduces complication rates in tertiary trauma unit.pdf	Ylitalo AAJ, et al., 2023, Finland	Ylitalo AAJ, Hurskainen H, Repo JP, Kiiski J, Suomalainen P, Kaartinen I. Implementing an orthoplastic treatment protocol for open tibia fractures reduces complication rates in tertiary trauma unit. Injury. 2023;54(9):110890.
6	One-stage combined "fix and flap" approach for complex open Gustilo–Anderson IIIB lower limbs fractures_a pr.pdf	Aljawadi A, et al., 2021, United Kingdom	Aljawadi A, Islam A, Jahangir N, Niazi N, Elmajee M, Reid A, et al. One-stage combined "fix and flap" approach for complex open Gustilo–Anderson IIIB lower limbs fractures: a prospective review of 102 cases. Arch Orthop Trauma Surg. 2021;141(7):1171-1181.
7	Radical treatment of severe open fractures of extremities by orthoplastic surgery_ a 10 year retrospective study.pdf; Problems and new orthoplastic strategies in treatment of severe open fractures of the lower limb.pdf	Yang Z, et al., 2021, China	Yang Z, Xu C, Zhu YG, Li J, Wu ZX, Zou JW, et al. Radical treatment of severe open fractures of extremities by orthoplastic surgery: a 10-year retrospective study. J Orthop Surg Res. 2021;16(1):337.

8	The effect of early versus delayed surgical debridement on the outcome of open long bone fractures at Bugando Medical Centre, Mwanza, Tanzania.pdf	Nobert N, et al., 2016, Tanzania	Nobert N, Moremi N, Seni J, Dass RM, Ngayomela IH, Mshana SE, et al. The effect of early versus delayed surgical debridement on the outcome of open long bone fractures at Bugando Medical Centre, Mwanza, Tanzania. J Trauma Manag Outcomes. 2016;10:6.
9	The impact of a multidisciplinary team on the management of fracture-related infections_ A surveillance study.pdf	Oliveira IS, et al., 2025, Brazil	Oliveira IS, Finelli CA, Ribeiro TC, Cunha CC, Durigon TS, Vargas RP, et al. The impact of a multidisciplinary team on the management of fracture-related infections: A surveillance study in Brazil. Braz J Infect Dis. 2025;29:104576.
10	Timing of Debridement in Low-Grade Open Forearm Fractures Does Not Affect Infection Risk_ A Retrospective St.pdf	Rotman D, et al., 2025, Israel	Rotman D, Atlan F, Shehadeh K, Ashkenazi I, Gurel R, Rosenblatt Y, et al. Timing of Debridement in Low-Grade Open Forearm Fractures Does Not Affect Infection Risk: A Retrospective Study. J Clin Med. 2025;14(9):2878.
11	Timing of debridement_ When to do it, and who should perform it_.pdf	Powell-Bowns MFR, Keating JF, 2024, United Kingdom	Powell-Bowns MFR, Keating JF. Timing of debridement: When to do it, and who should perform it? Injury. 2024;55:111604.
12	Two-Stage Combined Ortho-Plastic Management of Type IIIB Open Diaphyseal Tibial Fractures Requiring Flap.pdf	Al-Hourani K, et al., 2019, United Kingdom	Al-Hourani K, Fowler T, Whitehouse MR, Khan U, Kelly M. Two-Stage Combined Ortho-Plastic Management of Type IIIB Open Diaphyseal Tibial Fractures Requiring Flap Coverage: Is the Timing of Debridement and Coverage Associated With Outcomes? J Orthop Trauma. 2019;33(12):591-600.
13	ix and flap_ The radical orthopaedic and plastic treatment of severe open fractures of the tibia.pdf	Gopal S, et al., 2000, United Kingdom	Gopal S, Majumder S, Batchelor AGB, Knight SL, De Boer P, Smith RM. Fix and flap: the radical orthopaedic and plastic treatment of severe open fractures of the tibia. J Bone Joint Surg Br. 2000;82-B(7):959-966.
14	Delays in Debridement of Open Femoral and Tibial Fractures Increase Risk of Infection.pdf	Cortez A, et al., 2023, USA	Cortez A, Urva M, Subramanian A, Jackson NJ, Zirkle L, Morshed S, Shearer DW. Delays in debridement of open femoral and tibial fractures increase risk of infection. J Bone Joint Surg Am. 2023 Oct 18;105(20):1622–1629.
15	Lower Limb Comprehensive Reconstructive Surgery_ Experiences from an Orthopedic Teaching Unit.pdf	Kurian A, et al., 2024, India	Kurian A, Bliss J, Ganesh K, Kumar MJ, Inja DB, Ashok A. Lower limb comprehensive reconstructive surgery: Experiences from an orthopedic teaching unit. Curr Med Issues 2024;22:243-8.

16	Management of open elbow fractures_ experiences and outcomes from a UK major trauma center.pdf	Bano C, et al., 2022, United Kingdom	Bano C, Coffey D, Al-Tawil K, Tavakkolizadeh A, Rose V, Tahmassebi R, Karuppaiah K, Colegate-Stone T. Management of open elbow fractures: experiences and outcomes from a UK major trauma center. J Shoulder Elbow Surg. 2022;31(3):461-468.
17	Management of open tibial fractures - A regional experience.pdf	Townley WA, et al., 2010, United Kingdom	Townley WA, Nguyen DQA, Rooker JC, Dickson JK, Goroszeniuk DZ, Khan MS, Camp D. Management of open tibial fractures – a regional experience. Ann R Coll Surg Engl. 2010;92:693–696.
18	Management of severe open tibial fractures. The need for combined orthopaedic and plastic surgical treatment.pdf	Naique SB, et al., 2006, United Kingdom	Naique SB, Pearse M, Nanchahal J. Management of severe open tibial fractures: the need for combined orthopaedic and plastic surgical treatment in specialist centres. J Bone Joint Surg Br. 2006;88-B(3):351-357.
19	Nationwide study on open tibial fractures in the Netherlands_ Incidence, demographics and level of hospital care.pdf	Noorlander-Borgdorff MP, et al., 2024, Netherlands	Noorlander-Borgdorff MP, Şekercan A, Young-Afat DA, Bouman M, Botman M, Giannakópoulos GF. Nationwide study on open tibial fractures in the Netherlands: Incidence, demographics and level of hospital care. Injury. 2024;55:111487.
20	Open tibia fractures_ timely debridement leaves injury severity as the only determinant of poor outcome.pdf	Enninghorst N, et al., 2011, Australia	Enninghorst N, McDougall D, Hunt JJ, Balogh ZJ. Open tibia fractures: timely debridement leaves injury severity as the only determinant of poor outcome. J Trauma. 2011 Feb;70(2):352-7.
21	Orthoplastic reconstruction of type IIIB open tibial fractures retaining debrided devitalized cortical segments_ T.pdf	Al-Hourani K, et al., 2019, United Kingdom	Al-Hourani K, Stoddart M, Khan U, Riddick A, Kelly M. Orthoplastic reconstruction of type IIIB open tibial fractures retaining debrided devitalized cortical segments. Bone Joint J. 2019;101-B(8):1002–1008.
22	Orthoplastic surgical collaboration is required to optimise the treatment of severe limb injuries_ A multi-centre, pr.pdf	Boriani F, et al., 2017, Italy, Pakistan, and United Kingdom	Boriani F, Haq AU, Baldini T, Urso R, Granchi D, Baldini N, Tigani D, Tarar M, Khan U. Orthoplastic surgical collaboration is required to optimise the treatment of severe limb injuries: A multi-centre, prospective cohort study. J Plast Reconstr Aesthet Surg. 2017;70(6):715-722.

23	Orthoplastics Management of Open Lower Limb Fractures at a Major Trauma Centre_ Audit of Adherence to BOAST4 Guidelines.pdf	Lacey H, et al., 2024, United Kingdom	Lacey H, Bernard K, Syed L, O'Rourke E, Calvert-Ford Y, Bovis J, Guryel E, King I. Orthoplastics management of open lower limb fractures at a major trauma centre: Audit of adherence to BOAST4 guidelines. JPRAS Open. 2024;42:133–145.
24	Outcome of the management of open ankle fractures in an ortho-plastic specialist centre.pdf	Chummun S, et al., 2015, United Kingdom	Chummun S, Wright TC, Chapman TWL, Khan U. Outcome of the management of open ankle fractures in an ortho-plastic specialist centre. Injury. 2015;46(6):1112-1115.
25	Outcomes following the delayed management of open tibial fractures.pdf	Higgin R, et al., 2021, United Kingdom	Higgin R, Dean M, Qureshi A, Hancock N. Outcomes following the delayed management of open tibial fractures. Injury. 2021;52(8):2434–2438.
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