

Simultaneous Fix and Flap in Open Injuries - ICM Summary (10 Studies)

RQ: Is there a role for simultaneous fix and flap in open injuries?

Section 1: Background

Simultaneous or early fix-and-flap refers to coordinated definitive skeletal stabilisation and vascularised soft-tissue coverage performed during the same operative episode or within an early orthoplastic window. Severe open injuries, especially Gustilo-Anderson type IIIB/IIIC fractures, are associated with exposed bone or implants, contamination, infection, nonunion, flap failure and possible amputation. Early radical debridement, stable fixation and timely soft-tissue cover convert the wound into a closed vascularised environment, protect implants, reduce bacterial colonisation and support rehabilitation [1,4,5].

Across the included literature, early or well-coordinated fixation and flap coverage is associated with favourable limb salvage, acceptable infection rates, low flap failure and reliable union [1-3,6,7,9,10]. Immediate single-stage surgery is preferred when safe and feasible; however, a planned staged orthoplastic pathway may be reasonable in polytrauma, multiple fractures or logistical constraints [7,9].

Section 2: Data Extraction Table

Study	Design / Sample	Population / Intervention	Key Results
Gopal et al., 2000, UK	Retrospective review; 80 pts/84 fractures	Gustilo IIIB/IIIC open tibial fractures; radical debridement, stabilisation and muscle flap; single-stage or <=72 h coverage.	Limb salvage 95%; flap failure 3.5%; superficial infection 6%; deep infection 9.5%. Delay beyond 72 h associated with most complications.
Ogun/Cevat et al., 2001, Turkey	Case report; 1 child	13-year-old with Gustilo IIIB distal tibial fracture after shotgun injury; one-stage external fixation and distally based sural artery flap.	Fracture and flap healed uneventfully; no postoperative complications.
Ramasamy, 2017, India	Retrospective case series; 36 pts	Gustilo IIIB open tibial fractures with post-debridement wounds >5 cm; primary fixation plus immediate septocutaneous shift flap.	Overall union 100%; primary union 50%; reoperation 50%; deep infection 16%; flap failure 2.7%; no amputations.
Dheenadhayalan et al., 2023, India	Narrative review/guideline	Open fracture management principles: antibiotics, debridement, fixation, NPWT, early soft-tissue coverage and fix-and-flap.	Supports collaborative orthoplastic care and early definitive stabilisation with soft-tissue coverage to prevent exposed implant colonisation and deep infection.
Minehara et al., 2024, Japan	Narrative/symposium review	Japanese open fracture strategy including fix-and-flap, local antibiotic perfusion and bone-healing stimulation.	Highlights "Big 5" principles: emergency care, early antibiotics, adequate debridement/re-debridement, fracture/soft-tissue stabilisation and early closure.
Jitrapaikularn et al., 2024, Thailand	Retrospective paediatric series; 25 pts	Children <16 years with Gustilo IIIB tibial fractures and soft-tissue loss; concurrent plate fixation and pedicled flap coverage.	Fix-and-flap at mean 8.2 days; no flap complications; all fractures united (12-24 weeks); excellent/good functional outcome in all.
Parlomas et al., 2025, USA	Retrospective cohort; 274 pts	Adult Gustilo type III lower-extremity open fractures requiring flap coverage after fixation; compared <24 h, 24-72 h and >72 h from fixation to flap.	Infection 27.7%; rates rose from 23.2% to 31.5% when coverage delayed >72 h; time from fixation to flap was the only significant predictor.
Cheyrou-Lagrece et al., 2022, France	Retrospective comparative; 55 pts	Gustilo I-IIIA open tibial shaft fractures converted from external fixation to IM nail; one-stage vs two-stage conversion; IIIB/IIIC excluded.	SSI similar (12% vs 10%); one-stage conversion had faster consolidation, earlier weight-bearing and less malunion; indirectly supports early definitive stabilisation.
Nishida et al., 2025, Japan	Retrospective case series; 10 pts	Gustilo IIIB open long-bone fractures needing free flap when immediate fix-and-flap was not feasible; "fix followed by flap" protocol.	100% flap survival, no partial necrosis, no deep infection and union in all; median union 9.4 months; median fixation-to-flap interval 6 days.
Srivastava et al., 2025, UK/international	Systematic review; 5 studies/196 pts	Gustilo grade III upper-limb open fractures managed with combined orthoplastic fixation and soft-tissue reconstruction.	Early multidisciplinary care, particularly <=72 h, associated with limb salvage up to 100%, deep infection as low as 2.4% and union up to 84.3%.

Abbreviations: IIIB/IIIC = Gustilo-Anderson subtypes; NPWT = negative pressure wound therapy; IM = intramedullary; SSI = surgical site infection.

Section 3: Results Summary

Ten studies were included: retrospective reviews/series, case-based evidence, narrative reviews, one systematic review and timing-based cohort evidence. Most focused on severe open tibial fractures, with additional evidence for grade III upper-limb injuries [1-10].

The evidence consistently supports early coordinated skeletal stabilisation and soft-tissue coverage. Gopal et al. reported 95% limb salvage, 3.5% flap failure and 9.5% deep infection, with most complications occurring when coverage was delayed beyond 72 hours [1]. Ramasamy reported 100% union, 16% deep infection and no amputations using fix-and-shift in IIIB tibial fractures [3]. Paediatric evidence showed union in all cases and minimal flap problems with concurrent fixation and pedicled/local flaps [2,6].

Parlomas et al. showed that time from fixation to flap was the only significant predictor of infection, supporting coverage within 72 hours after fixation [7]. Nishida et al. showed that when immediate fix-and-flap was not feasible, a structured "fix followed by flap" protocol by orthoplastic surgeons achieved 100% flap survival, no deep infection and union in all 10 cases [9]. Srivastava et al. supported combined orthoplastic management in grade III upper-limb injuries, with early intervention associated with high limb salvage, low deep infection and acceptable union [10].

Section 4: Discussion

Early fix-and-flap is biologically rational because severe open fractures contain devitalised tissue, exposed implants/bone and bacterial contamination. Vascularised flap coverage improves perfusion, fills dead space, protects implants and improves delivery of immune cells and antibiotics [1,4,5]. The strongest timing message is that, after definitive fixation, soft-tissue coverage should occur as early as safely possible, preferably within 72 hours [1,7].

Immediate single-stage reconstruction is not always safe in polytrauma, multiple fractures or physiologically unstable patients. Nishida et al. supports a pragmatic staged orthoplastic pathway using thorough debridement, definitive fixation, NPWT until coverage and timely free flap once the patient is stable [9]. This should not justify avoidable delay; rather, it supports planned staging when immediate reconstruction is unsafe or impractical.

The evidence is limited by mostly retrospective or small studies, heterogeneous fixation methods, flap types, timing definitions and outcome reporting. Therefore, simultaneous fix-and-flap should be viewed as an orthoplastic principle, not a rigid rule: radical debridement, stable fixation and vascularised soft-tissue cover should be achieved at the earliest safe opportunity [1-10].

Section 5: Risk of Bias

Overall risk of bias: MODERATE. Most studies were non-randomised and lacked direct comparator groups. Bias arises from selection bias, heterogeneous injury severity, varied timing, fixation method, flap type, institutional expertise and overlap between review-level and primary evidence [1-10]. Despite this, the direction of evidence is consistent in favour of early coordinated orthoplastic management.

Section 6: Response / Recommendation

Simultaneous or early fix-and-flap has a definite role in selected severe open injuries, particularly Gustilo-Anderson type IIIB/IIIC fractures, when adequate debridement, stable fixation and orthoplastic expertise are available. Definitive fixation and vascularised soft-tissue coverage should be performed in the same sitting or at the earliest safe opportunity, preferably within 72 hours of fixation. When immediate surgery is not feasible, a planned staged orthoplastic fix-followed-by-flap protocol is reasonable in selected patients [1,3,6,7,9,10].

Section 7: Level / Strength of Evidence

Level / Strength of Evidence: MODERATE. The recommendation is supported by consistent observational, timing-based cohort and review-level evidence, but cannot be graded high because of absence of randomised trials, small sample sizes in some studies and heterogeneity of methods and timing [1-10].

References

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