

Orthoplastics: A Review of Collaborative Approach in the Management of Complex Extremity Trauma



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Abstract

Background: Complex extremity trauma often involves both skeletal and soft tissue injury. Delayed or fragmented care can lead to increased complication rates. The orthoplastic model integrates orthopedic and plastic surgery expertise within a collaborative framework.

Aim: This mini-review synthesizes current evidence supporting orthoplastic collaborative care in complex extremity trauma.

Methods: A narrative review of PubMed, MEDLINE, and peer-reviewed sources from 2000–2025 was performed, focusing on outcomes of orthoplastic collaboration in extremity trauma.

Results: Evidence demonstrates that early, coordinated orthoplastic management reduces flap failure, infection, and length of hospital stay, while improving limb salvage rates. Common procedures include early debridement, skeletal stabilization, and timely flap coverage.

Conclusion: Orthoplastic collaboration represents the modern standard of care for severe extremity trauma. Its adoption improves patient outcomes and reduces overall healthcare burden

Keywords: Gustillo-Anderson Classification; Orthoplastic; Cephalosporin; Mangled Extremity Syndrome; Emphasizing

Abbreviations: MESS: Mangled Extremity Severity Score; MESI: Mangled Extremity Syndrome Index; GAC: Gustillo-Anderson Classification; NPWT: Negative Pressure Wound Therapy

Introduction

Complex extremity trauma, including traumatic limb injuries involving combinations of bone fractures, soft tissue loss, neurovascular compromise, tendon injury, infection, or contamination, poses some of the most challenging surgical problems. Traditional models, where orthopedic surgeons handle bony fixation and plastic/reconstructive surgeons are consulted later, often suffer from delayed soft tissue coverage, higher rates of infection, multiple operations, prolonged hospital stays, and poorer functional outcomes [1]. The orthoplastic approach was first introduced in the 1990s [2]. “Orthoplastic” refers to a collaborative care model in which orthopedic and plastic/reconstructive surgeons jointly manage complex extremity injuries, sharing treatment from initial presentation to definitive skeletal reconstruction, soft tissue coverage, and rehabilitation. The term has been increasingly adopted as a standard of care for limb salvage in high volume trauma centers [1].

Classification / Types of Cases

Complex extremity trauma cases that benefit from orthoplastic care include open fractures with severe soft tissue defects, composite injuries with bone and tendon loss combined with neurovascular compromise, blast injuries, avulsion and degloving injuries, as well as chronic infections such as osteomyelitis. These cases share the feature of combined skeletal and soft tissue problems where timely multidisciplinary care is critical. There exist several scoring systems in the assessment of limb injuries, such as Gustillo-Anderson Classification (GAC), Mangled Extremity Severity Score (MESS), and Mangled Extremity Syndrome Index (MESI). However, they lack reliability, reproducibility, and ability to predict functional outcomes [3,4].

One classification, known as the Orthopaedic Trauma Association Open Fracture Classification (OTA-OFC), aims to better predict outcomes of complex traumatic injuries. The OTA-

OFC consists of five injury components-skin, muscle, vascular status, contamination, skeletal injury-each with three levels of severity (Table 1) [4-6]. In OTA-OFC, each category is graded from 1 to 3 based on severity. A recent systematic review demonstrated that OTA-OFC consistently outperformed GAC in interobserver reliability and predicting postoperative outcomes.⁴

This stratification assists in planning and in determining when orthoplastic collaboration is essential. Hao et al. found that OTA-OFC scores ≥ 10 were significantly associated with amputation and the need for soft tissue coverage [7]. In general OTA-OFC skin scores of 3 or total OTA-OFC scores ≥ 10 indicate the need for Orthoplastic collaboration.

Table 1: Stratifying cases for Orthoplastic Approach.

Parameter	Grade I	Grade II	Grade III
Skin	Wound edges able to approximate	Edges that do not approximate	Significant degloving
Muscle	No muscle necrosis, some muscle injury with intact muscle function	Loss of muscle but muscle remains functional, some localized necrosis in zone of injury that requires excision, intact muscle-tendon unit	Dead muscle, loss of muscle function, partial or complete compartment excision, complete disruption of a muscle-tendon unit, muscle defect does not reapproximate
Vascular Status	Intact	Vessel injury without distal ischemia	Vessel injury with distal ischemia
Contamination	Clean	Surface contamination	Deep contamination or high-risk environment
Skeletal Injury	None	Devascularized or missing fragments with partial contact	Segmental loss

Grade II criteria indicate possible benefit for Orthoplastic collaboration.

Grade III criteria indicate significant benefit for Orthoplastic collaboration.

Preoperative Management

At time of presentation, primary trauma survey should be done to ensure no other injuries are overlooked. Tetanus status should be updated. Antibiotic therapy should also be given immediately based on GAC classification-first generation cephalosporin for grade I-II with the addition of aminoglycoside for grade III, and metronidazole for soil contamination to cover anaerobes. Distal blood flow should also be assessed prior to reconstruction. CT angiography is often recommended to evaluate inflow, runoff, and any interruptions to blood flow [8].

Typical Operations / Treatment Components

The orthoplastic approach integrates both skeletal and soft tissue principles. Initial management involves meticulous debridement within the first 24 hours of injury and stabilization of the fracture, often with external fixation. Skeletal reconstruction serves as a foundational aspect of soft tissue management, restoring anatomic structure and function to facilitate safe mobilization. It is often not possible to do a complete debridement

during the initial operation, as many crush injuries may have evolving zones of injury, and highly contaminated wounds often require serial debridement. In between debridements, the wound can be managed with negative pressure wound therapy (NPWT), which has been shown to decrease edema and inflammatory mediators, promote granulation tissue formation, and decrease wound surface area through macro deformation [3,9].

Previously, Godina demonstrated that soft tissue coverage should be done within 72 hours to decrease rate of nonunion, infection, and osteomyelitis [3,8,10]. With the introduction of NPWT, the 72-hour rule is no longer absolute, as the use of NPWT decreases infection rates while managing the wound between serial debridement and coverage [9-11]. Therefore, the optimal timing of soft tissue coverage is based on having a clean, healthy, wound bed rather than time since injury.

Soft tissue coverage is then achieved using the most appropriate method, whether skin graft, dermal substitute, negative pressure wound therapy, local flap, regional flap, or free

tissue transfer. Negative pressure wound therapy, negative wound therapy with instillation, and dermal matrices are important adjuncts. The “reconstructive ladder” and its modern variant, the “reconstructive elevator,” emphasize that surgeons should not

hesitate to escalate to more complex techniques or use multiple techniques simultaneously when required for optimal outcomes (Figure 1).

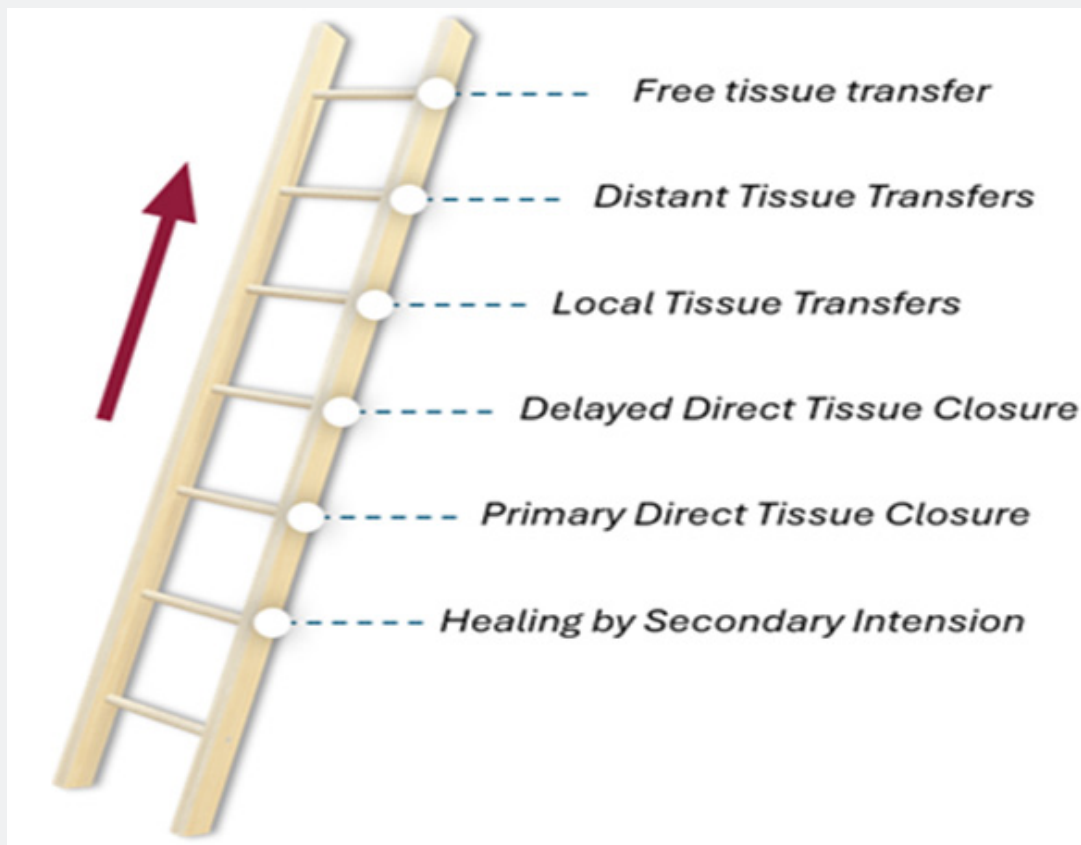


Figure 1: The Reconstructive Ladder.

Collaborative Process & Institutional Models

Orthoplastic collaboration requires early, coordinated evaluation-ideally at the first operation. Shared decision-making allows for skeletal fixation and soft tissue coverage to be planned and executed simultaneously. In some institutions, orthopaedic and plastic surgeons operate together during the initial session, ensuring stable fixation and immediate flap coverage. Established orthoplastic programs, such as those in the UK and Sweden, demonstrated that structured collaboration shortens hospital stay and decreases the need for revision surgeries [12].

Evidence for Improved Outcomes

Multiple studies have documented improved limb salvage outcomes with orthoplastic care. Hoyt et al. (2021) [13] demonstrated that collaboration reduced flap failure rates and complications resulting in reoperation in limb salvage cases [13]. Sommar et al. (2015) [12] reported a 50% reduction in hospital

stay duration and fewer revision procedures after establishing a formal collaboration model in Sweden [12]. A 2021 meta-analysis of orthoplastic management demonstrated decreased care decreased time to bone fixation and decreased infection [14]. Collectively, the literature confirms that a combined approach reduces morbidity and improves limb salvage outcomes.

Challenges / Considerations

Despite clear benefits, barriers remain. Some trauma centers lack consistent access to microsurgical expertise. Scheduling and resource constraints may delay timely coverage. Patient comorbidities such as diabetes and vascular disease may affect outcomes. Donor site morbidity and the long rehabilitation required after limb salvage are important considerations. Although cost is a concern, multiple studies suggest that orthoplastic collaboration ultimately reduces total healthcare expenditure by shortening hospital stays and decreasing complications.

Future Directions

Further research should include prospective multicenter studies comparing orthoplastic versus traditional care models, with standardized outcome measures that include function and quality of life. Regionalization of complex trauma care centers with dedicated orthoplastic teams may optimize results. Advances such as 3D surgical planning, telemedicine consultation, and newer biologic and synthetic materials may further enhance outcomes. Increasing emphasis should be placed on patient-centered outcomes such as return to work and long-term limb function.

Conclusion

The orthoplastic model, emphasizing combined orthopedic and plastic surgical management of complex extremity trauma, has demonstrated proven advantages in reducing complications and improving limb salvage. It should be viewed as the modern standard of care in trauma centers where resources permit. Institutional support, dedicated training, and formalized protocols are essential to expand its implementation and ensure all patients have access to this collaborative model.

References

1. Filippo Boriani, Ata Ul Haq, Tommaso Baldini, Roberto Urso, Donatella Granchi, et al. (2017) Orthoplastic surgical collaboration is required to optimise the treatment of severe limb injuries: A multi-centre, prospective cohort study. *J Plast Reconstr Aesthet Surg* 70(6): 715-722.
2. Levin LS (1993) The reconstructive ladder: An orthoplastic approach. *Orthop Clin North Am* 24(3): 393-409.
3. Song EY, Meaike JD, Langdell HC, Mithani SK (2024) The mangled upper extremity: a principled approach to management. *Plastic and Aesthetic Research* (11): 2.
4. Babapelumi Adejuyigbe, Mohini Gharpure, Ria Tilve, Shravya Kakulamari, Sophia Wang, et al. (2025) Revisiting the OTA-OFC: a systematic review of open fracture classification studies since 2010. *OTA Int* 8(2): e391.
5. No author (2018) OTA Open Fracture Classification (OTA-OFC). *J Orthop Trauma* 32(Suppl 1): S106.
6. Orthopaedic Trauma Association: Open Fracture Study G (2010) A new classification scheme for open fractures. *J Orthop Trauma* 24(8): 457-464.
7. Jiandong Hao, Derly O Cuellar, Benoit Herbert, Ji Wan Kim, Vivek Chadayammuri, et al. (2016) Does the OTA Open Fracture Classification Predict the Need for Limb Amputation? A Retrospective Observational Cohort Study on 512 Patients. *J Orthop Trauma* 30(4): 194-198.
8. Azoury SC, Stranix JT, Kovach SJ, Levin LS (2021) Principles of Orthoplastic Surgery for Lower Extremity Reconstruction: Why Is This Important? *J Reconstr Microsurg* 37(1): 42-50.
9. Van Rysselberghe NL, Gonzalez CA, Calderon C, Mansour A, Oquendo YA, et al. (2022) Negative Pressure Wound Therapy for Extremity Open Wound Management: A Review of the Literature. *J Orthop Trauma* 36(Suppl 4): S6-S11.
10. Godina M (1986) Early microsurgical reconstruction of complex trauma of the extremities. *Plast Reconstr Surg* 78(3): 285-292.
11. Rinker B, Amspacher JC, Wilson PC, Vasconez HC (2008) Subatmospheric pressure dressing as a bridge to free tissue transfer in the treatment of open tibia fractures. *Plast Reconstr Surg* 121(5): 1664-1673.
12. Sommar P, Granberg Y, Halle M, Skogh AC, Lundgren KT, et al. (2015) Effects of a formalized collaboration between plastic and orthopedic surgeons in severe extremity trauma patients; a retrospective study. *J Trauma Manag Outcomes* 9: 3.
13. Hoyt BW, Wade SM, Harrington CJ, Potter BK, Tintle SM, et al. (2021) Institutional Experience and Orthoplastic Collaboration Associated with Improved Flap-based Limb Salvage Outcomes. *Clin Orthop Relat Res* 479(11): 2388-2396.
14. Klifto KM, Azoury SC, Othman S, Klifto CS, Levin LS, et al. (2021) The Value of an Orthoplastic Approach to Management of Lower Extremity Trauma: Systematic Review and Meta-analysis. *Plast Reconstr Surg Glob Open* 9(3): e3494.



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