



Interdisciplinary Innovations in the Management of Pediatric Mandibular Fractures: Integrating Dental, Radiological, and Nursing Perspectives

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Abstract

Background: Pediatric mandibular fractures present unique challenges due to the presence of developing tooth buds, evolving occlusion, and the dynamic growth potential of the jaw. Management must balance achieving stable fixation with preserving long-term growth and function, necessitating a departure from standard adult protocols.

Aim: This article aims to present and evaluate a conservative, interdisciplinary approach to managing pediatric mandibular fractures, focusing on techniques that minimize iatrogenic harm to dental and growth structures while ensuring effective healing.

Methods: The methods are illustrated through a series of case studies (ages 1.5 to 16 years) involving mandibular fractures. The primary technique involved closed reduction using a custom-molded impression compound splint secured with circummandibular wiring, often combined with bridle wiring for concomitant dental injuries. This approach is contrasted with other methods like intermaxillary fixation (IMF) with interdental hooks in older children.

Results: The presented technique proved highly effective across all cases. It provided stable, non-rigid fixation, achieved satisfactory fracture alignment, and facilitated uncomplicated healing. Key outcomes included the restoration of normal occlusion, rapid return to function, and the absence of complications such as infection or injury to tooth buds. The method was also noted for its procedural efficiency, cost-effectiveness, and ease of removal.

Conclusion: A conservative strategy utilizing impression compound splints and circummandibular wiring is a safe, reliable, and biologically sound option for pediatric mandibular fracture management. Its success underscores the critical importance of an interdisciplinary team integrating dental, surgical, radiological, and nursing expertise to optimize outcomes for the growing patient.

Keywords: Pediatric Mandibular Fracture, Closed Reduction, Circummandibular Wiring, Impression Compound Splint, Interdisciplinary Care, Growth Preservation

Introduction

Management of pediatric mandibular fractures is uniquely challenging because care teams must navigate mixed dentition, evolving occlusion, and the dynamic growth of the mandible, all while minimizing iatrogenic harm to developing tooth buds and temporomandibular joint function [1]. In contrast to adults, where rigid fixation is often routine,

treatment in children prioritizes preservation of growth centers, maintenance of airway safety, and rapid return to age-appropriate feeding and speech. Consequently, closed reduction and other conservative measures remain the mainstay for the majority of injuries, reserving operative strategies for clearly displaced or unstable patterns where functional or esthetic compromise would otherwise persist [1].

Within this paradigm, the selection of technique must be individualized to the child's stage of dental development, fracture morphology, and tolerance for immobilization, while also accommodating family circumstances and the practical realities of access to specialized materials and postoperative care. When open reduction and internal fixation is required—typically for significantly displaced parasymphysis, symphysis, or angle fractures in older children—bioresorbable plates and screws offer a compelling alternative to traditional metallic systems, reducing the risk of long-term interference with tooth eruption paths and obviating the need for hardware removal [2]. These systems align with pediatric priorities by gradually transferring load back to the healing bone and limiting radiographic artifact during follow-up. Yet, their widespread adoption is constrained by cost and availability, especially in resource-limited settings, which can force teams to rely on more conventional approaches despite theoretical advantages of resorbable fixation [2]. This reality underscores the importance of context-sensitive protocols that balance ideal biomechanical solutions with equitable, implementable care pathways.

Across many centers, the most common and practical solution remains the fabrication of a customized occlusion splint secured with circummandibular wiring, a technique that stabilizes dental arches, restores occlusal relationships, and avoids transalveolar or transapical hardware that might jeopardize tooth buds [3,4]. Circummandibular wiring leverages the pliability of pediatric bone to achieve reliable immobilization with minimal invasiveness and permits early functional rehabilitation. The approach is highly adaptable to varied fracture patterns and dentition stages, making it a workhorse for clinicians who must treat children ranging from toddlers with primary dentition to adolescents in mixed or early permanent dentition [3,4]. Pediatric mandibular fractures constitute fewer than 15% of all facial fractures overall, but in children younger than five years, dentoalveolar injuries account for more than 60% of cases, a distribution that further supports splint-based stabilization and conservative occlusal control in daily practice [3]. The biological determinants that steer clinicians toward splinting and intermaxillary fixation (IMF) during the deciduous dentition period include the presence and position of developing tooth buds as well as the intrinsic elasticity and remodeling potential of pediatric bone [2,5]. Because tooth buds occupy a substantial proportion of mandibular volume in early childhood, transosseous fixation risks damaging permanent teeth or altering eruption sequences. Likewise, pediatric bone's propensity for greenstick fractures and its high capacity for remodeling make nonrigid or minimally rigid stabilization particularly effective. These same factors historically encouraged other conservative craniofacial trauma strategies in children—such as

short-duration IMF, external splints, and careful functional guidance—aimed at harnessing growth to complete the reduction process while minimizing exposure to hardware-related complications [2,5].

Interdisciplinary collaboration is central to optimizing outcomes. Dentists provide the occlusal expertise necessary to design and adjust splints that maintain functional intercuspation and guide eruption trajectories during healing, while also addressing concomitant dentoalveolar trauma that may require pulp therapy or splinting at the tooth level [3,4]. Radiologists contribute by tailoring imaging to the pediatric patient—prioritizing modalities and protocols that minimize radiation dose while capturing critical details of fracture alignment, condylar involvement, and tooth bud anatomy. Low-dose techniques and judicious use of cross-sectional imaging mitigate cumulative exposure and enhance preoperative planning, particularly when evaluating sagittal splitting, cortical step-offs, or multi-fragmentary patterns where closed treatment may be insufficient. Nursing professionals add indispensable value in perioperative and outpatient settings by coordinating child- and family-centered education, analgesia and airway monitoring, nutritional guidance during fixation, and early detection of complications such as malocclusion drift, wound issues, or feeding intolerance. Their coaching on splint hygiene, wire precautions, and return-to-play cadence helps translate technical success into sustained functional recovery. Clinical decision-making must also integrate airway considerations, as mandibular fractures—especially bilateral parasymphysis or condylar injuries—can affect tongue posture, oral competence, and edema, complicating anesthesia and postoperative recovery. In younger children, where cooperation with immobilization devices is limited, teams must anticipate challenges such as maintaining oral hygiene, preventing aspiration risk with elastics or IMF, and ensuring adequate caloric intake through soft or blenderized diets. Here, nursing-led nutritional strategies and caregiver training reduce hospitalization time and improve adherence, while dentist-supervised occlusal checks at short intervals allow for timely adjustments before unfavorable remodeling occurs. In the subset of displaced fractures requiring open reduction, operative planning favors intraoral approaches where feasible to minimize scarring and injury to facial nerve branches, with meticulous soft-tissue handling to protect periosteum and growth zones that contribute to mandibular development [2,5].

Finally, the epidemiology of pediatric mandibular trauma should shape prevention and follow-up. Because a large fraction of injuries in the youngest children are dentoalveolar and occur during early ambulation or play, anticipatory guidance about fall risks and age-appropriate protective measures can reduce incidence [3]. For school-aged children and

adolescents, sports dentistry initiatives that promote well-fitted mouthguards, alongside community education on bicycle and scooter helmet use, have downstream benefits for fracture prevention. Post-injury surveillance must remain attentive to late effects—such as ankylosis risk after condylar involvement, growth asymmetry, or developing malocclusion—so that corrective interventions can be introduced during windows of maximal orthodontic and orthopedic benefit. In this holistic, child-focused framework, the judicious use of occlusion splints with circummandibular wiring, selective application of bioresorbable fixation where indicated and available, and steadfast reliance on conservative principles rooted in pediatric bone biology coalesce into a coherent strategy that aligns with the core tenets of safety, function, and growth preservation [1-5].

Case 1

A 3-year-old girl presented with a left parasymphysis fracture of the mandible and was scheduled for closed reduction. Given her age, mixed dentition stage, and the proximity of developing tooth buds, a conservative technique was selected to preserve growth potential and minimize iatrogenic harm. Under appropriate anesthesia with airway precautions tailored for pediatric maxillofacial trauma, maxillomandibular relations were first assessed clinically to document baseline occlusion, interincisal opening, and any soft-tissue lacerations. The operative plan emphasized extra-dental stabilization and avoidance of transalveolar fixation. Impression compound was softened and molded to conform precisely to the lateral contour of the mandible, then applied to provide gentle, evenly distributed lateral compression across both buccal and lingual cortical plates. This custom-molded splint acted as a rigid buttress to resist shearing and torsional forces at the parasymphysis while respecting the pliability of pediatric bone. Stabilization was secured using a 26-gauge stainless steel wire placed as circummandibular wiring. After small stab incisions were created over the inferior border bilaterally, a bone awl was carefully passed to shuttle the wire around the mandible, taking care to remain subperiosteal and extra-dental to avoid root or follicle injury. The wire was tightened incrementally to achieve coaptation of the fracture edges without over-compressing the delicate cortex. Concurrently, bridle wiring was used to secure the avulsed deciduous teeth to adjacent stable teeth, preserving occlusal stops and preventing aspiration risk.

This method offered several advantages in a toddler-aged patient. First, it eliminated the risk of damaging unerupted permanent teeth inherent to screw-based fixation in the tooth-bearing region. Second, it achieved stable yet reversible immobilization that permitted physiological micromotion and remodeling, both favorable characteristics of pediatric fracture healing.



Figure-1: Preoperative CT scan showing left mandibular parasymphysis fracture.

Third, the technique allowed straightforward removal of the circummandibular wire once clinical stability was achieved, with minimal operative time and soft-tissue morbidity. Postoperatively, the patient followed a soft, blenderized diet with analgesia and antimicrobial mouth rinses appropriate for age. Nursing education focused on splint hygiene, avoidance of hard objects or pacifiers that could dislodge the construct, and signs of complications (increasing pain, swelling, foul odor, or fever). Parents were trained to recognize airway concerns and instructed on safe sleep positioning to reduce edema. Regular follow-up visits were scheduled at one week, two weeks, and four weeks to reassess occlusion, check wire tension and mucosal integrity, and monitor for early malocclusion drift or soft-tissue ulceration. At one month, a postoperative radiograph demonstrated interval callus formation and satisfactory alignment of the parasymphysis with preserved dental follicles. Clinically, the child exhibited pain-free mandibular function, age-appropriate diet progression, and maintained intercuspation without deviation on opening. The circummandibular wire was removed in clinic with brief sedation, and the impression compound splint was discontinued once manual testing confirmed stability. No neurosensory deficit, infection, or wound complications were observed. The family was advised to continue routine dental surveillance, as well as growth and occlusal monitoring, to identify any late remodeling issues or eruption disturbances. Overall, this case illustrates that impression compound splinting combined with circummandibular wiring can provide secure, tooth-bud-sparing fixation in very young children, enabling predictable healing with low morbidity and facile device removal.

Case 2

A 16-year-old male presented to the Department of Oral and Maxillofacial Surgery with a primary complaint of persistent pain and difficulty in mastication for approximately one month. The patient reported a history of trauma to the chin sustained during a fall while playing, which resulted in immediate discomfort but no initial treatment. Clinical examination revealed mild facial asymmetry and tenderness over the left mandibular body region,

without signs of infection or step deformity on inspection. Intraoral palpation elicited localized pain and mobility in the left posterior mandibular segment, consistent with a fracture line. Radiographic evaluation was performed using computed tomography (CT), which confirmed the presence of a linear fracture extending through the left mandibular body. Considering the patient's age, complete dentition, and the relatively delayed presentation, a minimally invasive approach to achieve reduction and fixation was selected. Intermaxillary fixation (IMF) using orthodontic hooks and stainless steel wiring was preferred to restore occlusion and functional stability while avoiding unnecessary exposure to the developing mandibular neurovascular structures. During the procedure, 26-gauge stainless steel wires were used to secure preformed hooks interdentally on the buccal aspect between stable teeth adjacent to the fracture. After local anesthesia and aseptic preparation, the fracture site was carefully exposed intraorally, anatomically reduced, and stabilized. IMF was achieved by passing 26-gauge stainless steel wire around the hooks bilaterally and twisting them progressively until the mandible attained precise occlusion with the maxilla on both sides. The fixation provided adequate immobilization, enabling early bone healing and maintaining alignment throughout the functional recovery period. Following stabilization, the patient was instructed on maintaining oral hygiene, adopting a soft or liquid diet, and performing limited mandibular movements to prevent stress on the fixation. The treatment achieved successful alignment without postoperative complications, and at the end of therapy, the interdental hooks were easily removed without trauma to the surrounding gingival or mucosal tissues. Post-treatment evaluation confirmed restoration of normal occlusion, improved chewing efficiency, and complete resolution of pain. This conservative IMF technique using interdental hooks demonstrated an effective, tissue-preserving, and reversible method for managing mandibular body fractures in adolescent patients.

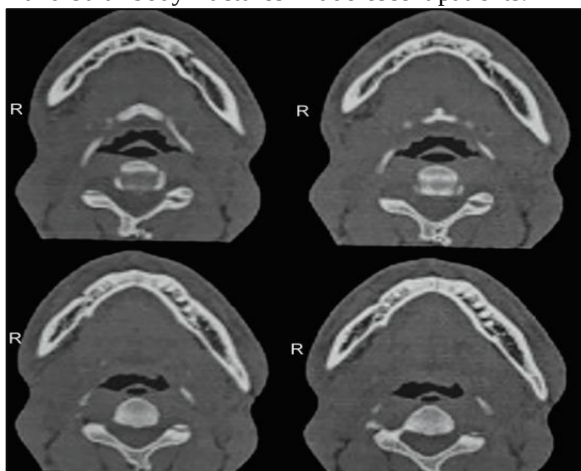


Figure-2: Axial CT showing left mandibular body fracture.

Case 3

A 1.5-year-old girl presented with a left parasymphysis fracture of the mandible and was planned for closed reduction under general anesthesia. Because of the patient's young age and the presence of developing deciduous and permanent tooth buds, a conservative, minimally invasive approach was prioritized to prevent growth disturbances or injury to erupting teeth. During the procedure, the avulsed deciduous teeth were carefully autotransplanted into their original sockets, ensuring correct anatomical orientation, and were then secured using 26-gauge stainless steel wire through bridle wiring. This technique provided immediate stabilization of the teeth while preserving alveolar bone height and facilitating reattachment of the periodontal ligament. To achieve stable fixation of the mandibular fracture, an 18-gauge stainless steel wire was contoured and adapted to the lower labial aspect of the alveolar bone, extending across the anterior region from teeth numbered 71, 72, 73, 81, 82, and 83. This adaptation served as a rigid splint providing lateral support across the anterior mandible. Subsequently, a 26-gauge stainless steel wire was passed subperiosteally using a bone awl after making small stab incisions over the inferior border of the mandible on both sides. The 18-gauge wire, functioning as a lateral compression splint, was intentionally designed without lingual support, thereby creating controlled compression over the buccal aspect of the mandible. This configuration effectively replaced the traditional open-cap splint, which can be cumbersome and has a greater potential to traumatize the gingival and mucosal tissues.

By combining circummandibular wiring for segmental stabilization with bridle wiring for the autotransplanted teeth, this method achieved solid fixation while avoiding injury to tooth buds. The choice of closed reduction and wiring avoided open surgical exposure, which carries significant risks of infection, scarring, and interference with jaw growth centers in pediatric patients. Moreover, the absence of intraoral splint fabrication simplified the procedure by eliminating the need for time-consuming laboratory impression work, which can be particularly challenging in uncooperative infants. Postoperative management included a soft or semi-liquid diet, maintenance of oral hygiene with gentle rinsing, and close observation for any signs of infection or wire displacement. Nursing staff and caregivers were instructed on cleaning techniques and recognizing early complications such as swelling, irritation, or feeding difficulties. Regular follow-up examinations were scheduled to assess healing progression, check the stability of the transplanted teeth, and ensure that mandibular growth remained symmetrical. At the one-month follow-up, a postoperative radiograph confirmed excellent bone healing, proper alignment of the parasymphysis region, and satisfactory positioning of the autotransplanted deciduous teeth. Clinically, the

patient exhibited normal mandibular motion and resumed feeding without discomfort. No complications such as wire loosening, soft-tissue ulceration, or infection were reported. This innovative technique using an 18-gauge lateral compression splint with circummandibular and bridle wiring proved to be a simple, effective, and biologically conservative approach for managing mandibular fractures in very young children. It achieved stable fixation, avoided injury to developing tooth buds, minimized soft-tissue trauma, and facilitated early healing and return to normal function, aligning with the principles of pediatric maxillofacial fracture management focused on growth preservation and functional recovery.



Figure-3: Preoperative CT scan showing left mandibular parasymphysis fracture.

Discussion

The present series highlights a pragmatic, biologically conservative strategy for stabilizing pediatric mandibular fractures that leverages the physical characteristics of impression (modeling) compound and simple wire-based constructs to protect developing dentition while restoring function. Impression compound—also called modeling compound—is a thermoplastic, reversible, and inherently stiff material that softens in a warm water bath and rehardens intraorally with rapid dimensional stability, properties that make it well suited for chairside splint fabrication in very young children [6]. In prosthodontic practice, Type I sheet compound is routinely tempered in water maintained at 55–60 °C, a range selected because it exceeds the compound's fusion temperature and ensures adequate plasticity for adaptation; as a mucocompressive material, it records tissues under functional load, an attribute that we repurpose here to generate gentle lateral compression across pediatric mandibular cortices while avoiding transdental or transalveolar hardware [7]. Translating these prosthodontic principles to trauma care yields a stabilizing appliance that is quick to mold, rigid when set, and easily removed without specialized laboratory support.

This technique's principal advantages in toddlers and young children stem from its minimal invasiveness and respect for growth biology. The combination of impression compound as a contoured buttress with circummandibular wiring provides a stable construct that avoids drilling in the tooth-bearing region, thereby minimizing the risk of injury to permanent tooth buds and preserving eruption paths. Because pediatric bone is pliable and highly remodeling, gentle coaptation with external support often suffices to achieve union without the need for rigid internal fixation. From a health-systems perspective, the approach is affordable, uses materials that are widely available in most maxillofacial units, and reduces operative time, which in turn shortens anesthesia exposure—an added safety benefit in infants and toddlers. Families also benefit from simplified postoperative care: the compound's rigidity stabilizes occlusion, while the smooth surfaces are easier to keep clean than the brackets, hooks, and lugs typical of arch bars. The case experiences also illustrate that this novel method facilitates speedy healing, stable fixation, and atraumatic removal, meeting the priorities of pediatric fracture management—namely, safety, function, and growth preservation. Nonetheless, we underscore that structured follow-up is not optional. Pediatric mandibular trauma can declare late sequelae, including occlusal drift, scar-related tethering, or asymmetric mandibular growth after condylar involvement; scheduled surveillance enables early detection and timely orthodontic or surgical intervention, consistent with best practices in pediatric maxillofacial care. Follow-up also provides opportunities to coach caregivers on splint hygiene, soft-diet progression, and signs of complications, thereby reducing unscheduled visits and improving adherence.

When considering alternatives, intermaxillary fixation (IMF) using interdental hooks is a credible, simple, rapid, and cost-conscious method for adolescents and selected older children. Properly applied, hook-based IMF secures the desired occlusion, avoids undue forces on anterior teeth, and remains minimally intrusive, with the added benefit of an emergency quick-release capacity if aspiration risk or emesis occurs [8]. However, two practical drawbacks often limit IMF or arch-bar approaches in younger patients. First, maintaining oral hygiene around dense wire and bracket architecture is challenging, increasing mucosal irritation and biofilm accumulation. Second, IMF screws and some preformed systems can be costly, and in small jaws with thin cortices they may not be ideal; in medically complex children or those with low bone density, screw purchase can be unreliable. Our impression-compound-based construct addresses both issues by eliminating transdental hardware in the aesthetic zone and reducing soft-tissue trauma, while preserving reversibility and enabling early functional recovery.

An additional advantage of the compound-and-wire construct is procedural efficiency. Because the compound can be adapted directly in the operating room after simple tempering, it avoids tedious laboratory procedures and difficult impressions that can be especially problematic in infants and toddlers who cannot cooperate with conventional tray-based techniques. This efficiency translates to shorter anesthesia times and faster turnover without sacrificing stability. In our experience, autotransplantation and bridle wiring of avulsed primary teeth, when indicated, restore occlusal stops and alveolar form, complementing the lateral compression provided by the compound and circummandibular wire to yield a balanced, growth-friendly fixation strategy.

The principal limitation observed with this approach is the occasional displacement of the 18-gauge wire used as a lateral compression splint during adaptation. Several mitigations can reduce this risk: meticulous pre-contouring to match the labial curvature; stepwise tightening of the circummandibular wire to seat the splint evenly; and intraoperative verification of occlusion after each incremental adjustment. In cases with high soft-tissue mobility or edema, temporary auxiliary sutures can help stabilize the splint margins until the compound fully sets. Even with these safeguards, clinicians should anticipate minor adjustments during the early postoperative period, which reinforces the value of close early follow-up. From a broader clinical governance perspective, the technique aligns with pediatric trauma tenets: minimize radiation (leveraging low-dose imaging protocols where feasible), minimize hardware crossing growth centers, and prioritize airway safety, nutrition, and caregiver education. Nursing-led pathways for analgesia, hygiene instruction, and diet advancement are indispensable to translate intraoperative success into predictable outpatient recovery. For adolescents with body fractures—such as the 16-year-old presented—IMF hooks remain an excellent option when occlusion can guide reduction and patient cooperation permits, but careful case selection is essential [8]. Conversely, in very young children with parasymphyseal injuries, the compound-and-wire construct offers an elegant balance of stability, safety, and simplicity. In summary, impression compound serves as more than a prosthodontic impression material; repurposed as a lateral compression splint, it becomes a versatile, minimally invasive, and cost-effective adjunct in pediatric mandibular fracture care [6][7]. Coupled with circummandibular and bridle wiring, it safeguards developing tooth buds, shortens operative workflows, and facilitates early healing and return to normal activities. While occasional wire displacement represents a manageable technical caveat, the overall risk–benefit profile strongly favors this approach in appropriately selected cases. Ongoing, routine follow-

up remains essential to detect growth or occlusal disturbances early and to maintain the long-term functional and developmental trajectory of the pediatric mandible [6][7][8].

Conclusion:

In conclusion, the management of pediatric mandibular fractures demands a specialized, conservative philosophy that prioritizes the preservation of growth potential and dental structures over rigid anatomical fixation. The case series presented demonstrates that techniques such as closed reduction with custom-molded impression compound splints and circummandibular wiring offer a highly effective and safe solution. This approach successfully achieves the primary goals of fracture management—stable fixation, restoration of occlusion, and functional recovery—while meticulously avoiding the significant risks associated with transosseous hardware, namely damage to developing tooth buds and growth centers. Its advantages of being minimally invasive, cost-effective, and easily reversible make it particularly well-suited for young children. The successful application of this technique hinges on seamless interdisciplinary collaboration. The integration of dental expertise for occlusal guidance and splint design, radiological input for low-dose imaging and precise diagnosis, and nursing care for perioperative management, family education, and nutritional support is indispensable. This team-based model ensures that care is not only technically successful but also holistic, addressing the child's physiological and psychosocial needs. Ultimately, by adhering to principles of biological conservation and leveraging simple, adaptable techniques, clinicians can achieve excellent functional outcomes and safeguard the long-term developmental trajectory of the pediatric mandible, ensuring these young patients recover fully and without future complications.

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