

# Surgical Sequence for Management of Panfacial Fracture

## A Systematic Review

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### Abstract

**Aim:** To evaluate and analyse the various sequencing strategies for the surgical management of panfacial fractures.

**Materials and Methods:** A comprehensive electronic and manual search of the literature, without date or language restrictions, was performed across several databases, including PubMed, SCOPUS, SpringerLink, EBSCO, and Google Scholar, 2011 to 2023. The search terms used were "panfacial fracture," "sequencing," "maxillofacial fracture," and "sequence of fixation."

**Results:** A total of 2820 studies were initially identified through database searches, of which 280 studies were shortlisted after title and abstract screening. Following full-text assessment, 13 studies met the inclusion criteria, comprising 676 participants (388 males, 288 females). Among the included studies, 1 study exclusively used the Top-to-Bottom approach, 2 studies focused on the Bottom-to- Top approach with an emphasis on Occlusion First, 4 studies combined the Bottom-to-Top and Outside-In approaches, and 6 studies employed a comprehensive strategy, integrating both the Bottom-to-Top & Outside-In as well as the Top-to-Bottom & Inside- Out approaches. The follow-up period varied from 3 weeks to 24 months.

**Conclusion:** This systematic review highlights the variability in surgical sequencing strategies for panfacial fracture management, with the Bottom-to-Top and Outside-In approach being the most commonly used and demonstrating superior outcomes compared to

other sequencing patterns. While Top-to-Bottom, Inside-Out, and Occlusion First approaches also yielded favorable results, evidence suggests that the Bottom-to-Top and Outside-In sequence achieves better functional and aesthetic outcomes. Early repair is recommended for optimal reduction and fixation; however, in cases with life-threatening injuries, delayed intervention may be necessary. Complications are observed across all sequencing methods but can be minimized with definitive treatment planning and a stepwise surgical approach.

**Keywords:** "panfacial fracture," "sequencing," "maxillofacial fracture," and "sequence of fixation."

## INTRODUCTION

Panfacial fractures present one of the most intricate challenges in maxillofacial surgery due to their involvement of the upper, middle, and lower regions of the face. These fractures commonly include a combination of the frontal bone, maxilla, zygomatic complex, naso-orbital-ethmoidal (NOE) region, and mandible. The severity and complexity of panfacial fractures, typically resulting from high-impact trauma such as motor vehicle accidents, gunshot wounds, or severe assaults, make precise anatomical reconstruction exceptionally difficult. The extensive fragmentation and displacement of facial bones associated with these injuries further complicate the reconstruction process, requiring meticulous planning and execution.

Historically, the management of panfacial fractures has been loaded with challenges. The loss of anatomical landmarks due to severe bone fragmentation makes it difficult to restore facial symmetry and function. Early treatment approaches often relied on conservative methods, which frequently led to postoperative complications such as malocclusion, facial deformities, and reduced facial projection. Advances in surgical techniques and technologies have since allowed for more precise and effective interventions. However, despite these advancements, the optimal approach to managing these complex injuries remains a topic of ongoing debate and investigation.

A critical aspect of managing panfacial fractures is the sequencing of surgical interventions. Sequencing refers to the order in which different

regions of the facial skeleton are addressed during surgery. Proper sequencing is essential for accurate fracture reduction, effective restoration of facial symmetry, and overall functional recovery. The lack of a universally accepted protocol highlights the need for a comprehensive examination of existing approaches to determine the most effective sequencing strategy.

Two primary sequencing approaches have emerged in the literature: the "bottom-top, outside-in" and the "top-bottom, inside-out" methods. The "bottom-top, outside-in" approach starts with the stabilization of the mandible and progresses upward through the facial skeleton. This method prioritizes the restoration of the lower facial structures, which are considered fundamental for aligning the upper facial segments. Conversely, the "top-bottom, inside-out" approach begins with the fixation of the upper facial structures, such as the frontal bone and zygomatic complex, before addressing the lower segments. This approach aims to reestablish the upper facial framework first, providing a reference for reconstructing the lower regions.

Despite the development of these methodologies, there is no consensus on a standardized sequencing protocol for panfacial fracture management. The choice of sequencing often depends on factors such as the surgeon's experience, the specific characteristics of the fractures, and the presence of concomitant injuries. This variability underscores the need for a systematic review of existing literature to evaluate the effectiveness of different sequencing strategies and to provide evidence-based recommendations.

Understanding the optimal sequencing for managing panfacial fractures is crucial for achieving successful surgical outcomes. Effective sequencing can lead to more accurate fracture reduction, improved restoration of facial symmetry, and enhanced functional and aesthetic results. By addressing the existing gaps in knowledge and practice, this study aims to provide a thorough examination of the various surgical sequencing approaches, their outcomes, and their implications for clinical practice.

The main purpose of this systematic review is to address these uncertainties by evaluating existing literature and surgical practices to determine the optimal sequence for managing panfacial fractures. By synthesizing evidence on various sequencing strategies, this review aims to provide clear guidance for achieving superior functional and aesthetic outcomes in the management of panfacial fractures. Understanding the ideal approach will not only enhance surgical precision but also contribute to improved patient outcomes and reduced postoperative complications.

#### **Aim of the study**

To evaluate and analyse the various sequencing strategies for the surgical management of panfacial fractures.

#### **Materials and Methods**

A comprehensive electronic and manual search of the literature, without date or language restrictions, was performed across several databases, including PubMed, SCOPUS, SpringerLink, EBSCO, and Google Scholar, 2011 to 2023. The search terms used were "panfacial fracture," "sequencing," "maxillofacial fracture," and "sequence of fixation." Additionally, the reference lists of all included studies and any published systematic reviews were checked to identify further relevant studies.

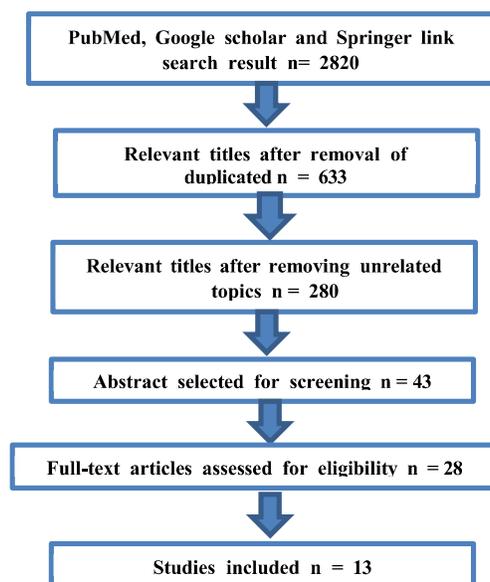
#### **Inclusion Criteria**

- Cross sectional studies, observational studies, prospective studies, retrospective studies, randomized control trials, Case control and cohort studies, Controlled clinical trials, English language.

#### **Exclusion Criteria**

- Inaccurate data for analysis, Incomplete data for analysis, In vitro studies, Animal studies, Panfacial fracture in pediatric patients, Panfacial burns, Vascular complications associated with panfacial fracture, Use of distraction device in the treatment of panfacial fracture, Other than English language.

#### **FLOW DIAGRAM DEPICTS THE PROCESS OF FINAL SELECTION OF STUDIES**



**TABLE 1:** The Characteristics of included studies

S.No.	Author	Year	Study design	Number of Patient	Male patients	Female patients	Male Female ratio	surgical sequence	Time of intervention	Outcome	Follow-up period	Complications
1	Rongtao Yang et al.	2012	Retrospective	107	96	4	24	Bottom to top and outside in	-	Good	3 to 24 months	Present
2	Lalitha Ramanujam et al.	2012	Retrospective	15	14	1	14	Bottom to top and outside in	Within	Satisfactory	-	Nil
3	Degala S, Sundar SS et al	2015	Comparative Prospective	11	11	-	-	Both Bottom to top and inside out and top to bottom and outside in	4 to 13 days— bottom top 7 to 16 days— top to bottom	Bottom-up approach 60%— excellent 40%— fair Top-down approach 50%— excellent 16%— good 32%— fair	6 weeks	Present
4	Kim et al.	2016	Review article	53	-	-	-	Both Bottom to top and outside in and top to bottom and inside out	-	Good (similar outcome on both approaches)	3 weeks	Present
5	Jorge Orlando Guerrissi et al.	2016	Clinical study	58	-	-	-	Both Bottom to top and outside in and top to bottom and inside out	7–15 days	Acceptables 85% and not acceptable 15%	12 months	Present
6	Abdeljalil Abouchadi et al.	2018	Retrospective	48	43	5	8.6	Bottom to top and outside in	9 days	Fair	6 months	Present
7	Jong Woo Choi et al.	2019	Retrospective	61	47	14	3.3	Bottom to top (Occlusion First)	3–24 days	-	6–20 months	-
8	Mohamed Koraitim, MD et al.	2020	Retrospective	73	61	12	5	Bottom to top lateral to medial	first few days	Normal facial contours in 90.4% of patients	6 months	Present
9	Scott Cynthia et al.	2022	Retrospective	76	72	4	18	Top to Bottom	-	-	6-months	Present
10	Shereen W. Arafat et al.	2022	Prospective	12	12	-	-	Bottom- up outside-in and top-down inside-out	first 5 days	83.7% of patients had excellent outcomes and 16.3% had good outcomes	6 weeks	No
11	Jae Hee Yoon et al.	2022	Review of Literature	124	-	-	-	Bottom to top, Top to Bottom & both	-	Favorable	-	-
12	Vijaylaxmi Shettar et al.	2023	Case series	4	-	-	0.5	Bottom to top (Occlusion First)	-	good	-	-
13	Ntokoza Bhekisisa Gumede et al.	2023	Retrospective	34	32	2	0.39	Bottom to top, top to bottom, inside-out/medial to lateral, or outside-in/lateral to medial	2 to 5 days	satisfactory in 32 out of the 34 patients	-	Present

## RESULTS

### Study selection process

The eligible studies were searched using electronic databases, i.e., Pubmed, google scholar from 2011 to 2023. The search terms were "panfacial fracture," "sequencing," "maxillofacial fracture," and "sequence of fixation.". A total of 2820 studies of potential interests were identified in the initial database search. After the title and abstract evaluation 280 studies were included. From that 28 full text articles assessed for eligibility and were selected. After evaluating the inclusion and exclusion criteria 13 suitable articles were taken for the study.

### Characteristics of the included studies

The extracted data and the characteristics of the studies included in the final analysis. It includes 13 studies, from these seven studies were retrospective, two studies were Prospective, two studies were Review of Literature, one Clinical study and one Case series.

Total 676 participants of Panfacial Fracture were treated with surgical sequence of Bottom to top and outside in and top to bottom and inside out, Occlusion First, medial to lateral, or lateral to medial. In included studies the etiology of road traffic accidents, interpersonal violence, sports-related accidents, gunshot wounds and industrial accidents as plausible causes of these fractures.

A total of 13 studies investigated different treatment approaches for patients. Among these, one study used the Top-to-Bottom approach exclusively, two studies focused on the Bottom-to-Top approach with an emphasis on Occlusion First, four studies combined the Bottom-to-Top and Outside-In approaches, and six studies employed a more comprehensive strategy, incorporating both the Bottom-to-Top and Outside- In as well as the Top-to-Bottom and Inside-Out approaches.

A total 676 participants in this study out of that 388 were male and 288 were female. All the age groups were included in the study. The surgical sequencing used for surgery were also mentioned in this study.

The analysis of 13 studies revealed diverse treatment outcomes. Success rates varied by approach, with one study reporting 60% excellent and 40% fair outcomes for the bottom-up approach, and 50% excellent, 16% good, and 32% fair for the top-down approach. Some other studies highlighted positive outcomes, including 83.7% excellent and 16.3% good results, 85% acceptability, and 90.4% normal facial contours. Other studies described outcomes as good, fair, or satisfactory, with one noting satisfactory results in 32 out of 34 patients. A few studies lacked detailed data but reflected generally favorable results overall.

The follow-up periods in 13 studies ranged from short-term durations like 3 to 6 weeks to longer-term periods of 6 to 24 months. While some studies tracked outcomes for 6 or 12 months, others reported ranges such as 6 to 20 months. However, several studies did not specify their follow-up periods.

Out of 13 studies, complications were reported in 8, while 1 study explicitly mentioned no serious complications. Two studies recorded no complications, and 3 studies did not specify whether complications occurred.

## DISCUSSION

Panfacial fractures represent one of the most complex challenges in maxillofacial surgery, as they involve multiple regions of the face, often requiring a structured and strategic approach for successful reconstruction. The primary concern in managing these fractures is achieving functional and aesthetic outcomes while minimizing complications. This systematic review analyzed 13 studies involving 676 patients, each undergoing surgical intervention for panfacial fractures. The studies assessed different sequencing approaches, including Bottom-to-Top and Outside-In, Top-to-Bottom and Inside-Out, Occlusion-First, Medial-to-Lateral, and Lateral-to-Medial techniques. The findings emphasize the importance of selecting the appropriate sequence based on fracture severity, location, and patient-specific conditions.

Among the different approaches, the Bottom-to-Top and Outside-In technique emerged as the most commonly used method. This approach prioritizes the mandible as the foundational structure, ensuring occlusal stability before progressing upwards to the midface and frontal bones. The advantage of this method lies in its ability to restore proper occlusion early in the procedure, which helps maintain facial symmetry and reduces the risk of malocclusion. Studies that employed this approach reported favorable outcomes, with 60% of patients achieving excellent results and 40% experiencing fair outcomes. Additionally, an 85% patient acceptability rate and 90.4% normal facial contour restoration highlight the efficacy of this sequencing strategy.

The Top-to-Bottom and Inside-Out approach, though less commonly used, is particularly beneficial in cases involving cranial base fractures or severe orbital injuries. This method focuses on stabilizing the frontal and orbital regions first, which helps prevent complications such as enophthalmos and orbital dystopia. However, this technique poses challenges in ensuring proper occlusal alignment, often requiring additional steps to correct mandibular positioning later in the procedure. The success rates for this approach were slightly lower than the Bottom-to-Top technique, with 50% of patients achieving excellent outcomes, 16% rated as good, and 32% classified as fair. Despite these variations, both approaches demonstrated effectiveness in restoring facial function and aesthetics.

An alternative approach known as the Occlusion-First method was also assessed in two studies. This technique prioritizes establishing a stable occlusion before proceeding with other fracture fixations. It is particularly useful in cases where occlusal alignment is disrupted due to mandibular fractures. Ensuring proper occlusion early in the procedure helps minimize the risk of postoperative malocclusion and temporomandibular joint dysfunction. The studies evaluating this method

reported favorable postoperative results, further validating its potential as a viable sequencing strategy in select cases.

Additionally, some studies examined Medial-to-Lateral and Lateral-to-Medial approaches, where fixation either begins at the midface and moves outward or starts from the periphery and progresses inward. While these techniques were less commonly used as primary sequencing methods, they were often integrated as adjuncts to the more widely accepted Bottom-to-Top and Top-to-Bottom strategies. Their effectiveness was largely dependent on the specific fracture patterns and surgeon preference.

The review also analyzed patient demographics and the etiology of panfacial fractures. The majority of patients were male (388 out of 676), with road traffic accidents being the most common cause, followed by interpersonal violence, sports injuries, gunshot wounds, and industrial accidents. These findings underscore the high-impact nature of panfacial fractures and the need for a multidisciplinary approach in their management.

The timing of surgical intervention emerged as a crucial factor in treatment outcomes. Most studies recommended early intervention within 3 to 15 days post-injury to prevent complications such as fibrosis, callus formation, and secondary deformities. However, in cases of polytrauma or neurological injuries, delayed intervention was necessary to stabilize life-threatening conditions before proceeding with facial reconstruction. The follow-up duration varied across studies, ranging from 3 weeks to 24 months. Longer follow-up periods provided valuable insights into the durability of surgical outcomes and the potential for late-onset complications.

Complications were reported in 8 out of 13 studies, with the most common issues including malocclusion, enophthalmos, facial asymmetry, delayed bone healing, infection, and temporomandibular joint dysfunction. One study explicitly stated that no serious complications

occurred, suggesting that meticulous surgical planning and execution can significantly reduce the risk of postoperative complications. The findings highlight the importance of individualized treatment planning, as rigid adherence to a single sequencing method may not be suitable for all cases.

Overall, this systematic review reinforces that the Bottom-to-Top and Outside-In sequence remains the preferred strategy for managing panfacial fractures due to its structured approach, stable occlusion, and predictable facial symmetry restoration. However, the Top-to-Bottom and Inside-Out method is indispensable in cases where cranial and orbital stabilization is a priority. A hybrid approach, incorporating elements of both strategies based on patient-specific fracture patterns, is often necessary for optimal outcomes. Early intervention is generally recommended, except in polytrauma cases where life-threatening injuries must be addressed first.

## CONCLUSION

This systematic review highlights the variability in surgical sequencing strategies for panfacial fracture management, with the bottom-to-top and outside-in approach being the most commonly used and demonstrating superior outcomes compared to other sequencing patterns. While top-to-bottom, inside-out, and occlusion-first approaches also yielded favorable results, evidence suggests that the bottom-to-top and outside-in sequence achieves better functional and aesthetic outcomes. Other approaches have their merits in specific clinical scenarios. Future research should aim to standardize surgical sequencing protocols and include long-term follow-up studies to refine best practices. By adopting an evidence-based approach, surgeons can enhance patient outcomes, minimize complications, and improve both functional and aesthetic recovery in panfacial fracture management.

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