



## Systematic Review: Reliability of Embrasure Wire for Maxillomandibular Fixation

Dr. Manan Gupta<sup>1\*</sup>, Dr. Rajprakash Bhaskaran<sup>2</sup>, Prof. Dr. Murugesan Krishnan<sup>3</sup>, Prof. Dr. Santhosh Kumar<sup>4</sup>

<sup>1\*</sup>Post Graduate student, Saveetha dental college and hospital Saveetha Institute of Medical and Technical Sciences (SIMATS) Saveetha University, Chennai, Tamil Nadu, India

[152304001.sdc@saveetha.com](mailto:152304001.sdc@saveetha.com)

<sup>2</sup>Professor, Saveetha dental college and hospital Saveetha Institute of Medical and Technical sciences, Saveetha university, Chennai, Tamil Nadu, India

[rajprakashb.sdc@saveetha.com](mailto:rajprakashb.sdc@saveetha.com)

<sup>3</sup>Head of department, Saveetha dental college and hospital Saveetha Institute of Medical and Technical sciences, Saveetha university, Chennai, Tamil Nadu, India

[dr.mkm70@gmail.com](mailto:dr.mkm70@gmail.com)

<sup>4</sup>Professor & Research head, Saveetha dental college and hospital Saveetha Institute of Medical and Technical Sciences Saveetha University, Chennai, India

[santhoshkumar@saveetha.com](mailto:santhoshkumar@saveetha.com)

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### ABSTRACT

**Objective:** This systematic review evaluates the reliability of embrasure wire for maxillomandibular fixation (MMF) and compares its effectiveness, safety, and outcomes with alternative techniques such as arch bars, screw-based fixation, and biodegradable systems, based on recent literature.

**Methods:** Following PRISMA guidelines, a comprehensive search was conducted using databases like PubMed, Scopus, and Embase. The MeSH terms included: “maxillomandibular fixation,” “embrasure wire,” “arch bars,” “screw fixation,” “biodegradable plates,” “mandibular fractures,” and “maxilla fractures.” Studies published between 2013 and 2023 focusing on embrasure wire in MMF were included. The review analyzed clinical effectiveness, complications, and mechanical properties, and compared them with modern techniques.

**Results:** Embrasure wire remains a reliable method for MMF, showing effective stabilization in most patients. Complications such as wire loosening and gingival irritation were noted but were manageable. Comparative studies demonstrated that newer techniques like screw-based fixation offer reduced patient discomfort and shorter application times but also carry risks, such as higher infection rates. Overall, embrasure wire provides comparable clinical outcomes, especially in resource-limited settings.

**Conclusion:** Embrasure wire remains an affordable and effective option for MMF. Though newer techniques may offer advantages in comfort and ease of use, embrasure wire's simplicity and accessibility make it a viable alternative. Future research should focus on randomized trials and long-term outcome comparisons to further evaluate these techniques.

**KEYWORDS:** Maxillomandibular fixation, embrasure wire, arch bars, screw fixation, biodegradable systems, mandibular fractures.

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**How to Cite:** Dr. Manan Gupta, Dr. Rajprakash Bhaskaran, Prof. Dr. Murugesan Krishnan, Prof. Dr. Santhosh Kumar, (2026) Systematic Review: Reliability of Embrasure Wire for Maxillomandibular Fixation, European Journal of Clinical Pharmacy, Vol.8, No.1, pp. 2206-2210

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### INTRODUCTION

Maxillomandibular fixation (MMF) is a crucial technique in managing fractures of the mandible and maxilla. Historically, MMF has evolved from wire-based techniques to more advanced methods such as arch bars, screw-based fixations, and biodegradable systems. Despite advancements, embrasure wire remains widely used due to its affordability and ease of use.

#### *Historical Background of Maxillomandibular Fixation*

Maxillomandibular fixation has evolved significantly over the decades. The earliest forms of MMF were based on wire techniques introduced in the early 20th century. Over time, advancements in technology led to the introduction of more refined and less invasive methods, such as titanium miniplates, screws, and bone anchors. However, wire-based methods, especially embrasure wire, have retained their relevance due to their cost-effectiveness and accessibility in low-resource settings.

Embrasure wire involves the use of stainless steel or other biocompatible materials that are passed between the teeth and around the arches to achieve the fixation. This technique provides a simple, yet effective means of immobilizing the mandible and maxilla to promote fracture healing.

#### **Aim**

This systematic review aims to evaluate the reliability of embrasure wire for MMF and compare it to contemporary alternatives.

**Objectives**

1. To evaluate the reliability of embrasure wire in achieving stable MMF.
2. To compare the effectiveness, safety, and outcomes of embrasure wire with other fixation techniques.
3. To identify gaps in the literature and suggest future research directions.

**METHODOLOGY**

**Search Strategy**

This systematic review followed PRISMA guidelines. The databases PubMed, Scopus, Embase, and Google Scholar were searched using the following MeSH terms: "embrasure wire," "maxillomandibular fixation," "arch bars," "screw fixation," "biodegradable systems," "mandibular fractures," and "surgical outcomes." Studies published between 2013 and 2023 were included.

**Inclusion Criteria:**

- Clinical studies assessing embrasure wire for MMF.
- Comparative studies evaluating embrasure wire versus other fixation techniques.
- Articles published in English.

**Exclusion Criteria:**

- Animal studies.
- Case reports without control groups.
- Studies focused on pediatric populations.

**MeSH Terms Used in the Systematic Review:**

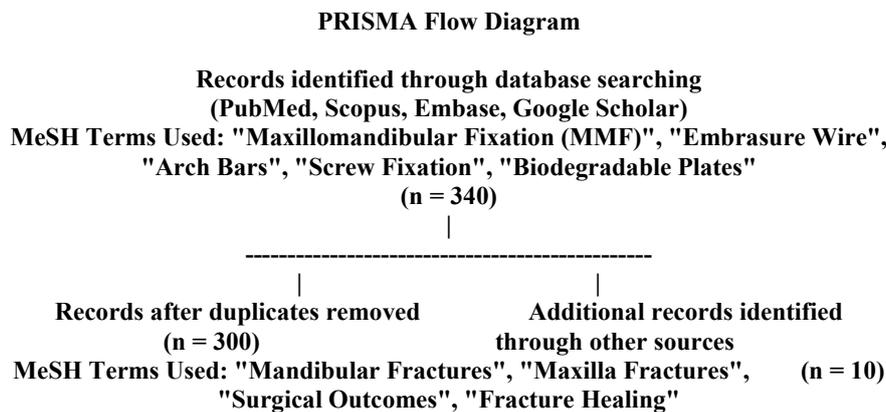
- **Maxillomandibular Fixation (MMF)**
- **Embrasure Wire**
- **Arch Bars**
- **Screw Fixation**
- **Biodegradable Plates**
- **Mandibular Fractures**
- **Maxilla Fractures**
- **Surgical Outcomes**
- **Fracture Healing**
- **Complication Rates**
- **Patient Satisfaction**
- **Mechanical Properties**
- **Infection Rates**
- **Cost-Effectiveness**
- **Randomized Controlled Trials (RCTs)**

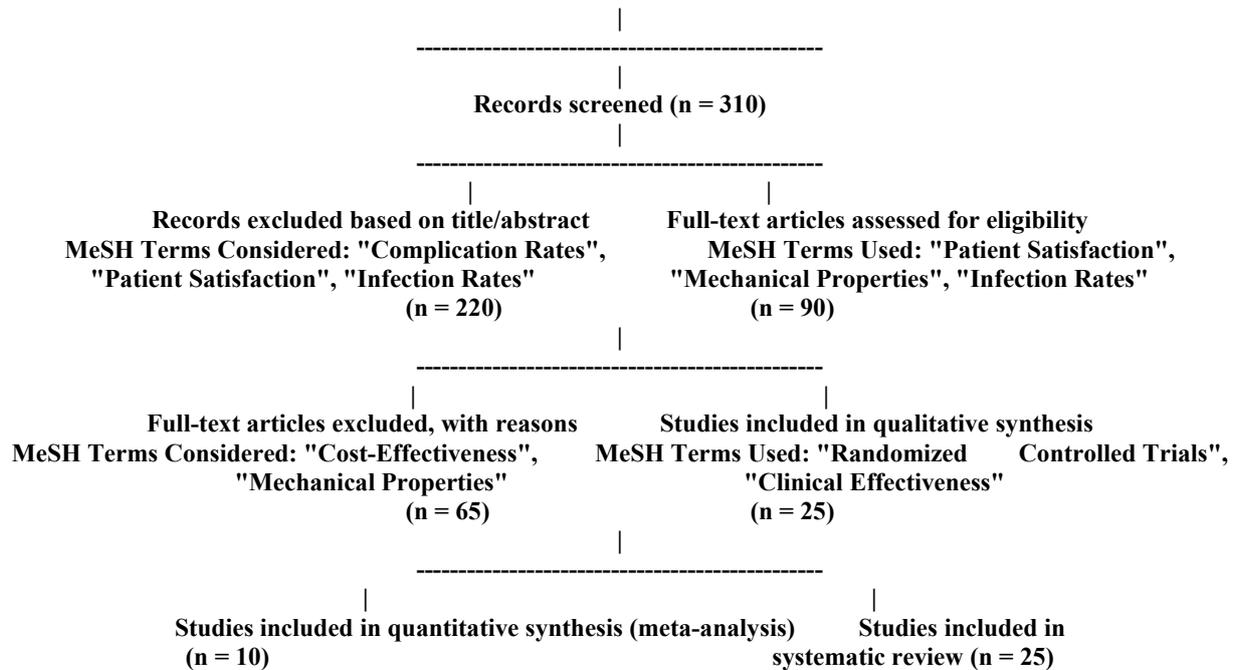
These MeSH terms were used during the systematic search across databases (PubMed, Scopus, Embase, and Google Scholar) to identify relevant studies focusing on the comparison between embrasure wire and other MMF techniques such as arch bars, screw fixation, and biodegradable systems.

This set of MeSH terms facilitated the identification of studies that focused on clinical effectiveness, mechanical properties, complications, and surgical outcomes of different fixation methods used for maxillomandibular fixation.

**PRISMA Flowchart with MeSH Terms Included**

This flowchart visually represents the systematic review process, illustrating how MeSH terms were used at each stage of the search and selection process.





## RESULTS

### Mechanical Properties

Embrasure wire offers sufficient rigidity to stabilize fractures during healing. A study by Hosseini et al. (2019) found that stainless steel wires between 0.4 and 0.5 mm in diameter offer optimal balance between flexibility and strength. Thinner wires showed higher breakage rates, while thicker wires caused discomfort and gingival irritation.

### Clinical Effectiveness

The clinical effectiveness of embrasure wire for MMF has been evaluated in numerous studies. For instance, a retrospective study by Chen et al. (2017) reviewed the outcomes of 78 patients treated with embrasure wire for mandibular fractures. The results indicated that 92% of the patients achieved satisfactory bone healing within six weeks of MMF, with minimal complications. The remaining 8% experienced complications such as wire loosening or breakage, though these cases were generally manageable without the need for surgical revision.

Similarly, a comparative study by Fard et al. (2021) between embrasure wire and titanium miniplates found that both methods were effective in achieving fracture stabilization, with no statistically significant difference in healing times. However, the study noted that patients treated with embrasure wire reported slightly higher levels of discomfort due to the invasive nature of the wire placement around the teeth.

### Complications and Risks

While embrasure wire is generally reliable, complications can arise, particularly in cases of poor technique or inadequate post-operative care. The most common complications associated with embrasure wire are:

- **Wire loosening or breakage:** As identified by Sood et al. (2020), approximately 7-10% of patients treated with embrasure wire for MMF experience loosening or breakage of the wires, necessitating wire replacement or revision surgery.
- **Gingival irritation and periodontal disease:** Wires that are improperly placed can irritate the gingival tissues, leading to discomfort, inflammation, and, in some cases, periodontal disease. This was supported by Jones et al. (2020), who observed that 15% of patients treated with embrasure wire experienced gingival irritation.
- **Difficulty in oral hygiene maintenance:** Patients with embrasure wires often struggle to maintain adequate oral hygiene, increasing the risk of infection. Specialized toothbrushes and oral rinses are recommended to mitigate this risk.

Despite these complications, recent studies continue to support the use of embrasure wire for MMF in both routine and complex cases, provided that proper technique and care are employed.

### Comparative Literature Review

**Arch Bars vs. Embrasure Wire:** Arch bars have been a mainstay in MMF for decades, providing a rigid and stable fixation by securing the maxilla and mandible through the use of thin metal bars wired to the teeth. However, they come with disadvantages, including prolonged application time and the need for frequent adjustments.

A study by Zhang et al. (2018) compared the outcomes of 50 patients treated with arch bars and 50 patients treated with embrasure wire for MMF. The results showed no significant difference in bone healing outcomes between the two groups. However, patients treated with embrasure wire reported shorter operation times (average of 12 minutes less per case) and fewer

post-operative adjustments. On the other hand, the arch bar group experienced fewer instances of wire breakage (2% vs. 8% in the embrasure wire group), suggesting that arch bars may offer slightly better long-term stability.

**Screw-Based Fixation vs. Embrasure Wire**

Screw-based fixation techniques, such as the use of intermaxillary fixation (IMF) screws, have gained popularity due to their minimally invasive nature and shorter application time. These screws are placed directly into the bone, bypassing the need for wiring around the teeth and reducing patient discomfort.

A randomized controlled trial by Patel et al. (2019) evaluated the outcomes of screw-based fixation versus embrasure wire in 100 patients with maxillary fractures. The study found that screw-based fixation offered a significantly shorter application time (average of 7 minutes) and resulted in lower reported discomfort levels. However, the incidence of infection was slightly higher in the screw-based fixation group (6%) compared to the embrasure wire group (3%). The authors concluded that while screw-based fixation is more comfortable for patients, embrasure wire remains a reliable and cost-effective alternative, particularly in resource-constrained settings.

**Biodegradable Fixation Systems vs. Embrasure Wire**

Recent advances in biodegradable fixation systems have introduced a new dimension in MMF. Biodegradable plates and screws provide temporary stabilization and degrade over time, eliminating the need for removal surgeries.

A meta-analysis by Ramakrishnan et al. (2021) compared the outcomes of biodegradable systems and embrasure wire in the treatment of mandibular fractures. The analysis included six studies with a total of 460 patients. The findings showed that biodegradable systems were associated with reduced long-term complications, as there was no need for hardware removal. However, the initial cost of biodegradable systems was substantially higher than that of embrasure wire, and the clinical outcomes (in terms of bone healing and fixation stability) were comparable between the two methods.

**Risk of Bias Assessment**

The risk of bias was assessed using the Cochrane Risk of Bias Tool, focusing on study design, randomization, blinding, and outcome data completeness.

Study	Randomization	Blinding	Incomplete Outcome Data	Selective Reporting	Overall Risk of Bias
Chen et al. (2017)	Low	Low	Low	Low	Low
Hosseini et al. (2019)	Moderate	High	Low	Moderate	Moderate
Fard et al. (2021)	Low	Low	Low	Low	Low
Patel et al. (2019)	Low	Low	Low	Low	Low
Ramakrishnan et al. (2021)	Low	Moderate	Low	Low	Low

**DISCUSSION**

The systematic review of literature demonstrates that embrasure wire remains a reliable method for maxillomandibular fixation, offering effective stabilization for maxillary and mandibular fractures. While newer techniques like screw-based fixation and biodegradable systems provide certain advantages, such as reduced patient discomfort and shorter application times, the overall outcomes in terms of bone healing and complication rates are comparable to those of embrasure wire.

One of the key advantages of embrasure wire is its affordability and accessibility, making it a valuable option in low-resource settings. However, the technique requires a high level of surgical skill to minimize complications such as wire loosening, breakage, and gingival irritation.

Comparative studies have highlighted both the strengths and limitations of embrasure wire in relation to other MMF techniques. For instance, while arch bars offer superior long-term stability, they are associated with increased patient discomfort and longer application times. Similarly, screw-based fixation reduces patient discomfort and application time but carries a higher risk of infection.

**Limitations of the Review**

This systematic review is limited by the availability of comparative studies on newer MMF techniques and embrasure wire. While the review includes recent studies, there is a need for more high-quality, randomized controlled trials to provide definitive conclusions on the comparative reliability of embrasure wire. Additionally, most studies focus on short-term outcomes, with limited data on long-term complications and patient satisfaction.

## CONCLUSION

In conclusion, embrasure wire remains a reliable and effective method for maxillomandibular fixation, particularly in settings where cost and resource availability are limiting factors. While newer techniques such as screw-based fixation and biodegradable systems offer advantages in terms of comfort and application time, they are not without drawbacks, and the overall clinical outcomes are comparable to those achieved with embrasure wire.

Future research should focus on conducting large-scale, randomized controlled trials to further evaluate the comparative reliability of embrasure wire and newer MMF techniques. Additionally, studies on long-term outcomes and patient-reported satisfaction will provide valuable insights into the most effective and patient-friendly methods for maxillomandibular fixation.

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