International Journal of Recent Advances in Multidisciplinary Topics
Volume 5, Issue 11, November 2024
https://www.ijramt.com | ISSN (Online): 2582-7839

Ultrasonic Versus Conventional Arthroplasty in the Treatment of Temporomandibular Joint Ankylosis: A Systematic Review

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***Abstract*: Background: Ankylosis of the temporomandibular joint (TMJ) results in significant functional and aesthetic impairment. Conventional surgical techniques, while effective, pose risks such as excessive bleeding and neurovascular injuries. Ultrasonic surgery has been proposed as a safer alternative for TMJ arthroplasty. Objective: To compare clinical outcomes of ultrasonic versus conventional surgical methods for the management of TMJ ankylosis. Methods: A systematic review of studies comparing ultrasonic and conventional arthroplasty for TMJ ankylosis was conducted. PRISMA guidelines were followed, and data were extracted from PubMed, Scopus, and Web of Science. Outcomes assessed included operation time, postoperative inter-incisal opening, intraoperative bleeding, complications, and recurrence rates. Results: Four studies met the inclusion criteria. Ultrasonic surgery demonstrated significantly reduced intraoperative bleeding and comparable long-term outcomes in inter-incisal opening. Recurrence rates were low in both methods. However, ultrasonic surgery required longer operation times and incurred higher costs. Conclusion: Ultrasonic surgery provides a safer alternative to conventional techniques for TMJ ankylosis, with reduced bleeding and soft tissue damage. Further randomized controlled trials with larger sample sizes are necessary to validate its efficacy and cost-effectiveness.**

***Keywords*: arthroplasty, TMJ, ankylosis, ultrasonic.**

1. Introduction

Ankylosis of the temporomandibular joint (TMJ) is a debilitating condition characterized by restricted mandibular mobility, leading to compromised speech, mastication, and aesthetics. Commonly caused by trauma, infection, or systemic conditions, TMJ ankylosis often necessitates surgical intervention. Conventional techniques such as gap and interpositional arthroplasty remain standard but involve risks like excessive bleeding, neurovascular injuries, and recurrence.

Ultrasonic surgery, employing piezoelectric vibrations, has emerged as a minimally invasive alternative for precise bone cutting while minimizing damage to surrounding structures. Despite its growing use in various surgical fields, its role in TMJ arthroplasty remains underexplored. This review evaluates the clinical outcomes of ultrasonic versus conventional techniques in managing TMJ ankylosis.

2. Materials and Methods

A systematic review was conducted following PRISMA guidelines. Studies were identified through PubMed, Scopus, and Web of Science using keywords such as "ultrasonic surgery," "TMJ ankylosis," and "arthroplasty." The inclusion criteria were:

- Human studies comparing ultrasonic and conventional methods.
- Studies reporting outcomes like bleeding, inter-incisal opening, and recurrence rates.
- English-language publications. Exclusion criteria included case reports, non-peer-reviewed articles, and animal studies. The Newcastle–Ottawa Scale was used to assess the risk of bias.

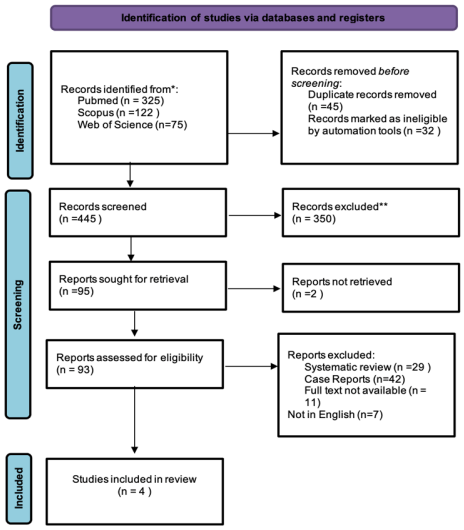

Fig. 1. PRISMA flow chart

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Table 1
Data extraction and analysis

Authors	Sample Size	Details of Ankylosis	Duration	Incision	Participants	Bleeding	Complications	Operating Time	Mouth Opening
Tingting Jia et al	25	38 ankylotic joints (12 unilateral and 13 bilateral)	March 2012 to March 2016	-	13 females, 12 males; Mean age 34.1 ± 16.8	Blood loss: 107.3 ± 62.3 ml (ultrasonic) vs. 186.3 ± 92.6 ml (conventional)	-	2.1 ± 0.8 hours (ultrasonic); 2.1 ± 1.1 hours (conventional)	MMO: 33.5 ± 4.8 mm (ultrasonic) vs. 29.2 ± 6 mm (conventional); Long-term stable opening
Hammuda et al	10	Group A: Piezoelectric; Group B: Rotary burr	-	Endural	6 females, 4 males; Mean age 24 (SD = 5.6)	163.33 ml (Group A); 169.44 ml (Group B)	-	-	Pre-op: 13.92 ± 5.33 mm; Post-op: Mean intra-op opening 42 mm; Stable at 6 months: 34.83 ± 2.79 mm
Anson Josea et al	35	62 TMJ (27 bilateral, 8 unilateral, 2 recurrent)	Jan 2011 - Dec 2012	Preauricular, extended temporal	23 men, 12 women; Mean age 16 (SD = 9)	Blood loss: Mean 43 ± 5 ml per side	Few complications	Operating time: 77 ± 8 minutes for single joint	MMO: Mean 35 ± 3 mm at 6 months
Dario Bertossi et al	110	Group A: Piezosurgery; Group B: Reciprocating saw	-	Bimaxillary osteotomy	-	Group A: Low (300 ml); Group B: Medium (400 ml), High (9500 ml)	Paraesthesia	3:31 - 5:02 minutes (Group A); 7:22 - 10:22 minutes (Group B)	-

Table 2
Quality assessment of included studies

Study ID	Authors	Representativeness of the Exposed Cohort	Selection of the Non-Exposed Cohort	Ascertainment of Exposure	Demonstration that Outcome of Interest was not Present at Start	Comparability of Cohorts	Assessment of the Outcome	Was Follow-Up Long Enough	Adequacy of Follow-Up	Total Score
1	Tingting Jia et al	✓			✓	✓	✓	✓	✓	5
2	Hammuda et al	✓		✓	✓		✓	✓	✓	6
3	Anson Josea et al	✓		✓	✓		✓	✓	✓	6
4	Dario Bertossi et al	✓		✓	✓		✓	✓	✓	6

3. Results

A. Study Characteristics

Four studies involving 180 participants were included. The primary outcomes assessed were intraoperative bleeding, postoperative inter-incisal opening (MMO), operation time, and complications.

B. Key Findings

1) Intraoperative Bleeding

Ultrasonic surgery significantly reduced intraoperative blood loss compared to conventional methods (107.3 mL vs. 186.3 mL; $p = 0.019$).

2) Inter-incisal Opening (MMO)

Both methods achieved comparable long-term improvements in MMO. Ultrasonic surgery resulted in an MMO of 33.5 ± 4.8 mm, while conventional methods achieved 29.2 ± 6 mm ($p = 0.06$).

3) Operation Time

Ultrasonic surgery required more time (2.1 ± 0.8 hours) compared to conventional methods (2.1 ± 1.1 hours).

4) Complications and Recurrence

Neither method reported significant complications like facial nerve injury or hematoma. Recurrence rates were minimal in both groups.

4. Discussion

This review highlights ultrasonic surgery as a promising alternative to conventional TMJ arthroplasty techniques. Its precision reduces intraoperative bleeding and soft tissue trauma, making it particularly suitable for anatomically complex cases. Furthermore, the cavitation effect from piezoelectric vibrations ensures cleaner surgical fields and reduces the risk of infection.

Despite these advantages, ultrasonic surgery has limitations, including longer operation times, higher costs, and the need for specialized training. Additionally, the small sample sizes and heterogeneity of included studies limit the generalizability of these findings.

Ultrasonic surgery also demonstrates a lower risk of osteonecrosis compared to conventional methods due to reduced thermal damage during bone cutting. However, cost

considerations remain a barrier to widespread adoption.

5. Conclusion

Ultrasonic surgery offers a safer, more precise alternative for TMJ ankylosis management, with significant reductions in intraoperative bleeding and comparable long-term outcomes. While its initial costs and operational challenges are higher, these are outweighed by its benefits in patient safety and surgical precision. Further randomized controlled trials are necessary to confirm its clinical advantages and cost-effectiveness.

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