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Comparative Efficacy and Safety of General Anaesthesia versus Local Anaesthesia in Temporomandibular Joint Arthroscopy: A Systematic Review and Meta-Analysis

[1]Dr. Preeti Tiwari, MDS, Professor, Department of Oral and Maxillofacial Surgery, Faculty of Dental Sciences Institute of Medical Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

[2]Dr. Muhammad Aaqib Shamim, MD, Junior Resident, Department of Pharmacology, All India Institute of Medical Sciences, Jodhpur

[3]Dr.TP Chaturvedi, MDS, PhD, Senior Professor, Department of Orthodontics and Dentofacial Orthopaedics, Faculty of Dental Sciences, Institute of Medical Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

[4]Dr. Vaibhav Pandey, MCh, PhD, Professor, Department of Pediatric Surgery, Institute of Medical Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

Corresponding Author: Dr. Vaibhav Pandey, MCh, PhD, Professor, Department of Pediatric Surgery, Institute of Medical Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

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Abstract

Background: Arthroscopy of the Temporomandibular Joint has shown to be effective for patient's refractory to non-surgical treatments. Studies have shown it to be successful in 80% of cases. Studies have shown Temporomandibular joint arthroscopy to be successful under local anesthesia although general anesthesia is the standard procedure of choice. This meta-analysis evaluates and compares the efficacy of general vs. local anesthesia for Temporomandibular joint arthroscopy.

Methods: The study has been registered in PROSPERO and prepared in accordance with PRISMA guidelines. Analyzing outcomes including pain relief, recovery time, complications, and patient satisfaction, these studies must compare the safety and efficacy of local anesthetic and general anesthesia. We calculated the variations in VAS and MMO change between General anesthesia and Local Anaesthesia. Prediction intervals and I-squared were used to express heterogeneity. Using the GRADE (Grading of Recommendations, Assessment, Development, and Evaluations) framework, the degree of certainty in the acquired evidence was evaluated. In R v4.3.2, all analyses were carried out utilizing conventional workflows

Results: Two studies were finally selected for analysis. The combined mean difference in VAS scores and mouth opening suggested no significant overall preference for Local anaesthesia over General anaesthesia.

Conclusion: Both local and general anesthesia can be utilized for arthroscopy based on the results of this meta-analysis.

Keywords: Temporomandibular Joint, Arthroscopy, General Anesthesia, Local Anesthesia

Introduction

Ohnishi in 1975 described first described arthroscopy of the temporomandibular joint which was subsequently evidenced to be utilized as a diagnostic aid with regards to temporomandibular joint disorders (TMDs) [1]. The technique was further developed by Murakami and Ito in Japan and Sanders in the United States which changed the perspective of management of TMDs which previously consisted of surgical interventions like discoplasty and discectomy [2]. Arthroscopy of the TMJ has shown to be effective for patients refractory to non surgical treatments. Although the success of TMJ arthroscopy correlates with the stage of derangement, various reports has shown it be successful in 80 % of cases [3]. McCain et al. in a retrospective study of 4800 TMD patients found improvement in clinical outcomes (range of motion, pain, diet and disability) over a follow up period ranging from less than 2 months – 2 years [4]. Situations arise where decision has to be made for more invasive procedures for the management of TMDs based on MRI and clinical findings alone. Diagnostic arthroscopy might alleviate the need for more invasive procedures [5,6]. TMJ arthroscopy is generally performed under general anesthesia, the reluctance being in inadequate pain control and unpredictable surgical time with local anesthesia. Some recent studies have shown the possibility of arthroscopy under local anesthesia. Furthermore, studies have also shown effectiveness of arthroscopic discopexy under local anesthesia [7,8,9,10]

Objectives

1. This systematic review and meta-analysis aims to compare the effects of general anaesthesia versus local anaesthesia on patient outcomes in TMJ arthroscopy.
2. Specifically, the review will assess pain management, recovery times, and complication rates associated with each type of anaesthesia, providing a comprehensive overview of their relative benefits and drawbacks.
3. The findings of this review will help inform clinical practices and patient care strategies in TMJ surgical procedures.

Methods

Study Design and setting: The International Prospective Register of Systematic Reviews (PROSPERO) database (ID: CRD42024542848) contains the protocol for this systematic review. It was also created with the Cochrane Handbook and the 27-item PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) 2020 Statement in mind.

Eligibility criteria

PICO question and inclusion and exclusion criteria

1. Population (P): Patients undergoing temporomandibular joint (TMJ) arthroscopy
2. Intervention (I): Local anesthesia.
3. Comparison (C): General anesthesia
4. Outcome (O): Efficacy (e.g., pain relief, functional improvement) and safety (e.g., complications, recovery time)

Study design: 18 years of age and older adult patients receiving TMJ arthroscopy are included in research (non-randomized controlled trials, controlled before-and-

after studies, cohort studies, case series). Analyzing outcomes including pain relief, recovery time, complications, and patient satisfaction, these studies must compare the safety and efficacy of local anesthetic and general anesthesia. The exclusion of reviews, case reports, editorials, in vitro investigations, animal model studies, and unpublished research like conference abstracts or trial protocols guarantees that the analysis is grounded on direct, pertinent, and peer-reviewed clinical data.

Filters

Language**:** English only.

Species: Human

Ages: middle aged, young, aged, older

Journal categories: dental, oral surgery, head and neck surgery, otolaryngology, maxillofacial surgery, plastic surgery.

Search dates: 1946- 2023.

Information source and search strategy: Two impartial reviewers, P.T. and V.P., performed electronic searches to find peer-reviewed English-language papers that had been published in their final form or as preprints, ahead of print, or online publications before April 2024. Included were the electronic bibliographic databases Google Scholar, Ovid, Scopus, Web of Science, MEDLINE (via PubMed), and Ovid. The main publications on oral and maxillofacial surgery and anesthesiology were manually searched, and the references of the included articles were examined for possible new papers. The entire electronic search approach is shown in (Table 1).

Table 1: Search Strategy

Database	Search Query	Results	Date of Last Search	Filters Used
PubMed	(("temporomandibular joint"[MeSH Terms] OR Temporomandibular joint[Text Word])) AND arthroscopy	877	09.05.2024	English; Publications Period: 2000-2023; Humans
OVID	(TMJ OR 'Temporomandibular joint' OR 'Temporomandibular joint disorders').mp. AND 'Arthroscopy'.mp.	1525	09.05.2024	English; Publications Period: 2000-2023; Humans
Web of Science	TS=((TMJ OR "Temporomandibular joint" OR "Temporomandibular joint disorders") AND Arthroscopy)	523	09.05.2024	English; Publications Period: 2000-2023; Humans
Scopus	(TITLE-ABS-KEY (TMJ OR "Temporomandibular joint" OR "Temporomandibular joint disorders") AND TITLE-ABS-KEY (Arthroscopy))	1035	09.05.2024	English; Publications Period: 2000-2023; Humans

Study Selection: All titles and abstracts that were found through the searches were initially vetted by the same two reviewers. After eliminating the duplicates, they looked over the complete texts of every article that might have been pertinent. Any disagreement among the reviewers about inclusion/exclusion and qualifying requirements was settled through conversation. T.P.C. was consulted as a third reviewer if necessary. An effort

was made to get in touch with the original writers when there were gaps in the data (Fig. 1).

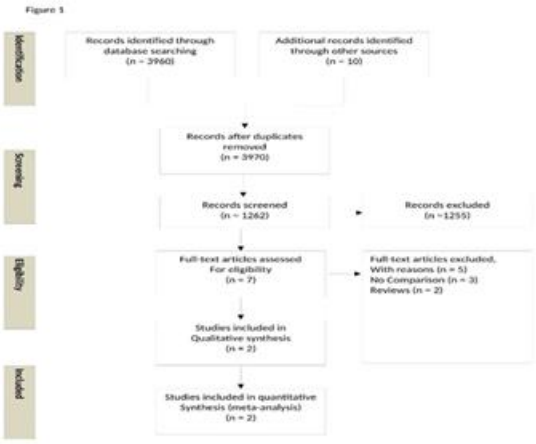

Figure 1: Flow diagram showing the detailed process of the literature survey following PRISMA guidelines

Data Extraction and Management: Relevant information regarding authorship, publication year, study design, sample size, intervention details, measured outcomes and key findings were recorded using a predetermined data extraction form. (MA, PT, RNB, and VP) completed this assignment, and Initials verified its accuracy and thoroughness twice.

Risk-of-bias Assessment: Two reviewers independently assessed the risk of bias using the Newcastle–Ottawa Scale for observational studies. Each study was evaluated across several domains including selection bias, performance bias, detection bias, attrition bias, reporting bias, and other potential biases.

Outcome Measures: We calculated the variations in VAS and MMO change between GA and LA. We modified the data where the interquartile range and median were provided instead of the mean and standard deviation. The standard deviation was used from a related study [7] when it was not provided. Mean differences for continuous outcomes and risk ratios for dichotomous outcomes, along with the related 95% confidence intervals, were used to quantify the impact of the treatments. To take into consideration the clinical variability, the estimates from each individual trial were combined using a random effects model1. Prediction intervals and I-squared were used to express heterogeneity. Using the GRADE (Grading of Recommendations, Assessment, Development, and Evaluations) framework, the degree of certainty in the acquired evidence was evaluated. In R v4.3.2, all analyses were carried out utilizing conventional workflows.

Results

Results Search results and study selection

Initially, our database search yielded a total of 3,960 records. Additionally, we identified 10 more records through other sources, bringing the total to 3,970 records after accounting for duplicates. The screening process was thorough, with 1,262 records being screened for more detailed evaluation. Of these, 1,255 records were excluded primarily due to irrelevance to the specific research questions regarding anaesthesia types in TMJ arthroscopy. The remaining seven full-text articles were assessed for eligibility based on predefined inclusion criteria. Five of these articles were excluded for reasons including the lack of direct comparison between anaesthesia types (three articles) and two being review articles without original data. Ultimately, two studies met all criteria for inclusion. These studies were included in both qualitative and quantitative syntheses, specifically a meta-analysis, to compare the outcomes of anaesthesia types effectively (Fig 1)

Characteristics of the included studies

Sah et al (2024) investigated the outcomes of TMJ arthroscopy under local versus general anaesthesia. This study involved a comprehensive assessment of 111

patients who underwent TMJ arthroscopy for various TMJ disorders. The main focus was to compare the effectiveness and safety of the two anaesthesia types, specifically measuring pain levels using the Visual Analog Scale (VAS) and the functional outcomes through Maximum Mouth Opening (MMO). (Table 2)[11].

Israel et al. (2010) performed a randomized controlled trial that included 44 patients diagnosed with inflammatory/degenerative TMJ disorders. Participants were allocated to undergo arthroscopy either in a standard operating room (OR) with general anaesthesia, where more advanced arthroscopic techniques were utilized, or in an office setting with lighter anaesthesia, focusing on less invasive procedures. Outcomes were assessed based on changes in pain (VAS scores) and jaw function (maximum interincisal opening, MIO) preoperatively and postoperatively. (Table 2) [12].

Table 2: Study Characteristics

Study Characteristics	Sah et al	Israle H.
Authors		
Year	2024	2006
Study Design	Retrospective study	Prospective study
Type of Randomization	NA	Not specified
Population	Patients with TMJ internal derangement	inflammatory/degenerative temporomandibular joint disease including synovitis, osteoarthritis and internal derangement
Inclusion and Exclusion Criteria	Patients aged between 10 and 15 years. Any patients who have a fear of surgery and are not cooperative.	Included: Adults aged 18-60 Meeting criteria for TMJ arthroscopy
Intervention	TMJ arthroscopy under local anaesthesia	TMJ arthroscopy under local anaesthesia
Control Group	TMJ arthroscopy under General anaesthesia	TMJ arthroscopy under General anaesthesia

VAS Scores for Pain Management: The forest plot for VAS scores illustrates a mixed effect of anesthesia types on pain reduction, with a high degree of heterogeneity (I^2 = 95%, p < .001), indicating substantial variability in the effect sizes between studies. The combined mean difference (MD) in VAS scores is -0.56 [95% CI: -3.11 to 1.98], suggesting no significant overall preference for LA over GA in terms of pain management. Specifically, Sah et al. (2023) reported a mean difference favouring LA significantly (-1.90 [95% CI: -2.88 to -0.92]), whereas the study by Israel (2006) observed a smaller and non-significant effect (0.70 [95% CI: 0.22 to 1.18]) favouring GA. This variance highlights differing responses possibly due to procedural, patient, or methodological differences. (Table 3) (Fig. 2)

MMO for Jaw Function: In terms of MMO, the heterogeneity among studies was moderate (I^2 = 59%, p = .12), with a pooled mean difference of -0.40 [95% CI: -2.46 to 1.66], indicating no significant difference overall between the anaesthesia types for improving jaw function. The individual study effects were similarly mixed, with Israel (2006) showing a non-significant trend favouring GA (-1.76 [95% CI: -4.20 to 0.68]), and

Sah et al. (2023) indicating a slight, non-significant advantage for LA (0.41 [95% CI: -0.79 to 1.61]). (Table 3) (Fig.2)

Table 3: Study Outcomes

			Anticipated absolute effects	
			Risk with GA	Risk difference with LA
Change in pain assessed with: VAS Scale from: 0 to 10	206 (2 non randomised studies)	⊕◯◯◯ Very low[a,b]	The mean change in pain was -4.20	MD 0.56 lower (3.11 lower to 1.98 higher)
Change in maximum mouth opening	206 (2 non-randomised studies)	⊕◯◯◯ Very low[a,b]	The mean change in maximum mouth opening was 10.78 mm	MD 0.4 mm lower (2.46 lower to 1.66 higher)

a. The evidence is downgraded one level for inconsistency because the point estimates point in opposite directions

b. The optimal information size is not met, and the pooled effect cross the line of no difference. Hence the evidence certainty is downgraded by two levels for imprecision

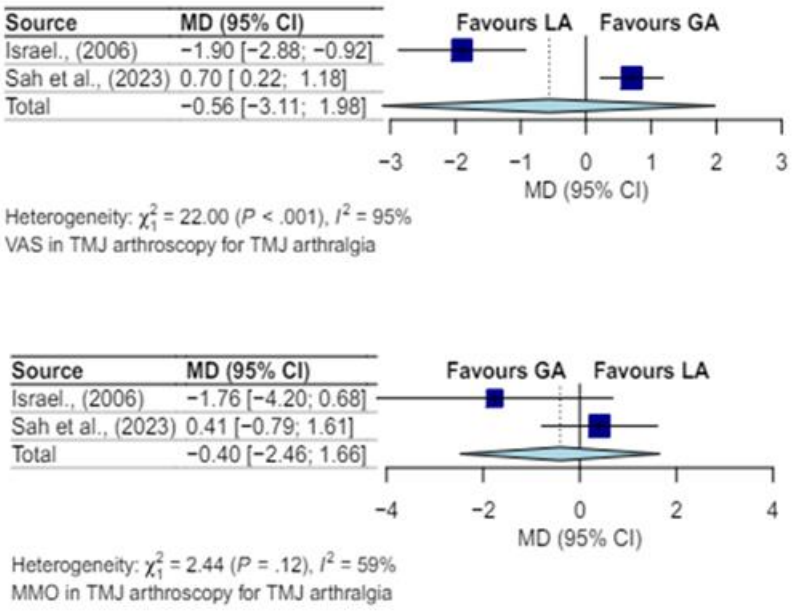

Figure 2: Comparison of Temporomandibular Joint Arthroscopy with General anesthesia vs. Local anesthesia

Risk of bias in the included studies Based on the Risk of Bias (ROB) assessment using the Newcastle-Ottawa Scale (NOS), both included studies, Israel H (2006) and Sah MK et al. (2024), scored a total of 5 out of a possible 9 points, indicating moderate methodological quality. (Table 4).

Certainty of evidence

The analysis of the certainty of evidence, guided by the GRADE approach, reveals that the evidence for pain and maximum mouth opening (MMO) among participants treated with Botulinum toxin have a very low certainty (Table 4).

Table 4: Newcastle-Ottawa Scale for the quality assessment of studies

Study	Selection (max 4 points)				Comparability (max 2 points)	Outcome (max 3 points)			Score (out of 9)
	Representativeness of the cohort	Selection of the control	Ascertainment of outcome	Demonstration of the outcome of interest was not present at start of study	Comparability the basis of the design or analysis	Assessment of outcome	Was follow-up long enough for outcomes to occur?	Adequacy of the follow-up	
Israel H, 2006	0	0	1	1	1	1	1	0	5
Sah MK et al. 2024	0	0	1	1	1	0	1	1	5

Discussion

The analysis, incorporating data from two non-randomized studies, did not reveal any significant differences in pain reduction or maximum mouth opening (MMO) between GA and LA. Both types of anaesthesia showed effectiveness in managing surgical outcomes, but the very low certainty of evidence and inherent study limitations necessitate a cautious interpretation of these results.

The findings are consistent with a broader discourse in surgical anaesthesia, where the choice between GA and LA often hinges on specific surgical settings, patient health statuses, and procedural complexities. In TMJ arthroscopy, both GA and LA have been documented to provide adequate conditions for surgery, with variances primarily influenced by individual patient reactions and preferences. However, the existing literature generally lacks large-scale, high-quality comparative studies that could definitively guide anaesthesia choices in this specific context.

The type of anaesthesia can significantly impact patient outcomes post-surgery, particularly in terms of pain management, recovery time, and overall patient satisfaction. While GA typically offers a completely pain-free experience during surgery, its association with longer recovery times and greater postoperative disorientation could detract from its suitability for outpatient procedures like TMJ arthroscopy. Conversely, LA, often associated with faster recovery, poses less systemic risk but might not provide sufficient pain relief for all patients, particularly in more extensive or complex procedures.

Hossam Eldin et al. in 2018 [13] evaluated the efficacy of one point system office based arthroscopic technique for TMDs. The overall success rate was 66% in the study group. Office based arthroscopic technique significantly improved maximal mouth opening, joint pain, function and loading sign. The overall success rates were 70.5% for Wilkes stage II, 64.0% for Wilkes stage III, 70.0% for Wilkes stage IV and 63.5% for Wilkes stage V.

In the management of internal derangement of the TMJ both arthrocentesis and arthroscopy have been used successfully. The 2015 meta-analysis by Al Moraissi et al[.14] compared the efficacy of arthrocentesis and

arthroscopy and found comparative post-operative complication rates. However, arthroscopy was found to have superior efficacy in terms of joint movement and pain. In terms of maximal mouth opening this might be attributed to the effectiveness in releasing negative pressure on the articular disc, releasing adhesions, widening the constricted joint space, altering the viscosity of the synovial fluid and reducing frictions. The superiority in reducing joint pain might be attributed to larger diameter entry portal with high pressure which removes the inflammatory mediators better compared to arthrocentesis. Nogueira et al. [15] also showed comparable complications with both arthroscopy and arthrocentesis.

Limitations and Future Research

This systematic review and meta-analysis face several limitations that impact the robustness and applicability of its findings. Firstly, the inclusion of only non-randomized studies introduces a higher potential for bias and limits the strength of the evidence compared to randomized controlled trials. Secondly, the small sample size across studies restricts the statistical power and precision of the meta-analysis, hindering the ability to detect small but clinically significant differences between anesthesia types. Additionally, significant heterogeneity in study designs, participant characteristics, and outcome measures contributes to inconsistencies in the results, complicating the interpretation and generalization of the findings to broader populations.

Conclusion

In conclusion, this suggests that both general and local anaesthesia are potentially effective, with no clear superiority of one over the other in decreasing postoperative VSA scores for pain management and enhancing MMO.

Abbreviations

TMD: Temporomandibular Disorders

TMJ: Temporomandibular Joint

VAS: Visual Analog Scale

MMO: Maximum Mouth Opening

MIO: Maximum Interincisal Opening

GA: General Anaesthesia

LA: Local Anaesthesia

ROB: Risk of Bias

NOS: New Castle-Ottawa Scale

Author Contributions

P.T. and V.P., performed electronic searches to find peer-reviewed English-language papers that had been published in their final form or as preprints, ahead of print, or online publications before April 2024. MA, PT and VP collected information regarding authorship, publication year, study design, sample size, intervention details, measured outcomes and key findings using a predetermined data extraction form and completed this assignment. Any disagreement among the reviewers about inclusion/exclusion and qualifying requirements was settled through conversation. T.P.C. was consulted as a third reviewer if necessary.

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