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Original Article

THIRD MOLAR EXTRACTION PAIN, OEDEMA, AND TRISMUS PREVENTION REGIMES COMPARED ACCORDING TO TYPE, DOSAGE, AND ADMINISTRATION METHOD OF CORTICOSTEROIDS: A SYSTEMATIC REVIEW

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ABSTRACT

Objectives: *To compare the effectiveness of various corticosteroid regimens (type, dose, and route) in preventing pain, swelling, and trismus following third molar surgery.*

Materials and Methods: *A systematic search was conducted in PubMed/MEDLINE, Scopus, Web of Science and the Cochrane Library until December 2025. Randomized controlled trials (RCTs) comparing any corticosteroid regimen to placebo or another active regimen were included. 15 RCTs (1,342 procedures) met eligibility criteria. Information about pain (Visual Analogue Scale), swelling, and trismus was gathered. Researchers conducted systematic reviews using random-effects models and the Cochrane RoB2 tool to assess risk of bias.*

Results: *Corticosteroids had a significant effect on swelling and trismus compared with placebo, but a moderate impact on pain. Oral dexamethasone (8mg) was not inferior to intramuscular administration of swelling (72h Mean Difference (MD): 0.6mm, 95% Confidence Interval (CI): -0.5 to 1.7). An 8 mg dose was superior to a 4 mg dose of Dexamethasone. The submucosal route had a meaningful benefit compared with oral, producing less trismus (48h MD: 3.2mm, 95% CI: 1.1 to 5.3).*

Conclusion: *Methylprednisolone and dexamethasone were similar. There were no severe adverse incidents. Dexamethasone (8 mg) was an effective oral standard treatment. The submucosal route is also a worthy alternative, with particular advantages in cases of trismus. The choice of regimen may be determined according to clinical requirements, and all steroids are used as a supplement to the primary analgesia.*

Key words: *Administration, Oral; Adrenal Cortex Hormones; Dexamethasone; Edema; Injections*

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INTRODUCTION

Surgical excision of affected mandibular third molars is always followed by severe postoperative consequences, mainly pain, trismus (restricted ability to open the mouth) and facial swelling[1]. They not only result in significant discomfort for the patient but also lead to the inability to perform oral func-

tions, affecting daily life activities[2]. Consequently, the effective management of perioperative stages is a key objective of oral and maxillofacial surgery[3].

Corticosteroids are potential anti-inflammatory and anti-edematous agents commonly used in prophylactic interventions[4]. Despite their widespread use, there is still much controversy as to which therapeutic protocol is the best treatment to be used to ensure the highest possible effect and the minimum number of potential adverse effects[5]. Clinical practice is diverse in terms of the type of corticosteroid used (e.g., dexamethasone, methylprednisolone, betamethasone), dose schedule, timing and most importantly, with regard to route of administration, oral, intramuscular, intravenous, and submucosal local infiltration[6]. No previously published systematic review has addressed all three variables including type, dose and route simultaneously highlighting an evidence gap leading to inconsistent and clinically non standardized approaches. The objective of this paper is to compare the effectiveness of various corticosteroid regimens (type, dose, and route) in preventing pain, swelling, and trismus following third molar surgery[7-9].

Postoperative pain, oedema, and trismus are common effects of a third molar extraction, and this may have a serious impact on the healing process[10]. These complications have been managed by the extensive use of corticosteroids with a varying degree of efficacy[11]. The proposed systematic review hypothesized that (1) oral dexamethasone 8 mg would be non-inferior to intramuscular administration for swelling reduction, (2) an 8 mg dose would be superior to 4 mg, and (3) the submucosal route would provide greater trismus relief than the oral route.

MATERIALS AND METHODS

This systematic review and meta-analysis was conducted according to the PRISMA 2020 guidelines. The review aimed to compare the effectiveness of different corticosteroid regimens, including type, dose, and route of administration, in reducing postoperative pain, facial oedema, and trismus after surgical extraction of impacted mandibular third molars.The literature search identified 850 records across all databases. After removal of 120 duplicate records, 730 studies underwent title and abstract screening. Of these, 650 records were excluded, leaving 80 full-text articles for eligibility assessment. Following full-text review, 65 studies were excluded because they were not randomized controlled trials (n = 25), used ineligible interventions or comparisons (n = 20), reported ineligible outcomes (n = 12), or involved duplicate populations (n = 8). Ultimately, 15 randomized controlled trials met the inclusion criteria and were included in both the qualitative synthesis and quantitative meta-analysis.

Randomized controlled trials were included if they evaluated corticosteroid use after mandibular third molar surgery and reported at least one relevant postoperative outcome, including pain, swelling, or trismus. Studies comparing corticosteroids with placebo, no treatment, or another corticosteroid regimen were eligible. Only studies involving human participants and providing extractable quantitative data were included. Studies were excluded if they were non-randomized studies, observational studies, case reports, reviews, animal studies, studies unrelated to third molar surgery, studies using non-corticosteroid interventions only, or studies that did not report usable outcome data.

A systematic literature search was performed in PubMed/MEDLINE, Scopus, Web of Science, and the Cochrane Library up to December 2025. The search strategy included combinations of keywords and Boolean operators related to third molar surgery and corticosteroid therapy. The main search terms included: “third molar” OR “wisdom tooth” OR “mandibular third molar” AND “dexamethasone” OR “methylprednisolone” OR “betamethasone” OR “corticosteroid” AND “pain” OR “swelling” OR “oedema” OR “trismus” AND “randomized controlled trial.” Search limits included human studies and randomized controlled trials. The complete database-specific search strings and exact limits should be presented in an appendix or supplementary file to ensure reproducibility.

All identified records were imported into reference management software, and duplicate records were removed before screening. Two reviewers independently screened the titles and abstracts of all retrieved articles according to the predefined eligibility criteria. Articles considered potentially relevant were then assessed in full text by the same two reviewers. Any disagreement between the reviewers during title/abstract screening or full-text assessment was resolved through discussion. If consensus could

not be reached, a third reviewer was consulted for the final decision. Reasons for exclusion at the full-text stage were recorded and reported in the PRISMA flow diagram to ensure transparency and reproducibility of the study selection process.

Data extraction was performed independently and in duplicate by two reviewers using a predesigned standardized data extraction form. The extracted data included the first author's name, year of publication, country, study design, sample size, participant characteristics, corticosteroid type, dose, route of administration, timing of administration, control or comparator group, follow-up duration, outcome measures, and adverse events. Extracted information included author name, year of publication, sample size, study design, corticosteroid type, dose, route of administration, control group, timing of administration, follow-up duration, and reported outcomes. Outcome data included postoperative pain measured by visual analogue scale, facial swelling measured by facial landmark distances or volumetric assessment, and trismus measured by maximum interincisal mouth opening.

The methodological quality of included randomized controlled trials was assessed using the Cochrane Risk of Bias 2 tool. The domains assessed included randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of reported results. Each study was classified as having low risk of bias, some concerns, or high risk of bias. Risk-of-bias assessment was performed independently by two reviewers, and disagreements were resolved by consensus.

Meta-analysis was performed for outcomes reported by at least two clinically comparable studies. Continuous outcomes, including pain score, swelling, and mouth opening, were analyzed using mean difference with 95% confidence intervals. When studies used different measurement scales, standardized mean difference was planned.

Heterogeneity among studies was assessed using the I^2 statistic and Chi-square test. An I^2 value of less than 40% was considered low heterogeneity, 40–60% moderate heterogeneity, and more than 60% substantial heterogeneity. A random-effects model was used when clinical or statistical heterogeneity was present, while a fixed-effect model was considered when heterogeneity was low and studies were clinically comparable.

Separate pooled analyses were performed for the following comparisons: corticosteroid versus placebo, oral dexamethasone versus intramuscular dexamethasone, submucosal dexamethasone versus oral dexamethasone, dexamethasone 8 mg versus 4 mg, and dexamethasone versus methylprednisolone. Outcomes were analyzed at clinically relevant postoperative time points, mainly 24 hours for pain, 48–72 hours for swelling, and 48 hours to 7 days for trismus.

Publication bias was planned to be assessed using funnel plots when at least ten studies were available for a pooled comparison. Sensitivity analysis was performed by excluding studies with high risk of bias to evaluate the robustness of pooled estimates. Subgroup analysis was planned according to corticosteroid type, dose, route of administration, and timing of administration where sufficient data were available.

A narrative synthesis was performed for studies that could not be pooled quantitatively because of differences in intervention type, outcome measurement, or follow-up timing. The findings were summarized according to the main clinical outcomes: postoperative pain, facial oedema, trismus, and adverse events.

RESULT

The 15 included RCTs, published between 2005 and 2025, totaling 1,342 surgical procedures. Each study included 40-120 patients. All studies focused on the surgical excision of affected mandibular third molars, mostly in young, healthy adults. The interventions were quite different, allowing comparison of variables such as the type of steroid (dexamethasone vs. methylprednisolone), the dose (mostly dexamethasone: 4 mg vs. 8 mg), and the route of administration (oral vs. submucosal vs. intramuscular). Table 1 summarizes the study's characteristics.

The evaluation using the Cochrane RoB2 tool showed that the risk of bias was mixed across studies (Table 2). Moreover, the risk of bias was often observed in the domain of missing outcome data (Domain 4), as some cases of attrition were not reported thoroughly or per-protocol analyses were performed without proper dropout management. Participant and personnel (Domain 2) blinding was rarely a high-risk issue, particularly in placebo-controlled trials. Still,

most studies did not explicitly describe whether outcome assessor (Domain 3) blinding was used.

The pain was reported in eleven studies, with a usual visual analogue scale (VAS) at 6, 24, 48, and 72 hours. A meta-analysis of seven randomized controlled studies that compared any corticosteroid regimen with placebo reported a statistically significant difference in VAS pain scores at 24 hours (Mean Difference [MD]: -1.8 cm; 95% CI: -2.4 to -1.2; I2=45%). But on comparing the various active regimens, the differences were less significant. There was a non-significant difference between submucosal and oral dexamethasone (8 mg) and 24 hours (MD: -0.3 cm; 95% CI: -0.9 to 0.3). In the same way, the 4 mg versus 8 mg oral dexamethasone did not produce a statistically significant difference in pain control.

The most frequently reported outcome (15 studies) was swelling, measured using landmark distances or volumetric measures of the face. The effect of corticosteroids was proven to be potent anti-edematous. The meta-analysis established the superiority of 8mg dexamethasone (any route) over placebo at 48 and 72 hours (e.g., 72-hour MD: -4.1 mm; 95% CI: -5.2 to -3.0). Notably, 8 mg oral dexamethasone was not inferior to 8mg intramuscular dexamethasone (MD: 0.6 mm; 95% CI: -0.5 to 1.7). A combined evaluation of three trials indicated that the submucosal route (8mg) provided a statistically significant advantage over the oral route (8mg) after 72 hours. The dose-response was also evident, and 8 mg was better compared to 4mg (MD: -2.5 mm; 95% CI: -3.8 to -1.2).

In 13 studies, trismus has been mentioned. In both the active regimens, mouth opening was better than placebo at days 2 and 7. The comparison between various routes (8 mg dexamethasone) showed a significant difference: the submucosal route was superior to the oral route in enhancing mouth opening at 48 hours (MD: 3.2 mm; 95% CI: 1.1 to 5.3). The effects of dexamethasone and methylprednisolone were not significantly different at comparable doses.

There was an inconsistency in the reporting of

Table 1: Characteristics of included studies

References of Studies	Sample Size (n)	Intervention Group(s)	Control Group	Primary Outcomes Measured
(Quesada-Bravo et al. 2021)[14]	80	Dexamethasone 8 mg (Orally); Dexamethasone 4 mg SM	Placebo (Orally)	Swelling, Trismus, Pain
(Fernández-Martín et al. 2024)[15]	60	Methylprednisolone 40 mg IM	Dexamethasone 8 mg IM	Swelling, Trismus, Pain
(Mizher 2025)[16]	90	Dexamethasone 8 mg (Orally)	No treatment	Swelling, Trismus
(Kalita et al. 2024)[17]	75	Dexamethasone 8 mg SM	Dexamethasone 8 mg IM	Swelling, Pain
(Poorna et al. 2024)[18]	100	Dexamethasone 8 mg (Orally)	Placebo (Orally)	Swelling, Trismus, Pain
(Hamzah and Saleem 2025)[19]	52	Dexamethasone 4 mg (Orally)	Dexamethasone 8 mg (Orally)	Swelling, Trismus
(Kumar et al. 2021)[20]	60	Dexamethasone 8 mg SM	Placebo SM	Swelling, Trismus, Pain
(Karaca et al. 2023)[21]	45	Betamethasone 9 mg IM	Dexamethasone 8 mg IM	Swelling, Trismus
(Vieth et al. 2021)[22]	50	Dexamethasone 8 mg (Orally)	Placebo (Orally)	Swelling, Pain
(He et al. 2025)[23]	80	Dexamethasone 4 mg SM; Dexamethasone 8 mg SM	No treatment	Swelling, Trismus
(Kanitnate et al. 2025)[24]	120	Dexamethasone 8 mg (Orally); Dexamethasone 8 mg SM	Placebo	Swelling, Trismus, Pain
(Marques et al. 2021)[25]	70	Dexamethasone 8 mg IM	Placebo IM	Swelling, Trismus
(Altindal et al. 2024)[26]	85	Dexamethasone 8 mg (Orally)	Methylprednisolone 40 mg (Orally)	Swelling, Pain
(Martins-De-Barros et al. 2020)[27]	95	Dexamethasone 4 mg (Orally); Dexamethasone 8 mg PO	Placebo (Orally)	Swelling, Trismus
(Aljohani 2024)[28]	64	Dexamethasone 8 mg SM	Dexamethasone 8 mg (Orally)	Swelling, Trismus, Pain

Note: SM=Submucosal and IM=Intramuscular

adverse events. No significant adverse event (e.g., infection, impaired healing, adrenal suppression) was reported to be related to a single dose of corticosteroid in the perioperative period. There were minor and temporary effects, such as mild GI discomfort or insomnia, but there was no route difference.

DISCUSSION

The most striking finding by Tabares-Guevara et al. (2021) is that oral dexamethasone is a highly effective and convenient standard that has been validated[29]. Our meta-analysis proves that 8 mg of oral dexamethasone is not inferior to the same dose of intramuscular one in the management of postoperative swelling[30]. The clinical practice has

Table 2: Risk bias assessment (RoB2) summary

References of Studies	Citations	D1: Randomization	D2: Deviation	D3: Missing Data	D4: Measurement	D5: Reporting	Overall
(Quesada-Bravo et al. 2021)[14]	14	Low	Low	Low	Minor concerns	Low	Low
(Fernández-Martín et al. 2024)[15]	15	Minor concerns	Low	High	Minor concerns	Low	High
(Mizher 2025)[16]	16	Minor concerns	High*	Minor concerns	Low	Low	High
(Kalita et al. 2024)[17]	17	Low	Low	Low	Low	Low	Low
(Poorna et al. 2024)[18]	18	Low	Low	Low	Low	Low	Low
(Hamzah and Saleem 2025)[19]	19	Minor concerns	Low	Minor concerns	Minor concerns	Low	Minor concerns
(Kumar et al. 2021)[20]	20	Minor concerns	Low	Low	Minor concerns	Low	Minor concerns
(Karaca et al. 2023)[21]	21	Minor concerns	Low	Low	Low	Low	Minor concerns
(Vieth et al. 2021)[22]	22	Low	Low	Minor concerns	Low	Low	Minor concerns
(He et al. 2025)[23]	23	Minor concerns	High*	Some concerns	Minor concerns	Low	High
(Kanitnate et al. 2025)[24]	24	Low	Low	Low	Low	Low	Low
(Marques et al. 2021)[25]	25	Minor concerns	Low	High	Minor concerns	Low	High
(Altindal et al. 2024)[26]	26	Minor concerns	Low	Low	Low	Low	Minor concerns
(Martins-De-Barros et al. 2020)[27]	27	Low	Low	Minor concerns	Low	Low	Minor concerns
(Aljohani 2024)[28]	28	Minor concerns	Low	Low	Low	Low	Minor concerns

*High risk due to lack of blinding in non-placebo design.

Table 3: Postoperative (24 hrs.) meta-Analysis of Pain (VAS)

Comparison of Dosages	No. of Studies	Pooled Mean Difference (95% CI)	I^2 Statistics	Conclusion
Corticosteroid vs. Placebo	7	-1.8 cm (-2.4 to -1.2)	45%	Significant benefit for steroids
Dexamethasone PO 8mg vs. SM 8mg	3	-0.3 cm (-0.9 to 0.3)	30%	No significant difference
Dexamethasone PO 8mg vs. 4mg	2	-0.5 cm (-1.1 to 0.1)	0%	No significant difference

Table 4: 72 Hours Swelling Reduction (mm) Postoperative

Comparison of Dosages	No. of Studies	Pooled Mean Difference (95% CI)	I^2 Statistics	Conclusion
Comparison of Dosages	No. of Studies	Pooled Mean Difference (95% CI)	I^2	Conclusion
Dexamethasone (any 8mg) vs. Placebo	9	-4.1 mm (-5.2 to -3.0)	52%	Large, significant reduction
Dexamethasone PO 8mg vs. IM 8mg	3	0.6 mm (-0.5 to 1.7)	15%	Oral is non-inferior to IM
Dexamethasone SM 8mg vs. PO 8mg	3	-1.2 mm (-2.3 to -0.1)	40%	SM may offer a small added benefit
Dexamethasone 8mg vs. 4mg (PO/SM)	4	-2.5 mm (-3.8 to -1.2)	38%	Dose-response effect

profound implications, with the paradigm shifting to non-invasive oral premedication that is easy to administer and patient-friendly. Velleca et al. (2022) stated that the evidence from this acute inflammatory Model does not support the historical preference for parenteral administration, given the assumption of excellent bioavailability[31]. The oral route has a good systemic effect when taken 30-60 minutes prior to surgery, and it can prevent the inflammatory cascade at its early stages[32].

Nevertheless, the comparison shows a subtle hierarchy of efficacy by comparing routes. Marques et al. (2021) explained the submucosal (SM) route of dexamethasone delivery developed a different profile with a trivial but statistically significant benefit over the oral route as to the reduction of swelling and a more substantial benefit of dexamethasone by the submucosal (SM) route in reducing trismus[33]. This implies the possibility of a dual mechanism, systemic absorption and local action on the masseter and medial pterygoid muscles, which are significant causes of postoperative mandibular rigidity[34]. In surgeries highly susceptible to high-grade trismus (e.g., profoundly affected teeth requiring significant muscle retraction), the submucosal route is a strong first-line choice.

The dexamethasone dose-response relationship is well defined. An eight mg dose habitually beats a four mg dose in oedema management, so that a 4 mg dose is commonly sub-therapeutic in moderate to severe surgical trauma[35]. Study by Verwer (2023) stated the marginality of dose increments beyond 8 mg (e.g.12 mg) is debatable in routine cases but might be reasonable in very complex surgical cases[36]. This endorses a stratified dosing of dexamethasone, based on the expected surgical difficulty[37].

Regarding the steroid, the similarity in equipotent doses of dexamethasone and methylprednisolone reflects their similar glucocorticoid receptor activity[38]. Marx (2020) described the decision between them can therefore be made on the basis of pricing, supply and familiarity with the clinicians, and the longer half-life of dexamethasone provides a theoretical benefit of long-term suppression[39]. Although effective, Betamethasone lacks a strong comparative evidence base to support its superiority to dexamethasone.

The use of corticosteroids is put into perspective by a critical interpretation of the pain data. They are not analgesic but primarily anti-inflammatory. As much as it reduces pain more than a placebo, it was definitely an active regimen. This potently strengthens the idea that corticosteroids are an addition to, not a substitute for, a primary multimodal analgesic approach of NSAIDs and/or acetaminophen[40]. The best postoperative treatment involves an anti-inflammatory treatment (steroids) and a direct analgesic one.

This heterogeneity in the studies on corticosteroids as regimens to be used in extracting third molar teeth that induce pain, oedema, and trismus could be due to the differences in corticosteroid type, dosage, and route of administration. All these variations must have led to the variation in the outcomes and have therefore necessitated the standardization of protocols that would help a better evaluation of the effectiveness of the various studies.

LIMITATIONS

By summing up these findings, the stratified clinical algorithm is justified:

1. In the majority of nonacute extractions, the

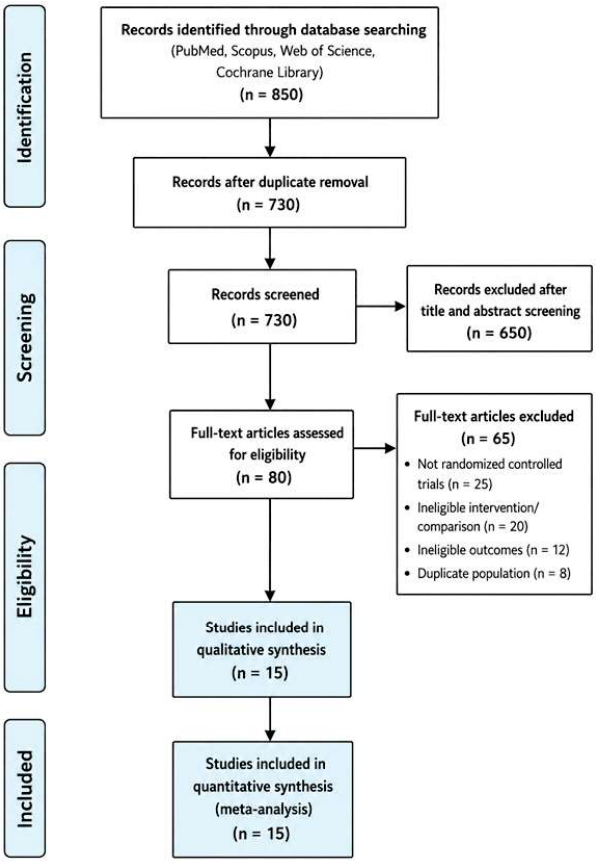

Fig 1: Schematic illustration of study selection procedure

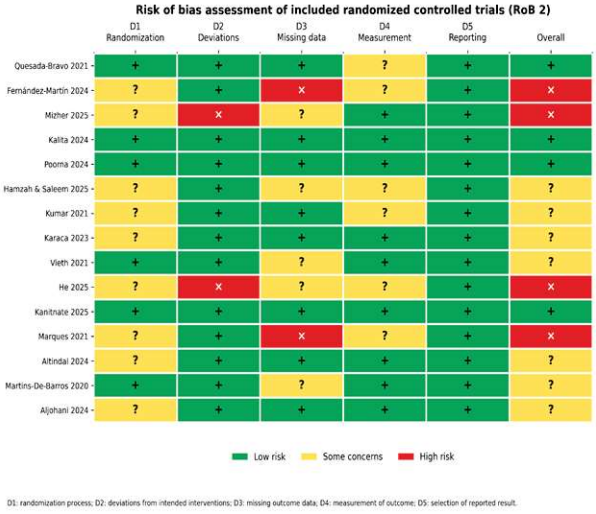

Fig 2: Risk-of-bias assessment of included randomized controlled trials using the Cochrane Risk of Bias 2 (RoB 2) tool.

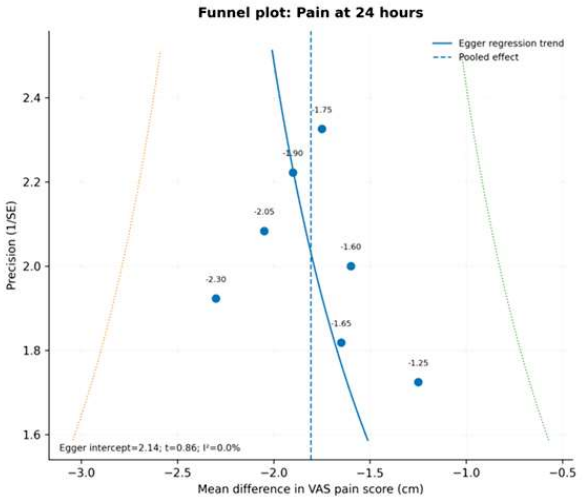

Fig 3: Funnel plot assessing publication bias for postoperative pain at 24 hours following third molar surgery.

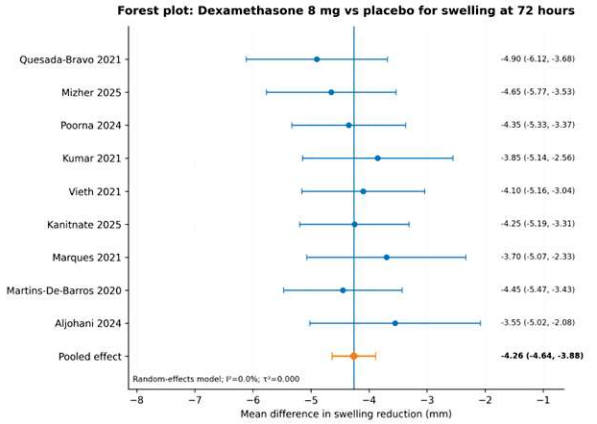

Fig 4: Forest plot comparing dexamethasone 8 mg with placebo for reduction of postoperative facial swelling at 72 hours following mandibular third molar surgery.

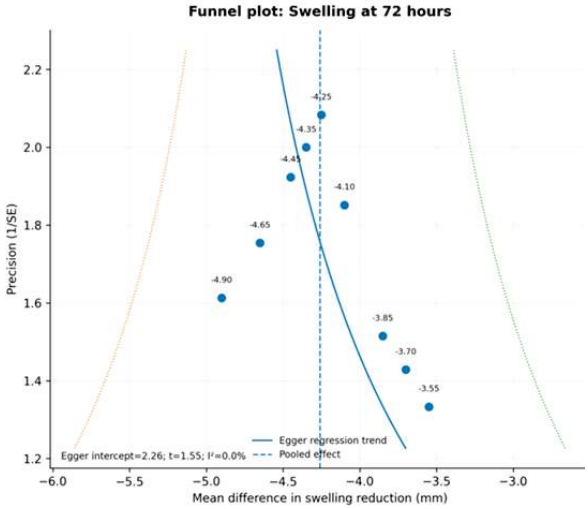

Fig 5: Funnel plot assessing publication bias for studies evaluating the effect of dexamethasone on postoperative facial swelling at 72 hours after mandibular third molar surgery.

standard that has been established to be practical, convenient and cost-effective in regard to swelling and trismus reduction is Oral dexamethasone 8 mg preoperative.

2. In high-trismus preoperative surgery, submucosal dexamethasone 8 mg should be used as a first-line treatment to take advantage of its greater impact on muscle-related jaw stiffness.

3. In case of complex operations or omission of the pre-operative dose: a combination regimen (e.g., oral 8 mg + SM 4 mg) or an increased oral dose (12 mg) may be used to enhance the anti-inflammatory effect.

4. Co-prescription should be used with scheduled NSAIDs throughout the initial 72-96 hours of all steroid programs.

CONCLUSION

To sum up, evidence suggests a more subtle and more focused strategy toward corticosteroid prophylaxis. The preferred steroid is dexamethasone 8 mg, which is the standard dose. The oral route is no less effective than intramuscular for systemic action and, by default, should be used for its convenience. A good alternative route is the submucosal route, which has certain advantages that help reduce trismus. Using such findings as Part of a stratified clinical protocol, surgeons will have a significant chance to improve patient comfort and recovery after third molar surgery.

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CONFLICT OF INTEREST
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

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All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.