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Review

Efficacy of secondary closure technique after extraction of third molars: a meta-analysis

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Abstract

The purpose of this study was to assess the influence of two suture methods on the postoperative complications of extraction of mandibular third molars (M3M). We searched the MEDLINE (PubMed), Cochrane Library, and Web of Science databases until 18 May 2018 for randomised controlled trials (RCT) that evaluated the influence of any suture techniques on postoperative complications after the removal of impacted M3M. Pain, facial swelling, and trismus were measured for both the early stage (2–3 days) and late stage (5–7 days) after extraction. We identified 655 records, of which five were assessed for eligibility. All trials included had a moderate risk of bias. The analysis showed that the patients whose wounds had been closed primarily had significantly more pain than those whose wounds were closed secondarily (a wedge of mucosa) during the early stage (standardised mean difference (SMD), −0.49; 95% CI −0.71 to −0.27; P < 0.0001) and the late stage (SMD −0.36; 95% CI −0.54 to −0.19; P < 0.0001) after the removal of impacted M3M. Patients whose wounds were closed secondarily had less swelling (mm) at the postoperative early stage (SMD −1.12; 95% CI −1.57 to −0.66; P < 0.00001) and late stage (SMD −0.51; 95% CI −0.68 to −0.33; P < 0.00001). There was more trismus in the primary closure group than in the secondary group during both stages. Our findings suggest that secondary closure causes less pain, facial swelling, and trismus in both early and late stages of surgical removal of impacted M3M, and therefore it improves the quality of life by reducing postoperative discomfort.

Keywords: primary closure; secondary closure; third molar; impacted teeth

Introduction

Impacted mandibular third molars (M3M) partially or completely erupt as a result of the obstruction of adjacent teeth, bone, or soft tissue. Some disorders and complications can be associated with their removal when impacted,[1] including postoperative pain, swelling, trismus, alveolar osteitis, dehiscence, infection, and periodontal destruction in the adjacent second molars.[2] Removal is therefore one of the most common procedures undertaken routinely in oral and maxillofacial surgical clinics.[3] Because extractions may range from easy to extremely difficult depending on the location, depth, angulation, and density of the bone,[4] postoperative

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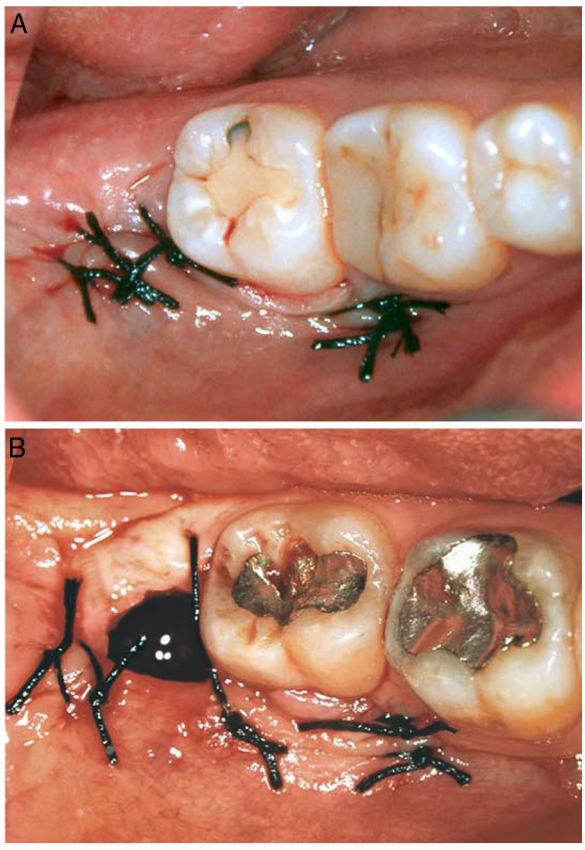

Fig. 1. (A) Primary healing: flap design and clinical image. (B) Secondary healing: flap design and clinical image.

complications have become the focus of attention for patients and clinicians.

Several studies have suggested that postoperative complications are closely related to surgical suture techniques,[5–14] surgical drainage,[15–23] laser treatment,[3] and the use of anti-inflammatory drugs.[24] In addition, some new interventions including collagen membranes,[25] bromelain,[26] betamethasone,[27] hyaluronic acid,[28] and ozone[29] have been proposed for the control of postoperative complications of extraction of impacted M3M. Experienced oral and maxillofacial surgeons learn the merits of allowing for spontaneous drainage after removal, unless there are extenuating circumstances, but the secondary healing technique discussed in this paper has not been widely used.

In primary closure, the socket is covered and sealed by an airtight mucosal flap (Fig. 1A).[6] In secondary closure, a 5–6 mm wedge of mucosa distal to the second molar is removed and the flap repositioned. Interrupted sutures are used to form a triangular opening distal to the second molar, which creates passive drainage of the inflammatory exudate, and avoids placing drains (Fig. 1B).[6]

In 2012, a structured review[30] of 14 randomised controlled trials (RCT) aimed to find out which secondary closure techniques were associated with fewer postoperative complications. The results showed that differences in postoperative pain and facial swelling between closure techniques are likely to be small; however, the high risk of bias, imprecision, and heterogeneity among the trials produced little confidence in the estimates. It is therefore necessary to organise classified research on different suture techniques and drainage in secondary closure techniques.

We found no relevant meta-analysis among the relevant publications retrieved. The aim of this study therefore was to compare the strength of the evidence regarding the impact of primary compared with secondary closure (a wedge of mucosa) on the severity of postoperative complications after removal of impacted M3M, including pain, facial swelling, and trismus.

Material and methods

Search strategy

Electronic searches of the MEDLINE (PubMed), Cochrane Library, and Web of Science databases were made by two independent examiners (SM and AZ) to identify relevant RCT. The search strategy for this review was updated on 18 May 2018 (Appendix: **supplemental data, online only**). The reference lists of reviews or other relevant papers were examined to identify any other eligible studies. Any disagreement among reviewers concerning the final inclusion of a paper was resolved by discussion.

Inclusion and exclusion criteria

The selected studies must have met the following criteria: they included RCT; patients had unilateral or bilateral impacted M3M; the effects of primary closure and secondary closure were examined by group comparisons; patients had pain, swelling, and trismus in the early (2 to 3 days) and late (5 to 7 days) stages after the removal of impacted M3M; patients had repositioning and airtight suturing of the flap of the primary closure, and the removal of a wedge of mucosa of width 5–6 mm from the second molar in the secondary closure, with the flap repositioned and sutured; and finally no patient gave a history of systemic disease, acute inflammation, or contraindication to the use of routine drugs. Studies were excluded if they reported non-randomised controlled trials; data were incomplete; or were structured reviews, review articles, clinical cases, or animal studies.

Assessment of quality

Each study was evaluated based on the revised recommendations of the Cochrane Collaboration tool,[31] which takes into account seven items. All these factors were evaluated, and the study was then assigned to one of three categories (low risk, unclear risk, or high risk) based on the estimated risk of bias. Two independent blinded reviewers (SM and AZ) provided the overall risk of bias for each study and across studies using

the guidelines recommended in the Cochrane Collaboration group.

Extraction of data

Data were extracted independently by two authors (SM and AZ) using a data extraction form, and the accuracy of the extracted data was confirmed by another author (CM). First author, study design, number of patients, mean age of patients (with range), details of the operation (including the impaction type of impacted M3M, surgical technique used, and total operating time), duration of follow-up, and measurements of pain, facial swelling, and trismus together with the outcome were extracted. If data were judged to be missing or not having an association with the research results, only the available data were used.

Statistical analysis

Meta-analyses were made using Review Manager 5.3 (Nordic Cochrane Centre). The generic inverse variance method was used to analyse continuous outcome variables. For the continuous data variables (pain, swelling, and trismus) using the same measurement instrument (a visual analogue scale, VAS), the weighted mean differences (WMD) or the standardised mean difference (SMD) and its 95% CI were used.[32] Heterogeneity between studies in a comparison was assessed by calculating I^2. The value of I^2 ranged from 0%–100%, where 0% indicated no heterogeneity, and larger values ($I^2 \geq 75\%$) suggested high heterogeneity. More specifically, a fixed effects model was used for studies with no obvious heterogeneity ($I^2 \leq 50\%$); otherwise, a random-effects model was applied ($I^2 \geq 50\%$). Probabilities of less than 0.05 were considered significant. For study designs (parallel or split-mouth), differences in surgical level, characteristics of patients, and other factors were not consistent among the studies included, so it was necessary to do a sensitivity analysis to assess the robustness of the overall findings. We found that the heterogeneity of the group "early stage of swelling" significantly decreased after one trial was excluded,[9] and the sensitivity analysis for the outcomes of other groups suggested no important differences.

Results

Selection process and characteristics of included studies

The search process was based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Fig. 1).[33–35]

A total of 655 papers were retrieved after the selection procedure (Fig. 2). After removing duplicates, 201 were excluded, and after review of the titles and abstracts, 23 papers were identified. Eighteen studies were excluded after the full-text screening process, which included a meta-analysis:

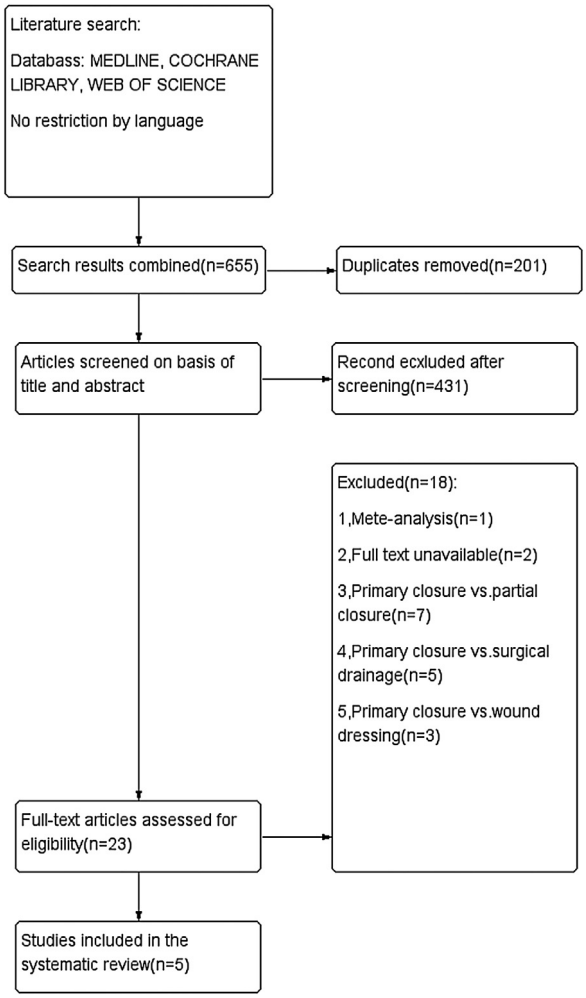

Fig. 2. Flow chart of the process of the search.

eight that compared primary with partial closure, five that compared primary closure with surgical drainage, and four that compared primary closure with wound dressing. Five studies[6–10] were therefore ultimately included in this structured review (Table 1).

In four of the included RCT,[6–10] facial swelling and pain were evaluated with the VAS in the early and late stages postoperatively. The other RCT [8] merely recorded the mean VAS scores of pain and swelling in the late stage; even so, it met the eligibility criteria. In four trials,[6–10] patients had full or partial bony impactions; the remaining trial[9] did not specify the type of impaction selected. All patients were given postoperative guidance about their health and an anti-inflammatory drug. The risk of bias in each of the domains of interest in each trial is shown in Fig. 3.

Efficiency of secondary compared with primary closure after the removal of impacted M3M

Pain: Five studies[6–10] that used VAS measurements comprised 518 extractions in 425 patients. The patients' teeth

Table 1
Characteristics of included studies.

First author and reference	Year	Design	No.	Age (range) (years)	Type of impaction	Operating time	Follow up (days)	Evaluation indicator	Participants	
									Intervention	Comparison
Chaudhary[7]	2012	RCT (parallel)	12	20–30	Partial bony	NR	1–6	Pain, swelling	Secondary closure*	Primary closure
Maria[9]	2011	RCT (parallel)	60	18–40	NR	NR	1,3,7	Pain, swelling, trismus	Secondary closure*	Primary closure
Khande[10]	2011	RCT (parallel)	60	25–30	Partial bony	NR	1–7	Pain, swelling, trismus	Secondary closure*	Primary closure
Danda[8]	2010	RCT (split-mouth)	93	18–31	Fully or partially bony	NR	7	Pain, swelling	Secondary closure*	Primary closure
Pasqualini[6]	2005	RCT (parallel)	200	19–27	Fully or partially bony	20-30	1–6	Pain, swelling	Secondary closure*	Primary closure

NR: not reported.
* A wedge of mucosa, width 5–6 mm, was removed from the distal of second molar and the flap was repositioned and sutured.

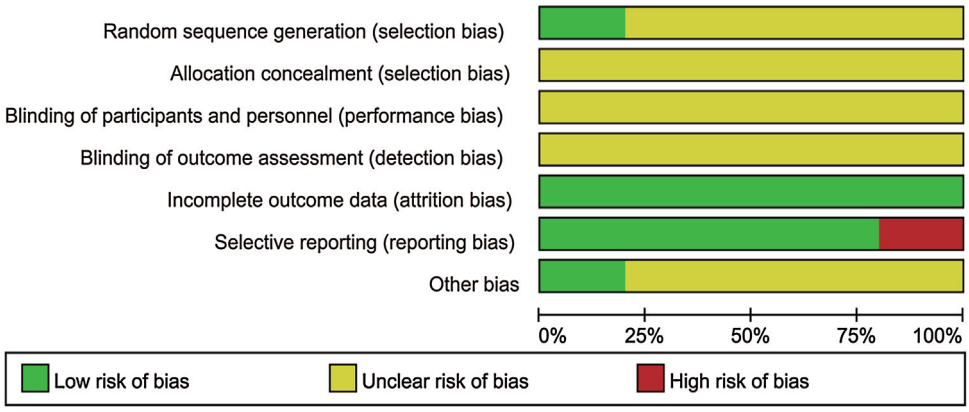

Fig. 3. Quality assessment of included studies.

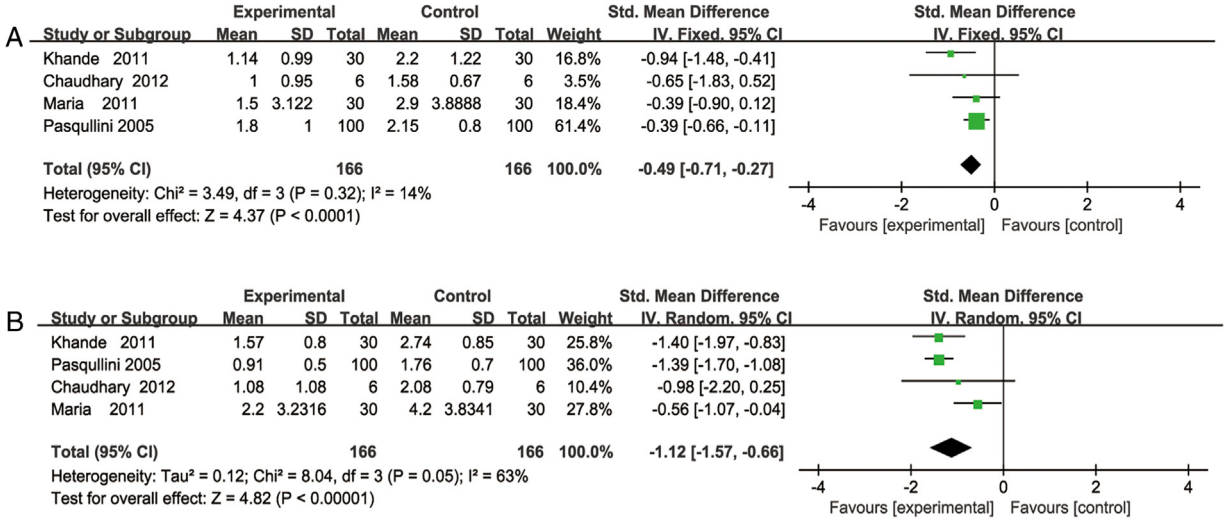

Fig. 4. Forest plots of comparison: secondary closure /primary closure groups. Outcome: visual analogue scale (VAS). (A) Early stage pain (Danda et al[8] was excluded).(B) Late stage pain.

were extracted, and after haemostasis had been achieved, were randomly allocated to primary or secondary closure (Table 1). Because the five studies of postoperative pain were measured using different types of VAS (5 cm,[7] 1 to 5 cm,[8] and 0 to 5 cm,[6,9,10] the SMD was used. for. The results of one trial[8] are not reported because the authors failed to describe the mean pain scores after three days. In the early stage, the secondary closure group showed significantly less pain (SMD −0.49; 95% CI −0.71 to −0.27; $p < 0.0001$), with low heterogeneity ($p = 0.32$; $I^2 = 14\%$) (Fig.4A). In the late stage, the comparison of pain results were similar to those seen in the early stage (SMD -0.36; 95% CI: -0.54 to -0.19; $p < 0.0001$), with low heterogeneity ($p = 0.28$; $I^2 = 21\%$) (Fig. 4B).

Swelling

Five trials[6–10] measured the results of facial swelling; but one trial[8] failed to report the mean VAS scores for facial swelling scores during the early days; consequently, four trials [6,7,9,10] evaluated facial swelling scores during the early and late stages. In the early stage the facial swelling scores of the primary closure group showed a significant increase compared with those of the secondary closure group (SMD −1.12; 95% CI −0.66 to −1.57; $p < 0.00001$), with medium heterogeneity ($p = 0.05$; $I^2 = 63\%$) (Fig. 5A).The sensitivity analyses showed that after the findings of Maria et al[9] were excluded, the heterogeneity of the group with swelling in the early stage was low ($p = 0.81$; $I^2 = 0\%$). Since the inclusion criteria for the type of impacted teeth in this trial[9] mentioned only mesioangular impaction, we think that heterogeneity is derived mainly from the poor classification of impacted M3M, and that there is still some unexplained heterogeneity. In all the studies that reported late-stage postoperative facial swelling, the swelling scores of the primary closure group showed a significant increase compared with those of the secondary closure group (SMD −0.51;95% CI −0.68 to −0.33; $p < 0.00001$), with low heterogeneity ($p = 0.59$; $I^2 = 0\%$) (Fig. 5B).

Trismus: two studies evaluated trismus, one[9] using a simple graduated metallic scale, and the other[10] using the percentage mouth opening to measure maximum mouth opening between the incisal edges of the upper and lower central

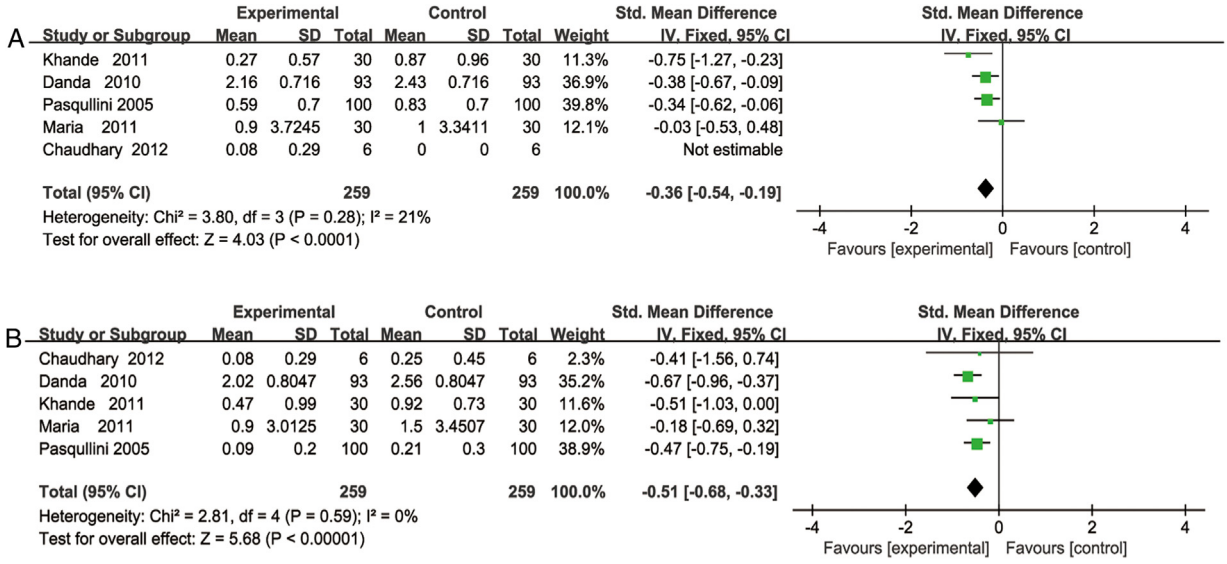

Fig. 5. Forest plots of comparison: secondary closure /primary closure groups. Outcome: visual analogue scale (VAS). (A) Early stage swelling (Danda et al [8] was excluded).(B) Late stage swelling.

Table 2
Trismus.

First author and reference	Method	Outcome (mean difference)		95% CI	p value
Maria[9]	Metallic scale	Early stage	12.40	3.06 to 21.74	0.0009
		Late stage	5.90	−0.31 to 12.11	0.06
Khande[10]	Percentage of trismus	Early stage	−15.47	−21.20 to -9.74	<0.00001
		Late stage	−4.75	−7.05 to -2.46	<0.0001

incisors. The analysis showed that at the early and late postoperative stages, secondary closure significantly reduced the degree of trismus (Table 2).

Complications

Pasqualini et al[6] reported that in the primary closure group of 100 patients, the mucosa had dehisced in 33 on day 7, and two showed signs of infection with suppurative alveolitis at three or four weeks postoperatively. According to Khande et al,[10] the mucosa dehisced in 10 of the 30 patients in the primary closure group, and wound healing was delayed in 20/30 patients in the secondary closure group.[10] Danda et al reported that alveolitis developed in both groups, with four in the primary closure group of 93 patients and three in the secondary closure group of 93 patients.[8]

Publication bias

Funnel plots were symmetrical when early and late pain and swelling were compared between the primary and secondary groups, indicating no publication bias.

Discussion

Summary analysis of major results (Arithmetic results and p values have been omitted)

The purpose of this meta-analysis was to assess the efficacy of primary and secondary closure for regulating pain, swelling, and trismus after the removal of impacted M3M. Five RCT[6–10] reported postoperative pain and facial swelling, and the results indicated that patients who had secondary closure may develop less pain at both early and late stages postoperatively. In terms of facial swelling, this structured review showed a significant difference between the secondary closure and the primary closure groups for both early and late swelling. Two RCT[9,10] measured the incidence of trismus. Khande et al showed that the percentage of trismus in the primary closure group was higher than that in the secondary closure group for the early and late stages.[10] Maria et al[9] reported a small difference between the two groups for the late stage (MD 5.90; 95% CI −0.31 to 12.11; p = 0.06). We analysed this because most patients with trismus have recovered during the late stage.

Characteristics of two types of closure

Most surgical wounds heal by primary intention, and the edges of the wound are brought together with sutures, sta-

ples, glue, or clips.[36] After all these, re-epithelialisation of the epidermis and progressive deposition of connective tissue around the surgical wound facilitate healing. Surgical wounds that heal by secondary intention can be left open to heal when there is a risk of infection or appreciable tissue loss.[36] However, Waheed and Council[37] suggested that during healing by second intention, granulation tissue forms and causes the contraction and final epithelialisation of the wound margin and, because the volume of tissue is needed to fill the defect, these tissues take longer to heal. In addition, partial or complete opening of the wound may increase the risk of postoperative infection. The specific indications of secondary healing for control of the risk of postoperative infection, therefore, are not clear enough.

The socket was closed primarily by the placement of two or three sutures on the distal arm of the incision, and one or two sutures on the mesial arm of the incision, and the flap was repositioned with silk sutures to make it airtight.[8] The socket was closed secondarily by removing a wedge of mucosa (5–6 mm wide) distal to the second molar, and the placement of one or two sutures on the mesial arm, and another on the distal arm, of the incision. The flap was repositioned and sutured with silk. The socket remains in communication with the oral cavity to facilitate the drainage of inflammatory products in this secondary closure technique. This special method of suture ensures the steadiness of the clot and promotes the healing of the wound by repairing the gingival flap with a suture. Simpson also reported that saliva entering the wound may aid the healing process.[38]

Some studies, however, have reported the shortcomings of this approach. The secondary closure group healed with more minor defects on the mucosal surface, and also tended to show attachment of the mucosa on the distal side of the second molar at a lower level than in the primary closure group.[5] In addition, Osunde et al suggested that there may be potential for the formation of a periodontal pocket, especially in relation to the second molar.[13]

Clinical applications

A recent structured review also reported that surgical drainage has an obviously favourable effect on postoperative complications after the removal of impacted M3M.[16] Compared with traditional surgical drainage, the secondary closure technique eliminates the pain that may be caused by the removal of the drain, and reduces the number of follow-up visits. If the patient has a dry socket postoperatively, the wedge window is convenient for surgeons to use for the necessary surgical treatment. Compared with laser treatment after operation, the cost of treatment is reduced. This technique can also replace the local injection of anti-inflammatory drugs, and alleviate concerns about the side effects of drugs, so is of value clinically.

Limitations

There are still many inconsistencies in the material and methods of the five RCT included in this review. First, only one trial[8] was designed as a split-mouth design, and the other four[6,7,9,10] are RCT with parallel design, so the susceptibility of patients may be a major source of interexperimental heterogeneity. Secondly, the specific classification standards for the selection of impacted M3M are not uniform. Thirdly, three items were judged as being not clear as a result of a lack of information, including concealment of allocation, the "blinding" of participants, and the personal qualities of the outcome data. Fourthly, the number of eligible RCT included was insufficient, and finally we used case data from five published papers for combined analysis, but failed to contact the author for incomplete personal data, which also increased the publication bias and heterogeneity of this paper. Consequently, the evidence regarding pain, facial swelling, and trismus may be altered in future studies.

Conclusion

Our findings suggest that the use of secondary closure has a favourable effect on pain, facial swelling, and trismus in both early and late stages after the surgical removal of impacted M3M. However, the superiority of the technique still needs to be confirmed by more high-quality RCT.

Conflict of interest

We have no conflicts of interest.

Ethics statement/confirmation of patients' permission

As it was a retrospective investigation we required neither ethics approval nor patients' permission.

Acknowledgement

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