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Risk of complications with retromandibular transparotid *vs.* anteroparotid approach for condylar fractures: a systematic review and meta-analysis

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Abstract. – OBJECTIVE: Retromandibular approaches have been known to reduce the risk of facial nerve palsy and improve the management of condylar fractures. As such, it is necessary to identify the best approach with the least complications. This review was conducted to obtain a comprehensive estimate for the risk of complications following both the transparotid and the anteroparotid approach for patients with mandibular condylar fractures.

MATERIALS AND METHODS: A comprehensive search was conducted using PubMed Central, EMBASE, MEDLINE, and Cochrane library, ScienceDirect and Google Scholar from January 1964 until October 2021. The Newcastle Ottawa scale and Cochrane risk of bias tool were used to assess the quality of the included studies. A meta-analysis was carried out using a random-effects model and reported pooled incidence with 95% confidence intervals (CIs). A funnel plot was used to assess possible publication biases.

RESULTS: In total, 40 studies with 2,096 participants were assessed and the majority of the included studies (29 out of 40 studies) had a high risk of bias. The pooled incidence of facial nerve palsy following the transparotid approach was 13% (95% CI: 10%-17%; I^2=66.8%), and 2% (95% CI: 1%-5%; I^2=57.8%) following the anteroparotid approach. The pooled incidence of sialocele following the transparotid approach was 2% (95% CI: 0%-4%; I^2=45.8%), and 2% (95% CI: 1%-5%; I^2=67.2%) following the anteroparotid approach. The pooled incidence of postoperative infection following the transparotid approach was 1% (95% CI: 0%-4%; I^2=63.1%), and 1% (95% CI: 0%-3%; I^2=0%) following the anteroparotid approach.

CONCLUSIONS: The incidence of facial nerve palsy was higher among patients undergoing the transparotid approach when compared to patients undergoing the anteroparotid approach. Further trials comparing both of these approaches are required to identify the best methodology with the lowest complication rate.

Key Words:
Condylar fracture, Facial nerve palsy, Meta-analysis, Retromandibular surgery.

Introduction

Condylar fractures constitute about 18% to 50% of all the mandibular fractures[1,2]. Despite the vast research on this topic, many controversies exist around the management of condylar fractures. It is important to understand the value of closed or open treatment[3], specifically the approach that is best suited for the purpose of *"open reduction and internal fixation (ORIF)"*, and the type of hardware that can be used for fixation of the fracture segments[4]. There are several approaches which can be employed for managing condylar fractures, such as submandibular, retromandibular, preauricular, intraoral, and rytidectomy[5,6]. Amongst these approaches, the retromandibular approach, first described by Girroti and Hinds in the year 1967, has become the most popular, as it has an added advantage of a minimal working distance between the incision and fracture[7].

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Typically, the retromandibular incision can occur either through the parotid gland by using the "*retromandibular transparotid approach"*[8], or the parotid gland can be bypassed by using the "*retromandibular trans-masseteric anterior parotid*" (TMAP) approach[9]. Each approach is known to have its own risks, benefits and associated complications. Recently, several studies have reported complications associated with both the TMAP and retromandibular transparotid approaches. However, there is wide variation in the overall complication rate between the two approaches. Hence, there is a need to systematically review and analyze these complications to identify the approach with the lowest risk for patients. The current study was conducted with the objective of updating the available literature and comparing the complications associated with the TMAP approach to the complications associated with the retromandibular transparotid approach, used for treating patients with condylar fractures.

Materials and Methods

Design

The protocol of the current systematic review and meta-analysis of observational studies was registered in PROSPERO under the registration number (CRD42021284390). The "Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement 2020" was utilized for reporting this systematic review and incorporating the meta-analyses[10].

Eligibility Criteria

Type of Studies

The included studies reported the complication rate of either the TMAP or retromandibular transparotid approach in patients treated for condylar fractures. There were no restrictions related to study design or setting. Both full texts and abstracts were included within the systematic review, while unpublished literature was excluded.

Type of Participants

All included studies examined patients undergoing surgery for mandibular condylar fractures independently from their ethnicity, comorbid status, or severity of the condition.

Type of Outcome Measure

Studies reporting any one of the following complications were included:

- Facial nerve palsy;
- Sialocele;
- Frey's syndrome;
- Infection.

Search Strategy

A systematic search of the literature was performed using electronic databases such as PubMed Central, EMBASE, MEDLINE, and Cochrane library and search engines, such as ScienceDirect and Google Scholar. Both medical subject headings (MeSH) and free-text words were when searching both the databases and search engines. The final search was completed on October 2021 and combined the individual search results using appropriate Boolean operators ("OR" and "AND") and only English language studies were included.

Study Selection

Study selection was performed by two independent investigators, who screened the title, abstract and keywords of the manuscripts identified by the literature search. Full-text articles were retrieved for the studies shortlisted based on the eligibility criteria and screened by the same two investigators. Studies that satisfied all of the eligibility criteria with respect to design, participants, exposure and outcome were included. Disagreements between the investigators were resolved and final consensus on inclusion of studies was reached with the help of another investigator.

Data Extraction

Manual extraction of data was done using a pre-defined, structured data extraction form. Data extracted using the form were as follows: authors, title of study, year of publication, study period, study design, setting, country/region, total sample size, statistical tests, outcome assessment details, average age, non-response rate, burden of complications in each approach. Data was entered by the primary investigator, and it was double-checked by secondary investigators for correct entry.

Risk of Bias (Quality) Assessment

Two investigators were responsible for assessing the quality of the included studies using the Newcastle-Ottawa (NO) scale for the risk of bias assessment for the observational studies and the

Cochrane risk of bias tool for the randomized controlled trials (RoB 2)[11,12]. The NO scale was assessed under the Selection (maximum 4 stars), Comparability (maximum 2 stars) and Outcome domains (maximum 2 stars) with the following criteria: representativeness, sample size justification, non-response, ascertainment of exposure, control for confounding, assessment of outcome and statistical tests. The total score ranged from 0 to 8 stars, with 7 to 8 stars indicative of "good" quality, 5 to 6 stars indicative of "satisfactory" quality, and 0 to 4 stars indicative of "unsatisfactory" quality.

RoB 2 was used to assess the bias risk under the following domains:

Domain 1: Bias risk arising from the process of randomization

Domain 2: Bias risk due to deviation from the intended intervention

Domain 3: Bias risk arising due to missing data on outcomes

Domain 4: Bias risk in the measurement of outcome

Domain 5: Bias risk in the selection of reported result

Based on the rating obtained from these domains, each study was classified as having "low bias risk", "high bias risk", and "some concerns" on the quality of evidence.

Statistical Analysis

The meta-analysis was performed with the final set of selected studies using the command package "metaprop" in STATA 14.2 (StataCorp, College Station, TX, USA)[12]. The Freeman-Tukey double arcsine transformation was used as a measure for variance stabilization and minimizing the effect of very small or large values on the overall estimate[12]. A random effects model was applied due to the anticipated heterogeneity and final data was reported as pooled prevalence with 95% confidence interval (CI). Visual representation of these pooled estimates was done by forest plot. Comparison of the complications rate was assessed between the two approaches by entering the number of events and participants in each group to obtain the pooled effect estimate in terms of odds ratio (OR) and graphically depicting them using a forest plot.

Heterogeneity was evaluated by chi square of heterogeneity and I^2 statistic. A *p*-value less than 0.05 in the Chi square test indicated significant heterogeneity, while the I^2 value was used to quantify the heterogeneity using the following criteria: less than 25% = mild heterogeneity, 25-75% = moderate heterogeneity and >75% = substantial heterogeneity[13]. Publication bias was evaluated and visually represented using a funnel plot, and the asymmetry of the plot was assessed using Egger's test. A *p*-value of < 0.10 was considered as statistically significant[14].

Results

Study Selection

Figure 1 shows the entire study selection process in the form of a PRISMA flowchart. Following the primary screen, 171 full-text studies were retrieved, and after removal of duplicates, became 127 studies. All 127 studies, plus three articles retrieved from the bibliography of the screened studies, underwent a secondary screen. Data from 40 studies, with 2,096 participants, satisfied the inclusion criteria and were included in the systematic review (Figure 1)[1,5,15-52].

Study Characteristics

The majority of the included studies (19 out of 40) were retrospective in nature, while 14 studies were prospective, and 2 studies were RCTs (5 studies did not report their study design). Most of the studies were conducted in Asian countries like India (11 studies) and China (6 studies). The mean age of study participants ranged from 28.3 to 44.5 years, and the sample sizes of the included studies varied from 24 to 129. In total, 22 studies reported on the transparotid approach, 14 studies on the anterior parotid approach and 4 studies on both approaches. The follow-up duration ranged from 1 month to 4 years, and 29 out of 40 studies were of poorer quality, while all other studies were considered good quality (***Supplementary Table I***).

Risk of Complications

Facial Nerve Palsy

There were 26 studies which reported on the rate of facial nerve palsy following the transparotid approach and 18 studies following the anteroparotid approach. The pooled incidence of facial nerve palsy following the transparotid approach was 13% (95% CI: 10%-17%; I^2=66.8%),

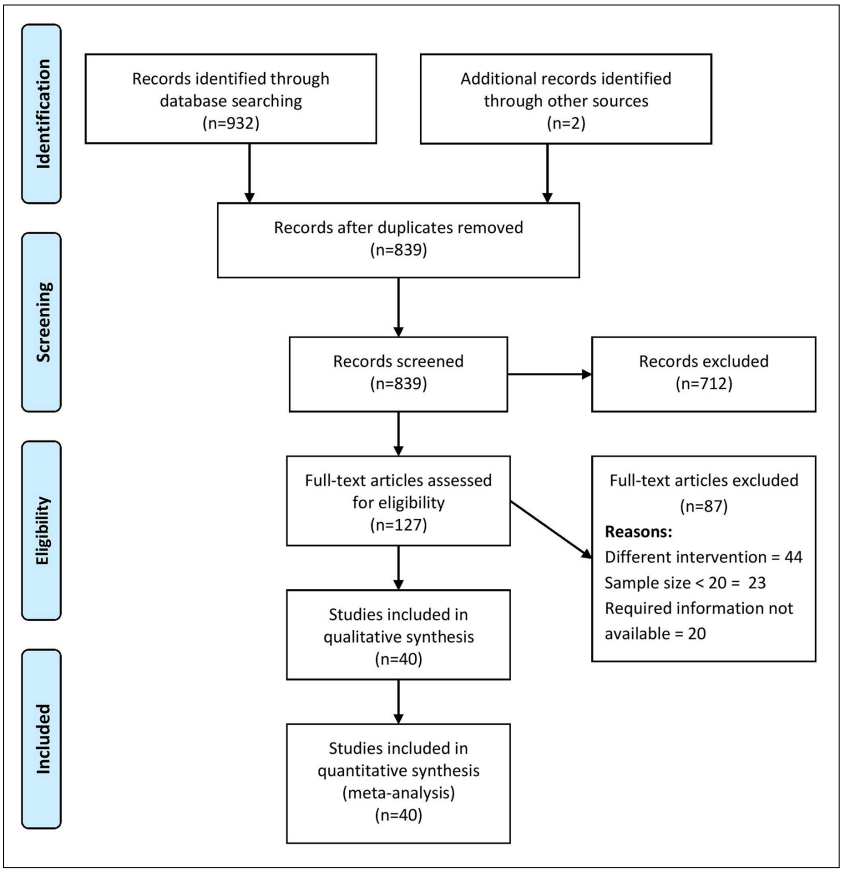

Figure 1. Search strategy.

while the pooled incidence was 2% (95% CI: 1%-5%; I^2=57.8%) following the anteroparotid approach (Figure 2 and 3).

For the transparotid approach, there were no significant small study effects, with a coefficient value of -0.39 (p=0.41). There were significant small study effects with coefficient value of 0.46 (p=0.06) suggesting publication bias for the assessment of facial nerve palsy following the anteroparotid approach.

For comparison between the two approaches, four studies have reported on facial nerve palsy for both transparotid and anteroparotid approaches. The pooled OR was 3.72 (95% CI: 0.70-19.75; I^2=35.6%), indicating that there is no significant difference in terms of facial nerve palsy between the two approaches.

Sialocele

In total, 8 studies reported the presence of sialocele following the transparotid and the anteroparotid approach. The pooled incidence of the presence of sialocele following the transparotid approach was 2% (95% CI: 0%-4%; I^2=45.8%), while the pooled incidence was 2% (95% CI: 1%-5%; I^2=67.2%) following the anteroparotid approach (Figure 4 and 5). Publication bias could not be assessed due to the low study number.

Infection

In total, 10 studies reported the rate of infection following the transparotid and the anteroparotid approach. The pooled incidence of postoperative infection following the transparotid approach was 1% (95% CI: 0%-4%; I^2=63.1%), while the pooled incidence was 1% (95% CI: 0%-3%; I^2=0%) following the anteroparotid approach (Figure 6 and 7).

For the transparotid approach, there was significant small study effects with coefficient value of -0.94 (p=0.01). There were no significant small study effects with coefficient value of -0.21 (p=0.23) which shows the absence of publication bias for the assessment of postoperative infection following the anteroparotid approach.

None of the patients who received the transparotid approach and only two patients in the anteroparotid approach group developed Frey's syndrome.

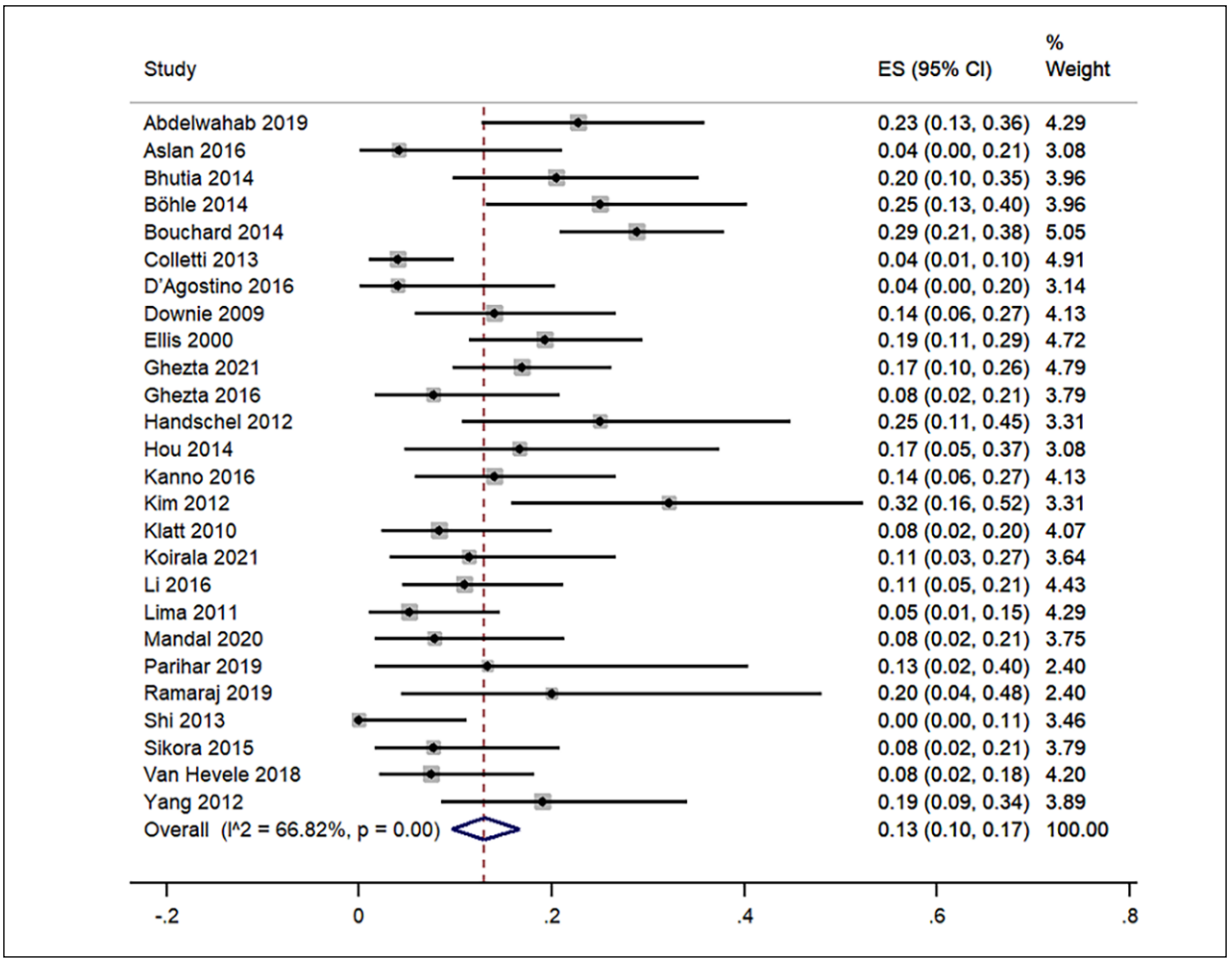

Figure 2. Forest plot showing the incidence of facial nerve palsy following the transparotid approach for mandibular condylar fractures.

Discussion

The current review provides important baseline information on the risk of complications following two retromandibular approaches for mandibular condylar fractures. The results presented here highlight that, independently from the surgical approaches employed, potential injury to the facial nerve branch exists and may only differ based on the chosen surgical approach. The majority of the included studies had a higher risk of bias, and significant heterogeneity was found among the included studies for almost all of the outcomes measured following both approaches.

While retromandibular approaches have been known to reduce the risk of facial nerve palsy and make it much easier for managing a case of condylar fractures, the incidence of facial nerve palsy was found to be higher among patients undergoing the transparotid approach (13%) when compared to patients undergoing the anteroparotid approach (2%). However, estimates based on these studies have demonstrated no significant difference between both of the approaches (though, the odds were higher for the transparotid approach). Previous reviews[3,53] examining the rate of complications between the two approaches also reported similar findings in which the transparotid approach resulted in a higher incidence of facial nerve palsy compared to the anteroparotid approach. The lower incidence of facial nerve palsy following the anteroparotid approach may be that this approach has significant differences from the other, more traditional external approaches. Typically, during

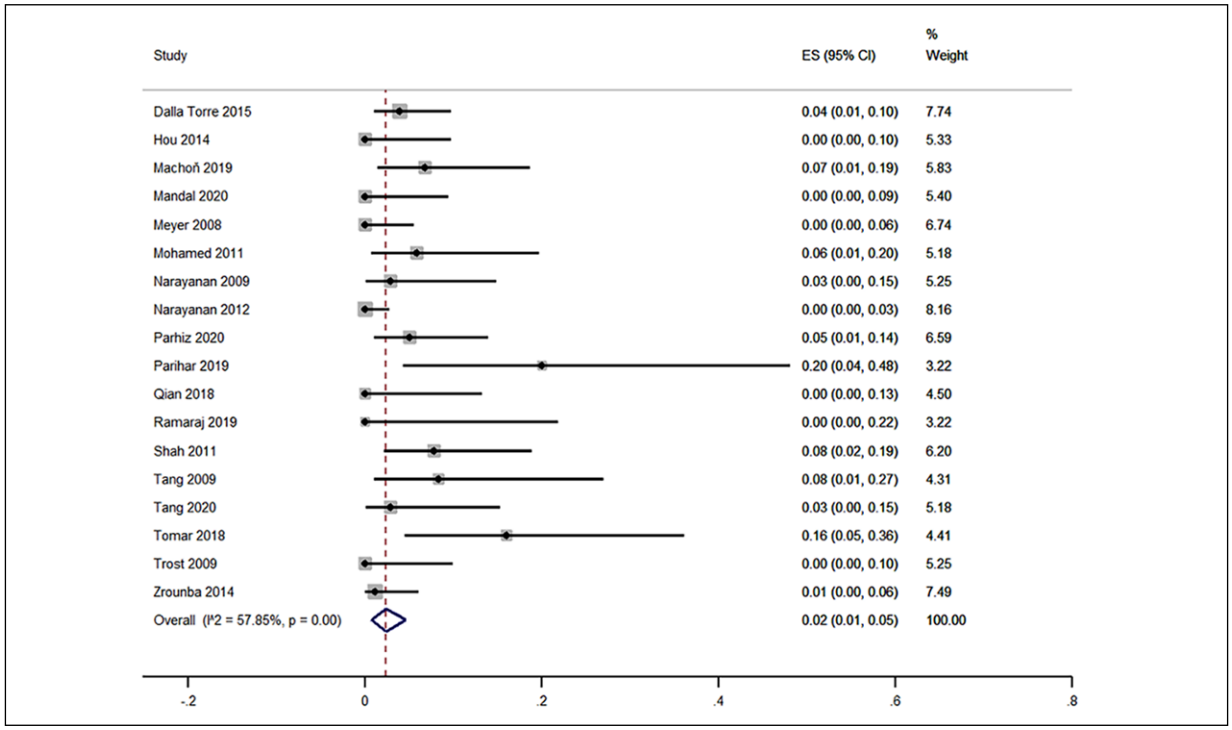

Figure 3. Forest plot showing the incidence of facial nerve palsy following the anteroparotid approach for mandibular condylar fractures.

the anteroparotid approach, the dissection occurs in an anterior-superior and remains in the subcutaneous tissue superficial to the platysma and superficial musculo-aponeurotic system. Once the anterior border of the parotid gland is identified and the masseter muscle is reached, will the dissection be deepened to the bone. However, during the traditional retromandibular approaches, after the skin incision, dissection is directed through the platysma, posterior to the

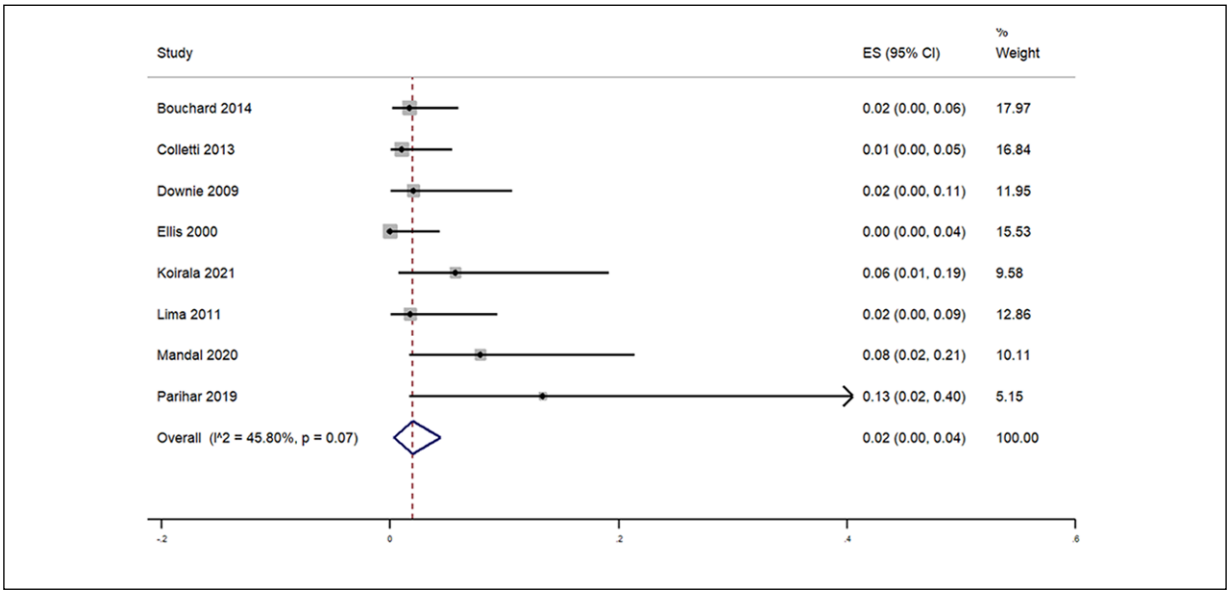

Figure 4. Forest plot showing the incidence of sialocele following the transparotid approach for mandibular condylar fractures.

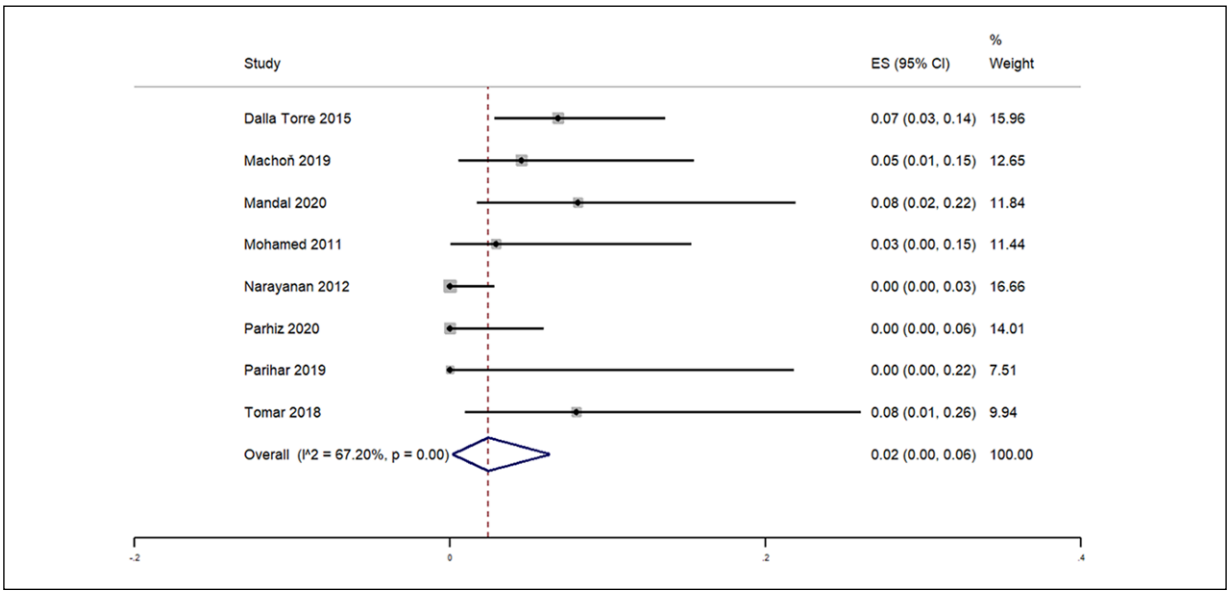

Figure 5. Forest plot showing the incidence of sialocele following the anteroparotid approach for mandibular condylar fractures.

parotid gland until the mandible is reached. This dissection occurs below the facial nerve branches, and subsequent retraction, to approach condylar neck, could result in facial nerve palsy. Hence, the anteroparotid approach could results in lower facial nerve palsy, if the facial nerve is easily identified over masseter muscle. This approach allows the dissection of the condylar neck to be directed towards the facial nerve branches, avoiding major injuries. Therefore, the anteroparotid approach seems to provide a greater advantage in terms of minimizing facial

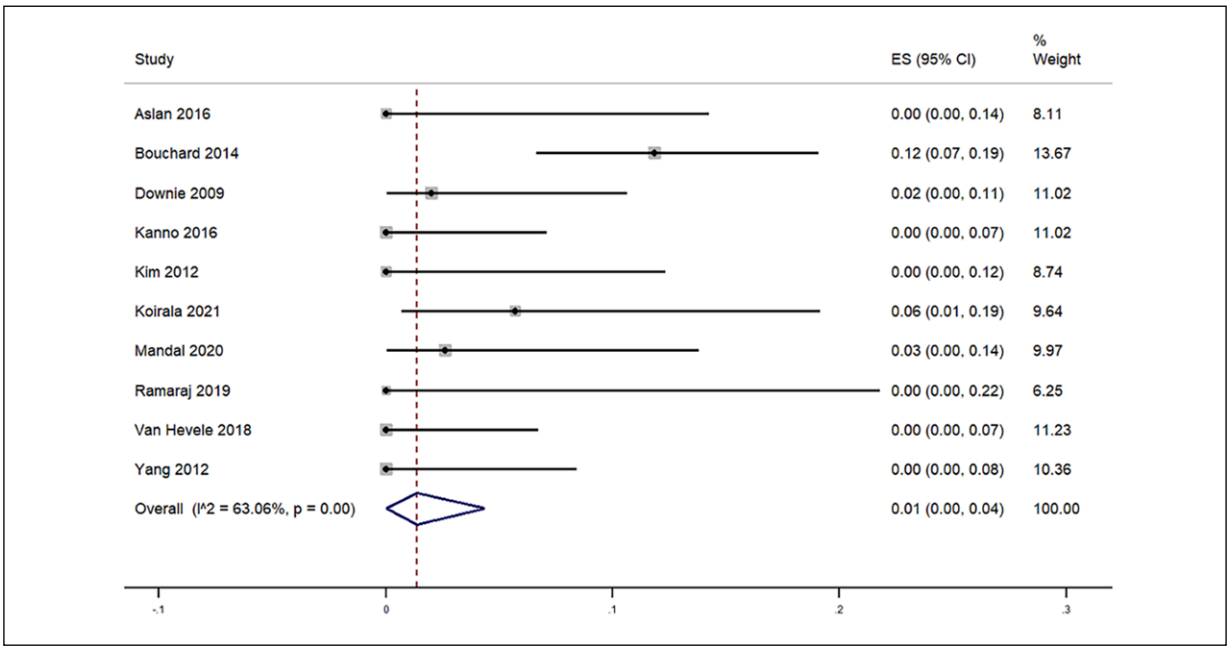

Figure 6. Forest plot showing the incidence of infection following the transparotid approach for mandibular condylar fractures.

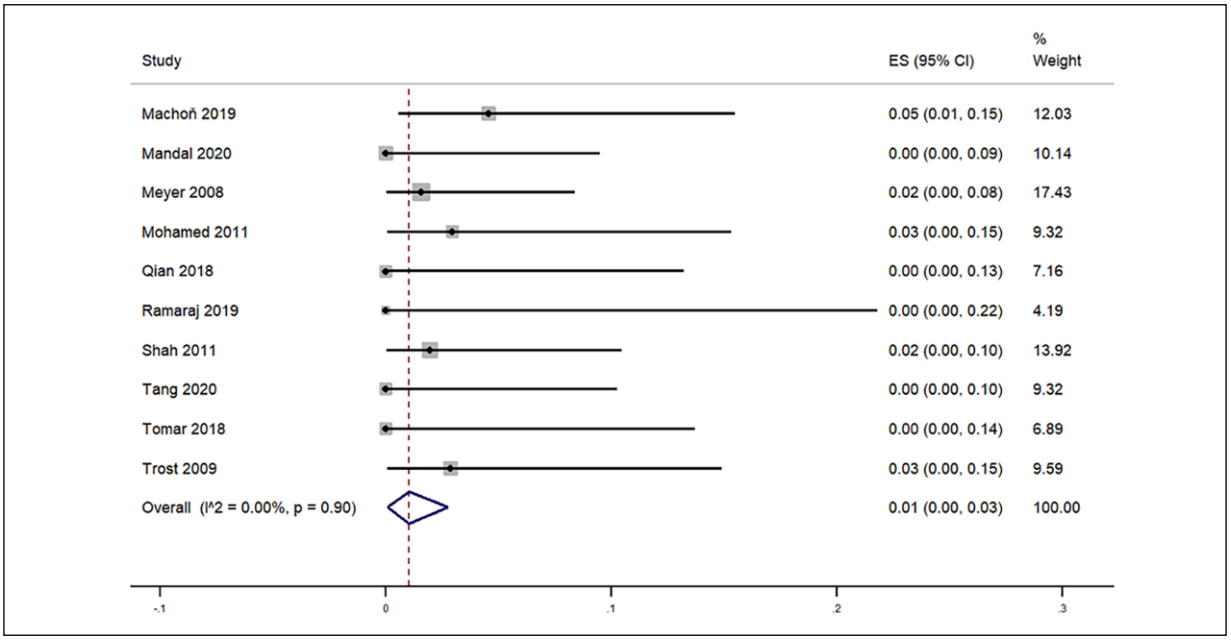

Figure 7. Forest plot showing the incidence of infection following the anteroparotid approach for mandibular condylar fractures.

nerve palsy when compared to the transparotid approach, whenever a retromandibular approach is considered for mandibular condylar fracturs. However, since the comparative studies did not find a significant difference between the two approaches, future studies, preferably RCTs, should focus on comparing the two approaches and find the best approach with the lowest risk of facial nerve palsy.

The risks of other common complications associated with retromandibular approach for the management of mandibular condylar fractures were also assessed. However, both of the approaches yielded a similar rate of complications in terms of postoperative infection, sialocele and almost none of the patients suffered from Frey's syndrome. These results demonstrate that both of the retromandibular approaches result in little to no risk of complications that are common with other approaches for condylar fractures.

While this review was current and comprehensive, with a large number of included studies, there were certain limitations. Most of the included studies were retrospective in nature, as such a selection bias may be possible, and may have resulted in biased estimates with respect to both of the approaches. The chi square test for heterogeneity also revealed significant variability across the included studies. Significant publication bias was observed, indicating that the point estimate obtained in this review should be interpreted with caution.

Despite these limitations, the current review provides important baseline information on the risk of complications following two retromandibular approaches for mandibular condylar fractures. The findings of our review highlight that the anteroparotid approach can be used for patients with limited risk of facial nerve palsy. This review also highlights the fact that very few studies have investigated the comparative risk of both retromandibular approaches, especially in the form of RCTs. Further studies comparing the two approaches are required to identify the best approach, which will help surgeons to determine the surgical procedure with least complication rate and best success rate for their patients.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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Authors' Contribution

X. Lu conceived and designed the study, X. Lu and X. Liu collected data and performed data analysis. X. Lu wrote the draft of this manuscript. X. Liu edited the manuscript.

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