Retromandibular and Periangular approach for condylar fracture fixation: a systematic review

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Abstract:
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. There are several approaches that can be employed for managing condylar fractures, such as submandibular, retromandibular, preauricular, intraoral, and periangular. The current study was conducted with the objective of updating the available literature and comparing the complications associated with the retromandibular and periangular approaches used for treating patients with condylar fractures. **Materials and methods:** The included studies reported the complication rate of either the periangular or retromandibular transparotid approach in patients treated for condylar fractures. There were no restrictions related to study design or setting. **Results:**
FACIAL NERVE PALSY: Totally 50 out of 351 cases with retromandibular approach had facial nerve palsy, of which 49 (14%) were temporary and only 1 case was permanent. While 12 (0.02%) out of 560 cases with periangular approach had temporary facial nerve palsy and no incidence of permanent facial nerve paralysis. **SIALOCELE & SALIVARY FISTULA:** The retromandibular group had 9 cases of sialocele and 9 cases of salivary fistula. While there was no incidence of sialocele or salivary fistula in the periangular group. **FREY SYNDROME:** There were 3 cases of Frey syndrome in the retromandibular group and no incidence of Frey syndrome in the periangular group. The difference was not significant. **Conclusion:** Periangular approach is better compared to retromandibular approach because of lower incidence of temporary facial nerve palsy, sialocele, salivary fistula, and Frey syndrome.
Keywords: Retromandibular, Periangular, condylar fracture, Facial nerve palsy, Paralysis, Sialocele, salivary fistula, Frey’s syndrome

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 (3,4), 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. There are several approaches

that can be employed for managing condylar fractures, such as submandibular, retromandibular, preauricular, intraoral, and periangular (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 the added advantage of a minimal working distance between the incision and fracture.
Typically, the retromandibular incision can occur either through the parotid gland or by using the retromandibular transparotid approach (7, 8).
However, there is wide variation in the overall complication rate between the two approaches. Hence, there is a need to systematically review and analyse 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 retromandibular and periangular approaches used for treating patients with condylar fractures.

Aim:
The aim of this systematic review was to analyse the existing literature to assess the differences in complication between Retromandibular and Periangular approaches to condylar fracture fixation

PICO:

Population	Adult population with condylar fracture
Intervention	Studies with Periangular approach
Comparison	Studies with Retromandibular approach
Outcome	Post operative Temporary or Permanent facial nerve palsy, Frey syndrome, sialocele and salivary fistula

Study design:
Prospective or retrospective longitudinal studies

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 (). The “Preferred Re- porting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement 2020” was used for reporting this systematic review

Eligibility Criteria

Types of Studies
The included studies reported the complication rate of either the periangular 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.

Inclusion criteria:

1. Studies with an adult population presenting with unilateral or bilateral condylar fracture.
2. Studies assessing periangular approach
3. Studies assessing retromandibular with transparotid approach
4. Studies with nerve stimulation or any nerve monitoring intraoperatively.
5. Studies conducted in the last 20 years.
6. Studies with a minimum of 3 months follow-up

Exclusion criteria:

1. Studies without nerve stimulation or any nerve monitoring intra operatively
2. Studies without proper description of surgical protocol or irrelevant technique to what is mentioned in the title
3. Pediatric population
4. Unstructured case reports, series, Reviews, opinions on use

Type of Outcome Measure

Studies reporting any one of the following complications were included:

- Facial nerve palsy;
- Sialocele & salivary fistula
- Frey's syndrome

Search strategy:

POPULATION	(((((((condyle[Title/Abstract]) OR (condylar[Title/Abstract])) OR (subcondylar[Title/Abstract])) OR (mandibular condyle[Title/Abstract])) OR (condylar neck[Title/Abstract])) OR (condylar base[Title/Abstract])) AND (fracture[Title/Abstract])) OR (fractures[Title/Abstract])
INTERVENTION	(((Peri-angular[Title/Abstract]) OR (periangular[Title/Abstract])) OR (high submandibular[Title/Abstract])) OR (high sub-mandibular[Title/Abstract])
COMPARISON	((((retromandibular[Title/Abstract]) OR (hind[Title/Abstract])) OR (hinds[Title/Abstract])) OR (transparotid[Title/Abstract])) OR (trans- parotid[Title/Abstract])

OUTCOME	((((((((((((((((((((((nerve palsy[Title/Abstract]) OR (facial nerve palsy[Title/ Abstract])) OR (facial nerve paralysis[Title/Abstract])) OR (nerve paralysis[Title/Abstract])) OR (nerve weakness[Title/Abstract])) OR (facial nerve weakness[Title/Abstract])) OR (palsy[Title/Abstract])) OR (paralysis[Title/Abstract])) OR (sialocele[Title/Abstract])) OR (sialocoele[Title/Abstract])) OR (salivary fistula[Title/Abstract])) OR (salivary gland fistula[Title/Abstract])) OR (parotid fistula[Title/Abstract])) OR (frey syndrome[Title/Abstract])) OR (frey's syndrome[Title/Abstract])) OR (nerve injury[Title/Abstract])) OR (facial palsy[Title/Abstract])) OR (facial paralysis[Title/Abstract])) OR (parotid gland[Title/Abstract])) OR (salivary fistulae[Title/Abstract])) OR (sialoceles[Title/Abstract])) OR (fistula[Title/Abstract])) OR (fistulas[Title/Abstract])

Study screening and selection: After collecting the data, the screening was done, and articles that did not match the inclusion criteria were excluded. One reviewer obtained the full texts of relevant articles following the search and inspection of titles and abstracts of citations to identify those articles that were likely to report the differences in complications between retromandibular and periangular approaches to condylar fracture fixation. The articles screened were cross-examined by both reviewers.

DATA EXTRACTION AND OUTCOMES

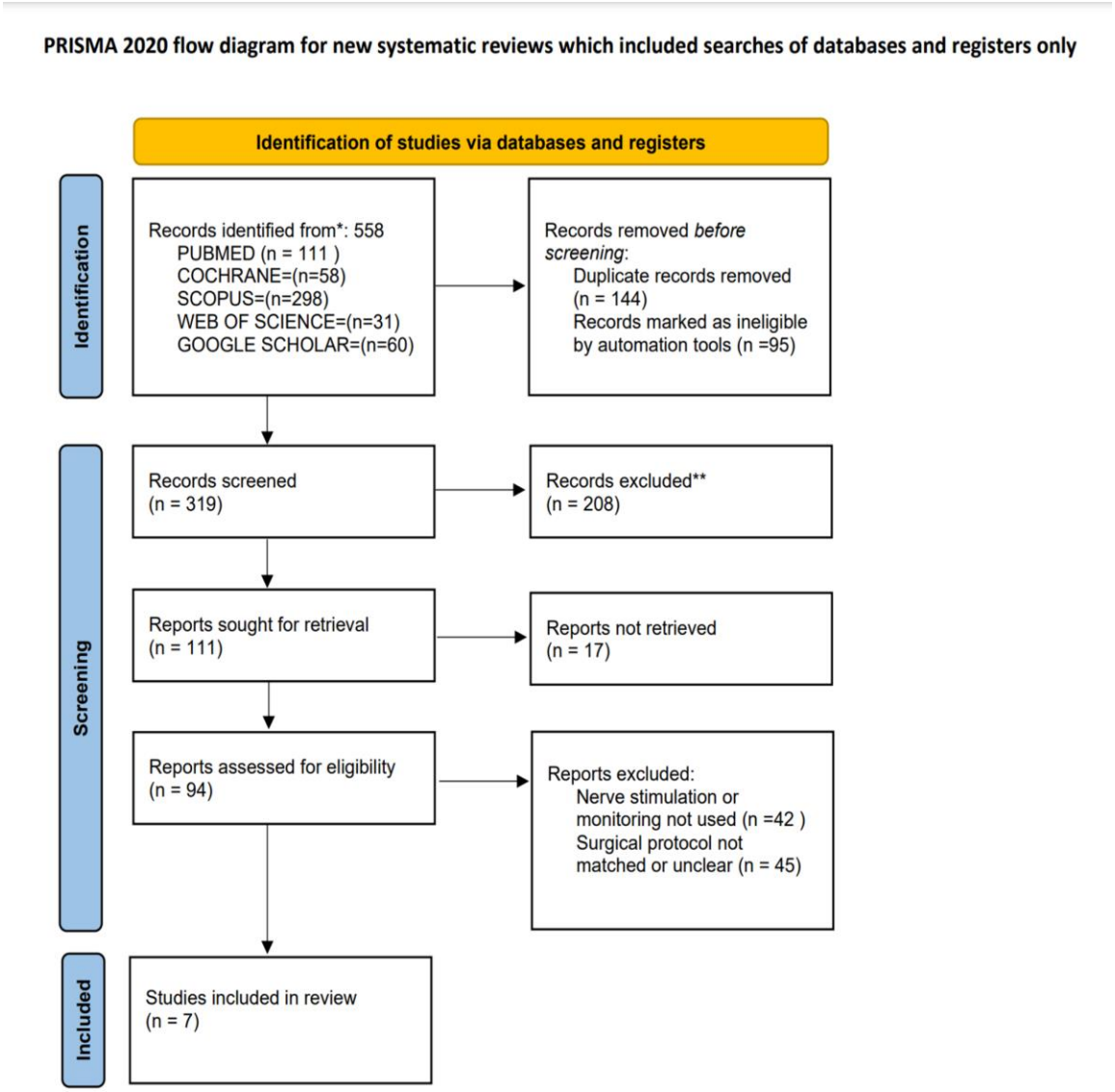
Manual extraction of data was done using a pre-defined, structured data extraction form. Data extracted using the form were as follows: authors, title of study, year of publication, study period, study design, setting, country/region, to- tal sample size, statistical tests, outcome as- sessment details, 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.

ASSESSMENT OF RISK OF BIAS

Newcastle-Ottawa (NO) scale for the risk of bias assessment for the observational studies 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 justifi- cation, 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.

Author and year	Representativeness of the sample	Sample size	Non-Response rate	Ascertainment of the screening/ surveillance tool	Comparability	Assessment of the outcome: (2)	Statistical test:	total	risk of bias

Carl Bouchard et al (2014) (9)	*	*	*		*	*	*	6	satisfactory
L. Yang et al (2012) (10)		*	*	*	*	**	*	7	good
D. Dalla Torre et al (2015) (11)	*	*	*	*	*	*	*	7	good
Sasaki et al (2023) (12)	*	*	*	*	*	*		6	satisfactory
Louvrier et al (2020) (13)	*	*	*	*		*	*	6	satisfactory
Mauro Pau et al (2016) (14)	*	*	*			**	*	6	satisfactory
Darpan Bhargava et al (2020) (15)	*		*	*		**	*	6	satisfactory



** Follow-up was less than 3 months, unstructured case reports or case series, no complications mentioned, Modifications of surgical techniques,

Level of evidence:

Study	Level of Evidence
Louvrier et al (2020)	Level 3
Mauro Pau et al (2016)	Level 3
Darpan Bhargava et al (2020)	Level 3
Carl Bouchard et al (2014)	Level 3

L. Yang et al (2012)	Level 3
D. Dalla Torre et al (2015)	Level 3
Sasaki et al (2023)	Level 3

SELECTION OF STUDIES

The Newcastle-Ottawa scale was used for assessing the quality of the studies finalised for the review. The NOS assigns stars to studies based on a variety of quality criteria. Studies with a rating of 7 stars are of priority quality; those with a rating of 9 are of high quality; and studies with a rating of 5 stars are of low quality.

STUDY NAME	STUDY TYPE	APPROACH	SAMPLE SIZE	FRACTURE TYPE	MEAN AGE	FACIAL NERVE PALSY	NERVE RECOVERY	FREY SYNDROME	SIALOCELE & SALIVARY FISTULA	FOLLOWUP
Louvrier et al (2020)	Retrospective study	Periangular	496	105 (21.2%) CN 391 (78.8%) CB. 6 CN (5.7%) required an additional pre-auricular approach	32 (13-72)	Temporary - 11 (2.2%) Permanent - 0	1st month	0	0	6 months
Mauro Pau et al (2016)	Prospective study	Periangular	44	All CB	11-83	Temporary – 0 Permanent - 0	NA	0	0	5 months
Darpan Bhargava et al (2020)	Prospective study	Periangular	20	All CB	18-55	Temporary - 1 (5%) Permanent - 0	2nd month	NM	0	3 months
Carl Bouchard et al (2014)	Retrospective study	Retromandibular	118	All CB	35.6 ± 15.8 (13-82)	Temporary - 26 (22%) Permanent – 1 (0.8%) Unresolved*- 8 (6.8%)	NM	1	Sialocele – 2 Salivary fistulas - 4	6.5 months
L. Yang et al (2012)	Prospective study	Retromandibular	48	CN - 15 (29%) CB - 33 (71%)	18 - 54	Temporary – 8 (18%) Permanent - 0	3-4 Weeks	NM	Salivary fistulas – 4 (8%)	1 year
D. Dalla Torre et al (2015)	Prospective study	Retromandibular	146	CN - 33 (26.6%) CB - 91 (73.4%)	33.6 (18-81)	Temporary - 4 (3.9%) Permanent - 0	3rd month	NM	Sialocele – 7 (6.8%) Salivary fistulas - 0	6 months
Sasaki et al (2023)	Retrospective study	Retromandibular	39	CN - 3 (7.7%) CB - 36 (92.3%)	38.5 (range 20–80)	Temporary - 3 (7.7%) Permanent – 0	3rd month	2	Sialocele – 0 Salivary fistulas – 1(2.6%)	18 ± 2.5 months

CN – Condylar Neck, CB – Condylar Base, NM – Not Mentioned
* Persistent facial paralysis at last appointment, but follow-up was less than 6 months.

Study characteristics:

Of the included studies, 3 out of 7 were retrospective in nature, while 4 studies were prospective. 3 of the studies were conducted in European countries like Austria and France, Canada (1), Japan (1), China (1), and India (1).

A total of 7 studies with a 911 total sample size were taken. In total, 4 studies reported on the retromandibular approach, 3 on the periangular approach. Periangular had a total sample size of

560 (61.4%) and retromandibular 351 (38.5%), and the sample sizes of the included studies varied from 39 to 496. The mean age of study participants ranged from 28.3 to 44.5 years. The follow-up duration ranged from 3 months to 18 months, and 5 out of 7 studies were of satisfactory quality, while all other studies were considered good quality.

The studies had a majority of 733 (81%) condylar base [CB] fractures, while 162 (18%) were condylar neck [CN] fractures. Of the cases treated with the periangular approach, 455 (81%) were CB fractures and 111 (14%) were CN fractures. In the cases treated with the retromandibular approach, 245 (79%) were CB fractures and 51 (14%) were CN fractures.

RISK OF COMPLICATIONS

FACIAL NERVE PALSY

Totally 50 out of 351 cases with retromandibular approach had facial nerve palsy, of which 49 (14%) were temporary and only 1 case was permanent. While 12 (0.02%) out of 560 cases with periangular approach had temporary facial nerve palsy and no incidence of permanent facial nerve paralysis.

SIALOCELE & SALIVARY FISTULA

The retromandibular group had 9 cases of sialocele and 9 cases of salivary fistula. While there was no incidence of sialocele or salivary fistula in the periangular group.

FREY SYNDROME

There were 3 cases of Frey syndrome in the retromandibular group and no incidence of Frey syndrome in the periangular group. The difference was not significant

Discussion:

Important baseline data on the risk of complications after two retromandibular techniques for mandibular condylar fractures are provided by the current review. The findings reported here demonstrate that there is a possibility of harm to the facial nerve branch regardless of the surgical technique used, and that the sole difference may be in the surgical strategy selected (16). Significant heterogeneity was seen across the included studies for nearly all of the outcomes examined using both methodologies, and the majority of the included studies had a higher risk of bias. Although retromandibular techniques have been shown to lower the risk of facial nerve palsy and facilitate the management of condylar fractures, patients undergoing the transparotid technique had a higher incidence of facial nerve palsy (13%) than those undergoing the anteroparotid technique (2%) (17, 18). Although the probabilities were higher for the transparotid strategy, calculations based on this research have shown no discernible difference between the two methods. Previous reviews 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 (19). The anteroparotid technique may have a decreased incidence of facial nerve palsy since it differs significantly from the other, more conventional external procedures. The dissection usually takes place in an anterior-superior

position during the anteroparotid approach, and it stays in the subcutaneous tissue that is superficial to the platysma and superficial musculo-aponeurotic system (20, 21). The dissection will be deepened to the bone when the masseter muscle has been reached and the anterior border of the parotid gland has been determined. Nevertheless, in the conventional retromandibular techniques, dissection is carried out through the platysma, posterior to the parotid gland, until the mandible is reached, following the skin incision (22). Facial nerve palsy may arise from this dissection, which takes place beneath the facial nerve branches, and the retraction that follows to get to the condylar neck. Therefore, if the facial nerve is easily detected over the masseter muscle, the anteroparotid approach may result in lower facial nerve palsy. This method prevents serious damage by directing the dissection of the condylar neck towards the facial nerve branches (23). Therefore, in terms of reducing facial nerve palsy, the periangualar technique appears to offer a bigger advantage.

For the treatment of condylar base fractures, Pau et al. [14] employed a modified high sub-mandibular approach. They discovered that the transecting masseter improves the surgical field by exposing the condyle, and the high sub-mandibular approach does not infringe upon the parotid gland, hence lowering complications.

According to Louvrier et al. [13], treating patients with condylar base fractures safely involves a high sub-mandibular approach. Among his research participants, 2.2% had transitory facial nerve palsy.The current study's methodology was nearly identical to the traditional peri-angular approach, but it minimised the risk of harm by making a smaller, curved incision and dissecting along the nerve filaments (24). In contrast to the method recommended by Kudva A et al., a pterygomasseteric sling was transected following the implantation of a curvilinear incision inferior and along the mandibular angle, followed by layered dissection (25). The suggested incision has the following benefits: avascular surgical plane, suitable condylar base exposure, early functional recovery, and little access to the surgical site due to the incision's size. Additionally, since it might be challenging to identify anatomic landmarks in obese patients, we advise using this incision. The limited study population is still the study's drawback, and multicentric, larger, comparable operations would be needed to validate the findings.

There is very little that the periangular has to do with the parotid gland. A variable portion of the masseter muscle's posterior surface may be covered by the parotid gland. This explains why salivary fistula, sialoceles, or Frey syndromes are never seen with periangular, in contrast to what is reported with other approaches. The full cut of the posterior border of the muscle that is required to have an adequate view over the posterior border of the ramus and an adequate control of the reduction may need to lift the gland, but in no case is a dissection inside the gland performed (26).

Conclusion:

Periangular approach is better compared to retromandibular approach because of lower incidence of temporary facial nerve palsy, sialocele, salivary fistula, and Frey syndrome.

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