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Comparing the efficiency of endoscopically assisted open reduction and internal fixation and conventional open reduction and internal fixation for mandibular condylar/ sub condylar fractures: A systematic review and meta-analysis

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Abstract

Purpose: The purpose of this study was to assess the outcome of endoscopically assisted open reduction and internal fixation (EAORIF) of mandibular condylar/sub condylar fractures in terms of the postoperative facial nerve damage, mouth opening, and intraoperative time, when compared to the conventional open reduction and internal fixation technique (ORIF).

Materials and Methods: A literature search of major databases was performed for the identification of condylar fractures treated by endoscopic approach and conventional surgery. The references listed included articles and textbooks that were also examined manually to find additional data eligible for the study. A total of 6 studies comparing EAORIF and conventional ORIF in terms of operation time, post-operative mouth opening and facial nerve damage were identified. They included a total of 127

participants. Quality of evidence ranged from fair to poor among the selected 6 studies.

Results: Meta- analysis in terms of the above mentioned parameters was performed and a significant reduction in facial nerve damage postoperatively was seen in patients treated with EAORIF; proving that EAORIF can reduce the risk of facial nerve damage.

Conclusion: EAORIF though being a complex technique and case sensitive, was still found to be superior than conventional ORIF. Literature states that the learning curve is quite steep for the use of EAORIF however, with proper case selection and training could give ideal results. Nevertheless, the overall quality of existing evidence was low and great caution should be exercised with generalizing the results of the included trials, more well designs randomized controlled trials can substantiate our results.

Keywords: Endoscopy, Mandibular Condylar Fracture, Sub condylar Fracture

Abbreviations: EAORIF- endoscopically assisted open reduction and internal fixation, ORIF- open reduction and internal fixation, MMF- maxillomandibular fixation, TMJ- temporomandibular joint

Introduction

Fractures of the mandibular condyle are one of the most common craniofacial fractures involving about 25–30% of all mandibular fractures (Colletti et al., 2014; Ellis et al.,1985).[1,2] Despite their prevalence, their treatment continues to be a contentious topic. The goals of management have always remained consistent i.e. restoration of baseline occlusion, speedy recovery, pain free mouth opening, minimizing the risk of joint ankylosis and preventing injury to the surrounding vital structures. However, despite the potential morbidity with open techniques, it is a commonly advocated procedure because of the anatomically correct reduction which allows immediate postoperative mandibular movements.[3] In the recent years, surgical trends have shown an interest for minimally invasive surgery, such approaches minimize unwanted sequelae such as, unaesthetic facial scars and facial nerve injury. EAORIF for condylar fractures can thus be successfully used in place of traditional method of ORIF for effective postoperative results.[4] Due to the various complications encountered during ORIF, a technique that combines the advantages of conventional ORIF and avoids its associated complications could be EAORIF that has now emerged as an alternative, to the conventional technique. [5]

The purpose of this study was to conduct a systematic review and meta-analysis so as to assess the outcome of EAORIF of mandibular condylar/sub condylar fractures in terms of the postoperative facial nerve damage, mouth opening, and intraoperative time, when compared to the conventional ORIF.

Material & Methods

Protocol: This Systematic Review and Meta-analysis (SRMA) was done using the PRISMA guidelines (Preferred Reporting items for systematic reviews and meta-analysis). (Fig 1.)

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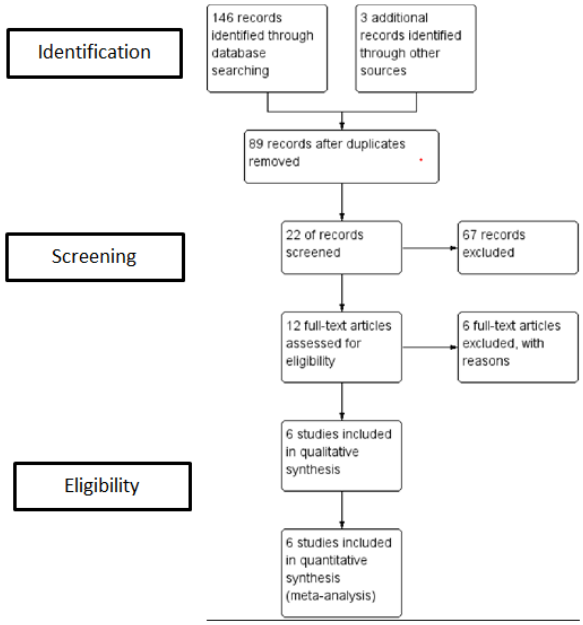

Fig.1: PRISMA Flow Diagram

Literature Search

An initial search was conducted on HINNARI, PUBMED, GOOGLE SCHOLAR, MEDLINE with a combination of keywords; ENDOSCOPY‘, MANDIBLE CONDYLE FRACTURE‘, REPAIR‘. These results were combined with OPEN REDUCTION and SURGERY in combination with the Boolean operators AND, OR. Identification of relevant data from 2009-2019.

Inclusion & Exclusion Criteria

Randomized Controlled Trials, Prospective and Retrospective studies comparing transoral and transoral endoscopic approaches with various other extraoral approaches and studies using transoral and transbuccal approaches with or without angulated screw drivers were included. Articles where endoscopically assisted reduction of condylar or sub condylar fractures was done to expose, reduce and stabilize the condyle were selected. The data obtained assessed facial nerve damage, postoperative mouth opening and operation time.

Study Selection

All retrieved articles were evaluated by two independent reviewers . A conflict between them was resolved by mutual consensus. After excluding the non-eligible articles, the articles were screened according to their titles and abstracts. Full-text articles were assessed and the articles which didn't meet the inclusion criteria were excluded.

Risk of bias assessment

The Cochrane Collaboration Tool was used for assessing the risk of bias for RCTs was used. The status of bias of each included trial was assessed at both levels study and outcome. (Fig 2 and 3)

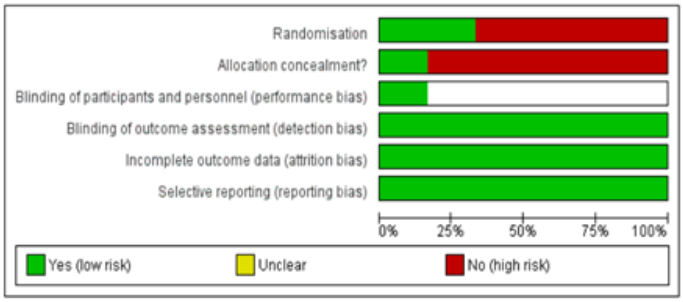

Fig.2 Cochrane’s Tool of Risk Assessment

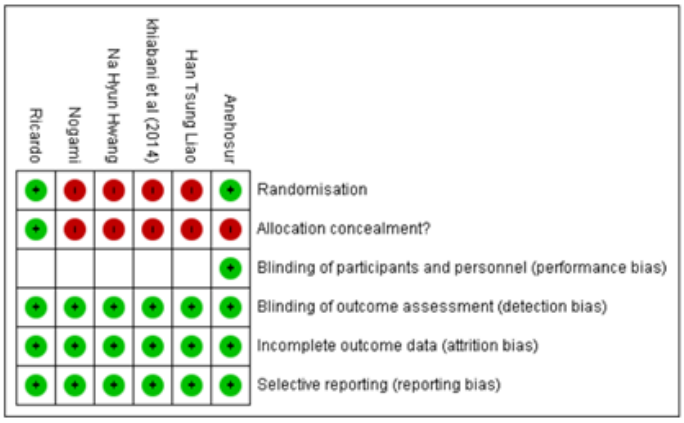

Fig.3 Risk of Bias Assessment

A funnel plot was used to assess the presence of publication bias between the included studies for each parameter individually and illustrated a symmetrical

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spread of the studies with regards to the standard error. This symmetrical distribution showed the presence of low publication bias and reliability.

Data extraction and analysis

Meta-analysis was conducted only if there were studies with similar comparisons made, reporting the same outcome measures. For binary outcomes, standard estimation of odds ratio (OR) was calculated by the random-effects model if heterogeneity was detected, otherwise a fixed effect models with a 95% confidence interval (CI) was performed. Weighted mean differences have been used to construct forest plots of continuous data[6].

Results

To assess the effectiveness of the intervention, the following outcomes were measured: operation time measured in minutes, postoperative mouth opening in millimetres, and facial nerve damage in terms of total number of patients involved with post-operative facial nerve damage. We did not limit the studies based on the method of assessment outcome variable and postoperative period of follow up. Estimate of effect was presented with 95% confidence intervals.

3.1 Results of Individual Studies and Parameters

Mouth opening

Two studies Nogami et al (2012) & Anehosur et al (2018) relating Endoscopic Assisted Oral Reduction Internal Fixation which assessed the operation timing in minutes were reviewed.[9,10] The cumulative overall analysis of operation time did not reveal any statistically significant advantage for Endoscopic Assisted Oral Reduction Internal Fixation when assessed the operation time of patients (OR was 0.125 to 1.259; P = 0.018) according to fixed effects model or random effects model (Table 3).

The test of heterogeneity among all studies showed Q = 23.5812, DF = 1, P < 0.0001; I^2=95.76% which was inconsistent. (Table 1 and 2, Fig 4 and 5)

Table 1: Statistical Analysis for Mouth Opening

Study	N1	N2	Total	SMD	SE	95% CI	t	P	Weight (%)	
									Fixed	Random
Khiabani et al (2014)	20	20	40	1.377	0.346	0.677 to 2.078			35.91	48.56
Han- Tsung liao et al (2015)	29	29	58	0.0249	0.259	-0.494 to 0.544			64.09	51.44
Total (fixed effects)	49	49	98	0.511	0.207	0.0989 to 0.922	2.462	0.016	100.00	100.00
Total (random effects)	49	49	98	0.682	0.676	-0.660 to 2.024	1.008	0.316	100.00	100.00

Table 2: Test for Heterogenicity

Q	9.7876
DF	1
Significance level	P = 0.0018
I^2 (inconsistency)	89.78%
95% CI for I^2	62.30 to 97.23

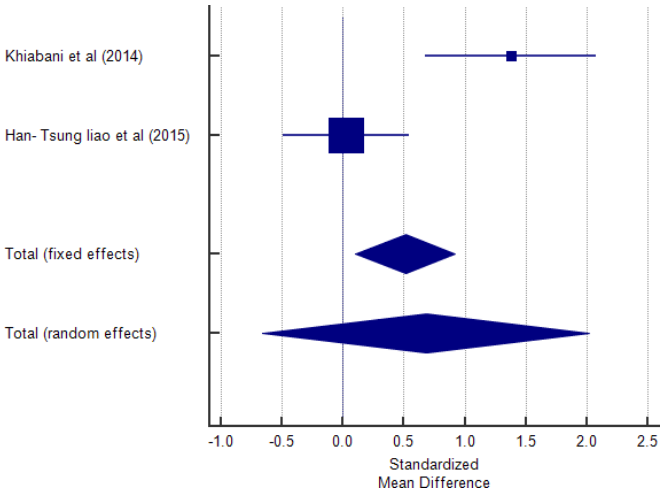

Fig 4: Pooled data for mouth opening

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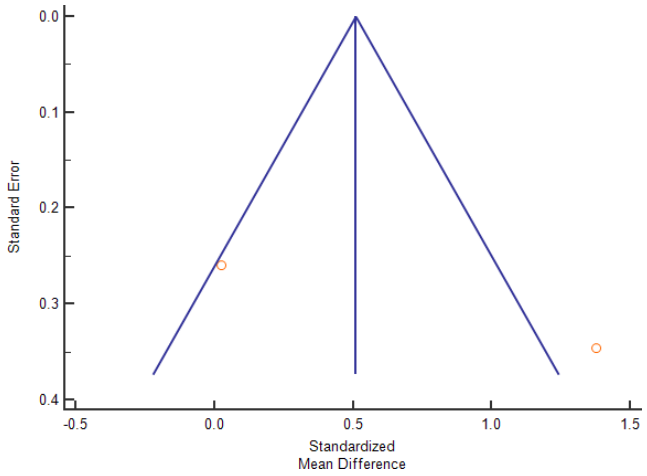

Fig 5: Funnel plot for mouth opening

Operation Time in minutes

Two studies Nogami et al (2012) & Anehosur et al (2018) relating Endoscopic Assisted Oral Reduction Internal Fixation which assessed the operation timing in minutes were reviewed.[9,10] The cumulative overall analysis of operation time did not reveal any statistically significant advantage for Endoscopic Assisted Oral Reduction Internal Fixation when assessed the operation time of patients (OR was 0.125 to 1.259; P = 0.018) according to fixed effects model or random effects model (Table 3). The test of heterogeneity among all studies showed Q = 23.5812, DF = 1, P < 0.0001; I^2=95.76% which was inconsistent. (Table 3 and 4, Fig 6 and 7)

Table 3: Statistical Analysis for Operation Time

Study	N1	N2	Total	SMD	SE	95% CI	t	P	Weight (%)	
									Fixed	Random
Nogami et al (2012)	15	15	30	-0.375	0.359	-1.109 to 0.360			62.46	50.53
Anehosur et a l(2018)	16	16	32	2.467	0.462	1.523 to 3.412			37.54	49.47
Total (fixed effects)	31	31	62	0.692	0.283	0.125 to 1.259	2.443	0.018	100.00	100.00
Total (random effects)	31	31	62	1.031	1.421	-1.811 to 3.873	0.726	0.471	100.00	100.00

Table 4. Test for Heterogenicity

Q	23.5812
DF	1
Significance level	P < 0.0001
I^2 (inconsistency)	95.76%
95% CI for I^2	87.81 to 98.52

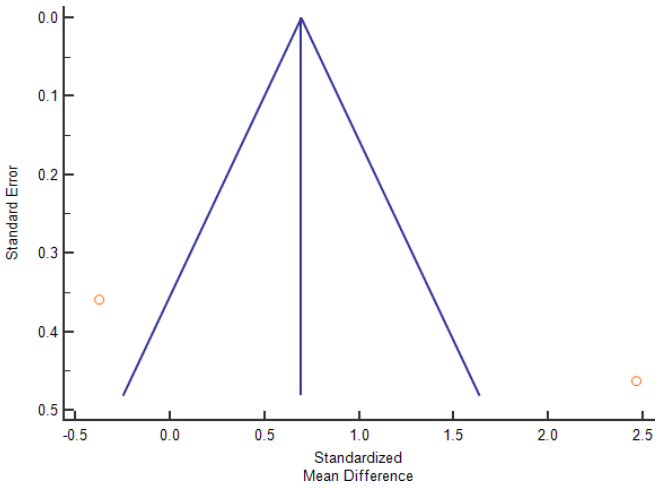

Fig. 6: Funnel plot for operation time

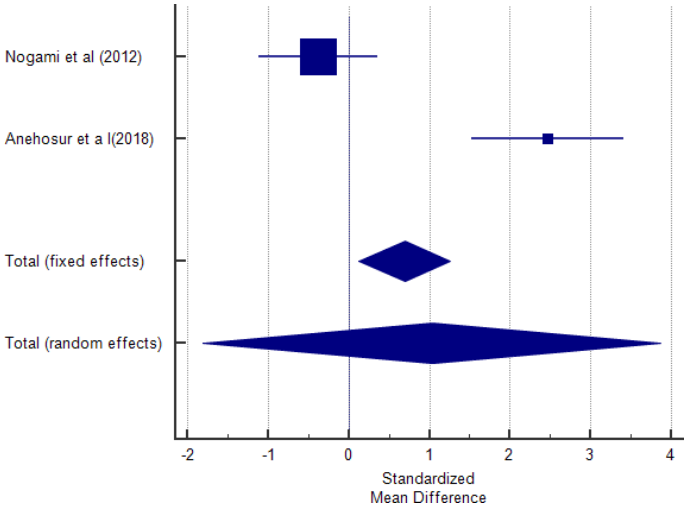

Fig. 7:Pooled data for operation time in minutes

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Facial Nerve Damage

Total of six studies relating Endoscopic Assisted Oral Reduction Internal Fixation which assessed the facial nerve damage were reviewed. Which included Na - Hyun Hwang et al (2016), Nogami et al (2012), Ricardo et al (2009), Anehosur et al (2018), Khiabani et al (2014), Han-Tsung liao et al (2015).[11,9,5,10,7,8] The cumulative overall analysis of facial nerve damage revealed a statistically significant advantage for Endoscopic Assisted Oral Reduction Internal Fixation when assessed the facial nerve damage of patients (OR was 0.154 to 0.929; P = 0.034) (Table 5). The test of heterogeneity among all studies showed homogeneity Q = 7.0677, DF = 5, P = P = 0.2157; I^2 =29.26% which was inconsistent. (Table 5 and 6, Fig 8 and 9)

Table 5: Statistical Analysis for Facial nerve damage

Study	Intervention	Controls	Odds ratio	95% CI	z	P	Weight (%)	
							Fixed	Random
Na - Hyun Hwang et al (2016)	0/15	1/15	0.312	0.0117 to 8.285			10.67	12.59
Nogami et al (2012)	0/15	1/15	0.312	0.0117 to 8.285			10.67	12.59
Ricardo et al (2009)	3/32	2/32	1.552	0.241 to 9.974			33.16	26.80
Anehosur et a l (2018)	1/16	9/16	0.0519	0.00545 to 0.493			22.63	21.45
Khiabani et al (2014)	0/20	2/20	0.180	0.00812 to 4.010			11.94	13.73
Han- Tsungliao et al (2015)	1/29	0/29	3.105	0.121 to 79.432			10.92	12.82
Total (fixed effects)	5/127	15/127	0.378	0.154 to 0.929	-2.120	0.034	100.00	100.00
Total (random effects)	5/127	15/127	0.406	0.109 to 1.516	-1.341	0.180	100.00	100.00

Table 6: Test for Heterogenicity

Q	7.0677
DF	5
Significance level	P = 0.2157
I^2 (inconsistency)	29.26%
95% CI for I^2	0.00 to 71.03

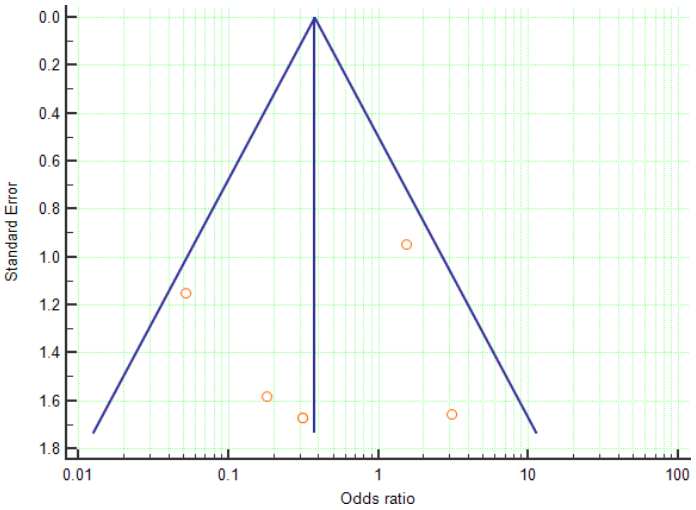

Fig 8: Funnel plot for Facial Nerve

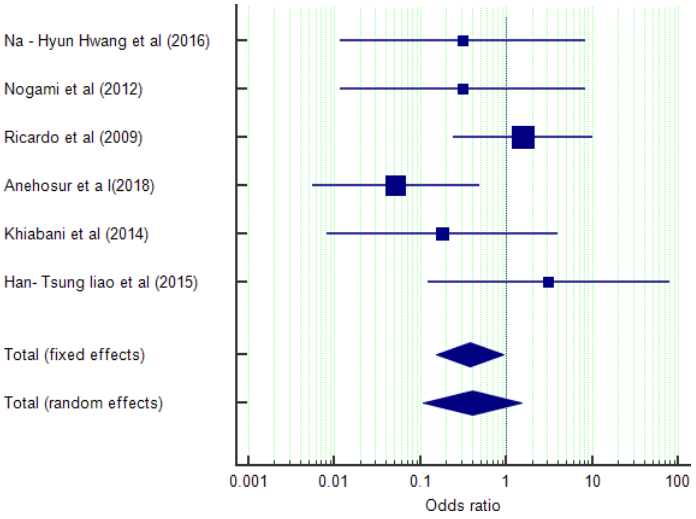

Fig 9: Pooled data for facial nerve damage

Discussion

The treatment of fractures of the mandibular condylar process remains controversial.[12] Historically, condylar process fractures were treated by closed reduction, which provided satisfactory outcomes in majority of cases, whereas open reduction was considered hazardous because of the complex regional anatomy particularly in reference to facial nerve injury[13]. Furthermore, before plate and screw fixation was introduced, open reduction involved placing an interosseous wire to stabilize the reduced segments and required a period of MMF to immobilize the

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segments to permit an osseous union therefore, the value of open reduction was debatable.[13] The development of rigid fixation permits open reduction and stable internal fixation without the need for postoperative MMF, and thus, creates renewed interest in open reduction treatment of mandibular condylar fractures. However, it did have its complication; injury to the facial nerve, which could cause temporary or permanent paralysis of the muscles of facial expression.[13] To overcome this complication, literature advocates several surgical approaches, knowing which surgical approaches are more or less likely to cause facial nerve injury may be important in the selection process for open reduction.[13]

Although traditional approaches to the sub condylar fractures are reliable, they show presence of visible scars, technical problems and various complications such as facial nerve palsy that have led to the relatively recent development of endoscopic approaches to these injuries.[7]

In our study, total six studies were included to assess post-operative facial nerve damage and the cumulative statistical analysis showed a statistically significant result for the endoscopy group. According to Muller et al, the conventional closed reduction of sub condylar fractures followed by MMF often results in malreduction and other functional post-operative sequelae like reduced mouth opening and potential TMJ derangements.[14] Hence, the authors strongly recommend the endoscopic repair of adult condylar and sub condylar fractures. In our study the cumulative analysis of two studies showing individual significance in EAORIF groups together showed no significant differences between endoscopic and extraoral approaches. The EAORIF of condylar and sub condylar fractures showed increased operation time as reported by various authors. However, when we compared two studies done by Anehosur et al and Nogami et al, the cumulative analysis revealed no significant difference. Though endoscopic approaches have steep learning curves and are time consuming, the surgeon could overcome these problems by improved training and experience. [10,9]

The meta-analysis performed finds an acceptably low rate of postoperative complications which include facial nerve injury and mouth opening. It revealed that complications after traditional ORIF and EORIF showed a lower incidence of facial nerve injury with EAORIF. The intraoperative time is more than traditional ORIF therefore; proper training and diagnosis can provide optimum results with EAORIF.

Most of the included publications in our review were retrospective studies that may have selection biases; also, not all included studies assessed all the three parameters. The presence or absence of variations in facial nerve anatomy may also play an important role in surgical outcomes. Within the constraints of the search strategy, only two randomized control trials were eligible for inclusion, therefore the evidence provided by this meta-analysis is type II evidence.[6] Despite which we have succeeded in establishing quantitative data.

Conclusion

This meta - analysis aimed to study the efficiency of EAORIF over the conventional ORIF technique by assessing the facial nerve injury, operative time and postoperative mouth opening. Our results showed positive effects of EAORIF over traditional ORIF in terms of facial nerve injury and no differences when operative time and postoperative mouth opening was assessed. Keeping in mind the limitations of this study and scarcity of data we would like to conclude that EAORIF, though technique sensitive, can prevent post-operative sequelae like facial

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nerve injury. Considering the parameters used in this meta-analysis and with the increasing impetus to using EAORIF in treatment of condylar/ sub condylar fractures; in future we may have substantial data in terms of randomized control trials which may help us and other researchers validate the results.

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