



COMPARISON OF OPEN AND CLOSED TREATMENT OF MANDIBULAR CONDYLE FRACTURES- A SYSTEMATIC REVIEW & META ANALYSIS

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Abstract:

Mandibular condylar fractures account for 19 to 52 % of fractures of facial skeleton. There are two different types of treatment modalities for condylar fractures, one is open method [surgical] and closed method [non-surgical]. Both treatment methods have their own complications, like in case of closed method of treatment complications pain, trismus and occlusal disturbances. Facial asymmetry, in case of open method, the complications include facial scar, facial nerve injury. Till date there is lot of debate about which method of treatment is most suitable for treating mandibular condylar fractures. This systematic review revealed that high quality evidence is lacking for the effectiveness of both the treatment methods of condylar fractures. This review also stressed the need for further research to help both patients and doctors in deciding about the treatment options.

Introduction

In trauma to the facial skeleton, mandibular fractures are most commonly involved.

Classification: Condylar fractures can be classified based on their fracture level, its dislocation, and relationship of head of the condyle to glenoid fossa (Lindahl 1977). In our daily practice; it is the level and degree of displacement of the fracture that is the most significant in deciding about treatment method.

Condylar fractures tend to occur commonly in three positions: the condylar head (within the joint capsule), high subcondylar (below the condyle and joint capsule but above the sigmoid notch) or low subcondylar where the fracture runs from the sigmoid notch to the posterior aspect of the mandibular ramus.

Treatment: The history of treatment of condylar fractures have been ranging for more than fifty years. Delaire in 1960 noted the poor results of treatment in

terms of mandibular physiology and function. He recommended functional treatment otherwise called as articular reeducation... The functional treatment method (with or without appliances) pioneered by him remains the most widely used condylar fracture treatment in the world.

Eminent surgeons in the 1920s have developed a principle to gain access to condyle at a time when only pins and steel wires were available. In 1980, Petzel first described the modern technique of compression screw osteosynthesis. It is supported and publicized by Uwe Eckelt of Germany. The modifications in the technique include direct cutaneous approach, initially using a rectangular plate and, later, a trapezoidal plate developed by Meyer, France, in 2001. This direct osteosynthesis technique has simplified the whole procedure and makes it more comfortable for most of the surgeons. Currently they use an endoscope for improved visualization of fracture site/segments. This has led to

the development of specific osteosynthesis materials as described by Constantin A. Landes & Lauer (Germany).

Till now, there is no predominantly available surgical techniques. Some surgeons always feel that the majority of techniques are still difficult to perform, and the risks of facial paralysis or obvious scarring are often possible. The use of osteosynthesis has slowly gained momentum and popularity due to its advantages like early return of function of jaws, anatomical reduction, painless and efficient method. Many authors have felt that the main aim of condylar head fractures relay on its functional reeducation.

Objectives: The objective of this review was to evaluate the effectiveness of Open and closed reduction treatment methods that can be used in the management of mandibular condyle fractures.

Null Hypothesis: There is no difference in the effectiveness of both open and closed reduction treatment of mandibular condylar fractures.

Materials and methods: Criteria for considering studies for this review

Types of studies: Only Randomized control trials comparing open and closed reduction treatment of mandibular condylar fractures are included in this study.

Types of Participants: Patients of any age with both unilateral and bilateral mandibular condylar fractures and treated by any one of open or closed reduction methods.

Types of Interventions: Any form of open or closed method of reduction and fixation of mandibular condylar fractures. Any studies that compared different methods of management of mandibular condylar fractures were considered for this study.

There are numerous nomenclatures for conservative management of mandibular condyle fractures like no active treatment other than soft diet, analgesics or antibiotics which is also known as functional treatment, intermaxillary (Maxillo mandibular) fixation with rigid or elastic traction, both are considered as closed reduction, if any of these methods were compared to an open reduction and internal fixation of fractured condyle through various techniques were considered eligible for inclusion in this review.

Types of Outcome Measures:

Primary outcome parameters:

- Post-operative mouth opening [maximum inter incisal opening distance],
- Post-operative Protrusive movements of mandible.
- Post-operative Lateral movements of mandible.

Secondary outcome parameters:

- Deviation or deflection during mouth opening, shortening of ramus.
- Assessment of pain with a visual analog scale with values from 0[no pain] to 10[strong pain].
- Malocclusion.
- Assessment of nerve function.

Search Methods for Identification

For identification of studies included or considered for this review, detailed search strategies were developed for the database searched. The MEDLINE search used the combination of controlled vocabulary and free text terms.

Searched Databases

- PUBMED Advanced Search (from January 1950 to June2011]
- Mesh
- MEDLINE

Language

- Articles in English only included.
- Hand searching
- American journal of oral and maxillofacial surgery.
- British journal of oral and maxillofacial surgery.
- International journal of oral and maxilla facial surgery.
- Journal of Cranio maxilla facial surgery.

Data Collection and Analysis

Study Selection:

The title, keywords and abstracts of reports identified from electronic searching for evidence of following criteria were examined:

- Randomized control trials only.
- Involving the method of treating mandibular condylar fractures by both closed and open methods.

Data Extraction:

Data extraction form was prepared based on previous publications and modified according to our

specifications. Studies rejected at this or subsequent stages were listed as excluded studies.

For each and every trial included in this study, the following data were recorded:

- Year of publication of the study.
- Details of the type of treatment (open method and closed method)
- Details of treatment outcomes reported in the trial (Method of assessment and mean duration of study)

Quality Assessment:

- The quality assessment of included studies were analysed as a part of data extraction process.
- Four important quality criteria were assessed as follows
 - Method of Randomization
 - Allocation concealment
 - Outcome assessors blinded to intervention.
 - Completeness of follow- up
- Other methodological criteria examined included:

- Presence or absence of sample size calculation
- Comparability of groups at the start
- Clear inclusion/ exclusion criteria.

RESULTS

Description of Studies:

The search identified 1254 publications out of which 1223 were excluded after reviewing the title or abstract. Full articles were obtained for 31 studies. .Therefore a total of 3 publications fulfilled all criteria for inclusion.

Risk of Bias in Included Studies:

The assessments for the four main methodological quality items are shown in table 1. The study was assessed to have a “High risk” of bias if it did not record a “Yes” in three or more of the four main categories, “Moderate” if two out of four categories did not record a “Yes”, and “Low” if randomization assessor blinding and completeness of follow – up were considered adequate.

Table 1:

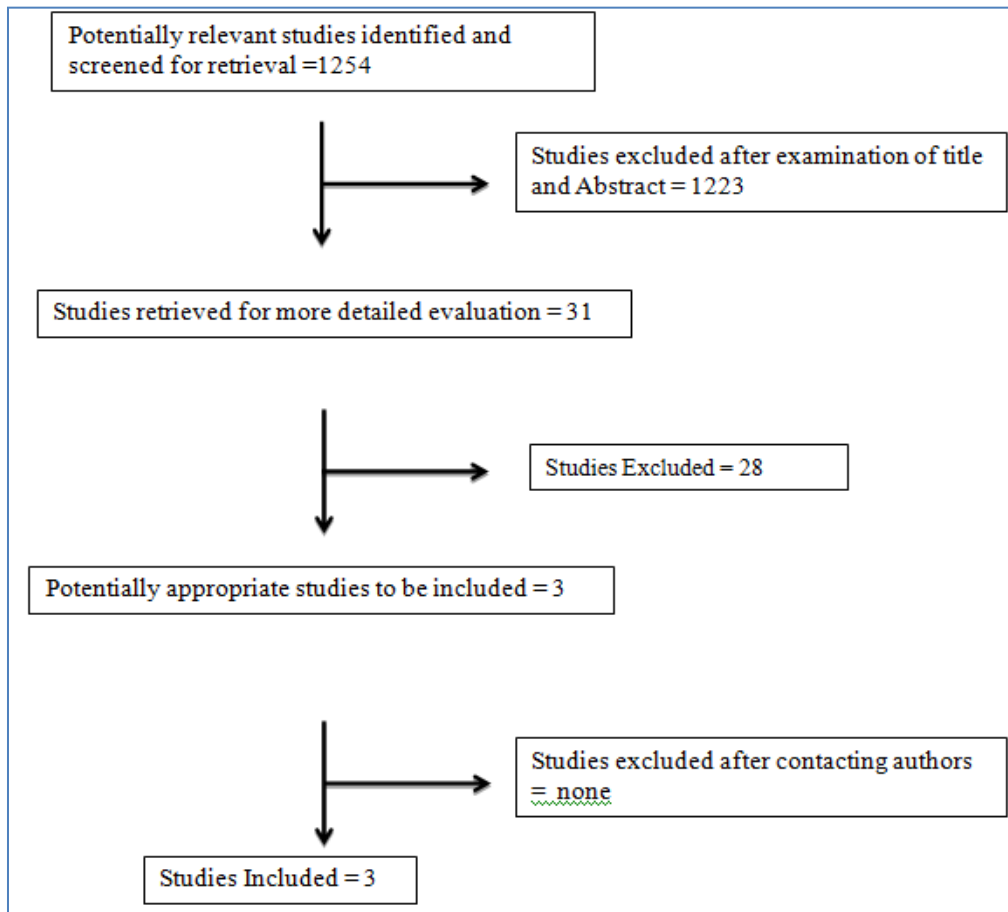


Table 2: Major and Minor Criteria

(Major Criteria)

Study	Randomization	Allocation Concealed	Assessor Blinding	Dropouts Described	Risk of Bias
Anil. K. Danda et al 2010	Yes	Yes	yes	none	Low
V. Singh et al 2010	Yes	Yes	Yes	none	Low
Eckelt et al 2006	Yes	yes	Unclear	none	low

(Minor Criteria)

Study	Sample Justified	Baseline comparison	I/ E Criteria	Method Error
Anil. k. danda et al 2010	yes	NA	Yes	No
V.Singh et al 2010	yes	NA	Yes	No
Eckelt et al 2006	Yes	NA	Yes	No

CHARACTERISTICS OF INCLUDED STUDIES

ANIL.K.DANA ET AL 2010		
Methods	Prospective Randomized Study.	
Participants	32 participants, Closed reduction=16. Open reduction=16.	
Interventions	Closed and open method of treatment of condylar fractures	
Outcomes	Maximum interincisal opening, protrusion, lateral movements of TMJ, pain, malocclusion, deviation of mandible, anatomic reduction of condyle .	
<i>Risks of Bias</i>		
<i>Item</i>	Author's judgement	Description
Allocation Concealment	yes	All the patients are randomized through lots using closed envelopes.

V.SINGH ET AL, 2010		
Methods	Prospective Randomized study.	
Participants	40 Patients; closed reduction = 22,Open reduction = 18	
Interventions	Closed and open method of treatment of condylar fractures	
Outcomes	Maximum interincisal opening, protrusion, lateral movements of TMJ, pain, malocclusion, deviation of mandible, shortening of ramus.	
<i>Risks of Bias</i>		
<i>Item</i>	Author's judgement	Description
Allocation Concealment	Yes	All the patients are randomized through lots using closed envelopes.

ECKELT ET AL 2006		
Methods	Prospective Randomized multi centre Study.	
Participants	66. participants: Closed method =30; Open method =36	
Interventions	Closed and open method of treatment of condylar fractures	
Outcomes	Maximum interincisal opening, protrusion, lateral movements of TMJ, pain, malocclusion, deviation of mandible, shortening of ramus.	
<i>Risks of Bias</i>		
<i>Item</i>	Author's judgement	Description
Allocation Concealment	Yes	Fall of patients from total sample size is justified as incomplete treatment or no data.

CHARACTERISTICS OF EXCLUDED STUDIES:

Gupta.M.Iyer.et al 2011	Unpublished article
Sforza et al.2011	Unpublished article.
Park et al 2010	Randomization not done. Patients themselves selected the treatment.
Sharif et al .2010	Review article
Laskin ET AL 2009	Review article
Schneider et al 2008	Randomization is inadequate.
Oliver et al	Review article
C. A. Landes et al 2008	Randomization inadequate. Patients themselves decide about treatment.
C. A. Landes et al 2008	Randomization inadequate.
Valiati et al 2008	Review of literature article
Nussbaum et al 2008	Review article
Haug et al 2007	Review article
Eulert. S. et al 2007	Retrospective study
Schneider et al2007	Retrospective study
Ishihama et al 2007	One treatment done prospectively and other they reviewed old patients.
Zachariades et al 2006	literature review
Meyer et al 2006	French article in French journal, no abstract available
C.A. Landes et al 2006	Randomization is inadequate. and follow up is unclear
Stiesh scholz et al 2005	Retrospective study.
Hlawitschka et al 2005	Randomization in adequate, and retrospective study
C. A. Landes et al 2005	Inadequate randomization
Ellis et al 2005	Literature review
Kondoh et al 2004	Comparision of closed vs intra articular injection of corticosteroid.
Haug et al, 2004	Review article
Throckmorton 2004	Chewing cycle was analysed as parameter
Assael et al 2003	Theoretical review
Brandt et al 2003	Review article
Andrade et al 2003	Portuguese article
Neff et al 2002	German article
Crivello et al 2002	French article
Kleinheinz et al 1999	Full text not available
Yang et al2002	Retrospective study
Hyde et al 2002	only open method was analysed
Zang et al	Chinese article
Ellis et al 2000	Only author's technique of treating condyle fracture
De riu et al2001	Inadequate randomization, 50% fallout of patients during follow up.
Ellis et al 2001	Non RCT, also they compared only bite forces as parameter
Haug et al 2001	Retrospective study
Throckmorton et al 2000	Retrospective study
Ellis et al 2000	Retrospective study
Palmieri et al 1999	Retrospective study.
Newman et al 1998	Inadequate study design, retrospective study.
Talwar et al	Inadequate data
Ziccardi et al 1995	Review article.
Hiding et al 1992	Review article
Worsaae et al 1995	Danish article
Worsaae et al 1994	Non RCT.
Hiding et al 1992	Retrospective study
Suzuki et al 1991	Article in Japanese
Muller et al 1976	Article in German

Effects of Open and closed method of treatment of condyle fracture of mandible.

“Outcomes of open versus closed treatment mandibular subcondylar fractures. A prospective randomized clinical study”.

One trial (V. Singh et al, 2010), the author evaluated 44 patients with subcondylar fractures of the mandible. All fractures were displaced; either angulated between 10 degrees and 35 degrees or the ascending ramus was shortened by more than 2 mm and patients were followed up after 6 months. Nonparametric data were compared for statistical significance with a chi (2) analysis and parametric data with an independent samples t test (P < .05).

In this study the author found that correct anatomical position of the fragments was achieved significantly more accurately in the operative group in contrast to the closed treatment group. Regarding mouth opening/lateral excursion/protrusion, significant (P = .00) differences were observed between both groups (open 39.6/12.5/5.9 mm vs closed 33.5/9.8/4.1 mm). The visual analogue scoring revealed significant (P = .00) difference with less pain in the operative treatment group (1.1 open vs 5.2 closed). No statistically significant difference was found between the 2 groups for occlusion (P = .86). The author finally concluded that both treatment options for condylar fractures of the mandible yielded acceptable results. However, operative treatment was superior in all objective and subjective functional parameters except occlusion.

“Open and closed treatment of unilateral subcondylar and condylar neck fractures”.

In the second trial by Anil. K. Danda et al 2010. A total of 32 patients with displaced unilateral condylar fractures were included in the present study.

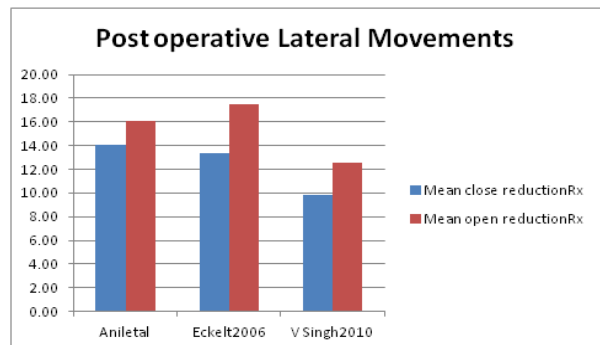
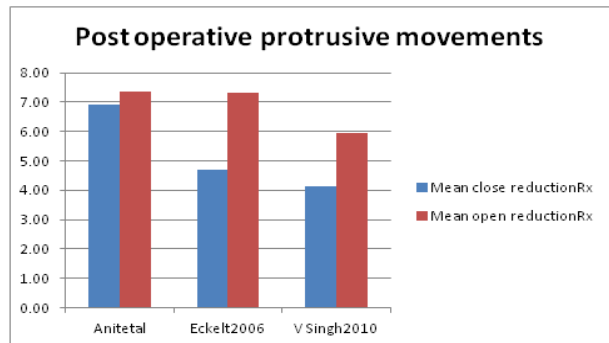
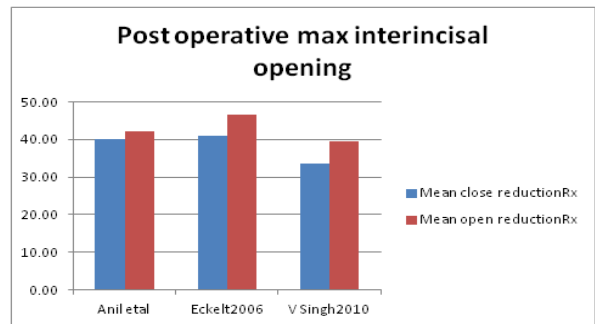
Finally the author concluded that the results of the present study have shown that no significant clinical difference exists between patients undergoing closed treatment with rigid maxillo-mandibular fixation or open reduction and internal fixation. However, a radiographically better anatomic reduction of the condylar process was seen in the patients treated with open reduction and internal fixation.

3rd trial:

Open versus closed treatment of fractures of the mandibular condylar process- a prospective randomized multi-centre study.

In the 3rd trial by Eckelt et al 2006. 66 patients were taken into study. The author found that Correct anatomical position of the fragments was achieved significantly more often in the operative group in contrast to the **closed treatment** group. Regarding mouth opening/lateral excursion/protrusion, significant (p=0.01) differences were observed between both groups (**open 47/16/7 mm versus closed 41/13/5 mm**). The visual analogue scoring revealed significant (p=0.03) differences with less pain in the operative **treatment** group (**2.9 open versus 13.5 closed**).

The Mandibular Function Impairment Questionnaire index recorded a significant (p=0.001) difference with less pain and discomfort in the **open treatment** group (**10.5 versus 2.4 points**). The author concluded that both **treatment** options for condylar **fractures** of the mandible yielded acceptable results. However, operative **treatment**, irrespective of the method of internal fixation used, was superior in all objective and subjective functional parameters.

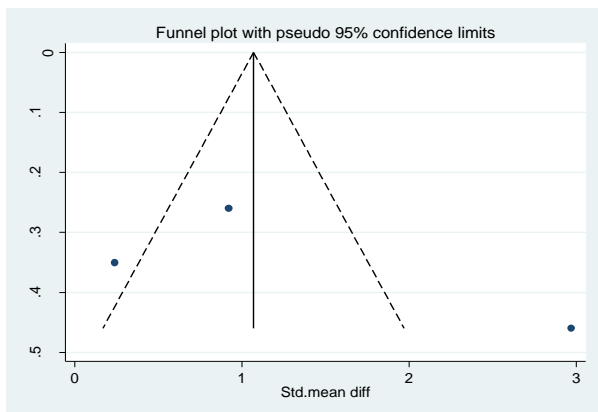
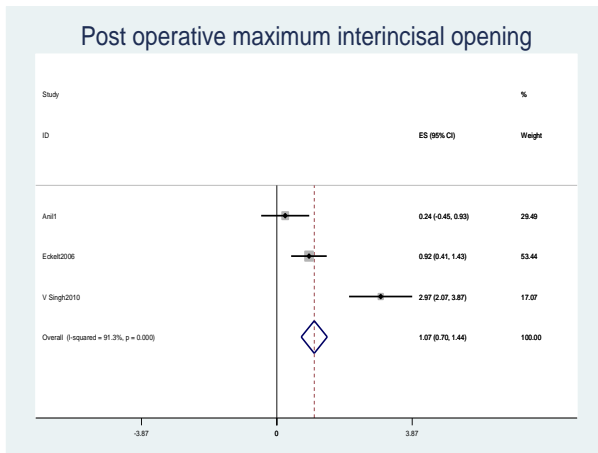


The results of the Meta analysis as follows:

Study	ES*	[95% Conf. Interval]	% Weight
Anil1	0.240	-0.446 0.926	29.49
Eckelt2006	0.920	0.410 1.430	53.44
V Singh2010	2.970	2.068 3.872	17.07
I-V pooled ES	1.069	0.697 1.442	100.00

Test of ES=0: z= 5.63 p = 0.000
 The effect sizes by these methods are significantly different from the Null effect of "zero".
 * ES is the standardized mean difference [(mean1-mean2)/SD]

FOREST PLOT FOR MAXIMUM INTERINCISAL OPENING



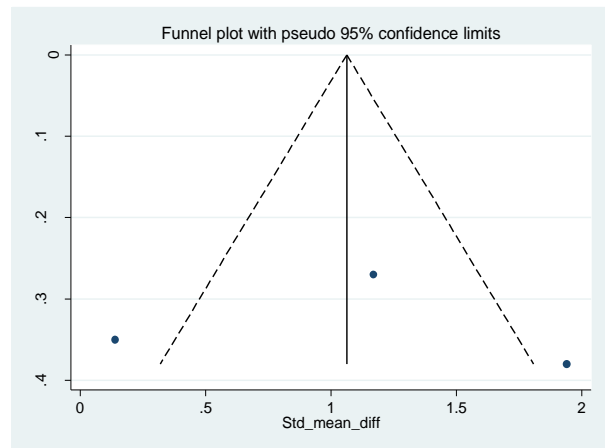
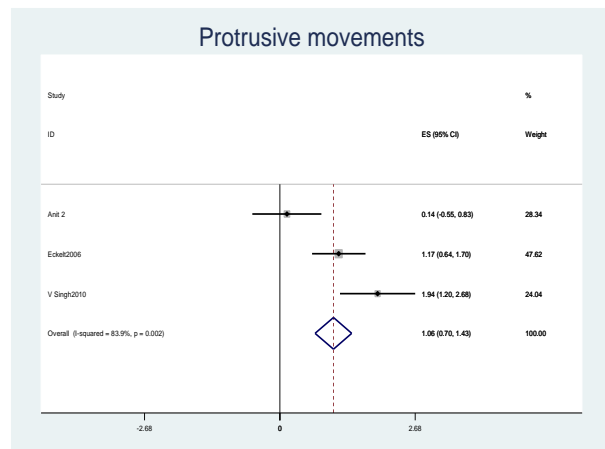
- Heterogeneity of effect size of each study is observed.
- Heterogeneity chi-squared = 23.02 (doff. = 2) p = 0.000
- Variation in ES attributable to heterogeneity = 91.3%.

Meta analysis of Protrusive movements:

Study	ES	[95% Conf. Interval]	% Weight
Anita 2	0.140	-0.546 0.826	28.34
Eckelt2006	1.170	0.641 1.699	47.62
V Singh2010	1.940	1.195 2.685	24.04
I-V pooled ES	1.063	0.698 1.428	100.00

Test of ES=0: z= 5.71 p = 0.000
 The effect sizes by these methods are significantly different from the Null effect of "zero".

FOREST PLOT FOR PROTRUSIVE MOVEMENTS:



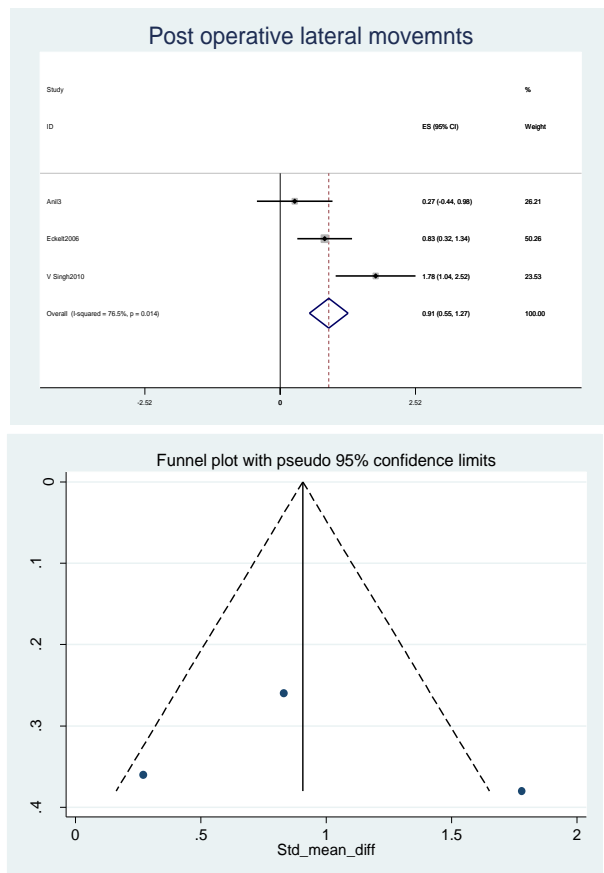
- Heterogeneity chi-squared = 12.44 (doff. = 2) p = 0.002
- Heterogeneity chi-squared = 12.44 (doff. = 2) p = 0.002
- Variation in ES attributable to heterogeneity = 83.9%

Meta analysis of Post operative lateral movements:				
Study	ES	[95% Conf. Interval]		% Weight
Anil3	0.270	-0.436	0.976	26.21
Eckelt2006	0.830	0.320	1.340	50.26
V Singh2010	1.780	1.035	2.525	23.53
Pooled ES	0.907	0.545	1.268	100.00

Test of ES=0: z= 4.92 p = 0.000

The effect sizes by these methods are significantly different from the Null effect of “zero”.

FOREST PLOT FOR LATERAL MOVEMENTS



Elements of heterogeneity are found.
 Heterogeneity chi-squared = 8.50 (doff. = 2) p = 0.014
 Variation in ES attributable to heterogeneity = 76.5%

DISCUSSION

The purpose of this review was to assess the efficacy of treating mandibular condylar fracture with open and closed reduction methods.

In this review, we examined 3 randomized control trials comparing open and closed reduction method of treatments for mandibular condylar fractures. So a total of 138 patients are evaluated. They are

randomly allotted to closed method and open method of treatments, out of 138 patients, 68 patients were treated by closed reduction type and 70 patients were treated by open reduction. Anil et al found that there is no significant difference between two methods of treatment with relation to primary outcomes like maximum mouth opening, protrusion and lateral movements of mandible. But he observed significant difference between two groups with regard to anatomic reduction of fracture segment. But other two authors are of view that there is statistically significant difference between two types of treatments with regards to both primary and secondary outcomes.

The analysis reveals that open reduction a method of treating mandibular condyle fracture has better outcomes with regard to parameters like post-operative mouth opening[standard mean difference ES=1.069 with the confidence interval of 95%.heterogeneity is chi squared 23.02]and for protrusive movements[standard mean difference ES=1.063 with 95% Confidence interval. Heterogeneity chi-squared = 12.44 (doff. = 2) p = 0.002] and also for lateral movements of the mandible [standard mean differences=0.0907 with the confidence interval of 95%.Heterogeneity chi-squared = 8.50 (doff. = 2) p = 0.014.

So this Meta-analysis favouring open reduction method of treating condyle fractures when these above parameters are to be considered.

For the treatment of Mandibular condylar fracture in children, most authors and literature consent towards closed reduction method. But recently many authors are agreeing for Open reduction method due to advent of modern technologies like minimally invasive surgeries [endoscopic surgery] ,also due to advances in the plating system with restorable plates and the vast experience and greater confidence of surgeons with open reduction and internal fixation methods.

But in case of treating adult condylar fractures, nobody is accepting for specific treatment method because it solely depends on the selection of case as well as the experience of surgeon in treating condylar fracture. . Factors to be considered before treating adult condyle fracture are side involved, level and displacement of fracture, teeth present for occlusion. Movement of mandible, surgical access for fractured site, facial nerve injury, and associated other fractures.

TABLE 1: Indications for open reduction and rigid internal fixation of mandibular condyle fractures (MITCHELL, 1997; HAUG and ASSAEL, 2001; BRANDT and HAUG, 2003).

Absolute Indications	Relative Indications
If patient wants to fix it	Bilateral condyle fracture in edentulous patient.
If pre traumatic occlusion cannot be achieved by closed method	In case where IMF and physiotherapy is not possible due to medical reasons
If we are planning for rigid fixation of other facial fracture.	Bilateral condyle fracture associated with mid face fracture and skeletal deformities o jaws.
In case of partially edentulous and periodontally weak teeth where we cannot achieve occlusion.	Unilateral condyle fracture with unstable base
Fractured condyle displaced to middle cranial fossa	If patient’s compliance is not possible
Foreign bodies	In patients with medical conditions like seizure disorders,
Lateral displacement of fractured condyle. Open fracture where there is lot of chances for alkalosis.	Status asthmatics patient. Mentally retarded and patients under anti-psychotic drugs.

TABLE 2: Contraindications to open reduction and rigid internal fixation of mandibular condyle fractures (MITCHELL, 1997; HAUG and ASSAEL, 2001; BRANDT and HAUG, 2003).

Contraindications.

Absolute contraindications	Relative contraindications
Condylar head fracture	In case where simple closed treatment itself gives good result and occlusion
Comminuted fracture of head of condyle	Fracture of the neck of condyle
Medically compromised patients for general anesthesia	Neurological status of the patient.
Good occlusion	
Adequate lateral movements of mandible	
No major complaint from patient like pain	

Ellis and Throckmorton compared vertical height of mandible and symmetry of face following open and closed reduction method of treating condylar fractures in 146 patients, 81 treated by closed and 65 by open methods. The patients treated by closed methods had significantly shorter posterior facial and ramus heights on the fractured side resulting in facial asymmetry.

In prospective study of Ellis with 64 patients comparing radiographic images of operated condyle with that none operated other side condyle, he found that only 2 degrees difference between the two, which is not significant statically. This study showed that it is possible to anatomically reduce the fractured condylar process.

Ellis, Simon and Throckmorton. In their study with 137 unilateral condyle fracture patients has compared the post-operative occlusal relationships between open and closed treatment methods. They concluded the patients treated by closed techniques had a significantly greater percentage of malocclusion compared with patients treated by open reduction, in

spite of the initial displacement of the fractures being greater in patients treated by open reduction.

Oliver et al in his 2010 systematic review in Cochrane, concluded that there is a lack of high quality evidence relevant to interventions considered in his review topic and so the effectiveness of the two interventions considered in his review cannot be ascertained. Therefore, clinical decisions should be based on clinical experience, individual circumstances and in conjunction with patient preferences and choices where appropriate.

Because of the relatively poor quality of the available data and the lack of other important information, the question of preferred treatment still remains unanswered, and there is clearly a need for further research. The authors propose that in future investigations the patients need to be randomized into treatment groups, and the examiners need to be blinded to the manner in which the patients are treated and similar methods of treatment need to be used.

Standardized methods of fracture classification, as well as data collection and reporting, need to be established so that valid comparisons among studies can be made. Studies with adequate sample sizes to determine clinically meaningful effects should be undertaken.

The decision about the choice of the type of treatment must always take into consideration some of the factors, such as the patients' general health status, type of fracture, diagnostic precision, and mainly the capability, experience and skill of the surgeons in this type of lesion.

Conclusion

Good quality research exists on the efficacy of closed and open modalities of treating condyle fractures. Only three suitable Randomized control trial were obtained following a literature search by two different investigators. All the studies showed good post-operative increase in mouth opening, protrusive and lateral movements in open reduction treatment.

There is also significant differences in secondary outcomes like pain malocclusion, mandibular deviation and shortening of ramus and mandibular function .But we cannot conclude that open reduction treatment is the best treatment method for mandibular fracture because there are heterogeneity involved in this study regarding type of fracture and which type of treatment, follow up etc. There is a lack of high quality evidence relevant to open and closed treatment of condyle fracture. Even this review is in favor of open treatment we cannot come to conclusion because of minimal availability of high quality RCT'S. Therefore, clinical decisions should be based on clinical experience, individual circumstances and in conjunction with patient preferences and choices where appropriate.

There is a need for well conducted randomized controlled clinical trials, important consideration should be given to the method of randomization, justifying sample size, allocation concealment, blinding of the outcome assessor and reasons for patients lost to follow-up should be considered during the planning, conducting and reporting phase of the study. Factors such as classification of fracture which should also be standardized and other factors such as quality of life; patient satisfaction levels and costs should also be investigated and reported.

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