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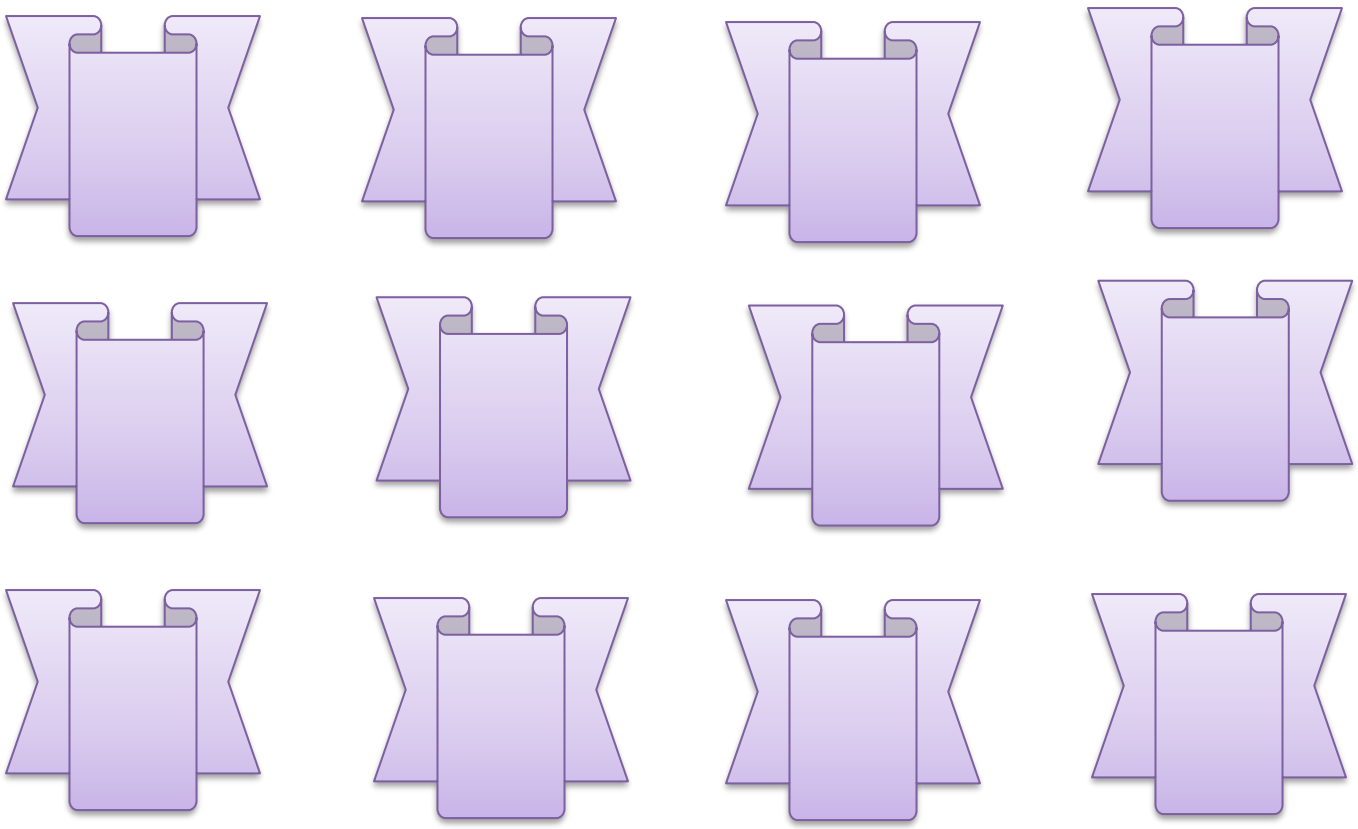

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Original Article

Open versus Closed Techniques in Management of Unilateral Sub-condylar Mandibular Fracture: A Meta-Analysis Study

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ABSTRACT

Background and aim: Management of sub-condylar fractures has been controversial for the last few years. Many surgeons think that closed treatment [CT] is better than reduction and internal fixation [ORIF] and say that there is no clinical significance between CT and ORIF. For this reason, many surgeons consider ORIF to be the best option for sub-condylar fractures.

Materials and Methods: Meta-analysis study to assess the potentiality of Open versus Closed techniques in management of unilateral subcondylar mandibular fractures which was performed In Adult, healthy Patients, and the outcome were investigated in our review which are the range of mandibular motion for a follow up period not less than 6 months.

Results: Studies included in meta-analysis were four papers , in relation to Maximal interincisal opening [MIO] , protrusive movement [PM] , and Lateral Excursion towards Non-Fracture Side [LENFS] , the mean difference were in favor of ORIF than closed treatment but the difference between the two groups was insignificant with MIO [MD = 2.80, 95% CI = [-0.70, 6.30], P value = 0.12] , PM [MD = 0.61, 95% CI = [-0.82, 2.04], P value = 0.40] , LENFS [MD = 1.66, 95% CI = [-0.48, 3.80], P value = 0.13], BUT in Lateral excursion towards fracture side [LEFS] , The mean difference of change was in the favor of ORIF and the difference between the two groups was significant [MD = 2.07, 95% CI = [1.56, 2.58], P value = 0.001].

Conclusion: Both treatment modalities provide acceptable outcomes with regards to mandibular motion. Our study favors open treatment for the management of displaced sub-condylar Mandibular fractures, and it is the favorable technique.

Keywords: Maxillofacial trauma; Mandibular fracture; Open reduction and internal fixation; Maxillary mandibular fixation.

INTRODUCTION

The mandibular sub-condylar fractures are the most controversial in terms of prognosis and treatment in the field of maxillofacial trauma, as evidenced by the wide range of reviews [1]. It was considered the most common maxillofacial fractures is that concerning the mandible [57%] Mandibular condylar fractures represent 18% to 57% of all mandibular fractures [2].

The treatment of condylar fractures has been controversial for the last few years. Many surgeons prefer to use CT and claim that there is no clinical difference between CT and open reduction and internal fixation [ORIF]. In addition to cast off the complications from the surgical operation itself, the use of CT additionally eliminates the morbidity associated with the surgical procedure, anesthesia, and related complications [3, 4].

Whether in prefer of ORIF or CT may be greatly be due to the shortage of standardization of variables related to the patients. those variables include the extent of the fracture, degree of displacement and whether or not the fracture is bilateral or unilateral. all these can act as confounding factors that can highly affect the treatment effects [4-6].

In our systematic review, we've got made an attempt to include and standardize all variables with either ORIF or Closed treatment [CT].as Up to date literatures still show a shortage regarding the beneficial effect of Open versus Closed techniques in management of unilateral sub-condylar mandibular fracture.

PATIENTS AND METHODS

Objective: Meta-analysis study to assess the potentiality of Open versus Closed techniques in management of unilateral subcondylar mandibular fractures.

Types of Participants: Adult, healthy patients, with unilateral displaced subcondylar mandibular fracture.

Types of Intervention: Open Reduction and Rigid Internal Fixation [ORIF]

Types of Comparison: Closed Treatment [CT].

Types of Outcomes: The outcome was investigated in our review which are the variety of mandibular motion; Measuring units of the outcome are shown in Table [1].

Table [1]: Functional outcome [Range of Mandibular Motion]

Outcome	Measuring unit/index
Range of mandibular movements	Maximal inter-incisal opening [MIO]
	Protrusive movement [PM]
	Lateral excursion towards the fractured side [LEFS]
	Lateral excursion towards the nonfractured side [LENFS]

Methods

1. Protocol and registration: This systematic review was reported according to the of **PRISMA** [preferred reporting items for systematic reviews and meta-analyses] statement. This systematic review was registered at plastic and reconstructive surgery Department, Faculty of Medicine, Al-Azhar University.

2. Eligibility Criteria: Trials included in this systematic review are characterized by the following: participants, interventions, outcomes and follow up periods' characteristics.

2.1 Study characteristics

A. Types of participants: Trials, including participants characterized by being 16 years of age or older who are suffering from unilateral displaced sub-condylar Mandibular fractures. Participants should not have any previous history of TMJ dysfunction. Any sub-condylar Mandibular fracture level with a degree of displacement between 10 to 45 degrees as viewed by the Panoramic view, CT or CBCT with vertical shortening of the ramus of 2 mm or more are included into our review.

B. Types of interventions: Studies comparing range of mandibular motion in groups of patients treated with any method of ORIF with groups treated with any method of CT.

C. Types of outcome measures: All studies with measurements of mandibular motion, aesthetic outcome, time of recovery and complications are reported [Table 1].

Primary outcomes: The mandibular motion following either the intervention or the control.

D. Follow up periods: Not less than 6 months post-treatment were included.

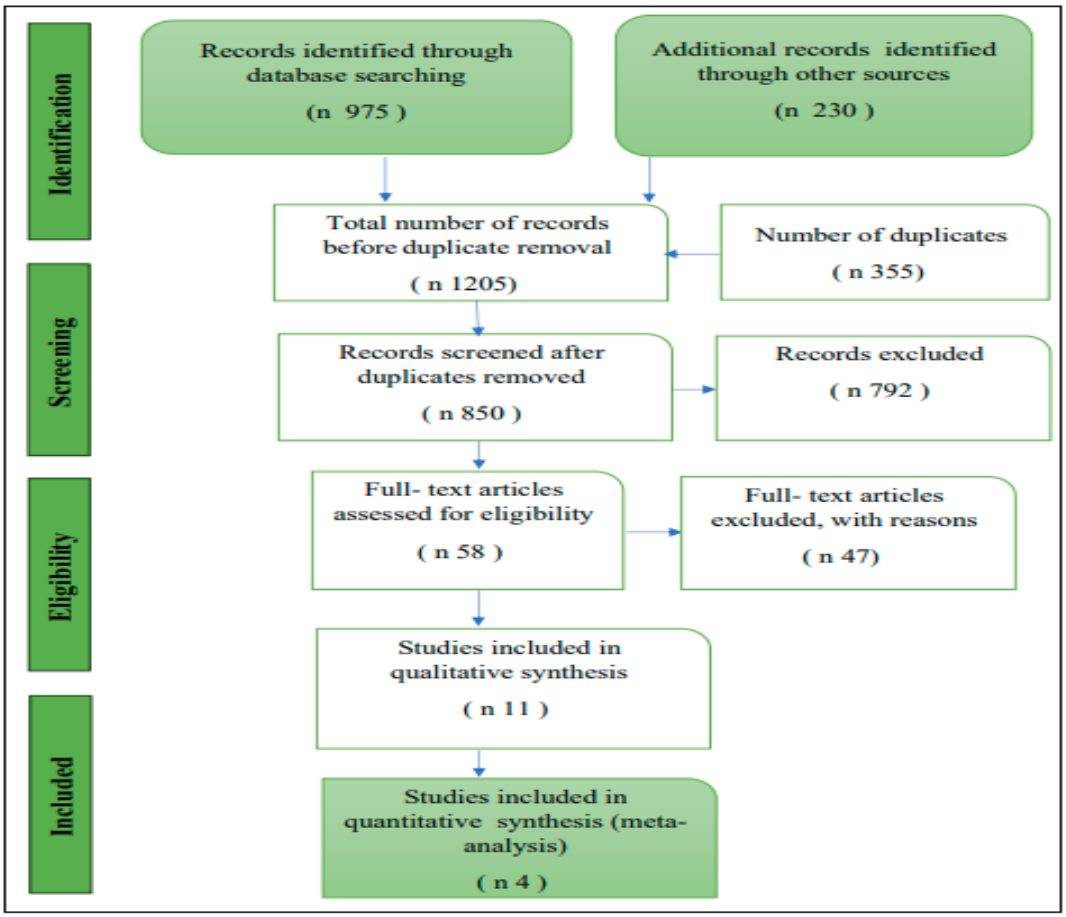

Table [2]: Study selection: [Table [2] PRISMA flowchart]

E. Study design: Randomized, non-randomized clinical trials and observational studies comparing open reduction and internal fixation to closed treatment in unilateral displaced sub-condylar Mandibular fracture with regards to mandibular motion, aesthetic outcome, time of recovery and complications.

2.2 Reporting characteristics: Publications in English language only were to be included in our review. There was limitation to the year of publication and only those studies that were published are to be included.

2.3 Inclusion and Exclusion Criteria

Inclusion criteria : Studies comparing open reduction and internal fixation versus closed treatment with regards to mandibular motion, studies on humans, comparative studies [randomized and non-randomized Clinical Trials] and observational studies, Adults [aged > 16 years old], patients with unilateral displaced sub-condylar mandibular fracture with no other mandibular fractures, post-operative follow-up is up to 6 months, no previous history of TMJ dysfunction, any sub-condylar fracture level with a degree of displacement between 10 to 45 degrees as viewed by the Panoramic View , CT or CBCT, vertical shortening of the ramus more than 2 mm and studies in English only.

Exclusion criteria: Studies comparing various open reduction and internal fixation approaches and procedures or studies comparing ORIF with CT with outcomes other than range of mandibular motion, cross-sectional studies, case reports, case series or any systematic reviews, Patients with Bilateral or any other Condylar Process Fracture **[CPF],** Non-displaced sub-condylar Mandibular fractures.

3. Information Sources

Search Terms: A literature search will be performed in PubMed, Cochrane, PLOS which are index in Clarivate - Scopus listed articles and web of science, approach through Egyptian Knowledge Bank [EKB] to download the articles from [2000 till 2022]. It gives us listing of included researches as shown in Table [3].

Table [3]: List of included studies

Author	Source	Included in Quantitative Synthesis	Included in Qualitative Synthesis
Danda *et al.* [7]	Cochrane	Included	Included
Singh *et al.* [8]	Cochrane	Included	Included
Rastogi *et al.* [9]	LILACS PubMed	Excluded- no statistical data available for meta-analysis	Included
Yang *et al.* [10]	LILACS PubMed	Excluded- insufficient statistical data	Included
Leiser *et al.* [11]	Free Hand Search	Excluded – measurements were qualitative	Included
Throckmorton and Ellis [12]	Free Hand Search	Excluded – insufficient statistical data for analysis.	Included
Throckmorton *et al.* [13]	Cochrane	Excluded – insufficient statistical data for analysis.	Included
Shiju *et al.* [14]	Cochrane	Excluded – same participants as in the study by **Rastogi *et al.*** [9] AND, insufficient statistical data for analysis	Included
Schneider *et al.* [15]	Cochrane	Excluded- insufficient statistical data	Included
Lee *et al.* [16]	PubMed	Included	Included
Singh *et al.* [17]	PubMed	Included	Included

4. Study selection: Selection of research covered in systematic review:

4.1. Data Management: The previously mentioned databases and search strategy will be uploaded individually into [EndNote] software; each one will be in a separately named folder according to the name of the used database.

4.2 Selection Process: Screening and duplicates removal of the articles and proper study selection was done through Automatically duplicates removal by the aid of [EndNote] Software, if not it was selected manually.

5. Data items

Variables for which data were sought: Data from the included studies are to be extracted into the customized data extraction forms. Due to the presence of multiple variables, we have constructed a table for each variable. This included:

[1] A table for demographic findings having the following items as shown in table 4: Age [Mean], sex, cause of fracture, and number of participants.

[2] A table for the methodology having the following items as shown in table 5: Study type, setting [Study design], Type of hardware used in CT or ORIF, Method used in treating associated mandibular fractures, and Follow up period. A table for results to deal with the outcomes of condylar fractures treated with ORIF to those treated with CT, regarding range of mandibular motion.

6. Risk of bias within person and across the studies

For both the randomized and non-randomized clinical trials the risk of bias will be assessed. Accordingly, randomized clinical studies will be rated as having low, unclear or high risk of bias.

The Cochrane Collaboration's tool for assessing the risk of bias domains: Sequence generation, Allocation concealment, Blinding of participants, personnel and outcome assessors, Incomplete outcome data, Selective outcome reporting, and Other sources of bias.

RESULTS

1. Type of hardware used in Closed Treatment [CT] groups as shown in table 5: In **Rastogi *et al.*** [9] and **Leiser *et al.*** [11] the method of CT was mentioned more precisely than the remaining articles. **Rastogi *et al.*** [9] mentioned the use of Erich's arch bar to obtain Occlusion by Producing rigid MMF. **Leiser *et al.*** [11] used arch bars for MMF in the non-surgical group of patients, the arch bars were fixed to the maxilla and mandible with the use of size 0.4 mm and 0.5 mm stainless steel wires. In the rest of the articles either rigid MMF by arch bar or interdental screws and/or EMMF were used without giving details on the type of hardware used.

2. Level and classification of condylar process fractures: There has always been a change in the nomenclature of CPFs in the literature. The anatomical term ―sub-condylar is sometimes referred to by the term ―condylar neck or ―condylar base ― Some of the fracture lines in the ―intracapsular fractures of the condylar head extend to involve the condylar neck. The terms dislocated and displaced CPF are used interchangeably in the literature. All CPFs in the included studies are displaced with variable degrees of displacement. Three articles [9, 14, 15] used the Loukota classification of CPF to define the sub-condylar and condylar neck fractures.

In two articles [7, 10], no particular definition or classification system was assigned to identify the sub-condylar fractures. However, in **Yang *et al.*** [10], the degree of displacement was classified by the author according to the degree of the condylar process displacement. **Throckmorton *et al.*** [13] and **Throckmorton and Ellis** [12] used their own classification of the CPFs. Those fractures extending below the most inferior point of the sigmoid notch were considered sub-condylar fractures. Meanwhile, the fractures involving the region below the condylar head but which are still above the sigmoid notch were considered as condylar neck fractures. This classification together with the classification proposed by Lindhal was used to define sub-condylar fractures in the study by **Singh *et al.*** [8]. **Leiser *et al.*** [11] did not mention the classification system used in defining the sub-condylar fractures. However, it was mentioned that those fractures that extended below the sigmoid notch were the only ones considered in the inclusion criteria of the study.

3. Degree of Displacement of the condylar process pre-treatment: In all of the articles, patients with displaced SCF were treated either with CT or ORIF. In six articles [8, 9, 10, 12, 13, 14], the degree of displacement between the fractured segment on the radiograph was mentioned. In **Singh *et al.*** [8], patients who received ORIF had an average degree of displacement of 19.3°. Meanwhile, the CT group had an average degree of 15.9°. In **Throckmorton *et al.*** [13] **and Throckmorton and Ellis** [12] the mean degree of displacement for the CT group was 11.4° and for the ORIF group it was 22.4°. In **Rastogi *et al.*** [9] **and Shiju *et al.*** [14] the mean displacement in the ORIF group was 23° while that in the CT group was 17°. In **Yang *et al.*** [10], there was a huge difference between the degree of displacement of the condylar fragments among the surgical and the non-surgical groups. In the ORIF group the mean degree of displacement on the coronal plane was 45.46°, whereas, in the CT group the degree of displacement was 3.5°. because of this, the choice bias turned into present as significantly displaced fractures had been managed via ORIF. In 3 articles [7, 11, 15], the degree of displacement of the pre-treated fractured condylar process was not mentioned. However, **Danda *et al.*** [7] and **Schneider *et al.*** [15] included participants with degree of displacement between 10° and 45° in their studies. **Leiser *et al.*** [11] mentioned only displaced SCF and did not specify the degree of displacement.

4. **Presence of systemic diseases that can affect bone healing:** In all of the included studies, the presence of a medical history the might affect bone healing among the participants was not mentioned. However, the presence of any kind of systemic disease was considered an exclusion among the participants in the study by **Rastogi *et al.*** [9] and **Shiju *et al.*** [14]. In **Leiser *et al.*** [11], the presence of systemic conditions such as uncontrolled diabetes mellitus, epilepsy, anorexia and chronic obstructive pulmonary disease were considered an indication for ORIF and a contraindication of CT.

5. Outcomes and follow up periods as shown in table 5:

- Maximum Inter-incisal opening was reported in all of the articles [7-17].

- Protrusive Excursion Movement was measured in 7 articles [7, 8, 9, 12-15]. **In Leiser *et al.*** [11]**, Lee *et al.*** [16] **and Yang *et al.*** [10]**,** only the MIO was reported. Lateral Excursion Movement was measured in 8 articles [7, 8, 9, 12, 13, 14, 15, 17]. In 2 articles; **Singh *et al.*** [8] and **Schneider *et al.*** [15], the sum of LEFS and LENFS was reported.

1. Follow up periods as shown in table 5: Seven articles [8, 9, 10, 12-15] said the comply with up 6 months after the preliminary remedy. but, in 2 articles [7, 11], the follow up was reported as a range. In **Danda *et al.*** [7], the follow up time for the intervention was in a range from 4-24 months, meanwhile that of the comparator was given in a range from 9-39 months. **Lesier *et al.*** [11] reported a mean observe up period of 28.2 months for the intervention as compared to 49.2 months within the comparator, in **Lee *et al.*** [16] follow up period was ≥ 3 months, and in **Singh *et al.*** [17] follow up period of 1, 3, 6 months.

2. Risk of bias within studies as shown in figure 5: Confounders and co-interventions that might affect the study results were extracted before assessing the risk of bias within each study. Both can be viewed in the following sections.

8.1 Confounders: After immense literature search, relevant confounders that were identified were extracted. These included methods of CT and ORIF, the type of hardware used in each treatment group, level and classification of CPFs, degree of displacement of the condylar process pre-treatment, presence of systemic diseases that can effect bone healing, age of the participants, how AMFs were treated, surgical experience of the operators, tool used in measuring the range of mandibular motion.

8.2 Co-interventions: The co-interventions reported in the included studies are: post-treatment physiotherapy and post treatment jaw exercise, postsurgical MMF in the ORIF group, post-treatment guiding elastics and EMMF in the CT group. Risk of Bias across Studies as shown in figure 6; presented as chances across all blanketed research.

9.1 Sequence generation: In the included RCTs, 3 studies [7, 8, 15] were judged as low risk. However, the 2 studies [9, 14] were judged to have an unclear risk with regard to sequence generation. This was due to the Insufficient information about the process of randomization, it was only mentioned that participants were randomly divided into 2 groups. In **Danda *et al.*** [7], it was mentioned that patients were randomized by lots using closed envelope. Meanwhile, in **Schneider *et al.*** [15], the type of treatment selected by the participants was done by allowing them to open a sealed envelope. This envelope was prepared by the study coordination center and approved by other centers.

9.2 Allocation concealment: All of the included RCTs were judged as having an unclear risk of bias with regards to the allocation concealment by the review authors. In three articles [7, 8, 15], the study mentioned the use of a sealed envelope but it was unclear whether the envelopes were opaque or sequentially numbered. Meanwhile, in **Rastogi *et al.*** [9] and **Shiju *et al.*** [14], the method of concealment was not identified.

9.3 Blinding of participants and Personnel: In the included RCTs, 3 studies [7, 8, 15] were judged as low risk because there was no blinding and it was found that the outcome will not likely be affected by the blinding. In **Rastogi *et al.*** [9] and **Shiju *et al.*** [14] the issue of blinding was not addressed and accordingly they were given an unclear risk of bias.

9.4 Blinding of the outcome assessment: two studies [7, 8] were judged to have a low risk of bias. **In Danda *et al.*** [7], the assessor who evaluated the patients postoperatively was blinded to the treatment protocol. While in **Singh *et al.*** [8], outcomes were measured by 2 residents who were not involved in the treatment planning or subsequent procedures. **Rastogi *et al.*** [9] **and Shiju *et al.*** [14] were judged to have an unclear risk of bias because the study did not address the issue of blinding. **Schneider *et al.*** [15] was considered as having a high risk of bias because there was no blinding and range of mandibular motion is considered assessor dependent and therefore the outcome is likely to be influenced.

9.5 Incomplete outcome data: Three studies [7, 8, 15] were judged as low risk because there were no missing outcome data. However, **Rastogi *et al.*** [9] and **Shiju *et al.*** [14] were considered to have a high risk of bias because data for the range of mandibular motion was completely missing.

9.6 Selective Reporting: four studies [7, 9, 14, 15] were considered to have a high risk of bias. **Rastogi *et al.*** [9] **and Shiju *et al.*** [14] did not mention the effect of treatment on motor and sensory function of facial nerve in the results. In **Schneider *et al.*** [15], the deviation of mouth opening or malocclusion in the study groups was not reported. In **Danda *et al.*** [7], the quantification of pain in the TMJ and mal-occlusion were not reported and therefore will not be able to be included in a meta-analysis.

9.7 Other bias: All of the studies were considered to have a high risk. In 3 studies [9, 14, 15], the method used in treating AMFs become no longer written. In **Danda *et al.*** [7], the follow up become now not targeted and became said within the form of a range. Meanwhile in **Singh *et al.*** [8], the treatment of AMFs become now not standardized for the treatment groups.

10. Results of individual studies: The results of the outcomes sought in this review are presented in the table [6].

10.1 Quantitative analysis

Four meta-analysis were reported in this systematic review including: Maximum inter-incisal opening [MIO], Protrusive Movement [PM], Lateral Excursion towards the Fractured Side [LEFS] and Lateral Excursion towards the Non- Fractured Side [LENFS].

1. Maximum Inter-incisal Opening [MIO]: The outcome was present in four studies [7, 8, 16, 17]. The mean difference was in the favor of ORIF but the difference between the two groups was insignificant [MD = 2.80, 95% CI = [-0.70, 6.30], P value = 0.12, Fig. 7]. The heterogeneity between studies was considerable and we used the random effect model [P value = 0.001, i2 = 94%].

2. Protrusive Movement [PM]: The outcome was present in three studies [7, 8, 17]. The mean difference of change was in the favor of ORIF but the difference between the two groups was insignificant [MD = 0.61, 95% CI = [-0.82, 2.04], P value = 0.40, Fig. 8]. The heterogeneity between studies was considerable and we used the random effect model [P value = 0.001, i2 = 90%].

3. Lateral Excursion towards Fracture

A. Side [LEFS]: The outcome was present in three studies [7, 8, 17]. The mean difference of change was in the favor of ORIF and the difference between the two groups was significant [MD = 2.07, 95% CI = [1.56, 2.58], P value = 0.001, **Fig. 9**]. The heterogeneity between studies might not be important and we used the fixed effect model [P value = 0.24, i2 = 29%].

B. Lateral Excursion towards Non-Fracture Side [LENFS]: The outcome was present in two studies [7, 8]. The mean difference of change was in the favor of ORIF but the difference between the two groups was insignificant [MD = 1.66, 95% CI = [-0.48, 3.80], P value = 0.13, **Fig. 10**]. The heterogeneity between studies was considerable and we used the random effect model [P value = 0.01, i2 = 85%].

Table [4]: Demographic findings of included studies

Study ID	Number of participants as shown in figure 3 and 4					Mean Age [years]	Gender as shown in figure 2		Etiology of the fractures [%]
	Total Number	Intervention	Comparator	Dropouts			Male	Female	As shown in figure 1
				Intervention	Comparator				
Danda *et al.* [7]	32	16	16	0	0	N/A >18 years	27	5	Road traffic A [75] Assaults [18.6] falling from H [6.7]
Leiser *et al.* [11]	37	21	9	0	0	27.1 for CR 30.2 for ORIF	24	6 4:1	FFH [46] RTA [30] IPV [24]
Rastogi *et al.* [9]	50	25	25	0	0	N/A >18 years	N/A	N/A	N/M
Schneider *et al.* [15]	41	18	23	0	0	N/A >18 years	N/A	N/A	N/M
Singh *et al.* [8]	40	22	18	0	0	30.6	33	7	RTA [60]
Yang *et al.* [10]	36	14	22	0	0	26.25 for ORIF 25.53 for CR	41	25	N/M
Lee *et al.* [16]	198	103	95	0	0	>12 years	147	51	N/M
Singh *et al.* [17]	20	10	10	0	0	29.8	N/M	N/M	**Group A:** RTA [70%] Assault [30%]. **Group B:** RTA [40%] Assault [30%] FFH [30%]

Table [5]: Methodology Characteristics

Study ID	Study design	Method of CT [time]	Method of fixation by open method			Other mandibular fractures [n]		observe up Time range	
			Surgical approach	Method of osteosynthesis		Intervention	Comparator	Intervention	Comparator
Danda *et al.* [7]	RCT	Rigid MMF [2 weeks] followed by Elastic MMF [2 weeks]	Preauricular approach, Sub-mandibular approach, TMAP, RM	1 or 2 miniplates followed by 2 weeks Elastic MMF	Not mentioned	ORIF	N/M	[21.5 M] 4-24 M	[22.3 M] 9-39 mo.
Leiser *et al.* [11]	RS	MMF under GA [14 days]	TMAP	1 or 2 AO osteosynthesis miniplates	Yes	There were no facial bones that needed further reduction in the inclusion.		Minimum 1 year [28.2 M]	Minimum 1 year [49.2 M]
Rastogi *et al.* [9]	RCT	Rigid Maxillo-Mandibular F [2 weeks] followed by guiding elastics [1 or 2 weeks].	Retromandibular approach	Single titanium miniplate	Yes	ORIF	ORIF	6 M	6 M
Schneider *et al.* [15]	RCT	Elastic MMF [10 days]	PR,SM,RM, PA,IA	Miniplates/ miniscrews/ lag screws	Yes	N/M	N/M	6 M	6 M
Singh *et al.* [8]	RCT	Elastic MMF [7-35 days] followed by guiding elastics	RM,TMAP	Miniplates and 3-5 days of guiding elastics	Yes	ORIF/CT	ORIF/CT	6 M	6 M
Yang *et al.* [10]	RS	Rigid MMF [3 weeks] followed by intermittent MMF.	EAORIF, PR	Rigid Miniplate followed by 1 week of MMF	Yes	ORIF	ORIF	1 W, 2 W, 1 M, 2 M, 3 M, 6 M, 1 Y	1 W, 2 W, 1 M, 2 M, 3 M, 6 M, 1 Y
Lee *et al.* [16]	RCT	Rigid MMF	RM	2 miniplates	N/M	N/M	N/M	≥ 3M	≥ 3M
Singh *et al.* [17]	RCT	Elastic MMF for period 7 – 42 days [mean 21 days].	RM	2 mm miniplates [MMF kept for 3-5 days post op.]	Yes	N/M	N/M	1, 3, 6 months follow up	1, 3, 6 months

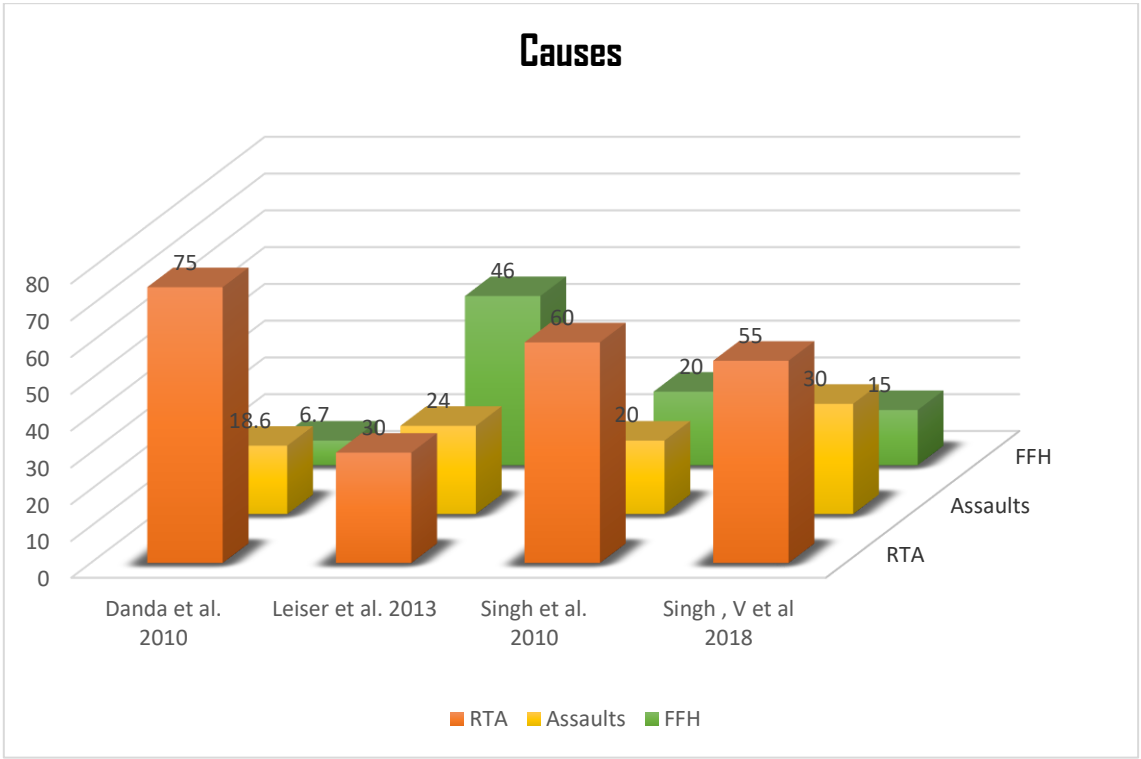

Figure [1]: Distribution of the studied cases according to cause of fractures

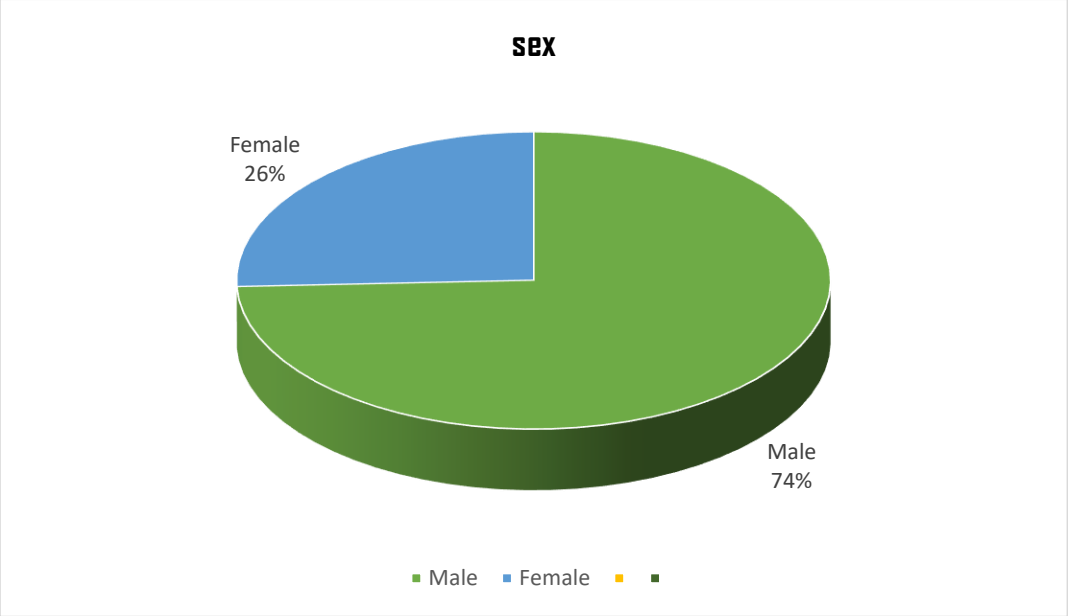

Figure [2]: Distribution of the studied cases according to sex

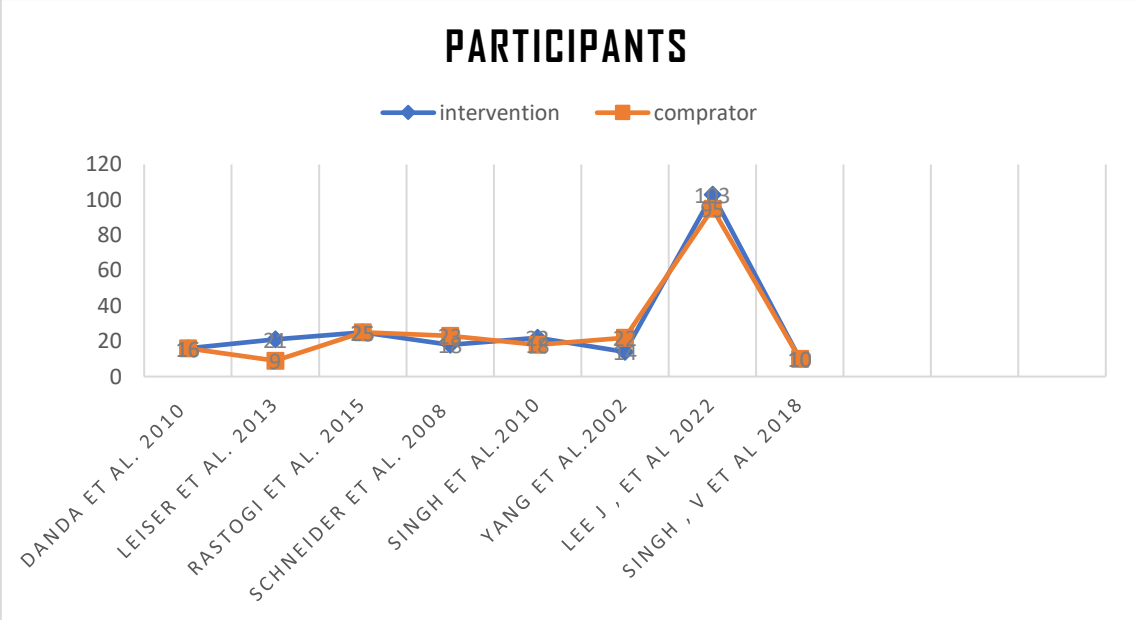

Figure [3]: Types of participants

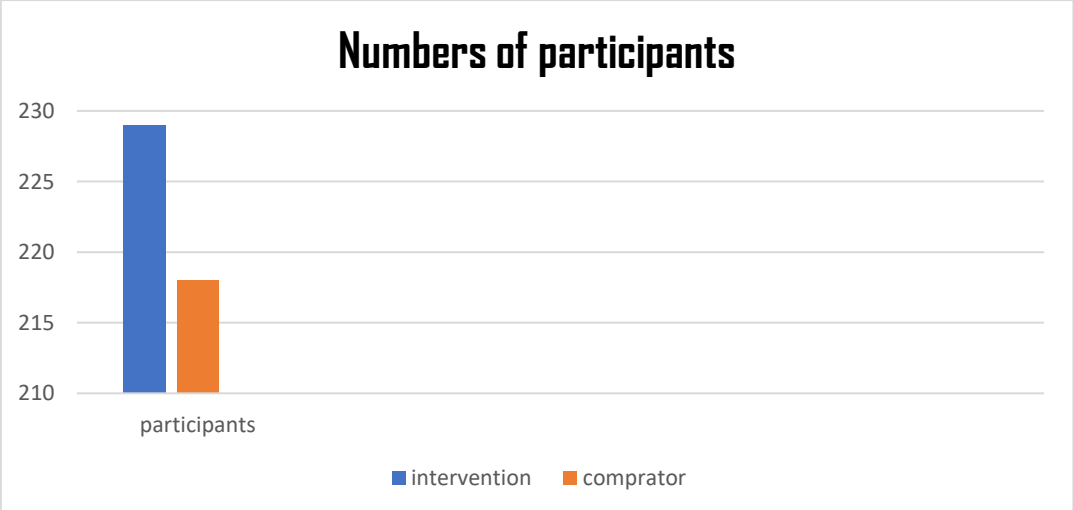

Figure [4]: Numbers of participants

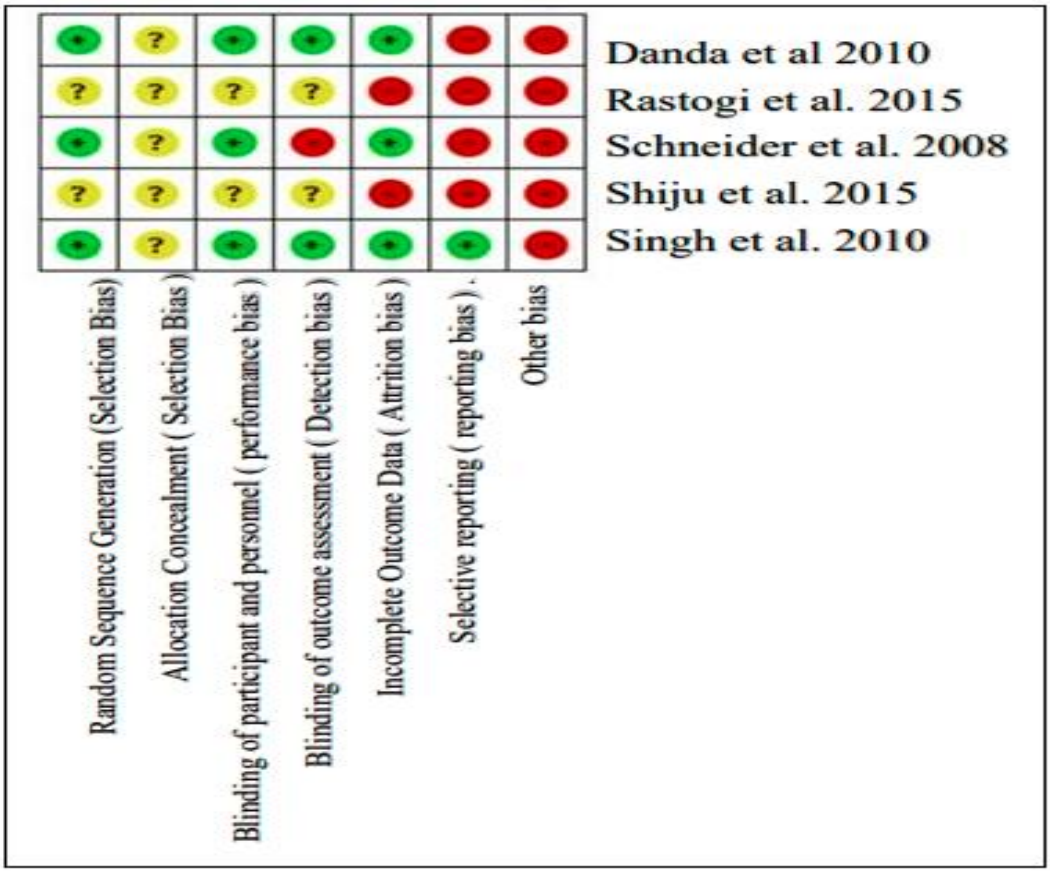

Figure [5]: Risk of bias for studies included

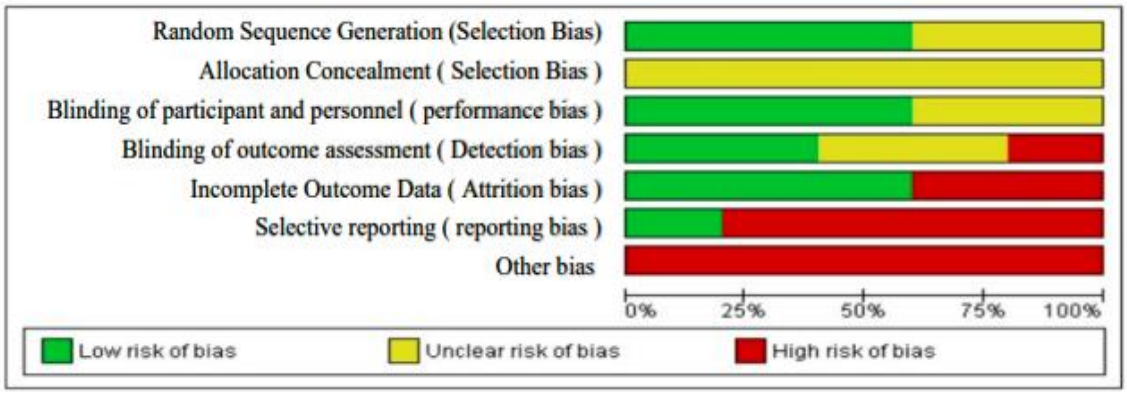

Figure [6]: Risk of bias graph: review authors' judgments about each risk of bias item presented as percentages across all included studies

Table [6]: Results of Outcomes across the studies included in the meta-analysis

		CT			ORIF		
		Mean	**SD**	**n**	**Mean**	**SD**	**n**
MIO	Danda *et al.* [7]	40.062	7.2	16	42.125	4.6	16
	Singh *et al.* [8]	33.54	1.89	22	39.61	2.22	18
	Singh *et al.* [17]	37.8	2.57	10	40.9	1.91	10
	Lee *et al.* [16]	30.07	4.2	95	30.5	4.7	103
PM	Danda *et al.* [7]	6.93	1.17	16	7.37	1.44	16
	Singh *et al.* [8]	4.13	0.77	22	5.94	1.1	18
	Singh *et al.* [17]	1.60	1.07	10	1.1	0.87	10
LEFS	Danda *et al.* [7]	6.5	1.46	16	8	2	16
	Singh *et al.* [8]	9.86	1.64	22	12.55	1.33	18
	Singh *et al.* [17]	4.8	0.78	10	6.7	0.82	10
LENFS	Danda *et al.* [7]	7.56	2	16	8.06	2.03	16
	Singh *et al.* [8]	9.86	1.64	22	12.55	1.33	18

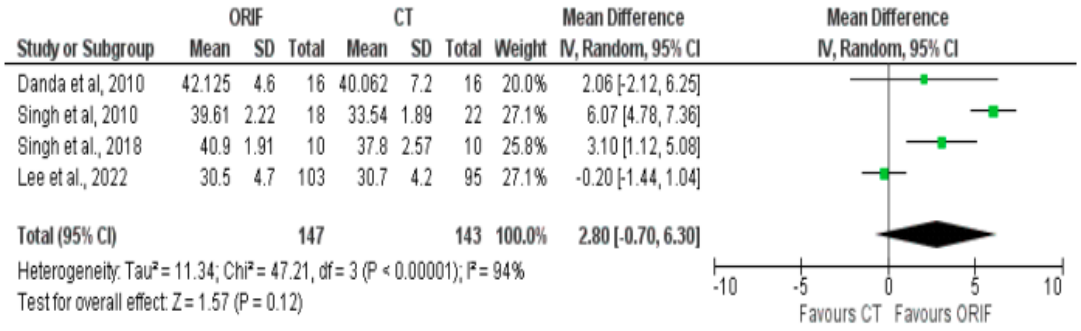

Figure [7]: Forest plot of random – effect meta-analysis for MIO measurements in the two groups

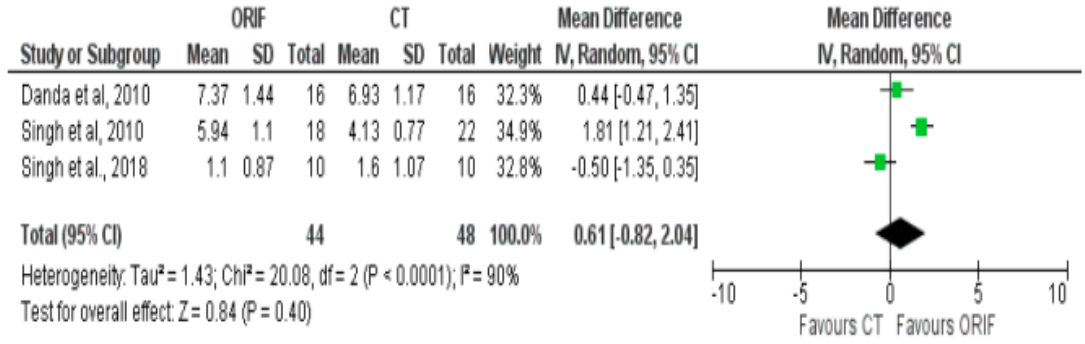

Figure [8]: Forest plot of random – effect meta-analysis for PM measurements in the two groups

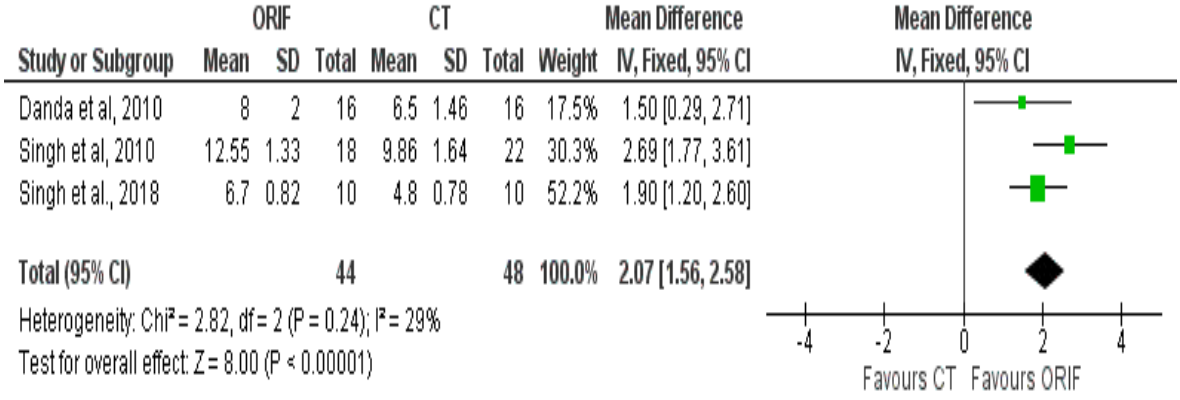

Figure [9]: Forest plot of random – effect meta-analysis for LEFS measurements in the two groups

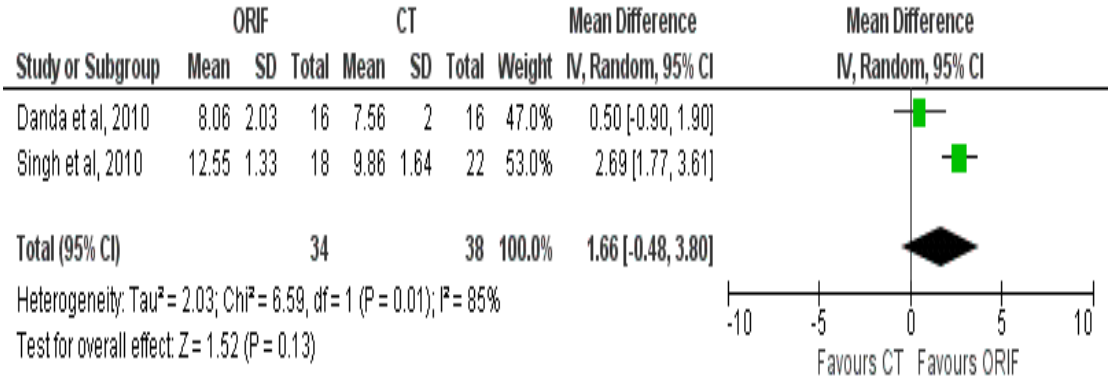

Figure [10]: Forest plot of random – effect meta-analysis for LEFS measurements in the two groups

DISCUSSION

The Mandibular motion was the primary and only outcome that was sought in this review. The risk of bias assessment for the RCT exposed serious limitations regarding the methodological qualities and reporting and all of the RCTs have been judged as having an excessive risk. NRCTs included in our review reported similar participants and were judged as high quality This review included a total of 447 participants. However, only 290 persons were included in the meta-analysis. The findings of the review advise superior results for mandibular motion in the ones sufferers treated by way of open method than the ones treated by CT. MIO, PM, and LENFS were prefer ORIF than CT which aren't statistically different among the 2 treatment groups. However, LEFS Was superior with ORIF which was statistically significant.

There are some studies with and others against results reported by our review. **Berner *et al.*** [18] conducted a systematic review and meta-analysis to evaluate ORIF and CT regarding mandibular motion, malocclusion and TMJ pain. eight research have been covered within the meta-analysis, four studies had been prospective RCTs [7, 8, 15, 19], four studies were RSs [12, 20, 21, 22]. From these, we had 2 studies covered in our meta-analysis; **Danda *et al.*** [7] and **Singh *et al.*** [8]. In our review, **Schneider *et al.*** [17] turned into best included in the qualitative statistics synthesis as there was insufficient statistical data to conduct a systematic review.

In the review by **Berner *et al.*** [18], the Standard deviation in **Schneider *et al.*** [15] was calculated based on an estimate using the equation [SD= interquartile range/1.349], this equation can be used in normally distributed data. However, the data in **Schneider *et al.*** [15] was not normally distributed and therefore, the use of this equation is highly disputed. Four studies [19-22] included participants with bilateral fractures. In addition, the degree of dislocation or displacement was variable among the participants in the studies. In **De Riu *et al.*** [21], some patients were presenting with non-displaced CPF. These findings could highly influence the results and could act as confounding variables that get effect on the results.

Moreover, it is worth mentioning the fact that some of the studies included in the review by **Berner *et al.*** [18] included participants with condylar head fractures. This appeared in 4 studies [12, 15, 19, 22]. Even though, the consequences for level of fracture became offered one after the other in **Eckelt *et al.*** [19], **Schneider *et al.*** [15] and **Throckmorton and Ellis** [12], no strive become executed to present a separate meta-analysis for each stage of sub-condylar fracture.

In **Berner *et al.*** [18], the MIO have insignificant distinction between the 2 groups with a 95% CI = –0.68 to 4.93, p = 0.14. these findings were barely similar to the results that have been reached via our review in which there has been no statistically extensive difference with 95% CI [-1.838 – 0.193], P-value = 0.112. but, the outcomes for laterotrusion and protrusion showed a statistically significant difference in prefer of open approach. these findings had been similar to those offered via our meta-analysis had been results preferred the ORIF as regards to LEFS.

In some other systematic review and meta-analysis by **Nussbaum *et al.*** [23], were mentioned it become impossible to carry out a reliable meta-analysis as a result of presence of big variations inside the manner study parameters. We strongly support this fact because we had to exclude a number of studies from the meta-analysis. Out of the 11 studies that met the inclusion criteria, we were only able to conduct a meta-analysis in 4 of them. We had to estimate the standard deviation from the mean, median and range values in two of the studies by using an equation. In spite of these drawbacks, **Nussbaum *et al.*** [23] determined to perform a meta-analysis besides and included thirteen research of their review. One of the studies [12] was included in our meta-analysis.

Out of the 13 included studies, 8 studies provided continuous data reporting the MIO. Their records explain that patients became treated with the aid of CT had higher mouth opening [MIO] than those dealt with by way of ORIF, 95% CI 0.02 to 0.68, P < .05. these findings are contrary from the ones provided by our review had been there has been no statistically considerable difference among the mean MIO within the two groups. 2 analyses were conducted for the lateral excursion movement, one for the LEFS and the other for the LENFS. For the LEFS 2 studies [12, 21] were included in the meta-analysis. The analyses suggested statistically significant difference among the groups in LEFS which select ORIF than CT, the other analysis for the LENFS included 3 studies [12, 21, 22], and there has been a

statistically great difference between the 2 groups and the superiority for open method [ORIF]. that is just like our results that were in choose for ORIF for each LEFS.

Four studies [12, 20, 21, 22] were included in the meta-analysis for mandibular protrusion. The analysis showed insignificant difference between the groups. The presence of some studies in the review by **Nussbaum *et al.*** [23] that were excluded in our meta-analysis is believed to justify the contradiction that appears in the results. **Nussbaum *et al.*** [23] included the studies of **Santler *et al.*** [22] and **De Riu *et al.*** [21] in the meta-analysis for lateral excursion. each were excluded in our review due to the fact they covered individuals with unilateral and bilateral CPF in addition to displaced and non-displaced fractures which changed into excluded from our study.

Chrcanovic [24] provided a meta-analysis to evaluate open method ORIF versus closed technique CT in treating mandibular condylar process fracture CPF. the search provided 36 studies that's excessive variety of studies to be protected in a single meta-analysis regarding sub-condylar mandibular fracture. The inclusion and exclusion criteria became made very wide in a try to consist of the maximum range of studies possible. All RCT, NRCT, RS that were evaluating results and post treatment complications for open and closed treatment for CPF have been included in this study.

Range of mandibular motion is one of the outcomes soughs in this review. Three studies [7, 8, 12] have been a number of the 36 research that were covered in our meta-analysis.

Twenty-two research have been met eligibility criteria and present in the meta-analysis for the MIO, there was no statistically big impact on the final results of mandibular motion MIO. This similar to the findings of our review that defined also no statistically significant difference across the final results of MIO among the surgical and the non-surgical groups. 13 studies had been met eligibility criteria and present in the meta-evaluation for protrusion and 28 studies for lateral excursion. LEFS showed a statistical significance difference in prefer of ORIF with 95% CI 0.14–1.22, P = 0.01. and our study show statistically significant difference in choose of ORIF than CT in relation to LEFS.

Chrcanovic [24] included the most important variety of studies possible. Eligibility criteria become particularly based totally at the study designs. though seemingly this gives a stronger meta-analysis. evidently, while greater studies are covered that could significantly affect the treatment outcomes because of more than one variety of variables. In **Chrcanovic** [24] 's study, studies with distinctive stages of fractures and displacements or dislocations of CPF were covered in a single meta-analysis. studies with more than one follow-up length were also protected within the identical meta-analysis. LEFS and LEFNS were mixed with studies that mentioned lateral excursion in the direction of the fracture and non-fracture side.

Liu *et al.* [25] mentioned very comparable eligibility criteria along with similar age, fracture site, leveling and displacement degree and dislocation to our study. They covered only unilateral CPF and excluded any study with bilateral CPF. Three studies [7, 8, 15] have been covered of their meta-analysis.

There was only one difference which is **Schneider *et al.*** [15] was now not included in our meta-analysis because there was statistically insufficient information.

For MIO, **Liu *et al.*** [25] mentioned no statistical significance difference suggesting no difference within the MIO among the two treatment groups CI= -6.69 to 2.16, P =0 .32. those facts found out similar end result to our meta-analysis have been also no statistical significance became determined most of the groups regarding the MIO. however, when a meta-analysis became conducted on the sum of laterotrusion in **Liu *et al.*** [25] a statistical significance became found with 95% CI= -3.26 to -1.92, P < 0.001 and this outcome was in favor of ORIF. This result is similar to what was reported by our meta-analysis.

In our review, the statistical differences that are reported between the two groups if present are not necessarily a measure of mandibular dysfunction. mandibular motion range is a single entity that provide a concept about the mandibular feature. there are numerous different factors including the state of TMJ pain, clicking and malocclusion. For this reason, the effect of each treatment modality may be in comparison among each other's by clinical dysfunction. including deviation on opening, pain on opening and clicking, tenderness of the muscles and joints as well as the mandibular motion.

There was a large number of variables in the participants. Although, we found 11 eligible studies meet the eligibility, we were able to perform meta-analysis on 4 of them.

Conclusion: There are many factors that influence the decision whether to perform ORIF or CT in the treatment of unilateral displaced sub-condylar mandibular fractures. Both treatment modalities provide acceptable outcomes with regards to mandibular motion. However, more mandibular motion is expected by ORIF than CT in treating unilateral displaced sub-condylar mandibular fractures. There are many other factors that should be taken into account to assess mandibular function and aesthetic outcome. This includes presence of TMJ pain, clicking, tenderness in the muscles of mastication and TMJ as well as deviation on mouth opening. The difference in results of treatment modalities in terms of LEFS, was statistically significant. ORIF should be the preferred treatment. Closed treatment [CT] in absence of displacement had satisfactory outcome, although accurate reduction produced by open method ORIF. Our study favour open treatment for the management of displaced sub-condylar mandibular fractures, and it is the favourable technique.

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