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Research Article

Impacted Mandibular Third Molar as a Risk Factor in the Incidence of Mandibular Angle Fractures - A Systematic Review and Meta-analysis

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Abstract

Background: Presence of impacted mandibular third molars in the oral cavity is most common. However, many times impacted mandibular third molars can lead to mandibular angle fracture. The purpose of this study was to know the incidence of mandibular fractures in patients with impacted mandibular third molars.

Materials and Methods: The articles for this systematic review and meta-analysis were procured from electronic databases like PubMed, Cochrane library, Embase, Medline etc. 19 articles were included in the qualitative analysis and 9 of those in meta-analysis. The risk of bias for observational studies was done with Newcastle-Ottawa Scale (NOS).

Result: All studies from 19 articles showed a significant association of impacted mandibular third molar in the incidence of mandibular angle fracture, the meta-analysis reported an overall odds ratio of 3.22 [95%CL = 1.56, 6.64].

Conclusion: This study concluded that there is a strong association between impacted mandibular third molar and incidence of mandibular fractures.

Keywords: Impacted Mandibular Third Molar; Mandibular Angle Fracture

Introduction

The mandible is the strongest bone in the facial skeleton. But because of its anatomic location and vulnerability to traumatic forces, the incidences of mandibular fractures are considered to be high, comprising 76% of all maxillofacial fractures (Yunhae Lee., *et al*. 2019) [1]. The most commonly occurring mandibular fractures are the mandibular condyles (56.5%), mandibular symphysis (45.0%), body (25.5%), and angle (16.5%) (A.C.V. Armond., *et al*.) [2].

Epidemiological findings show an increased risk of mandibular angle fractures among males, 30 years and younger (Fuselier., *et al*. 2002 and DP Motloba., *et al*. 2016) [3,4]. Risk factors include the type of trauma, nature, the direction of force, characteristics of the aetiological agent. Physical activities like contact sports events may Involve low-intensity impact, but if enforced to the weakened mandibular angle might result in fracture. Automotive accidents, on contradictory, might transfer high-intensity force directly to the lesioned areas of the mandible, leading to a greater incidence of fractures (DP Motloba., *et al*. 2016) [4].

The angle is a distinctive anatomic subcomponent of the mandible. It works as the transition zone between dentate and edentate regions and is commonly related to impacted teeth. Reasons for mandibular angle fracture might be because the mandibular angle and ramus are both involved within the strong masticatory musculature and also the mandible is constituted of cortico-cancellous bone (Rajkumar., *et al*. 2009) [5]. (Dodson and Huelke, 1997) [3,7] described that the bones fracture at the site of tensile strain as their resistance to compressive forces is greater. The lingual side of the mandible concerning second and third molars is the site considered of maximum tensile strain resulting from the anterolateral implementation of force from the same side. Finite element analysis using micro-CT in cadaver mandibles has also shown that in a mandible with a third molar, stress is saturated around the root apex of the third molar, which alters the saturation and propagation of stress in the mandible, which increases the risk of an angle fracture [6].

(Huelke., *et al*. 1961) [7] reported that the mandibular fractures occur more in dentate rather than in edentate regions of the mandible, this can be in correspondence with an increased number of angle fractures that occur in presence of impacted mandibular third molar. Furthermore, he concluded that the isolated mandible is prone to a particular pattern of tensile strain when forces are applied to it. (Huelke and Hagan) [7,23], 1961 detailed the site of injuring force from which clear cut patterns emerged, condylar fractures were the most common site followed by angle fractures as the second most common fractures (Huelke., *et al*. 1961) [7].

Multiple studies have shown that the presence of impacted mandibular 3rd molar increases the risk for mandibular angle fracture by 2-3 times (Yunhae Lee., *et al*. 2019 , Rajkumar., *et al*. 2009, Seiji Iida., *et al*. 2004, Jasser Ma'aita., *et al*. 2000, Atsushi Kasamatsu., *et al*. 2003, David R. Halmos., *et al*. 2004, Joyce T Lee., *et al*. 2002, Sarfaraz Khan, 2017) [1,5,8-13]. Significant concord holds that the third molars decrease the cross-sectional area of the bone, leading to the weakening of the mandible, thus leading to an increased risk of mandibular angle fractures (DP Motloba., *et al*. 2016 and Hanson, BP., *et al*. 2004) [4,14]. This may be prevented by prophylactic ousting of impacted mandibular 3rd molar which will allow bone deposition in the socket eventually resulting in a decrease in the incidence of mandibular angle fractures (Hanson, BP., *et al*. 2004) [14].

Various studies have examined the effect of the position of the mandibular 3rd molar on mandibular fracture patterns. (Fuselier., *et al*. 2002) [3] determined that angle fractures have a notable connection to both the angulation and vertical positions of the mandibular 3rd molar, with mesioangular mandibular third molar to be more common in patients with angle fractures. (Samieirad., *et al*.) [15] showed that the horizontal position of M3 and the mandibular fracture site had a notable statistical connection, with class II being the most common type.

The last Meta-analysis was done in 2019 which showed there was a significant correlation between impacted mandibular third molar and incidence of mandibular angle fractures, so there was a need to frame a latest meta-analysis with good quantitative data to allow timely review of this topic.

Materials and Methods

Search approach

Articles for the studies were searched using keywords like "Mandibular Angle fracture", Impacted Mandibular 3rd molars" from electronic databases like Cochrane Library, PubMed, EMBASE, and MEDLINE. Articles were also searched in google scholar and Clinical Trials Registry. The titles and abstracts of each article were reviewed initially by one author and thereafter by two more authors and studies that satisfied all of the eligibility criteria were includedin this systematic review after mutual agreement between the authors (Search strategy is displayed in diagram 1).

Result of search

Articles were searched on electronic databases like PUBMED, COCHRANE, EMBASE by keywords like "incidence of angle fractures in patients with impacted third molar". third molar as a risk factor for anglefractures". A total of 5390 articles were found by searching through google scholar.Then, after removing duplicates and articles with irrelevant contents, 31 articles were procured which were then screened further. In the next steps, 4 articles were excluded based on titles and 8 articles were excluded based on abstracts which left a total of 19 articles to be included in the final quantitative analysis and 9 articles for meta-analysis.

Inclusion criteria

- Cross-sectional studies.
- Observational studies.
- Prospective and retrospective studies.
- Cohort and case-control studies
- Clinical trials evaluating the association between the presence of themandibular third molar and mandibular angle fracture.
- Articles with the English language.

Exclusion criteria

- Inaccurate data for quantitative analysis.
- Incomplete data for quantitative analysis.
- Articles in a non-English language.
- Studies including patients with diseases of bone metabolism.

Selection of studies

Full articles were thoroughly reviewed by two authors in two phases. In the first phase articles with relevant titles and abstracts were searched and from them irrelevant content, duplicates, etc. were removed. After this, Articles that were relevant with full text and in the English language were selected for screening in the second phase. In the second phase, the articles which were selected in the first phasewere screened for inclusion and exclusion criteria and after thorough processing, relevant articles were selected for statistical analysis.

Quality assessment and risk of bias

Case-control studies showed a risk of bias score ranging from 4 to 7 pointsout of a total of 9 points on NOS (Newcastle-Ottawa scale). From a total of 10 studies 8 studies scored 5 points, 1 study scored 4 points and 1 study scored 7 points. Cross-sectional studies showed a risk of bias ranging from 4 to 7 points out of 10 points. From a total of 4 studies, 2 studies scored 4 points 1 study scored 7 points and 1 study scored 6 points. Cohort studies showed a risk of bias ranging from 3 to 6points out of 9 points. From a total of 4 studies, 2 studies scored 4 points 1 study scored 3 points and 1 study scored 6 points.

Data extraction

The extraction of data was performed in two stages. In the first stage of data extraction, the following data were extracted: author, country of origin of article, year of publication of articles, sex distribution, type of analysis (patients and fractures), mean age, and the main cause of mandibular fracture. In the second stage, the following data were extracted: mandibular angle fracture (present or absent), third molar (present or absent). Collected data allowed for computationof odds ratio for the association of mandibular angle fracture with the presence of an impacted mandibular third molar, with a 95% confidence interval for all studies and subgroups. Cochran's test of homogeneity was undertaken based on inverse variance weights. Review Manager Software ver.5.4.1 was used for the computation of data and forest plots and funnel plots were made.

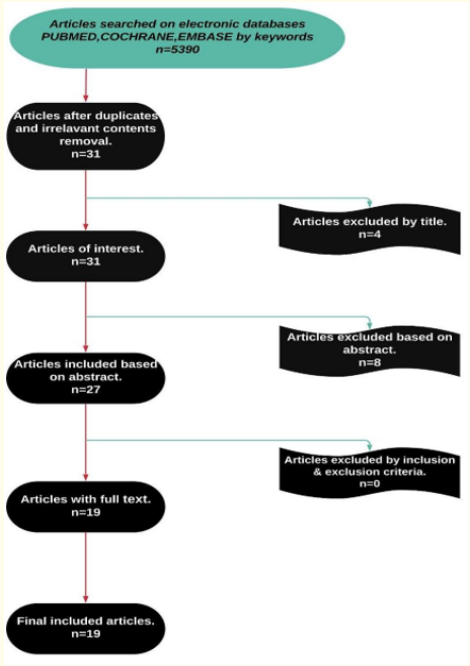

Diagram 1: Search Strategy.

Statistical analysis

Information regarding the mandibular angle fracture and the presence of impacted mandibular third molar was extracted from each of the included studiesand the odds ratio was calculated for the association of fracture with the presence of athird molar with 95% confidence intervals. A fixed effects model was used.

Results

Initially, 31 studies were included in the study. Then after going through titles, abstracts, and inclusion/exclusion criteria 12 were excluded from the study which left 19 articles to be included for the systematic review and 9 articles from them were included in meta-analysis. The search strategy for this is summarized in diagram 1.

Study	Selection	Comparison	Outcome	Score
Joyce lee	★★★	★	★	5/9
Ma'aita	★★★	★	★	5/9
Ugboko	★★	0	★★★	5/9
Fuselier	★★★	★	★	5/9
Halmos	★★★	★	★	5/9
Rajkumar	★★	0	★★★	5/9
Thangavelu	★★★	★	★	5/9
Antic	★★★	★	★	5/9
Syed adnan ali	★★	0	★★	4/9
Sarfaraz	★★★	★	★★★	7/9

Table A: Showing publication bias of Case-control studies, according to the Newcastle-Ottawa scale.

Study	Selection	Comparison	Outcome	Score
Meisami	★★★★	0	★★	6/9
Sirius-daninaoka	★★★★	0	★★★	7/9
Patil	★★★	0	★	4/9
Syed adnan ali	★★	0	★★	4/9

Table B: Showing publication bias of Cross-sectional studies, according to the Newcastle-Ottawa scale.

Study	Selection	Comparison	Outcome	Score
Meisami	★★★★	0	★★	6/9
Sirius-dan inaoka	★★★★	0	★★★	7/9
Patil	★★★	0	★	4/9
Syed adnan ali	★★	0	★★	4/9

Table C: Showing publication bias of cohort studies, according to the Newcastle-Ottawa scale.

Author	Year	Country	Cases (fracture)	Control (fracture)	Total patients	Odds ratio	95% CL interval	P-value
Rajkumar	2009	India	136(49)	18(3)	154	2.81	0.7767-10.2108	0.1152
Yunhae Lee	2019	Korea	82(44)	47(16)	129	2.24	1.0669-4.7174	0.0331
Kasamatsu	2003	Japan	111(48)	40(5)	151	5.33	1.9435-14.6359	0.0012
Joyce Lee	2000	U.S.A	367(99)	70(10)	430	2.21	1.0918-4.4994	0.0276
Ma'aita	2000	Jordan	426(127)	189(25)	615	2.78	1.7428-4.4548	<0.0001
Sarfaraz	2017	Pakistan	66(49)	54(9)	120	14.41	5.8380-35.5770	<0.0001
Iida	2003	Japan	189(100)	157(23)	346	6.54	3.8663-11.0834	<0.0001
Halmos	2004	U.S.A	70(30)	28(3)	98	6.25	1.7243-22.6538	0.0053
Ugboko	2000	Nigeria	331(52)	77(24)	408	0.41	0.2337-0.7248	0.0021

Table 1: Data for studies included in meta-analysis.

Author	Year	Place	Total Patients	Angle Fracture Present	Third Molar Present	Gender:Male/ female	Mean age in years (range)
Joyce Lee	2000	U.S.A	437	109	317	NR	31.7 years
Ma'aita	2000	Jordan	615 (713)	152	426	79%/21%	33.2 (17 to 75)
Ugboko	2000	Nigeria	490	76	408	NR	NR
Fuselier	2002	U.S.A	1210	326	837	81.1%/18.9	30.8 ± 10.4
Meisami	2002	Canada	214 (TF = 413)	127	326	82.6% / 17.4%	NR
Kasamatsu	2003	Japan	151 (TF = 240)	53	111	80.1%/19.9%	29.9
Iida	2003	Japan	346	123	102	250/96	NR
Halmos	2004	U.S.A	1450 (HM = 2663)	733	2469	1449/NR	30.6 (2 to 87)
Rajkumar	2009	India	154	52	136	88.4%/11.6%	33.2 (17 to 70)
Sirius-Dan Inaoka	2009	Brazil	134	43	38	87 / 47	26.35 (16 to 55)
Thangavelu	2010	India	460 (TF = 870)	175	260	345/115	29.3 ± 10.8
Patil	2011	India	190	80	73	NR	21–30 (most common)
Antic	2014	Serbia	NR	NR	NR	NR	NR
A.Tiwari	2015	India	100 (TF = 152)	36	NR	96 / 4	Gp A: 26.74 ± 9.83, Gp B: 34.04 ± 14.12
Syed Adnan Ali	2015	Canada	87 (HM = 174)	39	138	94.3%/5.7%	26.97 ± 9.88
Sarfaraz	2017	Pakistan	120	58	112	105 / 15	NR
Nogami	2018	Japan	241	104	77	141/100	33.3 ± 11.9
Yunhae Lee	2019	Korea	129	60	82	94/35	35.2±14.5
Anhad Mehra	2019	India	280	150	146	258/22	28.99
Note: TF = Total fractures in patient, HM = Hemi-mandibles							

Table 2: Master chart showing description of included studies.

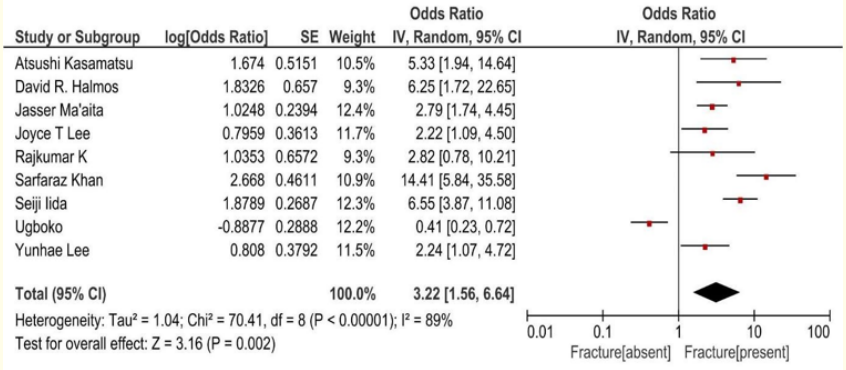

Diagram 2: Forest plot for meta-analysis.

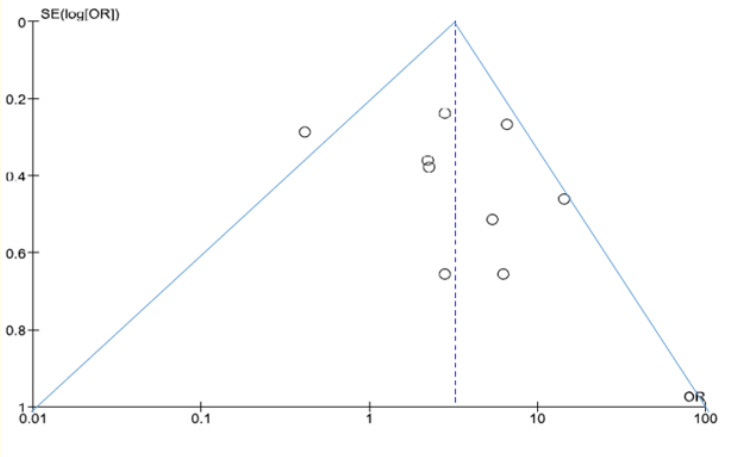

Diagram 3: Funnel plot showing publication bias of articles in meta-analysis.

The data extracted from the 19 studies have been tabulated in variousstables mentioned below:

Data obtained from several articles like "author's name, year of study, place of study, Cases and controls mentioned in the respective studies, odds ratio, 95 % CL interval, P-value" has been shown in table 1.

Forest plot presenting the odds ratio for mandibular angle fracture in patients with impacted mandibular third molar is shown in diagram 2. Funnel plot showing publication bias is shown in diagram 3. The master chart showing the description of included studies is shown in table 2. All studies from 19 articles showed a significant association of impacted mandibular third molar in the incidence of mandibular angle fracture except one done by (Ugboko., *et al*. 2000, Nigeria) [18] which showed that the incidence of mandibular angle fracture is less significant in patients with impacted mandibular third molar (especially in Nigerian population).

Discussion

Till recent times, many studies have been done to estimate the correlation between impacted mandibular third molars and incidences of angle fractures. Many meta-analysis were also done in the past to serve this purpose. A meta-analysis done by (Hanson., *et al*. 2004) [14] showed that the presence of a third molar increased the likelihood of mandibular angle fracture with an estimated relative risk of 2.4. Another meta-analysis done by (D.P Motloba., *et al*. 2016) [4] showed the overall relative risk was 1.44 (95% CI = 1.31 to 1.57). A study by (Armond., *et al*. 2017) [2] to understand the influence of third molars in mandibular fractures showed an odds ratio of 3.83, 95% confidence interval (CI) 3.02-4.85. Another 2017 meta-analysis done by (Francesco., *et al*.) [16] showed that the relative risk of mandibular angle fracture with the third molar was 1.90 (95% CI = 1.47-2.46). A meta-analysis done in 2019 showed there was a significant affinity of angle fractures and impacted mandibular third molar with odds ratio 0.55 (95% confidence interval 0.34-0.88).

(Ma'aita., *et al*. 2000) [9] in his study showed a significant association between angle fractures and mandibular third molars ($P < 0.0001$). Also, (Iida., *et al*. 2004) [8] and (Sarfaraz., *et al*. 2017) [13] reported a significant association of angle fractures and mandibular third molars with a P value less than 0.0001.

(Halmos., *et al*. 2004) [11] showed that subjects with mandibular angle fractures were statistically younger than subjects without angle fracture (29.5 versus 30.8 years) (Halmos., *et al*. 2004) [11]. In their study (Antic., *et al*. 2016) [17] reported a statistically significant difference in patients with mandibular angle fracture aged between 15 and 25 years, with a 1.7-fold higher relative risk. These studies proved that there is a strong association of mandibular angle fracture in younger patients, relating to their dentate condition and their attitude to contact sports.

The purpose of this meta-analysis was to estimate the incidence of angle fractures in patients whom impacted mandibular third molar was present. To serve this purpose, 19 studies from all around the world were selected to be a part of this systematic review and from them, 9 studies for meta-analysis. The inference that is concluded from this meta-analysis will serve as a foundation in people with an increased risk of mandibular fracture (eg: those who are engaged in contact sports), in whom prognostication of the location of a possible mandible fracture can be elicited, which will enable the development of appropriate prevention programs. The results of the studies in the literature show a positive association between the presence of a mandibular third molar and the presence of mandibular angle fractures when mandible fractures are assessed. The results of this meta-analysis confirm the results of these studies. The presence of a third molar increases the chance of a mandibular angle fracture, inducing weakness in the mandibular angle region. Some authors have hypothesized that the prophylactic removal of the third molar would protect the mandibular angle, eliminating the fragile area.

One mechanism by which third molars have been postulated to increase the risk of angle fractures is by occupying osseous space and thus weakening the angle region (Joyce lee., *et al*. 2000) [12]. To back those postulates, mandibular fractures have been reported to occur occasionally (at a very low incidence of 0.0046%) after wisdom tooth removal (when the angle region is weakened further because the tooth is extracted) when usual food is consumed.

Some studies were excluded because they reported angle fractures while they were removing the lower third molar. Also, studies that included completely erupted third molar in the missing third molar group were excluded as they will undervalue the association between angle fractures and mandibular third molars.

Various studies which had adequate quantitative data were analyzed for calculation of Odds ratio with 95% confidence interval (Seji lida., *et al*. 2004, Samierad., *et al*.) [8,15]. The Forest plot was plotted based on the odds ratio and standard error (random-effects model was used). The evidence of bias and heterogeneity in this meta-analysis is sparse yet the elucidation of the discoveries of the study should be used with wariness, as there could be alternative clarification of the cause and effect. The overall results are reliable with the available best literature, and hence can be regarded as sensible.

This meta-analysis reported an overall odds ratio of 3.22 [95%CL = 1.56, 6.64], heterogeneity: $Tau^2 = 1.04$; $Chi^2 = 70.41$, df = 8 ($P < 0.00001$); $I^2 = 89\%$, test for overall effect: Z = 3.16(0.002).

Conclusion

This systematic review and meta-analysis concluded that the presence of impacted mandibular third molar acts as a risk factor in the incidence of mandibular angle fractures in a highly significant manner.

Conflict of Interest

None.

Ethical Clearance

This article does not contain any studies with human participants or animals performed by any of the authors.

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