MANAGEMENT OF COMPLICATIONS OF MANDIBULAR FRACTURE AFTER MANDIBULAR THIRD MOLAR SURGERY: A SYSTEMATIC REVIEW

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Abstract

Background: Mandibular third molar surgery is one of the most commonly performed oral surgical procedures. Surgical complications following between 2.6% to 30.9% of impacted mandibular third molar extractions result in hemorrhage, edema, chronic discomfort, trismus, mandibular fracture, and nerve damage The occurrence of mandibular fracture with incidence rates ranging from 0.0034% to 0.075% for extractions of lower third molars.
Purpose: The aim of this systematic review is to discuss the management of complications of mandibular fracture after mandibular third molar surgery.
Methods: We performed a systematic search on several electronic reference databases (PubMed, ScienceDirect, Web of Science, Cochrane). Inclusion criteria were articles published in English, full-text availability, and articles published between 2003 and 2023. The studies analyzed the location of the fracture, timing, classification, and management of mandibular fracture due to mandibular third molar surgery.
Results: A total of 8 studies were included. The location of mandibular fractures looks very different, 75% more often affecting the structure of the mandibular angulus. The time of occurrence of mandibular fracture as a such as less than 2 weeks to 3 months. Most 90% of patients with mandibular fractures in this case are treated using open reduction and internal fixation. Other follow-up procedures such as eating soft foods at 45 days to 3 months.
Conclusion: In the surgical removal of mandibular third molar, it is necessary to conduct preoperative study and planning, identifying all possible errors, risk factors and complications that may arise. If they occur, the surgeon must establish an accurate diagnosis and treat or refer the patient to a qualified professional. Open reduction and internal fixation is the main option to treat patients with mandibular fracture due to complications of mandibular third molar extraction.

Keywords: Mandibular third molar, complication, management, mandibular fracture

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A. Introduction

Odontectomy is an act of removing or extracting teeth because they cannot grow or teeth grow partially, where the teeth cannot be removed by extracting ordinary pliers. This extraction process begins with the creation of a mucoperiostal flap and then the removal of the undercut bone that blocks tooth removal. Therefore, good preparation and proper surgery plan are needed for the lifting surgery.[1]

The third molars of the lower jaw are the most commonly extracted teeth, accounting for 18% of overall tooth extraction.[2,3] Third molars usually grow between the ages of 8 to 15 and begin to appear between the ages of 17 to 22.[4] As a result of this delayed growth, mandibular third molars are often impacted, with 17 to 69% impacted in some degree.[5]

Mandibular third molar surgery is one of the most commonly performed oral surgical procedures. The most common surgical indication is infection (pericoronitis) around a portion of a third molars eruption that affects adjacent soft tissue or bone.[6] Another indication, according to the 2000 National Institute for Health and Clinical Excellence (NICE, UK) recommendations, is irreversible caries, third-root internal/external resorption.[7]

Surgical complications following Between 2.6% to 30.9% of impacted mandibular third molar surgery result in hemorrhage, edema, chronic discomfort, trismus, mandibular fracture, and nerve damage. Recent studies have examined patient characteristics as risk factors for postoperative problems, including age and sex, the level of an impacted tooth, surgical methods, and operator competence.[8,9]

The mandible, which accounts for 36% to 54% of all maxillofacial trauma, is the facial bone most vulnerable to fractures. The angle, which accounts for about 40% of all mandibular fractures, is one of the most frequent sites for mandibular fractures. Lower third molar impaction decreases bone amount and density in this area, increasing the risk of local fractures.

Therefore, this topic is important in the field of oral and maxillofacial surgery because to the high occurrence of lower third molars in mandibular angle fractures (60.4%).[10,11]

Mandibular fractures are a subset of lower third molar problems that are particularly severe in nature. The occurrence of this complication is relatively rare, with incidence rates ranging from 0.0034% to 0.075% for extractions of lower third molars[12]. Similar percentages were reported in investigations conducted by Joshi et al.[13], Boffano et al.[14]. The study conducted by Grau-Manclús et al.[15] presents findings indicating a more limited variation, ranging from 0.0033% to 0.0046%. Similarly, Ethunandan et al.[16] establish an incidence rate of 0.00033% and 0.0049%. Postoperative fractures have the highest prevalence, with reported incidences ranging from 0.0042% to 0.0046%, in contrast to intraoperative fractures, which had varying frequencies between 0.0033% and 0.0036% of cases.[17]

The accurate estimation of the impact of mandibular third molars on the occurrence of angle fractures remains uncertain, despite extensive research conducted on this topic. The lack of definitive evidence has led to the scientific community's failure to reach a consensus on the ethical basis for the preventive extraction of asymptomatic mandibular third molars.

Roughly 50% of mandibular fractures involve the angle region. The anatomical location in question is commonly linked to the emergence of mandibular third molars, which has led to the proposition that these teeth may contribute to angle fractures. There is a widely accepted consensus that the third molars function as organs that take space, leading to a reduction in the strength of the jaw and consequently increasing the likelihood of fractures. The extraction of third molars facilitates the process of bone formation within the socket, leading to a decrease in the likelihood of angle fractures.[18]

The mandible exhibits certain regions that possess relatively lower resistance to fractures, including the mandibular angle, condyle, mandibular symphysis, body, and coronoid process. The gonial angle, situated between the ascending branch and the mandibular body,

possesses a distinct bone structure. Its proximity to the lower third molar contributes to its high prevalence (40%) as a site for fractures.[18]

According to previous studies, it has been shown that these cases have a considerable number and variety, a number of morbidities have also been reported due to this problem. Based on this, the aim of this systematic review is to discuss the management of complications of post odontectomy mandibular fractures.

MATERIAL AND METHODS

a. Eligibility criteria

Inclusion criteria for those studies are as follows:

1. Published in English, and full-text was available.
2. Published between January 2001 up to Juli 2023.
3. The studies were cohort, case control, case series, cross sectional, randomized control trial (RCT), systematic review.
4. The studies used mandibular third molar surgery and mandibular fracture due to mandibular third molar surgery.
5. The studies assessed the outcome about management mandibular fracture due to complications of mandibular third molar surgery

b. Guidelines

We used the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guideline to perform the reporting of this study. We can find 8 appropriate studies included in the review, as shown in the flow diagram in Figure 1.

c. Search strategy

Two investigators (TAK, SAS, EMO) independently conducted a literature search on August 01, 2023 for relevant articles available in several databases (PubMed, ScienceDirect, Web of Science and the Cochrane Central Register of Controlled Trials (CENTRAL))

following PRISMA guidelines. The following keywords were used: ((Molar, Third) OR (Mandibular fractures) OR ((Molar Third, Removal) OR (Extraction)) AND ((Complication). A manual search was also conducted to obtain relevant articles fulfilling the criteria mentioned. Any inconsistencies were resolved by consensus with a third author (HYY).

d. Data extraction and quality assessment

Data were extracted based on author, year, study design, sample size, result and discussion. The key outcome measure was the type of fracture, fracture location, timing, and management fracture mandibulae due to complications of odontectomy.

RESULTS

Study characteristics

In this systematic review, we found a total of eight studies, with case report and systematic review study types. There are 5 case reports and 3 systematic reviews. A total of 495 caseins were involved in this study. All of these studies discuss the management of mandibular fractures as a complication of lower M3 removal. The ages in this study varied from 20 years to 60 years.

Mandibular third molar classification

The classification in this study is based on the Pell and Gregory classification. This is based on the relationship between the impacted lower wisdom tooth (3rd molar) to the ramus of the mandible (lower jaw) and the 2nd molar (based on the space available distal to the 2nd molar).

Pell and Gregory classification were class: 1) There is sufficient space available between the anterior border of the ascending ramus & the distal aspect of the 2nd molar for the eruption of the 3rd molar; Class 2) The space available between the anterior border of the ramus & the distal aspect of the of the 2nd molar is less than the mesio-distal width of the crown of

the 3rd molar. It denotes that the distal portion of the 3rd molar crown is covered by bone of the ascending ramus; Class 3) The 3rd molar is totally embedded in the bone of the anterior border of the ascending ramus because of the absolute lack of space. It is obvious that Class 3 teeth present more difficulty in removal as a relatively large amount of bone has to be removed and there is a risk of damaging the ID nerve or fracturing the mandible (or both).

Class A) The occlusal plane of the impacted tooth is at the same level as the occlusal plane of the 2nd molar. (The lowest portion of impacted 3rd molar is on a level with or above the occlusal plane); Class B) The occlusal plane of the impacted tooth is between the occlusal plane & the cervical margin of the 2nd molar. (The lowest portion of impacted 3rd molar is below the occlusal plane but above the cervical line of the of 2nd molar); Class C, The impacted tooth is below the cervical margin of the 2nd molar. (The lowest portion of impacted 3rd molar is below the cervical line of the of 2nd molar). There is are no Classes 1 – 3 (as in the mandibular classification).

Fracture Location

The location of mandibular fractures looks very different, when observed further on the right side more often than the left mandible, with as many as 75% more often affecting the structure of the mandibular angulus.

Timing

The time of occurrence of mandibular fracture as a complication of molar odontectomy 3 varies quite varied, such as less than 2 weeks to a maximum of 3 months.

Management of mandibular fracture

Most 90% of patients with mandibular fractures in this case are treated using open reduction and internal fixation. Other follow-up procedures such as eating soft foods at 45 days to 3 months.

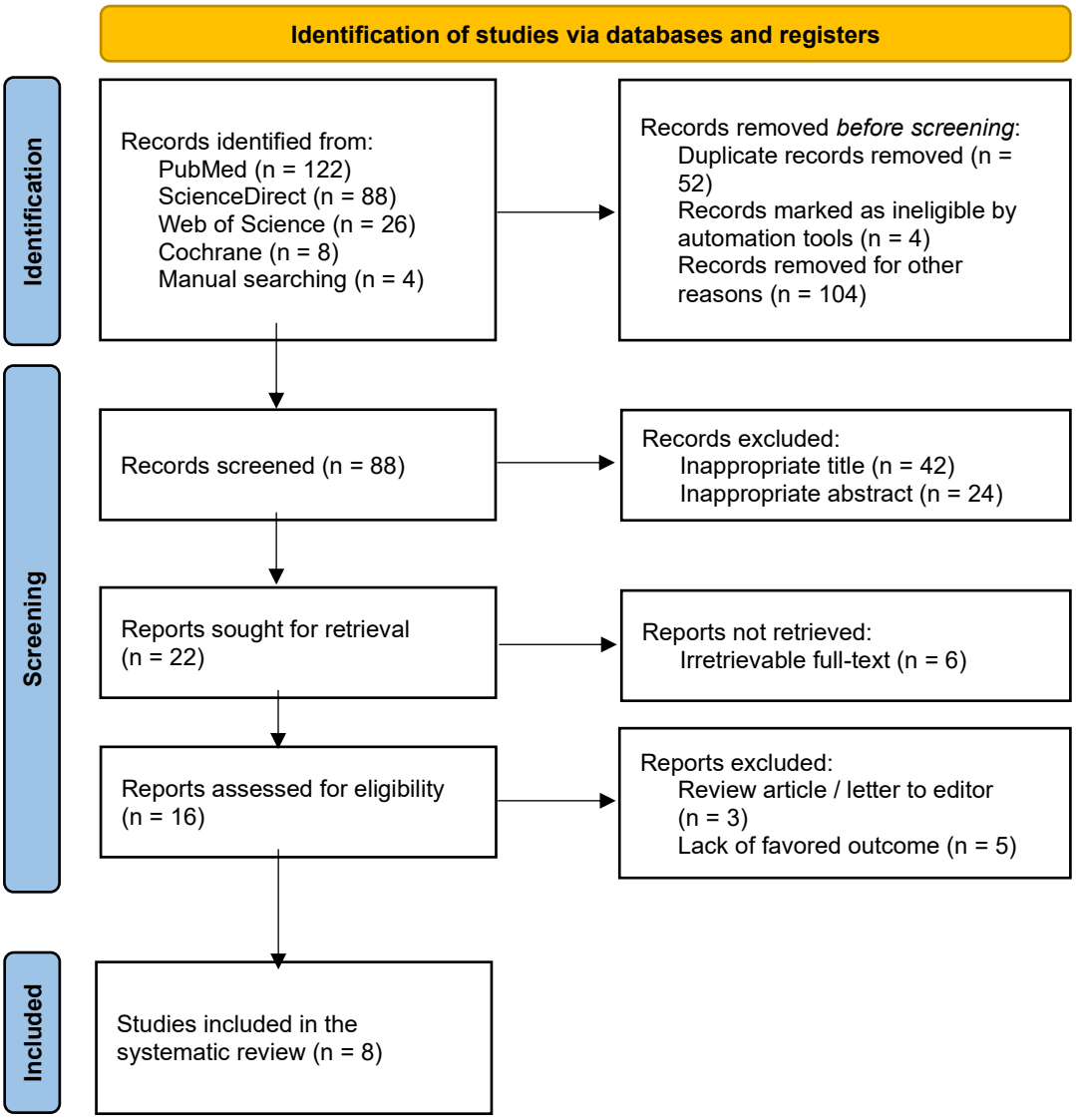

Figure 1. PRISMA flow diagram

Table 1. Characteristic of the study

No	Author	Study Design	Sample size	Age	Classification	Fracture Location	Timing	Management fracture
1	Silva, et al., 2011[19]	Case report	1	33 years old	(Pell and Gregory's classification: IIB	Right mandibular angle	Two days after the surgery	• The patient underwent preoperative planning with an orthodontist (for the placement of brackets) and with a maxillofacial surgeon (for maxillomandibular fixation with steel wires n.1). • Extraoral access was performed in the submandibular region using Risdon's technique to expose the fracture. • The fractured parts were reduced and fixed with locking plate systems and 2 mm screws according to Champy's technique following load sharing principles.

No	Author	Study Design	Sample size	Age	Classification	Fracture Location	Timing	Management fracture
2	Cutili, et al 2013[20]	Case report	3	27, 32, 36 years old	Winter's and Pell and Gregory's classifications. mesioangular variety, class II-C; mesioangular variety, class II-B; and vertical variety, class II-C	Left mandibular	20 day after surgery	open surgical reduction, IF by titanium miniplates and IMF in normal occlusion using elastic bands, removed after 6 weeks
3	Silva, et al 2020[19]	Case report	1	23 years old	PIA and Gregory IIA classification	Left mandibular	7 day after surgery	Open reduction
4	Agrawal, et al., 2020[21]	Case report	1	30 years old	NR	Right mandibula	4 day	The management strategies for mandibular angle fractures are diverse and range from no treatment, soft diet, and intermaxillary fixation to open reduction and internal fixation.
5	Chankaya, et al.,[22]	Case report	1	35 years old	NR	Right mandibula	1 week	The patient was advised to follow a soft diet and was followed up. During the follow-up visits, the patient was symptom-free. Bone

No	Author	Study Design	Sample size	Age	Classification	Fracture Location	Timing	Management fracture
	2018							union was observed radiologically after 1 month
6	Boffano, et al., 2013[14]	Systematic review	187	40 years old	NR	NR	Intraoperative: 26% Postoperative: 74%	Open reduction and internal fixation via an extraoral approach is the most frequently adopted treatment option followed by conservative management with a soft diet and bone grafts with fixation.
7	Joshi, et al., 2016[13]	Systematic review	177	27-51 years	NR	Mandibular angle: 136 (75%) Mandibular body: 40 (22%) Canine area 16 (3%)	Intraoperative: 44 (25%) Postoperative: 130 (75%) (1-5 weeks (86%)	Open reduction and fixation with miniplates and monocortical screws is currently preferable in patients with unfavorable mandibular fractures
8	Pires, et al 2017[12]	Systematic review	124	40-60 years	Pell and glory Class I: 4 (10.2%) Class II: 24 (61.5%) Class III: 11(28.2%)	NR	Postoperative: 2 weeks: 32.8% 3 weeks: 27.9% 4 weeks: 18.0%	The treatment options for this type of fracture are diverse and include conservative treatment a postoperative diet of soft food for 45 days to 3 months,maxillomandibular fixation with

No	Author	Study Design	Sample size	Age	Classification	Fracture Location	Timing	Management fracture
					A: 2 (5.1%) B: 16 (41.0%) C: 21 (53.8%)			elastics, and open reduction with internal fixation.

Discussion

Mandibular fractures associated with the extraction of lower third molars are considered to be among the most serious complications that might arise during or after the procedure. The occurrence of complications might manifest either immediately or as a delayed event, typically within the initial four weeks following the removal of 3MI.[23] According to the study conducted by Pires et al[12], the most critical phase of vulnerability occurs within the second and third weeks following surgery. This is attributed to the replacement of granulation tissue in the alveolus with connective tissue, which subsequently leads to a decrease in the resistance of the mandibular bone.

Mandibular third molar surgery is a commonly performed surgical treatment that is frequently encountered in the routine practice of general doctors and maxillofacial surgeons. In the majority of instances, this treatment is conducted without any trans-and postoperative problems. However, it is possible to argue that the failure surgeries can be attributed to insufficient preoperative surgical planning and subpar transoperative surgical performance. However, it is worth noting that these operations are associated with the growing phenomenon of medical litigation.[24]

Fractures that arise intraoperatively are less prevalent in comparison to those that occur postoperatively. Intraoperative factors associated with this complication include the improper utilization of surgical instruments, incorrect surgical techniques involving excessive force exertion, a mesioangular position of the lower third molar, possibly attributable to the higher prevalence of mesioangular and vertical angulations in the general population as indicated by Morales-Trejo et al's study, and a correlation with the anterior zone of the mandibular ascending ramus type II and III, as well as Pell & Gregory's depths B and C. These factors have been documented in various studies. [23]

According to Pires et al, it is likely that this phenomenon might be ascribed to the increased level of complexity involved in extracting the lower third molar, which necessitates more extensive ostectomies. The authors also discuss the correlation between postoperative mandibular fractures and a prior occurrence of pericoronitis. This association may be attributed to the potential impact of recurring or chronic infections on the process of decalcification, thereby increasing the likelihood of fracture.[12] Ethunandan et al[16] and Grau-Manclús et al.[15] have demonstrated that Winter's drift is an unsuitable tool due to its shorter stem and thicker handle, which increases the risk of excessive force being applied during the initial application of the first-class lever.

In this particular instance, it is hypothesized that the mandibular fracture occurred due to the cumulative impact of forces exerted by the masticatory muscles on a jaw that had been weakened following the extraction of the third tooth. It is of significance to acknowledge that the mandibular fracture occurred in the posterior region of the mandible. In addition to the compromised bone structure following the surgical procedure, robust muscular attachments are present in the posterior region of the jaw, specifically the masseter and medial pterygoid muscles. The fracture was significantly influenced by the traction vectors generated by these muscles, in conjunction with the stresses exerted by other muscles involved in mandible movement, such as the digastrics. Given the possible hazards associated with delayed mandibular fractures, it is imperative to provide patients with comprehensive knowledge regarding the intricacies of the chewing process and the muscular forces that have the ability to impact the vulnerable surgical area.[25]

In addition to masticatory forces, there are additional potential factors that can contribute to late mandibular fractures. These causes encompass systemic illnesses that result in bone fragilization, as well as local trauma that affects the surgery site. The factors mentioned above

were not considered in the current instance due to their absence in the patient's preoperative (systemic diseases) and postoperative (local trauma) medical history.

It is important to emphasize that these fractures are more commonly observed in elderly patients, as the mandible tends to weaken due to a reduction in bone elasticity during the aging process. Fractures occurring during surgery exhibit a higher prevalence in females, likely due to the thinner thickness of the mandible and consequently increased bone fragility in this gender. Conversely, males tend to be more prevalent in postoperative cases, possibly due to their higher masticatory strength. The left side is particularly affected due to its prominent presence in the surgical domain, while the right-handed surgeon demonstrates superior control over applied strength in the patient's right side compared to the left side.[13] The portion that is angled experiences the greatest impact. The low resistance observed in this context can be attributed to the transitional nature of the site between the body and the mandibular branch, as noted by Joshi et al.[13]addition to this, it should be noted that this particular location serves as a protective environment for the third molar, resulting in a decrease in bone volume within this specific area.

The findings in the present paper align with the existing literature in terms of the fracture's location, affected side, and the gender of the patient. However, there is a discrepancy regarding the age of the patient. Moreover, it is crucial to emphasize that various contributing factors led to the fracture, however the primary reason is likely attributed to the technique utilized, perhaps involving excessive and inappropriate physical force. One notable observation is that mandible fractures during third molar extraction surgery are more frequently observed in patients classified as II/III and type B/C according to the Pell and Gregory classification, as opposed to those classified as class I and type A.[12]

The treatment options for mandible fractures can be broadly categorized as non-surgical, utilizing the jaw manipulation technique (JMB), or surgery, involving a bloody reduction and internal fixation using plates and screws. Boffano et al, state that open reduction and internal fixation via an extraoral approach is the most frequently adopted treatment option followed by conservative management with a soft diet and bone grafts with fixation.

The factors influencing the treatment options for a fracture primarily include the type and anatomical characteristics of the fracture. These factors determine the approach taken based on the fracture's traits and stability, whether it is favorable or unfavorable. In the context of stability, it is crucial to consider the involvement of the masseter, temporal, and medial pterygoid muscles in the mandibular angle fractures (MAF). These muscles play a significant role in influencing the bone and minimizing the risk of dislocation in both vertical and horizontal fractures. In simpler terms, the muscular action acts as a stabilizing force against the fracture's displacement. However, in cases when the fractures are vertically and horizontally unfavorable, the proximal segment is displaced in an upward and medial direction. This occurs when the fracture's branch aligns with the muscles' action, Considering this perspective, numerous strategies have been documented in the literature for mitigating arithmetic faults (MAF).[26]

The non-surgical treatment known as closed intermaxillary block is typically administered over a period of 45 days. This approach is commonly employed when the fracture is deemed to be in a good state or when the patient declines to undergo the treatment while under general anesthesia. In the realm of surgical interventions, three notable approaches emerge: Champy's Technique, AO/ASIF Technique (Arbeitsgemeinschaft für Osteosynthesefragen), and Modified AO Technique employing dual plates. When appropriately indicated, these three factors have been shown to yield significant outcomes. However, in order to get these outcomes, it is crucial to accurately classify the fracture hence preventing any

potential postoperative complications. Champy's technique involves the fixation of a miniplate from the 2.0 mm system, following a reduction in the mandibular angle fracture.

This fixation is achieved using non-compressive monocortical screws, positioned at the upper edge of the mandible's angle through intraoral access. This can be utilized in fractures that are categorized as simple, specifically those that are linear in nature, characterized by a single trace, without comminution, and exhibiting minimal or no displacement, while also showing intact bone segment. The AO Technique involves the utilization of a 2.4 mm reconstruction plate, available in several sizes, which is applied in a bicortical manner and secured along the inferior border of the mandible. In the modification of this technique, a 2.4 mm plate is placed in the compression zone of the basal region of the mandible. Additionally, a 2.0 mm plate is fixed in the tension zone, specifically the upper edge adjacent to the teeth. Both plates are inserted using an extraoral approach known as Risdon's access. The choice of fixation material is crucial as it needs to provide sufficient strength to support the applied load in the fractured area. Consequently, these plates are typically utilized in more complex fractures characterized by comminution, dislocation, and significant loss of bone tissue.[26]

Conclusion

In the surgical removal of the mandibular third molar, it is necessary to conduct preoperative study and planning, identifying all possible errors, risk factors and complications that may arise. If they occur, the surgeon must establish an accurate diagnosis and treat or refer the patient to a qualified professional. the patient to a qualified professional. Open reduction and internal fixation is the main option to treat patients with mandibular fracture due to complications of 3rd molar extraction.

REFERENCES

1. Andersson L (Lars), Kahnberg KErik, Pogrel MAnthony. Oral and maxillofacial surgery. 2010 [cited 2023 Jun 22];1274. Available from: https://www.wiley.com/en-ie/Oral+and+Maxillofacial+Surgery-p-9781405171199

2. Jafarian M, Etebarian A. Reasons for extraction of permanent teeth in general dental practices in Tehran, Iran. Med Princ Pract [Internet]. 2013 [cited 2023 Jun 22];22(3):239–44. Available from: https://pubmed.ncbi.nlm.nih.gov/23295210/

3. Alesia K, Khalil HS. Reasons for and patterns relating to the extraction of permanent teeth in a subset of the Saudi population. Clin Cosmet Investig Dent [Internet]. 2013 Jul 30 [cited 2023 Jun 22];5:51–6. Available from: https://pubmed.ncbi.nlm.nih.gov/23986651/

4. Jung YH, Cho BH. Radiographic evaluation of third molar development in 6- to 24-year-olds. Imaging Sci Dent [Internet]. 2014 [cited 2023 Jun 22];44(3):185–91. Available from: https://pubmed.ncbi.nlm.nih.gov/25279338/

5. Hashemipour MA, Tahmasbi-Arashlow M, Fahimi-Hanzaei F. Incidence of impacted mandibular and maxillary third molars: a radiographic study in a Southeast Iran population. Med Oral Patol Oral Cir Bucal [Internet]. 2013 Jan [cited 2023 Jun 22];18(1). Available from: https://pubmed.ncbi.nlm.nih.gov/23229243/

6. Rizqiawan A, Lesmaya YD, Rasyida AZ, Amir MS, Ono S, Kamadjaja DB. Postoperative Complications of Impacted Mandibular Third Molar Extraction Related to Patient's Age and Surgical Difficulty Level: A Cross-Sectional Retrospective Study. Int J Dent [Internet]. 2022 [cited 2023 Jun 22];2022. Available from: /pmc/articles/PMC8749374/

7. Overview | Guidance on the Extraction of Wisdom Teeth | Guidance | NICE.

8. Rizqiawan A, Lesmaya YD, Rasyida AZ, Amir MS, Ono S, Kamadjaja DB. Postoperative Complications of Impacted Mandibular Third Molar Extraction Related to Patient's Age and Surgical Difficulty Level: A Cross-Sectional Retrospective Study. Int J Dent [Internet]. 2022 [cited 2023 Aug 1];2022. Available from: /pmc/articles/PMC8749374/

9. Deliverska EG, Petkova M. COMPLICATIONS AFTER EXTRACTION OF IMPACTED THIRD MOLARS - LITERATURE REVIEW. Journal of IMAB – Annual Proceeding Scientific Papers. 2016 Jul 4;22(3):1202–11.

10. Fernandes IA, Souza GM, Silva de Rezende V, Al-Sharani HM, Douglas-de-Oliveira DW, Galvão EL, et al. Effect of third molars in the line of mandibular angle fractures on postoperative complications: systematic review and meta-analysis. Int J Oral Maxillofac Surg. 2020 Apr 1;49(4):471–82.

11. Mandibular third molar and angle fractures: a meta-analysis [Internet]. [cited 2023 Aug 1]. Available from: http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S0011-85162016001000010

12. Pires WR, Bonardi JP, Faverani LP, Momesso GAC, Muñoz XMJP, Silva AFM, et al. Late mandibular fracture occurring in the postoperative period after third molar removal: systematic review and analysis of 124 cases. Int J Oral Maxillofac Surg [Internet]. 2017 Jan 1 [cited 2023 Aug 1];46(1):46–53. Available from: https://pubmed.ncbi.nlm.nih.gov/27688170/

13. Joshi A, Goel M, Thorat A. Identifying the risk factors causing iatrogenic mandibular fractures associated with exodontia: a systemic meta-analysis of 200 cases from 1953 to 2015. Oral Maxillofac Surg [Internet]. 2016 Dec 1 [cited 2023 Aug 1];20(4):391–6. Available from: https://pubmed.ncbi.nlm.nih.gov/27660249/

14. Boffano P, Roccia F, Gallesio C, Berrone S. Pathological mandibular fractures: a review of the literature of the last two decades. Dent Traumatol [Internet]. 2013 Jun [cited 2023 Aug 1];29(3):185–96. Available from: https://pubmed.ncbi.nlm.nih.gov/23294978/

15. Grau-Mancls V, Gargallo-Albiol J, Almendros-Marqus N, Gay-Escoda C. Mandibular fractures related to the surgical extraction of impacted lower third molars: a report of 11 cases. J Oral Maxillofac Surg [Internet]. 2011 May [cited 2023 Aug 1];69(5):1286–90. Available from: https://pubmed.ncbi.nlm.nih.gov/21193255/

16. Ethunandan M, Shanahan D, Patel M. Iatrogenic mandibular fractures following removal of impacted third molars: an analysis of 130 cases. Br Dent J [Internet]. 2012 Feb 25 [cited 2023 Aug 1];212(4):179–84. Available from: https://pubmed.ncbi.nlm.nih.gov/22361547/

17. Bodner L, Brennan PA, McLeod NM. Characteristics of iatrogenic mandibular fractures associated with tooth removal: review and analysis of 189 cases. Br J Oral Maxillofac Surg [Internet]. 2011 [cited 2023 Aug 1];49(7):567–72. Available from: https://pubmed.ncbi.nlm.nih.gov/20947226/

18. Guillaumet-Claure MA, Juiz-Camps AM, Gay-Escoda C. Prevalence of intraoperative and postoperative iatrogenic mandibular fractures after lower third molar extraction: A systematic review. J Clin Exp Dent. 2022;14(1):85–94.

19. dos Santos Silva W, Silveira RJ, de Araujo Andrade MGB, Franco A, Silva RF. Is The Late Mandibular Fracture From Third Molar Extraction a Risk Towards Malpractice? Case Report with the Analysis of Ethical and Legal Aspects. J Oral Maxillofac Res. 2017 Jun 30;8(2).

20. Cutilli T, Bourelaki T, Scarsella S, Fabio D Di, Pontecorvi E, Cargini P, et al. Pathological (late) fractures of the mandibular angle after lower third molar removal: A case series. J Med Case Rep. 2013;7.

21. Agrawal P, Jadhav A, Bhola ND. Primum Non Nocere: A Case Report of Iatrogenic Fracture of the Mandibular Angle During Excision of an Impacted Third Molar. Cureus. 2022 Aug 4;

22. Cankaya AB, Erdem MA, Cakarer S, Cifter M, Oral CK. Iatrogenic Mandibular Fracture Associated with Third Molar Removal. Int J Med Sci [Internet]. 2011 Sep 17 [cited 2023 Aug 1];8(7):547. Available from: /pmc/articles/PMC3180770/

23. Guillaumet-Claure MA, Juiz-Camps AM, Gay-Escoda C. Prevalence of intraoperative and postoperative iatrogenic mandibular fractures after lower third molar extraction: A systematic review. J Clin Exp Dent. 2022;14(1):85–94.

24. Camargo IB, Melo AR, Fernandes AV, Cunningham LL, Laureano Filho JR, Van Sickels JE. Decision making in third molar surgery: a survey of Brazilian oral and maxillofacial surgeons. Int Dent J. 2015 Aug 1;65(4):169–77.

25. Semel G, Emodi O, Ohayon C, Ginini JG, Rachmiel A. The Influence of Mandibular Gonial Angle on Fracture Site. J Oral Maxillofac Surg [Internet]. 2020 Aug 1 [cited 2023 Aug 1];78(8):1366–71. Available from: https://pubmed.ncbi.nlm.nih.gov/32275898/

26. Lopes Ferreira da Silva M, Virgínia Maria Machado Vanderley V, Nunes Nascimento M, José Carvalho Neves P, Almeida Júnior P. MANDIBLE FRACTURE ASSOCIATED TO THIRD MOLAR EXODONTIA: A CASE REPORT. 2020; Available from: https://doi.org/10.37118/ijdr.19966.09.2020