Mastication Muscle Function in Mandibular Fracture Patients After Open Reduction Internal Fixation (ORIF) (Improved Masticatory Muscle Function in Mandibular Fracture Patients Post Open Reduction Internal Fixation (ORIF) Procedure: A Systematic Review)

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Abstracts

The maxillofacial zone is a common site of traumatic injury, which has a direct impact on the aesthetics and function of the patient's face. The mandible is the main structural skeletal bone associated with the face, and the maxillofacial area is a common site of injury. Mandibular fractures have a significant impact on masticatory function. The main cause could also be the patient's ability to chew vigorously until the strength is below normal. This is related to dental comfort and mental attitude. Treatment consisting of surgery along the length of the mandibular fracture, focuses on restoring the structural shape of the mandible, with the hope of restoring normal form and function. Writing purpose systematic review (SR) for studied further regarding the improvement of masticatory muscle function in mandibular fracture patients after open reduction internal fixation (ORIF). SR writing is done with search and analyze journal from PMC, Pubmed and Science Direct portals with criteria inclusion and exclusion that have been determined. Nine articles journal Which identified four (4) prospective articles, one (1) retrospective, one (1) cross sectional, one (1) systematic review, one (1) case report, and one (1) case control. Of the ten journal articles that have been reviewed, there are articles, all of which measure masticatory muscle function as an indicator of the success of open reduction procedures. fixation (ORIF). It's just that there are various research specifications that vary, both in terms of the age of the research subjects, part of the injury, method, type of action, data analysis and other indicators that need to be considered in each study. There is an increase in masticatory muscle function in mandibular fracture patients after open reduction internal fixation (ORIF).

Keywords: Mandibular Fracture, Muscle mastication, ORIF.

Introduction

The mandible is the second most frequently fractured part of the maxillofacial skeleton after the nasal bones because of its position and prominence. The angle (27.0%), symphysis (21.3%), body (16.8%), ramus (5.4%), and coronoid (1.0%) were the most frequently injured locations, independent of on the mechanism.1 The maxillofacial zone is a common site of traumatic injury, which has a direct impact on the aesthetics and function of the patient's face. The mandible is the main structural skeletal bone associated with the face, and the maxillofacial area is a common site of injury.2

Understanding mandibular biomechanics is important because it involves many functions. The prognosis for fracture treatment is to improve the resistance of the fracture site to normal and achieve regular masticatory function.3 The chewing task determines the suspect's ability to bite without pain. The main factors of chewing function are the frequency of functional movements of the mandible, bite, increase in bite force, and work of the chewing muscles.4

Mandibular fractures have a significant impact on masticatory function. The main cause could also be the patient's ability to chew vigorously until the strength is below normal. This is related to dental comfort and mental attitude.5 Treatment consists of surgery along the length of the mandibular fracture, focusing on restoring the structural shape of the mandible, with the hope of restoring normal form and function.6

In the process of surgical treatment, injuries in the form of lacerations of chewing muscles, resulting soft tissue, and nerve injuries of unknown cause can further impact the masticatory system.7Significant recovery of chewing strength increases after in cases of open and closed reduction of mandibular condyle fractures.8 Research conducted by Omeje et al in a group of 56 people with mandibular fractures showed that these patients were eligible for ORIF (Open Reduction and Internal Fixation) reported higher scores in the Bodily Pain domain, whereas patients treated with Maxillo-Mandibular Fixation showed higher scores in the physical and psychosocial domains.9 This study aims to examine further the improvement in masticatory muscle function in mandibular fracture patients after open reduction internal fixation (ORIF).

Methods

Strategy and terms search developed consult with Oral and Maxillofacial Surgery specialist Faculty UNHAS Dentistry. Search strategy only covers studies human in English. Original research study from journal peer- review includes trials randomized controlled, trial comparative And studies prospective /retrospective Increased masticatory muscle function in mandibular fracture patients after open reduction internal fixation (ORIF).

Search literature done by three authors (MTJ, AT and MG) who are experts in their fields, because our goal to know Increased masticatory muscle function in mandibular fracture patients after open reduction internal fixation (ORIF). We try For produce question Which wide, and terms key become focus main. MeSH used For get correct term for keywords. As for terms search key identified using truncated words (in matter this *) with the word form Masticatory Muscle * AND Mandibular Fracture * AND / OR Open Reduction Internal Fixation (ORIF) *.

Search beginning Google Scholar done For determine relevance term key, but google scholar No used as machine search in this research Because machine search This No can doubled. For determine framework time Which appropriate For review, Google Scholar search related to improved masticatory muscle function in mandibular fracture patients after open reduction internal fixation (ORIF) in 201 4 - 202 4 so date This chosen Which in accordance For study This. Databases what you are looking for including PubMed, Science direct and PMC. Criteria inclusion and exclusion, consistent with objective review we, developed and outlined in Table 1.

Criteria Inclusion and Exclusion

Criteria inclusion analyzed based on component PICOS as following; (1) Published journals 2014 -2024; (2) English language articles and human species articles; (3) Mandibular Fracture; (4) Cross-sectional studies, cohort study, case reports, case control and systematic review

Criteria exclusion; (1) Studies in outside period time Which determined; (2) Articles are not in English.

Table 1. Description Table Criteria Inclusion based on PICOS criteria

P	Population	Mandibular Patients Fracture
I	Intervention	Open reduction internal fixation (ORIF)
C	Comparison	Masticatory Function Muscle
O	Outcomes	Improved Masticatory function Muscle
S	Study Design	C linear trial, cross-sectional study, cohort study, and systematic review

Risk of Bias Assessment

Risk of bias assessment using JBI critical appraisal checklist for analytical randomized type trials adjusted based on the type of research study. The assessment results are then categorized according to Saletta et al 10 where is the question calculated based on the percentage of positive answers ('yes') only. Then, the risk of bias (RoB) of each study was categorized according to the final score as 'high' (score equal to or lower than 49%, leading to exclusion of articles), 'medium' (score ranging from 50% to 69%) or ' low' (score higher than 70%).

Data extraction

Data retrieved from fulfilling article criteria inclusions and conditions that is author, year, country, research references, aim and number of research subjects, type studies and research results related to improving masticatory muscle function in mandibular fracture patients after open reduction internal fixation (ORIF).

Study selection

A total of 509 journal articles were obtained through searches through 3 databases (Pubmed, Science direct and PMC) and identified 9 journals that met the inclusion criteria (Fig 1). After through process filtering, from deletion duplicates (18), did not meet the requirements for using automatic tools (263) and were removed for other reasons (107), excluded because they did not meet the criteria (101), obtained 20 full articles papers, some of which were excluded (7), found 13 that met the requirements, then re-evaluated those that did not have sufficient information (4), the final result was that 9 journal articles were reviewed (Figure 1).

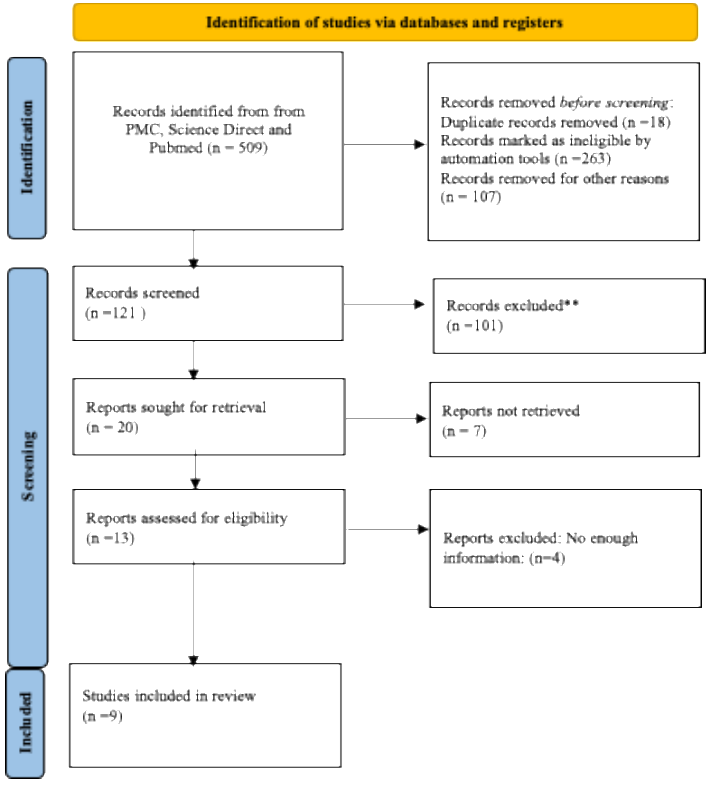

Figure 1. Study Flowchart Based on the 2020 PRISMA Guidelines

Characteristics Study

Characteristics studies in study from 9 article journal Which identified four (4) prospective articles, one (1) retrospective study, one (1) cross sectional, one (1) systematic review, one (1) case report, and one (1) case control. As for summary results identification can be seen in Table 2 below:

Table 2. Summary of Selected Studies

No	Title	Author, Year, Country Reference	Objectives	Type Study	Results
1	Oral motor and electromyographic characterization of adults with facial fractures: a comparison between different fracture severity	Pagliotto et Al, 2017, Brazil [11]	To characterize the oral motor system of adults with facial injuries and compare oral motor performance/function between two different groups.	Cross-sectional study	Deficits were greater in individuals in G1, especially at maximal incisor opening. In addition, patients in G1 and G2 showed similar masticatory muscle electromyographic profiles (i.e., patients with facial fractures

					showed lower overall muscle activity and significant asymmetric activity of the masseter muscle during maximum voluntary tooth clenching).
2	Open Reduction and Internal Fixation Versus Closed Reduction and Maxillomandibular Fixation of Condylar Fractures of the Mandible : A Prospective Study	Prakash et al, 20 22, India [12]	To compare open reduction and internal fixation with closed reduction and maxillomandibular fixation in the management of condyle fractures.)	Prospective Study	Second Treatment options for mandibular condyle fractures provide possible results accepted with difference clinical significance in matter occlusion, mouth opening, movement functional, and pain in patients with reduction open.
3	Anatomical position of the mandibular condyle after open versus closed treatment of unilateral fractures: A three-dimensional analysis	Buitenhuis et al, 2023, Netherlands [13]	to compare open and closed treatment for unilateral mandibular condyle neck and base fractures with final three-dimensional (3D) condyle position at 6 months of follow-up. 3D position was associated with mandibular function and pain.	Prospective Study	After a unilateral condyle fracture, a more 3D position bad linked with more mouth opening small and reported results patient more bad. This matter No depending on the treatment chosen, though there is subtraction more anatomy well after open treatment
4	Open Reduction and Internal Fixation Obtains Favorable Clinical and Radiographic Outcomes for Pediatric Mandibular Condylar Fractures	Zhang et al, 20 17, China [14]	For review systematically method used For evaluate accuracy of virtually planned 3D orthognathic surgery, in effort reach protocol evaluation objective that can be universally used.	Retrospectiv e Study	Surgery with ORIF is a relatively safe and effective method for pediatric MCF. Future mandibular condyle growth and long-term TMJ function are greatly influenced in postoperative patients.
5	Evaluation of Masticatory Forces in Patients Treated for Mandibular Fractures: A Case-Control Study	Salunkhe et al, 2022 [5]	This study aims to evaluate masticatory strength in patients treated for mandibular fractures. To assess the extent of damage to the masticatory system caused by various mandibular fractures and the time period required for its normalization.	Cases Controls	Temporary adverse effects on masticatory strength. Bilateral mandibular fractures have a stronger influence on bite force than unilateral mandibular fractures. These fractures also take longer to normalize.
6	Analysis of Mandibular Muscle Variations Following	Inchingolo, et al, 20 23 UK [15]	For analyze activity muscles after mandibular CF.	Systematic Reviews	Device study tracker jaw magnetic explain change cycle mastication after

	Condylar Fractures: A Systematic Review nb				fracture, with differences were observed between surgical and non-surgical treatments.
7	Rehabilitation and Management of Complex Multiple Para-Symphysis Mandible Fracture: A Case Report	Hatwar et al, 2022, India [16]	For know results rehabilitation after mandibular fracture	Cases reports	Rehabilitation given For reduce pain and swelling, gain return range motion full, increase mobility gradually, and maintain associated muscles remain strong. Protocol six Sunday given to patient. It was found that approach therapeutic Enough effective for patient
8	Evaluation of the effect of different mandibular fractures on the temporomandibular joint using magnetic resonance imaging : five years of follow-up	Nabil et al, 2016, Egypt [17]	For investigate the trauma that caused it delayed TMJ disorders more on the non-fracture side than on the fractured side of the mandible. Joint disorders jaw on the side of the fracture occurs in stages acute and stage furthermore	Prospective Study	Trauma causes slower TMJ disruption on the non-fractured side of the mandible than on the fractured side of the mandible. Disorders of the jaw joint on the side of the fracture occur in the acute and later stages
9	Six -hole versus Four hole Miniplates in Isolated, Unilateral Angle Fracture of the Mandible	Kumar et al, 2020 India [18]	For find appropriate situation For " six " hole miniplate fixation in reduction open and internal fixation of displaced and nondisplaced unilateral angle mandibular fractures	Prospective Study	There was a significant increase in muscle activity after assessing bite force in the group of patients who were given a single 4-hole plate compared to another group of patients who were given a single 6-hole plate.

Risk Bias Assesment

The risk of bias of the nine (9) studies is summarized in Table 3 using cohort assessment study (Prospective and retrospective studies), cross sectional, systematic reviews, cases reports and cases controls

As for summary For results evaluation from five cohort study articles get 81.8-100% (>70%) which mean had a low risk of bias, there were two articles that did not meet the criteria, namely identification of confounding factors and inclusion strategy, 12,17 and one article that did not have two groups so it was considered not to meet the criteria for two groups from the same origin.14 Only two articles met all criteria including meeting indicators such as patients within and across groups had similar characteristics, exposure measures were clearly defined and described in detail

in clinical procedures, exposure measurements were valid, study time was sufficiently long in reporting research and precise statistical analysis.13,18

For assessment of the risk of bias of the cases report is at getting a result of 100, which means it is in the low category (>70%), 19 The study does not include complete patient demographic characteristics, but the history, current clinical condition, diagnostic tests, treatment procedures, conditions after intervention, anticipatory steps and case reports provide learning.

For assessing the risk of bias in systematic studies review show result 90.9 which means it is in the low category (>70%), the study only had no data extraction error, the remaining 20 met the criteria including inclusion criteria, keyword search strategy, and bias assessment, valid instrument, consisting of a review team of more than 2 reviewers for the feasibility of the study, there are efforts in data extraction to minimize errors, appropriate methods of combining studies where descriptive information and explanations are adequate to support the final synthesized findings, tests to assess potential publication bias, have suggestions that are appropriate to the study or reported data as well as recommendations for future researchers.

For assessing the risk of bias of case studies controls show a result of 100 which means it is in the low category (>70%) and met the criteria including comparable groups, clearly defined cases and controls, measured according to standards, mentioned confounding factors and identified strategies to deal with confounding results, assessed exposure period and statistical analysis. 5

For assessment of cross- study risk of bias sectional show the result is 87.5 which means it is in the low category (>70%) only does not meet one criterion, namely the confounding factor strategy, the rest fulfills all the criteria including clear inclusion of inclusion criteria, detailed subjects, exposure measured using valid and reliable standard criteria, clear procedures, measurement strategies for handling and appropriate statistical analysis and valid.11

Cases Reports									
Studies	Demographics characteristics clearly	History clearly	Current clinical condition	Diagnostics tests or assessment	Treatment procedure (s) clearly multiple measurements	Post-intervention clinical condition	Unanticipated events identified	Cases reports provide takeaway lessons	Ratings results (%)
Hatwar *et al*, [16]	+	+	+		+	+	+	+	100

Systematic Reviews												
Study i	Reviews Questions Clearly	Inclusion Criteria	Search Strategy	Sources and Resources Used	Criteria For Appraising Studies	Reviewers > 2	Minimize Errors in Data Extraction	Methods Used to Combine Studies	Bias Assessed	Recommendations For Policy	Specific Directives For New Research	Ratings Results (%)
Inchingolo, *et al* [15]	+	+	+	+	+	+	-	+	+	+	+	90.9

Cases Controls											
Study i	groups comparable Clearly	cases and controls matched	identification	measured in a standard	measured in the same	confounding factors identified	strategies to deal with confounding	outcomes assessed	exposure period	statistical analysis	Ratings Results (%)
Salunkhe, *et al* [5]	+	+	+	+	+	+	+	+	+	+	100

Cross Sectionals									
Studies	inclusion criteria clearly	Subjects details	exposure measured in a valid and reliable	standards criteria used for measurements	confounding factors procedure (s) clearly multiple measurements	strategies to deal with confounding	outcomes measured in a valid and reliable	appropriate statistical analysis	Ratings results (%)
Pagliotto *et al*, [11]	+	+	+	+	+	-	+	+	87.5

Study Results and Research Synthesis

Nine journal articles that have been reviewed, there are articles, all of which measure masticatory muscle function as an indicator of the success of open reduction procedures. fixation (ORIF). It's just that there are various research specifications that vary, both in terms of the age of the research subjects, part of the injury, method, type of action, data analysis and other indicators that need to be considered in each study. Based on the type of invoice studied, covering the face as a whole,11 mandible,5,17 condyle,12–15 symphysis 16 and angle.18

On Pagliotto's studies et al., aim characterized the oral motor system of adults with facial injuries and compared oral motor performance/function between two different groups, the results showed that the deficit was greater in individuals in the group with ORIF procedures, especially in maximal incisor opening. Additionally, the patient was in ORIF and closed reduction showed a similar masticatory muscle electromyographic profile i.e., patients with facial fractures showed lower overall muscle activity and significant asymmetric activity of the masseter muscle.11

Study of Prakash et al., compare open reduction and close reduction in the management of condyle fractures, the results of the study show that two treatment options for mandibular condyle fractures provide possible results accepted with difference clinical significance in matter occlusion, mouth opening, movement functional, and pain in patients with open.12 A systematic review Inchingolo et al., stated that the device tracker jaw magnetic prove exists change cycle mastication after fracture, with differences were observed between surgical and non-surgical treatments.1 There was a significant increase in muscle activity after assessing bite force in the group of patients who were given a single 4-hole plate compared to another group of patients who were given a single 6-hole plate.18

Buitenhuis's research suggests that anatomy more good after open reduction.13 Surgery with ORIF is relative method safe and effective For patient mandibular condylar fractures in children, and are very affecting growth condyle and masticatory 14 The results of the study by Salunkhe et al., evaluated masticatory strength in patients treated for mandibular fractures and found a temporary adverse effect on masticatory strength. Bilateral mandibular fractures have a stronger influence on bite force than unilateral mandibular fractures.5 To reduce pain and swelling, get return range motion full, increase mobility gradually, and maintain associated muscles remain strong. Protocol six Sunday given to patient. It was found that approach therapeutic Enough effective for patients.16 Trauma causes more TMJ disorders slow on the non- mandibular side experienced a fracture compared to the side of the mandible that experienced the fracture. Bilateral mandibular fractures have a bad effect on recovery joints jaw in period long. All cases of bilateral condylar fractures internal TMJ disorders during the follow -up period.17

Discussion

Currently, bite force has emerged as a reasonable clinical indicator. Bite force assessment can be considered a useful parameter to assess post-treatment healing and the efficacy of the masticatory system and thus a useful indicator of treatment outcome.21Healing can be considered a dynamic process that increases gradually and can be observed through the forces of mastication.22

Additionally, a person's ability to chew or chew without pain or interference refers to masticatory function.4These forces depend on occlusion, the number of muscle fibers recruited to function, and the force created by the masticatory muscle fibers.23

The increase in chewing strength levels varies by gender and age, calculations should be standardized based on initial values. Understanding the muscle attachments and pressure exerted on the mandible will assist the surgeon in making management decisions. It may be more important to show in simple terms whether a fault is favorable or not.24 Fractures and impingement of the mandible can hinder daily activities. Fractures such as these have a significant impact on the mastication process and require special attention to the maxillofacial system.24,25

Mandibular fractures can improve the ability of masticatory muscle function. Prakash Study et al., shows that the mouth opening is maximum before operation ranges from 10 to 21 mm, with average 16.64 in patients group A, while in group B, it ranged from 17 to 25 mm, with an average of 20.18. There is significant increase in mouth opening at each follow continued, with a maximum average of 37.36 mm in group A and an average of 33.64 mm in group B. However, mouth opening increased more significant in the group reduction open compared to group reduction closed, maximum mouth opening in the ORIF group increased significantly post operation during six month of action advanced (37.36 mm) compared before operation (16.64 mm).12

Functional results objective post-surgery includes maximum mouth opening and increase performance mastication, and reported results patient (PRO) of The function of the mandible is mastication ability.13 In accordance with research by Gupta et al.,26 and Takenoshita et al., 27 This Possible caused by a reduction Trismus and TMJ pain go hand in hand walking time, patient do exercise opening the mouth, and healing fracture.12 On the other hand, related studies with orthognathic surgery has document decline extensibility and strength muscle post- surgery, improvement fatigue muscle tone, hypomobility, and changes efficiency biomechanics and length muscle mastication as clinical 28Additionally, signs this was still reported 6 months after surgery in patients who underwent Mandibular distraction, possible big caused by decline regeneration fiber muscle consequence stretching during surgical procedure.29

Clinical palpation studies highlight age-dependent variations in the outcome of condyle fractures, with children generally experiencing less severe dysfunction than adolescents and adults, potentially related to persistent dislocation of condyle fragments. Bite force analysis describes the dynamic adaptation of the masticatory system post-fracture, with initially observed reductions in force and subsequent adjustments to protect the injury site. Electromyographic studies provide insight into changes in muscle activity, revealing muscle adaptations and functional changes, especially in patients with unilateral fractures. CT scans provide valuable insight into soft tissue changes and muscle atrophy, emphasizing the importance of long-term evaluation.1

Conclusion

Patient with a good mandibular fracture symphysis, condyle and angle of showing significant deficits in muscle mastication and action surgery with Open Reduction and Internal Fixation (ORIF) can improve muscle function, especially in chewing.

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