

Surgical Treatment of the Non-Surgical Jaw Condyle Fracture Version: A Literature Review

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ABSTRACT

Introduction: Mandibular condyle fractures are quite frequent among facial traumas. These fractures have a direct relation to the temporomandibular joint (TMJ), and their treatment has shown many controversies, being discussed continuously. **Aim:** The objective of the present study was to make a review of the literature on surgical versus non-surgical treatments, with emphasis on its advantages, disadvantages, indications, and contraindications. **Methodology:** A bibliographic search was carried out in the main data banks: Scientific Electronic Library Online (SciELO) (www.scielo.org), Bireme (www.bvsalud.org) and Pubmed (www.pubmed.gov), which collected papers which were published from 1970 to 2017. 51 articles and 06 complementary materials met the inclusion criteria, Such as articles in English and Portuguese found in those databases, in which randomized clinical trials, clinical cases, case studies, systematic reviews, literature reviews, and articles addressing adult an imbalance patients were also included. We excluded articles that were based on animal experiments, or that were not from the dental area. **Results:** The treatments used for these condylar fractures include non-surgical treatment, also called conservative, and surgical treatment. In the conservative treatment, the maxillomandibular fixation (FMM) is made using elastic bands to maintain the occlusion of the patient, physiotherapy for functional restoration and liquid / pasty diet. In surgical treatment, the means used are osteosynthesis materials for reduction and fixation of fractured segments. **Conclusion:** Both treatments are effective and can be performed, but it is necessary to evaluate which treatment is most appropriate for each case. Inappropriate choice of treatment can result in problems such as pain, crepitation, facial asymmetries, shortening of the mandibular ramus, and even temporary or permanent paralysis.

KEYWORDS: Mandibular Condyle. Contrecoup Injury. Mandible. Traumatology

INTRODUCTION

The jaw is a bone of the face that anatomically divides into eight areas: symphysis, parsiphysis, body, angle, branch, alveolar process, condylar process, and coronoid process. It is located in the lower part of the face and is the only movable bone found in it, according to the classification of AO Foundation (1998). Mandibular fractures correspond to about 20% to 50% of cases of facial fractures. Among the regions affected, the most prevalent are the condyle (32%), symphysis / parsiphysis (29%), angle (20%), body (12.5%), branch the alveolar process (1.9%) and the coronoid process (1.2%).¹

The fracture of the condylar process leads to a rupture in the continuity of the mandible, which may lead to malocclusion, internal disorders of the temporomandibular joint (TMJ), decreased jaw movement,

ankylosis, an imbalance in mandibular growth (when it occurs in children), hampering its function.²

Among the principal etiological factors of condylar fractures are: automobile accidents, falls off the own height, sports accidents, and physical aggression. These fractures may be due to direct trauma when the force exerted directly on the condyle. Or indirect traumas, when the force exerted reaches another area, usually symphysis, where the energy is transmitted through the bone, indirectly fracturing the condyle region, known as a backlash fracture.³

The treatment option for these fractures is the reduction of bone fragments and restoration of function. The type of reduction to be chosen, whether open or closed, will depend on several factors such as degree of dislocation of the condyle, level of fracture, whether it occurred unilaterally or bilaterally, whether there are other

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associated facial fractures, local and systemic condition of the patient, age of the patient and history of temporomandibular joint disorder.⁴

Open or surgical treatment consists of exposing the fracture area for reduction and fixation through osteosynthesis with mini implants and screws. The closed or non-surgical treatment reduces the fracture without exposing the fractured site, immobilizing the dental elements by means of a maxillomandibular block that can be made with Erich arches and elastic or orthodontic devices. The knowledge acquired about the treatment of these fractures is extremely important, despite controversies in the literature. The choice of a correct conduct is necessary to have a good prognosis.⁶

The aim of the present study was to evaluate and discuss the advantages and disadvantages related to the treatment of mandibular condyle fractures, comparing studies performed with surgical treatment and conservative treatment.

MATERIALS AND METHODS

A bibliographic search was conducted in the main databases: Scientific Electronic Library Online (SciELO) (www.scielo.org), Bireme (www.bvsalud.org) and Pubmed (www.pubmed.gov), which collected were published from 1970 to 2017. Inclusion criteria were: articles in English and Portuguese found in these databases, in which randomized clinical trials, clinical cases, case studies, systematic reviews, literature reviews, were also included and articles addressing adult and pediatric patients. Excluded were those that were based on animal experiments, or that were not from the dental area.

Through the bibliographic research, 51 articles and 6 complementary materials were selected, all of which were extracted from the Scientific Electronic Library Online (SciELO) (www.scielo.org), Bireme (www.bvsalud.org) and Pubmed (www.pubmed.gov), as previously reported (Figure 1 and Graph.1). The following titles of specific medical subjects and keywords were used: Mandibular Condyle ([MeSHTerms]), Mandible ([MeSH Terms]), Traumatology ([MeSH-Terms]).

RESULTS

Based on the data found in several articles, the objective of the study was to analyze the best treatment, indications, contraindications, complications and methods, to reach the conclusion of which procedures should be established for each specific case, understanding that the main advantages and disadvantages of surgical versus non-surgical treatment should be presented (Figure 2).

Faced with careful selection and reading of the work, the following research results showed that studies show advantages of surgical treatment compared to non-surgical treatment. Better occlusion results, anatomical restoration and faster recovery rates in the open treatment, thus reporting that the postoperative period of patients treated through the surgical technique presented lower TMJ pain and less mandibular deviation. The open technique has the advantage of not having a deviation in the oral opening. Postoperative improvements, pain reduction, and satisfactory occlusion were better for open-treated patients⁷.

Both treatments in the neck and subcondylar fractures in relation to the aptness, buccal opening, and later-

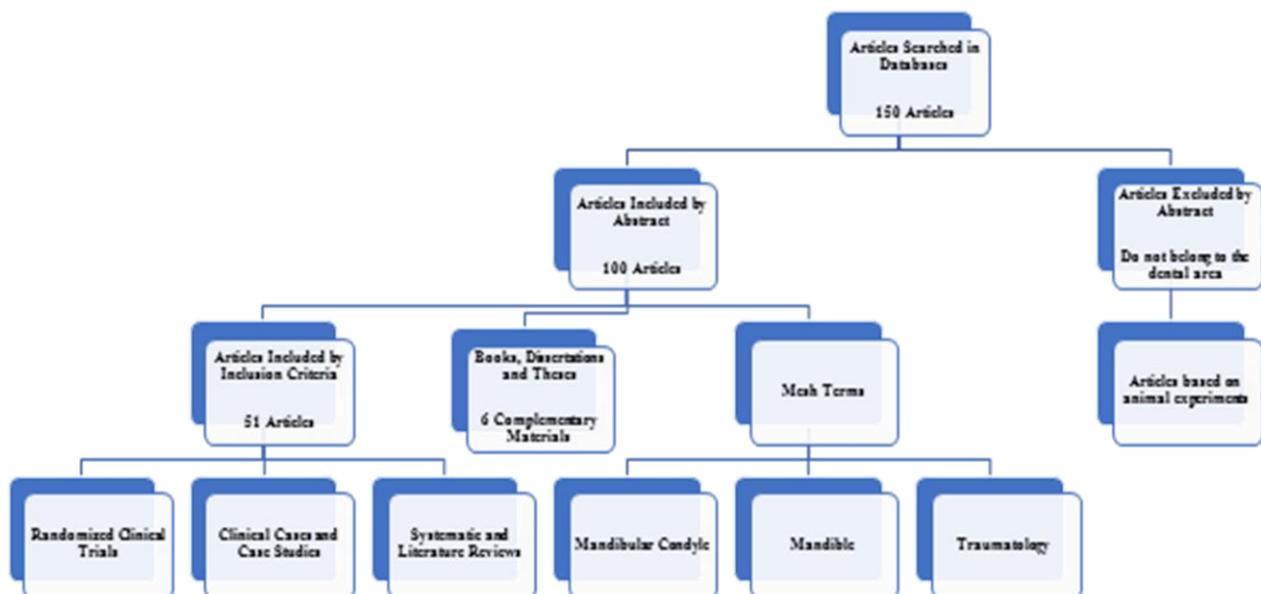
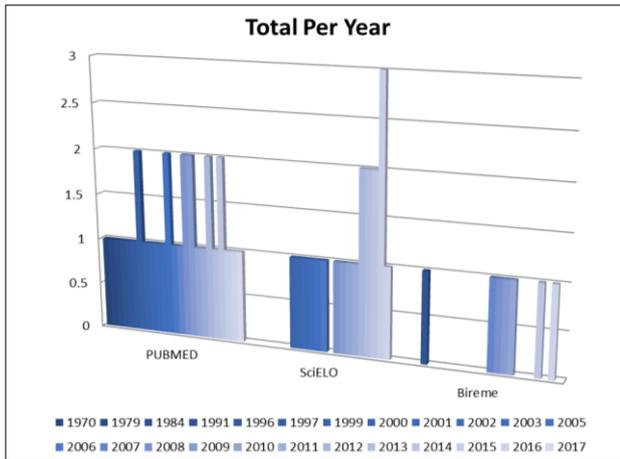


FIGURE 1 - Flowchart of the criterion of inclusion of articles.



Graph 1 - Cumulative Graph

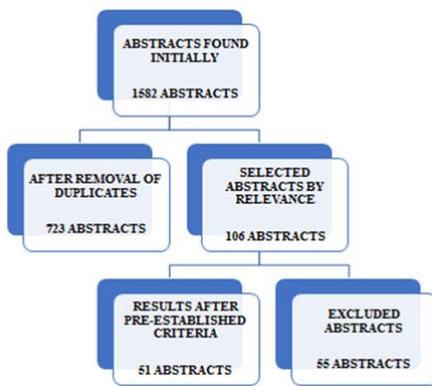


Figure 2 - Flowchart of the criteria for framing the articles

protrusive movements, the results obtained were without significant differences, that is, both treatments are effective, being at the discretion of the dental surgeon what is the most appropriate treatment for each case.⁸

Some disadvantages are found in the surgical treatment since this is presented as a more invasive procedure. Temporal paralysis of the marginal branch of the facial nerve mandible was found in addition to a smaller mouth opening (MMO) in patients submitted to open reduction. Another disadvantage was the presence of a postoperative parotid fistula. In a conservative procedure, a great advantage is that there is no need for general anesthesia, not generating a postoperative full of pain, as well as a lower risk of infection and inflammation when compared to a surgical procedure. In addition to not having problems with regard to scars and aesthetics, as it is unnecessary to perform a surgical access. Making an easy, simple, effective and satisfactory procedure in many cases. The advantage of a postoperative with less pain when performing excursive movements and also mentions the presence of a smaller edema.¹⁰

With regard to conservative treatment, in some cases, atrophy of mastication muscles may occur, as well as the patient may present difficulty in eating, carrying out oral hygiene, communication and some social implications. Another important factor is the non-cooperation of the patient, and sometimes it may happen that the patient

does not cooperate during physiotherapy and this generates a disadvantage in the treatment because this is a very important stage for the reestablishment of the function. In addition, it leads to a longer duration of trismus, recovery time and lower masticatory efficiency.¹¹

DISCUSSION

Anatomy of the mandibular bone: The mandible is an odd bone that is part of the viscerocranium, formed by a body that joins two branches and has a temporomandibular joint that joins the skull. Anteriorly on its outer face is the mental protrusion that is a bony eminence where the mandibular symphysis is located in the median line. Laterally, in the region of premolars is situated the mental foramen from which the mental nerve leaves. The horizontal part of the mandible is called the body of the mandible. In the upper part of the body is the alveolar process where the roots of the lower teeth are inserted.¹²

Subsequently, the region where the mandibular branch is located, an important area for insertion of the chewing muscles. The anterior margin of the branch ends in the coronoid process and inferior to this, the margin continues to originate the external oblique line that joins the branch to the body of the mandible. The posterior margin of the branch originates the condylar process that is formed by the neck and the head of the mandible, the condyle is in contact with the articular disc located in the mandibular fossa and articulates with the temporal bone forming the temporomandibular joint, which is of extremely important for the stomatognathic system. The region located between the coronoid and condylar processes is called the mandible incisura.¹³

In its medial or internal face in the anterior region can be observed an important point of muscular insertion known as genital spines. In the posterior region, there is the mandibular foramen which is the opening to the mandibular canal through which the inferior alveolar vessels pass and the inferior alveolar nerve which is responsible for the innervation of the mandibular dental elements.¹⁴

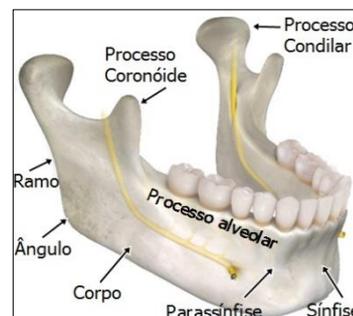


Figure 3: Anatomical classification of bone jaw. Source: Adapted from <http://www.vidadeodonto.com.br/articulacao-temporomandibular.html>.

Classification of the mandibular fractures: Mandibular fractures can be classified according to the anatomy of the mandibular bone, which is in symphysis, parsiphysis,

body, angle, branch, alveolar process, coronoid process and condylar process. As for the fracture pattern: green branch: they are incomplete fractures, with almost no mobility, occurring usually in children. Simple fracture: Complete cut of the single line bone that does not communicate with the outside and with the minimal fragmentation of the region. Composite fracture: there is communication of the fractured bone with the external medium. Complex fracture: causes damage to underlying structures such as vessels and nerves. Comminuted fracture: fractures that have several fragments, usually caused by high impact forces. Pathological fracture: occur due to the presence of some pre-existing bone lesion. He also classifies the direction of the fracture trait, which are the favorable fractures: which resist the forces of displacement promoted by the action of the muscles and the unfavorable fractures: that they do not resist the forces of displacement exerted by the action of the muscles causing that the fragments tend to separate.¹⁷

Classification of the condylar fractures: The condyle as the most fragile region of the mandible is the site of higher prevalence of fractures. Condylar fractures may be unilateral when they occur on only one side of the mandible or bilateral when they occur on both sides of the mandible and may originate from direct or indirect trauma.¹⁸

Several classifications have been proposed for these fractures, among them is the classification as to the anatomical location that is divided into: head of the condyle, corresponding to the uppermost part in oval shape, neck of the condyle that lies just below the head and is thinner and the subcondylar region, which extends from the deepest point of the sigmoid notch, to the most posterior part of the mandible branch.¹⁹

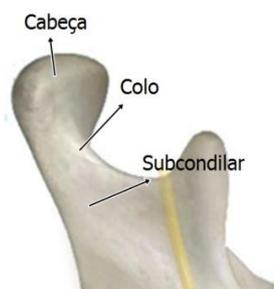


Figure.4: Anatomical classification of the condylar process, proposed by Lindahal. **Source:** Adapted from <http://www.vidadeodonto.com.br/articulacao-temporomandibular.html>

They may still be classified according to the displacement of the condyle head and may be of the non-displaced type, displaced (moderately or severely) with a deviation to mesial, distal, anterior or posterior. Also, according to its relation with the joint capsule and the fossa articular, being of the intracapsular type when it occurs above the insertion of the articular capsule, extracapsular when it occurs outside the joint capsule and can still occur outside the joint fossa, according to the classification of the AO Foundation.²⁰

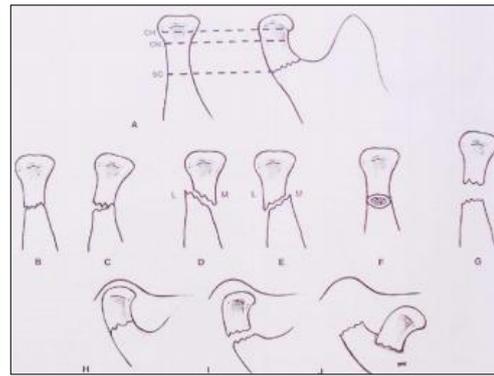


Figure.5– Classify anatomically. A - Displacement: B - Displaced, C - Diverted, D - Displaced medially, E - Displaced laterally, F - Dislocated anterior or posterior, G - No contact between fractured segments. - Regarding the relation with a joint depression. H, I, J. **Source:** CONCI, 2014, p.17.

Etiology and epidemiology: The literature shows that the prevalence of mandibular fractures is higher in men than in women. Accompanying mainly young adults in an age group of 20-30 years. The main cause was the auto accident, followed by falls of the same height, aggressions and others²¹. In children up to 6 years of age, the main cause of these fractures is the fall of the height itself, mainly due to traumatism in the sinus and symphysis region where it leads to an indirect fracture in the condyle region, also known as a backlash fracture.²²

Treatment of the condylar fractures: The condylar process cannot be limited only to the correction of the fracture, but also to a series of adjustments that must be taken into account in order to try to restore the joint by returning the patient to his function.²³

Surgical treatment: Mandibular condyle fractures were generally treated by the maxillomandibular fixation technique. With the emergence of internal fixation systems such as plates and screws, indications for open treatment have increased. The surgical treatment consists in exposing the fractured site, through a surgical approach, so that a reduction of the fracture and fixation of the bone segments can be accomplished.²⁴ Currently there are still controversies regarding the choice of an open or closed treatment for condylar fractures due to its complexity and involvement of an important structure that is the temporomandibular joint.²⁵

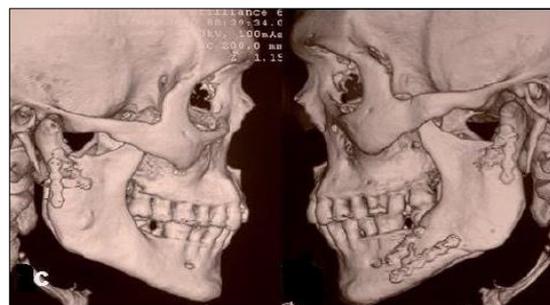


Figure.6- Computed tomography showing fixation of fractures with the plate and screw system. **Source:** http://revodonto.bvsalud.org/scielo.php?script=sci_arttext&pid=S180852102013000200011&ln=es

Types of surgical accesses: The types of accesses used include the intraoral, preauricular, submandibular and retromandibular routes, which will depend on the exact location of the fracture, type of fixation to be used, association with other facial fractures, the proximity of the fracture with noble structures like the facial nerve, besides the aesthetic factor.²⁶

Preauricular access is indicated for fractures in the condyle and intracapsular head regions. Its main advantages are better access of the fractured segments, greater ease of insertion of the fixation systems, in cases of elevated fractures. It has as disadvantages the limitation of the access in condyle neck and subcondylar region, possibility of damages to the facial nerve and presence of scar.²⁷

The submandibular access is indicated in specific cases of low extracapsular fractures. The entire region between the mandibular angle and the neck of the condyle can be exposed through this access. Its main disadvantage is the presence of facial scarring, as well as the possibility of damage to the marginal branch of the facial nerve mandible.^{28,29} Another access also used is the retromandibular, indicated in fractures of high extracapsular region. It has superiority over reduction and more direct fixation when compared to pre-auricular access.³⁰

A less commonly used type of access is the intraoral approach, and its endoscopically assisted dislocation, having as main advantages the absence of extra-oral scar and less possibility of damage to noble structures. However, it presents a greater limitation in relation to fracture access, leading to greater technical difficulty and the need for adequate material. Coronal access is indicated in specific cases, especially when there is a relationship with other facial fractures.³¹

Types of internal fixation: With the advent of fixation systems, cases of fractures that could not or would not have a good prognosis if treated through a closed reduction were given a surgical indication³². Among the methods of internal fixation are the plate and screw systems, which are being widely used due to cost-benefit and their great advantages such as the variety of sizes, shapes, and diameters, good union of the bone segments, biocompatibility, stability to bone structure, the absence of bone callus and primary healing of bone.³³

These plaque systems can be of two types: resorbable and non-resorbable. Non-resorbable materials are those made generally of titanium alloy. Absorbable materials are usually made of polymers and are currently used more in children because they are in the stage of mandibular growth and development.³⁴

Another method of fixation that is currently in disuse is the lag screw technique, which consists of the immobilization of the fractured segments through the use of long bicortical screws. Some disadvantages of this technique include a possible injury to noble structures such as nerves and vessels and the need for a thick

cortical. Another less commonly used method for this type of fracture is the use of steel wire or Kirschner.³⁵

Indications for surgical treatment: Most studies comparing open and closed treatment indicate that severely displaced condylar fractures presenting a displacement greater than 45°, disordered occlusion, bilateral fractures that present a worse prognosis, fractures with luxation or extracapsular comminutions, fractures in which there was displacement of the condyle outside the mandibular fossa and condylar fractures associated with other facial fractures tend to be treated by means of an open or surgical reduction³⁶. In pediatric patients, the choice of treatment for condylar fractures is conservative or non-surgical treatment because the child is in the bone growth phase.³⁷

Complications: Possible complications include lesions of the nerves and blood vessels, salivary fistula, loosening of the fixation system, infection, malocclusion, mandibular deviation, TMJ ankylosis, facial nerve damage, and internal disarrangement of the joint.³⁸

Non-Surgical Treatment: The conservative approach to mandibular condylar fractures, also known as non-surgical treatment, occurs when the fracture site is not surgically exposed, and a maxillomandibular fixation is performed for a shorter period, followed by repeated elastic therapy of a physiotherapy with post- and a liquid / pasty diet in order to achieve occlusal reestablishment. In this technique there is no need to perform a bloody procedure, thus reducing morbidity and surgical complications, so it has been used for a long time, although in recent years many dental surgeons opt for the surgical technique.³⁹

Conservative treatment is the most commonly used method when it comes to pediatric patients. Besides being conservative, the child presents an excellent chance of regeneration and normal continuous development, and can be restored to mandibular symmetry, functions, occlusion and to prevent complications, without interfering with occlusal development and future growth.⁴⁰

Patients with condylar fractures without displacement, mild occlusion dislocation, and moderate displacement, especially in unilateral cases, seem to be better treated by closed reduction and maxillomandibular fixation with medication for symptomatic relief and physiotherapy, as well as patients with highly displaced fractures, especially bilateral fractures, are apparently best treated with open reduction and semi-rigid fixation.⁴¹

Indications for non-surgical treatment: Conservative treatment should be indicated for patients who have a fragment deviation of less than or approximately 45°, or when the mandible head is located within the glenoid cavity, and in cases where the patient has absences of dental elements, and there is a probability of need for prosthesis.⁴²

In cases of fractures without dislocation of the condyle that may present deviation or not, conservative treatment

with elastic physiotherapy for correction of occlusion is the most indicated.⁴³ It is also possible to find condylar fractures without repercussion in the occlusion, for these cases a liquid / pasty diet for 2 weeks and observation is indicated.⁴⁴

Conservative treatment is related to bone remodeling and stimulation of condylar growth. It is indicated for pediatric patients and intracapsular fractures that present little or no displacement.⁴⁵⁻⁴⁸ Appropriate physiotherapy associated with or without a previous intermaxillary fixation, or for a longer period of time, added from a liquid and pasty diet consisting of a functional treatment may be indicated for almost all condylar fractures that do not present displacements, that is, fractures without the need for surgical intervention.⁴⁹⁻⁵²

Types of maxillary and jaw block: Fixation with brackets and orthodontic wires that do not allow dental movement.



Figure.7 – Fixation of mandiblemaxilla with orthodontic appliances and appliances. **Source:**

http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1415-54192007000500008

Erich of Bar:



Figure.8 – Maxillomandibular fixation with Erich of bar.

Complications: A complication of the treatment closed a considerable reduction in the height of the mandibular branch and posterior facial height, but in relation to aesthetics, such reduction of posterior facial height is negligible in most cases, being diagnosed only in imaging tests, that is, success in the treatment of condylar fractures can be obtained, using only the non-surgical treatment.⁵³⁻⁵⁷

CONCLUSION

It can be concluded from this study that the treatment of mandibular condyle fractures can be performed both by surgical and non-surgical treatment, and an analysis of the clinical situation of each case individually is required to choose the most appropriate treatment; conservative treatment is still the most indicated in cases of mandibular condyle fracture in children. In adult patients, the presence or absence of malocclusion, systemic conditions of the patient, fractures with displacements and fracture level for the correct choice of treatment should be taken into account in cases of bilateral mandibular condyle fractures, one side should always be treated surgically, in both types of treatment, whether surgical or non-surgical, the results are usually satisfactory when established and performed adequately.

REFERENCES

1. Al-kayat, A; Bramley, P. A modified pre-auricular approach to the temporomandibular joint and malar arch. *British Journal of oral surgery*. 1979, 17: 91-103.
2. Al-moraissi, E.A; Ellis, E. Surgical treatment of adult mandibular condylar fractures provides better outcomes than closed treatment: a sistematic review and meta-analysis. *J Oral Maxilofac Surg*. 2015, 73: 482-493.
3. Almeida, R.T.D; Botelho, M.R; Paiva, F.G. Diversos métodos de fixação interna rígida para o tratamento de fraturas de côndilo. *Rev Bras Cir Craniomaxilofac*. 2010, 1:29-35.
4. Alpert, B.; Seligson, D. Removal of asymptomatic bone plates used for orthognathic surgery and facial fractures. *J Oral Maxillofac Surg*. 1996, 54(5): 618-621.
5. AO Foundation Transforming Surgery –Changing Lives. Suíça, December 1984.
6. Araújo, C.F.D.N; Braga, P.L.S; Ferreira, J.D.B. Delayed treatment of condylar fracture: case report. *Rev Cir Traumatol Buco-Maxilo-Fac*. 2013, 13(2): 17-24.
7. Atilgan, S. et al. Mandibular fractures: a comparative analysis between Young and adult patients in the south eastregion of Turkey. *Journal of Applied Oral Science*. 2010, 18(1).
8. Barde, D; Mudhol, A; Madan, R. Prevalence and pattern of mandibular in Central India. *National Journal of Maxillo facial Surgery*. 2014, 5(2): 153-156.
9. Belli, E. et al. Surgical evolution in the treatment of mandibular condyle fractures. *Bio Med Central Surg*. 2015, 8(15): 16.
10. Bereket, C. et al. Incidence of mandibular fractures in blacksea region of Turkey. *Journal section: Oral Surgery*. 2014, 7(3): 410–413.
11. Bianchini, E.M.G. et al. Interdisciplinary approach for comminuted condyle fracture of by firearms – myofunctional focus. *Rev. CEFAC*. 2010, 12(5).
12. Boffano, P. et al. Current Opinions on Surgical Treatment of Fractures of the Condylar Head. *Journal List Craniomaxilofac Trauma Reconst*. 2014, 7(2): 92-100.
13. Brons, R.; Boering, G. Fractures of the mandibular body treated by stable internal fixation: a preliminary report. *J Oral Surg*. 1970, 28(5/6): 407- 415.

14. Carneiro, S. et al. Treatment of condylar fractures: a retrospective cohort study. *Med Oral Patol Oral Cir Bucal*. 2008, 13(9): 89-94.
15. Champy, M. Atlas of Rigid Fixation of Facial Skeleton, 1999.
16. Chen, S. et al. Width-controlling fixation of symphyseal/parasymphyseal fractures associated with bilateral condylar fractures with 2 2.0-mm miniplates: a retrospective investigation of 45 cases. *J Oral Maxillofac Surg*. 2016, 74: 315-327.
17. Choi, J; Oh, N; Kim, I-K. A follow-up study of condyle fracture in children. *Int J Oral Maxillofac Surg*. 2005, 34(8):851-858.
18. Choi, B.H; Yi, C.K; Yoo, J.H. M.R.I examination of the TMJ after surgical treatment of condylar fractures. *J Oral Maxillofac Surg*. 2001, 30:296-299.
19. Choi, K.Y. et al. Current concepts in the mandibular condyle fracture management part II: open reduction versus closed reduction. *APS Archives of plastic surgery*. 2012.
20. Conci, A.C. Estudo comparativo das técnicas de fixação óssea em fraturas de côndilo mandibular através de análise por elementos finitos. 2014, 69.
21. Cruz, G. et al. Fraturas de face na infância: experiência em 369 casos. *Rev Bras Cir Craniomaxilof*, 2009; 12(4):133.
22. De riu, G. et al. A comparison of open and closed treatment of condylar fractures: a change in philosophy. *Int. J. Oral Maxillofac. Surg*. 2001, 30: 384–389.
23. Du brul, E. L. Anatomia Oral de Sicher e DuBrul. 8. ed. São Paulo: Artes Médicas, 1991.
24. Eckelt, U. et al. Open versus closed treatment of fractures of the mandibular condylar process—a prospective randomized multi-centre study. *Journal of Cranio-Maxillofacial Surgery*. 2006.
25. Ellis, E. et al. Occlusal results after open or closed treatment of fractures of the mandibular condylar process. *J oralmaxillofac Surg*. 2000, 58(3): 260-268.
26. Ellis, E; Throckmorton, G. Facial symmetry after closed and open treatment of fractures of mandibular condylar process. *J oralmaxillofac surg*. 2000, 58(7): 719-728.
27. Ellis, E; Throckmorton, G.S. Treatment of mandibular condylar process fractures: biological considerations. *J Oral Maxillofac Surg*. 2005, 63(1): 115-134.
28. Ellis, E; Muniz, O; Anand, K. Treatment considerations for comminuted mandibular fractures. *J Oral Maxillofac Surg*. 2003, 61(8): 861-870.
29. Eppley, B.L; Sadove, A.M; Havlik, R.J. Use of resorbable plate and screw fixation in pediatric craniofacial surgery. *Plast Reconstr Surg*. 1997, 100(1): 1-7.
30. Ghasemzadeh, A.B.S. et al. Treatment of pediatric condylar fractures; a 20 – year experience. *Plast Reconstr Surg*. 2015, 136(6): 1279-1288.
31. GUPTA, M. et al. Analysis of different treatment protocols for fractures of condylar process of mandible. *J Oral Maxillofac Surg*. 2012, 70: 83-91.
32. Guven, O; Keskin, A. Remodelling following condylar fractures in children. *J Craniomaxillofac Surg*. 2001, 29(4): 232-237.
33. Han, L. et al. Correlation between condylar fracture pattern after parasymphyseal impact and condyle morphological features: a retrospective analysis of 107 chinese patients. *Chinese Medical Journal*. 2017, 30:20.
34. Haug, R.H; Brandt, M.T. Closed reduction, open reduction and endoscopic assistance: current thoughts on the management of mandibular condyle fractures. *Plast Reconstr Surg*. 2007.
35. Jindal, G. et al. Management of mandibular condylar fractures – A pragmatic approach. *J Maxillofac Oral Surg*. 2005, 4:21.
36. Kumaran, S; Thambiah, L.J. Analysis of two different surgical approaches for fractures of the mandibular condyle. *Indian Journal of Dental Research*. 2012, 23(4): 463-468.
37. Lindhal, L. Condylar fractures of the mandible. IV. Function of masticatory system. 1. *Int J Oral Surg*. 1997, 6: 195-203.
38. Luo, S. et al. Surgical Treatment of Sagittal Fracture of Mandibular Condyle Using Long-Screw Osteosynthesis. *J Oral Maxillofac Surg*. 2011, 69:1988-1994.
39. Manganello, L.C; Silva, A.A.F. Mandibular condylar fractures: classification and treatment. *Rev Bras Otorrinolaringol*. 2002, 68: 749-55.
40. Mendonça, J.C.G; Bento, L.A; Freitas, G.P. Tratamento de fraturas de côndilo mandibular: revisão da literatura. *Rev Bras Cir Craniomaxilofac*. 2010, 13(2): 102-6.
41. Miloro, Michael et al. Princípios de Cirurgia Bucomaxilofacial de Peterson, Segunda edição, 2008.
42. Norton, N. S. Netter: Atlas de cabeça e pescoço. Rio de Janeiro: Elsevier. 2007, 632.
43. Rampasso, C.L. et al. Evaluation of prevalence in the treatment of mandible condyle fractures. *Rev Col Bras Cir*. 2012, 39(5): 373-376.
44. Santler, G. et al. Fractures of the condylar process: surgical versus nonsurgical treatment. *J oralmaxillofac. Surg*. 1999, 57: 392-397.
45. Schneider, M. et al. Open versus closed treatment of fractures of the mandibular condylar process: a randomized, prospective, multicenter study with special evaluation of fracture level. *Journal of Cranio-Maxillofacial Surgery*. 2008, 66 (12): 2537- 2544.
46. Schon, R. et al. Endoscopy - assisted open treatment of condylar fractures of the mandible: extraoral vs intraoral approach. *Int J Oral Maxillofac Surg*. 2002, 31(3): 237 - 243.
47. Shiju, M. et al. Fractures of the mandibular condyle – Open versus closed – A treatment dilemma. *Journal of Cranio-Maxillofacial Surgery*. 2015, 43(4): 448-451.
48. Silva, A.P; Sassi, F.C; Andrade, C.R.F. Caracterização miofuncional orofacial e eletromiográfica de pacientes submetidos à correção da fratura condilar por redução aberta e fechada. *CoDAS*. 2016, 28(5).
49. Smets, L.M; Van damme, P.A; Stoelinga, P.J. Non-surgical treatment of condylar fractures in adults: a retrospective analysis. *J Craniomaxillofac Surg*. 2003, 31(3):162-167.
50. Stacey, D. et al. Management of mandible fractures. *Plast Reconstr Surg*. 2006, 117(3):48-60.
51. Tabrizi, R. et al. Comparison of nonsurgical treatment options in pediatric condylar fractures: rigid intermaxillary fixation versus using guiding elastic therapy. *The Journal of Craniofacial Surgery*. 2013, 24(3).
52. Valiati, R. et al. The treatment of condylar fractures: to open or not to open? A critical review of this controversy. *Int J Med Sci*. 2008, 5(6): 313-318.
53. Vesnaver, A. Open Reduction and Internal Fixation of Intra-Articular Fractures of the Mandibular Condyle: Our First Experiences. *J Oral Maxillofac Surg, Solovenia*. 2008, 66 (10):2123-2129.
54. Wulkan, M; Parreira junir, J.G; Botter, D.A. Epidemiologia do trauma facial. *Rev Col Bras Cir, Rio de Janeiro*. 2005, 51(5): 290-295.

55. Yang, W.G. et al. Functional Results of Unilateral Mandibular Condylar Process Fractures after Open and Closed Treatment. *J Trauma*. 2002; 52:498 –503.
56. Zachariades, N. et al. Fractures of the mandibular condyle: a review of 466 cases. Literature review, reflections on treatment and proposals. *J Craniomaxillofac Surg*. 2006, 34(7): 421-32.
57. Zide, M.F; Kent, J.N. Indications for open reduction of mandibular condyle fractures. *J Oral Maxillofac Surg*. 1999, 41(2):89-98.
58. Anatomical classification of bone jaw. Source: Adapted from <http://www.vidadeodonto.com.br/articulacao-temporomandibular.html>.
59. Anatomical classification of the condylar process, proposed by Lindahal. Source: Adaptado de <http://www.vidadeodonto.com.br/articulacao-temporomandibular.html>
60. Computed tomography showing fixation of fractures with the plate and screw system. Source: http://revodonto.bvsalud.org/scielo.php?script=sci_arttext&pid=S180852102013000200011&ln=es
61. Fixation of mandiblemaxilla with orthodontic appliances and appliances. Source: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1415-54192007000500008

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