**SCOPING REVIEW**

# Surgical *vs.* Non-Surgical Management of Mandibular Condyle Fractures in Adolescent

**Abdurrahman Adirhesa[1], Carolina Cita Brilliani[1], Fredy Mardiyantoro[2*]**
[1]Resident of Oral & Maxillofacial Surgery, Faculty of Dental Medicine, Universitas Airlangga, Surabaya, Indonesia.
[2]Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Universitas Brawijaya, Malang, Indonesia.

**Article Info**

***Article history:***
Received 26-06-2023
Revised 10-10-2024
Accepted 18-10-2024
Published 31-01-2025

***Keywords:***
Mandibular condyle fractures
Surgical management
Non-surgical management
Open reduction
Closed reduction
Traffic accidents

***Corresponding author**:
Fredy Mardiyantoro
fredy.fre@ub.ac.id

**ABSTRACT**

**Background:** Mandibular condyle fractures are common among adolescents, often resulting from trauma such as falls or road traffic accidents. These fractures, which involve the articular surface of the mandible, can lead to complications like malocclusion, restricted mouth opening, and temporomandibular joint dysfunction. Treatment for mandibular condyle fractures varies, with non-surgical management, including closed reduction and functional therapy, often favored for its less invasive nature, especially in growing adolescents. Surgical interventions, such as open reduction and internal fixation, are considered for more complex fractures or when non-surgical methods fail. However, the decision between surgical and non-surgical treatment remains contentious, particularly in adolescents, whose condylar fractures might heal better due to the regenerative capacity of their growing bones. **Objective:** This review aimed to compare the outcomes of surgical and non-surgical management of mandibular condyle fractures. **Material and Method:** This review was conducted by searching the Scopus database for case reports published between 2014 and 2024, which described either surgical or non-surgical treatment of adolescent mandibular condyle fractures. **Result:** A total of 7 case reports were included, highlighting the use of various treatment approaches. Non-surgical methods, including functional appliances and mouth-opening exercises, showed promising results, with improved mouth opening and condylar remodeling. Similarly, surgical approaches, though more invasive, resulted in good functional and aesthetic outcomes, with minimal complications when proper anatomical understanding was applied. **Conclusion:** Both non-surgical and surgical approaches can be used to treat condylar fractures in adolescents, provided that proper evaluation, planning, and a thorough understanding of the condyle's anatomy and surrounding tissue are ensured.

**How to cite:**
Adirhesa, A., Brilliani, C. C., Mardiyantoro, F. 2025. Surgical vs Non-Surgical Management of Mandibular Condyle Fractures on Adolescent. Majalah Biomorfologi-Biomorphology Journal, 35(1):48-58.

***Majalah Biomorfologi* (Biomorphology Journal)** p.ISSN:0215-8833, e.ISSN: 2716-0920
doi: 10.20473/mbiom.v35i2.2025.48-58

**Highlights**

1. Non-surgical treatments can involve various appliances. However, all non-surgical treatments are typically supplemented with mouth-opening exercises.
2. Surgical treatments usually consist of open reduction and internal fixation, which can be implemented using various anatomical approaches.

## BACKGROUND

Mandibular condyle fractures are among the most common maxillofacial fractures, with a prevalence as high as 45% (Kozakiewicz & Walczyk, 2023). These fractures can be caused by several etiologies. Reports indicate that 45.71% of mandibular condyle fractures are caused by falls from a height, 40% by road traffic accidents, 6% by workplace accidents, 6% by sports accidents, and 3% by assault (Badar, et al., 2014).

Treatment modalities for mandibular condyle fractures vary among medical centers. Some centers provide surgical management, while others offer non-surgical management. Each modality has its own advantages and disadvantages (Chrcanovic, 2015). Non-surgical management is considered a more conservative approach to treating mandibular condyle fractures, but some reports suggest it may fail to achieve optimal functional and aesthetic results. Surgical management is more invasive, with its own risks and complications, but successful surgical treatment is reported to yield more ideal functional and aesthetic outcomes. Currently, there is still no consensus regarding the preferred treatment modality (Ren, et al., 2020).

Reports show that mandibular condyle fractures are more likely to occur in adolescent patients compared to adult patients. Adolescents are defined as individuals within the 10-19 years age range (Liang, et al., 2019). Adolescent patients account for 69% of mandibular condyle fractures, whereas adult patients account for 45% of these cases (Kozakiewicz & Walczyk, 2023). This finding may be explained by the fact that one of the etiologies of mandibular fractures is falling from a bicycle or scooter accident. The use of bicycles and scooters is more common in adolescents than in adults. Bicycle and scooter accidents often result in trauma to the chin, which can cause indirect trauma to the mandibular condyle (Tuna, et al., 2012). Reports indicate that chin lacerations are often associated with mandibular condyle trauma, which is why it is advisable to always check for mandibular condyle fractures in patients with chin lacerations (Kozakiewicz & Walczyk, 2023).

The closed reduction method is considered a non-invasive alternative for treating condylar fractures, especially in adolescents. Open reduction is considered too invasive for such a young age. The potential for successful closed reduction methods to treat condylar fractures in adolescents is believed to be due to the fact that, at this age, the condyle is an active growth and remodeling center with a very regenerative nature and relatively high osteogenic potential (Kamath, et al., 2023).

Given the high prevalence of mandibular condyle fracture among other maxillofacial fracture cases, the lack of agreement between surgical and nonsurgical treatment modalities for mandibular condyle fracture, and the tendency for the adolescent age group to have a higher prevalence of mandibular condyle fracture, this study aimed to review the results between surgical and nonsurgical management of mandibular condyle fracture among adolescents.

## OBJECTIVE

The objective of this review was to compare the outcomes of surgical and non-surgical management of mandibular condyle fractures in adolescents and their anatomical significance across different approaches.

## MATERIAL AND METHOD

This paper reviewed case reports to obtain more representative results. The review was conducted by searching the Scopus database using keywords, including 'surgical management of condyle fracture case reports,' 'non-surgical management of condyle fracture case reports,' 'open reduction for condyle

fracture case reports,' and 'closed reduction for condyle fracture case reports.' The search was refined by limiting the publication years to the last 10 years to ensure more up-to-date results. The review aimed to answer the question of whether there is a difference in the outcomes of closed reduction and open reduction for condylar fractures among adolescents.

The keyword 'surgical management of condyle fracture case reports' resulted in 131 documents. The keyword 'non-surgical management of condyle fracture case reports' resulted in 2 documents. The keyword 'open reduction for condyle fracture case reports' resulted in 49 documents. The keyword 'closed reduction for condyle fracture case reports' resulted in 21 documents. In total, 203 documents were identified in the Scopus database search.

The inclusion criteria for this scoping review were case report papers published between 2014 and 2024, written in English, and reporting either non-surgical or surgical management of condylar fractures in adolescents. Only case report articles were included in this review. The population criteria included case reports featuring adolescents who had suffered from a mandibular condylar fracture. The intervention criteria required articles that reported either the closed reduction or open reduction method. The outcome criteria included case reports with immediate postoperative results and/or at least 3 months of follow-up, as this period is believed to be sufficient for remodeling to occur. The 203 documents identified were screened by title to eliminate duplicates and irrelevant documents. Twenty-three items were relevant to the topic based on the title alone. These 23 items were screened by abstract, and it was found that 7 were research papers rather than case reports. These 7 research papers were excluded, leaving 16 items. The 16 remaining items were sought for full-text retrieval, and all were successfully retrieved. The 16 items were then assessed for eligibility. It was found that 9 of the items did not have adolescents as their subjects, so only 7 reports were deemed eligible for inclusion in the review.

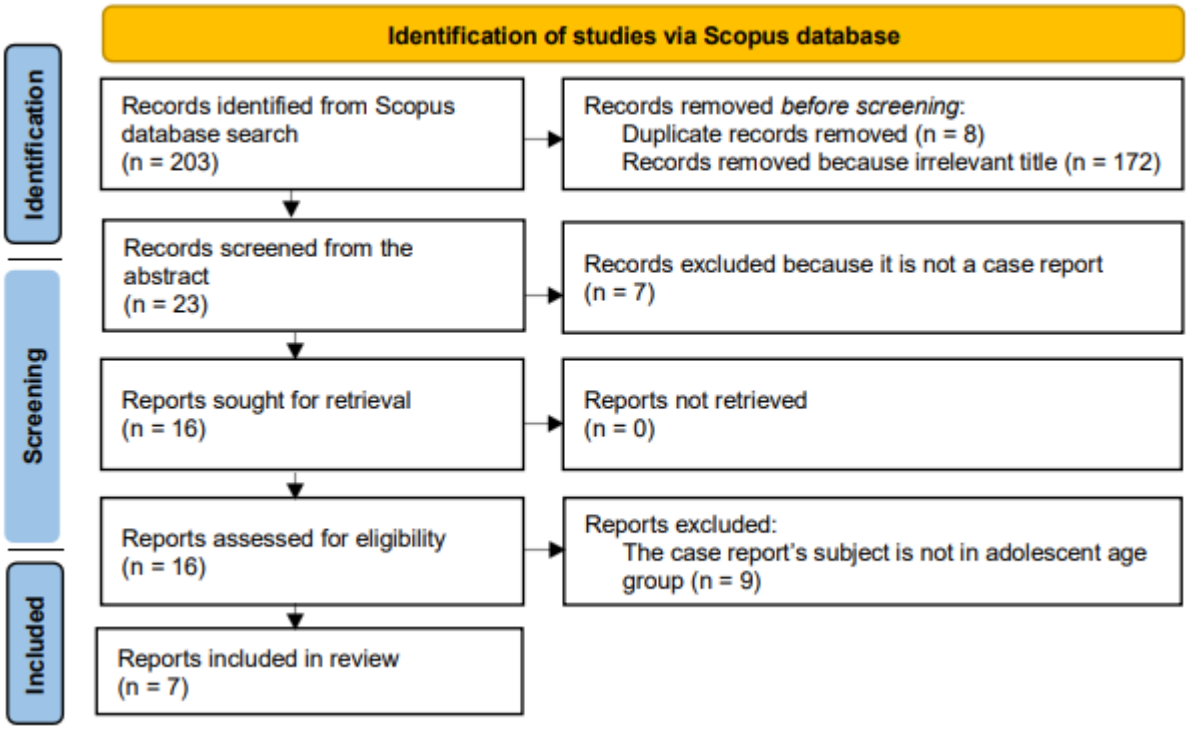


Figure 1. ScR PRISMA diagram.

## RESULT

The outcomes of both non-surgical and surgical management of mandibular condyle fracture are presented in Table 1.

Table 1. PICO Table of reports regarding non-surgical and surgical management of mandibular condyle fracture.

| References | Demographic | Demographic | Intervention | Outcome |
|---|---|---|---|---|
| Abdullayev, et al., (2020) doi: 10.1016/j.omsc.2019.100134. | Female 8 years old | The patient experienced pain in the left parotid region, a laceration in the chin region, restricted mouth opening, and a crossbite following a fall from a height. A CT scan revealed a low subcondylar fracture of the right condyle, along with a medial shift dislocation. | The nonsurgical intervention involves using class I elastic for 2 weeks, and then replacing it with class III and cross-midline elastic for another 4 weeks. | After one month of treatment, the patient's mouth opening has improved, albeit with a slight deviation from the interdental midline. Radiological examination showed partial repositioning of the condyle with signs of ossification on the lateral aspect. Six months after the treatment, the patient's mouth opening is in good condition, with no deviation from the interdental midline. Radiological examination showed a reasonable degree of repositioning and remodeling of the condyle. |
| Bedoya-Rodriguez & Ramirez-Yanez, (2020) doi: 10.17796/1053-4625-44.6.12. | Female 11 years old | The patient presented with a limited mouth opening (20 mm), pain, limited lateral excursions, a bleeding laceration in the chin area, and pain upon palpation of both TMJs following a fall from height. The CT scan revealed a bilateral mandibular condyle fracture that was displaced medially. | The patient underwent a nonsurgical intervention, utilizing the myofunctional Bionator appliance to sustain the mandible's vertical dimension and forward positioning for a period of 6 months. After 6 months, the Bionator was then swapped with Indirect Planas' Tracks that allowed the patient to perform mandibular lateral excursion for another 2 months. During 8 months of treatment, the patient was also instructed to perform functional exercises to prevent ankylosis and exercise mandibular lateral excursion. | After eight months of treatment, the CBCT no longer showed condylar fractures, and both TMJs had successfully undergone condylar remodeling. However, the right condyle now had a higher, rounded shape, while the left condyle had a lower, flattened shape. The patient was then instructed to continue treatment for another eight months using Indirect Planas' Track. After 16 months of treatment, the condyles were symmetrical in shape and level, and the patient had a standard mouth opening and mandibular lateral excursion. |
| Hamada, et al., (2017) doi: 10.1016/j.p | Female 11 years old | The patient presented with trismus, pain, and laceration of the | A nonsurgical intervention was performed using intermaxillary | Three weeks after treatment (two weeks after the fixation was removed), the patient had a 30 mm mouth opening. One year |

| | | | | |
|---|---|---|---|---|
| dj.2017.08.002. | | chin and lower lip after falling off of a stage. A panoramic radiograph revealed a fracture to the left mandibular condyle. | fixation and Schuchardt splints during the first visit. The fixation was removed after one week, and the patient was instructed to perform opening exercises. Four weeks after the treatment, the splints were also removed. | after treatment, the left mandibular condyle showed good regeneration, and the mouth opening had reached 52 mm. The patient was then instructed to attend follow-up examinations every six months for the next 10 years, with no complications observed. |
| Junior, et al., (2018) doi: 10.24873/j.rpemd.2018.05.215. | Female<br>18 years old | The patient presented with a contused lacerated wound on the chin, edema in the right and left preauricular areas, bone crepitus, and limited mandibular movement associated with pain following a motorcycle accident.<br><br>A panoramic radiograph revealed a mandibular fracture in the mental region, a right subcondylar fracture, and a left condylar process fracture. | The patient was initially treated surgically to address the mental fracture.<br><br>After surgery, the patient continued with non-surgical intervention to treat the bilateral condylar fractures. This non-surgical intervention involved the placement of orthodontic appliances and elastics with a 5 mm height in the posterior occlusal region bilaterally. The anterior teeth were secured with elastics. The posterior fixation was maintained for two days, while the anterior intermaxillary fixation was kept for seven days. After the removal of both the posterior and anterior fixations, the patient was instructed to perform mouth opening, bilateral excursion, and mandibular protrusion exercises for 90 days. | Thirteen months after treatment, a CT scan showed remodeling of the mandibular condyle, which had reached an ideal position in the mandibular fossa. Clinical examination revealed a 47 mm mouth opening, with normal protrusive and lateral excursion movements. |

| | | | | |
|---|---|---|---|---|
| McLeod & Van Gijn, (2018) doi: 10.1016/j.bjoms.2018.01.003. | Male<br>15 years old | The patient presented with pain and swelling in the right TMJ, along with malocclusion, following a road traffic accident. A panoramic radiograph revealed a comminuted fracture of the right condylar head and neck. | The patient was intervened surgically with open reduction of the condyle and internal fixation using a sonic sheet and pins to secure the condyle head. | After 2 years of follow-up, the patient has normal dietary function without any report of pain with 50 mm interincisal opening and no growth disturbance on the mandible. |
| Lee, et al., (2022) doi: 10.5125/jkaoms.2022.48.5.267. | Male<br>16 years old | The patient presented with panfacial bone fractures and bilateral mandibular subcondyle fractures. The patient sustained Le-Fort III fractures, blowout fractures, zygomatic arch fractures, and mandibular symphysis fractures after falling from a three-story building. | The patient was surgically treated with an open reduction of the orbit, zygomatic arch, maxilla, symphysis, and subcondyle on both sides. The subcondyles were also openly reduced, and osteosynthesis was achieved using two titanium plates on each side. Open reduction was followed by intermaxillary fixation. | At 6 years of follow-up, the patient had a 25-mm mouth opening, and posterior occlusion was in an acceptable range for functioning.<br>The patient was also instructed to do mouth-opening exercises.<br>Four months after surgery, the patient has a 37 mm mouth opening. |
| Lauand, et al., (2020) doi: 10.1007/s10006-020-00864-5. | Female<br>12 years old | The patient presented with severe trismus (9 mm) associated with pain. The patient also showed signs of malocclusion, chewing difficulties, and mandibular retrognathism. The patient had a bicycle accident 6 years ago and experienced a mandibular condyle fracture that was treated conservatively. CBCT showed a dense radiopaque ankylotic block on the right condyle. | The patient was intervened surgically by doing an osteotomy on the ankylosed condyle. | No ankylotic mass was found during the immediate postoperative period. Five months after the operation, condylar remodeling was observed, and no complications were reported. |

## DISCUSSION

The condyle is part of the mandible that forms the temporomandibular joint, connecting the mandible to the temporal bone of the skull. The condyle is covered by articular discs and capsules, which are reinforced by the medial and lateral ligaments. These structures all articulate with the glenoid fossa in the temporal bone to form the temporomandibular joint (Walker & MacLeod, 2017).

The main goal of mandibular condyle fracture management is to restore the pre-traumatic function of the masticatory system. This includes restoring the pre-traumatic position of the fractured segment, dental occlusion, and maxillofacial symmetry. Current approaches to managing mandibular condyle fractures indicate that these goals can be achieved through either a non-surgical or a surgical strategy. The non-surgical strategy typically involves closed reduction and functional treatment, while the surgical strategy generally involves open reduction and internal fixation (Ren, et al., 2020).

The decision between non-surgical and surgical strategies depends on various factors, such as the patient's age and anatomy. The patient's age is particularly important, as the mandibular condyle is still undergoing growth and development in adolescents, making conservative treatment more viable and offering a better prognosis (Nota, et al., 2020). Anatomy also plays a crucial role in this decision. When opting for a surgical approach, the operator must consider the anatomy of the surrounding tissues (Snyder & Cunningham, 2017).

The complexity of the mandibular condyle's surrounding anatomy makes surgical access relatively difficult and can influence the complexity of fractured fragment displacement. The lateral pterygoid muscle is attached to the medial surface of the condyle (Figure 2). This anatomical arrangement typically causes the fractured condylar fragments to be displaced anteromedially. Anteromedial displacement can complicate proper reduction and hinder sufficient visualization of the surgical site (Deng, et al., 2016).

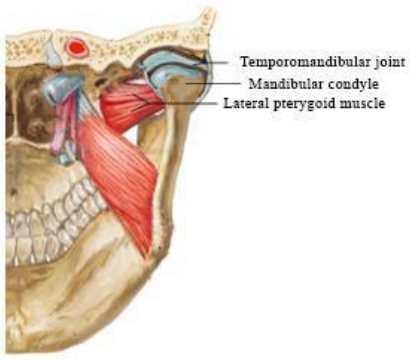


Figure 2. Relation between the condyle and lateral pterygoid muscle (Netter, 2018).

The condylar process of the mandible is surrounded by complex innervation. The anatomy of the nerve branches around the condylar process becomes crucial when the operator selects a specific approach for surgical access. The pre-auricular approach involves an incision along the skin crease near the tragus, with access to the condyle through the space between the buccocervical and temporozygomatic nerve trunks. The submandibular approach requires careful consideration of the marginal mandibular nerve. Without a proper understanding of the facial nerve anatomy, condyle fracture surgery carries a risk of nerve injury (Moorthy & Krishna, 2021).

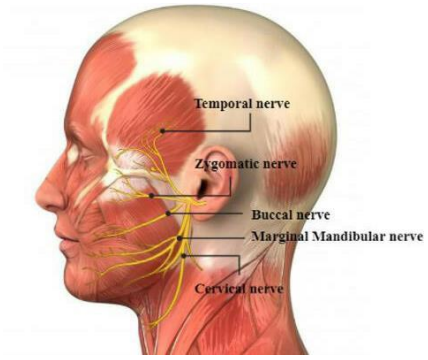


Figure 3. Branches of facial nerve that needs to keep in mind in condylar surgery (Khalifeh, et al., 2022).

The anatomical relationship between the chin and mandibular condyle also highlights the connection between trauma to the chin and the condyle. The chin is located at the most anterior point of the mandible and is one of the most common areas to be impacted during accidents, especially bicycle accidents and road traffic accidents. In most of the cases reviewed, there appears to be a relationship between chin lacerations and condylar fractures. This finding underscores the importance of the operator being suspicious of a condylar fracture when a patient presents with a chin injury after an accident (Nayak, et al., 2021).

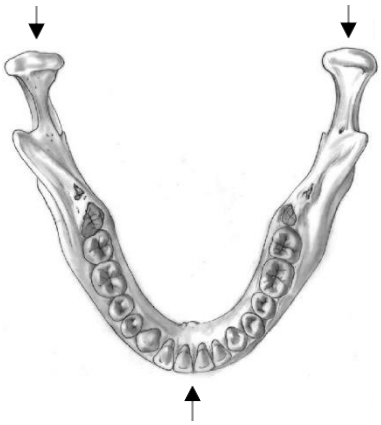

Figure 4. Anatomical relationship between mental area and condyle. The mode of impact is demonstrated using black arrows (Cunningham, et al., 2016).

The literature review showed that Hamada, et al., (2017), Junior, et al., (2018), Abdullayev, et al., (2020), and Bedoya-Rodriguez & Ramirez-Yanez, (2020) reported successful outcomes with non-surgical interventions in adolescent patients with fractured condyles. They used different appliances in each case. This finding highlights the importance of appropriately assessing the fracture and selecting the correct appliance (Stähli, et al., 2021). Although the appliances used varied, all the reports included in this review shared one common approach: all of them instructed patients to perform mouth-opening exercises, demonstrating the importance of these exercises in achieving normal mouth opening and preventing TMJ ankylosis (Nagori, et al., 2014).

Reports indicate that trauma to the temporomandibular complex, including but not limited to condylar fractures, carries a significant risk of temporomandibular joint ankylosis. While bone fractures typically require immobilization, prolonged immobilization in the case of condylar fractures can lead to the risk of temporomandibular joint ankylosis (Monteiro, et al., 2021). It is crucial to avoid prolonged external restrictions in order to preserve the temporomandibular joint's range of motion. Therefore, temporomandibular joint exercises should be considered mandatory (Marji et al., 2020).

Reports from McLeod & Van Gijn, (2018), Lauand, et al., (2020), and Lee, et al., (2022) also showed positive results with no complications, despite using surgical approaches. All the patients in these reports showed good functional and aesthetic outcomes following surgery. Surgical approaches remain a promising option for fracture management, particularly with a better understanding of human anatomy (Kolk, et al., 2020). Research by García-Guerrero, et al., (2018) supports this finding, showing that complications associated with surgical approaches are infrequent and minimal. The primary complication is facial nerve damage, but this can be mitigated with a better understanding of the anatomy (García-Guerrero, et al., 2018).

Although older papers suggest that non-surgical approaches are associated with less-than-ideal outcomes, such as reduced mouth opening, deviated mouth opening, malocclusion, and reduced stomatognathic function, this does not appear to be the case here. With proper assessment and planning, non-surgical approaches can be a viable solution for condylar fractures, especially in growing adolescent patients (Vanpoecke, et al., 2020). The surgical approach is also associated with comorbidities and complications following surgery, but it seems that with a better understanding of human anatomy, these risks can be minimized (Shakya, et al., 2020).

### Strength and limitations

This review emphasizes the critical importance of a thorough understanding of the anatomy of the condyle and its surrounding tissues when comparing non-surgical and surgical approaches. However, this study does not specify the type of appliance used in the non-surgical approach. Therefore, further research is needed to evaluate specific appliances for a more accurate comparison.

## CONCLUSION

Adolescents with condylar fractures can be treated surgically or non-surgically, as long as they obtain the right evaluation and planning and the anatomy of the condyle and the surrounding tissue is well-understood.

### Acknowledgment

The authors would like to thank the Department of Oral & Maxillofacial Surgery, Faculty of Dental Medicine, Universitas Airlangga, Surabaya, Indonesia.

### Conflict of Interest

All authors have no conflict of interest.

### Funding Disclosure

None.

### Author Contribution

AA and CCB contribute to the study conception and study design, data analysis and interpretation, article drafting, critical revision of the article for important intellectual content, and final approval of the article. FM contributes to the technical, administrative and logistic support and provision of study materials.

## REFERENCES

Abdullayev, E., Rahimov, C., Farzaliyev, I., et al. 2020. Non-surgical treatment of condylar fractures in children. Oral and Maxillofacial Surgery Cases, 6(1): 100134. doi: 10.1016/j.omsc.2019.100134.

Badar, M. A., Shah, S. A. A., Wahid, A. 2014. Etiology of mandibular condylar fractures: A study from Tertiary Care Hospital of Lahore. Pakistan Oral and Dental Journal, 34(1): 42–45. Available at: https://www.researchgate.net/publication/260998429_Etiology_of_Mandibular_Condylar_Fractures_A_Study_From_Tertiary_Care_Hospital_of_Lahore.

Bedoya-Rodriguez, A., Ramirez-Yanez, G. O. 2020. Bilateral condylar fracture: A case treated with a conservative myofunctional approach. Journal of Clinical Pediatric Dentistry, 44(6): 464–468. doi:

10.17796/1053-4625-44.6.12.
Chrcanovic, B. R. 2015. Surgical versus non-surgical treatment of mandibular condylar fractures: A meta-analysis. International Journal of Oral and Maxillofacial Surgery, 44(2): 158–179. doi: 10.1016/j.ijom.2014.09.024.
Cunningham, C., Scheuer, L., Black, S. 2016. Developmental juvenile osteology, in. Elsevier: 149–176. doi: 10.1016/B978-0-12-382106-5.00006-2.
Deng, T., Liu, C. K., Liu, P., et al. 2016. Influence of the lateral pterygoid muscle on traumatic temporomandibular joint bony ankylosis. BMC Oral Health, 16(1): 62. doi: 10.1186/s12903-016-0220-1.
García-Guerrero, I., Ramírez, J. M., Gómez de Diego, R., et al. 2018. Complications in the treatment of mandibular condylar fractures: Surgical versus conservative treatment. Annals of Anatomy - Anatomischer Anzeiger, 216: 60–68. doi: 10.1016/j.aanat.2017.10.007.
Hamada, M., Nomura, R., Yano, H., et al. 2017. Mandibular condyle fracture in Japanese girl and 10-year follow-up findings. Pediatric Dental Journal, 27(3): 169–172. doi: 10.1016/j.pdj.2017.08.002.
Junior, P. R., Padovan, L., Momesso, N., et al. 2018. Non-surgical management of bilateral mandibular condyle fracture: Six-year follow-up. A case report. Revista Portuguesa de Estomatologia, Medicina Dentária e Cirurgia Maxilofacial, 59. doi: 10.24873/j.rpemd.2018.05.215.
Kamath, A. T., Roy, S., Pai, D. 2023. Paediatric condylar trauma - primary management considerations - A review. Journal of Oral Biology and Craniofacial Research, 13(2): 236–242. doi: 10.1016/j.jobcr.2023.01.011.
Khalifeh, B., Ballout, N., Arab, A. Al. 2022. Tissue engineering in injured facial nerve: A narrative review. Journal of Neuroscience Research and Alzheimer's Disease, 1(1): 1–26. Available at: https://www.researchgate.net/publication/363799386_Tissue_Engineering_in_Injured_Facial_Nerve_A_Narrative_Review.
Kolk, A., Scheunemann, L. M., Grill, F., et al. 2020. Prognostic factors for long-term results after condylar head fractures: A comparative study of non-surgical treatment versus open reduction and osteosynthesis. Journal of Cranio-Maxillofacial Surgery, 48(12): 1138–1145. doi: 10.1016/j.jcms.2020.10.001.
Kozakiewicz, M., Walczyk, A. 2023. Current frequency of mandibular condylar process fractures. Journal of Clinical Medicine, 12(4): 1394. doi: 10.3390/jcm12041394.
Lauand, G. A., Meneses-Santos, D., Santos, F. T., et al. 2020. Surgical correction of ankylosed TMJ in a child: Case report. Oral and Maxillofacial Surgery, 24(4): 509–514. doi: 10.1007/s10006-020-00864-5.
Lee, Sung-Jae., Chun, Y. J., Lee, S. J., et al. 2022. Modified high-submandibular appraoch for open reduction and internal fixation of condylar fracture: Case series report. Journal of the Korean Association of Oral and Maxillofacial Surgeons, 48(5): 267–276. doi: 10.5125/jkaoms.2022.48.5.267.
Liang, M., Simelane, S., Fillo, G. F., et al. 2019. The state of adolescent sexual and reproductive health. Journal of Adolescent Health, 65(6): S3–S15. doi: 10.1016/j.jadohealth.2019.09.015.
Marji, F. P., Anstadt, E., Davit, A., et al. 2020. Pediatric mandibular condylar fractures with concomitant cervical spine injury: A treatment protocol for prevention of temporomandibular joint ankylosis. Journal of Craniofacial Surgery, 31(3): e248–e250. doi: 10.1097/SCS.0000000000006178.
McLeod, N. M. H., Van Gijn, D. 2018. Use of ultrasound-activated resorbable sheets and pins in the management of fractures of the condylar neck of the mandible: A case series. British Journal of Oral and Maxillofacial Surgery, 56(3): 182–185. doi: 10.1016/j.bjoms.2018.01.003.
Monteiro, J. L. G. C., Guastaldi, F. P. S., Troulis, M. J., et al. 2021. Induction, treatment, and prevention of temporomandibular joint ankylosis—A systematic review of comparative animal studies. Journal of Oral and Maxillofacial Surgery, 79(1): 109-132.e6. doi: 10.1016/j.joms.2020.07.018.
Moorthy, A., Krishna, S. 2021. Management of medical comorbidities in maxillofacial surgery. in Oral and Maxillofacial Surgery for the Clinician. Singapore: Springer Nature Singapore: 25–48. doi: 10.1007/978-981-15-1346-6_3.
Nagori, S. A., Jose, A., Bhutia, O., et al. 2014. Undiagnosed mandibular condylar fractures causing temporomandibular joint ankylosis: A problem in northern India. The National Medical Journal of India, 27(5): 251–5. Available at: http://www.ncbi.nlm.nih.gov/pubmed/26037423.
Nayak, S. S., Arun, S., Taranath Kamath, A., et al. 2021. The influence of the mandibular chin angle on the occurrence of mandibular condylar fracture: A retrospective study. The Scientific World Journal. Edited by D. Endoh, 2021: 1–7. doi: 10.1155/2021/2380840.

Netter, F. H. 2018. Atlas of human anatomy. Elsevier. Available at: https://shop.elsevier.com/books/atlas-of-human-anatomy/netter/978-0-323-39322-5.

Nota, A., Caruso, S., Ehsani, S., et al. 2020. Three-dimensional volumetric analysis of mandibular condyle changes in growing subjects: A retrospective cross-sectional study. CRANIO®, 38(5): 320–326. doi: 10.1080/08869634.2018.1537088.

Ren, R., Dai, J., Zhi, Y., et al. 2020. Comparison of temporomandibular joint function and morphology after surgical and non-surgical treatment in adult condylar head fractures. Journal of Cranio-Maxillofacial Surgery, 48(3): 323–330. doi: 10.1016/j.jcms.2020.01.019.

Shakya, S., Zhang, X., Liu, L. 2020. Key points in surgical management of mandibular condylar fractures. Chinese Journal of Traumatology, 23(2): 63–70. doi: 10.1016/j.cjtee.2019.08.006.

Snyder, S. K., Cunningham, L. L. 2017. The biology of open versus closed treatment of condylar fractures. Atlas of the Oral and Maxillofacial Surgery Clinics, 25(1): 35–46. doi: 10.1016/j.cxom.2016.10.006.

Stähli, C., Eliades, T., Papageorgiou, S. N. 2021. Functional appliance treatment for mandibular fractures: A systematic review with meta-analyses. Journal of Oral Rehabilitation, 48(8): 945–954. doi: 10.1111/joor.13178.

Tuna, E. B., Dündar, A., Çankaya, A.B., et al. 2012. Conservative approach to unilateral condylar fracture in a growing patient: A 2.5-year follow up. The Open Dentistry Journal, 6(1): 1–4. doi: 10.2174/1874210601206010001.

Vanpoecke, J., Dubron, K., Politis, C. 2020. Condylar fractures: An argument for conservative treatment. Craniomaxillofacial Trauma & Reconstruction, 13(1): 23–31. doi: 10.1177/1943387520902881.

Walker, C. J., MacLeod, S. P. R. 2017. Anatomy and biomechanics of condylar fractures. Atlas of the Oral and Maxillofacial Surgery Clinics, 25(1): 11–16. doi: 10.1016/j.cxom.2016.10.002.