CLINICAL PRACTICE GUIDELINES

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ORAL HEALTH PROGRAMME
MINISTRY OF HEALTH MALAYSIA

MANAGEMENT OF MANDIBULAR CONDYLE FRACTURES

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http://www.moh.gov.my
http://www.ohd.gov.my
http://www.acadmed.org.my
Also available as an app for Android and iOS platform: MyMaHTAS

STATEMENT OF INTENT

These guidelines update and supplant the original guidelines developed in 2005 and are based on the best available contemporary evidence. They are intended as a guide for the best clinical practices in the management of mandibular condyle fractures presently. However, it must be noted that adherence to these guidelines do not necessarily lead to the best clinical outcomes in individual patient care, as every health care provider is responsible for the management of his/her unique patient based on the clinical presentations and management options available locally.

REVIEW OF THE GUIDELINES

These guidelines were issued in June 2019 and will be reviewed in 2024 or earlier if important new evidence becomes available. When it is due for updating, the head of the related specialty will be informed and a multidisciplinary team will be formed subsequently. A discussion will be made on the need for a revision including the scope of the revised CPG. The systematic review methodology used by the Malaysia Health Technology Assessment Section (MaHTAS) will be employed in reviewing the guidelines.

Every care is taken to ensure that this publication is correct in every detail at the time of publication. However, in the event of errors or omissions, corrections will be published in the web version of this document, which is the definitive version at all times. This version can be found on the websites mentioned above.

LEVELS OF EVIDENCE

LEVEL	STUDY DESIGN
I	Evidence obtained from at least one properly designed randomised controlled trial.
II-1	Evidence obtained from well-designed controlled trials without randomisation.
II-2	Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one centre or research group.
II-3	Evidence obtained from multiple time series studies, with or without intervention. Dramatic results in uncontrolled experiments (such as the results of the introduction of penicillin treatment in the 1940s) could also be regarded as this type of evidence.
III	Opinions of respected authorities, based on clinical experience; descriptive studies and case reports; or reports of expert committees.

Source: Adapted from Harris RP, Helfand M, Woolf SH, Lohr KN, Mulrow CD, Teutsch SM, Atkins D. Current Methods of the U.S. Preventive Services Task Force: A Review of the Process. Am J Prev Med. 2001;20 (suppl 3):21-35.

In line with the current development in CPG methodology, the CPG Unit of MaHTAS is in the process of adapting **Grading Recommendations, Assessment, Development and Evaluation (GRADE)** in its work process. The quality of each retrieved evidence and its effect size will be carefully assessed/reviewed by the CPG Development Group. In formulating the recommendations, overall balances of the following aspects will be considered in determining the strength of the recommendations:

- overall quality of evidence
- balance of benefits versus harms
- values and preferences
- resource implications
- equity, feasibility and acceptability

GUIDELINES DEVELOPMENT AND OBJECTIVES

GUIDELINES DEVELOPMENT

These clinical practice guidelines (CPG) were developed by an expert committee consisting of Oral and Maxillofacial Surgeons, a Paediatric Dental Specialist, a Public Health Specialist and a general dentist from the Ministry of Health, the Ministry of Education and private sector.

The previous edition of the CPG on Management of Unilateral Condylar Fracture of the Mandible (December 2005) was used as the basis for the development of these guidelines. The recommendations were formulated taking into consideration the best available evidence and local practices. Several improvements have been introduced in this edition. The scope has been expanded to include management of all mandibular condyle fractures. In addition, new and updated information have been included in these guidelines. Besides this, clinical audit indicators have also been identified for the purpose of monitoring and evaluating outcomes.

Literature search was carried out using the following electronic databases: Medline, Pubmed, Cochrane Database of Systemic Reviews (CDSR) and Embase while full text journal articles were retrieved from these databases. The search was limited to literature published from 2006 to 2017, humans and in English. The reference lists of all relevant articles retrieved were also searched to identify further studies. Future CPG updates will consider evidence published after this cut-off period. The search strategy can be found in **Appendix 1.** The details of the search strategy can be obtained upon request from the Oral Health Technology Section, Oral Health Programme, Ministry of Health Malaysia.

There were eight (8) clinical questions which were assigned to members of the development group. The group members met a total of 16 times throughout the development of these guidelines. All retrieved literature were appraised by at least two members, presented in the form of evidence tables and discussed during group meetings. All statements and recommendations formulated were agreed upon by both the development group and reviewers. This CPG is based on reference to the findings of systematic review, randomized controlled trials, observational studies and case reports, with local practices taken into consideration. However, when there was a lack of evidence, recommendations were based on consensus of group members. Although ideally patients' views and preferences need to be considered in the development of CPGs, in this instance, it was not feasible.

The literature used in these guidelines were graded using the US/Canadian Preventive Services Task Force Level of Evidence (2001), while the formulation of recommendation was done using the principles of GRADE. The writing of the CPG strictly follows the requirement of Appraisal of Guidelines Research and Evaluation (AGREE II).

The draft was reviewed by a panel of internal and external reviewers. Recommendations were presented to the Technical Advisory Committee for CPGs, and finally to the HTA and CPG Council, Ministry of Health, Malaysia for approval.

OBJECTIVE

To review and expand the scope of the existing guidelines on the management of unilateral condylar fractures developed in 2005, and develop a revised set of evidence based, best practice recommendations for the management of all mandibular condyle fractures i.e. both unilateral and bilateral.

SPECIFIC OBJECTIVES

i. To reinforce knowledge on detection of mandibular condyle fractures
ii. To recommend appropriate diagnostic tools for confirmation of mandibular condyle fractures
iii. To recommend best treatment modalities for mandibular condyle fractures
iv. To recommend on rehabilitation of treated patients with mandibular condyle fractures to normal function
v. To identify possible complications following treatment of mandibular condyle fractures

CLINICAL QUESTIONS

The clinical questions addressed by these guidelines can be found in **Appendix 2.**

TARGET POPULATION

These guidelines are applicable to all patients with mandibular condyle fractures.

Inclusion criteria

Newly diagnosed mandibular condyle fractures secondary to trauma only.

Exclusion criteria

Old or untreated mandibular condyle fractures.

TARGET GROUP / USER

This CPG is meant for all health care providers involved in the diagnosis and management of mandibular condyle fractures namely: specialists of related disciplines, dental officers, medical officers and allied health professionals

HEALTHCARE SETTINGS

Outpatient and inpatient settings inclusive of all healthcare facilities

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REVIEW PANEL

These guidelines were reviewed by a panel of independent reviewers from both public and private sectors who were requested to comment primarily on the comprehensiveness and accuracy of interpretation of the evidence supporting the recommendations in this CPG. The following internal and external reviewers provided comments and feedback on the proposed draft:

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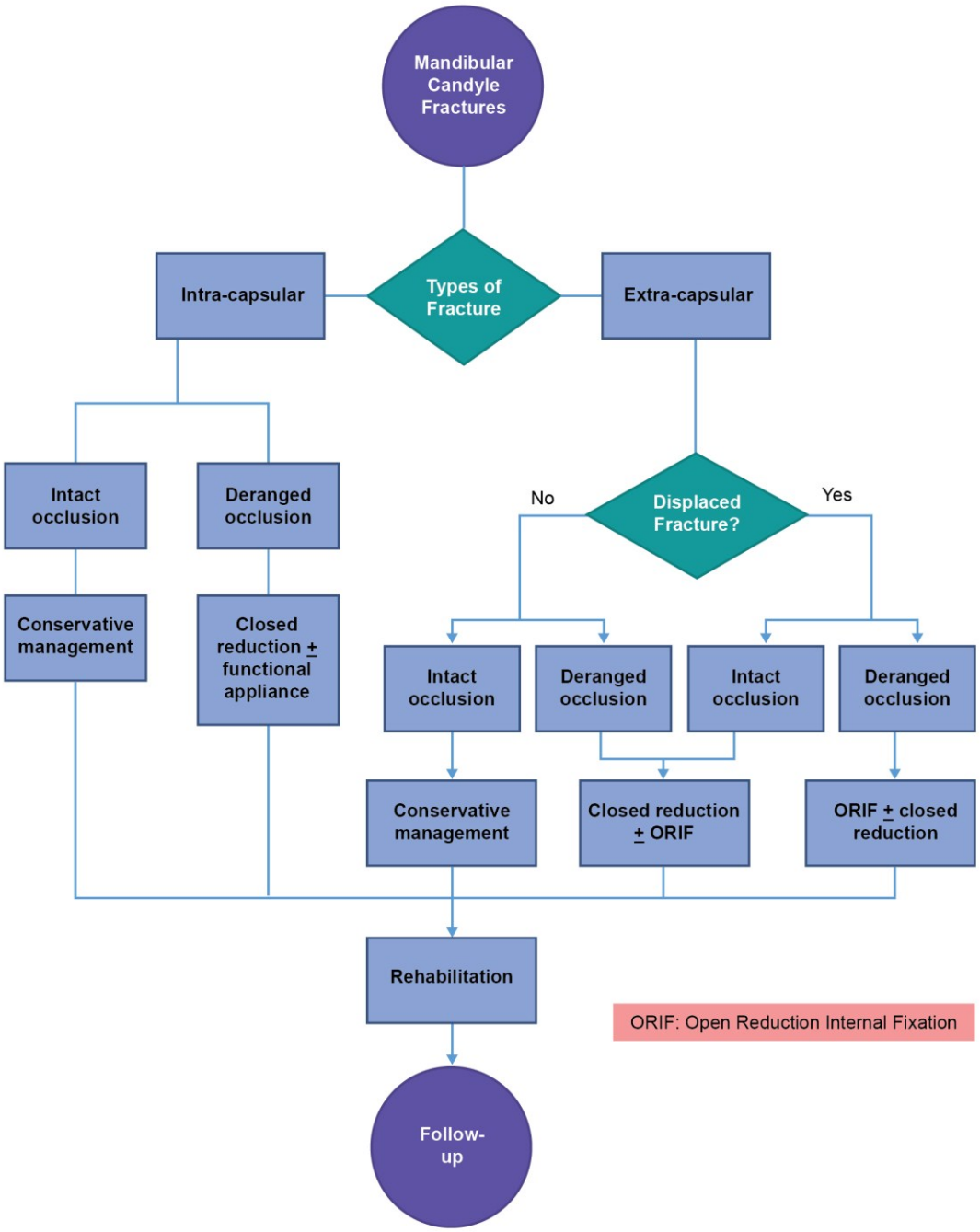
ALGORITHM FOR MANAGEMENT OF MANDIBULAR CONDYLE FRACTURES



LIST OF KEY MESSAGES

Diagnosis	• A reverse Towne's view or a posterior-anterior skull view allows for the evaluation of the possibility of a medial / lateral displacement in mandibular condyle fractures. It acts as an adjunct to an OPG in these fractures.
	• 3-dimension Computed Tomography (3D-CTs) show better visualisation of the position and displacement of bone fragments, and comminution of fractures which is useful for surgical planning in mandibular condyle fractures.
Treatment	The standard outcomes to determine successful treatment of mandibular condyle fractures are: • Mouth opening >40mm (adult) and >35mm (children) • No pain at the affected site • Mandible has good movements in all directions • Recovery of pre-injury occlusal relationship (satisfactory to clinicians and patients) • Temporomandibular joint stability • Minimal chin deviation on mouth opening • No obvious facial asymmetry
	• Open reduction internal fixation (ORIF) of mandibular condyle fractures shows better outcomes in restoring ramus height and occlusal status, protrusive and laterotrusive movements, and preventing chin deviation on opening.
	• No one method of Intermaxillary Fixation (IMF) has been shown to be superior in the management of mandibular condyle fractures.
	• Closed treatment of mandibular condyle fractures shows good clinical outcomes for paediatric patients.

LIST OF KEY RECOMMENDATIONS

Diagnosis	• An underlying mandibular condyle fracture should be suspected and investigated in patients presenting with soft tissue injuries on the chin and any type of open bite.
	• Computed Tomography (CT) or Cone-beam CT scans should be used in the diagnosis of mandibular condyle fractures when feasible. o Plain radiographs may be used as an option.
Treatment	• For closed reduction of mandibular condyle fractures, rigid intermaxillary fixation (IMF) may be carried out for: o two weeks followed by 1-2 weeks of elastic IMF or o three weeks followed by functional treatment
	• Open reduction internal fixation of mandibular condyle fracture should be considered based on the following: o patient's factors o availability of accurate diagnostic facilities o types of fracture o surgeon's experience
	• Rehabilitation and regular follow-up should be carried out post-treatment of mandibular condyle fractures to ensure optimum outcomes.

1. INTRODUCTION

The Mandibular Condyle is the supero-posterior process on the ramus of the mandible and composed of two parts: a superior part, the articular portion / condylar head, and an inferior part, the condylar neck **(Figure 1).**

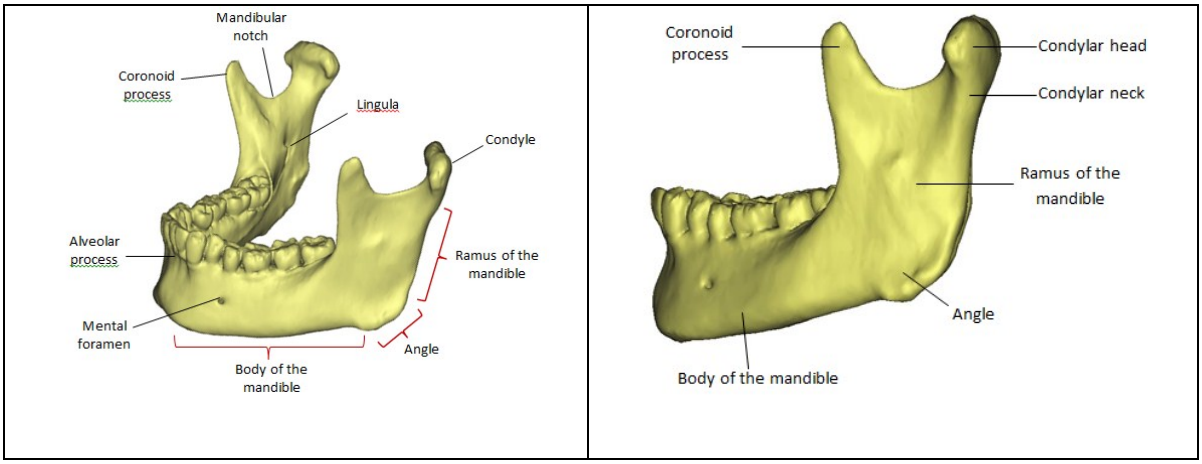


Figure 1: Anatomy of Mandibular Condyle

The main aetiology for condylar fractures varies according to geographical, socio-economic and demographic (age and sex) status of the population. Motor vehicle accidents (MVA), interpersonal violence, falls and sports injuries were the most common causes seen in developed and developing countries. The mechanism of injury involved in mandibular condyle fractures were:

- Indirect trauma, in which forces were transferred from the more resistant skeleton (e.g. chin region anteriorly and body of mandible region laterally) to the mandibular condyle. [1, level III]
- The position of the jaw (open or closed) in relation to the direction and magnitude of the force also played a part in the type of fractures sustained.

The mandible and zygoma by nature of their location and anatomy, are the two most commonly fractured facial bones. In Malaysia, studies have shown that fractures of the mandible range from 42.7% - 83.1% of all facial bone fractures. Inherently weak areas of the mandible which commonly fracture are the condyle, the angle and the parasymphysis. Condylar fractures have been reported to account for 19.3% - 33.2% of mandibular fractures. [2-4, level III]

In Malaysia, in children under the age of 15 years, mandibular fractures accounted for 58.3% - 65% of all facial bone fractures, of which 27% were condylar fractures. [4-5, level III] This is consistent with findings from other centres and is considered as a characteristic feature of paediatric mandibular fractures.[6-7, level III]

Due to the high prevalence and incidence of condylar fractures, we should not miss this diagnosis as it could lead to serious complications such as ankyloses. [8, level III] Refer to **Appendix 5.**

Management of mandibular condyle fractures consists of surgical and non-surgical interventions. Irrespective of the treatment methods, several complications such as pain, restricted mandibular movement, muscle spasm, deviation of the mandible, malocclusion, pathological changes in the temporomandibular joint (TMJ), malunion, facial asymmetry, and ankylosis have been reported. [8-10, level III] Additionally, in children, fractures of the condylar process may damage the growth centres leading to altered growth and deformity of the facial skeleton.[11, level III]

In view of the high prevalence and potential complications of mandibular condyle fractures, this CPG aims to provide evidence-based guidance on the management of these fractures.

2. DIAGNOSIS

2.1 Clinical Presentation [12-13, level III]

a. General complaints:
   - Pain on opening and closing the mouth
   - Swelling in front of the ear
   - Difficulty in chewing
   - Bleeding from the ear
   - Difficulty in breathing

b. Examination

   i) Extra-oral:
   - Pre-auricular swelling with ecchymosis and oedema
   - Facial asymmetry
   - Soft tissue injuries (abrasions, lacerations) on the chin or pre-auricular area **(Figure 2)**
   - Limitation of mouth opening
   - Tenderness to palpation over TMJ area and / or condyle is not palpable on mouth opening and closing

- Chin deviation to the affected side on mouth opening and closing (in cases of unilateral condylar fractures)
- Facial weakness (in cases of facial nerve injury)
- Sensory disturbances to the lip and chin region (inferior alveolar nerve courses through the mandibular body and angle. Fractures of the subcondylar area extending to the bony canal can cause temporary or permanent anaesthesia of the lip, teeth, and gingiva)
- Pre-auricular hollowing (in cases of medial displacement of the condylar head)

ii) Intra-oral

- Malocclusion:
  - Anterior open bite (in cases of bilateral condyle fractures) **(Figure 2)**
  - Premature posterior contact on the affected side and open bite on unaffected side (in cases of unilateral condyle fracture)
  - Posterior open bite on the affected side (due to haemarthrosis)

Figure 2: Clinical features of mandibular condyle fractures

Recommendation 1

- An underlying mandibular condyle fracture should be suspected and investigated in patients presenting with soft tissue injuries on the chin and any type of open bite.

2.2 Investigations - Imaging

Imaging modalities such as plain radiographs, computed tomography (CT) scans, and cone-beam CT (CBCT) scans, are the main investigations in the diagnosis of mandibular condyle fracture.

2.2.1 Plain Radiographs

- **Orthopantomogram (OPG)**

OPG is commonly used in the diagnosis of a variety of dental and maxillofacial conditions **(Figure 3).** Image quality using digital OPG with post-processing (manipulation of contrast and image density) was better than without post-processing and film-based OPG ($p<0.05$).[14,level III] However, OPG was less accurate in determining condylar fractures compared with CT scans. [15-16, level III]

3a: Bilateral condyle fractures (red circles) and right parasymphisis fracture

3b: Bilateral condyle fractures (red circles) and symphysis fracture

Figure 3: OPG radiographs showing bilateral condyle fractures

- **Other Plain Radiographs**

Other plain radiographs used in the diagnosis of mandibular condyle fractures are lateral oblique, transcranial, reverse Towne's, and posterior-anterior (PA) views.[17-18, level III] Reverse Towne's or PA views are frontal projection radiographs. They allow for the evaluation of a medial / lateral displacement in mandibular condyle fractures. [18, level III]

There is no retrievable evidence on the effectiveness and safety of plain radiographs. However, it is known that most of these imaging techniques are less helpful due to the superimposition of the facial bone complex.[17,19, level III] **(Figure 4 to 6)**

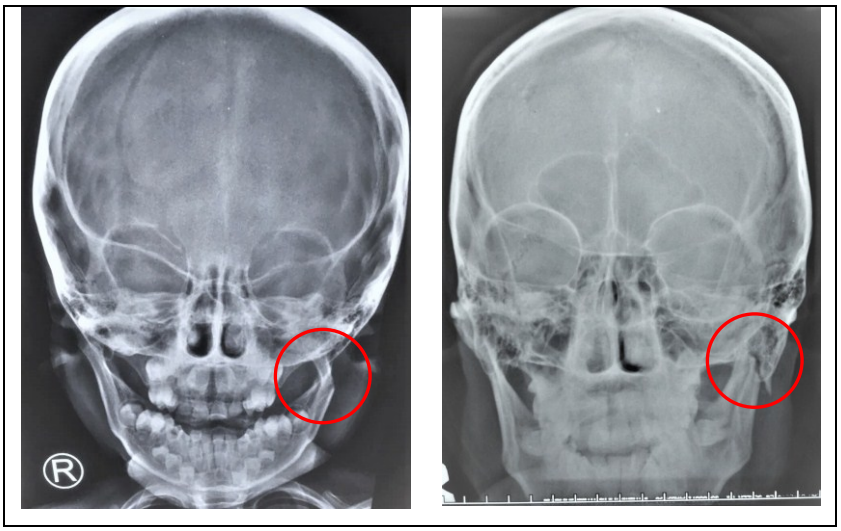


Figure 4: Posterior-anterior skull

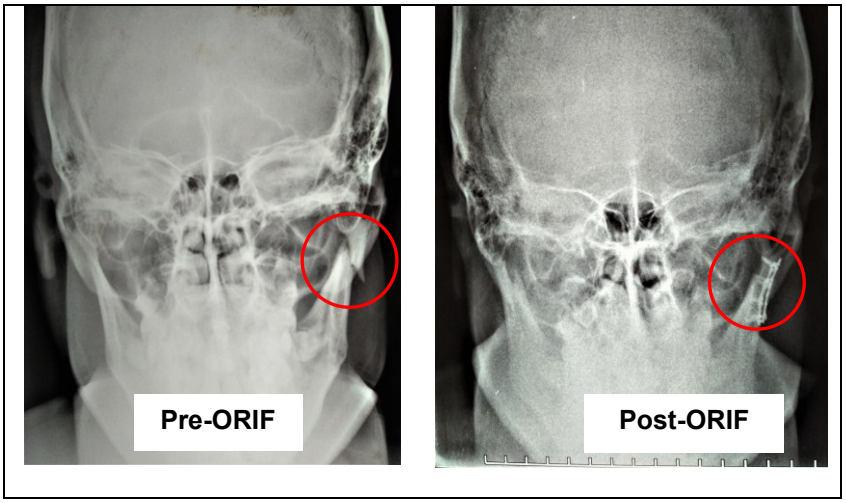


Figure 5: Reverse Towne's view (pre and post ORIF)

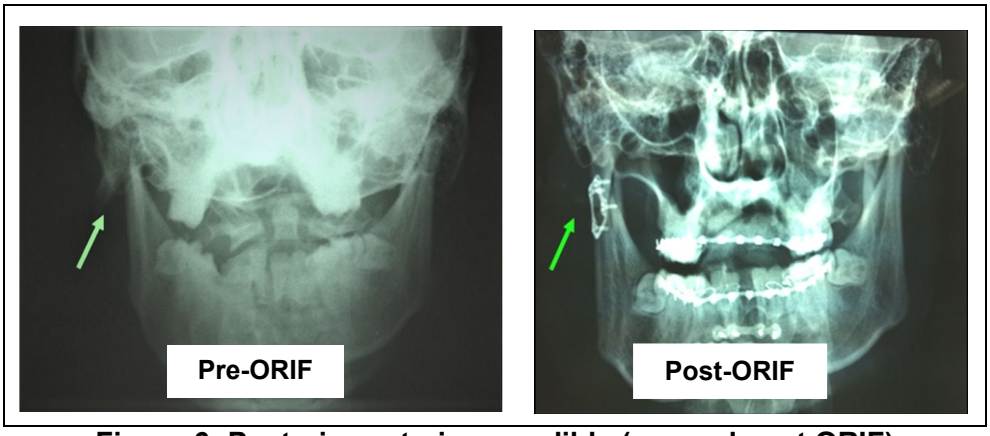


Figure 6: Posterior-anterior mandible (pre and post ORIF)

Key Message 1

- A reverse Towne's view or a posterior-anterior skull view allows for the evaluation of the possibility of a medial / lateral displacement in mandibular condyle fractures. It acts as an adjunct to an OPG in these fractures.

2.2.2 Computed Tomography (CT)

CT scans are useful in the diagnosis of mandibular condyle fractures. It allows a 3-dimensional (3D) assessment of the condyle in relation to the mandibular fossa without superimposition of interfering structures.[19, level III] It is used to classify types of condylar trauma and also needed to determine condyle displacement into middle cranial fossa or external auditory canal.[20, level III] Immediate total body CT scans are usually performed in patients with polytrauma. Therefore, it can be obtained earlier than OPG.[17, level III]

CT scans are more sensitive in the diagnosis of mandibular condyle fractures compared to OPGs (100% vs 87.5%).[15, level III] In terms of assessment of suspected condylar fractures in children, CT scans have better accuracy than OPG with sensitivity of 92% and 70%, and specificity of 87% and 77% respectively. [21, level III]

Coronal CTs were more accurate in determining type of mandibular condyle fractures compared with conventional radiographs (OPG and posteroanterior mandibular radiographs) in high neck condylar fractures of the mandible (Spiessl III and V).[16, level III]

2-dimensional (2D) **(Figure 7)** and 3-dimensional (3D) CT **(Figure 8)** images have equal accuracy in the diagnosis of mandibular condyle fractures. However, when compared with observation during surgery, 3D-CT showed better visualisation of the position and displacement of bone fragments, and comminution of mandibular condyle fractures than 2D-CT. Thus, it is useful for surgical planning.[22, level III]

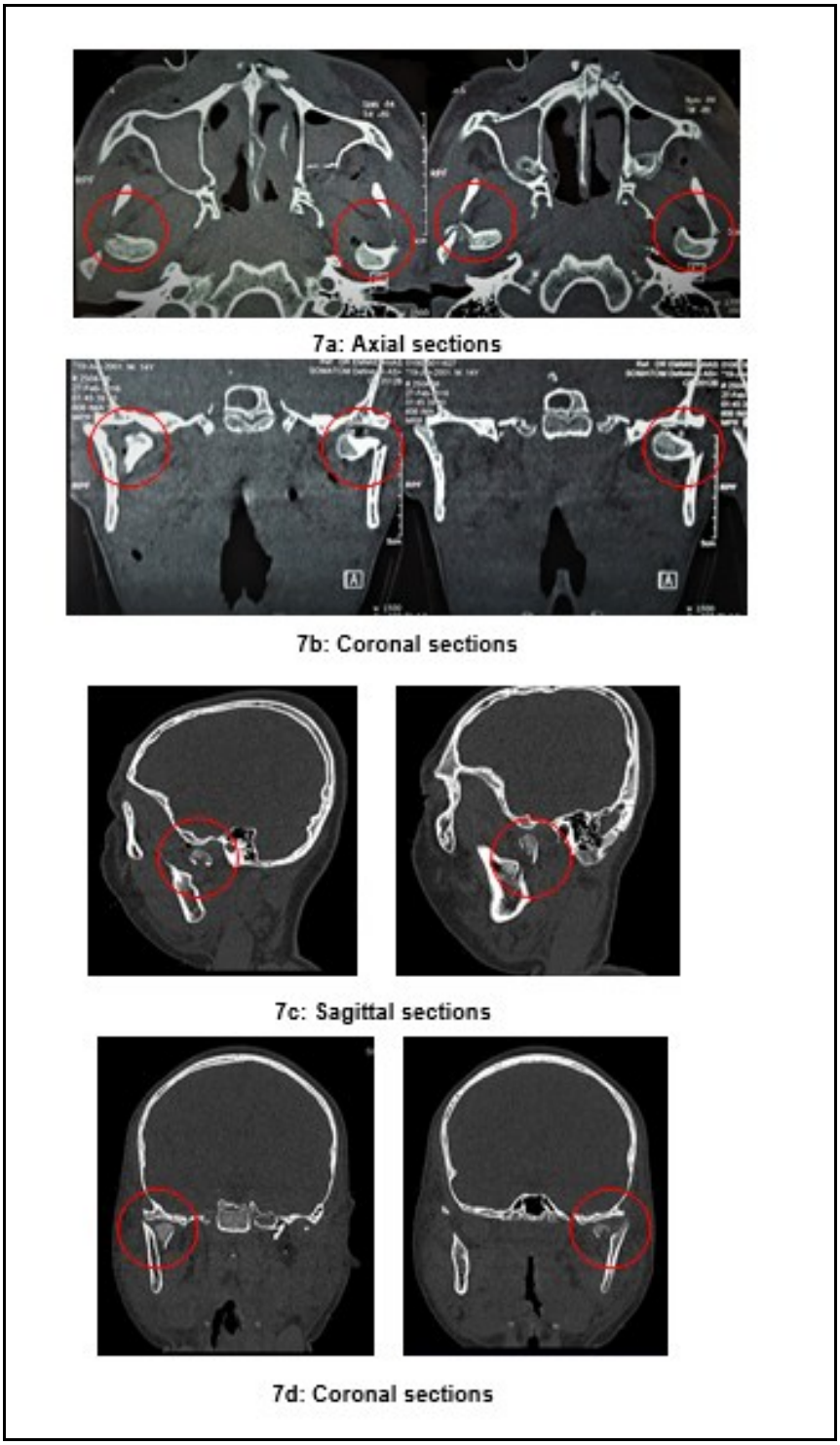


Figure 7: 2-D CT showing bilateral mandibular condyle fractures in different views

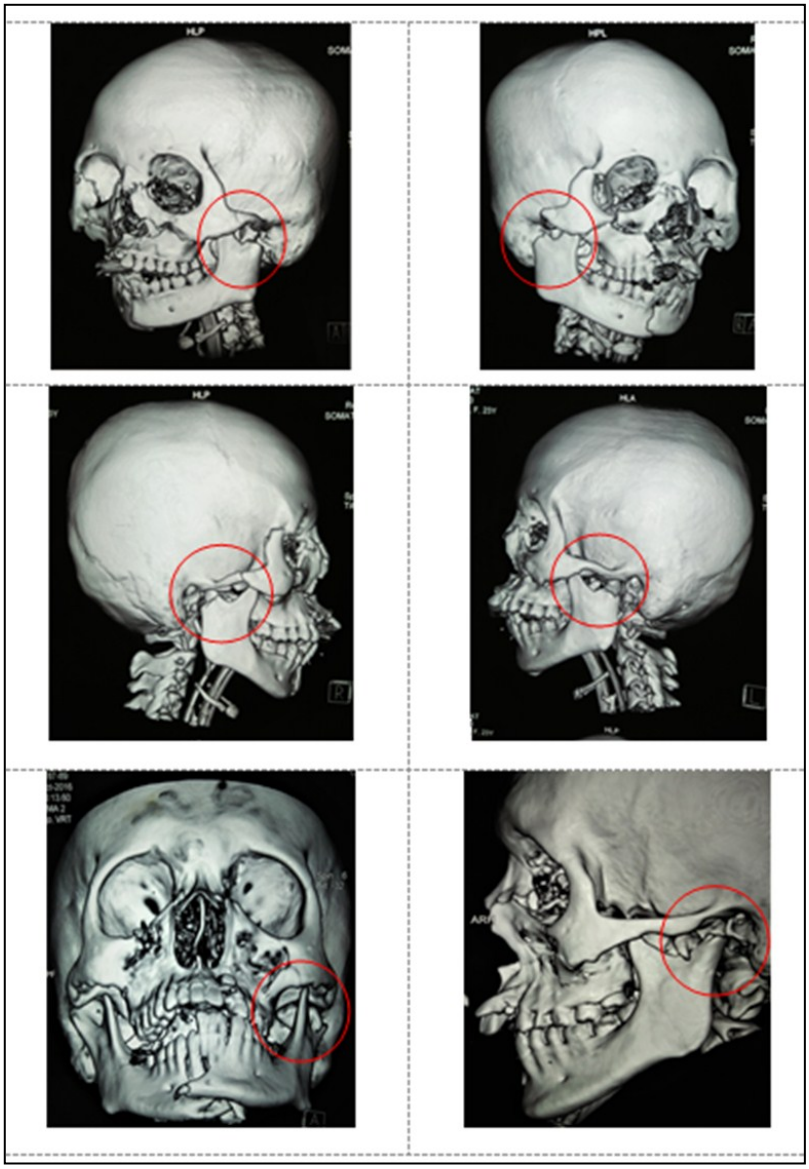


Figure 8: 3-D CTs showing mandibular condyle fractures

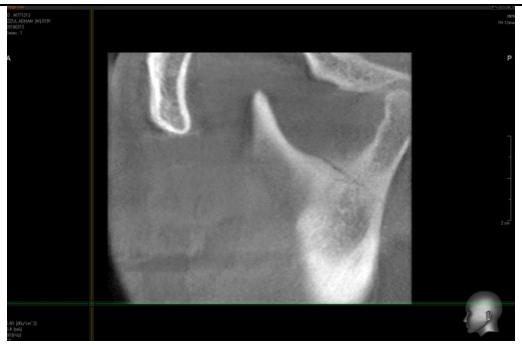
Key Message 2

- 3D-CTs show better visualisation of the position and displacement of bone fragments, and comminution of fractures which is useful for surgical planning in mandibular condyle fractures.

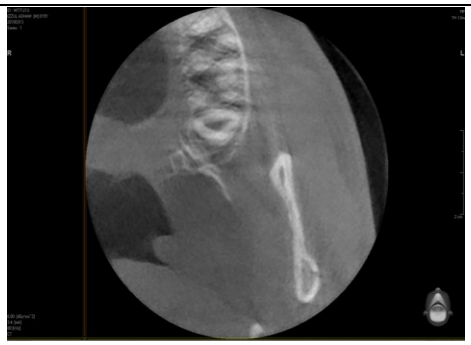
2.2.3 Cone-beam Computed Tomograph (CBCT)

CBCT scans are very suitable for maxillofacial imaging. The images produced are 2D and 3D, similar to CT scans **(Figure 9).** In addition, CBCT scans produce less metal artifacts but is not reliable in viewing soft tissue.[23-24, level III]

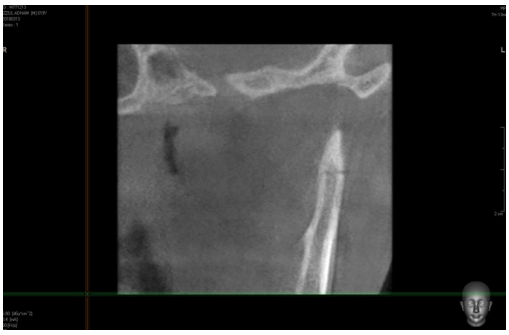
CBCT scans were able to confirm suspected mandibular fractures (based on clinical, OPG and / or PA skull) in 63.2% of sites ($p<0.0001$). Therefore, it is useful as an alternative to CT scans for ambulatory patients without history of loss of consciousness. [25, level III]



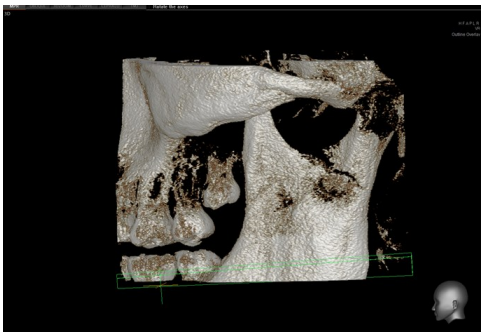
9a: CBCT sagittal view



9b: CBCT axial view



9c: CBCT coronal view



9d: CBCT 3D

Figure 9: CBCT of mandibular condylar fracture

Recommendation 2

- Computed Tomography (CT) or Cone-beam CT scans should be used in the diagnosis of mandibular condyle fractures when feasible.
    - Plain radiographs may be used as an option.

2.3 Classification

The classification of the mandibular condyle fractures takes the following into consideration:

- anatomical regions
- direction and degree of displacement
- relationship between the condylar head and the glenoid fossa

The two most commonly used classifications are Lindahl (refer to **Appendix 3**) and Spiessl and Schroll (refer to **Appendix 4**).

3. MANAGEMENT

Treatment modalities for mandibular condyle fractures are conservative management, closed reduction (CR) and open reduction with internal fixation (ORIF). Choice of treatment modality for each patient depends on the following factors: [26-27, level III]

- fracture (e.g. age, position and location of fracture, and associated injuries)
- patient (e.g. age, compliance, systemic medical conditions, cosmetic impact and patient's preference)
- surgeon (e.g. experience and preference)

Other factors that should be considered in choosing the treatment modality are cost and anaesthesia time.

3.1 Conservative

The definition of conservative management for mandibular condyle fractures varies. However, in this CPG it refers to management with:

- Soft diet
- Physiotherapy (e.g. mouth-opening exercise)
- Analgesics and anti-inflammatory medications

This management is indicated for diacapitular or condylar head fractures in paediatric patients. [28, level II-2]

3.2 Closed Reduction

Closed treatment (refer to **Appendix 6**) is defined as treatment that does not involve surgical exposure of the fracture. This usually consists of a period of intermaxillary fixation (IMF) using either stainless steel wires, elastics or a combination of both followed by physiotherapy.

When comparing different types of IMF, Schuchardt's device (acrylated archbar) or screws alone have no difference in the functional outcome, but the insertion of 4 - 6 screws requires much less time and is less harmful to the teeth and the periodontium. [27, level III]

Evidence suggests rigid IMF for 2 weeks followed by 1-2 weeks of elastic IMF [29-30, level I] or 3 weeks of rigid IMF followed by functional treatment. [27, level III] For intra-capsular condylar fractures, 10 days of IMF followed by a functional orthodontic activator is suggested. [13, 27, level III]

Recommendation 3

- For closed reduction of mandibular condyle fractures, rigid intermaxillary fixation (IMF) may be carried out for:
  - two weeks followed by 1-2 weeks of elastic IMF or
  - three weeks followed by functional treatment

3.3 Open Reduction and Internal Fixation (ORIF)

ORIF involves surgical exposure of the fracture, anatomical reduction, followed by osteosynthesis. Surgical approaches for ORIF can be retromandibular / transparotid, pre-auricular, submandibular, endoscopic assisted intra-oral approach [27, level III] or a combination of these approaches (refer to **Appendix 7**).

The absolute indications for open reduction in children and adults are as follows:

- displacement into middle cranial fossa [31, level III]
- inability to obtain adequate occlusion [31, level III ; 32, level II-2]
- lateral extra-capsular displacement of the condyle [31, level III]
- presence of a foreign body (e.g. gunshot wound) [31, level III]

The relative indications (primarily in adults) are as follows:

- when closed reduction is not recommended for medical reasons (e.g. patients with seizure disorders, psychiatric problems, alcoholism, refractory behaviour, mental retardation or retardation secondary to neurologic injury)

Other indications:

- failed conservative treatment
- failed closed reduction treatment
- medial dislocation of condyle >30°; displaced fractures with >5mm bone overlap; or complete loss of bone contact [33, level III]
- shortening of the ascending ramus of > 8mm; or when considerable displacement or angulation in a coronal and/or sagittal plane is present [26, level III, 34, level II-1]
- displacement of the condylar head from the glenoid fossa [26, level III;]
- mechanical obstruction of jaw opening caused by a displaced condylar head
- bilateral mandibular condylar fractures [30, level I]
- unilateral or bilateral mandibular condylar fractures with severely comminuted midfacial fractures [32, level II-2]

ORIF in intra-capsular condylar fractures is controversial because it carries a high risk of avascular necrosis, [30, level I; 32, level II-2] osseous and fibrosis ankyloses. [30, level I]

3.4 ORIF versus Closed Reduction

Closed reduction has been the preferred treatment for many years. However, long-term complications associated with it include open bite, pain, inadequate restoration of vertical height of the ramus, arthritis, and deviation of the mandible. [35, level I] This has led to a trend towards open treatment which allows anatomical repositioning and internal fixation, hence, improving functional aftercare. [36-37, level III] However ORIF is also associated with complications such as facial nerve injury and visible scars. [38, level I]

Key Message 3

The standard outcomes to determine successful treatment of mandibular condyle fractures are:

- Mouth opening >40mm (adult) and >35mm (children)
- No pain at the affected site
- Mandible has good movements in all directions
- Recovery of preinjury occlusal relationship (satisfactory to clinicians and patients)
- TMJ stability
- Minimal chin deviation on mouth opening
- No obvious facial asymmetry

In two meta-analysis, when compared with closed reduction in the management of mandibular condyle fractures, ORIF showed:

- higher maximal mouth opening [39, level I]
- decreased occurrence of malocclusion [39-40, level I]
- reduced pain (VAS score) [40, level I]

There was no significant difference in temporomandibular joint pain, facial symmetry and mandibular activity between both treatment modalities.[39, level I] However, another meta-analysis and an RCT showed no significant difference in mouth opening between ORIF and closed reduction. [29, level I ; 32, level II-2]

ORIF was better when compared with closed reduction in terms of:

- protrusion [32, level II-2; 40, level I]
- lateroexcursion [32, level II-2; 40, level I]
- ramus height shortening [40, level I]

Immediate post-treatment assessment showed ORIF was better than closed reduction in the following outcomes:

- medio-lateral angulation of fractured condyle [29, 41, level I]
- restoring ramus height [29, 41, level I]
- occlusal status [29, 41, level I]

However, at six months, there was no significant difference between ORIF and closed reduction for all outcomes except for deviation of mouth opening (0% vs 70%). [29, 41, level I]

A meta-analysis on management of mandibular condyle fracture in adults showed ORIF was superior to closed reduction in the following outcomes at 6 - 36 months: [38, level I]

- maximal inter-incisal opening (WMD=3.32 mm, 95% CI 2.42 to 4.04 mm)
- laterotrusive movement (WMD=1.14 mm, 95% CI 0.73 to 1.55 mm)
- protrusive movement (WM=.99 mm, 95% CI 0.70 to 1.29 mm)
- malocclusion (OR=0.41, 95% CI 0. 26 to 0.62 mm)
- chin deviation on mouth opening (OR=0.62, 95% CI 0.39 to 0.99 mm)

However, there was no significant difference in pain between both groups.

Key Message 4

- ORIF of mandibular condyle fractures shows better outcomes in restoring ramus height and occlusal status, protrusive and laterotrusive movements, and preventing chin deviation on opening.

Recommendation 4

- ORIF of mandibular condyle fracture should be considered based on the following:
  - patient's factors
  - availability of accurate diagnostic facilities
  - types of fracture
  - surgeon's experience

3.5 Mandibular Condyle Fractures in Children

In children below the age of 5 years, condylar fractures were seen in 76 % of mandibular fractures. [42, level II-3] This reduced to 50% in patients aged 13-15 years. [42, level II-3] Unilateral condylar fractures represented 83 % of the fractures.

Mandibular condylar fractures in this group are unique as there is a significant correlation between age and site of condylar fracture. [13, 42, level II-3]

Intra-capsular fractures were more commonly seen in children aged below 12 years old. [42, level II-3] In children, sagittal fractures of the mandibular condyle were commonly seen and 4% to 26% of cases were complicated by ankyloses. [40, level I]

CT scan is the gold standard for radiographic investigations in a paediatric patient presenting with clinical sign and symptoms suggestive of an underlying condylar fractures. [13, level III]

The management of MCF in the paediatric group consists of conservative, closed reduction and ORIF, with closed reduction being the most common practice. [43, level III]
i) Conservative treatment in the paediatric patients especially in diacapitular and condylar head fractures consists of: [28, level III ; 44, level III]

- Liquid or soft diet for several weeks with close observation
- Functional exercises and/or physiotherapy

ii) Closed reduction consists of:

- IMF with rigid wires and/or elastics for a period of 7-10 days. There was no difference in clinical outcomes between the two methods for children below 12 years old. [13, 45, level III]
- Functional appliance therapy– design of the appliance and duration of application is based on individual specific treatment objectives with the overall aim of re-establishing the vertical dimension of the face.
- Occlusal splints - thickness and duration of the splint is dependent on the dental developmental stage and classification of the fracture [13, 46, level III]

Closed treatment in paediatric condylar fracture yields generally good results and adequate condylar remodelling with few major complications. Favourable clinical outcomes were found in 74% of the patients. For subjective assessment, 83% had no subjective symptom and 98% describe chewing function as normal. Radiographically 87% remodelling was considered complete. However, it should be noted that radiographic and clinical outcomes are not correlated, in which satisfactory outcome was found even though the radiograph did not show this. [43, level III]

Because of the increased risk of joint dysfunction and aberration in mandibular growth, non-surgical management should be considered the first line treatment for paediatric condylar fractures. [28, level III]

iii) ORIF

There is limited evidence on the effectiveness and safety of ORIF in paediatric patients. However, there are case reports describing the use of resorbable plates in paediatric patients.

Key Message 5

- No one method of IMF used in closed reduction has been shown to be superior in the management of mandibular condyle fractures.

Key Message 6

- Closed treatment of mandibular condyle fractures shows good clinical outcomes for paediatric patients.

3.6 Post-treatment complications

Complications related to surgical management of MCF are infrequent. [47, level III] Reported complications are:

a) facial nerve damage (8.6%, of which 8.3% was temporary and 0.3% was permanent)
b) breakage or loss of repair materials (1.79%)
c) salivary leakage (1.62%)
d) salivary fistula (1.11%)
e) infection (0.60%)
f) Frey's syndrome (0.51%)
g) hemorrhage (0.17%)
h) seroma (0.17%)
i) sialocele (0.17%)
j) acoustics effects (0.17%)
k) condylar resorption (0.09%)
l) incorrect repositioning (0.09%)
m) pre-auricular hyperaesthesia (0.09%)

Complications related to surgical approaches are discussed in **Appendix 7.**

In closed reduction, reported complications are:
a) malocclusion (p<0.001) [47, level III]
b) inadequate remodeling (3.05% of cases ,13 out of 425 cases) [47, level III]
c) TMJ dysfunction (p=0.015) [47, level III]

In children, the added concern in treatment of mandibular condylar fractures is its effect on growth and development of the jaw. However there is no retrievable high level evidence on this.

4. REHABILITATION

There is no retrievable evidence on effectiveness and safety of any one method of rehabilitation in MCF. The development group consensus on rehabilitation for MCF in paediatric or adult patients consist of:
a) Early mobilisation:
   IMF not more than 2 weeks in condylar head (intracapsular) fracture
b) Active jaw movements:
   Intensification of jaw exercise after removal of rigid IMF, for at least 6 months
c) Close supervision:
   Weekly visit as outpatient in the first 30 days post treatment
d) Compliance by the patients:
   Comply to the treatment protocol (refer to **Appendix 8**) and follow up schedule

5. FOLLOW-UP

There is also no retrievable evidence on any effective protocol for follow-up in mandibular condyle fractures.

Based on development group consensus, regular follow-up is required until the following outcome criteria are achieved:

- satisfactory occlusion
- maximal inter incisal distance is more than 35 mm for children, and 41 mm for adults
- deviation from the midline during mouth opening is less than 3 mm
- protrusion of 5 mm, and laterotrusion of 6 mm
- no sign of ankylosis
- no functional and growth disturbance

- until permanent dentition is established in children with deciduous / mixed dentition

Recommendation 5
- Rehabilitation and regular follow-up should be carried out post-treatment of mandibular condyle fractures to ensure optimum outcomes.

6. IMPLEMENTING THE GUIDELINES

It is important to standardise the management of mandibular condyle fractures at all healthcare facilities in Malaysia using an evidence-based CPG in order to manage it appropriately. Recognition of signs and symptoms and appropriate responses from the health professionals are important factors in management of mandibular condyle fractures. Clinicians are required to keep abreast with knowledge through continuing professional education as well as understanding of patient expectations. Therefore, it is important for these guidelines to be disseminated to healthcare professionals in all healthcare facilities.

Cost implications on management of mandibular condyle fractures vary depending on several factors such as patients' co-morbidities and expectations and type of treatment advocated. Successful treatment outcomes would require proper clinical and radiographic assessment thus involving further cost.

6.1 Facilitating and Limiting Factors

Wide spread practise of this CPG can be facilitated by:

a) Dissemination of the CPG to healthcare professionals and teaching institutions via printed and electronic copies
b) Continuing professional education on the management of mandibular condyle fractures for healthcare professionals
c) Presence of adequate resources in all healthcare facilities for diagnosing and treating of mandibular condyle fractures

Limiting factors for application of the recommendations of the CPG include:

a) Lack of understanding or limited knowledge on the management of mandibular condyle fractures
b) Variation in skills and treatment practices
c) Constraints in equipment and facilities
d) Inadequate funds

6.2 Potential Resource Implications

Potential resources implications to implement the CPG are as follows:

a) Widespread distribution of this CPG to all healthcare facilities.
b) Re-enforce training of healthcare professionals to ensure knowledge and information is up to date.

6.3 Proposed Clinical Audit Indicators

To assist in the implementation of the CPG, the following are proposed as clinical audit indicators for quality management:

Percentage of satisfactory occlusion in the treated mandibular condyle fractures	=	Number of patients with satisfactory occlusion in the treated mandibular condyle fractures within a year / Total number of patients with treated mandibular condyle fractures in the same period	X 100%
Standard: More than 90%			

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Appendix 1

Example of Search Strategy

The following Medical Subject Heading terms or free text terms were used either singly or in combination. The search was limited to literature published from 2006 to 2017, humans and in English:

Clinical Question: What are the complications related to treatment options?

1. MANDIBULAR FRACTURES/ (6427)
2. mandibular fracture*.tw. (2792)
3. Condylar fracture*.tw. (1202)
4. TMJ fracture*.tw. (18)
5. Temporomandibular joint fracture*.tw. (23)
6. 1 or 2 or 3 or 4 or 5 (7562)
7. Complication*.tw. (828979)
8. ANKYLOSIS/ (3775)
9. ankylose*.tw. (748)
10. TEMPOROMANDIBULAR JOINT DISORDERS/ (12238)
11. ((tmj or temporomandibular or temporomandibular joint) adj disorder*).tw. (4869)
12. ((tmj or temporomandibular or temporomandibular joint) adj disease).tw. (123)
13. TEMPOROMANDIBULAR JOINT DYSFUNCTION SYNDROME/ (4865)
14. (temporomandibular joint adj (syndrome or dysfunction)).tw. (835)
15. MALOCCLUSION/ (23174)
16. cross bite*.tw. (533)
17. crossbite*.tw. (1560)
18. malocclusion*.tw. (10564)
19. Open bite.tw. (2210)
20. Anterior open bite.tw. (974)
21. 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 (876740)
22. 6 and 21 (1781)
23. limit 22 to (english language and humans and yr="2005 -Current") (718)

Appendix 2

Clinical Questions: Management of Mandibular Condyle Fractures

Epidemiology and clinical diagnosis

1. What are the clinical presentations of mandibular condyle fractures?
2. What is the accuracy of the following imaging methods to diagnose mandibular condyle fractures:
   Plain radiographs, CT scans and CBCT?
3. How are mandibular condyle fractures classified?
4. What are the problems / complications associated with mandibular condyle fractures?

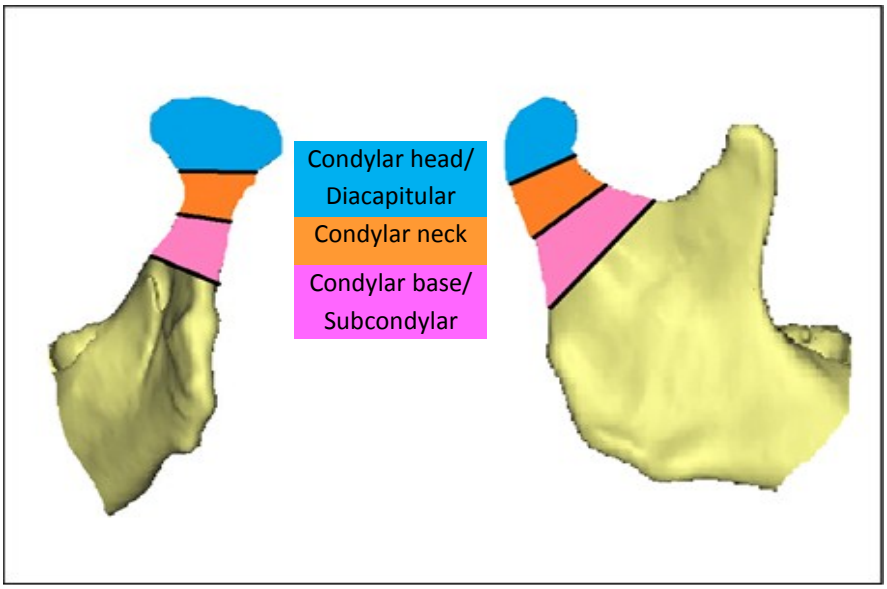
General treatment and management plan

1. What are the effective and safe treatment options for mandibular condyle fractures?
   - Conservative
   - Closed reduction
   - Open reduction
2. What are the complications related to treatment options?
3. What are the effective and safe methods of rehabilitation in mandibular condyle fractures?
4. What is the effective protocol for follow-up in mandibular condyle fractures?

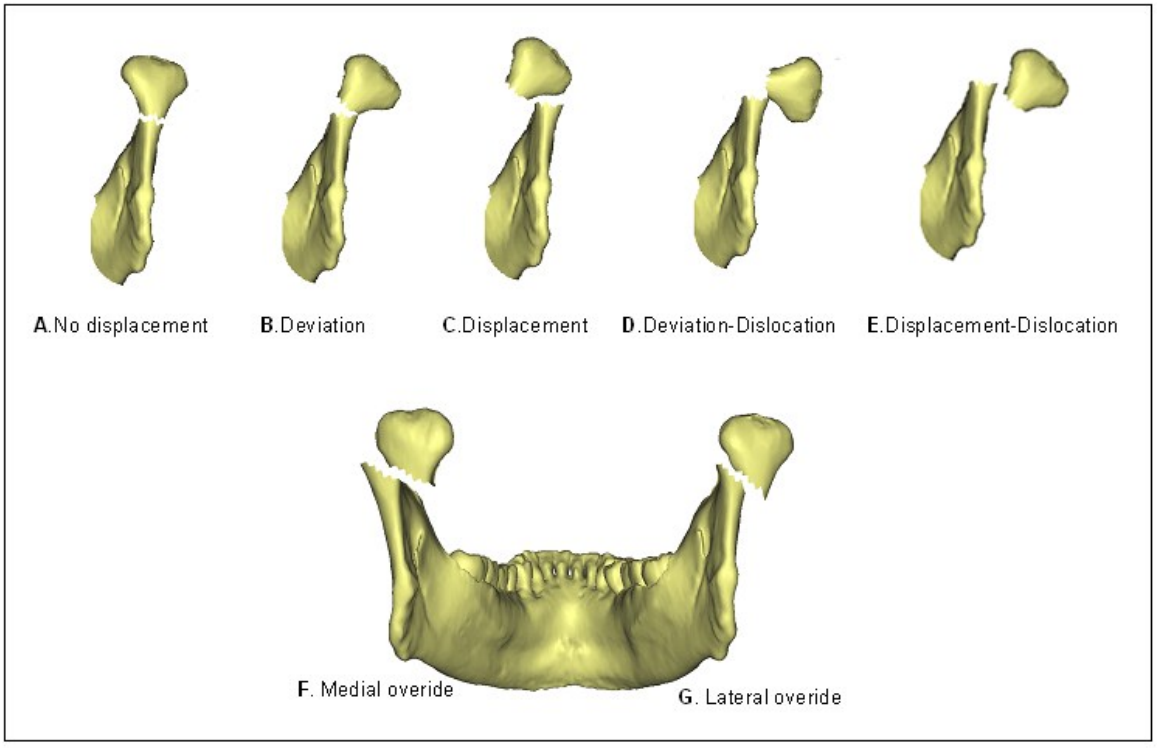
Appendix 3

Lindahl Classification (1977)

1. Based on anatomical location

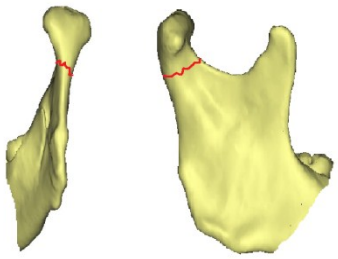
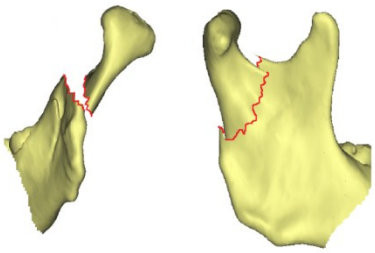
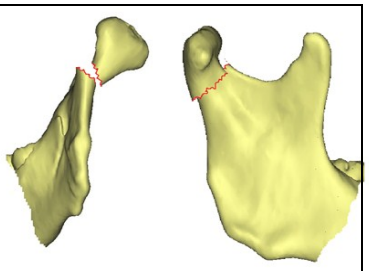
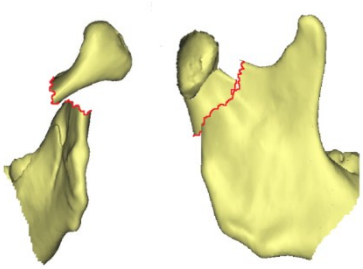
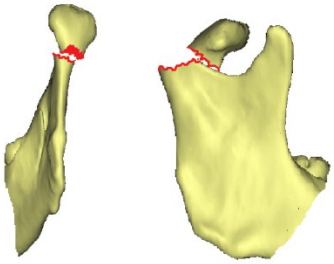
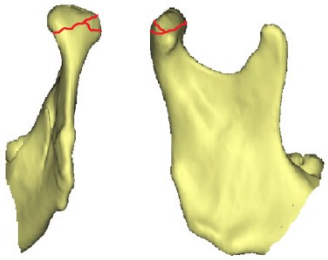


2. Based on degree of fracture fragment displacement



Appendix 4

Spiessl and Schroll Classification (1972)

 **Type I: Fracture with no dislocation**	 **Type II: Inferior condylar neck fracture with dislocation**	 **Type III: Superior condylar neck fracture with dislocation**
 **Type IV: Inferior condylar neck fracture with luxation**	 **Type V: Superior condylar neck fracture with luxation**	 **Type VI: Intracapsular fractures**

Appendix 5

Complications of Undiagnosed and Untreated MCF

Untreated condylar fractures lead to complications such as malocclusion, pain, mandibular hypomobility, TMJ problems and ankyloses and facial deformity.

Malocclusion

Untreated unilateral condylar fractures may have premature contact on the affected posterior teeth, open bite on the contralateral posterior teeth and deviation of mandible to the affected side. For bilateral condylar fractures, the malocclusion commonly present is an anterior open bite.

Mandibular hypomobility

Mandibular hypomobility can be defined in general as inter-incisal opening less than 40 mm to frank ankyloses. [48, level III] The affected mandibular movement includes maximum inter-incisal opening (MIO), lateral excursive and protrusive jaw movements are frequently adversely affected by mandibular condyle trauma.

Temporomandibular joint complications

- Pain

Pain is usually moderate and located in the temporomandibular joint (TMJ) area or muscles of mastication such as temporalis and masseter of the affected site. [49, level III] The pain is usually present on mouth opening but occasionally may be present during occlusion.

- Temporo-mandibular joint derangement

TMJ derangement occurs when there is a change in the shape of the disc. This could lead to disc displacement and the major symptoms include joint sound, abnormal movement of the condyle head, impingement of condyle head, mandibular movement limitation and joint pain. For TMJ derangement, changes in disc shape and the functional disorders of the condyle-disc complex are minimized and prevented by the early reduction and rigid fixation of the displaced bone fragments adjacent to the joint.

- TMJ ankylosis

Ankylosis is the most common cause of hypomobility. Ankylosis is divided into intra-capsular ankylosis and extra-capsular ankylosis. The ankylosis that is associated with the untreated condylar fractures is the intra-capsular type. The subtypes of intra-capsular ankylosis according to Sawhney (1986) [50, level III] are:

i) Type 1: minimal bony fusion but extensive fibrous adhesions around the joint
ii) Type II: there is more bony fusion, especially at the outer edge of the joint surface, but no fusion within the more medial area of the joint
iii) Type III: there is a bridge of bone between the mandible and the temporal bone
iv) Type IV: the joint is replaced by a mass of bone

- Traumatic arthritis of the TMJ

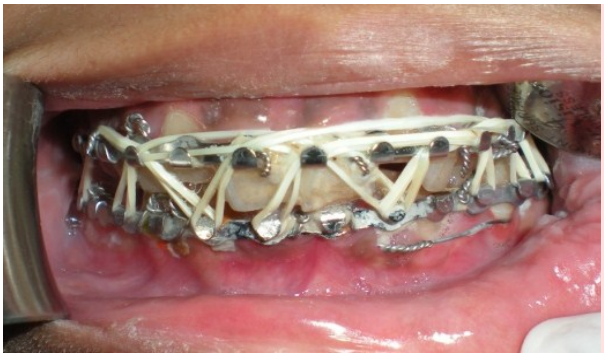
Traumatic arthritis is an arthritis that occurs secondarily after the deformity of the joint. It is caused by direct injury to the articular cartilage or fracture due to trauma. In the intra-capsular fracture of the condyles, articular surface injury occurs during the trauma onset, and subsequently traumatic arthritis occurs due to chronic and repeated joint movement. [51, level III] Clinical symptoms that may occur in an early phase include joint sound and pain during joint movement. As bony arthritis progresses, joint sound increases and as well as lock sensation, pain, and mouth opening limitation.

Facial deformity

Decreased mandibular growth occurs in 20% to 25% of patients with mandibular condyle fracture. [51, level III] This growth abnormality has been reported to be attributed to direct condylar growth and severe functional disorders caused by adjacent muscular stiffness, injury of soft tissues, and scars. The clinical features may include mandibular retrognathism, anterior open bite, chin deviation and contralateral posterior open bite. [52, level III]

Appendix 6

Types of Closed Reduction

	**Archbars incorporated with upper occlusal splint in paediatric case.**
	**Archbars with elastics**
	**Archbars with stainless steel wires**

Appendix 7

Surgical approaches

1. Pre-auricular approach

- Indications: condylar head and upper neck fractures
- Mohan et al. (2012) found, when compared with the retromandibular approach, the pre-auricular approach had more postoperative facial nerve weakness which they attributed to retraction injury to access lower neck fractures. [53, level III]
- Cosmetically, the scar is well hidden within the pre-auricular crease. [53, level III]

2. Retromandibular approach

- Indications: direct access to the ramus and the condylar neck with minimal retraction.
- Risk of facial nerve damage via the retromandibular approach is minimal. This risk is increased with prolonged traction at the operative site, surgeon's experience, post injury edema, and other factors causing difficult wound access such as obesity. [29, level I]

3. Submandibular approach

- Indications: access to ramus and low subcondylar fractures.
- Submandibular approach showed higher incidence of facial nerve palsy and a higher percentage of visible/hyperthropic scars compared to other surgical approaches to the mandibular condyle. [27, level III]
- Paralysis or paresis of the marginal mandibular branch of the facial nerve can also occur either from direct injury or from retraction forces

Overall, scarring in open reduction was described as acceptable in most cases. [27, level III, 54 -56 level III]

1. Pre-auricular
2. Retromandibular
3. Submandibular

4. Endoscopic-assisted reduction and internal fixation (ERIF) [38, level I, 57, level III]

Indication: lower condylar fractures where dislocation with lateral override is present.

- This is an intraoral approach using an endoscope to assist in visualization. Right-angle drills and screw drivers are used to assist in fixation.
- However, ERIF has a steep learning curve and requires well trained assistants

5. Osteosynthesis in ORIF

The introduction and implementation of better materials for osteosynthesis over the past 30 years have broadened the indications for surgical treatment of mandibular condylar fractures. [32, level II-2, 38, level I]

Two four-holes miniplates have been the gold standard since the early 2000s. The fixation of MCF with 2 miniplates is more stable than a single plate repair [27, level III] as it avoids high mechanical strain complications such as TMJ disorders, non-union or fibrous union. [57, level III]

Multiple variations of condylar plates have been advocated to improve rigid fixation such as two parallel plates, angulated straight plates, 3D plates such as: Y, delta, lambda square and trapezoidal condylar plates (TCP). Recently TCP has increased in popularity – it is thought to better achieve the principle of functionally stable osteosynthesis as described by Champy. [57, level III]

Two parallel miniplates

TCP

Lambda plate

Appendix 8

Rehabilitation protocol

A) Paediatric Patient

The protocol for rehabilitation with removable splint: [58, level II-2]

- A removable occlusal splint with varying thickness is fabricated according to the age, developmental stage of the mandible, and degree of condylar dislocation. This is worn for 1-3 months, accompanied by functional exercises.
- Under parental supervision, children are instructed to have a soft diet and wear a removable semihard occlusal splint for 1-3 months, 24 hour per day until restoration of the occlusion relationship.
- Mouth opening exercises begin at the third week after injury and included vertical opening, contralateral excursions, and protrusive movements in front of a mirror.
- Exercises continued for more than 6 months.

In addition, the group suggests the use of guiding elastics if necessary as an adjunct.

B) Adult Patient

In adults, either open or closed treatment, early rehabilitation is essential to have a good functional outcome. The protocol post treatment is as follows: [56, level III]

- Guidance elastics for 7 days
- Elastics at night for an additional 7 days
- Soft diet for 30 days
- Functional exercise from day 15 onwards
- Intensification of functional therapy from day 30 to at least 6 months
- Weekly visit as outpatient in the first 45 days post op
- Monthly for the following 6 months

However, this recommendation can be tailored to individual clinical needs.

Appendix 9

Glossary

	Terminology	Definition
1	Diacapitular fracture	Fracture through condylar head
2	Functional appliance	Any device/appliance that helps patient to reposition upper and lower jaw gradually into the correct occlusion over a period of time e.g functional orthodontic activator and occlusal splint
3	Dislocation	Displacement of any part, more especially of a bone. Also called luxation
4	Luxation	Dislocation
5	Displacement	An abnormal position of the head of the mandibular condyle in the fossa due to deviation or shift of the mandible, which is often the result of malocclusion

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