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Evaluation Of The Mandibular Condylar Fractures

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ABSTRACT

BACKGROUND

Treatment of subcondylar fractures of the mandible is one of the most controversial aspects in the field of maxillofacial traumatology. This controversy centers on the positive and negative aspects of open and closed approaches for the treatment of this kind of fractures.

Aims of the study

The aims was to evaluate the incidence, etiology, site and patterns, and treatment methods, and outcome of the patients with mandibular condylar fractures.

Patients and Methods

A total of 20 patients with a condylar fracture were selected and They were treated with conservative treatment(3 patients), closed reduction with maxillomandibular fixation(16 patients), or open reduction with internal semirigid fixation(1 patient).

RESULTS

Twenty condylar fracture of the mandible were treated in the department of Oral & Maxillofacial surgery at the AL_Shahid Ghazi Hariri teaching hospital ,Baghdad ,during a 1-year period .16 were unilateral fracture &4 were bilateral fracture with male to female ratio 5.7:1 .the age range between 21-31 years .

CONCLUSION

Young male patients are the most likely involved by trauma Most fractures can be treated closed treatment. Closed treatment is a simple method and gives excellent functional results.

Keywords: Mandibular condylar fractures ; maxillofacial traumatology; H*ospital surgery specialist;* Baghdad

INTRODUTION

At the present time the pattern of the surgery and surgical training , changes all the time . Condylar fractures account for 25-35% of the mandibular fractures and deserve a special consideration different than the rest of the mandible due to both anatomical differences and healing potential (Williams,1995). Misdiagnosis or inappropriate treatment of condylar fractures can lead to anatomical and functional impairment (Narayanan et al. 2009). Although there are various guidelines regarding the management of condylar fractures of the mandible by open or closed treatment, there is still a continuing debate over how to best manage this type of fractures. For decades closed reduction has been the preferred treatment, but closed treatment requires varying periods of maxillomandibular fixation (MMF) (0 to 4 weeks) followed by aggressive physiotherapy. Also, long-term complications like pain, arthritis, open bite, deviation of the mandible on opening and closing

movement, inadequate restoration of vertical height of the ramus leading to malocclusion, and ankylosis do exist with the closed reduction method (Virendra Singh et al 2010).

AIMS OF THE STUDY:

The purpose was to evaluate the incidence, etiology, site and patterns, management and treatment methods, and outcome of the patients with mandibular condylar fractures.

PATIENTS AND METHODS

PATIENTS:

A total of 20 all ages patients with condylar fracture of the mandible were treated by closed(conservative ,non-surgical) and open method (surgical) in the department of oral & maxillofacial surgery at the specialized surgeries hospital ,Baghdad ,Iraq ,from the period of (1/9/2012) to (31/8/2013) and were followed –up clinically for 30 days after completion of the treatment.

Diagnosis of the mandibular condylar fractures:

The diagnosis was based on the clinical and radio graphical examination:

CLINICAL EXAMINATION:

EXTRA ORAL:

On admission , careful examination of the vital signs and whole body was carried out ,and if needed, consultation with other departments was done ,especially for those patients with multiple injuries or in suspicion of their general condition .

Attention was paid to the patency of the airways , control of bleeding and any lacerated wounds intraorally and /or etraorally have been sutured by 3/0 black silk suture .Any mobile or displaced segments of the fractured mandible fixed initially by temporary interdental wiring .

The diagnosis of mandibular condyle fractures was based on careful correlation of history , observation of the of history ,observation of the signs and symptoms by visual finding and manual examination and corrected interpretation of the radiographs.

The patients were examined for the presence of the area of:

- the facial swelling ,
- ecchymosis ,
- tenderness over the fracture site ,
- obvious deformity of the bony contour,
- inability to close the anterior teeth to gather,
- facial asymmetry with chin deviation off the midsaggital plane ,
- Changes in the neurosensory,
- Gentle pressure on the two angle or symphysis ,always elicit pain in the fractured mandible.

INTRA ORAL:

Patients were examined for :

- Changes in the occlusion
- Open bite deformities
- Limited opening and
- Deviation with opening.

Radiographical examination:
Include the following essential radiographs:

- ✓ Orthopantomogram(OPG)
- ✓ Anterioposterior (PA)
- ✓ Reverse town's view(RTV)
- ✓ Lateral oblique
- ✓ Computed tomography(CT)

THE STUDY PROTOCOL :
For all patient included in the study ,a standardized record(key sheet) form was made, this consisted of 4 main topics :

- ❖ Personal detailes
- ❖ General medical history
- ❖ Family history
- ❖ History of present illness

- Candidate patients were only presented with fractures of the mandibular condylar region .
- Isolated fractures coronoid ,ramus ,symphysis / parasymphysis and the body of the mandible in the posterior region were counted as associated with mandibular condylar fractures .
- Apart from one case operated upon local anesthesia, all fractures were reduced and fixed under general anesthesia.
- To follow patients and monitoring for late complications ,patients seen every 2 weeks after operation for the lst 2 month ,then every month for at least 6 months postoperatively.
- All patients were placed on a prophylactic antibiotic therapy from the time of the admission until 5days postoperativly.

METHOD OF THE TREATMENT
If the patient is able to attain a normal centric occlusion ,non immobilization regime can usually be undertaken .

This comprises:
- o Using analgesics as required in the early period
- o Taking great care to avoid another impact to the area
- o A short Advocating a soft diet for a period of 2-3 weeks

- period of IMF for 7to 10 days should be advised in case of excessive pain and undertaken when the patient is no able to attain his normal occlusion.
- 16 patients were operated on under general anesthesia with nasal or oralendotracheal intubation. The sterile preparations and draping were carried out to all patient in conventional manor.
- The range of patient-stay in the hospital was from 5 to 7 days. Antibiotics used were mainly penicillin derivatives(500mg. ampiclox I.V.injection 4 times daily) and (metronidazole I.V. infusion 500mg. 3 times daily) during period of patient, s stay in the hospital, while the oral form of these antibiotics were used for the following week. Analgesics were used in the form of injectable or oral diclofenac or paracetamol (500mg.).
- The sutures in the surgical site were removed at around 7 to 10 days

Postoperatively

RESULTS

DISTRIBUTION

AGE

The age of the patient with mandibular condylar fractures treated range between 2-50 years .

The modal decade was 21-30 years (the 3 decade of life),most cases in the study were in this decade (7 cases ,35%) as shown in figure (1)

Table (1) : Age distribution

Ages	Frequency	Percent
2 – 10 years	4	20%
11 –20 years	6	30%
21 -30 years	7	35%
31 – 40 years	2	10%
41 – 50 years	1	5%
TOTAL	20	100%

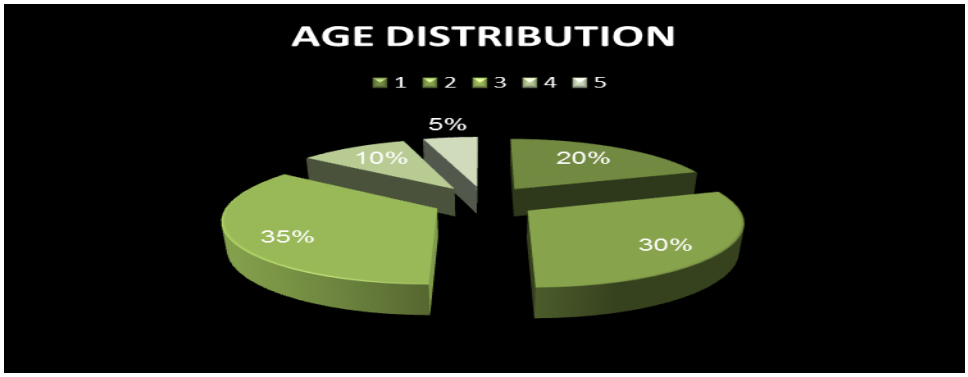

Figure (1) : Age Distribution sex

20 of the patient with mandibular condylar fracture ,there were (17) male and (3)female .

Table (2): Sex Distribution

Sex	Frequency	Percent

Female	3	15%
Male	17	85%
Total	20	100%

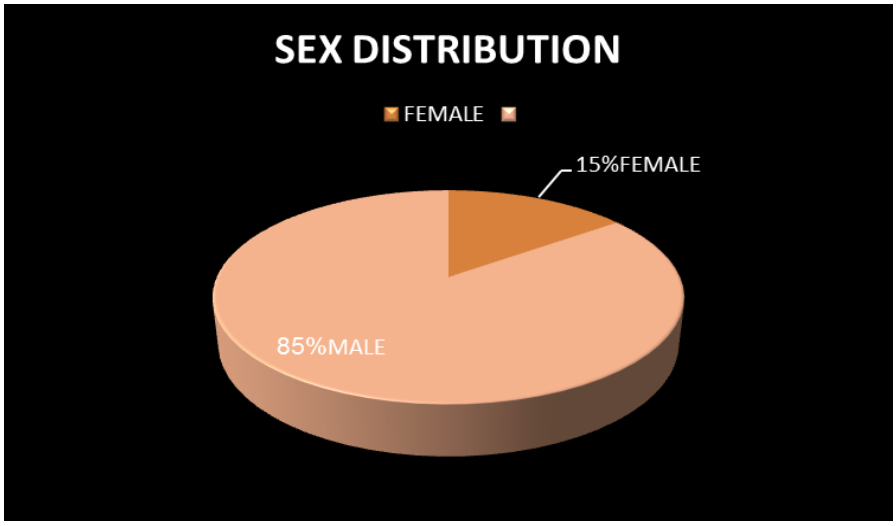

Figure (2): Sex Distribution

FRACTURE SITE :

(20%) fracture were in the right side (4), while (60%) were in the left side (12) and (20 %) were in bilateral sides (4) .

Table (3) : Fracture site distributions

	Frequency	Percent
Right side	4	20%
Left side	12	60%
Bilateral	4	20%

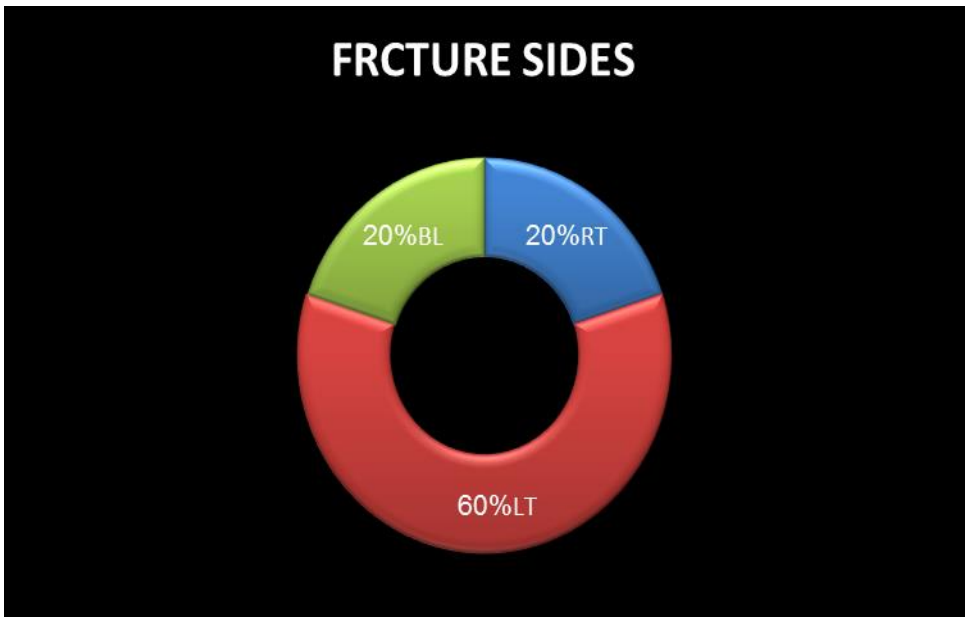

Figure (3) : Fracture site distributions

ETIOLOGY :

Regarding etiology , fall from the height injuries predominated over road traffic accident injuries in a ratio of 40%,this is followed by blast ,altercation and fit from patient with epilepsy followed by motor cycle (1case)as shown in the table

Table (4): **etiology.**

Etiology	Frequency	Percent
RTA	5	25%
BLAST	2	10%
ALTERCATION	2	10%
FIT	2	10%
MOTOR CYCLE	1	5%
FFH	8	40%

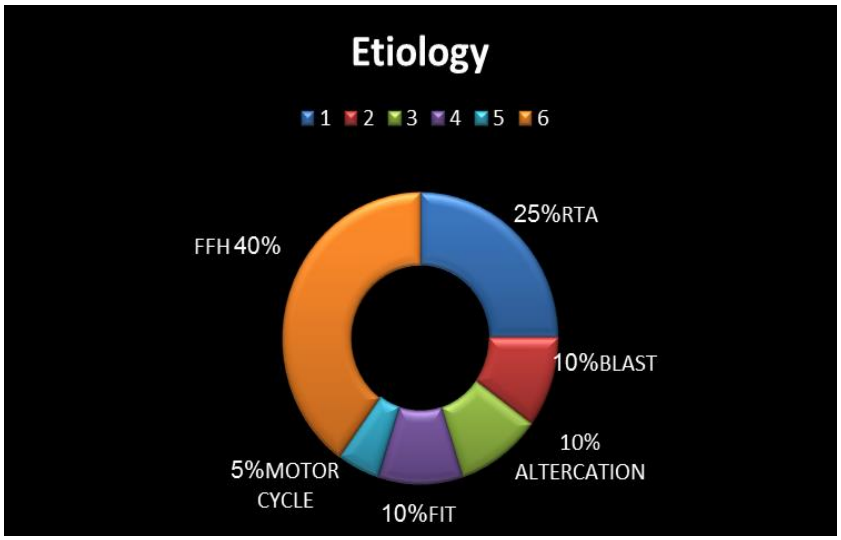

Figure (4) : etiology.

ASSOCIATED FRACTURES

There were 13 fracture associated with other facial fractures ,from these 9 fractures were with other mandibular fracture and the other without associated fractures.

Table (5) : Associated fractures.

Associated fractures	Frequency	Percent
CERVICAL SPINE	1	5%
PARASYMPHSIAL	5	25%
SYMPHSIAL	2	10%
ANGLE	2	10%
Zygoma	2	10%
Pan facial trauma	1	5%
Not Associated fractures	7	35%

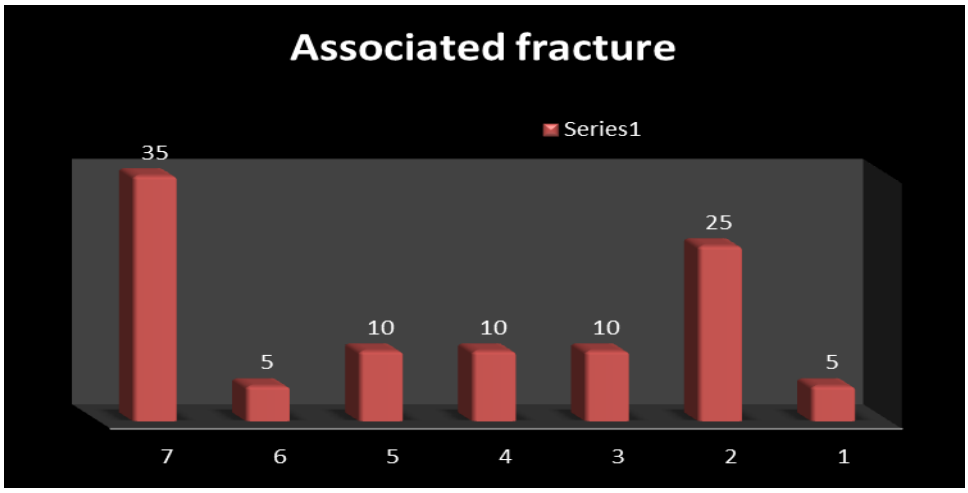

Figure (5) : Associated fractures.

METHOD OF THE TREATMENT

The patient were operated either under closed reduction , open reduction or conservative ,the period of the immobilization required for clinical union of mandibular condylar fracture differ according the method of reduction.

TYPE OF ANESTHESIA

The patient were operated either under general anesthesia (16) ,local anesthesia(1) or without anesthesia(3).

Table (6) : Type of anesthesia

Type of anesthesia	Frequency	Percent
Local anesthesia	1	5%
General anesthesia	16	80%
Conservative	3	15%

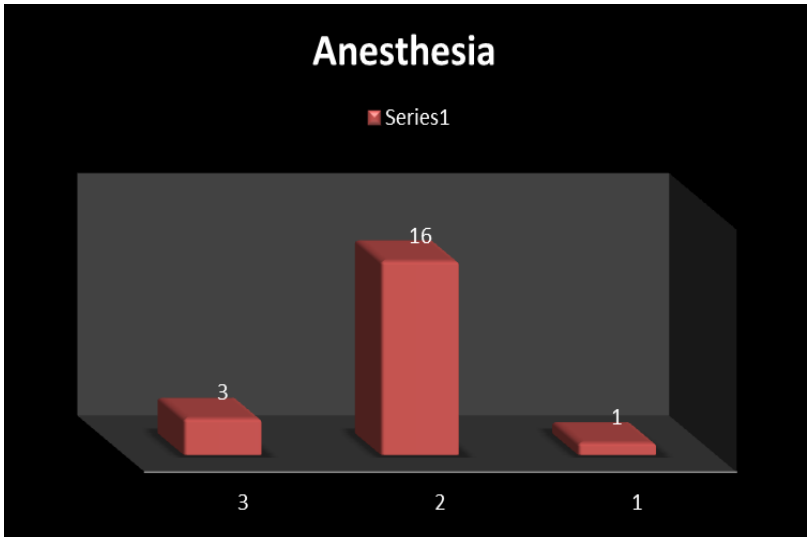

Figure (6) : Type of anesthesia

DISCUSSION

This prospective study investigated the clinical outcome of treatment of mandibular condylar fracture in 20 patients.. the decision on management of the mandibular condyle fracture remain a major topic of maxillofacial surgery practice as some variables still affect the decision of the treatment.

AGE AND SEX DISTRIBUTION:

Treatment of condylar fractures depends on various factors; the age of the patient, the co-existence of other mandibular or maxillary fractures, whether the condylar fracture is unilateral or bilateral, the level and displacement of the fracture, and the state of the dentition and the dental occlusion (Zachariades N, Farronato G, Elif Bahar Tuna et al., 2012).

The sample of this study was too small to build a comprehensive discussion about the epidemiological results ,however we can end up with some hints about the pattern of the distribution and causes of mandibular condylar fractures .Young males predominance was clear shown in sex and age distribution ,mean of age was 26 and male to female ratio 6/1 these findings are comparable with the results of (Richard A.Loukota ,Khild Abdel –Galil 2012 and John D. Langdon 2012). However our male to female ratio is higher due to that in our country men go and spend a lot of time in the outside house .

THE ETIOLOGY

Regarding the etiology , we divided the injuries or trauma into fall ,RTA, blast, altercation ,fit and motor cycle injuries. we think that the number of the fractures caused by altercation was more because patients are not always telling the truth about the exact etiology of the injury , this may be due to some legal and social reasons. Iraq since passed few years lived in war although it is not the real war as it became the worlds battle for the terrorist attack to the victum. Falls were the main cause of such kind of injuries and followed by RTA as more of people tend to learn and use car followed equally by blast , altercation and fit ,this is in agreement with Banks et al 2005 .

Our result was also in agreement with (Peter E. Larsen 2004) who stated that falls show a greater proportion of subcondylar fractures, as high as 36.3% in one study.

Site of the fracture

In our study left side is more commonly involved and this in agreement with (Peter E. Larsen 2004) who stated that left side is more commonly involved probably because most assailants are right-handed and the left side of the jaw would be the side most likely to be struck .

(Peter E. Larsen 2012) reported the posterior and superior movement of the condyles is limited from an evolutionary stand point in the that posterior and superior of the condyle would cause injury to the middle cranial fossae .therefore ,fracture of the condylar head and tympanic plate protect the cranium from injury also ,displacement of the condyle in a posterior direction is a very rare clinical event with the biped status and binocular vision of humans ,the condylar necks form a valuable breakpoint that protects the neurocranium.

Associated fractures

The condylar fracture are frequently associated with other fractures. the most common combination is with other mandibular fractures notably parasymphysial and symphysial due to the pattern of the kinetic energy transferred to the condyle ,these findings look similar to those of (Peter E. Larsen 2004)who stated in response to loading, the mandible is similar to an arch because it distributes the force of impact throughout its length

(Figure-1).

However, unlike the arch, the mandible is not a smooth curve of uniform bone, but rather it has discontinuities such as foramina, sharp bends, ridges, and regions of reduced cross-sectional dimension like the subcondylar area. As a result, parts of the mandible develop greater force per unit area, and consequently ,tensile strain is concentrated in these locations. When a force is directed along the parasymphysis-body region of the mandible, compressive strain develops along the buccal aspect, whereas tensile strain develops

along the lingual aspect .This produces a fracture that begins in the lingual region and spreads toward the buccal aspect (Peter E. Larsen 2012).

The mobile contralateral condylar process moves in a direction away from the impact point until it is limited by the bony fossa and associated soft tissue. At this point, tension develops along the lateral aspect of the contralateral condylar neck, and a fracture occurs. If greater force is applied to the parasymphysis- body region, not only will tension develop along the contralateral condylar neck leading to fracture in this area, but continued medial movement of the smaller ipsilateral mandibular segment will lead to bending and tension forces along the lateral aspect and subsequent fracture of the condylar process on the ipsilateral side(Peter E. Larsen 2012) .

Force applied directly in the symphysis region along an axial plane is distributed along the arch of the mandible. Because the condylar heads are free to rotate within the glenoid fossa to a certain degree, tension develops along the lateral aspect of the condylar neck and mandibular body regions, as well as along the lingual aspect of the symphysis. This leads to bilateral condylar fractures and a symphysis fracture (Figure - 2). (Peter E. Larsen 2012) Overall, parasymphysis fractures were the most commonly associated with fractures of the condylar process.

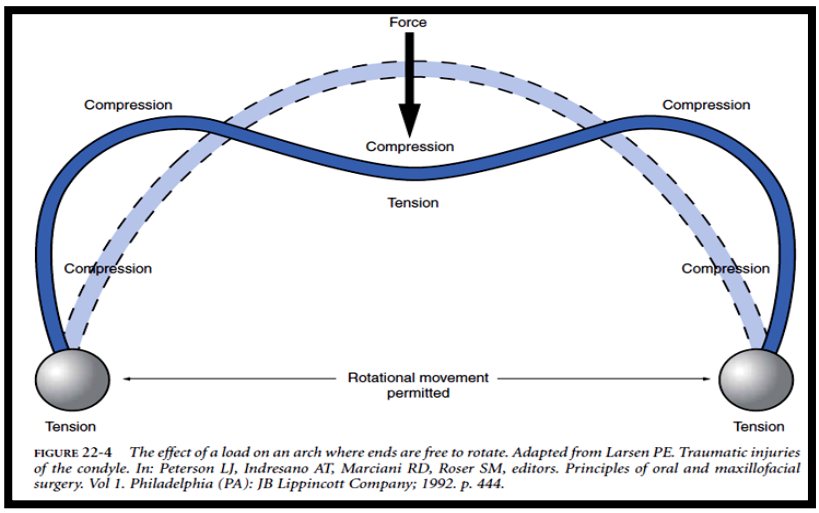

FIGURE 22-4 *The effect of a load on an arch where ends are free to rotate. Adapted from Larsen PE. Traumatic injuries of the condyle. In: Peterson LJ, Indresano AT, Marciani RD, Roser SM, editors. Principles of oral and maxillofacial surgery. Vol 1. Philadelphia (PA): JB Lippincott Company; 1992. p. 444.*

Figure (1) the effect of a load on an arch where ends are free to rotate. (Peter E. Larsen 2012)

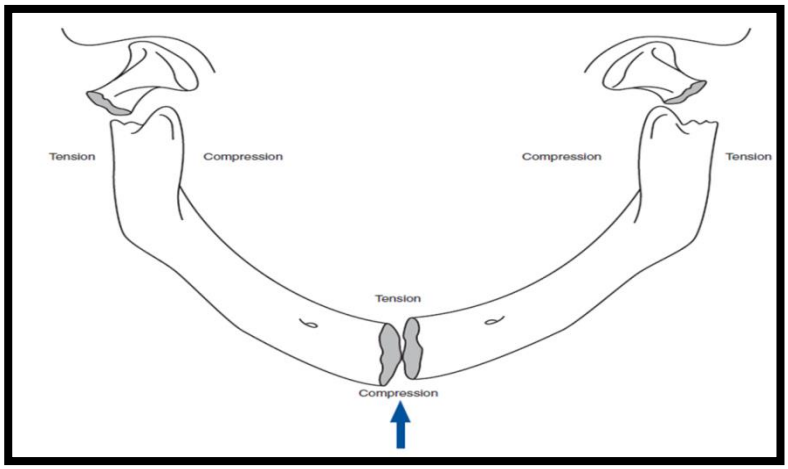

Figure (2) Force directed at the symphysis along an axial plane is distributed along the arch of the mandible. Tension is dissipated along the mandible, and the fracture occurs bilaterally in the area of least stability, the condylar neck. As in other fractures, a symphysis fracture may develop caused by tension from the blow. Adapted from Larsen PE. Traumatic injuries of the condyle. (Peter E. Larsen 2004)

Condylar fractures may give rise to serious problems, such as growth disturbances of the face, disorders of the TMJ (such as ankylosis and dysfunction), malocclusion, and chronic dislocation and pain on the injured side (Silvennoinen U, Zachariades N , Farronato et al .,2009).

Following trauma there may be an asymmetry at multiple facial levels, including both jaws and varying degree of limited mandibular movement due to muscle spasm, edema and haemarthrosis. The management of mandibular condylar fractures in children has been aimed at restoring normal joint function, occlusion and symmetry (Zachariades N, Farronato G, et al .,2009). There are two main therapeutic approaches for condylar fractures:

conservative treatment with intermaxillary mobilization followed by functional therapy; and

surgical intervention to reposition and stabilize the fragments.

Functional therapy is generally preferred in childhood, since it permits early mobilization, adequate functional stimulation of condylar growth in growing subjects and bone remodeling in all subjects [Valiati et al .,2008]. It is indicated in almost all condylar fractures occured in childhood, and in intracapsular and extracapsular fractures that do not include serious condylar dislocation in adults [Farronato et al .,2009 ,].

On the other hand, condylar fractures are surgically treated in the case of displaced fractures or dislocation of the condylar head especially in adults (Zachariades N, Farronato et al .,2009) Different techniques are described as a treatment alternative such as open reduction with intraosseous fixation, immobilization with intermaxillary fixation (IMF) or non immobilization and early mobility. Open reduction and internal fixation may be indicated in bilateral injuries with loss of a vertical ramus height. However, where the condyle is minimally displaced and the height of the ramus is normal, the closed treatment is appropriate. The correct determination of the treatment depends on various influencing factors, including

the physical and imaging evidence of the fracture,

the extent of injury (whether it is unilateral or bilateral),

the level of the fracture, the degree of displacement and dislocation,

the size and position of the fractured condylar segment,

the dental malocclusion and mandibular dysfunction, and

(vi) the completeness of the dentition and the age of the patient. However, there is a great consensus that closed management is advocated for such fractures (Zachariades N, et al 2006, Li Z, et al 2011).

Children have a greater osteogenic potential than adults which allows rapid union within three weeks and non-unionor fibrous union is rarely seen in pediatric patients. These factors allow for a much greater potential to remodel even in imperfectly reduced fractures . The usually favorable prognosis of a pediatric condylar fracture not only means the normal union of fractured fragments but also morphologic structure recovery of the condyle without any growth disturbances. (Li et al .,2011) .

In the presented case, we considered that conservative treatment of condylar fracture in growing child resulted in a good functional result with reduction of the condylar head in the fossa and correct positioning of the ramus. We concluded that a conservative treatment method is technically simpler with a satisfactory long-term outcome of jaw function in the management of mandibular condylar fractures in children.

At the end of the 30 months follow-up period, our case demonstrated that a condylar fracture during the growing period in children is compensated for by continuous condylar growth and remodeling. (Kalia V et al 2008). It appears that pediatric condylar fractures could be managed by closed procedures and obtain an encouraging prognosis, as long as there was no damage to the fibrous attachments of the capsule, disc, and

condylar cartilage . (Elif Bahar Tuna1, Aysun Dündar1, Abdülkadir Burak ,Çankaya2 and Koray et al ., et al .,2012)

The main controversies in condylar fractures relate to the basic philosophy of management. Both conservative and surgical treatment strategies have developed. However, if subcondylar fracture patients with dislocation of the condylar head from the mandibular fossa are treated conservatively, severe deviation of the jaw occurs frequently with opening. It is our recommendation that, in such cases, open reduction should be selected (Akira Sugamata et al .,2011) .

The greater incidence of condylar fractures in children than adults may be explained by the higher proportion of medullary bone with only a thin rim of cortex in children. Most condylar fractures are treated by observation or closed reduction and a short period of IMF, for 7–10 days, followed by a period of physical therapy to prevent ankylosis . Low condylar neck fractures may be treated with immediate ORIF using micro- or mini-plates to mobilize the joint as soon as possible. Also, minimally invasive techniques such as ORIF of condylar fractures under endoscopic visualization is interesting and may gain acceptance.

In addition, early mobilization associated with physical therapy consisting of mandibular opening exercises should be done.

The treatment of condylar fractures remains controversial among maxillofacial surgeons. Earlier, the indications for the open reduction were limited as evident in criteria given by Zide and Kent in 1983, since they were based on the techniques, materials, and scientific reports available at that time. Over the period of time, however, the concept of rigid internal fixation has been increasingly applied to the injured craniomaxillofacial skeleton. With the development of improved materials for fixation and refinement of surgical techniques, a paradigm shift has occurred, with acceptance and even reliance on rigid internal fixation by both the surgeon and the patient.

The result is that new considerations regarding the indications or contraindications and advantages or disadvantages of open treatment over closed treatment have evolved. Most of the past research has been oriented towards the unilateral condylar process fracture. (Hyde et al .,2002) and (Singh et al .,2010)

perhaps a less disruptive condition than bilateral fractures, in which neither condylar process retains normal morphology. There were few studies that deal with the problems related to bilateral condylar process fracture. In bilateral sub condylar fractures the dilemma remains whether to manage it conservatively perform open reduction and internal fixation (ORIF) of one side only or perform ORIF of bilateral condyles. The age of the patient, the level of fracture, angle of displacement, dislocation of condylar head and presence of other associated fractures influences a surgeon’s decision (Virendra Singh et al .,2012).

Once the decision to operate has been made, an osteosynthesis device has to be selected. The placement of a single 4- or 6-hole straight miniplate vertically on the posterior border of the condylar neck remains the most commonly used technique world wide . The main explanation for this is that this technique does not comply with the osteosynthesis principles regarding functional stability which should be followed when intervening with miniplate osteosynthesis in the mandibular area. Therefore, more and more authors advocate the use of 2 miniplates in combination (the first being placed in the axis of the condylar neck as usual, the second being placed obliquely under the mandibular notch as a stay) and report significantly better results with this technique. Advanced osteosynthesis devices are nowadays on the market, such as the Modus Tri Lock Trauma Condyle® plate (Medartis, Basel, Switzerland). However, this plate is simply a reinforced straight 5- or 6-hole miniplate and yet needs to be evaluated both experimentally and clinically. The 3-D Modus Delta-Plate® (Medartis, Basel, Switzerland) is a 4-hole delta-shaped miniplate, the base of the delta being fixed on the ramus and its upper arm being fixed on the condylar fragment. A recently

published study reports rather good clinical results, but a 15.4% radiological failure rate (secondary displacement of the fracture and/or screw loosening) (Lauer et al .,2006, Christophe Meyer et al .,2008).

Possible complications of the surgical approach, such as damage of the facial nerve and creation of visible scars, mean that the indication for surgical reduction versus non-surgical treatment of displaced condylar fractures remains controversial in maxillofacial surgery , and . Complications such as malocclusion, open-bite deformity and loss of chin projection are more likely to occur in bilateral condyle fractures. To minimize complications related to surgical approach, endoscope-assisted techniques using limited incisions have been described for various indications in the cranio-maxillofacial area , and . The transoral endoscope-assisted approach is a minimally invasive approach for treatment of displaced condylar fractures. Using this approach, facial nerve injury and visible scars are avoided. Postoperative swelling is reduced and early rehabilitation of the patient is achieved and . Reduction of operating time was noted due to a steep learning curve using this technique, and the transoral approach proved to be a reliable surgical approach also for bilaterally displaced subcondylar or condylar neck fractures with comminution. In the case of a bilateral condyle fracture with mild displacement on one side, fixation or inspection of both fractures is recommended to avoid further displacement by intraoperative manipulation. Miniplate osteosynthesis using two miniplates is preferably used in this mechanically demanding fracture site. (O. Fakler, M.C. Metzger, N. Weyer, R. Schmelzeisen 2008)

Injuries from blast trauma have many causes. Primary blast injuries are caused by the sudden increase in air pressure after an explosion.9 Secondary blast injuries occur when bomb fragments or nearby debris are energised by the explosion and cause penetrating injuries. Tertiary blast injury is caused when the casualty is thrown by the explosion and collides with nearby objects. Quaternary blast injury is related to the thermal effects of the explosion or buildings, or objects falling on the patient. The effect of blast trauma differs depending on where the person is located. An enclosed passenger in the rear of a heavily armoured troop carrier may be protected from the primary blast wave and be affected by the tertiary effects of the blast. If he is on foot patrol or exposed, he will be more exposed to fragmentation. (J. Breezea, A.J. Gibbonsb, N.C. Huntc, A.M. Monaghand, I. Gibbe, A. Hepperf, M. Midwintera et al., 2011).

CONCLUSIONS & SUGGESTIONS

CONCLUSIONS:

From the results of this study, we can conclude the following:

1- Young male patients are the most likely involved by trauma .

2- Most fractures in adults can be treated closed.

3- closed reduction is a simple method and gives excellent functional results.

4- Fractures in children are best treated closed except when the fracture itself anatomically prohibits jaw function.

5- Physical therapy that is goal-directed and specific to each patient is integral to good patient care and is the primary factor influencing successful outcomes, whether the patient is treated open or closed.

6- When open reduction is indicated, the procedure must be performed well, with an appreciation for the patient's occlusal relationships, and it must be supported by an appropriate physical therapy and follow-up regimen.

REFERENCES

- Akira Sugamata, Naoki Yoshizawa, and Yoshio Jimbo et al :Open Reduction of Subcondylar Fractures Using a New Retractor: plastic Surgery International ,Volume 2011 (2011), Article ID 421245, 5 pages.
- Banks,P.:Killeys fractures of the facial skeleton .2nd ed E&S Livingstone 2005:104-112.
- Christophe Meyer, Simone Zink, Brice Chatelain, Astrid Wilk et al :Clinical experience with osteosynthesis of subcondylar fractures of the mandible using TCP® plates, Journal of Cranio-Maxillofacial Surgery, Issue 5, July 2008;Volume 3: Pages 260–268.
- ElifBahar Tuna, Aysun Dündar, Abdülkadir Burak Çankaya, and Koray Gençay et al ; Conservative Approach to Unilateral Condylar Fracture in a Growing .Patient: A 2.5-Year Follow Up ,The Open Dentistry Journal, 2012:6: 1-4.
- Farronato G, Grillo ME, Giannini L; Long-term results of early condylar fracture correction: case report. Dent Traumatol .2009; 25: e37-42.
- Harold Ellis, Clinical Anatomy. A revision and applied anatomy for clinical students, Tenth Edition, Blackwell Science ,2002 :p:291-292.
- J. Breeze, A.J. Gibbons, N.C. Hunt, A.M. Monaghan, I. Gibb, A. Hepper et al; Mandibular fracture in British military personnel secondary to blast trauma sustained in Iraq and Afghanistan .British Journal of Oral and Maxillofacial Surgery: 2011:49pp. 607–611.
- John D. Langdon ,Mohanf. patel, RobertA.Ord, Peter A. Brennan : Operative oral and Maxillofacial Surgery ,management of condylar fractures ,including endoscopic reduction. hodder Arnold ,2nd ed.2011:485-492 .
- Kalia V, Singh AP. Greenstick fracture of the mandible: A casere port. J Indian Soc Pedod Prev Dent .2008; 26: 32-5.
- Li Z, Zhang W, Li ZB, Li JR; Mechanism in favorable prognosis of pediatric condylar fractures managed by closed procedures. An experimental study in growing rats. Dent Traumatol .2010: 26(3): 228-35.
- Lauer et al., 2006G. Lauer, W. Pradel, M. Schneider, U. Eckelt et al ; Transoral osteosynthesis of condylar neck fractures using a three-dimensional plate. Mund Kiefer Gesichtschir, (2006 :10 : pp. 335–340 [in German].
- Narayanan V, Kannan R, Sreekumar K: Retromandibular approach for reduction and fixation of the mandibular condylar fracture a clinical experience. Int J Oral& Maxillofac Surg .2009:38:835-9.
- O. Fakler, M.C. Metzger, N. Weyer, R. Schmelzeisen et al; Preliminary functional results of endoscope-assisted transoral treatment of displaced bilateral condylar mandible fractures .Maxillofacial Surgery, Issue 2, February ,2008:Volume 37: Pages 111–116.
- Peter ward Booth, Barry L.Eppley, Rain Schmelzeisen. Maxillofacial Trauma & esthetic facial reconstruction .condylar fractures. 2nded. Elsevier saunders .2012: pages270-287 .
- Peterson L, Ellis E, hupp J , et al: Contemporary Oral and Maxillofacial surgery ,4thed,Mosby.St Louis,2003.
- Richard Loukota :Fractures of the mandibular condyle: evidence base and current concepts of management. British Journal of Oral and Maxillofacial Surgery . Issue 7, October 2010: Volume 48: Pages 520–526.

- Richard A.loukota ,Khalid Abdel –Galil :Condylar fractures :In Peter ward Booth ,Barry l.Epply ,Rain Schmelzein :maxillofacial trauma & esthetic facial reconstruction 2nd ed Elsevier sunders :2012 :270-287.
- Richard S. Snell, Clinical anatomy by The regions: The head and Neck , Lippincott Williams & Wilkins,8th ed.2012 :p:667-851.
- Richard L. Drake, Wayne Vogl , Adam W.M. Mitchell: Gray's anatomy for students Elsevier ;head and neck 2007
- Shufang Luo, Bo Li, Xing Long, , Mohong Deng, , Hengxing Cai, and Yong Cheng et al ; Surgical Treatment of Sagittal Fracture of Mandibular Condyle Using Long-Screw Osteosynthesis . American Association of Oral and Maxillofacial Surgeons .J Oral Maxillofac Surg .2011: 69:1988-1994, 2011
- Silvennoinen U, Lindqvist C, Oikarinen K. Dental injuries in association with mandibular condyle fracture. Endod Dent Traumatol 1993: 9: 254-9.
- Virendra Singh , Amrish Bhagol, Rahul Dhingra: A comparative clinical evaluation of the outcome of patients treated for bilateral fracture of the mandibular condyles, Journal of Cranio-Maxillofacial Surgery . Issue 5, July 2012:Volume 40: Pages 464–466.
- Valiati R, Ibrahim D, Abreu ME, 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: 313-8.
- Williams JL: Maxillofacial injuries. 2nd edition Vol (I). Churchill Leving stone 1995: pp: 405-409.
- Williams P Grays anatomy(1995):The Anatomical Bases of Medicine and Surgery .New York: Churchill Livingston,1995.
- Zachariades N, Mezitis M, Mourouzis C, Papadakis D, Spanou A.Fractures of the mandibular condyle: a review of 466 cases. Literature review, reflections on treatment and proposals. J Craniomaxillofac Surg 2006; 34: 421-32.