ORIGINAL ARTICLE

MANAGEMENT OF PEDIATRIC MANDIBULAR FRACTURE: AN ENIGMA

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INTRODUCTION

Facial fracture management is often complex and demanding, particularly within the paediatric population. However with further advances in imaging modalities, bone fixation technology, microsurgical technique, and distraction osteogenesis, the management of these injuries continues to evolve at a rapid pace.

"The sports of children satisfy the child."

Oliver Goldsmith

Fig 1: Sports Injury

The impetuous nature and adventurous spirit of childhood combine to encourage participation in physical activities with little thought for the immediate consequences.

Facial fractures in children account for approximately 5% of all facial fractures. A male predilection is seen in all age groups[13]. The aim of this paper is to review various approaches for the management of mandibular fractures in children and the related controversies associated with it.

ETIOLOGY

The most common fracture in children requiring hospitalization and/or surgery generally involves the mandible and, in particular, the condyle, followed by angle and body fractures.

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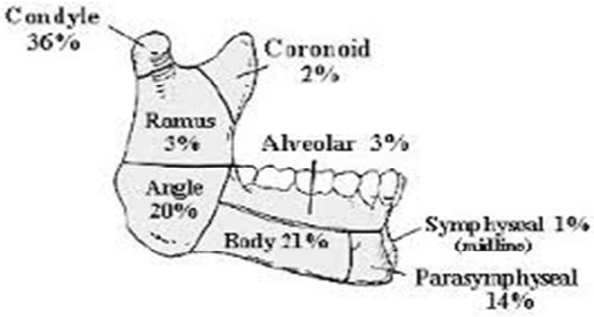

Fig 2: Incidence of Mandibular fracture at different sites

Aetiology of mandibular fractures in children are usually falls and sports injuries. The protective anatomic feature of a child's face decreases the incidence of facial fractures. In younger children (less than 5 years of age), the face is in a more retruded position relative to the "protective" skull, therefore, there is a lower incidence of midface and mandibular fractures and a higher incidence of cranial injuries. With increasing age and facial growth directed in a downward and forward direction, midface and mandible becomes more prominent; thus, the incidence of facial fractures increases, while that of cranial injuries decreases. The high elasticity of young bones, a thick layer of the adipose tissue covering them, a high cancellous-to-cortical bone ratio and flexible suture lines are some of the reasons contributing to the low incidence of facial fractures and minimal displacement of the fracture fragments.[10]

CLINICAL EXAMINATION & INVESTIGATION

Clinical examination of the patients was done to see the status of intraoral or extra-oral swelling, facial lacerations or abrasions, bleeding, involvement of the cerebrospinal fluid soft tissue injuries, facial deformity, ophthalmic involvement, degree of mouth opening, dentition, molar gagging, deviation of midline, bite-type, missing teeth, mid-palatal split, disturbed occlusion, fractured or avulsed teeth, retro-positioning of maxilla, infection, etc.

The X-ray PA view, lateral oblique 30° of the mandible left or right, orthopantomogram (OPG) and occipitomental view of skull 30° of midface but the

Fig 3: Image depicting extraoral abrasion and oedema in facial injury

imaging technique which is of value, especially following trauma, is a computed tomography (CT) scan.

Plain radiographs in young children are less helpful than in adult's due to unerupted tooth buds obscuring fractures, the increased incidence of greenstick fractures and the fact that the cortex is underdeveloped, leading to difficulty in visualizing fractures.

WHY CONTROVERSY??????

- Loose anchorage system due to attrition of deciduous teeth and physiologic resorption of roots.
- Precarious dental stability in the mixed dental development period.
- Difficulties in securing IMF using arch bars and eyelets as primary teeth are not sufficiently stable and may be avulsed due to the pressure exerted. In addition, the partially erupted secondary teeth are not sufficiently stable in the paediatric soft bone.
- Shape of the primary teeth: Conical shape with wide cervical margins and tapered occlusal surface makes placement of wires technically challenging.
- Restricted normal dietary intake in children on IMF was reported to result in significant weight and protein loss and reduced tidal volume
- The wires cause discomfort and damage periodontal tissues.
- Children on IMF are at an increased risk of aspirating gastric contents should they vomit.

RECENT TRENDS IN THE MANAGEMENT:

OPEN REDUCTION:

Fig 4: Miniplate used in the open reduction of symphysis fracture

1. **Metallic Rigid Fixation-** Open reduction and rigid internal fixation (ORIF) using stainless steel wires and plates has become the standard of care for management of displaced fractures. According to Zimmerman et al 2006, ORIF provides stable three-dimensional reconstruction, promotes primary bone healing, shortens treatment time and eliminates the need for or permits early release of MMF.

   Shortcomings- But as we know rigid metal fixation is difficult in children as mixed dentition occupies entire vertical dimension of the bone and places erupting teeth, inferior alveolar nerve at risk during screw insertion and also developing mandible poses risk of intra bony translocation of metal plates and screws, which disturbs the further growth of the bone[1]. The plate is ideally to be removed after 3 months in order to avoid disrupting facial growth.

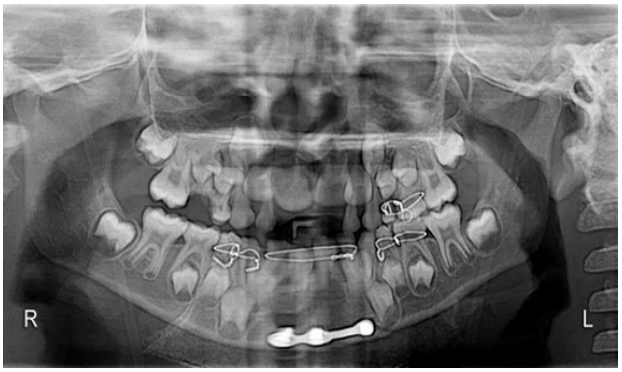

Fig 5: OPG showing relation of miniplates with eruption of teeth

2. **Resorbable Plates:** Resorbable plating system is advantageous in the treatment of paediatric facial fractures. After preparing the fracture site, a 1.5-mm resorbable plate with 2 screw holes on each side of the fracture is held along the inferior border of the mandible in tooth-bearing regions. The drill holes are through the outer cortex only so as to avoid drilling into unerupted teeth. Resorbable screws, which are approximately 1.5 mm in diameter and 4 or 5 mm in length, are inserted until flushes with the plate. *Unlike fixation with rigid metal plates, resorbable plates cannot be over bent and they lie passively against the bone.* [2]

   Advantage of resorbable screws in the paediatric mandible is the avoidance of potential odontogenic injury during its placement. As the drill hole and tapping of the screw threads penetrate only the outer cortex, injury to developing teeth is avoided. Even if the resorbable screw tip encroaches upon a tooth, its tip is blunt and it is non-penetrating and its subsequent resorption removes potential obstruction to tooth eruption. As such, resorbable plates and screws may be applied in even the youngest mandible, where the entire bone is composed entirely of teeth and nerve.

   These systems are made of high molecular weight poly-alpha hydroxy acids, which are broken down into by-products through hydrolysis and phagocytosis[6]. The degradation products are then excreted by respiration and/or urine. The resorbable plates and screws retain full strength within 4-6 weeks, and are completely resorbed by 12-36 months. They also do not interfere with radiographic studies.

   Shortcomings- Complications associated with resorbable systems are oedema of the tissue around the plate and visibility of the plate since they are larger and weaker than their titanium counterparts, they require a heating source to facilitate bending, the working time is limited, and the screws are not self tapping. These properties make them less attractive for use in patients with complex pan facial injuries, severe displacement, and comminuted fractures. Resorbable plates are also expensive and technique sensitive in comparison to titanium plates.

CLOSED REDUCTION:

Fig 7: Fabricated cap splint

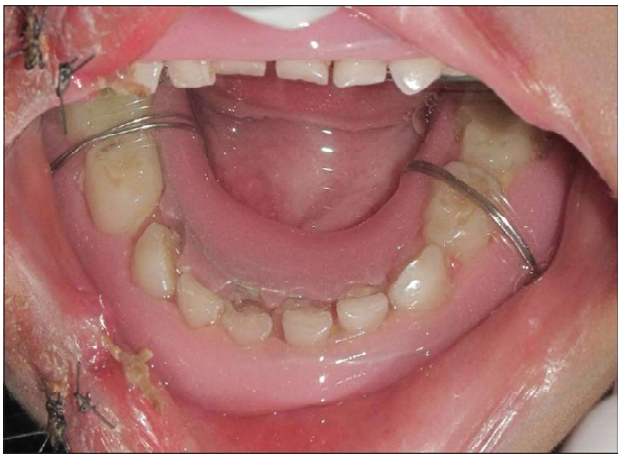

Fig 8: Cap Splint with Circummandibular wiring

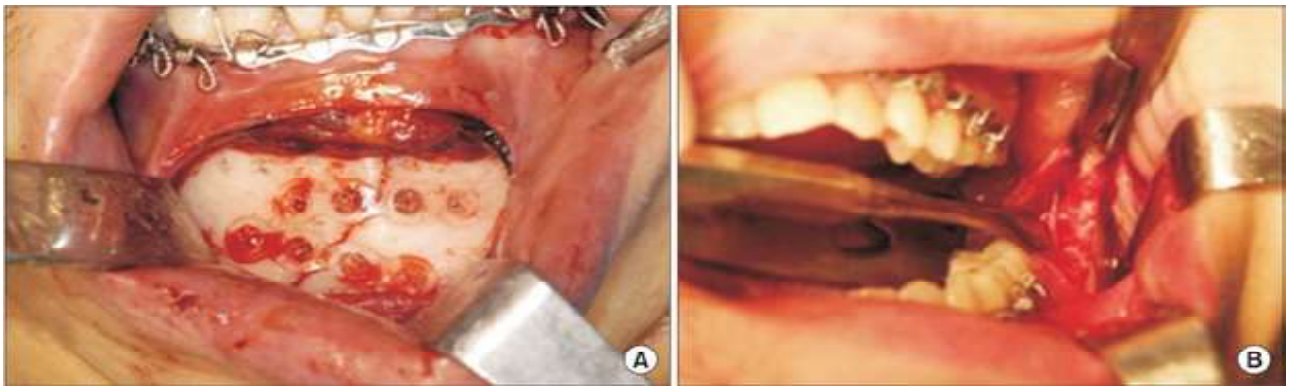

Fig 6: A- Resorbable plates used in the symphysis region B- Angle region

1. **Circumandibular wiring:**

   Several studies have recommended the use of pre-fabricated acrylic splints with circum-mandibular wiring as a treatment for paediatric mandibular fractures. These splints are more reliable than open reduction or IMF techniques with regard to cost effectiveness, ease of application and removal, reduced operating time, maximum stability during healing period, minimal trauma for adjacent anatomical structures and comfort for young patients.[5]

2. **Nickel titanium staples** :

   Laster *et al* described them as which are inserted in a relatively non-invasive and pain free manner and their eventual removal, if required, is done as quickly as their insertion, facilitated by the fact that the staples are not osseointegrated.

   Due to their superficial location, there is little risk for inhibiting and deforming facial bone development or having any effect on proximal strategic structures such as nerves and developing dentition. Furthermore, the reduced compression rendered by the staples on the bony fragments result in primary healing with no callus produced.[8]

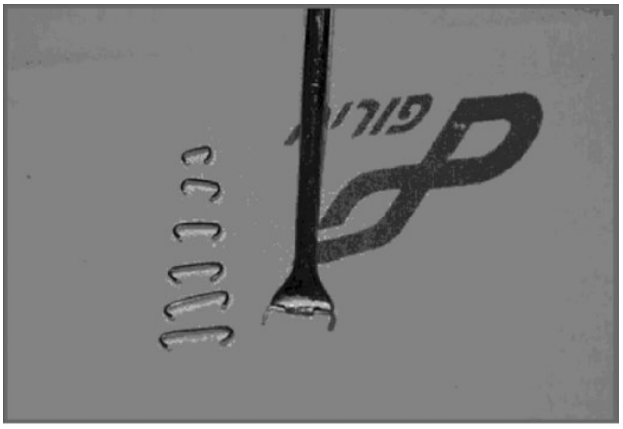

Fig 9: Preformed staples of all sizes. The arms are temporarily straightened after cooling

Fig 10: The frozen opened arms staple is inserted to the predrilledholes. The heat of the body causes reshrinking of the arms, thus compressing the two fragments.

CONDYLAR FRACTURES:

The condyle has enormous potential for regeneration and reshaping in the group aged 3–12 years. In adolescence age group (13-18 years) the capacity of bone regeneration is similar to children but bone remodelling is less than in children.

In spite of significant regeneration and remodelling in children, the long-term effects of condylar fractures in growing individuals must be considered. If condylar fractures in children are not properly managed, there is growth disturbance, asymmetry of face and TMJ disorders like ankylosis and dysfunction, malocclusion, chronic dislocation.

Clinical evidence supports condylar fractures in children over the age of 4 years have less danger of growth impairment from damage to the condylar centre. The experimental evidence suggests that the glenoid fossa grows downward and becomes shallow to adapt to the new position of the condyle. The most common fracture of condyle is intracapsular.

THE MANAGEMENT OF MANDIBULAR CONDYLAR FRACTURES DEPENDS ON VARIOUS FACTORS IN CHILDREN: [14]

1. The age of the child.
2. The co-existence of other facial fractures.
3. Unilateral or bilateral in nature.
4. The amount of displacement of the fracture.
5. The dentition and the dental occlusion status

THERE ARE TWO MAIN THERAPEUTIC APPROACHES FOR CONDYLAR FRACTURES IN CHILDREN. [15]

1. Conservative treatment with intermaxillary fixation or MMF followed by functional therapy.
2. Surgical intervention to reposition and stabilize the fragments.

The use of functional appliances in the immediate post condylar trauma treatment allows the mandible to relate to the maxilla thus stimulating muscular activity, which is within the pain threshold of the patient. It also helps in reduction in oedema and also removal of metabolites following muscular spasm. The results obtained with functional appliances are more effective than those obtained through traditional physiotherapy exercises, which are much more difficult to carry out in young children.

Paediatric condylar fractures can be effectively managed by closed procedures with good prognosis, as long as


Fig 11 & 12: Functional appliance holding both arches together reducing fracture segments together in centric occlusion

there is no damage to the fibrous attachments of the capsule, disc, and condylar cartilage.

OPEN REDUCTION IS INDICATED IN VERY RARE IN CHILDREN AND INDICATIONS ARE-[16]

1. Displacement in middle cranial fossa.
2. Unacceptable occlusion after closed technique trail failed or mechanical obstruction is present.
3. Avulsion of the condyle from the capsule.
4. Bilateral fracture of condyle with comminuted midface fracture
5. Penetrating wound.

CONCLUSION

The anatomical complexity of the developing mandible and teeth and concerns regarding biocompatibility of implanted hardware often mandate the use of surgical techniques in children that differ markedly from those used in adults.

In cases of mandibular fractures of a young child, disruption of periosteal envelope may have unpredictable effects on growth and child's mandible is filled with teeth in various ages of development and this has to be considered when deciding on closed vs open reduction but finally wisdom and experience of the surgeon in accordance with the circumstances decide the outcome of the treatment. Behavior management and caregiver education are incredibly important. While treating pediatric patients pedodontist should be involved to provide long term follow-up of the injured dentition. Considerations must be given to the psychological aspects of surgery and general anesthesia is justified even for simple procedures.

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