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Open cap splint with circummandibular wiring for management of pediatric mandibular parasymphysis/symphysis fracture as a definitive treatment modality; a case series

CASE REPORT

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Abstract – Management of pediatric maxillofacial injuries is mainly governed by their psychological, physiological, developmental, and anatomical characteristics. Pediatric mandibular fractures can have variable etiologies but have similar manifestations as those in adult patients. There are various treatment modalities to treat mandibular parasymphysis/symphysis fractures in children, which have their own limitations and complications. We currently describe our experience with open cap splint as a treatment modality which involves fewer risks in treating 10 pediatric parasymphysis/symphysis mandibular fractures.

Overall, facial fractures in pediatric population comprise <15% of facial fractures in general population (1, 2). Incidence of mandibular fractures in children is higher than that of midface fractures, of which condylar fractures are most often diagnosed followed by parasymphysis, angle and body fractures. Low incidence of mandibular fractures in pediatric population is mainly attributed to protected environment provided to them and differential growth pattern (1, 3). Other factors like preventive legislation (speed limits, use of helmets, airbags etc.) have also contributed to their low incidence. Various etiologies mentioned in literature as well as those observed in our series are mainly road traffic accidents, falls, sports, and birth trauma (4, 5) Anatomical complexity of developing mandible especially presence of tooth buds, eruption of deciduous, and permanent teeth governs treatment planning in children. Open reduction and internal fixation (ORIF) and other traditional methods of fracture reduction and fixation employed in adults have little applicability in children. The use of occlusal splints with circummandibular wiring is a versatile technique that can be used for wide range pediatric patients.

Case history

Ten consecutive pediatric patients with maxillofacial injuries operated during 2007–2010 were followed. Detailed history, examination and radiological assessment were carried out for every patient (Table 1). Clinical manifestations similar to adult patients were observed like trismus, sublingual ecchymosis, step deformity, lacerations, and malocclusion. Radiological assessment was carried out using orthopantogram (OPG), periapical radiograph, PA mandible (posterior-anterior view), occlusal films or C T scan (Figs 1–4).

Procedure

Before surgery, impressions were taken in each case and casts were prepared. Any previous photograph of patient smiling or earlier dental treatment records are always helpful in performing mock surgery on casts. After performing mock surgery, cast segments were held in reduced position and occlusion with maxillary cast; later acrylic splints leaving occlusal surface open were prepared in each case involving lingual and buccal flanges (Figs 1d and 5). In two patients sedation was required while taking impressions as they were uncooperative. Under general anesthesia, mandibular arch was manually reduced with occlusion as guidance (which is easier to evaluate intraoperatively compared to splints covering occlusal surfaces of dentition), later acrylic open cap splint was tried for stability. Stab incisions were then placed in submandibular and submental region to

Table 1. Patient details

Patient no	Age/sex	Diagnosis	Malocclusion	Etiology	Associated fractures	Complications	Duration of splint
Case 1	1.5 years/M	Symphysis*	Mild (<2 mm displacement)	Fall from cradle	Nil	Nil	2 weeks
Case 2	2 years/M	Lt parasymphysis*	Mild (<2 mm displacement)	Fall from bed	Nil	Nil	2 weeks
Case 3	4.5 years/M	Rt parasymphysis*	Severe(>4 mm displacement)	RTA fall from auto rickshaw	Nil	Nil	3 weeks
Case 4	5 years/M	Rt parasymphysis*	Moderate, (2–4 mm displacement)	RTA, truck	Nil	Nil	3 weeks
Case 5	5 years/F	Rt parasymphysis*	Moderate, (2–4 mm displacement)	Fall from swing	Nil	Nil	2 weeks
Case 6	7 years/M	Lt parasymphysis*	Severe(>4 mm displacement)	RTA, two wheeler	Rt Condyle*	Nil	3 weeks
Case 7	8 years/M	Rt parasymphysis*	Moderate, (2–4 mm displacement)	RTA, hit by two wheeler	Nil	Nil	2 weeks
Case 8	8 years/F	Lt parasymphysis*	Severe(>4 mm displacement)	RTA, two wheeler	Nil	Nil	2 weeks
Case 9	9 years/M	Rt parasymphysis*	Moderate, (2–4 mm displacement)	Hit by horse	Nil	Hypertrophic scars	3 weeks
Case 10	11 years/F	Rt parasymphysis*	Moderate, (2–4 mm displacement)	RTA, fall from cycle	Nil	Nil	3 weeks

*, fracture.

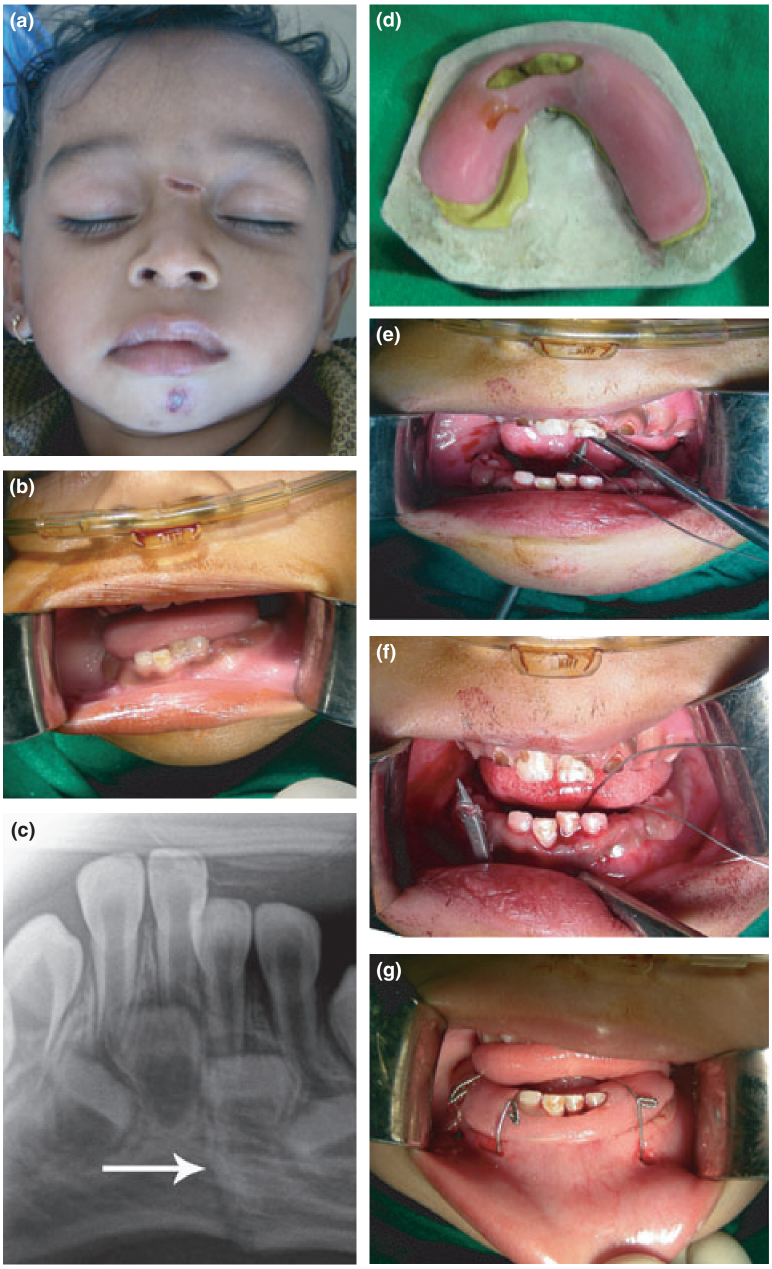

Fig. 1. (a) Profile photograph showing abrasions over chin and nose. (b) Intraoral photograph showing deranged occlusion. (c) Intraoral periapical radiograph reveals symphysis fracture. (d) Open cap splint prepared on cast in reduced position. (e) Awl on lingual side fed with 26 gauge wire. (f) Awl in buccal vestibule. (g) Open cap splint *in situ*.

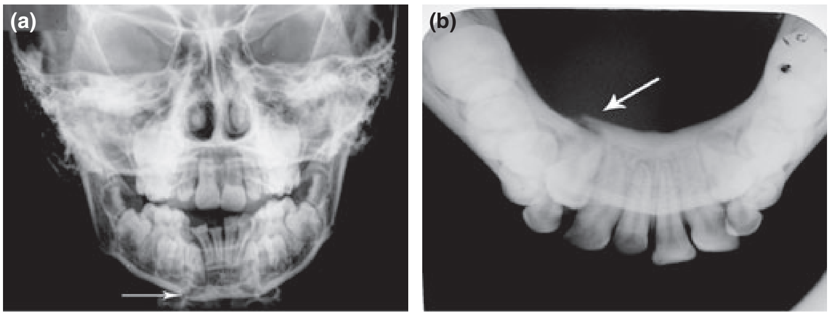

Fig. 2. (a) PA mandible radiograph showing right parasymphysis fracture. (b) Occlusal radiograph showing lingual aspect of fracture.

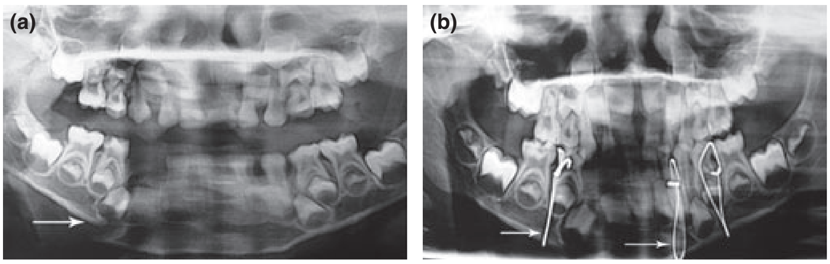

Fig. 3. (a) Preoperative orthopantogram (OPG) revealing fracture site. (b) Post operative OPG reveals fracture reduction and circummandibular wires *in situ*.

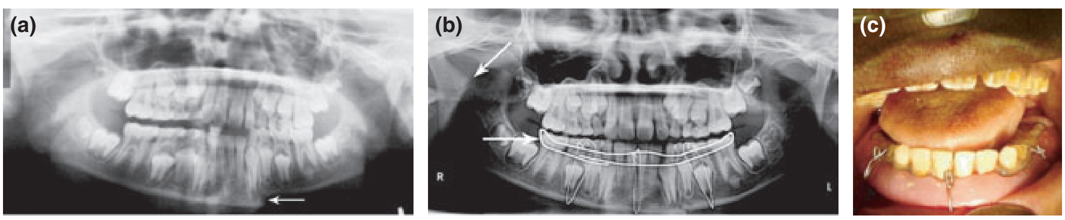

Fig. 4. (a) Preoperative orthopantogram (OPG) revealing parasymphysis fracture. (b) OPG revealing right subcondylar fracture and splint reinforced with wire. (c) Open cap splint *in situ*.

Fig. 5. Open cap splint on a permanent dentition cast.

facilitate passage of mandibular bone awl (Kelsey-Fry), which was then used to enter lingually along the body of the mandible through stab incision and piercing lingual mucosa. A 26 gauge orthodontic wire was fed to awl, once wire is secured to awl; it was withdrawn till tip of awl reaches the lower border of mandible and then carefully passed onto buccal sulcus along the body of the mandible. Care should be taken to keep mandibular awl as close as possible to the surface of mandible to minimize soft tissue injury. At least one wire was passed on either sides of fracture, taking care not to injure mental neurovascular bundle. Again mandible was held in occlusion with splint in position; both buccal and lingual ends of wires were held together, and splint was stabilized by twisting the wire in clockwise direction in the respective regions (Figs 1g and 4c). Finally occlusion was rechecked and stability of splint was verified.

Result

All patients were followed up for a period of 6 months, except one, and none of them had any complications (malunion, infection, hypertrophic scars, malocclusion, temporomandibular joint (TMJ) pain, and trismus) in postoperative period and there was uneventful healing/union of fracture segments in all patients. Only one patient had developed hypertrophic scar at laceration site, which was not attributed to fracture management procedure. In every case, the surgical splint was removed during 15–21 postoperative days. The 6-month follow-up showed good occlusion, without interference in teeth eruption and no signs of TMJ problems.

Discussion

The frequency of fracture types varies between the pediatric and adult populations. In the adult population, nasal bone fractures are the most frequent facial fractures, whereas mandible fractures are the most common of the bony injuries in children (6, 7). This is attributed to differential growth pattern of cranial volume and facial volume (at birth ratio of 8:1 changes to 2.5:1 at growth completion), also downward and forward growth of mandible and midface as one grows older. Various studies suggest condylar fractures (31–45%) are more common than parasymphysis fractures (13–26%) in pediatric age group because the highly vascularized pediatric condyle and thin cortices along with high amount of medullary bone are poorly resistant to impact forces during falls (2, 8, 9). Ten patients discussed here had parasymphysis/symphysis fractures, only one of them had associated subcondylar fracture (10%). Age of patients ranged from 1.5 to 11 with a mean of 6 years, which correspond to children going to school and increased unsupervised physical activity and sports. Most important factors affecting treatment planning of fractures in the pediatric mandible are the child's age and the stage of tooth development. Considering pediatric patients have high metabolic rate of most developing tissue, high osteogenic capacity of the periosteum, and high rate of healing, one should minimize the time of immobilization that is 2–3 weeks. In our patients, splints were left *in situ* for 2–3 weeks period, and splints and circummandibular wires were removed on opd basis. As chances of developing ankylosis (hampering condylar growth) are more in children, one should keep duration of maxillo–mandibular fixation to minimum. Arch bar, eyelet wiring is technically challenging in pediatric patients as primary teeth have conical shape with wide cervical margins and tapered occlusal surface. Primary teeth and partially erupted secondary teeth do not have sufficient stable foundation and can be accidently avulsed during wiring maneuvers. We used open cap splints in every patient, thus eliminating the need of maxillo–mandibular fixation, and wiring is performed around mandible sparing dentition. Developing tooth buds present near lower border of mandible and partially erupted teeth may be traumatized while placing plates, screws for rigid fixation or during exerting excessive pressure during wiring maneuvers. Various treatment modalities indications and complications are summarized in Table 2 (2, 10–12). For greenstick/minimally displaced fractures, closed reduction is the most frequently advised along with close observation, a liquid-to-soft diet, and analgesics during healing phase. Open cap splints, prefabricated occlusal splints, lingual splints, circumferential wiring, arch bars or Gunning splints can be used for closed reduction and immobilization in pediatric mandibular parasymphysis/symphysis fracture (Table 3). In past we have used cap splints (covering occlusal surface) in a couple of patients with drawback of taking repeated radiographs (OPG) postoperatively for the evaluation of fracture segments during the course of

Table 2. Various treatment modalities for management of pediatric parasymphysis/symphysis fractures

Treatment modality	Indications	Advantages	Drawbacks
Conservative management	Minimally displaced,* Green stick,* Condylar*	Early mobilization, Decreased muscular atrophy, Decreased risk of ankylosis, Better oral hygiene	Displaced, Complex
Maxillomandibular fixation with arch bar, eyelet wiring	Minimally displaced,* Green stick*		Should not be used in patients <11 years, Avulsion of primary teeth, Technically challenging because of tapered occlusal surface with wide cervical margins
Occlusal splints with circummandibular wires	Displaced*	Can be used in wide range of age group, Early mobilization, Decreased muscular atrophy, Decreased risk of ankylosis, Good oral hygiene	Excessive force during wiring can easily cut into immature cortical bone, Mental nerve damage
Drop wires	Minimally displaced* in combination with circummandibular wiring	Less operative time, Less periosteal stripping (site) compared to ORIF	Ineffective for angle region, Long period of immobilization is required
Open reduction and internal fixation	Displaced,* Complex*	Early mobilization, Quicker resumption of a soft diet, Good oral hygiene	Growth impairment, Tooth buds trauma, Second surgery for removal of metallic implants, Migration of implants, Bio-resorbable plates are bulkier and can lead to sterile abscess formation
Nickel–titanium (NiTi) staples	Minimally displaced*	Semi rigid, Little potential damage to adjacent structures, periosteum stripping not required	Freezing of staples before insertion

*, fracture.

Table 3. Comparison of different splints in management of pediatric parasymphysis/symphysis fractures

	Open cap splints	Lingual splints	Prefabricated cap splints	Gunning splints
Occlusion can be checked intra- and postoperatively	Yes	Yes	Only intraoperatively	Not possible
Maintenance of oral hygiene	Possible	Possible	Not possible	Not possible
Require stable dentition	Not required	Yes	Yes	Not required
TMJ position	In occlusion	In occlusion	Slight open bite position	Slight open bite position
TMJ movements	Not restricted	Not restricted	Not restricted	Restricted
Circummandibular wiring	Required	Not required	May be required	Required
Impressions/casts	Required	Required	Not Required	Required
Esthetics	Good	Good	Poor	Poor
Indicated for displaced fractures	Yes	No	No	Yes

treatment. With the use of open cap splints, we have reduced dependence on repeated radiographic evaluation, as occlusion is clearly visible, mastication for soft diet and maintenance of oral hygiene is possible. Drop wires from either lateral piriform rim or nasal spine are used in combination with circummandibular wires, eyelet wiring for management of simple mandibular parasymphysis/symphysis fractures. Drop wires placement requires incision and stripping of periosteum in non-traumatized midface region.

Limitations and complications of open reduction with internal rigid fixation (trauma to tooth buds, restricted growth, need for non-resorbable implant removal after healing, sterile abscess formation, risk of migration of implants) with micro or miniplates or biodegradable devices and monocortical screws restrict their use in severely displaced fracture cases. Apart from conventional method of passing circummandibular wire using mandibular awl, few studies suggest use of intravenous cannula stillete. Few advantages of using intravenous cannula stillete are inconspicuous extraoral wound compared with that created when using an awl, less chances of wire contamination, less postoperative pain (13, 14). Our personal experience with mandibular awl has been satisfying (no incidence of postoperative pain, infection), thus we recommend use of either mandibular awl or intravenous cannula stillete.

Few technical tips

1 Once mandibular awl is fed with 26 gauge wire, care should be taken to tighten (twisting) the wire end adequately, so as to prevent soft tissue trauma as the awl travels through the tissue.

2 Wire should form a small loop near mandibular awl, allowing free movement of wire within awl; this facilitates passage of awl with wire around the lower border of mandible. One can do so by keeping straight probe along tip of awl and twisting wire ends around it; after probe is removed one should compress the loop formed slightly to make it elliptical.

3 Making grooves with straight fissure bur intraoperatively on labial and/or lingual surface of splint, such that the wire engages the grooves, to prevent slippage of wire over splint.

4 One can reinforce the splint by incorporating a wire all around the dentition within splint material.

Summary

Open cap splints for treatment of pediatric mandibular parasymphysis/symphysis fractures are more reliable than open reduction or intermaxillary fixation techniques and other treatment modalities with regard to occlusion guided fracture reduction, maximum stability during healing period, ease of application and removal, reduced operation time, minimal trauma for adjacent anatomic structures, wide age group safe usage, ease of maintenance of oral hygiene, and comfort for young patients.

Conflict of interest

None.

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