Management of unilateral condylar fracture in a 9.6-year-old female

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ABSTRACT. Background Fractures represent a particular kind of pathology in children, as they take place within a rapidly growing organism. Condylar fractures must be focused upon not only as a cause of direct damage to the bone structure, but also with regards to future disorders in the dentofacial development, skeletal deformities and articular dysfunctions. The treatment aims at restoring function, occlusion, and symmetry. Aim of this paper is to emphasise, through the description of a case report, the need for correct diagnosis and the importance of a functional treatment by means of early muscle activation, in order to prevent any consequences on facial development. Case report A case of a 9.6-year-old female with monocondylar and intracapsular fracture following a car accident is described. In accordance with the literature, the patient did not undergo surgical treatment, but followed a functional orthodontic protocol. The significant symptoms reduction and the rapid improvement of mandibular functions confirm the excellent healing potential in paediatric age, while the X-ray evaluations 1 year and 3.7 years later testify the condylar reshaping. Since the latter can continue over many years, the clinical and radiological follow-ups of the patient will have to cover the entire growth period.

Key words: TMJ; Condylar fractures; Functional appliances; Children.

Introduction

Fractures of mandibular condyle can be counted among the most controversial issues in maxillofacial traumatology regarding classification, diagnosis and therapeutic management.

The fractures of the condyle represent 29-40% of the fractures of the facial skeleton, and about 20-35% of all mandibular fractures [Villarreal et al., 2004]. Facial fractures are usually a rare report in paediatric patients compared with both the frequency in the adult population, and other areas in the body [Chacon et al., 2003; Remi et al., 2003]. The lower prevalence of mandibular fractures in children can be explained with the resilience of a developing facial skeleton, its smaller proportions compared with the cranial volume, a high ratio of medullary and cortical bone, the presence of tooth germs and cartilaginous growth sites which contribute to the resilience and stability of the jaw [Chacon et al., 2003; Remi et al., 2003; Defabianis, 2004; Defabianis 2003; Defabianis 2001a; Infante Cossio et al., 1994]. Facial skeleton fractures in children represent 4% to 6% of all body fractures [Chacon et al., 2003]. In reality, recent epidemiological studies deem that the frequency of condylar fractures is probably higher than that reported in current literature, and especially in children under the age of 6 it might be even higher than in adults [Defabianis, 2004; Defabianis, 2003; Defabianis, 2001a; Iida and Matsuya, 2002]. In children under the age of 2 years, the small size and the vascular nature of the condylar head, combined with its thin cortex, make this area prone to intra-articular flattening (crush injuries). As the mandible grows and develops, between the age of 7 and 8 years, bearing structural resemblance to the adult one, fractures are more often extra-capsular and involve the neck of the condyle [Chacon et al., 2003]. The frequency of mandibular fractures varies depending on social factors and age; they gradually increase from birth to 16 years, with a higher incidence in males [Defabianis, 2003; Defabianis, 2001a; Infante Cossio et al., 1994]

In children fractures represent a particular pathology, as they occur in a rapidly growing organism [Remi et al., 2003]. The long-term effects strictly depend on the patient’s age and, although recovery capabilities and bone remodelling are excellent during growth, condylar fractures can determine modifications in the development of the facial skeleton, with aberrant consequences from a functional and aesthetical point
of view. In case of undiagnosed and untreated fractures, the consequences become evident during growth with asymmetrical facial development. It has been proved that condylar fractures evolve, in 5-10% of the cases, in a deficit of the dentofacial development, skeleton deformities and dysfunctions of the joints [Infante Cossio et al., 1994]. In most cases early diagnosis and an adequate treatment can reduce the impact on the facial growth, with positive results both on a functional and aesthetical standpoint [Defabianis, 2003].

Case report

A 9.6-year-old female needed to be checked for facial trauma following a car accident that took place three days earlier.

Her general health conditions were good, but she referred pain in the right temporomandibular joint (TMJ) region. The extraoral evaluation showed asymmetry of the face on a frontal view, with shifting of the chin towards the right side, bruises and oedemas of the chin, where the traumatic impact occurred (Fig. 1). The oral evaluation revealed malocclusion: the lower midline was deviated toward the right, with omolateral crossbite and contralateral open bite. The TMJ evaluation showed functional reduction in mouth opening (12 mm between the edges of the upper and lower incisors) (Fig. 2), with deviation of the midline toward the right; the right maximum lateral movement was maintained, while the contralateral one was very limited, as well as the mandibular protrusion. A click could be heard to palpation of the right TMJ while opening.

The radiological evaluation (panoramic radiograph, anteroposterior skull radiograph and spiral CT scans) confirmed the vertical intracapsular fracture of the right mandibular condyle with dislocation (Fig. 3).
According to the literature, the patient did not undergo surgical treatment, but followed a functional orthodontic protocol. As taking the impression of the dental arches was not possible, due to the limited mouth opening and pain, brackets were placed on the teeth of the upper left arch (6.3-6.4-6.5-2.6) and on those of the contralateral lower arch (8.3-8.4-8.5-4.6) and connected with interarch elastics (about 2 oz.), in order to centre the lower jaw. Physiotherapy exercises were prescribed (maximum mouth opening, protrusion, right and left laterality) to stimulate the condylar physiological movements, and a semi-liquid diet was recommended. After three weeks an appliance with a midline screw and a maximum laterality construction bite, contralaterally to the injured joint (lower midline displaced by about 2 mm to the left) was placed, to be worn continuously (Fig. 4 b, c), while maintaining the physiotherapy schedule.

The activator works on the capsular and periosteal functional matrix, modifying both the muscular stimuli and the functional spaces by means of vertical distraction of the side involved, thus enhancing condylar remodeling. There were almost immediate signs of symptoms reduction, together with improvement of the mandibular functions: the maximum mouth opening after one week was about 20 mm, even with the persisting displacement towards the right and the right-sided click of the joint.

The significant symptoms reduction and the rapid improvement of the mandibular function confirmed the excellent healing potential in children, while the radiographic checkups (panoramic radiograph and CT scans) carried out after one year showed the remodeling process of the condyle (Fig. 5).

The patient proved to be cooperative: she was called for periodical clinical checkups, in order to evaluate the facial growth and the functional recovery progress: after 18 months she had a well balanced mandibular growth with maximum mouth opening of about 40 mm, no click or lateral deviation of the mandible toward the right with good lateral and protrusion movements (Fig. 6). The functional appliance therapy

**Fig. 4A** - Functional therapy with interarch elastics (about 2 oz) for 3 weeks. **Fig. 4B, C** - Functional therapy with activator.

**Fig. 5A, B** - After 1 year, the panoramic radiograph and the spiral computed tomography scans show the remodeling process of the condyle.

**Fig. 6 A, B, C** - Clinical evaluation after 18 months shows a well balanced mandibular growth and a maximum mouth opening of about 40 mm.
Fig. 7 A, B, C, D, E - Clinical evaluation of the face and the TMJ function 3.7 years after fracture of the right mandibular condyle.

Fig. 8 A, B, C - Evaluation of the remodeling process of the right condyle 3.7 years after the injury with panoramic radiograph and cone beam computed tomography.
lasted about 24 months. The midline screw was activated a quarter turn every three weeks, and the acrylic was ground away from the appliance to guide dental eruption.

After one year from the beginning of the functional treatment also a lingual arch was placed, to preserve the leeway space. Afterwards the activator was used as retainer for about 12 months, until the end of the mixed dentition phase. After a clinical and a radiographic checkup 3.7 years after the trauma (Fig. 7, 8), a fixed orthodontic treatment was scheduled in order to optimize occlusion, given the good TMJ function.

Although the traumatized joint was completely functional and pain-free after a short period, the remodeling of the condylar head and neck will require many years to fully match the healthy contralateral joint.

Since the clinical and radiologic follow-up might take up many years to come, it will have to cover the entire growth period of the patient.

Discussion

TMJ injuries can often occur with few symptoms and clinical signs, and the child’s reactions can be too subtle to be alarming in regard to the entity of the damage. The difficulty in adequately evaluating children’s pain, especially under the age of 10, or the presence of more serious damage in an acute stage, can lead to delayed diagnosis and treatment, with potential future growth problems [Chacon et al., 2003; Defabianis, 2004; Defabianis, 2001a].

Falls on the chin and pre-auricular bruises are potential causes of condylar fractures. Condyle fractures, both intra- and extra-capsular, are considered as a mechanisms meant to prevent brain damage through cranial penetration of the condyle: the fast deceleration will cause fracture of the most vulnerable anatomical structure of the jaw, that is the condylar process [Chacon et al., 2003; Spanio et al., 2002].

The trauma can produce tearing of the ligaments or of the capsule, intra-articular fractures with or without dislocation, haemorrhage or oedema in the intra-articular space, and changes in muscular length. The post-traumatic inflammatory arthropathy is characterised by pain both at rest and during activity, and reduced TMJ mobility. Inflammation of the synovial tissue can cause dense fibrous adhesions between the disc and the adjoining structures, and favour a TMJ disfunction with pain and occlusal disorders [Villarreal et al., 2004; Remi et al., 2003; Ghazal et al., 2004].

Failure to recognise the presence of the fracture can lead to belated complications, linked to the incorrect consolidation of the fragments, with subsequent deformation of the articular eminences and functional alterations which can lead to ankylosis of the TMJ. The latter is caused, from a pathogenetical point of view, by the fact that often a haematoma builds up around the fragments: this can be replaced by granulation tissue, and then by fibrous connective tissue which can transform into bone tissue causing a fusion of the joint. Such event is more likely to take place due to a possible intramaxillary blockage, which conditions the mobility of the TMJ, thus leading to scar tissue [www.sicmf.org/AggDiagnTerapeu.html].

Apart from functional alterations during growth, there can be modifications in the structural dentofacial development in the three spatial planes and a serious dysmorphism of the middle and lower thirds of the face, characterised by a three-dimensional hypodevelopment (particularly the sagittal and vertical planes), and by lateral mandibular deviation on the same side of the injury, along with a pivoting of the upper jaw and a more or less serious dental malocclusion [Villarreal et al., 2004]. Approximately 8% of the patients with condyle fractures develop severe mandible growth disorders [Chacon et al., 2003].

Radiological evaluations, such as panoramic radiographs and CT scans, are a necessary complement that will help ascertain the location of the fracture, its degree and the displacement direction, as well as the possible presence of related damages [Chacon et al., 2003]. The panoramic radiograph is the most common evaluation requested in the first place, but unfortunately it is subject to a high rate of false negatives, due to the projection of the condyles on just one anatomical level and the juxtaposition with other dense bone structures [Chacon et al., 2003; www.sicmf.org/AggDiagnTerapeu.html]. In 30° anteroposterior skull radiography according to Towne’s projection, the head is positioned in such a way that the condyles and the sub-condylar area are not obscured by the base of the skull.

In case of lack of clear X-ray images, the CT scan is currently the most accurate examination, particularly in case of intracapsular fractures, with regards to the location of the fragments, the degree and direction of the displacement and possible intracranial injuries. The acquisition of images with complex movements (spiral) allows for a low exposure time compared with the traditional linear CT scans. A new volumetric acquisition method (cone beam) has been recently introduced, in which radiation doses are considerably reduced, but equally diagnostic. This new type of CT should therefore be considered as a routine evaluation for the assessment of possible condylar fractures, especially in children [Remi et al., 2003; Spanio et al., 2002; Graziani et al., 1995].

The management of condylar fractures in children is still debated, because of its impact on the mandibular...
growth and the mobility of the joint [Villarreal et al., 2004; Chacon et al., 2003; Remi et al., 2003; Infante Cossio et al., 1994].

The principles of the treatment of mandible fractures in children can differ from the treatment in adults, since the rigid fixation with plates and screws can lead to risks for the skeletal growth and for teeth that have not yet erupted [Defabianis, 2002; Silvestri et al., 2004]. New diagnostic technologies and a deeper understanding of the face growth process have brought to a more conservative approach of joint injuries [Defabianis, 2003]. The difficulties of surgical access, the limited bone contacts of the fragments, the functional complexity of the TMJ, the influence of the insertions of the masticatory muscles, are all reasons for a particularly complex treatment of these fractures.

The conservative therapy usually permits to reach good results; main goals of this kind of approach are the activation of the bone remodeling process, rebalancing of the intra-articular functional structures, and recovery of mandibular movements concerning the injured condyle. This happens through an early restoration of a stable occlusion and through the normalisation of the muscle activity.

The indications for surgical treatment in children are limited [Remi et al., 2003], as these seem to worsen the tendency to growth disorders [Remi et al., 2003; Defabianis, 2003; Defabianis, 2001a; Deleyiannis et al, 2006]. Surgical treatment is justified only in adults with dislocation and malocclusion, in order to permit healing of instable or irreducible fractures in which intermaxillary fixation must be avoided [Villarreal et al., 2004; Hovinga et al.; 1999].

In children the treatment of choice in case of mandible fractures is the maxillo-mandibular fixation, while for condyle fractures good results are generally obtained after just the functional orthodontic treatment [Infante Cossio et al., 1994; Girthofer e Goz, 2002; Zachariades et al., 2006].

This conservative approach can include a period of close checkups with a gradual increase in function, if the condyle fracture is documented through X-rays but the occlusion remains stable, or, in more severe cases, the use of high relieving, stabilizing splints or the immobilisation of the mandible for a short period of time (one or two weeks at the most), followed by a period of guiding elastics and physiotherapy [Chacon et al., 2003].

Several authors agree in deeming a period of immobility (not more than 2 weeks) and early mobilisation as necessary in order to avoid ankylosis of the TMJ as a complication of the fracture [Infante Cossio et al., 1994]. It is therefore taken for granted that a long period of immobilisation of the jaw is not acceptable anymore, given the negative consequences on function. The use of functional appliances in the immediate post-trauma treatment allows the lower jaw to relate to the maxilla, and by stimulating muscular activity (within the pain threshold), it favours resorption of the oedema and removal of metabolites following muscular spasm [Defabianis, 2003; Defabianis, 2001a; Defabianis, 2001b]. The control of the vertical dimension is a key element of the treatment: its failure could cause disc compression during movement. The results obtained with functional appliances are more effective than those obtained through traditional physiotherapy exercises, much more difficult to carry out in children. The appliance must be used as many hours as possible, not only in the weeks during the healing period, but also in the following two years at least, when bone regeneration and compensatory growth take place [Defabianis, 2003; Defabianis, 2001a; Defabianis, 2001b].

The complete remodeling of the condyle is not infrequent in children, thanks to the high potential of osteoblast and osteoclast rearrangement: if occlusion is restored and normal function continues, the articular surfaces will regenerate and remodel, while the lower jaw position is maintained [Defabianis, 2001a; Defabianis, 2001b]. The remodeling capacity is considerably lesser, usually limited to adaptation of the condyle and the fossa after fracture. The best regeneration can be seen in patients in an active growth stage, under the age of 12.

Regarding the remodeling process, the importance of the child’s age at the time of the trauma is still unclear and controversial. The fracture’s site, the degree of dislocation and the severity of the injury are more likely to condition the remodeling process. More extensive remodeling processes are obviously necessary in case of severe dislocating fractures, with consequent increased risk of imperfect healing. An incomplete remodeling is frequent (56%) particularly in case of displaced fractures (80%); the main sign being a flattened or irregular surface of the condyle head, with neck deformity [Infante Cossio et al., 1994]. A correct function of the masticatory system is certainly the most important variable in the remodeling of the TMJ [Defabianis, 2001a; Defabianis, 2001b].

Although the traumatised TMJ can be completely functional and asymptomatic after just a short period of time, remodeling of head and neck can take many years in order fully match the healthy contra-lateral joint [Girthofer e Goz, 2002]. Therefore the clinical and radiological follow-ups of these patients must cover the entire growth period, during mixed dentition, until the permanent occlusion becomes stable.

Conclusion

Condylar fractures are the most common type of facial skeleton fractures in childhood, but they are often overlooked, due to the few clinical signs. A fracture not diagnosed and not adequately treated can
cause long-term effects that become evident during the growth, such as deficit of dentofacial development, dysmorphism, malocclusion, and TMJ disorders. The diagnosis of condylar fracture in childhood must be supported not only by the history, the clinical examination and the panoramic radiograph, but also through more sophisticated and accurate imaging analysis such as the CT, which is necessary in order to verify location, degree and direction of displacement of the fracture.

According to the international guidelines, the patient presented in this paper was treated with a non-surgical, functional method: first of all, the use of intermaxillary elastic tractions anchored to a partial fixed appliance, such as the one described, in association with physiotherapy exercises to avoid functional stasis; subsequently, the use of a functional appliance in maximum laterality opposite to the site of the lesion. In the immediate post-trauma period, an early functional approach restores a stable occlusion, so that the jaw is correctly related to the maxillary with balanced and symmetrical movements, thus stimulating the condylar remodeling through vertical dimension control and distraction of the injured side. The fast reduction of the symptoms and the improvement of the mandibular function confirm the excellent recovery potential in childhood. The process of condylar remodeling, already evident at the 12 months CT follow-up in the case described, can continue for many years: the clinical and radiological follow-ups of the patient will have to cover the whole growth period.

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References
www.sicmf.org/AggDiagnTerapeu.html