The Importance of Early Recognition of Condylar Fractures in Children: A Study of 2 Cases

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Maxillofacial fractures in general and mandibular fractures in particular seem to be less common in children than in adults; however, this finding might be influenced by the fact that condylar fractures in children are often undiagnosed and so the true incidence is likely to be higher than that reported in literature. Traumatic lesions of the temporomandibular joint often are overlooked as they can apparently occur with relatively little pain, few clinical signs, and insufficient reaction by the child to alert an adult to the seriousness of the injury. Only 1 to 2 years later, when growth disturbances appear, are they perceived as a problem, but by that time, the dysplastic growth pattern has stabilized and will continue over a period of years. The problem is frequently underestimated because of the difficulties inherent in pediatric pain assessment. The fact that the mechanisms of pain perception in children differ somewhat from adult pain perception mechanisms is one factor that can make pediatric pain assessment difficult. This paper outlines 2 case reports that draw attention to pain in children in the case of temporomandibular joint injury. The inability to assess pain adequately may lead to a delay in diagnosis and treatment and possibly result in future growth disturbances and facial asymmetries. J OROFAC PAIN 2004;18:253–260

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Diagnosis and treatment of facial trauma must focus not only on direct damage to osseous structures but also on future disturbances in dentofacial development. Normal development of the mandible, as well as some portions of the upper jaw and face, is related to proper function of the masticatory apparatus. When function is altered for any reason, for example because of a traumatic event, abnormalities may occur that can have serious consequences for the development of the face.

Maxillofacial fractures in general and mandibular fractures in particular seem to be less common in children than in adults. This difference could be due to differences in the facial osseous structures of adults and children, ie, the resilience of the developing mandible in infants and its smaller size relative to the cranium and the forehead.[1–3] More recent epidemiologic studies provide new perspectives, because they are more likely to take into account the fact that temporomandibular joint (TMJ) fractures in children, which are often undiagnosed, are likely to have a higher incidence than that reported in the literature.[4,5] A lower prevalence of mandibular fractures in children than in adults (from 1% to

14.7% lower, depending on the age group) has been found in several studies.[6–8] The incidence seems to increase gradually from birth up to 16 years of age. The sex distribution shows a predominance of boys in all age groups; this trend increases with age.[3,5,6] The most common fracture site is the condyle.[9,10] The higher incidence of condylar fractures in children than in adults may be explained by the higher proportion of medullary bone with only a thin rim of medullary cortex in children.[11]

The consequences of the acute trauma may be torn ligaments or capsules, intra-articular bone fracture, soft tissue lesions with effusion or hemorrhage in the joint space, dislocation (luxation), or fracture, separately or in combination. Such trauma invariably causes a traumatic arthritis characterized by resting pain, pain on movement, and limited jaw movement due to the reduced mobility of the TMJ.[12] Minor injuries such as facial lacerations, abrasions, and dental lesions can also occur. Some of these injuries may resolve, either leaving the joint normal or with a predisposition to later deleterious changes. Direct injuries may result in musculotendinous tears, contusions, changes in muscle length, and inflammation, leading to uncoordinated movements and musculoskeletal dysfunction.[13]

However, these findings are not always recognized and sometimes are overlooked as trauma can apparently occur with relatively little pain, little clinical evidence, and insufficient reaction by the child to alert an adult to the seriousness of the injury. Only 1 to 2 years later, when growth disturbances appear, are they perceived, but by that time, the dysplastic pattern of growth has stabilized and will continue during the subsequent years. Adequate pain assessment is essential to provide optimal care and treatment, but in children, it is often difficult. In general, self-report about the character, location, and intensity of pain is often the most useful guide to pain assessment. In infants, however, self-report is often unavailable, which makes clinical evaluation of these patients challenging.[14,15] Furthermore, mechanisms of pain in infancy are quite complex: First, pain sensitivity differs somewhat from other sensory modalities[14]; second, pain experience is dependent on a learning process and seems to be strongly related to the stage of cognitive development of the child.[16]

The aim of this case study was to draw attention to pain in children affected by TMJ injuries.

Case Reports

Case 1

A healthy 9-year-old boy was referred to the author's attention by his pediatrician because of a developing facial asymmetry. The mother stated that the asymmetry had become more evident over the last year. According to the boy's medical history, trauma to the mandible had occurred 18 months earlier while he was playing football with friends. On that occasion the boy had been brought to the family dentist, but as he apparently had relatively mild pain without any clinical evidence of disturbances either to dental or facial structures, no radiographic examination had been performed. The slowly developing facial asymmetry went unnoticed for many months and then suddenly was perceived as a problem.

The clinical examination disclosed a shift of the chin to the left (4 mm) with some apparent effect on adjacent areas of the maxilla (Fig 1). Opening movements were within normal limits, with a mild limitation in both protrusive (5 mm) and lateral excursions, particularly to the left (4 mm). The intraoral examination revealed a mixed-dentition stage and deviation of the upper and lower midlines (4 mm) (Fig 2).

Panoramic radiography and the posteroanterior cephalometric projection showed a markedly altered morphology of the left condyle compatible with a diagnosis of a medially dislocated and fractured condyle. A computerized tomography (CT) scan showed the medial angulation of the fractured condylar neck on the left. Remodeling of the left condyle and fossa, which were flatter than the right ones, was evident (Fig 3). Magnetic resonance imaging (MRI) also showed the altered shape and the dislocation of the condylar head and disk.

The patient was scheduled for therapy with a functional orthopedic appliance but the treatment was delayed because of family problems. After 1 year, facial asymmetry and deviation during mouth opening had worsened from 4 to 5 mm (Fig 1b). The intraoral view showed an increase in midline deviation, from 4 to 5 mm.

The patient has been scheduled for functional appliance therapy and is now in treatment.

Figs 1a and 1b *(a)* In 2002, a developing facial asymmetry with a shift of the chin toward the left side could be observed. *(b)* A year later, facial asymmetry had worsened in this patient (case 1).

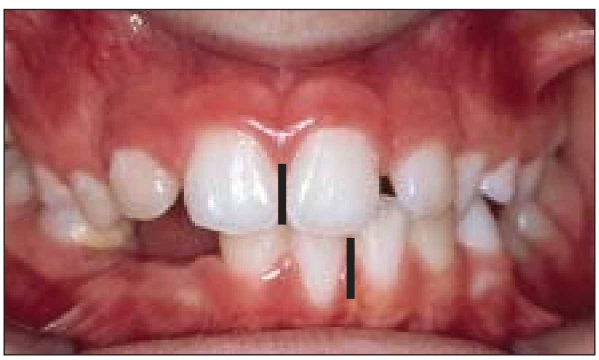

Fig 2 An intraoral view of the patient (case 1). He is at a mixed-dentition stage; there is deviation of the upper and lower midlines (4 mm). The midlines are indicated by black bars.

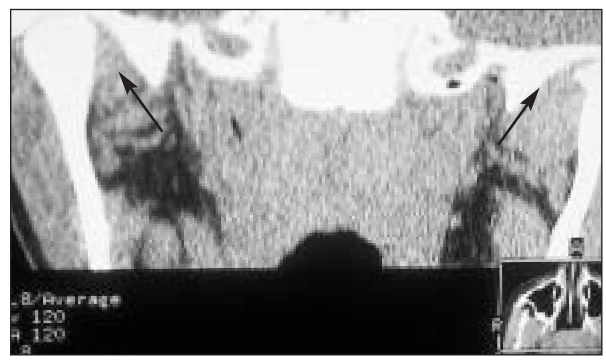

Fig 3 The CT scan in case 1 showed the medial angulation of the fractured condylar neck on the left and the remodeling of the left condyle fossa, which is flatter than the right one. The fossae are indicated by arrows.

Case 2

A healthy 8-year-old boy was referred to the author's attention by his pediatrician for clinical and radiologic examination following a facial trauma: He had fallen off his bike and hit his chin (Fig 4). The patient reported mild pain in the area of the right TMJ, particularly during mandibular movements, and a change in occlusion after the trauma.

The clinical examination showed a reduction in mouth opening (down to 22 mm) with a shift of the chin toward the right side, limitations in lateral excursions, and a remarkable open bite. Gentle palpation of the area of the right condyle elicited crepitation.

Panoramic radiography, a posteroanterior cephalometric projection, and a tomogram revealed a unilateral, medially dislocated fracture of the right condyle (Fig 5). The patient was treated with conservative methods. A soft diet and antiphlogistic drugs were recommended for a week to mitigate symptoms and to avoid adhesions between the articulating parts.[17–19] He was then scheduled for functional appliance therapy. After a year of functional orthopedic appliance therapy, no developing facial asymmetry was present, mouth opening was 40 mm, and a marked reduction of the anterior open bite was evident. An MRI scan showed remodeling of the fractured condyle; the functional unit of the disk and the condyle was preserved. Three years after the trauma, the results are very encouraging: No facial asymmetry can be noticed (Fig 4b), the occlusion is normal and stable, and MRI shows an almost perfect restoration of the right condylar shape (Fig 6). The patient is not in treatment anymore, but he is still under observation to evaluate growth and facial development.

Figs 4a and 4b *(a)* A frontal photograph showing the lesion resulting from the trauma on the boy's chin *(arrow)*. *(b)* Three years after the trauma, no facial asymmetry can be observed in the patient (case 2).

Fig 5 The tomography in case 2 shows a medially dislocated fracture of the right condyle *(arrow)*.

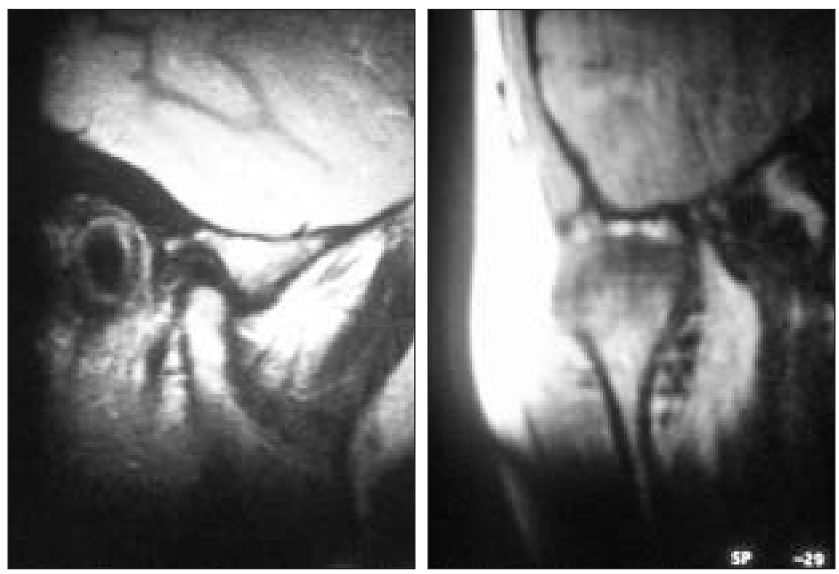

Fig 6 MRI scans in case 2 show the almost perfect restoration of the right condylar shape in both lateral and frontal views.

Discussion

The integrity and interaction of bony and soft tissue structures may be highly disturbed by injury of the TMJ. Early diagnosis of TMJ fractures is essential for the prevention of long-term functional and esthetically debilitating sequelae,[12] but such fractures are often overlooked because of the limited clinical signs and because relatively little pain may be reported by the child.[14] Adequate pain assessment in children is often difficult, and is sometimes impossible, particularly in children younger than 10 years old.[15] Failure to assess pain correctly may lead to a delay in diagnosis and treatment with possibly serious consequences for facial development.

In case 1, the seriousness of the injury was underestimated, probably because of the relative inability of the child to localize and to describe pain. Once, the common belief was that pain perception in children differed somewhat from the other sensory modalities: Whereas olfaction, hearing, and vision seemed to have specific areas of the brain that received and integrated sensorial stimulation, there did not appear to be any specific areas of the brain that received and integrated pain-producing stimulation.[20–23] Nowadays it is well accepted that pain is a multidimensional experience, but little is known of how the brain represents these dimensions.[24] Anatomic, physiologic, and lesion data implicate multiple cortical regions in the complex experience of pain, but the roles the different cortical areas play in pain processing is a controversial topic. Functional imaging studies of human subjects also have identified a diverse assortment of brain areas engaged in the processing of pain and the existence of a highly distributed, supraspinal mechanism engaged in the processing of pain intensity.[24,25]

A study by Bushnell et al[26] demonstrated that the activation of primary somatosensory cortex is highly modulated by cognitive factors that alter pain perception, including attention and previous experience. Indeed, it is not easy to explain why some individuals claim that they are very sensitive to pain, while others say that they tolerate pain well, or to determine whether such subjective reports reflect true interindividual experiential differences. A study by Coghill et al[27] that used psychophysical ratings to define pain sensitivity and functional MRI to assess brain activity revealed that highly sensitive individuals exhibited more frequent and more robust pain-induced activation of the primary somatosensory cortex, anterior cingulate cortex, and prefrontal cortex than insensitive ones did.

Pain is a complex, multidimensional phenomenon that influences a wide variety of nervous system functions, including sensory-discriminative, affective-motivational, and cognitive-evaluative components of the nervous system. Emotions have been shown to alter pain perception, but the underlying mechanism is unclear since emotions also affect attention, which itself changes nociceptive transmission.[28] For all these reasons, adequate self-report about the character, location, and intensity of pain is often unavailable in children. The result is that even serious traumas such as those involving the TMJ are often overlooked. Unfortunately, in case 1, the consequences became evident only months later, resulting in the development of facial asymmetry that was perceived as a problem both by the child and the family. The lack of growth on the injured side was due to the spontaneous healing of the displaced TMJ fracture. An ankylosis-like effect on growth is possible even though the mandible is able to move: This is due to a restriction to translate the mandible forward out of the fossa, resulting in functional limitations of the movement. When opening is restricted to only a hinge type of movement, a progressive growth deficit often occurs and results in mandibular deformity and alteration of related structures.[29,30] Even if the patient is immediately scheduled for functional appliance therapy, the results may be very disappointing. Any trauma affecting the condyle alters the normal progression of function and harmonious development of facial structures.[30] If not treated, the dysplastic patterns of growth may continue and worsen over the years. This is illustrated by case 1: In a year, the clinical situation of the patient had worsened as far as face asymmetry and occlusion were concerned. This will affect the course of development and even though the deformity may not be progressive, it may not be self-correcting, and there may be no way to compensate for lost or retarded growth.[30,31] So, in case 1, after consolidation of the mandibular dysfunction and facial maldevelopment, treatment was simply aimed at preventing further worsening during growth; full recovery is impossible.[32–34]

In case 2, adequate pain assessment and a correct clinical evaluation allowed the early diagnosis of a fracture of the right condyle. The patient was immediately scheduled for functional appliance therapy. The aim was to offer comfort while the hematomas were resolving and the tissues were recovering and to help the mandible keep a proper relation to the maxilla.[35] Furthermore, the appliance may have helped to keep the muscles functioning,[29–36] even if muscular movement was limited by pain. In this way, the restoration of proper function of the masticatory system and the prevention of mechanical restrictions created by scarring and loss of motion were promoted from the beginning of treatment.[37,38] The physiologic stability of the bony components is in fact the result of many interrelated factors, normal function being a prominent one. Facial structures have been shown in humans to be strongly dependent on the muscular balance: When the neuromuscular system is in harmony, the mandibular muscles collectively exert their effect on both position and movement of the jaw.[39,40] Alterations in function due to bone fractures may result in disturbances of dentofacial development.[12,41] For all these reasons, proper intermaxillary relationships may be essential for a correct transfer of forces through the maxilla to the rest of the cranial bones.[39] In case 2, results were very encouraging: After 2 years of treatment there was a complete *restitutio ad integrum* of both condylar dislocation and occlusion; no facial asymmetry was noticed at the end of the treatment.

The assessment of pain might be a factor in the lack of early recognition of these injuries. The age at which pain is first perceived in infancy remains an unresolved question. It was once thought that pain experience in neonates and children differed from adults—that nerves might not be able to conduct nociceptive signals before the myelinization of nerve tracts occurs. However, it is no longer believed that complete myelinization is required for nerve tracts to function.[20,42] The number and distribution of the nociceptors and nociceptive pathways in premature or newborn infants and babies should be viewed not only in the context of the future function in mature humans (ie, transmission and modification of information), but also as important factors in the maturation of neuronal pathways and synapses and in the differentiation of the neuronal cells themselves.[23]

Pain perception modalities and the stage of cognitive development related to the age of the child are 2 other important factors to consider.[20,21] The theories of Jean Piaget are useful in considering cognitive development in children: He has suggested that pain goes through a series of systematic stages during a child's cognitive development.[16] The first stage is a preverbal sensorimotor stage spanning the first 18 to 24 months of life. This is followed by a period of conceptual intelligence that lasts for the remainder of life. The conceptual intelligence period is divided into 4 stages: the preconceptual stage (age 2 to 4 years), the intuitive stage (age 4 to 7), the concrete operational stage (7 to 11), and the formal operation stage (11 and beyond).

Children aged 2 to 7 are increasingly able to describe characteristics of their pain to caregivers. In the early stages of conceptual intelligence (age 2 to 7), the child's world is very ego-centered.[43] His or her view of the world is animistic and artificialistic, and he or she cannot distinguish what is real from what is not real. The descriptions of pain made by children during these stages reflect this developmental level: Only salient aspects of a problem or a single feature of a multifaceted experience is emphasized in the child's perception. If the child hurts him- or herself by bumping a door, for example, the child may hit the door so that it hurts also.

The 7- to 12-year-old child is in the period of concrete operations and cognitive development.[43] In this period, the child's thinking is more stable and reasonable and he or she can understand many cause-and-effect relationships. With this knowledge, the child can understand that specific procedures cause pain. At the end of this stage and at the beginning of the formal operational stage (11 and beyond), a child is able to express pain much as an adult would. Children aged 10 years and older seem adept at pain localization and description.[44]

Pain is a complex, multidimensional experience that varies in quality, strength, duration, location, and unpleasantness; it may be most reliably assessed by methods that combine behavioral, physiologic, and self-report measures.[16] Behavioral and physiologic indices of pain can be useful but may also be nonspecific and misleading: For example, tachycardia, typically seen in patients experiencing pain, may also be a physiologic response to fear or distress. Furthermore, psychological factors, such as the situational and emotional factors that exist when we experience pain, can profoundly alter the strength of pain perceptions.[28,45,46] In anxiety-provoking situations, children may frequently regress to an earlier, more comfortable level of behavioral functioning: A child who under normal circumstances could verbalize where he or she hurts, may lose the ability to do so when anxious.

The conclusion is that the intensity and unpleasantness of pain are neither simply nor directly related to the nature and extent of tissue damage. Furthermore, even when children say they are uncomfortable or want their parents, they do not often relate this unhappiness to pain, but to a kind of psychological need for support.[46] Consequently, the understanding of pain requires not only understanding of the nociceptive system but also recognition and control of the many environmental and psychological factors that modify human pain perceptions.[28,45–47]

Conclusions

For the aforementioned reasons, in case of facial trauma, the clinical history of the patient must be evaluated very accurately and overall clinical conditions must be carefully examined, no matter how the mild pain or how asymptomatic the traumatized area may seem. Often, there is a diagnostic dilemma, especially when the clinical findings are not clear, since a thorough clinical examination and normal occlusion do not rule out condylar head fracture. So, though it can be difficult to obtain satisfactory radiographs, a radiographic examination is highly recommended in all cases of facial trauma. Radiographs can contribute to the diagnosis but in many cases are inconclusive, difficult to interpret, and of limited value. When clinically possible, pantomograms and CT scans are highly recommended, particularly in cases in which temporal or facial bone trauma is suspected, as they may enable detection of fractures and osseous cortical abnormalities that might be missed on TMJ radiographs.

After a diagnosis has been made, appropriate treatment of the patient is essential to avoid or at least limit the consequences to facial development. Complete regeneration of the condyle following fractures is not uncommon in young patients as the result of a remodeling process, with no residual deficiency in function and growth.[48,49] Better regeneration occurs in actively growing patients under the age of 12. The follow-up of these patients must cover the entire period of growth during the mixed-dentition stage until the permanent occlusion has become stable.

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