Post-traumatic TMJ internal derangement: impact on facial growth (findings in a pediatric age group)

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Many clinical studies have shown how jaw injuries sustained during impact trauma to the face or mandible are the single most important cause of TMJ subsequent internal derangement. Proper function of the masticatory system is certainly the most influential variable in the TMJ remodelling; once a TMJ is internally deranged, adaptative or degenerative osteocartilagineous processes take place in the mandible, temporal bones and muscles. To evaluate relationships between consequences of post-traumatic TMJ internal derangement and disturbed facial skeleton growth in children, 25 patients (16 boys, 9 girls), 14 year of age or younger, were selected out of a group of 74 and analysed. They all had been treated by physiotherapy and had undergone combined clinical and radiographic examination for five years. Symptoms included, either individually or in various combination, pain, mechanical TMJ dysfunction and facial skeletal abnormalities, such as mandibular retrognathia and lower facial asymmetry manifested by chin deviation from the midline. Seventeen patients were found to have at least one abnormal and internally deranged TMJ on imaging studies; in twelve of them a mandibular asymmetry with chin deviation from the midline to the smaller or more degenerated TMJ was evident. Of the eight retrognathic patients, five were found to have bilateral TMJ derangement. In three patients both TMJ(s) were normal with normal facial structure.

These data suggest that TMJ derangement in children may potentially have an impact on facial growth and lead to the development of retrognathia, with or without asymmetry, in many cases.
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INTRODUCTION

Previous reports have identified jaw injuries sustained during impact trauma to the face or mandible as the single most important cause of temporomandibular joint (TMJ) subsequent internal derangement.[1-7] Fractures of the mandibular condyle have been shown to result in skeletofacial deformity and TMJ derangement.[2-9] MR imaging have contributed substantially to our understanding of joint anatomy, physiology and pathology.[10,11] Katzberg reported a causal relationship between pediatric TMJ derangement and subsequent facial deformity in a clinical study of 34 children with arthrography.[10]

Proper function of the masticatory system is certainly the most influential variable in the TMJ remodelling; once a TMJ is internally deranged, adaptative or degenerative osteocartilagineous processes take place in the mandible, temporal bones and muscles.[1,8,12] If the structural changes in the TMJ(s) and the facial skeleton are slow, teeth may adapt resulting in the display of retrognathia and/or facial asymmetry with good occlusion; alternatively, rapid TMJ degeneration may outpace dental adaptation and lead to malocclusion. Disturbances in the harmonic interplay of the masticatory muscles cause further deviation of the mandible towards the affected side when the patient opens his mouth wide, as well as limitation of lateral excursions towards the unaffected side.

The aim of the study was to investigate the impact of post-traumatic internal derangement on facial growth in children.

MATERIALS AND METHODS

Seventy-four (74) traumatized patients 14 year of age or younger (mean age: 5.7; range: 2 to 9 at the time of injury) were selected for study. All reported a history of major injury to the face, mandible and/or facial structures resulting in post-traumatic symptoms, but none of them had been treated orthodontically after the trauma. Symptoms ranged from pain to mechanical dysfunction

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Table 1. RADIOLOGICAL STAGES OF TMJ DERANGEMENT[11,13,14]

STAGE	RADIOLOGIC FINDINGS
0	normal anatomy
1	- disk displacement - normal disk structure - moderate bone remodelling
2	- disk displacement - disk deformity - disk reduction - bone remodelling
3	- severe disk degeneration - definite bone remodelling

Table 2. CLINICAL CRITERIA FOR FOLLOW-UP EVALUATION

Clinical findings	Range of movement (0)	Good (1)	Satisfactory (2)	Poor (3)
Ability to open the mouth	40 mm	30-40 mm	20-30 mm	<20 mm
Deviation of mandibular mid line in central occlusion	0-1 mm	2-3 mm	3-4 mm	> 4 mm
Deviation of midline during mouth opening	0-2 mm	3-4 mm	4-5 mm	>5 mm
Protrusive normal excursion	10-12 mm	10-8 mm	8-6 mm	< 6 mm
Lateral normal excursion	8-12 mm	8-6 mm	6-4 mm	< 4 mm
Noises in joint	none	existing	existing	existing

(clicking, masticatory dysfunction) and facial skeletal abnormalities (facial dysmorphology, malocclusion). All the patients examined had been treated by physiotherapy after the injury with a specific treatment protocol (muscle exercises and control of posture and oral habits) and for a variable period duration (16-24 weeks); all had denied any history of previous TMJ problems, orthodontic treatment or TMJ surgery at the moment of the visit.

All the children were scheduled for a specific follow-up program to evaluate symptoms, masticatory function and facial development. They were monitored clinically and radiologically six and twelve months after the trauma and were subsequently routine check-up once a year for the following five years.

Forty-eight of them had had a bicycle accident, nineteen had sustained direct blows to the jaw while playing with friends, four had been hit in the mandible while playing football, two had fallen downstairs hitting their chin and one had been kicked in the jaw by a horse. Thirty-seven had suffered from unilateral and twenty-four from bilateral TMJ fractures. In forty-five cases, condylar fractures were not dislocated, in sixteen they were. Thirteen patients showed fractures of the body of the mandible and of the zygomatic bone, with TMJ intra-articular bone fracture.

Out of the group of the 74 patients selected, eight moved to other towns and interrupted the follow-up program and nineteen refused to be included in it because of fear of extra radiation exposure. Twenty-two children poorly cooperated with the program, cancelled many appointments and, when recalled, did not come. Twenty-five patients (16 boys, 9 girls) properly cooperated and were selected for study. Out of the selected patients, nineteen had suffered from unilateral TMJ fractures, and six from bilateral ones. Among the patients belonging to the first group, sixteen exhibited no dislocated fracture, and three dislocated ones. Among the people belonging to the second group, five showed dislocated TMJ fractures and one did not.

Before imaging, each patient was evaluated with a detailed history and a physical examination and then imaged with screening panoramic radiography, latero-lateral and postero-anterior cephalometric projections, closed and open mouth lateral TMJ tomograms, MR and TC scan.

All the patients completed a simple questionnaire (with parental assistance) concerning the presence and duration of pain, pain in the ear, headaches, mechanical dysfunction (TMJ clicking, limitations in jaw movements), occlusal disturbances and alterations in facial appearance. All patients were referred to an outpatient imaging center for TMJ imaging studies to evaluate suspected TMJ internal derangement because of the symptoms referred. Each of them underwent MR imaging of both TMJs and masticatory muscles. TC scans were performed in all cases.

All imaging studies were interpreted by diagnostic radiologists experienced in TMJ imaging. Specific notes were made in each case of the presence or absence and radiologic stage of TMJ internal derangement[11,13,14] (Table 1).

The patients were evaluated by dental clinicians blinded to both therapy and results. The standardized clinical examination included palpation, auscultation of the TMJ and assessment of the range of mandibular movements (Table 2)

RESULTS

Radiographic findings included skeletal abnormalities such as retrognathia, anterior open bite, mandibular alterations in size and symmetry and modification in condylar size and structure (Table 3).

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Table 3. RESULTS

STAGING	NUMBER OF PATIENTS	SYMPTOMS	IMAGING STUDY RESULTS
0	3	none	normal TMJ(s)
1	5	- recurrent headaches - occasional ear pain	- one TMJ deranged
2	9	- facial asymmetry - chin deviation - good occlusion	- one TMJ deranged - TMJ remodelling
	3	- retrognathia - facial asymmetry - chin deviation	- one TMJ deranged - TMJ remodelling
3	5	- retrognathia - deformity of jaw	- TMJ derangements - TMJ remodelling

Consequences after trauma included symptoms ranging from inflammatory (pain) to mechanical (clicking, masticatory dysfunction) and structural (facial dysmorphology, malocclusion). Pain, ear pain and headaches were occasional and non specific and did not constitute the predominant complaint, while developing face asymmetry and mechanical dysfunction did. TMJ derangement(s) was almost invariably noticed in cases of severe retrognathia or lateral asymmetry. Bilaterally dislocated TMJ fractures were always associated to mandibular hypoplasia and symmetric deformity of the jaw, while unilateral ones were associated to retrognathia and mandibular asymmetry.

In three patients both TMJs were normal, with normal facial structure (stage 0**)**.

Five patients reported recurrent headaches, occasional ear pain with joint clicking on the injured side and moderate reduction in mouth movements **(**stage 1). No facial alteration was present. On imaging studies one internally deranged TMJ was present with simple meniscus displacement and normal disk structure (Figure 1).

Nine children, exhibited evident asymmetry of the jaw with chin deviation to the affected side and good occlusal relationships. Limitation in mouth movements due to limited function of the affected TMJ and joint clicking (stage 2) were present. Disk displacement and deformity with remodelling of the injured condyle were evident on imaging studies (Figure 2).

Three patients showed an evident retrognathia with mandibular asymmetry, manifested by chin deviation from the midline and limitation in mouth movements (stage 2). Imaging studies revealed displacement and deformity of the meniscus with condylar remodelling (Figure 3).

Five children exhibited decreased mandibular growth with evident retrognathia with progressive deformity of jaw and face and limitation in mouth movements (stage 3).

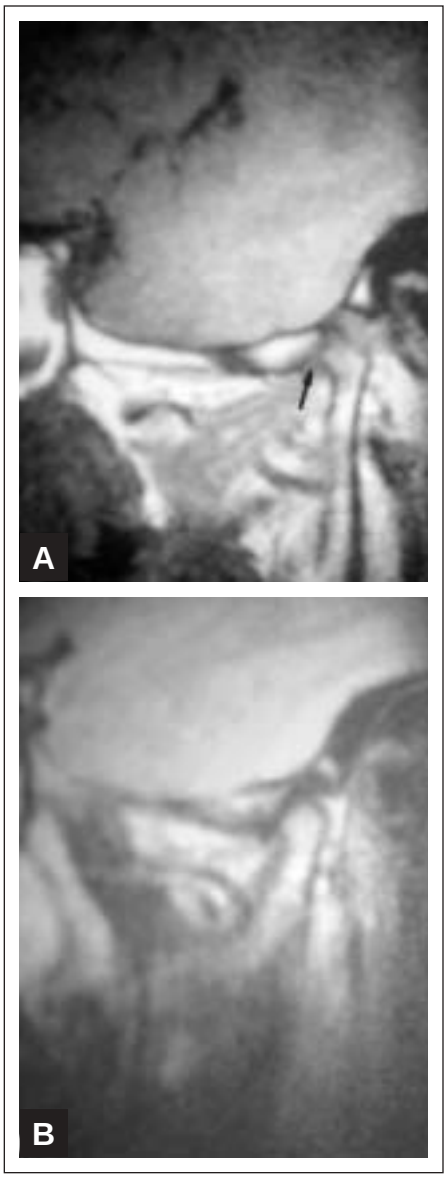

Figure 1. Early stage (stage 1) TMJ derangement in 10-year-old girl with normal occlusion, normal facial structure, joint clicking and episodic "ear pain". **A,** Closed-mouth image reveals a very light forward displacement of the meniscus on the left (arrow) and **B,** Open-mouth image shows moderate reduction in sagittal excursions.

Bilateral TMJ derangements with bone remodelling and disk degeneration were evident on imaging studies (Figure 4).

Main complaint: mechanical dysfunction and facial asymmetry. Pain, ear pain and headaches were occasional and non specific.

DISCUSSION

Unfortunately an unknown percentage of people affected by traumatic lesions of the TMJ (fractures, contusions, etc) develop a TMJ internal derangement with symptomatic alterations in mandibular functions and movements.[15-17]

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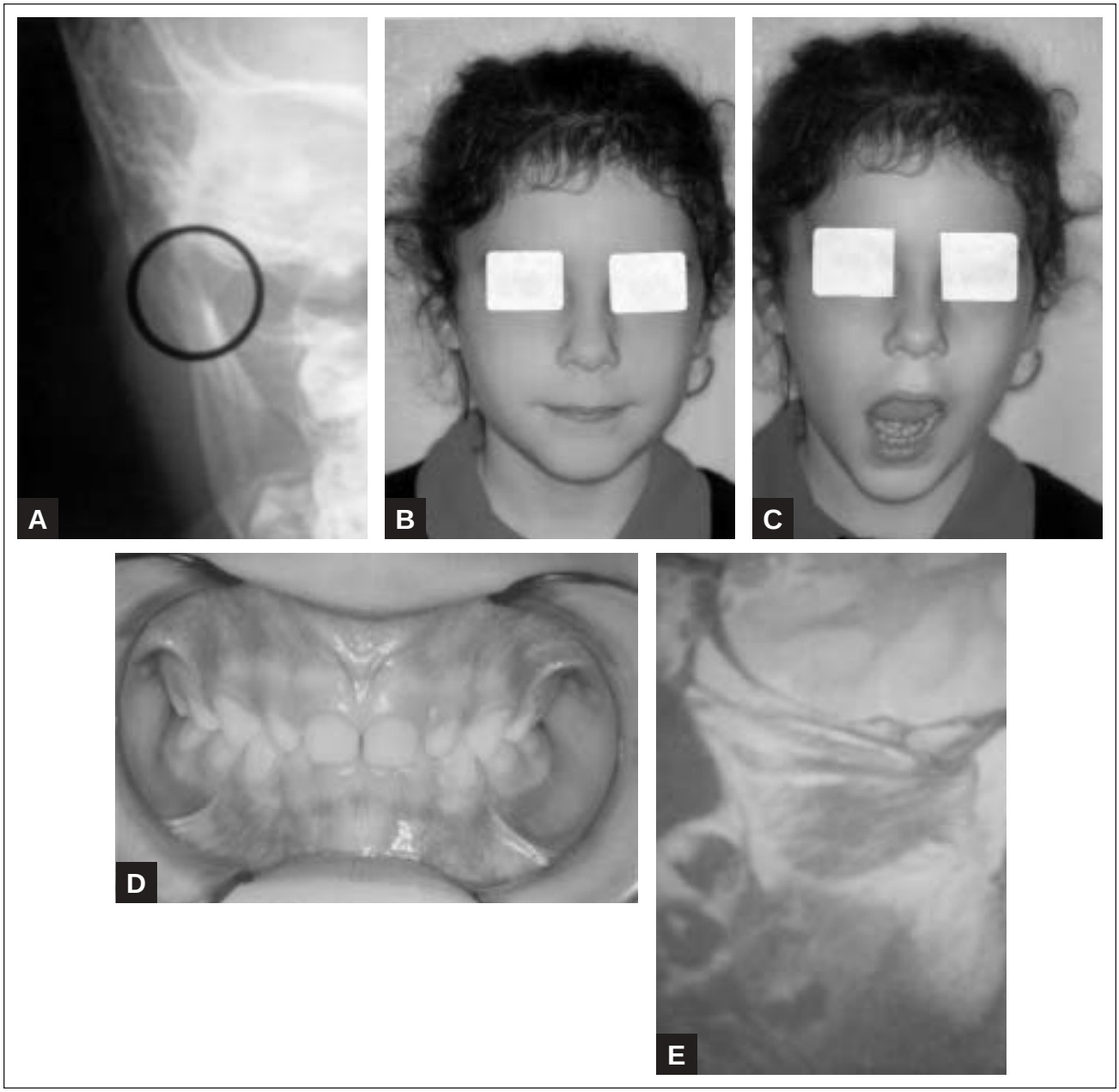

Figure 2. Intermediate stage (stage 2) TMJ derangement in 8-year old girl suffering from **A,** right, intra-articular bone fracture and ipsilateral TMJ clicking **B,** Frontal photograph: the asymmetry of the jaw with mild chin displacement towards the injured joint and **C,** the chin deviation to the affected side during mouth opening are evident. **D,** Intraoral view showing good occlusal relationships **E,** Closed-mouth imaging reveals anterior displacement of the meniscus and moderate bone remodelling.

The clinical incidence, significance and long-range consequences of injuries to the TMJ are underestimated. In a clinical study, trauma preceded the clinical onset of symptoms in 42.5% of the patients examined with proved internal derangement of the TMJ.[1]

The consequences of the acute trauma may be torn ligaments or capsule, intra-articular bone fracture, soft tissue lesions with effusion or hemorrhage in the joint space, dislocation (luxation) and fracture, each separately or in combination. This invariably causes a traumatic arthritis characterised by resting pain, pain on movement and reduced mobility of the TMJ owing to the traumatic arthritis. Some of these injuries may resolve leaving the joint normal or with a predisposition to later deleterious changes. It is important to investigate and to document the existence of post-traumatic inflammatory TMJ arthropathy because of the potential injurious effects of untreated, under going joint inflammation and meniscus derangement.[13] Inflammation, manifested radiologically by joint effusion and soft-tissue swelling, is often associated with meniscus derangement, joint adhesion, pain, and

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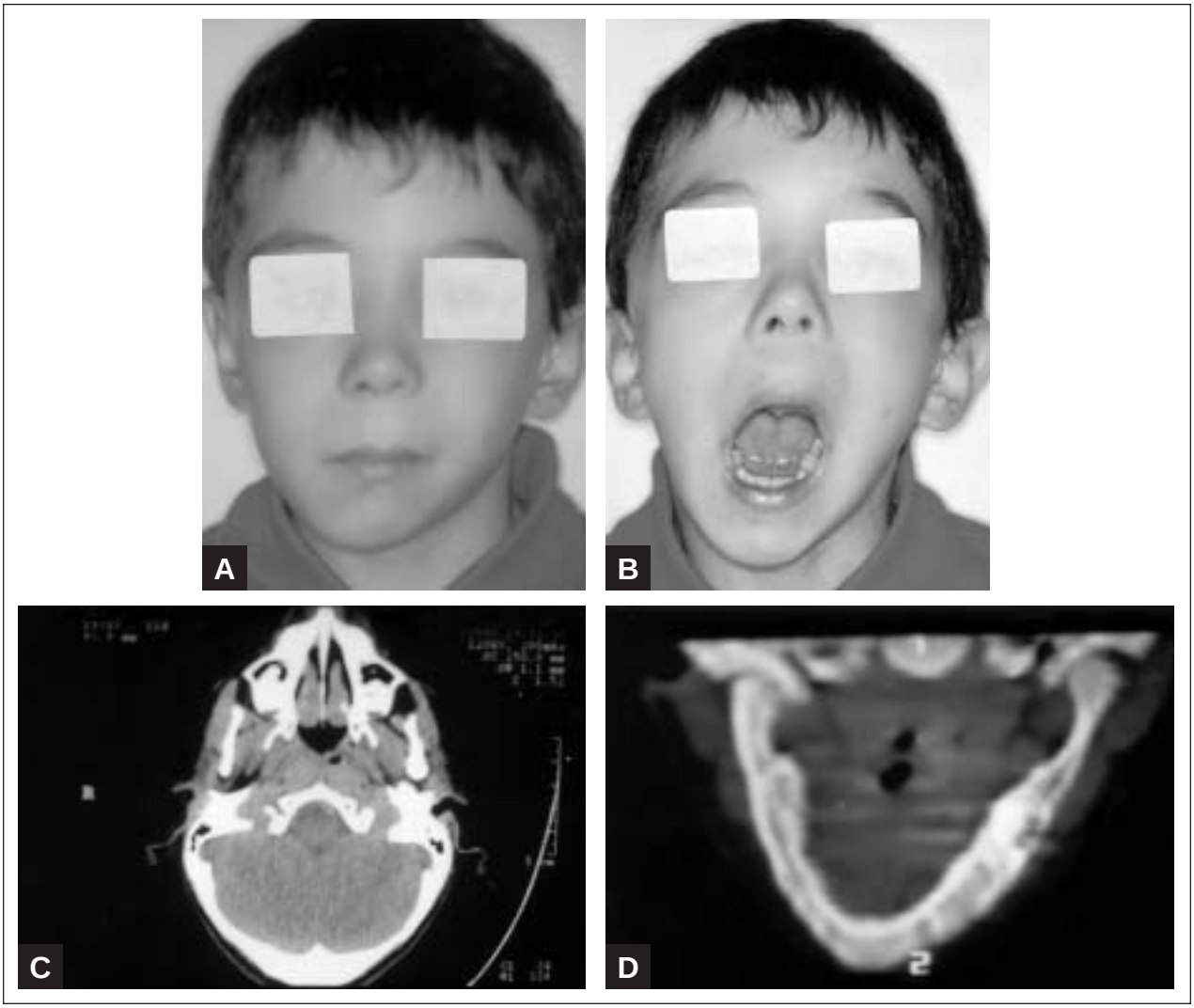

Figure 3. Intermediate stage (stage 2) TMJ derangement in 5-year-old boy with progressive worsening asymmetric retrognathia and joint clicking **A,** Frontal photograph: the developing face asymmetry is evident **B,** Chin deviation to the affected side during mouth opening is present **C,** TC scan: the remodelling of the right condyle and **D,** the asymmetrical development of the mandible are evident.

occlusal disturbances.[16] Clinical episodes of inflammation, induced or aggravated by the meniscal derangement, add insult to the disk and synovial tissues, often resulting in the formation of dense fibrous adhesions between the meniscus and the adjacent joint structures and further compromising function.[1,11,13,14]

Jaw injuries during childhood likely play a role in the pathogenesis of joint derangement;[1] after injuries of sufficient magnitude, progressive joint degeneration may occur and lead to clinical disability.[1,14] Study of TMJ dysfunction in children are important to determine whether early problems predispose patients to craniofacial growth abnormalities and/or mandibular dysfunction in adulthood. We have noted that children with severe retrognathia and mandibular asymmetry usually have advanced degrees of TMJ derangement with characteristic skeletal shifts towards the deranged joint.

Previous clinical studies predating MR imaging have shown a definite relationship between mandibular condyle dysmorphology, TMJ derangement and facial skeleton abnormalities.[18,19] Recent MR investigation demonstrate a causal relationship between TMJ derangement and secondary facial skeleton remodelling or disturbed growth.[14,20-22] Patients have been observed longitudinally to develop retrognathia, unstable occlusion disturbances and mandibular asymmetry after development of proven TMJ derangement and osseous degeneration.[18,24]

According to some authors, in the growing facial skeleton, internal derangement of the TMJ(s) disk(s) either retards or arrests condylar growth: this results in decreased vertical dimension in the proximal mandibular segment(s) with ultimately mandibular deficiency or asymmetry.[8,10] Sometimes in children with bilateral joints degeneration it is possible to observe

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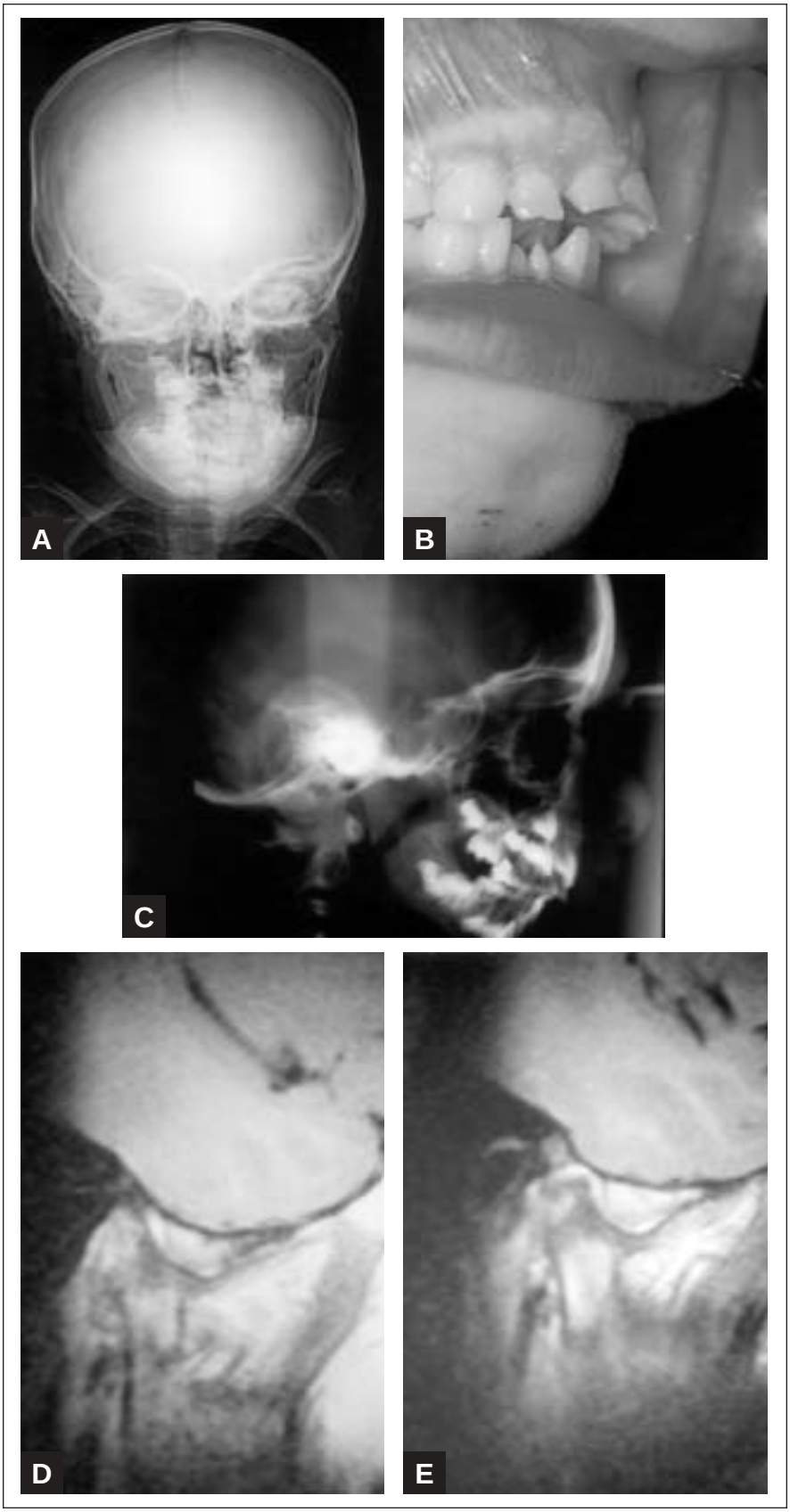

Figure 4. Bilateral late stage (stage 3) TMJ derangements in 9-year-old boy with progressive worsening retrognathia, anterior open bite, functional limitation in mouth movements and bilateral joint clicking **A,** Postero-anterior cephalometric radiograph showing a bilateral TMJ fractures and the medial dislocation of the condyles (arrows). **B,** Intraoral view showing the anterior open bite. **C,** Lateral cephalometric radiograph showing retrognathia and open bite, **D,** Closed-mouth images of right TMJ reveal anterior displacement and degeneration of the meniscus and a deformed condyle **E,** views of opposite (left) joint (both joints imaged simultaneously) reveal a deformed condyle.

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an arrest or a regression in proximal mandibular segments, with a possible development of a progressive anterior open bite leading to elongation of anterior facial dimension.[25]

SUMMARY

The role of TMJ derangement in facial maldevelopment deserves further investigation. The relations between joint injuries, internal derangement of the TMJ and skeletal occlusion disturbances merits consideration: unstable occlusion is a commonly observed consequence of TMJ derangement, particularly when the joint is inflamed.[1,4,14] Any process, including fractures, that results in sudden changes in vertical dimension within either the joint space or the mandibular condyle, or the condylar neck, can cause alterations in skeletal occlusion. Slow, incisial changes of vertical dimension are usually compensated for by dental adaptation, such as intrusion, eruption and migration of teeth. More rapid changes in the joint may exceed the capacity of dental adaptation resulting in occlusal disturbances.[21]

Trauma to the mandible and facial bones is the most common cause of radiologically demonstrable masticatory muscle alteration.[24] Direct injuries may result in muscolo-tendinous tear, contusion, changes in muscle length and inflammation, often leading to muscolo-skeletal dysfunction. Fractures commonly result in alterations of muscle length, which affects coordinated movements of paired groups such as the masticatory and spinal musculature.[25] Both acute and late masticatory muscle disorders should be considered, and imaging should be performed in patients who have suffered traumatic injury to the craniomandibular apparatus. When clinically possible, performing of tomograms and MR is highly recommended as they may enable detection of fractures and osseous cortical abnormalities that might escape detection at TMJ radiograms. TC should be considered in cases in which temporal or facial bone trauma is suspected.

CONCLUSION

In conclusion, these data suggest that injuries to the face, mandible and TMJ may result in significant intracapsular soft-tissue and osseous derangement, progressive joint degeneration and clinical disability leading to alterations in mandibular growth and potential development of asymmetries and/or malocclusions. These cases must be carefully diagnosed, treated and monitored to evaluate facial development and occlusion.

REFERENCES

1. Wilkes CH. Internal derangement of the temporomandibular joint: pathologic variations. Arch Otolaryngol Head Neck Surg 115: 469-77, 1989.
2. McGuirt WF, Salisbury PL III. Mandibular fractures: their effect on growth and dentition. Arch Otolaryngol Head Neck Surg 113: 257-261, 1987.
3. Norman JE. Post-traumatic disorders of the jaw joint. Ann R Coll Surg Engl 64: 27-36, 1982.
4. Moss KF, L-Attar A. Ten years of mandibular fractures an analysis of 2137 cases Oral Surg 59: 120-129, 1985.
5. Proffitt WR, Vig KWL, Turvey TA. Early fracture of the mandibular condyles: frequently an unsuspected cause of growth disturbances Am J Orthod 78: 1-24, 1980.
6. Leake D, Doykos J, Mautaz *et al*. Long-term follow-up of fractures of the mandible condyle in children. Plast Reconstr Surg 47: 127-131, 1971.
7. Lindahal L, Hollender L. Condylar fractures of the mandible. A radiographic study of remodelling processes in the temporomandibular joint. Int J Oral Surg 6: 153, 1977.
8. Schellhas KP. Temporomandibular joint injuries. Radiology 173: 211-6, 1989.
9. Schellhas KP. Internal derangement of the temporomandibular joint: radiology staging with clinical, surgical and pathologic correlation. Magn Reson Imaging 7: 495-515, 1970.
10. Katzberg RW, Tallents RH, Hayakawa K, Miller TL, Goske MJ,Wood BP. Internal derangement of the temporomandibular joint: findings in he pediatric age group. Radiology 154: 125, 1985.
11. Schellas KP, Wilkes CH, Fritts HM, Omlie MR, Heithoff KB, Jahn JA. Temporomandibular joint: MR imaging of internal derangements and postoperative changes. AJR 150: 381-389, 1988.
12. Schellhas KP, Piper MA, Omlie MR. Facial skeleton remodelling due to temporomandibular joint degeneration: an imaging study of 100 patients. Am J Roentgenol 155: 373-83, 1990.
13. Schellas KP, Wilkes CH. Temporomandibular joint inflammation: comparison of MR fast scanning with T1-and-T2-weight-ed imaging techniques AJR 153: 93-98, 1989.
14. Schellhas KP, Wilkes CH, Fritts HM, Lagrotteria LB, Omlie MR. MR of osteochondritis dissecans and avascular necrosis of the mandibular condyle. Am J Roentgenol 152: 551-60, 1989.
15. Moses JJ, Topper DC. A functional approach to treatment of temporomandibular joint internal derangement. J Craniomand Disord Facial Oral Pain 5: 19-26, 1991.
16. Razook SJ, Gotcher JE, Bays AR. Temporomandibular joint noises in infants: review of the literature and report of cases. Oral Surg Oral Med Oral Pathol 6: 658-663, 1989.
17. Mintz SS. Craniomandibular dysfunction in children and adolescents: a review. Cranio 11: 224-311, 1993.
18. Katzberg RW, Keith DA, Guralnick WWC, Manzione JV, Ten Eick WWR. Internal derangement and arthritis of the temporomandibular joint. Radiology 146: 107-12, 1983.
19. Raustia AM, Pirttiniemi P, Pyhtinen J. Correlation of occlusal factors and condyle position asymmetry with signs and symptoms of temporomandibular disorders in young adults. J Craniomand Pract 13: 152-156, 1995.
20. Schellhas KP, Keck RJ. Disorders of skeletal occlusion and temporomandibular joint disease. Northwest Dent 68: 35-42, 1989.
21. Schellhas KP. Unstable occlusion and temporomandibular joint disease. J Clin Orthod 23: 332-7, 1989.
22. Rao VM, Barbaria A, Manoharan *et al*. Altered condylar morphology associated with disc replacement in TMJ dysfunction: observations by MRI. Magn Reson Imaging 8: 231-5, 1990.
23. Nickerson JW, Moystad A. Observations on individuals with radiographic bilateral condylar remodelling. J Craniomand Pract 1: 21, 1982.
24. Schellas KP. MR of muscle of mastication. AJNR 10: 829-837, 1989.
25. Schellas KP, Piper MA, Bessette RW, Wilkes CH. Mandibular retrusion, temporomandibular joint derangement and orthognathic surgery planning" Plast Reconstr Surgery 1992.

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