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Morphological occlusal features following condylar fractures in children

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SUMMARY Early fracture of the mandibular condyles may be related to an asymmetric morphologic occlusion. The aim of the study was to investigate the morphologic occlusal symmetry of non-surgically treated children after condylar fractures. The original study group consisted of 55 subjects (31 males and 24 females) who suffered temporomandibular joint condylar fractures at a young age and were treated conservatively, with physiotherapy only. Thirty-two of the respondents who were injured at a mean age of 6.5 years (range 9 months–12 years) comprised the study group. Their occlusion was re-examined intra-orally as well as on study models, at the mean age of 10.5 years (range 2.8–20.7 years). Of these, 21 suffered unilateral and 11 bilateral condylar fractures. The control group comprised a random population of 705 school children. The chi-square test was used for statistical comparison.

The general distribution of occlusal patterns (Angle) differed significantly in the study group and in the controls. From the asymmetric occlusal features, only the lower midline deviation was found to be slightly more prevalent in the injured group, with almost perfect coincidence of the side of the fracture and the direction of the lower midline deviation. No significant differences were found in the distribution of posterior crossbite, anterior crossbite, and Class II subdivision in the two groups. Among children who experienced condylar fractures, a higher prevalence of malocclusion was diagnosed; the most prominent asymmetric trait was lower midline deviation coinciding with the side of the unilateral fractured condyle.

Introduction

An asymmetric morphologic occlusion may be related to several conditions, such as early fracture of the mandibular condyles (Proffit *et al.*, 1980; Proffit and Fields, 2000), functional shift (Ben-Bassat *et al.*, 1993; Brin *et al.*, 1996; Sonnesen *et al.*, 1998, 2001b; Sonnesen and Bakke, 2007), faulty body posture (Solow and Sonnesen, 1998; Sonnesen *et al.*, 2001a, 2007; Motoyoshi *et al.*, 2002; Ben-Bassat *et al.*, 2006), as well as local factors such as missing teeth (Pedersen *et al.*, 1978). Facial trauma resulting in diagnosed (Lund, 1975) and undiagnosed mandibular fracture (Proffit *et al.*, 1980; Regev *et al.*, 2002; Defabianis, 2003) has been described as an aetiological factor for facial skeletal asymmetry.

The treatment modalities for temporomandibular joint condylar fracture vary from open reduction to physiotherapy only and depend on the type and severity of the fracture, timing of diagnosis and treatment, and the surgeon's experience. However, little is known about the occlusal manifestations (Holan, 1998) following early diagnosed and treated jaw fractures (Hovinga and Stegenga, 1999). It was the purpose of this study to clinically evaluate the dentition of a group of children who suffered condylar fracture and were treated conservatively following the trauma. The null hypothesis tested was that there is no difference in the occlusion of children after non-surgically treated condylar fractures and between children that had not suffered fractures.

Subjects and methods

This research was carried out following the Helsinki Criteria and approved by the Human Subject Commission of the Hadassah Medical Center.

The original study group consisted of 55 subjects (31 males and 24 females) presenting at the Oral and Maxillofacial Surgery Department at the Hadassah Medical Center between 1995 and 2004 due to chin trauma who were diagnosed with condylar fractures. Their age at the time of injury ranged between 9 months to 12 years. The children were followed-up by one surgeon (ER). All presented with mild clinical signs and symptoms (i.e. pain and limited mouth opening) and their occlusion at the time of injury was recorded as appropriate for their age and dental developmental stage. In all cases, the fractures were diagnosed by a computed tomographic scan (Figure 1). All fractures were either type VI (intracapsular) or type I (greenstick). All patients and parents were given instructions for self-physiotherapy, which included symmetric mouth opening and closing to their stable occlusion as well as lateral excursions. In the first 3 months post-injury, the children were seen once a week and then

monthly for the first year. After that, they were seen once every 3–6 months. Mouth opening, lateral excursions, occlusion, and facial symmetry were examined at each visit.

For the purpose of this study, all children were recalled for a follow-up examination, after a mean period of 4 years (range 0.5–9 years) post-injury, and 36 responded (65.5 per cent; Table 1; Figure 2). The dropouts were caused mainly by lack of communication (changed addresses or telephone numbers) and in a few cases by lack of interest on the part of the parents.

The occlusion of the children was evaluated clinically by an orthodontist (IB) as to Angle classification and the following asymmetric morphologic occlusal features: midline deviations (measured in millimetres), crossbites, and Class II subdivisions. Carious lesions, crowding, or early extractions, which could possibly affect the original dental relationships, were also recorded.

Of the 36 respondents, 11 had undergone or were undergoing orthodontic treatment. The pre-treatment records of seven patients were obtained from their orthodontists. The other four patients were excluded from the study. The final study group therefore consisted of 32 participants, 22 males and 10 females. Twenty-five underwent a clinical examination. For 17, study models were also taken, while for the remaining eight, the impressions were not attempted either due to their very young age or due to their lack of cooperation. The occlusion of the seven orthodontically treated children was determined on the pre-treatment orthodontic study models. Twenty-one subjects in the final study group had suffered unilateral and 11 bilateral fractures of their mandibular condyles.

The examined group was compared with a control group of school children (Ben-Bassat *et al.*, 1997) at the age of 6–13 years. For evaluation of the morphologic occlusion, only those without loss of mesio-distal tooth material (by caries or extractions) were included ($N = 705$). This group

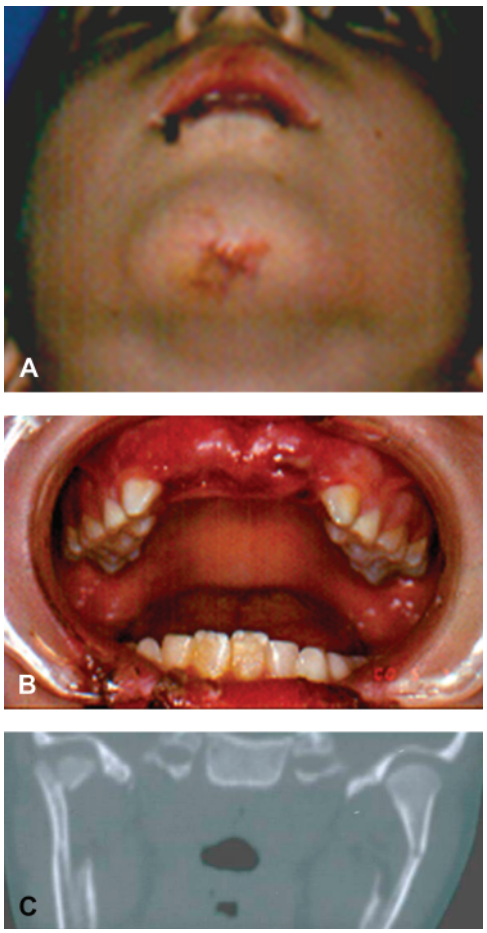

Figure 1 Clinical photographs and computed tomographic scan of a patient in this study. (A) Chin injury. (B) Intra-oral view after avulsion of the primary maxillary incisors. (C) Computed tomographic scan demonstrating condylar fracture.

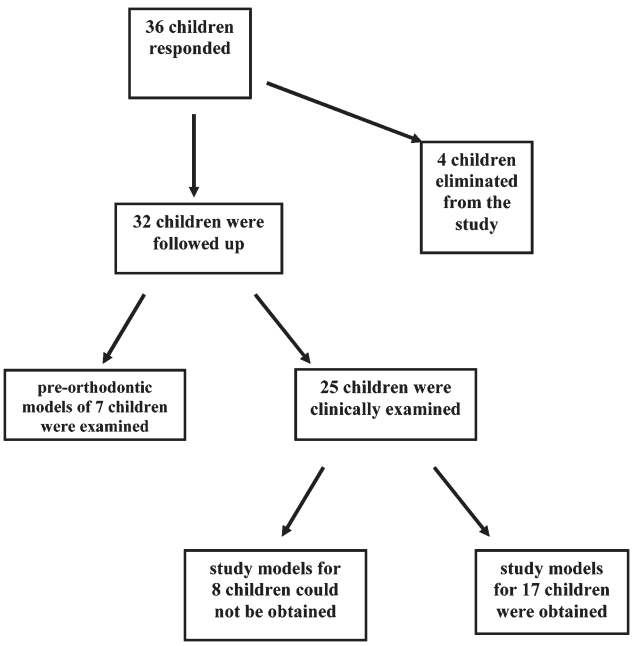

Figure 2 Composition of the study group.

Table 1 Demographic details of the study group.

Study group	Age at injury (years)			Age at follow-up (years)			Clinical follow-up only	Study models at follow-up	Pre-orthodontic study models
	Mean	Median	Range	Mean	Median	Range			
$N = 32$	6.5	7	0.75–12	10.5	10.9	2.8–20.7	$n = 8$	$n = 17$	$n = 7$

was previously clinically examined by two of the authors (YBB and IB) utilizing the same examination form.

The clinical findings were confirmed by evaluation for all subjects for which both study models were available and a clinical examination was carried out. Thus, the clinical examination alone or study models alone could be justified.

For statistical comparison of the categorical variables, the chi-square test was used. Due to the relatively small study group and the wide range of their chronological ages, it was not possible to analyse the results by age and gender.

Results

The general distribution of the malocclusion types according to Angle was different from that of the control group (Table 2; P = 0.048). The clear indication of asymmetry in this classification is the subdivision Class. Although a higher prevalence of this Class was found in the study group, this difference was not statistically significant (Table 3).

Examination of the other asymmetric occlusal characteristics (Table 3) revealed significantly more mandibular midline deviations in the study group (P = 0.033). A mean deviation of 1.5 mm was equally distributed between the right and left sides (Table 4).

Coincidence of the side of fracture and the direction of the lower midline deviation was almost perfect (Table 4). In all cases of a unilateral fracture and lower midline deviation (except for one), the deviation was towards the fractured side and in the bilateral cases, the distribution of right and left deviation was equal. No significant differences between the groups were found regarding crossbites or upper midline deviations.

Discussion

The response rate to the follow-up examination was acceptable (65.5 per cent) and similar (Smets *et al.*, 2003) or higher than in other studies (33.8 per cent, Markey *et al.*, 1980; 27 per cent McGuirt and Salisbury, 1987). In spite of this, the study group, which finally consisted of 32 patients was small. Nevertheless, since reports on occlusal follow-up after early detected and treated condylar fractures are rare, it is an important study group. In addition, the sample is unique in that all patients were treated and monitored post-trauma by one surgeon and examined at the follow-up visit by one orthodontist. A possible bias in the study group may result from the fact that the children with more severe occlusal and/or facial features would be more eager to respond to the recall examination.

A random group of children was used as the controls (Ben-Bassat *et al.*, 1997). Ideally, for such a study, an additional control group should also include children with similar injuries left untreated. Unfortunately, it is impossible to obtain such a group neither prospectively (for ethical reasons) nor retrospectively because injured children without treatment who develop normally cannot be detected.

In the present study, the distribution of the various malocclusion Classes at follow-up was significantly different (P = 0.048) from the control group. The study group was characterized by a low prevalence of normocclusions and Class I malocclusions and a higher prevalence of Class II malocclusions. This is in agreement with Proffit *et al.* (1980) who identified a higher prevalence of Class II malocclusions with asymmetry in cases of unilateral condylar fracture or mandibular deficiency in cases of bilateral fractures.

It was expected that the asymmetric morphologic occlusal features such as Class II subdivision, crossbites, and midline deviation would be more prevalent in the study group. These features have been observed, for example, in patients

Table 2 Comparison between the distribution of the malocclusion categories in the study and control groups (P = 0.048).

	Study group (N = 32)		Control group* (N = 703)	
	N	%	N	%
Normocclusion	1	3.1	52	7.4
Class I	13	40.6	345	49.1
Class II (total)	16	50.0	301	42.7
Class II division 1	8	25	225	32
Class II division 2	4	12.5	16	2.3
Class II subdivision	4	12.5	60	8.5
Class III	2	6.3	5	0.7

* For 2 patients data were missing.

Table 3 Asymmetric occlusal features.

	Study group (N = 32; %)	Control group (N = 703; %)	P
Class II subdivision	4 (12.5)	60 (8.5)	0.4
Posterior crossbite	7 (21.9)	128 (18.2)*	0.4
Upper midline deviation	5 (15.6)	67 (9.5)*	0.11
Lower midline deviation	14 (46.6)**	231 (32.9)	0.033

*For these parameters, N = 705.
**For this parameter, N = 30 because one child did not have lower incisors and another one had a dental midline shift.

Table 4 Relationship between the side of fracture and the side of lower midline deviation.

Side of fracture	Number of children with fractures (%)	Number of children with lower midline deviation	Side of lower midline deviation	
			Right	Left
Right	11 (34.4)	4	3	1
Left	10 (31.2)	4	0	4
Bilateral	11 (34.4)	6	3	3
Total	32 (100)	14	6	8

Figure 3 Well-compensated occlusal development of a female subject at the age of 21 years, following undiagnosed left condylar injury during an automobile accident at the age of 5 years. (A) Facial asymmetry and chin deviation. (B) Canting of the occlusal plane. (C) Bilateral Class I dental relationship, anterior crossbite of the upper left lateral incisor without functional shift, slight tilting of the lower incisors to the right. (D) Panoramic view showing malformed left condylar head and neck and overall shortening of the left ramus by 7 mm. (E) Tracing of the postero-anterior cephalogram indicating tilt of the occlusal plane (8 degrees), chin deviation to the left, and upper and lower midline deviation to the left due to compensatory tilting of the upper and lower incisors.

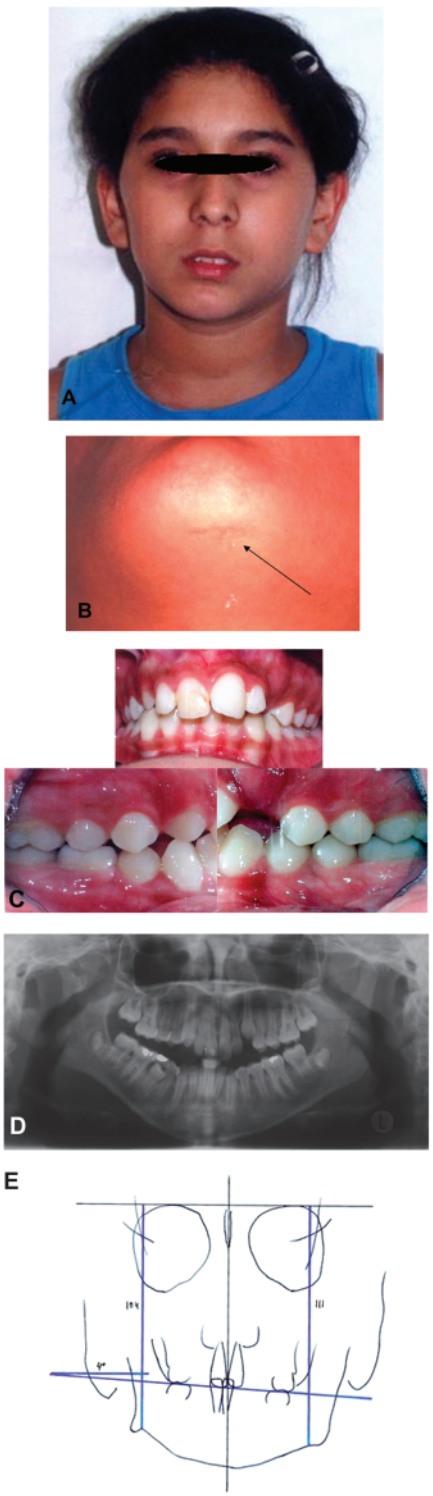

Figure 4 Partially compensated occlusal development of a female subject at the age of 12.5 years, following undiagnosed right condylar injury as a consequence of a fall and chin trauma at 5 years of age. (A) Facial asymmetry and chin deviation. (B) Scar tissue on the chin (arrow) following injury. (C) Class II division 1 subdivision right dental relationship. (D) Panoramic view exhibiting rudimentary right condylar head and neck and overall shortening of the right ramus by 8 mm. (E) Tracing of a postero-anterior cephalogram indicating mild tilting of the occlusal plane (4 degrees), chin deviation to the right, and lower midline deviation to the right.

developing dental asymmetries due to idiopathic scoliosis (Ben-Bassat *et al.*, 2006). A Class II subdivision and persistent midline deviation have been observed post-treatment in non-traumatized children treated for posterior crossbites without obvious facial asymmetry (Ben-Bassat *et al.*, 1993; Brin *et al.*, 1996). Thus, these asymmetric morphologic occlusal features can be perceived as sensitive indicators of asymmetric facial growth. However, only the lower midline deviation, which corresponded almost perfectly with the side of the condylar fracture, was statistically significantly different between the two groups in the present study. Based on these results, the null hypothesis can be only partially rejected because only the malocclusion distribution and prevalence of lower midline deviation were found to be statistically different in the study group compared with the controls. Thus, conservative treatment of physiotherapy and monitoring were successful in keeping the occlusal sequellae of mandibular condylar fractures to a minimum in this sample.

As mentioned, it seems impossible to collect a sample of undiagnosed untreated fractures. However, some sporadic cases of undiagnosed fractures (not included in this study group) suggest that early untreated condylar fractures may show different levels of occlusal compensation (Solow, 1980) as can be demonstrated by the following two examples: some are highly compensated (Figure 3), while others are only partially compensated (Figure 4). However, at the time of injury it is not possible to predict the development of the child and thus, early treatment, such as that utilized in this study, is indicated in order to improve the chances for favourable development.

It should be remembered, however, that this study group presented with relatively mild symptoms, which in other cases could be overlooked. In addition, at follow-up, almost half of the patients were still young and probably pre-pubertal (chronological age younger than 10.5 years). Thus, further follow-up, including imaging should be continued in order to monitor their acceptable occlusion in the long term.

Conclusions

1. Malocclusion was more prevalent among children who experienced condylar fractures.
2. The most prominent asymmetric occlusal feature was lower midline deviation coinciding with the side of the unilateral fractured condyle.
3. It seems that in the present sample, early detection and conservative treatment following condylar fracture prevented possible development of severe occlusal asymmetry, with the reservation regarding the young age of the study group.

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