Case Report: Assessment, documentation, and treatment of a developing facial asymmetry following early childhood injury

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Abstract: Prepubertal trauma is often implicated as the cause of asymmetric growth of the mandible. A series of photographs taken before and after early childhood injury to the orofacial complex illustrates the development of a three-dimensional dentofacial deformity in a patient. The diagnosis and combined surgical orthodontic treatment plan to correct the facial asymmetry and malocclusion are discussed.

Key Words: Prepubertal trauma, Asymmetry, Mandibular growth, Growth and development, Orthognathic surgery

Although vertebrates consist primarily of bilateral structures, perfect lateral symmetry is found infrequently in nature. A certain degree of facial asymmetry is normal and provides uniqueness and a basis for differences among us. It is when an asymmetry becomes more apparent or severe that we begin to believe it is "abnormal" and a contributing component of a dentofacial deformity.

Orthodontists often attempt to categorize an asymmetry as dental, skeletal, muscular, functional, or a combination thereof.[1] Mandibulofacial asymmetries can also be classified based on the time of onset, as outlined by Pirttiniemi.[2] Anomalies may be embryonic in nature or they may develop during the fetal term. Embryonic disturbances may be linked to disruption of cellular proliferation and development, as suggested by the roles neural crest cells perform in the development of hemifacial microsomia[3] or cleft lip and palate.[4-6] Other disturbances that arise during the fetal period may cause permanent deformations of shape and size of craniofacial structures.[7-9] The etiology of asymmetry may be tumors in the temporomandibular joint region,[10] condylar hyperplasia or hypoplasia,[11,12] hemifacial atrophy (Romberg syndrome),[13] scleroderma en coup de sabre,[14] inflammatory arthritic disease,[15] ankylosis,[16] intra-articular disorders with an associated arthrosis,[17] condylar fracture or prepubertal trauma.[18] Traumatically induced internal derangement of the temporomandibular joint may also lead to asymmetric mandibular growth and contribute to the development of facial asymmetry.[19]

Prepubertal trauma has been implicated as a cause of asymmetric growth of the mandible. Skolnick et al.[20] demonstrated a statistically significant association between prepubertal trauma and radiographic evidence of mandibular asymmetry in a sample of 109 orthodontic and orthognathic surgery patients. This study is consistent with previous work[21,22] that suggests a relationship between prepubertal trauma and mandibular asymmetry. However, it is difficult to demonstrate an unequivocal cause-and-effect relationship between the two events in a human population.

This case report describes a patient with maxillomandibular facial asymmetry in all three spatial planes. The case is documented with photographs taken from 6 months to 28 years. Onset and progression of the asymmetry becomes noticeable after trauma to the patient's orofacial region, suggestive of an association between prepubertal trauma and the development of mandibulofacial asymmetry. The combined surgical orthodontic correction is described.

History and etiology

A 28-year-old female presented with a chief complaint of "a crooked lower jaw" and "my teeth are not meeting in front." Her medical his-

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Figure 1A

Figure 1B

Figure 1C

Figure 1D

Facial photographs from 1 year to 7 years. A: 1 year; B: 3 years; C: 5 years; D: 7 years

tory was significant for an allergy to sulfa drugs and for adenoidectomy as a child. Her dental history was remarkable for previous comprehensive orthodontic treatment involving the removal of four first premolars during adolescence and extraction of the third molars. Orthodontic records from the patient's earlier treatment were requested by letter and telephone but were never forwarded.

When questioned about prior facial trauma, the patient noted only that her primary central incisors were discolored in early school photographs. Her mother confirmed that the patient had been dropped and had struck her face when she was about 2 years old. Subsequently, the teeth began to change color. Photographs taken between 6 months and 17 years demonstrate progressive facial asymmetry following this isolated event (Figures 1A-D). Although it cannot be proven, it is highly likely that trauma played a significant role in the development of the patient's asymmetry.

Figure 2A

Figure 2B

Figure 2C

Pretreatment facial photographs

Figure 2D

Pretreatment intraoral photograph

Figure 3A

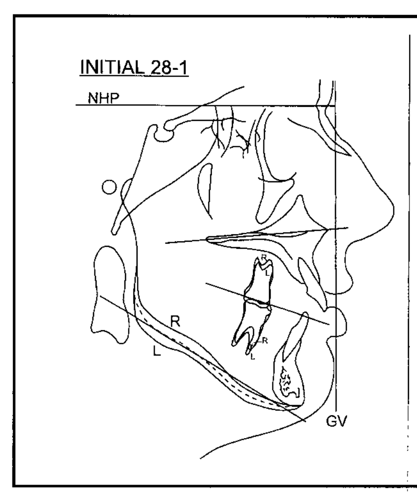

Figure 3B

A: Initial lateral cephalometric radiograph; B: Initial cephalometric tracing

Findings and diagnosis

The patient presented with vertical maxillary excess, maxillary transverse deficiency, and mandibular asymmetry to the left with an associated inferior border discrepancy. Review of facial photographs (Figure 2A-C) also revealed a prominent orbital asymmetry. The left globe was lower than the right (hypo-ophthalmia) and the left upper lid crease was markedly longer. In addition, the patient had an anterior openbite with two distinct occlusal planes present in the maxillary arch and an occlusal cant that ran superiorly to the right when viewed from the frontal perspective. The malocclusion was manifest by a 7.0 mm overjet, a half-cusp Class II canine relationship, mandibular midline discrepancy to the left, and upright mandibular incisors with

Figure 4A

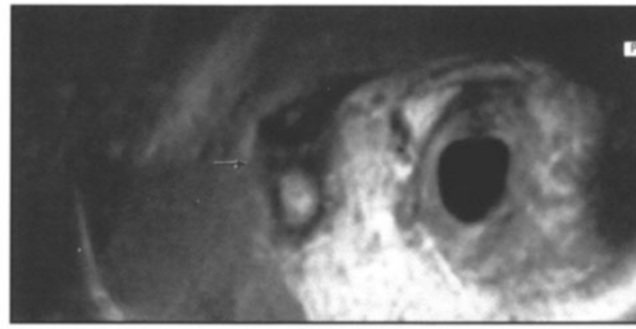

Figure 4B

Pretreatment MRI (arrows denote disc). A: Right side T-1 weighted sagittal-oblique closed-mouth view. B: Right side T-1 weighted sagittal-oblique open-mouth view

minor crowding. The patient complained of headaches, which occurred occasionally in the temporal region. A normal range of mandibular movement was present, but there was a lateral deviation to the right upon opening. Plain radiographs were significant for left condylar remodeling, and an MRI of the temporomandibular joint revealed bilateral reducing disk displacement (Figure 4).

Treatment plan

A combined surgical orthodontic plan was recommended and accepted by the patient to achieve facial esthetic and occlusal goals.

Presurgical orthodontic goals: Comprehensive edgewise appliances would be used for approximately 10 to 12 months to achieve presurgical orthodontic goals. An occlusogram coordinated with a surgical prediction tracing[23] was used to determine presurgical orthodontic requirements as well as maxillary transverse considerations (Figures 5 and 6). The maxillary and mandibular templates were rearticulated with the surgically predicted anteroposterior change in the A-B (^OP) relationship. The change in the apical bases reflects A-P changes effected by maxillary impaction, advancement, and mandibular autorotation. The mandibular arch would be leveled with continuous archwires, providing proclination of the incisors in order to resolve the minor arch length deficiency. In the maxilla, the three distinct segments were to be maintained. The second premolar roots would be moved distally and the canine roots mesially to prevent root damage during interdental osteotomies. In addition, the maxillary intercanine width needed to be increased orthodontically to accept the mandibular arch during surgical repositioning. The maxillary posterior transverse width was to be maintained presurgically.

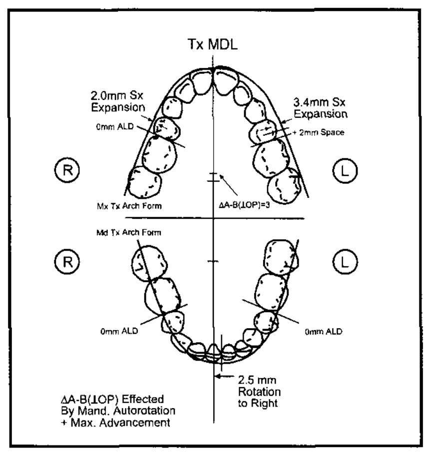

Figure 5
Occlusogram

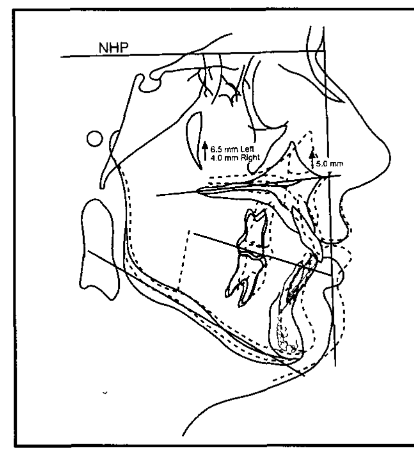

Figure 6
Surgical prediction tracing

Figure 7
Intermaxillary fixation and training elastics (3 weeks postop)

Surgical goals: Differential impaction of the three maxillary segments to decrease the excessive lower facial height and tooth-to-lip exposure (presently 10.0 mm at rest and 15.0 mm when smiling) by approximately 5.0 mm. This would also help reduce lip incompetence. Surgical prediction tracings were used in planning an anterior segment impaction of 5.0 mm, a right posterior segment impaction of 4.0 mm, and a left posterior segment impaction of 6.5 mm to correct the anterior openbite, occlusal cant, and vertical asymmetry. In addition, approximately 5.0 mm of expansion would be needed to correct the maxillary posterior transverse deficiency. The entire maxilla was to be advanced about 2.0 mm to maintain a Class I occlusion after mandibular autorotation. Vertical ramus osteotomies were planned to rotate the mandible

2.5 mm to the right and allow for the correction of the occlusal cant, inferior border, and midline discrepancies.

Postsurgical orthodontic goals: Minor postsurgical orthodontic finishing as needed, followed by maxillary and mandibular Hawley retainers.

Treatment progress

The patient was banded/direct bonded with Roth prescription .022 appliances in the maxilla and mandible through the second molars. In the maxilla, .016 x .022 ss posterior segments with distal root bends were placed on the premolars and a .016 x .022 anterior segment with mesial root bends was placed on the canines, with an activation to widen the intercanine distance. A passive transpalatal arch was also placed. A continuous .016 NiTi wire was placed in the mandible to begin leveling the arch. The stiffness of the archwire increased until continuous .017 x .025 ss and .017 x .025 segments with similar activations were placed in the mandible and maxilla, respectively. A small mesial-out activation was placed in the transpalatal arch. Progress records confirmed that segmental maxillary surgery would be needed. However, only the maxillary right posterior needed to be segmented to obtain excellent model-surgery occlusion. Surgical hooks were crimped and spot-welded 1 week prior to surgery.

Table 1
Cephalometric summary

Area of study, measurement	Norms	Pretreatment	Posttreatment
Cranial base			
AR-PTM(//HP)	32.8 ± 1.9	36	37
PTM-N(//HP)	52.8 ± 3.0	50	47
Maxilla to cranial base			
N-A(//HP)	-2.0 ± 3.7	-2.0	0.0
Mandible to cranial base			
N-B(//HP)	-6.9 ± 4.3	-10	-10
N-Pg(//HP)	6.5 ± 5.1	-6.5	-7.0
Maxillomandibular relationships			
N-A-Pg(angle)	2.6 ± 5.1	2.0	6.0
A-B(^OP)	-0.4 ± 2.5	+8.0	0.0
Vertical height			
N-ANS(^HP)	50 ± 2.4	57	54
ANS-Gn(^HP)	61.3 ± 3.3	81	79.0
PNS-N(^HP)	50.6 ± 2.2	61	55.0
MP-HP(angle)	24.2 ± 5.0	31.5	27.0
Ar-Go(linear)	46.8 ± 2.5	51	49
Go-Pg(linear)	74.2 ± 5.8	78	79
Ar-Go Gn(angle)	122.0 ± 6.9	131	128
OP-HP(angle)	7.1 ± 2.5	18.5	12
Maxillary and mandibular incisor position			
1-NF(^NF)	27.5 ± 1.7	37.5	35.0
1-MP(^MP	40.8 ± 1.8	42.5	44.0
6-NF(^NF)	23.0 ± 1.3	31.5	29.0
6-MP(^MP)	32.1 ± 1.9	37.0	36.5
1-NF(angle)	112.5 ± 5.3	110	104
1-MP(angle)	95.9 ± 5.7	82	93
Soft tissue			
G-Sn-Pg(angle)	12 ± 4	10	16
G-Sn(//HP)	6 ± 3	5	8
G-Pg(//HP)	0 ± 4	-1	-1
G-Sn/Sn-Me	1 ± .04	1.0	1.0
Sn-Gn-C(angle)	100 ± 7	122	115
Cm-Sn-Ls(angle)	102 ± 8	105	115
[Ls to (Sn-Pg)]	3 ± 1	4.0	3.0
[Li to (Sn-Pg)]	2 ± 1	3.5	3.0
1 to STM	2.0	8.0	4.0
Interlabial gap	2 ± 2	6.0	0.0

For the surgical procedure, the patient was placed under nasotracheal general anesthesia. An 0.045" Z-wire was placed into nasion for vertical referencing and the maxilla was exposed in the standard fashion. Vertical and horizontal reference points were made at the piriform rim and zygomaticomaxillary buttress areas. Differential impaction of 4 mm on the right and 6.5 mm on the left was completed to address the skeletal cant and vertical maxillary excess. The maxilla was advanced 2 mm and segmented between the right canine and premolar with a chisel. Fixation was achieved bilaterally, with a miniplate anteriorly at the piriform rim and a 24-gauge interosseous wire posteriorly at the buttress.

Bilateral vertical ramus osteotomies were performed to allow for occlusal plane cant, facial height, inferior border, midline, and asymmetry corrections. The patient was then placed into intermaxillary fixation using 26-gauge wire. Skeletal suspension wires were placed between ANS and the maxillary archwire, and another in circummandibular fashion around the lower border of the mandible to the mandibular archwire between the first premolar and canine. A 2-0 alar cinch suture was placed to prevent excessive widening of the alar base. The patient was released from IMF 18 days postoperatively. The maxillary splint was kept in place to maintain the transverse dimension, and training elastics were used to guide the patient's occlusion for an additional 3 weeks (Figure 7). The splint was then removed and continuous .018 ss maxillary and .016 ss mandibular archwires with finishing bends were placed. Light triangular elastics in the canine region and monthly finishing bends preceded debonding.

Results

Comparison of the initial and final orthodontic records reveal that the patient's facial esthetics had improved as gingival exposure decreased about 3.0 mm anteriorly and even more posteriorly. Tooth-to-lip exposure decreased by the same amount. Cephalometric superimpositions illustrate that the excessive lower facial height was reduced and lip incompetence decreased by 6.0 mm (Figure 8, Table 1). The facial asymmetries (transverse and vertical) were also improved, and the inferior borders became more symmetric (Figures 9 and 10). The patient's nasolabial angle increased by 10 degrees, to 115. Differential impaction of the maxilla averaged about 6.0 mm posteriorly, with a greater impaction of the left, correcting the cant and asymmetry. The angulation of the anterior segment was corrected and it was also impacted, although to a lesser extent (3.0 mm) than planned (5.0 mm superior movement). The maxilla was advanced about 2.0 mm and expanded 5.5 mm in the premolar area. Maxillary intercanine width was expanded orthodontically, providing a good canine-guided occlusion at the time of surgery. The interdental osteotomy performed on the right side did not damage the adjacent roots. The concomitant increase in transverse width of the maxilla significantly improved the esthetics of the patient's smile. Vertical ramus osteotomies allowed the mandible to be rotated to the right and moved into a more superior position on the left. This corrected the inferior border discrepancy and provided coincident maxillary and mandibular dental midlines with the facial midsagittal plane. Leveling of the mandibular arch occurred, as did proclination of the lower incisors to assist in resolving the minor arch-length discrepancy.

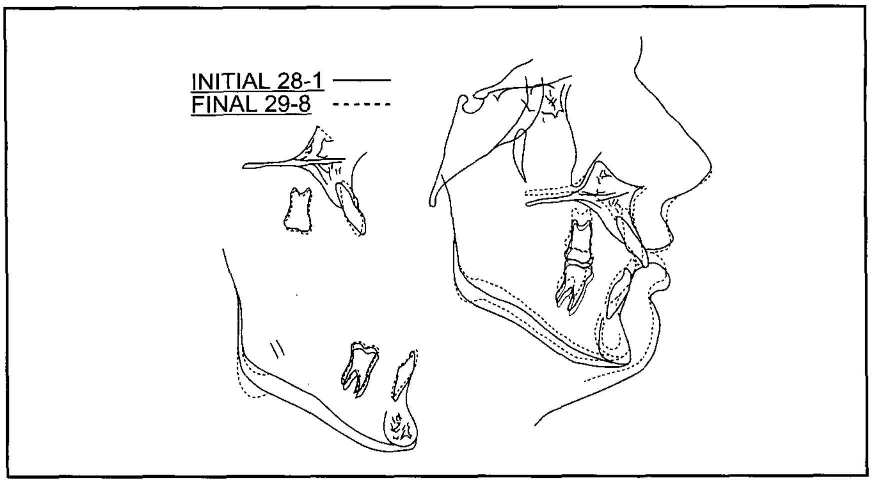

Figure 8
Cephalometric superimpositions

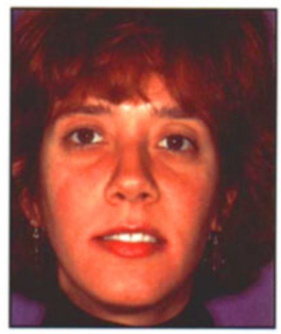

Figure 9A Figure 9B Figure 9C
Posttreatment facial photographs

Figure 9D
Posttreatment intraoral photograph

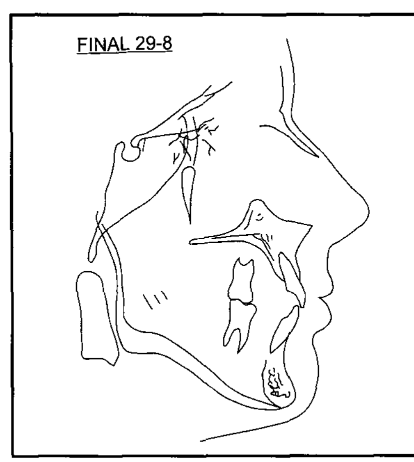

Figure 10A Figure 10B
Final radiographs and tracings. A: Lateral cephalometric radiograph; B: Cephalometric tracing

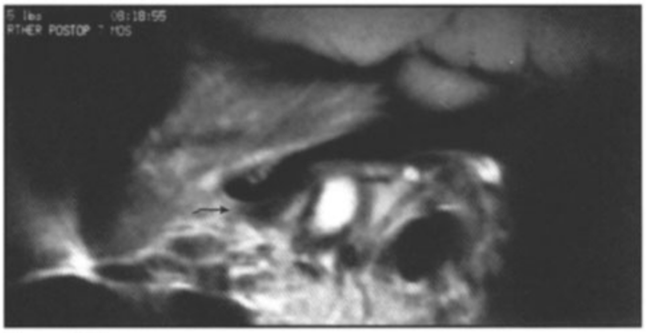

Figure 11A

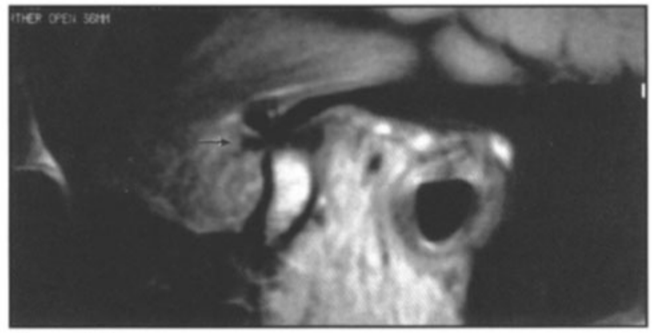

Figure 11B

Posttreatment MRI (arrows denote disc). A: Right side T-1 weighted sagittal-oblique closed-mouth view; B: Right side T-1 weighted sagittal-oblique open-mouth view

A mutually protected, canine-guided occlusion was obtained. There was mild condylar sag on the left side that resolved over time (6 weeks); a postoperative MRI revealed no change in disk position (Figure 11). The anterior openbite, crossbites, canine relationship, midline discrepancy, mandibular arch length deficiency, and overjet were all corrected.

Retention

Maxillary and mandibular Hawley retainers were placed, but the patient was uncomfortable with a prematurity in occlusion occurring on a wire clasp, so a positioner was fabricated. The patient was instructed to wear the positioner for 4 hours during the day and at night. After 2 weeks, wear was curtailed to nights only.

Final evaluation

Serial photographs provide a unique opportunity to document a postnatally expressed, developing facial asymmetry. The timing of the trauma and the subsequent facial changes strongly suggest that the etiology of this asymmetry was the early childhood injury. Although temporomandibular joint internal derangements have been associated with facial changes and alterations in mandibular growth, whether they played a role in this patient's case cannot be determined.

The patient's dentofacial deformity improved significantly. The vertical maxillary excess, anterior openbite, facial asymmetry, and malocclusion were corrected with 10 months of presurgical orthodontics, maxillary and mandibular surgery, and 6 months of postsurgical orthodontic finishing. The MRI of the temporomandibular joints was repeated 6 months after surgery and showed no change is disk position; the patient remained asymptomatic. She is functioning well in a mutually protected, canine-guided occlusion.

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