A new cephalometric diagnostic method for Down's Syndrome patients with open bite

Juan J. Alió Sanz

Professor of Orthordontics. Universidad Complutense de Madrid. Co-director of the Master's Program in Orthordontics. Universidad Complutense de Madrid. Secretary General of the Iberoamerican Association of Orthodontists

Correspondence:
Prof. Juan J. Alió Sanz
C/ Herreros de Tejada nº 24
28016 Madrid, Spain
E-mail: jjaliosa@odon.ucm.es

Received: 08/07/2007
Accepted: 26/09/2007

Indexed in:
-Index Medicus / MEDLINE / PubMed
-EMBASE, Excerpta Medica
-SCOPUS
-Indice Médico Español
-IBECS

Alió-Sanz JJ. A new cephalometric diagnostic method for Down's Syndrome patients with open bite. Med Oral Patol Oral Cir Bucal. 2008 Mar1;13(3):E171-5.

http://www.medicinaoral.com/medoralfree01/v13i3/medoralv13i3p171.pdf

Abstract

Vertical cephalometric analysis is a new cephalometric diagnostic method, created and studied by the author, which allows us to identify objectively the dental and skeletal components found in certain types of open bites.

Down's Syndrome patients frequently have this type of malocclusion which produces a significant dysfunction of the whole stomatognathic system. The primary complication of the treatment lies in the difficulty of identifying exactly how much of an open bite is dental and how much is skeletal; indeed, it is precisely this extremely important factor where this diagnostic method will be useful. Only two indexes are needed. The first, called SOBI (skeletal open bite index), measures the skeletal component, while the DOBI (dental open bite index) measures the dental component. The quantitative value of both components will establish a diagnosis-prognosis for the patient.

Key words: *Open bites, cephalometric, Down's Syndrome.*

Introduction

Open bites are a type of malocclusion characterized by the teeth of the upper arch not coming into contact with those of the lower arch, whether they be anterior, posterior or complete.

Open bites are usually classified as a so-called vertical malocclusion because it is in this facial plane where we can best work out a precise diagnosis.

The functional repercussion brought about by this type of malocclusion is very broad and significant due to the fact that it produces the total or partial disability of almost all the functions of the stomatognathic system, especially those related to chewing and swallowing. The chewing function is affected since the intercuspid contact is extremely limited, particularly when the open bite is complete, that is, both anterior and posterior. Swallowing is also affected since the tongue has to seal the open space in order to achieve an adequate closure of the oral cavity. This is why we will invariably find atypical swallowing, also called infantile swallowing, in all open bites.

The appearance of open bites in certain vertical (dolichofacial) growth patterns will negatively affect this growth with a tendency to make the mandible turn clockwise and become larger, hence, the vertical problem of the patient (1). This problem also has an aesthetic repercussion since it causes the lower third of the patient's face to enlarge, possibly preventing closure of the lips and a tendency to oral breathing (2). These processes, in turn, end up making the open bite even worse. Therefore, as can be seen, all these factors work together to worsen the initial malocclusion (3).

In general, open bites are classified into dentoalveolar and skeletal categories (1). This classification, purely structural, includes a prognosis typification since dentoalveolar open bites will have, in principle, a good prognosis and respond well to orthordontic treatment, while skeletal open bites have a bad prognosis and their treatment is normally directed towards surgical correction. The main problem lies in being able to distinguish one type of open bite from the other, a task that can be quite difficult especially in mixed cases which are, in fact, the most common.

Chronologically, most open bites develop at an early stage as a consequence of certain habits or oral dysfunctions and it is the subsequent growth of the patient that determines the skeletal component of the malocclusion. To avoid this worsening of the problem it is important to control the vertical component of this growth (4), however, this goal can sometimes be unachievable. In fact, if we could control the patient's vertical growth, we could almost certainly correct all malocclusions (5). Nevertheless, where we can make progress is in gaining in-depth knowledge about the skeletal and dentoalveolar components of a particular open bite through a cephalometric diagnosis system which tells us from the start exactly what the corrective possiblilities of the malocclusion are.

Open bites in patients with Down's Syndrome

Down's Syndrome is one of the most frequent chromosomatic anomalies and represents 10% of all oligofrenias. It was described by L. Down in 1896 and is commonly known as mongolism due to the craniofacial features shared by these patients, especially an anomalous development of the skull, mandibular hypoplasia and a higher rate of malocclusion than in the general population (6-15).

The most frequent occlusal alterations present in these patients are bone class III, dental ageneses and open bites. The craniofacial morphology of Down's Syndrome patients, and in particular the sagittal reduction in size of the anterior cranial fossa, can often induce the specialist to erroneously make a class III diagnosis (16). Dental ageneses are extremely common, especially for upper lateral incisors and lower second premolars. However, in spite of the high rate of the aforementioned malocclusions, the one that will have the greatest negative impact on the patient is an open bite, considering that it is the malocclusion calling for the most complex treatment. The causes of this high incidence of open bites (11,15,17,18) can be quite varied. It is worth mentioning the characteristic macroglossia found in this Syndrome and that it tends to produce a dental biprotrusion accompanied by an anterior open bite. Another cause can be the deficient development of the mandibular condyle which originates a characteristic micrognathia that favors the subsequent appearance of an open bite.

Open bites in Down's Syndrome patients have a skeletal root which makes the prognosis quite negative. However, if we could pin down this fact objectively we would be more confident when deciding whether or not to treat the patient and even, perhaps, fail in giving him the necessary treatment due to a badly established prognosis.

This is precisely the objective of this paper. We will put forward an original, new cephalometric method that will try to solve the problem of identifying and diagnosing open bites, measuring the dentoalveolar and skeletal components separately.

Therapeutic focus for open bites in Down's Syndrome patients

When confronted with any kind of malocclusion in a patient with Down's Syndrome it is necessary to consider a series of objectives that are not applicable when treating normal patients with the same problem. The first thing we have to do is establish the degree of functional discapacity that the malocclusion produces in the patient. In the case of open bites, this degree of dysfunction is generally very high. The priority is precisely to determine what type of open bite we are being confronted with. In order to do so, we look to the clinical, cephalometric differential diagnosis.

Once we have determined these aspects, it will be necessary to choose what type of appliance we will be using, considering the advantages and disadvantages for each particular case. In general, many problems arise with the use of removable appliances in these patients because for these solutions to work, the patient has to cooperate and understand the problem. Permanent appliances do away with these disadvantages, but they are more complex and require good hygiene.

Description of Vertical Cephalometric Analysis

Vertical cephalometric analysis is a calibrated method specifically for the differential diagnosis of skeletal and dentoalveolar open bites.

Cephalometric Landmarks

1. Skeletal Cephalometric Landmarks

1.1. Nasion (Na): the most anterior point of the frontal-nasal suture

1.2. Sella turcica (S): geometric center of the sella turcica of the sphenoid

1.3. Suborbitale (Or): the lowest point of the orbit

1.4. Porion (Po): the highest point on the external rim of the external auditive meatus

1.5. Anterior nasal spine (ANS): the most anterior point of the upper maxilla

1.6. Posterior nasal spine (PNS): the most posterior point of the upper maxilla

1.7. Gonion (Go): meeting point of the bisection formed by the tangent along the lower rim of the mandibular mass and the tangent along the posterior rim of the ramus

1.8. Gnathion (Gn): Mid-point of the bisection of the angle formed by the tangent along the lower rim of the mandibular mass and a tangent perpendicular to this one along the most anterior part of the mentum.

1.9. Ramus 1 (R1): the most posterior point of the concavity of the anterior rim of the ascending ramus

1.10. Ramus 2 (R2): Parallel point to the Frankfort plane from Ramus 1

2. Dental cephalometric landmarks

2.1. Upper incisor rim (Isb): the most incisal point of the vestibular face of the upper incisor

2.2. Upper incisor apex (Isa): the point at the furthest tip of the radicular structure of the upper incisor
2.3. Lower incisor rim (Iib): the most incisal point of the vestibular face of the lower incisor
2.4. Lower incisor apex (Iia): the point at the furthest tip of the radicular structure of the lower incisor
2.5. Upper first molar occlusal (MS): halfway point of the occlusal face of the upper first molar
2.6. Lower first molar occlusal (MI): halfway point of the occlusal face of the lower first molar

Skeletal cephalometric planes
1. SN plane. Between the sella (S) landmark and the nasion (N)
2. Frankfort plane. Between the Suborbitale (Or) landmark and the porion (Po)
3. Palatal plane. Between the anterior and the posterior nasal spines
4. Mandibular plane. Between the gonion and the gnathion
5. Mandibular ramus. Between landmarks R1 and R2.

Dental cephalometric planes
1. Upper incisor axis. Between the apex landmark (I.Sa) and the incisor landmark (I.Sb)
2. Lower incisor axis. Between the apex landmark (I.Ia) and the incisor landmark (I.Ib)
Cephalometric measurements
1. Angular cephalometric measurements
1.1. PP/SN: SN plane with palatal plane
1.2. FH/PP: Frankfort plane with palatal plane
1.3. SN/PM: SN plane with mandibular plane
1.4. FH/PM: Frankfort plane with mandibular plane
1.5. Gonion: Mandibular plane with a plane of the ramus

2. Linear Cephalometric Measurements
2.1. I:Sa – PP: perpendicular from I.Sa to the palatal plane
2.2. I:Sb – PP: perpendicular from I.Sb to the palatal plane
2.3. I.Ia – PM: perpendicular from I.Ia to the mandibular plane
2.4. I.Ib – PM: perpendicular from I:Ib to the mandibular plane
2.5. MS – PP: perpendicular from the occlusal landmark of the upper molar to the palatal plane
2.6. MI – PM: perpendicular from the occlusal landmark of the lower molar to the mandibular plane
2.7. Ramus width: distance between the two landmarks R1 and R2

Cephalometric standards

1. *Cephalometric standards for angular values*
SN/PP: 8º (SD=2)
FH/PP: 1º (SD=2.5)
SN/PM: 32º (SD=4)
FH/PM: 25º (SD=3)
Gonion: 120º(SD=5)
2. *Cephalometric standards for linear values*
I.Sb-PP: 27mm (SD=2)
I.Sa-PP: 7 mm (SD=1)
I.Ib-PM: 40 mm (SD=2)
I.Ia-PM: 20 mm (SD=1
MS-PP: 23 mm (SD=2)
MI-PM: 32 mm (SD=2)
Ramus: 32 mm (SD=2)

VCA: Diagnosis with indexes

The fundamental value of the cephalometric analysis that we are describing lies mainly in its capacity to describe the dental and skeletal components of an open bite qualitatively as well as quantitatively. Furthermore, by doing so, it allows us to predict the prognosis and the different possible treatments.
In order to carry this out, we have developed two indexes: the skeletal open bite index (SOBI) and the dental open bit index (DOBI).

Skeletal open bite index (SOBI) (Table 1)
The value of this index is that it allows us to find out the skeletal component of the open bite. The measurements which it is composed of are the following:
1. Maxillary measurements:
PP/SN
PP/FH
2. Mandibular measurements:
PM/SN
PM/FM
Gonion
Ramus
As can be seen, all the SOBI measurements are angular, except for the ramus. Each cephalometric parameter will have a positive or negative value depending on how it compares to the cephalometric standard. (See Table.)

Dental open bite index. (Table 2)
The value of this index will describe and quantify the dental component of the open bite. The value it is made up of are exclusively dental and all are linear:
I:Sb-PP
I:Sa-PP
I:Ib-PM
I:Ia-PM
MS-PP
MI-PM
As in the case of the SOBI, the quantification of the index is carried out by comparing the cephalometric value of the patient to the cephalometric standard, thereby obtaining a specific positive or negative value. (See Table 2)

Table 1. Skeletal open bite index. SOBI.

Parámetros	IMAE+2	IMAE+1	IMAE 0	IMAE-1	IMAE-2
PP/FH	8	4.5	1	-2.5	-4.5
PP/SN	4	6	8	10	12
PM/FH	17	21	25	29	33
PM/SN	24	28	32	36	40
GONIACO	110	115	120	125	130
RAMA	36	34	32	30	28

Table 2. Dental open bite index. DOBI.

Parámetro	IMAD+2	IMAD+1	IMAD 0	IMAD-1	IMAD-2
Isa-PP	9	8	7	6	5
Isb-PP	29	28	27	26	25
Iia-PM	22	21	20	19	18
Iib-PM	44	42	40	38	36
MS-PP	27	25	23	21	19
MI-PM	36	34	32	30	28

Assessment of the indexes

The final quantity of each index is carried out with the sum of the values we have reached with the previous formula. The following values are therefore possible:

Skeletal open bite index (SOBI).
SOBI=0. Neutral
SOBI=-1. Unfavorable
SOBI=-2. Very unfavorable
SOBI=+1. Favorable
SOBI=+2. Very favorable

Dental open bite index (DOBI).
DOBI=0. Neutral
DOBI=-1. Unfavorable
DOBI=-2. Very unfavorable
DOBI=+1. Favorable
DOBI=+2. Very favorable

Application of vertical cephalometric analysis on patients with Down's Syndrome

- Case 1
Patient: CPC
Age: 16.3 years
The intraoral examination reveals a complete open bite, anterior and posterior, accompanied by a maxillary compression with a bilateral cross bite and functional deviation of the midline. Diastemas between the incisors can be found in the upper arch, most likely caused by the pressure of the tongue which is placed in a low position.
In the upper arch, we can see the absence of 13 and 23 and in the lower arch there is a positive bone-dental discrepency.
The facial analysis shows us that the patient has a dolichofacial tendency accompanied by the typical features found in Down's Syndrome.
A conventional cephalometric analysis confirms a bone class III with a maxillomandibular cause, with a vestibuloversion of the lower incisors in the mesofacial pattern.
Using VCA on this patient gives us a SOBI result of –3 and a DOBI result of –10.
These results suggest that the most important component of this open bite is dental, and so we therefore have a good chance of treating it successfully with an exclusively orthordontic treatment. It is important to add that if we relied solely on the conventional cephalometric system, this patient would be the recipient of orthordontic-surgerical treatment. This kind of treatment is almost impossible when dealing with individuals with Down's Syndrome.
- Case 2
Patient: JLO
Age: 14.1 years
The intraoral examination reveals a complete open bite, anterior and posterior, with a very severe maxillary compression which produces a bilateral cross bite, getting worse in the molar area, causing what could be called a scissor bite. A functional, dental deviation of the midline, an inverted projection and a negative upper bone-dental discrepancy can also be seen. Ageneses can be found in the area of the upper and lower lateral incisors.
The facial examination shows a dolichofacial type with a biretroversion profile.
Using a conventional cephalometric analysis we can observe a bone class III due to mandibular posterorotation with some lower incisors with a high degree of linguoversion.

The VCA gives us a SOBI value of –10 and a DOBI value of –1.

Therefore, this patient has an open bite with a strong skeletal component and a slight dental compensation. The prognosis of an exclusively orthordontic treatment is very unfavorable.

- Case 3

Patient: SMS

Age: 14.8 years

The intraoral examination reveals an anterior open bite from canine to canine with an important vestibulo-version of the upper and lower incisors. We can also see a dental deviation from the midline with a bone-dental discrepancy in both arches. There is a hypoplasia of the upper lateral incisors.

The facial examination indicates that the patient has a biprotrusive profile in a dolichofacial pattern.

Upon doing the conventional cephalometry we can see a bone class I with a high degree of vestibulo-version of the upper and lower incisors.

The VCA gives us the following values of the indexes: SOBI=-10 and DOBI=-1.

We can therefore conclude that this patient has a similar open bite to the one we have seen before, even though in this case it would seem to be less severe. With the conventional examination we might try a compensatory treatment of the open bite. With the VCA we discover that the success of this treatment will be extremely complicated.

Conclusions

The vertical cephalometric analysis is a new diagnostic method that tells us in a simple, clear way the dental and skeletal components of a particular open bite. This information is of the greatest importance in order to predict the prognosis of the malocclusion and direct us to the best possible treatment.

References

1. Nielsen I. Maloclusiones verticales: etiología, desarrollo, diagnóstico y algunos aspectos del tratamiento. Rev Esp Ortod 1994; 24: 123-138.
2. Linder-Aronson S. Adenoids. Their effect on mode of breathing and nasal airflow and their relationship to characteristics of the facial skeleton and the denition. A biometric, rhino-manometric and cephalometro-radiographic study on children with and without adenoids. Acta Otolaryngol Suppl. 1970;265:1-132.
3. Skieller V. Cephalometric growth analysis in treatment of overbite. Rep Congr Eur Orthod Soc. 1967;:147-57.
4. Pearson LE. Vertical control in treatment of patients having backward-rotational growth tendencies. Angle Orthod. 1978 Apr;48(2):132-40.
5. Creekmore TD, Radney LJ. Fränkel appliance therapy: orthopedic or orthodontic. Am J Orthod. 1983 Feb;83(2):89-108.
6. Nelson WE, Vaugham VC, McKay RJ. Tratado de pediatría. 7ed. 1980. p. 132-4.
7. Shapiro BL. Prenatal dental anomalies in mongolism: comments on the basis and implications of variability. Am A. NY Acad Sci. 1970; 171:562-77.
8. Shapiro BL, Gorlin RJ, Redman RS, Bruhl HH. The palate and Down's syndrome. N Engl J Med. 1967 Jun 29;276(26):1460-3.
9. Cohen MM. Congenital, genetic, and endocrinologic influences on dental occlusion. Dent Clin North Am. 1975 Jul;19(3):499-514.
10. Cohen MM, Winer RA. Dental and facial characteristics in down´s syndrome (Mongolism). J Dent Res. 1965 Jan-Feb;44:Suppl:197-208.
11. Cohen MM, Arvystas MG, Baum BJ. Occlusal disharmonies in trisomy G (Downs' syndrome, mongolism). Am J Orthod. 1970 Oct;58(4):367-72.
12. Kisling K. Craneal morphology in Down's syndrome. A comparative roentencephalometric study in adults males. Munksgaard. 1960; 107:90-8.
13. Jensen GM, Cleall JF, Yip AS. Dentoalveolar morphology and developmental changes in Down's syndrome (trisomy 21). Am J Orthod. 1973 Dec;64(6):607-18.
14. Soto MT, Alió JJ. Muelas L, Barbería E. Morfología y alteraciones dentarias en el sindrome de Down. Rev Iberam ortod. 1992; 11: 43-47.
15. Alió JJ, Soto MT, Moreno JP. Prevalencia de maloclusiones en el síndrome de Down. Rev Iberam Ortod. 1992; 11: 48-53.
16. Alió JJ. La atención odontológica en pacientes medicamente comprometidos. Ed Lab Normon SA. M-11.818.1996. Capítulo 9. p. 257-85.
17. Vigild M. Prevalence of malocclusion in mentally retarded young adults. Community Dent Oral Epidemiol. 1985 Jun;13(3):183-4.
18. Oreland A, Heijbel J, Jagell S. Malocclusions in physically and/or mentally handicapped children. Swed Dent J. 1987;11(3):103-19.