Nature versus nurture: A case report comparing the clinical and cephalometric pattern in twins

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Received - 02 November 2018 Initial Review - 18 November 2018 Accepted - 31 December 2018

ABSTRACT

Malocclusion is a manifestation of genetic and environmental interaction on the development of the orofacial region. Orthodontists may be interested in genetics to help understand why a patient has a particular occlusion. Orthodontists usually assume that the genetic factors are of major significance to the development of malocclusion. Studies of twin similarities have lent support to this concept. Twin study is one of the most effective methods available for investigating genetically determined variables of malocclusion. Discordancy is a frequent finding in dizygotic twins. However, discordancy in monozygotic (MZ) twins is a rare finding. Here, we report the case of MZ female twins aged 16 years and a comparison of the clinical and cephalometric pattern was done in both the twins. The present case shows discordancy between MZ female twins in relation to their extraoral and intraoral findings. The purpose of this study of MZ twins is to assess the genetic and environmental components of variation within the cranio-dento-facial complex.

Key words: *Genetics, Hereditary, Monozygotic twins, Orthodontics, Twins*

In orthodontics, the effects of genetics on the etiology of some dentofacial characteristics such as facial form, crowding, spacing, Class II malocclusion, Class III malocclusion, and pathologies have come to light. Understanding the role of genetics is becoming necessary for diagnosis and treatment planning.

The classical twin research design involving comparisons of similarities in monozygotic (MZ) or identical pairs and dizygotic or fraternal pairs has enabled researchers to quantify the relative contributions of genetic (nature) and environmental (nurture) factors to variation in many human physical and behavioral features and disorders [1]. This case report supports the hypothesis that genetics is not the sole controlling factor for the etiology of particular malocclusion.

CASE REPORT

A pair of MZ female twins aged 16 years presented to the department with a chief complaint of irregularly placed lower front teeth. The girls exhibited a marked similarity in facial appearance. Both had similar dentition with respect to the number of teeth present, molar relation crowding, overjet, and overbite. However, their occlusions were dissimilar to some extent (explained on the basis of cephalometrics and photographs later).

In twin 1, extraoral features revealed more facial convexity as compared to twin 2. Lips were incompetent in twin 2 as compared to twin 1 who showed competency of lips. On smile analysis, twin 1 revealed a non-consonant smile arc as compared to twin 2 who revealed more of consonant smile arc (Figs 1 and 2).

Intraoral occlusal examination reveals differences in individual tooth positions. Occlusal examination showed rotated canine on the right side in twin 2 which is not seen in twin 1. Spacing was seen in twin 2, distal to canine. Rotation of premolars was seen in twin 2. The difference in the morphology of the second molar was seen in twin 1. Lower anterior crowding appears more severe in twin 1 as compared to twin 2. Both have Class I molar relation bilaterally. There were scissors bite on the left side in twin 1 which was not seen in twin 2 (Figs. 3 and 4). Few cephalometric parameters also revealed marked differences in skeletal morphology. The degree of differences in cranio-dento-facial morphology of twins is shown in Table 1.

A cephalometric analysis in both twins showed a Class II maxillomandibular relationship but more severe in twin 1. The mandible was more retrognathic in twin 1 as compared to twin 2. There was not much difference in position of the maxilla and mandible in relation to the cranial base. The height of the anterior facial and posterior facial height was more in twin 1 as compared to twin 2, but overall ratio showed more vertical growth pattern in twin 2. The effective length of the maxilla was more in twin 1; however, the maxilla-mandibular differences were almost similar in both the twins. The position of upper and lower lips was quite similar in both the twins. Lower incisors were placed more forwardly in twin 2. The position of the underlying skeletal bases

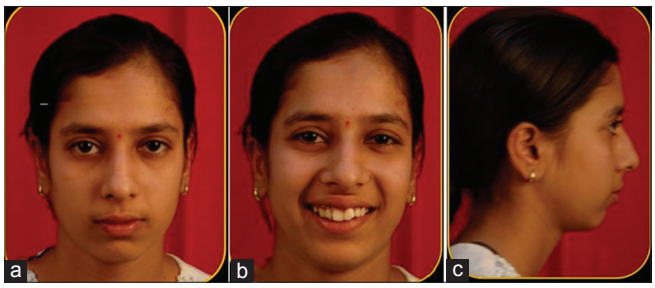

Figure 1: Twin 1 showing (a) front facial profile; (b) front smiling; (c) lateral profile

Figure 2: Twin 2 showing (a) front facial profile; (b) front smiling; (c) lateral profile

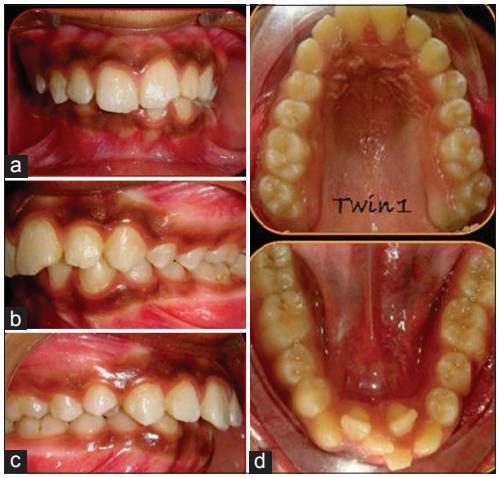

Figure 3: Twin 1 showing intraoral photographs (a) front; (b) left lateral; (c) right lateral; (d) occlusal

Figure 4: Twin 2 showing intraoral photographs (a) front; (b) left lateral; (c) right lateral; (d) occlusal

Table 1: Cephalometric parameters of twins

Parameters	Twin 1	Twin 2
SNA	81.5°	82°
SNB	75°	76°
ANB	7°	6°
Go-Gn to Sn	36°	38°
Anterior facial height	124 mm	100 mm
Posterior facial height	77 mm	73 mm
Jarabak ratio	62%	60.3%
FMA	34.5°	32°
Y-axis	64°	62°
Gonial angle	138.5°	135°
Anterior cranial base	75 mm	74 mm
Ramus height	55 mm	54 mm
Mandibular body length	71.5 mm	71 mm
Effective mandibular length	114 mm	113 mm
Effective maxillary length	93 mm	89 mm
Maxillomandibular length	21 mm	24 mm
Facial angle	81°	84°
UFH/LFH	0.7 mm	0.7 mm
Saddle angle	123°	122°
Articular angle	138.5°	144°
Sum of posterior angle	399.5	399
N perpendicular to point A	1.5 mm	4 mm
N perpendicular to Pog	14 mm	4 mm
Ls – (Sn-Pg')	8 mm	6 mm
Li – (Sn – Pg')	6 mm	7 mm
U incisor to Sn plane	111°	107°
U incisor to NA (mm)	6.5 mm	6 mm
L incisor to Apog line	6.5 mm	5 mm
L incisor to NB (mm)	5 mm	9 mm
Overjet	6 mm	5 mm
Overbite	100%	100%
Nasolabial angle	110°	106°

and their dentition contributed such difference. There was not much difference in overjet and overbite. Thus, marked differences in the cranio-dento-facial structures were noted in MZ twins.

DISCUSSION

Twin study is one of the most effective methods available for investigating genetically determined variables in orthodontics. Discordancy of malocclusion in MZ twins is a rare finding [2]. The variation in the shape and size of cranio-dento-facial structures depends on both genetic and environmental influences [3]. The separation of these two factors in the contribution of the severity of malocclusion is significant for clinical orthodontics. It may be possible to assess the prognosis of each type of the patient on the basis of hereditary background and environmental factors. The occlusion and skeletal malocclusion affected by environmental factors can be altered and improved by orthodontic treatment. Horowitz *et al.*[4] studied adult twin pairs using only linear

cephalometric measurements and demonstrated highly significant hereditary variations in the anterior cranial base, mandibular body length, lower facial height, and total face height. Studies have shown that there are distinct skeletal and facial patterns in MZ twins [5,6]. It is due to weak genetic control in such MZ twins [7].

In the present study, the convexity of the face in twin 1 was more as compared to twin 2. Relatively, the backward position of the mandible (Angle SNB) and increased effective maxillary length contributed to such variation. The anteroposterior position of the mandible in the present study seems to be significantly influenced by environmental factors which are genetically determined as reported by the studies done by Townsend and Richards [8]. There is a significant variation in the anterior and posterior facial height in both the twins.

As per the studies reported, anterior facial height is genetically determined [8] which is not so in the present study. The shape of the cranial base (saddle angle) was similar among twins. It was reported that the form of the cranial base is strongly influenced by environmental factors [9]. The articular angle and effective length of the maxilla and mandible were different in both twins. The growth pattern was almost similar in both the twins. Lower incisors were more forwardly placed in twin 2. The dentoalveolar compensation is considered an important environmental factor in the variation in both the twins.

From this twin study, we can conclude that genetics is not the only controlling factor for the etiology of malocclusion. Environmental factors do play an important role in the discordance of malocclusion in twins. Observations by orthodontists of twin pairs presenting at clinics can provide valuable information into how genes and the environment interact during development [1]. By studying twins, researchers can understand the role of genetic effects and the effects of shared and unique environmental effects.

Orthodontists are charged with the task of altering dental and skeletal morphology in growing and non-growing individuals at a one-on-one clinical level. These alterations must be carried out in a population characterized by great biologic diversity, evidenced by differently shaped faces and occlusal relationship. This variability of the craniofacial skeleton and dentition has been attributed to both genetic and environmental influences. One approach to refining our knowledge of the relative contribution of genetic and environmental influences on the variability of the craniofacial skeleton and dentition has been through the comparative study of twins.

CONCLUSION

Twin study is one of the most effective methods available for investigating genetically determined variables in orthodontics and other fields. Hence, the use of this model has proven effective in partitioning the variance of the craniofacial skeleton and its dentition into genetic and environmental components.

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Funding: None; Conflict of Interest: None Stated.

How to cite this article: Gupta JK, Jain VK, Gupta KC, Gupta KK. Nature versus nurture: A case report comparing the clinical and cephalometric pattern in Twins. Indian J Case Reports. 2019;5(1):10-12.

Doi: 10.32677/IJCR.2019.v05.i01.004