Class - III malocclusion: Genetics or environment? A twins study

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Abstract

Etiology of class-III malocclusion is generally believed to be genetic. A wide range of environmental factors have been suggested as contributing factors for the development of class-III malocclusion. Twin study is one of the most effective methods available for investigating genetically determined variables of malocclusion. Discordancy for class-III malocclusion is a frequent finding in dizygotic twins. However, class-III malocclusion discordancy in monozygotic twins is a rare finding. The purpose of this study of monozygotic twins is to assess the genetic and environmental components of variation within the cranio-dento-facial complex.

Key words: Class-III malocclusion, Genetics, monozygotic twins

Introduction

As defined by Angle,[1] class-III malocclusion represents a very small proportion of the total malocclusion. Class-III malocclusions are most prevalent in Oriental populations (3-5% in Japan[2] and 1.75% in China[3]). Its etiology is generally believed to be genetic, and familial occurrence has been demonstrated in several studies.[4,5] Certain X-chromosome aneuploidal conditions can also lead to mandibular prognathism[6] and are predominantly inherited trait.[7] A wide range of environmental factors have been suggested as contributing to the development of class-III malocclusion. Among those are enlarged tonsil,[8] difficulty in nasal breathing,[8] congenital anatomic defects,[9] disease of the pituitary gland,[10] hormonal disturbances,[11] a habit of protruding the mandible,[10] posture,[10] trauma and disease,[9] premature loss of the sixth-year molar[10] and irregular eruption of permanent incisors or loss of deciduous incisors.[12] Other contributing factors such as the size and relative positions of the cranial base, maxilla and mandible, the position of the temporomandibular articulation and any displacement of the lower jaw also affect both the sagittal and vertical relationships of the jaw and teeth.[13-16] The position of the foramen magnum and spinal column[17] and habitual head position[18] may also influence the eventual facial pattern. The etiology of class-III malocclusion is thus wide ranging and complex.[19] For investigation of genetically determined variables in orthodontics, twin study method is the most effective. Baker reported a case in which monozygotic twins were concordant for mandibular prognathism.[20] Korkhaus also reported two cases of monozygotic twins; one pair was concordant and another pair was discordant for class-III malocclusion.[21] The purpose of this study is to assess the variation of cranio-dento-facial complex of monozygotic twins with class-III malocclusion.

Case Report

A pair of monozygotic female twins is presented. The girls exhibited a marked similarity in facial appearance (Figure 1 and 2). Both had similar dentition; however their occlusions were dissimilar to some extent (Figure 3 and 4). In twin-1 reverse overjet, overbite and class-III molar relations were more severe than twin-2 (Figure 3 and 4). Both the twins had bilateral posterior crossbite. Cephalometric parameters of twins are shown in Table 1. Few cephalometric parameters also revealed marked differences in skeletal morphology. The degree of differences in cranio-dento-facial morphology of twins is shown in cephalometric superimposition (Figure 5). Cephalometric analysis showed class-III maxillo-mandibular relationship in both twins but more severe in twin-1. As compared to twin-1, twin-2 had flat cranial bases. The position of the maxilla was more backward and the position of mandible was more forward in twin-1 as compared to twin-2. Height of the anterior face was similar in both the twins but posterior facial height was more in twin-2. Position of the mandible in relation to anterior

Figure 1: Extraoral photographs of twin-1; 1a-Front view and 1b-Lateral view

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cranial base and Frankfort-horizontal plane was significantly different among twins. Effective length of the maxilla and mandible were less in twin-2, however the maxillo-mandibular differences in both the twins were almost equal. Position of upper lip in relation to the esthetic line was significantly different among twins. However, both twins had no absolute difference in lower lip position. The position of the underlying skeletal bases and their dentition contributed such difference. Class-III relationship of the incisors (Reverse overjet) and vertical overlap of incisors (Overbite) were more severe in twin-1. Thus marked differences in the craniao-dento-facial structures were noted in the monozygotic twins.

Discussion

Twin study is one of the most effective methods available
for investigating genetically determined variables in orthodontics and in other medical field. Discordancy for class-III malocclusion is a frequent finding in dizygotic twins,[22] however, class-III malocclusion discordancy in monozygotic twins is a rare finding. The variation in shape and size of the cranio-dento-facial structures depends on both genetic and environmental influences.[23] Many traits in cranio-dento-facial morphology relate to additive genetic and environmental factors.[24] The separation of these two factors in the contribution of severity of class-III malocclusion is significant for clinical orthodontics. It may be possible to assess the prognosis of each type of patient with class-III malocclusion on the basis of hereditary background and environmental factors. The region affected by environmental factors can be improved by orthodontic treatment. Many cephalometric studies showed distinct skeleto-facial pattern in monozygotic twins having class-III malocclusions.[14,15,21] It has been pointed out that because of a relatively weak genetic control similarity in facial structures decrease in older monozygotic twins.[25]

In the present study, concavity of the face (Angle of convexity) in twin-1 was more as compared to twin-2. Relatively more backward position of the maxilla (Angle SNA, N perpendicular to point-A) and forward position of the chin (Angle SNB, N perpendicular to Pog) contributed to such difference in the severity of facial concavity. The antero-posterior position of the mandible (Angle SNB, N perpendicular to Pog) in the present twin study was influenced significantly by environmental factors. However in a previous study undertaken by Townsend and Richards[26] reported that antero-posterior position of the mandible is genetically determined. Anterior facial height of both twins was apparently equal. It showed that the height of the anterior face is genetically determined and did not play any role in the discordance of class-III malocclusion. This is in agreement with the result of study done by Townsend and Richards.[26] The shape of the cranial base (Saddle angle) was different among twins. This characteristic played a major role in the discordance of class-III malocclusion. It was suggested that the form of the cranial base is least genetically controlled and strongly influenced by environmental factors.[27] The relative position of the maxilla (Angle SNA), temporomandibular joint (Articular angle) and effective length of mandible and maxilla were different in both twins. These characteristics played a significant role in the severity of class-III malocclusion as described by many authors.[14,15,26] Vertical position of the mandible in relation to the Frankfort-horizontal plane (FMA) was identical in both twins, but the interesting difference was the position of mandible in relation to anterior cranial base (SN-GoGn). Such severe spatial discrepancy of mandible in twin-1 was due to more upward tipping of anterior cranial base. Positions of the upper incisors were more variable than the lower incisors. Proclination of the lower incisors was relatively more in twin-2. Such dento-alveolar compensation was considered as an important environmental factor in the variation of severity of class-III incisor relationship among the twins. From this twin study it was concluded that genetic is not the sole controlling factor for the etiology of the class-III malocclusion. The multifactorial etiology of class-III malocclusion was confirmed. Environmental factors plays significant role in its severity. There are many open questions and further study need to be carried out to elucidate the true etiology of the class-III malocclusion.

References

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