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ORIGINAL ARTICLE

Changes in mandibular border movements in adult patients after correction of functional anterior crossbite

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Abstract *Background/purpose:* An effective approach for assessing masticatory function is necessary. The goal of this study was to establish an efficient method for evaluating mandibular border movements in patients after functional anterior crossbite was corrected.
Materials and methods: Five patients with functional anterior crossbite were included in this study. They were treated with edgewise appliance and improved super-elastic nickel–titanium archwire. The digital images were collected before and after anterior crossbite was corrected. The trajectory paths of mandibular border movement were evaluated on both the frontal and sagittal planes.
Results: When the mandibular border movement paths were analyzed on the frontal plane for the vertical displacement, significant increases in the maximum left- and right-lateral movements were observed. For the horizontal displacement, although decreasing trends were observed in the maximum mouth opening and protrusive movements, no significant difference was detected. However, horizontal displacements were generally greater in men than in women. When the mandibular border movement paths were analyzed on the sagittal plane, significant increases in all the vertical and horizontal displacements were observed at all border movements, except the maximum mouth opening. However, if the data were compared between men and women, significant difference was shown only in the horizontal displacement of the maximum protrusion.

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Conclusion: On both the frontal and sagittal planes, after correction of the anterior crossbite there are increases in vertical and horizontal displacements at all kinds of mandibular border movements except for the horizontal displacements at the maximum mouth opening and the maximum protrusion.

Introduction

The masticatory system is a functional system with a complex physiological structure composing of teeth, supporting structures around teeth, maxillary and mandibular bones, temporomandibular joint (TMJ), muscles and soft tissues attached to the mandible, as well as the vascular and nervous systems involved in mastication.[1] Disturbances in the structure, pattern, and function of the masticatory system are reflected by functional or structural disorders in its other components.[2,3]

The factors influencing masticatory functions can be divided into two groups according to physiological structures. The first group is the anatomic structures in the head and neck, including teeth, bones, muscles, TMJ, and ligaments. The second group is the ability of the nervous system that integrates the inputs from peripheral receptors and the rhythmical masticatory movements produced by a central pattern generator. Among the anatomic structures in the head and neck, dentition status appears to have a direct effect on masticatory function. Moreover, the most important factor influencing masticatory performance is the condition of teeth, including the number of teeth, occlusal patterns of teeth, structural intactness of teeth, and contact area between teeth.

Anterior crossbite is one kind of functional crossbite that can be defined as a situation in which the mandible is forced to an anterior position due to occlusal interference of the anterior teeth when the mandible is moving from mouth opening position to centric occlusion. The crowded maxillary and mandibular incisors are typically found in anterior crossbite patients who seek orthodontic treatment. In 1990, Eismann and Prusas[4] reported that anterior crossbite usually leads to excessive compression on the periodontal tissues during mastication. In case of anterior crossbite with concomitant teeth grinding, not only the produced large forces but also the direction of occlusal forces can result in changes of TMJ.[4,5] Thus, the stimulation of pressure receptors in the periodontal ligament and TMJ in anterior crossbite patients during mastication may change mandibular movements in order to relieve discomfort or to prevent structural damage.[6] For the anterior crossbite, patients who have no need for surgery, Proffit et al[7] described the principles for orthodontic treatment including labial tipping of the tooth axis of the maxillary anterior teeth or lingual tipping of the tooth axis of mandibular incisors. Furthermore, there are many optional devices for orthodontic treatment, which can be categorized into removable and fixed appliances.

This study aimed to establish an effective method for assessing masticatory efficiency, thereby to investigate the relationships between the mandibular border movements and the patterns of permanent dentition before and after the orthodontic treatment of functional anterior crossbite, and to contribute to the improvements in assessing malocclusion, treatment outcome, and occlusal function.[8–10]

Materials and methods

This study enrolled five patients (two men and three women, aged 16–28 years) from Division of Orthodontics, Department of Dentistry, China Medical University Hospital (CMUH). The inclusion criteria for the patients were as follows. First, the patients should have occlusal contacts in the center of the occlusion and should be diagnosed as having angle class III malocclusions of the first molars. Second, the relationships between maxillary and mandibular incisors should appear as an anterior crossbite in all four incisors during centric occlusion and the contact area should not be at the cutting edges of the maxillary and mandibular incisors during the closure to the centric relation position. Third, the permanent teeth should be intact and none of the teeth missing except the third molars. In addition, none of the teeth had unfilled cavity or obvious periodontitis. A single crown was acceptable, but there should be no dental bridge or fixed partial denture in the oral cavity. Fourth, no significant TMJ disorders were noted and there was no pain in masticatory muscles before entering the study. Fifth, the patients received no orthodontic treatments before entering the study.

All patients understood the procedures and related specific precautions. They signed the informed consent before entering the study. This study was reviewed and approved by the Institutional Review Board at the CMUH (Institutional Review Board number, CMUH-103-REC3-045).

All patients were treated with standard orthodontic brackets, adhesives, and improved super-elastic Nitinol nickel–titanium (Ti-Ni) alloy wire (ISW). The brackets were firstly bonded on the maxillary teeth, followed by using the ISW for leveling. Anterior crossbite arch was used for labial tipping of the maxillary incisors. The patients were asked to revisit the outpatient clinic every 2 weeks for evaluation to avoid the occurrence of excessive labial tipping of the incisors. Anterior crossbite arch was removed only after the cutting edges became the contact areas of the maxillary and mandibular incisors during the closure to the centric relation position (centric occlusion), and then replaced by a plain ISW for leveling. The mandibular incisors were also bonded with brackets for leveling. The patients were asked to revisit once per month at outpatient clinics for assessment. If necessary, the ISW multiloop edgewise archwire was placed in the mandibular arch for lingual tipping of the mandibular incisors, and appropriate intermaxillary elastics