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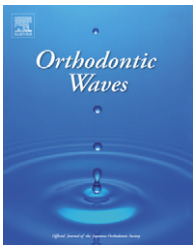

Research paper

Relationship between masticatory function, dental arch width, and bucco-lingual inclination of the first molars

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ABSTRACT

The aim of this study was to clarify the influence of masticatory function on dental arch forms. We evaluated the relationship between the masticatory movement path and occlusal force (as masticatory function) and the dental arch width and first molar bucco-lingual inclination. The subjects were 60 healthy adult females (mean 23.4 years; S.D. 1.6 years) without previous orthodontic treatment or functional abnormalities in the temporomandibular joint. Furthermore, the subjects were divided into a wide group (W-group) and a narrow group (N-group) based on mean maxillary inter-molar width in Japanese females. The masticatory path was recorded using gnathohexagraph system. Maximum occlusal force was measured using a simple type occlusal force meter. And subjects' arch width and bucco-lingual inclination of the first molars was measured. W-group showed larger arch width and the first molar was more upright on the buccal side compared with N-group. Furthermore, the lateral component of masticatory movement and maximum occlusal force was large in W-group compared with N-group. In the group which strong occlusal force and grinding type mastication had wide arch width and the mandibular first molars upright on the buccal side.

1. Introduction

The formation of dental arch morphology is influenced by jaw bones, muscles surrounding the mouth, and masticatory function. We have investigated dental arch form and molar tooth inclination from the perspective of orthodontics. Our evaluation of the relationship between first molar bucco-lingual inclination and maxillo-facial morphology [1,2] showed that the mandibular first molars were more upright on the buccal side, the mandibular cortical bone was thicker, and the dental arch width was larger in short facial type subjects in contrast to the long facial type. Comparing the dental arch form in Jomon period Japanese and that in modern Japanese [3], we reported that the molars were more upright on the buccal side and the dental arch width was larger in Jomon period Japanese. In these reports, we concluded that differences of masticatory function especially occlusal force and direction of occlusal force which applied to molars in the occlusal terminal phase influenced dental arch form and tooth inclination of the first molars. Furthermore, by a comparison of changes in dental arch form in crowding-improved and crowding-aggravation groups for 6 years until completing the permanent dental arch [4], the level of first molar buccal inclination and increases in the arch width were larger in the crowding-improved group than in the crowding-aggravation group. We speculated that masticatory function was involved

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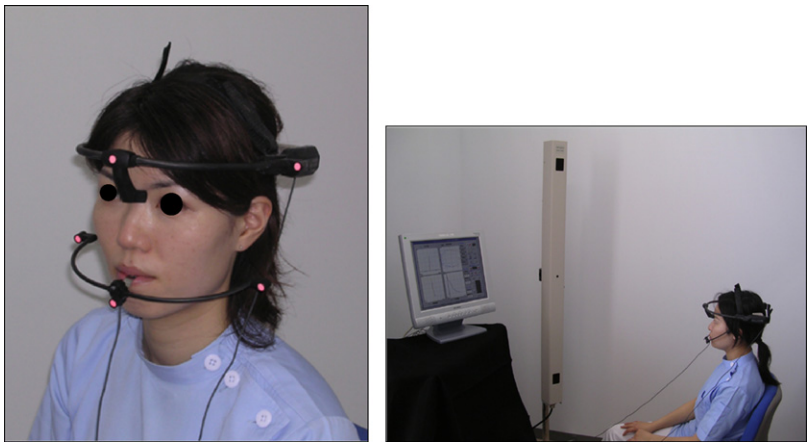

Fig. 1 – An experimental view of a subject with wearing a head frame and a face bow of Gnatho-Hexagraph. Six degrees of freedom consisted of a head frame, a face bow, light-emitting diodes (LEDs), optical cameras, and a personal computer (Gnathohexagraph system, Ono Measurement Apparatus Co., Kanagawa). The sampling frequency was 89.3 Hz. The mean measurement error of the system was 150 μm (S.D. = 10 μm) [6]. Each subject was seated in an upright but relaxed position with the head unsupported and naturally oriented. A head frame and a face bow, each with three light-emitting diodes, were set securely onto the head and the dental clutch, which was bonded to the labial surfaces of lower incisors, respectively. The clutch was bent to ensure that the movement of the mandible and lip was inhibited as little as possible [7]. Two CCD cameras were placed approximately 1.2 meters in front of the subject.

in these differences, and increases in masticatory function caused first molar positional changes and increased the arch width. Therefore, we considered that masticatory function influences the tooth inclination of the first molars and arch width, and increases in malocclusion in modern Japanese are related to decreases in masticatory function. However, we have not investigated the relationship between masticatory function and dental arch form in detail, and there have been few other previous reports. In this study, to clarify the influence of masticatory function especially occlusal force and direction of occlusal force which applied to molars in the occlusal terminal phase on dental arch form and molar inclination, we evaluated the relationship between the masticatory movement path and maximum occlusal force and the dental arch width and first molar bucco-lingual inclination.

2. Materials and methods

2.1. *Subjects and selection conditions*

The subjects were 60 healthy young adult females (mean 23.4 years S.D. 1.6 years) without previous orthodontic treatment and functional abnormalities in the temporomandibular joint, and with the induction induced canine teeth, in whom normal overlap was noted without marked maxillo-mandibular antero-posterior disharmony, the amount of crowding was less than −2.0 mm, all permanent teeth excluding the maxillo-mandibular third teeth had erupted, and no restorations were inserted in the maxillo-mandibular bilateral first molars. All subjects' informed consent was obtained prior to the investigation. And this study was conducted according to a protocol reviewed by the Board of Nihon University School of Dentistry at Matsudo. Furthermore, setting the mean maxillary arch width which was defined as the distance between the bilateral mesio-buccal cusp tips of the maxillary first molars in Japanese females as the reference value [5], the subjects were divided into a wide group (W-group) whose maxillary arch width was higher than the reference value, and a narrow group (N-group) whose value was lower than the reference value.

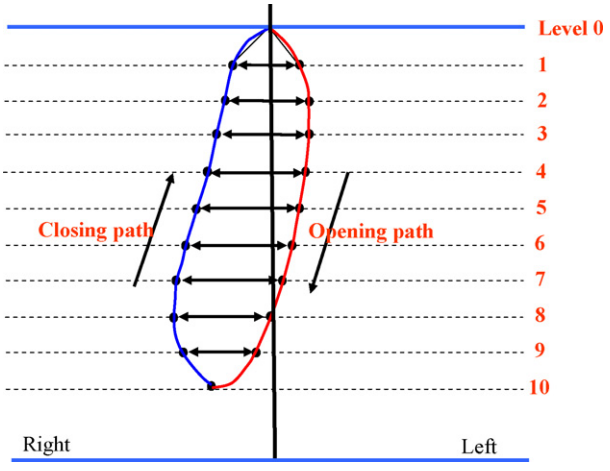

Fig. 2 – The measurements of masticatory widths (MW). Setting the intercuspal position to level 0, and mean maximum mouth opening position to level 10, we measured the distance corresponding to levels 1–9 on the mouth opening and closing paths, and the mean value was calculated as the masticatory width.