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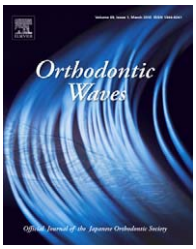

Research paper

Comparison of the efficiency of two types of intraoral splints in the RED system for maxillary distraction osteogenesis

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ABSTRACT

Purpose: This study was conducted to compare the ratio of maxillary advancement to the amount of activation achieved by distraction osteogenesis (DOG) using a rigid external distraction system with two different types of intraoral splints and to evaluate the applicability of a new type of splint.

Materials and methods: The mechanical deformation and the distraction efficiency of two types of intraoral splints, Type 1 and Type 2, were evaluated. The Type 1 was a conventionally used intraoral splint. Type 2 was a reinforced, custom-made splint composed of twin-labial arches made of 0.060-in. orthodontic wires. In this study, 11 cleft lip and palate patients were analyzed; 5 patients were treated using Type 1 splint and the other 6 using Type 2. Lateral cephalograms taken at 4 stages—the onset, the end of activation, immediately after the removal of distraction device, and 1 year after distraction—were superimposed and measured to estimate the advancement and relapse at point A.

Results: Type 2 splint demonstrated significantly higher strength than Type 1 in a tensile test. Distraction efficiency for Type 1 and Type 2 was 31.6% and 51.0%, respectively, demonstrating significantly higher efficiency for Type 2. On the other hand, the amount of relapse during the 1-year follow-up period did not show significant difference between two groups.

Conclusion: The distraction efficiency was affected by the types of intraoral splints used and maxillary distraction could be effectively performed using the reinforced intraoral splint without impairing the stability after DOG.

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1. Introduction

Distraction osteogenesis (DOG) is the process of generating new bone in a gap between two bone segments in response to the application of graduated tensile stress across the bone gap. Originally, DOG was a surgical process used to lengthen the long bones, fill the bone defects, and reconstruct skeletal deformities. This technique was first conceptualized by Codivilla [1] and its application for aiding the regeneration of hard and soft tissues was further developed by Ilizarov [2,3]. In this technique, osteotomized bone segments are gradually distracted at a rate of 1 mm/day after surgery, and the callus is stretched using a distraction device to promote osteogenesis. McCarthy et al. [4] were the first to succeed in lengthening the human mandible by using the distraction technique. Molina et al. [5] introduced maxillary advancement using DOG, which involved the use of an orthopedic face mask and elastics for applying traction after a maxillary corticotomy. Although their approach seemed promising, the amount of maxillary advancement achieved therein was insufficient.

Later, Polley and Figueroa [6–9] developed a rigid external distraction (RED) system. After a complete Le Fort I osteotomy, a cranially fixed halo was used as a point of anchorage to advance the maxilla that was connected through the dentition by an intraoral splint and surgical wires to the RED system. With the use of the external, adjustable, rigid distraction device, patients with severe maxillary hypoplasia can be treated using a precise and controlled distraction process and predictable results can be obtained.

The conventional intraoral splint of the RED system was made with a commercially available orthodontic headgear facebow [8]. However, the intraoral sprints and traction hooks occasionally deform as the distraction proceeds. As a result of the deformation, the efficiency of maxillary advancement by DOG would be impaired during activation of the RED device. The efficiency of DOG is assessed on the basis of the ratio of maxillary advancement to the amount of activation achieved using the traction screws. The purpose of this retrospective study is to evaluate the applicability of a new type of intraoral splint used in the RED system for maxillary DOG.

2. Materials and methods

2.1. *Intraoral splints*

In the present study, two types of intraoral splints were evaluated. Type 1 intraoral splint was a conventionally used, commercially available orthodontic headgear facebow which comprised of a long outer bow and an inner bow without loops [8]. The inner bow was bent to obtain the desired arch form, and the loose ends were passed through the headgear tubes for future fixation. The outer bow was bent anteriorly and upward, in order to clear the upper lip and with the hook ending at the level of the palatal plane. Further, the outer bow was stabilized with 0.060-in. orthodontic wires (Fig. 1A and B).

Type 2 was reinforced, custom-made splint composed of twin-labial arch of 0.060 in orthodontic wires bent to desired

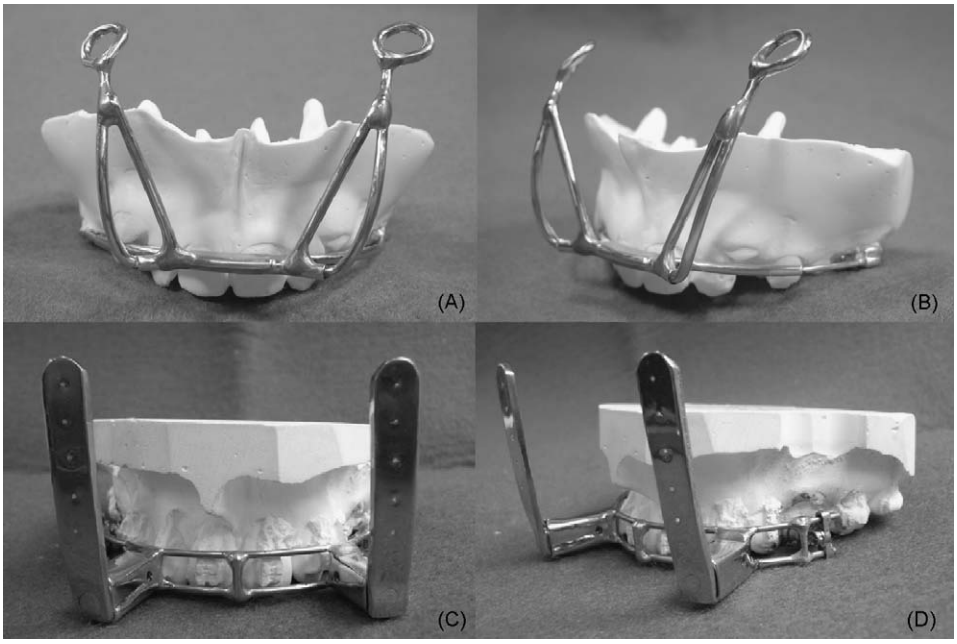

Fig. 1 – Frontal and lateral views of the intraoral splints.
(A and B) Type 1 is made of a commercially available orthodontic headgear facebow. The inner bow was bent to obtain the desired arch form. The outer bow was bent anteriorly and upward, in order to clear the upper lip and with the hook ending at the level of the palatal plane. The outer bow was stabilized with 0.060-in. orthodontic wires. (C and D) Type 2 is a reinforced custom-made splint composed of twin-labial arch of 0.060 in orthodontic wires. The arches were stabilized with 0.060-in orthodontic wires at the midpoint and posterior positions on both the sides. Two cast tubes, "sleeves", were weld to the intraoral splint just medial to the oral commissures and used to secure cast traction hooks. The traction hooks had pinholes at several levels that could be chosen for the application of desired vector of distraction.