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Case Report

Temporary anchorage device with interchangeable superstructure for mandibular tooth movement

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ABSTRACT

The aim of this report is to introduce our new temporary anchorage device (TAD) for the mandible, the superstructure of which is removable and enables mesiodistal movement, intrusion and extrusion, as well as expansion and constriction, employing the palatal implant with the same system as we reported previously. The TAD has a removable superstructure on a plate fixed on two screws. It is positioned on the external oblique ridge, and the superstructure shape can be changed into various forms. Case 1 was a 19-year old woman with an anterior open bite; her mandible was shifted to the left. The molar relationship was Class III on the right and Class II on the left, and inclination of the occlusal plane was observed. Intrusion of the maxillary right molars and distalization of the left molars were performed using the palatal implant. Distalization of the mandibular right molars was achieved using the TAD. Case 2 was a 38-year old man with an anterior cross bite and deviation of the mandible to the left. Distalization of the mandibular right molars and movement of the midline to the right were achieved using the TAD. The TAD system can handle all force systems, move teeth effectively, and save treatment time.

1. Introduction

Our previous paper described our new palatal implant with an interchangeable superstructure, the i-station1 [1]. The i-station1 enables three-dimensional movement of the maxillary teeth, such as mesiodistal movement, intrusion and extrusion, and expansion and constriction. Such a system has been needed in mandibular orthodontics as well, but there have been many challenges to overcome, including that the mandibular mucosa is movable and there is insufficient space for implant placement in the mandible. We have overcome these problems and successfully developed a new interchangeable implant system, the i-station3.

2. Implant design and placement

The i-station3 consists of a pair of screws, φ2 × 12 mm (i-screw), a plate (i-platform3) that is set on the screws, a superstructure (i-arm) fixed on the plate, and three caps (i-caps) that lock the superstructure (Fig. 1). The i-screw has a stopper to fix the i-platform3. Thanks to this stopper, the i-platform3 never sinks down and is completely fixed by the i-cap and maintained on the mucosa. Furthermore, this system requires no incision to embed it under the mucosa, minimizing surgical invasion (Fig. 2A). The i-platform3 consists of eight hexagonal holes in a line, one slot, and an attachment to attach the i-arm at the end (Fig. 1). The i-platform3 can be placed from the top regardless of the interval between the pair of screws. One i-screw is installed in the slot and another i-screw is installed in one of the eight holes according to the interval. The minimum longest diameter of the slot is obtained by adding the diameters of the two holes to the distance between the holes, which enables the i-station3 to be applied to the mandible, whose space is limited. The unnecessary part of the i-platform can be cut off using a plate cutter (Fig. 2B). Even if the two i-screws are not placed parallel or do not have the same height, the i-platform3 can be easily placed only by pushing with a band pusher to change the shape. Therefore, a complicated bending technique is not required (Fig. 2C). The i-screw head for the i-platform3 and the hole in the i-platform3 are integrated because the shape of both is hexagonal, and therefore, they are

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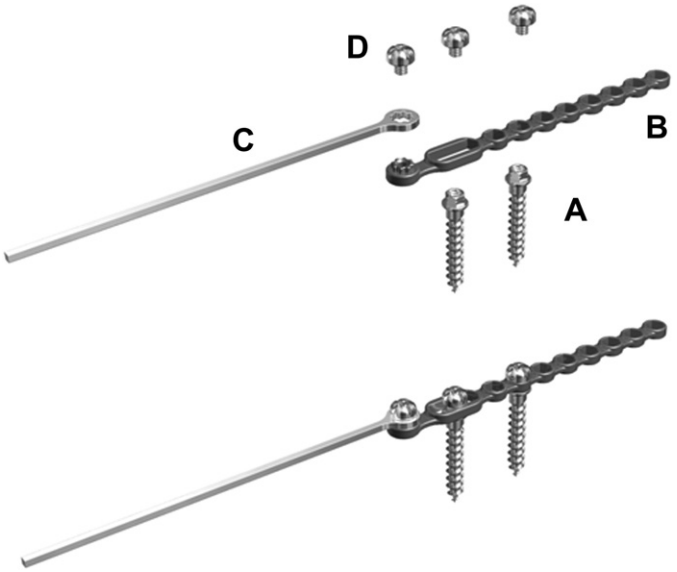

Fig. 1. Parts of i-station3—i-screws (A), i-platform3 (B), i-arm (C), and i-caps (D)—and assembled i-station3.

very stable and prevent loosening of i-caps and i-screws caused by rotation (Fig. 2D). The i-arm can be moved at 45-degree increments, which enables traction in various directions (Fig. 2E). The i-arm is made of stainless steel and has two types of components:

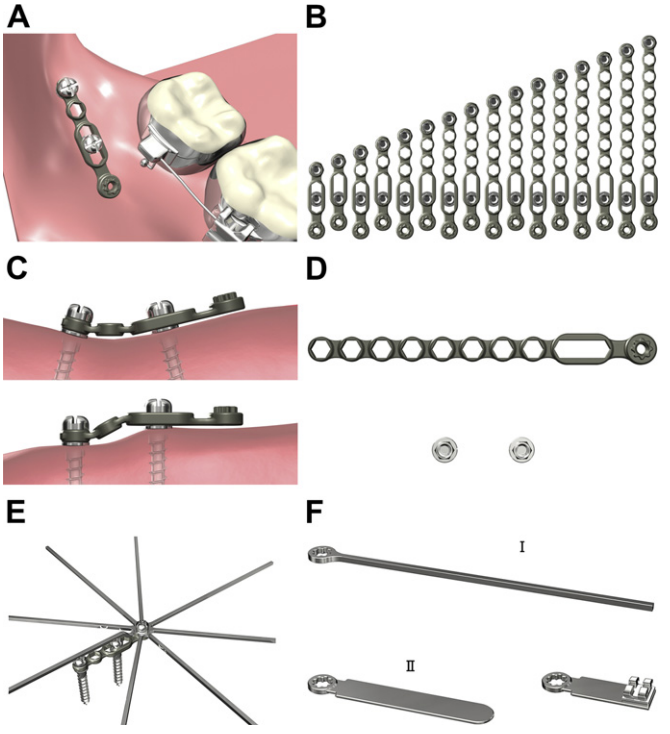

Fig. 2. Characteristics of i-station3. (A) The i-platform3 fixed on the mucosa. (B) The i-platform3 can be placed at any interval between the screws. (C) The i-platform3 can be placed even if two i-screws have different height or are not placed parallel. (D) The i-screw head and hole in i-platform3 are hexagonal. (E) The i-arm can be moved at 45-degree increments so that 360-degree traction is possible. (F) Types of i-arm: I) i-arm square wire; II) i-arm plate. The i-arm plate can be soldered to a bracket (unnumbered illustration).

Fig. 3. The i-platform3 placed in external oblique ridge area.

a 0.032 × 0.032-inch i-arm square wire and a 4-mm-wide plate (i-arm plate). The shape can be changed according to the purpose. The i-arm plate is used with welding brackets, and so forth (Fig. 2F).

The i-station3 is placed in the external oblique ridge area of the mandible. This is because the cortical bone in this area has sufficient thickness and hardness, and further, the i-screw never reaches the tooth roots or the inferior alveolar canal [2,3]. After a pilot hole is created directly through the mucosa with a 1.6-mm diameter drill without making an incision in the mucosa, the i-screw is inserted into the hole. Again, another hole is created with a drill at an appropriate interval from the previously inserted screw, and the second i-screw is inserted into the new hole. The i-platform3 is cut with the same interval between i-screws and pushed with a band pusher in the screw head. Then, the i-platform3 is fixed on i-screws using i-caps (Fig. 3). An alginate impression is taken and the i-arm is fabricated on a plaster model. The i-arm is set on the i-platform3 on the day of the next visit.

2.1. Orthodontic mechanics

Figure 4 illustrates the orthodontic mechanics using the i-arm. Figure 4A shows the method by which mesial movement of molars can be achieved by traction using elastic modules by extending the arm forward. Figure 4B shows the method of lateral movement of the anterior teeth for midline correction. Figure 4C shows a method of distal movement of the mandibular entire dentition by extending the arm backward. Figure 4D shows the specific method using the i-arm plate. A bracket was welded to the i-arm plate, and an activated stainless steel wire was inserted into the brackets of the plate and the first molar. Shortening of the wire achieves intrusion of the molars, and expansion of the wire achieves extrusion of the molars.

3. Case 1

3.1. Orthodontic problems

The patient was a 19-year-old woman complaining of open bite. Open bite from the left first molar to the right first molar was observed. The molar and canine relationship was Class III on the right side and Class II on the left side. Overbite was −1 mm, overjet 1 mm, and space deficiency was −5 mm in the maxilla. A skeletal deviation to the left in the mandible was observed; the maxillary