Fixed Functional Space Maintainer Incorporating a Tenon-Mortise Connector

Abstract

This case report highlights the incorporation of a tenon-mortise type of nonrigid connector between two adjacent pontics in a fixed functional space maintainer, to allow limited passive eruption and alignment of young permanent teeth. A 13-year-old male patient had lost his lower second premolar and first molar on the right side, secondary to the surgical removal of an odontogenic keratocyst a year ago. A space maintainer had to be placed until implants, or a fixed partial denture could be placed, after the completion of his growth. The appliance consisted of band type retainers with rests on the first premolar and the second molar, rigidly connected to their adjacent pontics (second premolar and first molar), with a tenon-mortise type of connector between the pontics. The casting was composed of nickel-chromium, out of which the pontics were layered with ceramic.

Keywords: *Ceramic, functional space maintainer, nickel-chromium, nonrigid connector, retainer*

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Introduction

The occlusal forces directed on to a fixed partial denture (FPD) are transmitted on to its constituents such as pontics, connectors, and retainers.[1] High-stress concentrations occur mostly in the region of the connector and the cervical areas of abutment teeth near the edentulous ridge.[2,3] For this reason, connectors have been considered as the heartthrob of abutments.[1] They are further classified into rigid connectors (solder joints or cast connector) and nonrigid connectors (NRC); precision attachment or stress breaker.[4]

NRC are generally indicated in FPD involving ier abutments; misaligned abutments requiring excessive preparation to achieve parallelism that could lead to pulp exposure; long edentulous span where distortion due to shrinkage from the pull of porcelain on thin sections of the framework is a possibility; anterior and posterior regions in the lower arch since the mandible flexes mediolaterally while opening and closing; abutments that cannot provide adequate retention and; mobile abutments that need to be splinted together.[5,6] However, this case report highlights the incorporation of a tenon-mortise type of NRC between two adjacent pontics in a fixed functional space maintainer (FFSM), to allow limited passive eruption and alignment of the abutments, that happened to be young permanent teeth. Never before in literature has an NRC been used between two adjacent pontics that constituted an FFSM.

Case Report

A 13-year-old male patient visited the Department of Pedodontics with the complaint of missing lower right teeth in the posterior region. On intraoral examination, 45 and 46 were found to be missing [Figure 1a and b]. All other teeth were present in both the arches, consistent with his age. Extraorally, no significant findings were observed. A case history revealed that the patient had undergone surgery for the removal of an odontogenic keratocyst almost 1 year ago. A preoperative orthopantomograph (OPG) revealed the presence of the cyst in relation to 45 that had extended till 46, necessitating their removal [Figure 1c]. Postoperatively, a removable partial denture was inserted to replace the missing teeth (45 and 46); however, the patient had discontinued its use since he was unhappy with the inconveniences associated with a removable appliance. OPGs taken after 6 months postoperatively showed uneventful healing of the cystic space [Figure 1d].

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It was decided to fabricate an FFSM until implants or an FPD could be placed, after the completion of his growth. Informed consent was obtained from the patient and his parents after explaining the outcomes and the advantages of placing an FFSM until the completion of his growth. A pattern resin (GC Corporation, Tokyo) coping was used for gingival retraction, to completely expose the distal portion of the semi erupted 47 [Figure 1e], following which, a light body putty (Aquasil, Dentsply) impression was made of the lower arch [Figure 1f].

In the dental laboratory, the impression was poured with die stone, and a cast was obtained. Wax patterns were fabricated of the retainers (bands and rests) and the pontics, such that, the distal pontic (46) and its band encircling 47 formed one assembly, while the mesial pontic (45) and its band encircling, 44 formed another assembly [Figure 2a and b]. Both the assemblies were connected using a castable tenon-mortise type of NRC. The assemblies were then casted using nickel chromium [Figure 2c-f]. A metal trial was carried out intraorally to check for accuracy and minor adjustments [Figure 3a]. The casting was then layered with ceramic [Figure 3b-d] and bonded intraorally using luting glass ionomer cement [Figure 3e and f].

Discussion

NRC utilize the "broken stress" principle by enabling stress distribution and preventing destructive strain.[6-8] NRC transfer shear stresses to the supporting bone, relieving the connectors and minimizing mesiodistal torquing of the abutments, allowing them to move independently.[9,10] They also contribute to increasing the stability, duration, and overall success of any long span FPD by functioning as safety valves against the leverage forces exerted by rigid connectors.[5,11]

The most commonly used NRC is of the tenon-mortise type consisting of a key (tenon or patrix) and a keyway (mortise or matrix), wherein a T-shaped key is locked in a dovetail-shaped key way, such that the cylindrically shaped keyway (mortise) is parallel to the path of the key (tenon).[5,12,13] Other types of NRC used include cross pin and wing connector, loop connector, and split connector.[4]

In this design, the band (retainer) on the anterior abutment (44) was rigidly connected to the pontic (45) posterior to it, and the band on the distal abutment (47) was rigidly connected to the pontic (46) anteriorly to it. However, both the pontics (45 and 46) were connected to each other with a tenon-mortise NRC. Since 44 and 47 had recently erupted, passive eruptive movement, and alignment of 44 and 47 were expected to occur over the next few years. Therefore, it was necessary to incorporate an NRC assembly between the pontics so that both 47 and 44 would have limited ability to erupt or realign further.

If the NRC was placed between the retainer on 44 (abutment) and 45 (pontic), it would have resulted

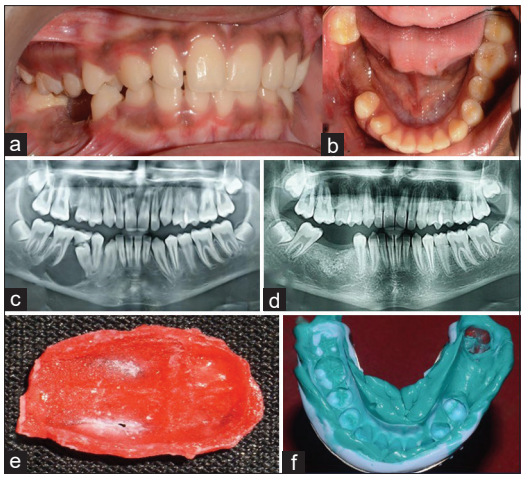

Figure 1: (a) Right lateral intraoral view, (b) Occlusal view of the lower arch, (c) Preoperative orthopantomography, (d) Postoperative orthopantomography, (e) Pattern resin coping, (f) Light body putty impression

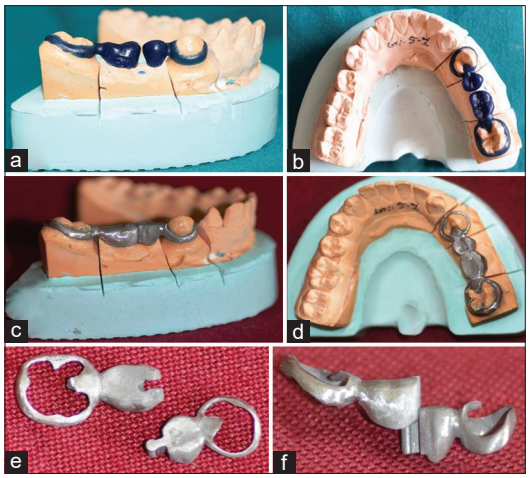

Figure 2: (a) Right lateral view of the wax pattern, (b) Superior view of the wax pattern, (c) Right lateral view of the casting, (d) Superior view of the wax pattern, (e) Tenon and mortise assemblies attached to their corresponding pontics and retainers, (f) Precision attachment between the tenon and mortise assemblies

Figure 3: (a) Intraoral metal trial, (b) Right lateral view of the casting layered with ceramic, (c) Superior view of the casting layered with ceramic, (d) Precision attachment of the final appliance, (e) Intraoral occlusal view of the appliance, (f) Intraoral right lateral view of the appliance

in an excessively long cantilever situation wherein the retainer on the distal abutment (47) and both the pontics (45 and 46) would have had to be rigidly connected together. Likewise, if the NRC was placed between the retainer on 47 (abutment) and 46 (pontic), it would have resulted in an excessively long cantilever situation wherein the retainer on the mesial abutment (44) and both the pontics (45 and 46) would have had to be rigidly connected together. The above design options could have resulted in the difficulty in obtaining parallelism between the retainer and the rigidly connected pontics especially in the case of the mesially angulated distal abutment (47). Preparation of 47 to achieve parallelism could not be considered since it was a young permanent tooth. Moreover, the excessively long cantilever would have resulted in abutment failure, either by connector breakage, debonding of retainers, destruction of the periodontium, or intrusion of abutment teeth. Intrusion of an abutment could lead to debonding or bond failure of its retainer, leading to marginal leakage and dental caries.[12]

Alternatively, if the NRC was placed on either side (one NRC between the retainer of 44 and 45, and the other between the retainer of 47 and 46) with a rigid connector between the pontics (45 and 46), the pontics could easily dislodge by superior displacement during mastication. Both the abutments (44 and 47) would also have had to be prepared to achieve parallelism to incorporate NRC on either side, which was not an option in this case since they were young permanent teeth. Moreover, since bands were used as retainers, enough connector width was unavailable to incorporate a tenon-mortise NRC between either of the retainers and their adjacent pontics. Therefore, designing the FFSM incorporating an NRC in the middle between both the pontics (45 and 46) was the best alternative.

Bands were used as retainers instead of crowns because the abutments that supported them could not be prepared since they were young permanent teeth. Occlusal rests were incorporated in the FFSM that rested on the mesial and distal abutments, to transmit occlusal forces along their long axes and to prevent the downward displacement of the bands. The occlusal rests did not require any tooth preparation since they were fabricated on the mesial triangular fossa of 47 and on the distal triangular fossa of 44. The modified ridge lap design was used to fabricate the pontics for the advantage of being hygienic and easily cleansable.

The FFSM was inserted to bridge the edentulous span that had resulted after the surgical removal of 45 and 46. It was planned to remove the FFSM and place implants or an FPD, after the completion of his growth. The FFSM fabricated had limitations such as increased laboratory time and costs. However, the patient is being followed up at 6 month intervals for the last 3 years, and there have been no complaints with the FFSM ever since its insertion.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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