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Enhancing Pediatric Orthodontic Outcomes: A Modified fixed functional nance palatal space maintainer for arch integrity, function and aesthetics - A Case Report

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Abstract
Introduction: Deciduous teeth are crucial for a child's development, aiding speech, chewing, aesthetics, and guiding permanent teeth alignment. Premature loss due to caries, trauma, or ectopic eruption can lead to undesirable tooth movement and malocclusions.
Patient Concerns: A six-year-old male reported pain in the upper and lower front and back teeth for four months. Intraoral examination revealed root stumps in teeth 51, 61, 64, and 55; severe caries in teeth 52, 62, 54, 74, and 84; and proximal caries in teeth 63, 73, and 83. The patient was concerned about aesthetics, missing spaces, and compromised masticatory function following necessary extractions.
Clinical Findings: Intraoral examination revealed significant carious destruction and compromised primary tooth resulting in space loss due to necessary extractions. Radiographs (IOPA) confirmed the need for space maintenance to prevent malocclusions, address masticatory issues, and improve aesthetics.
Primary Diagnoses: Extensive carious destruction in primary teeth with associated space loss, leading to risks of future malocclusions, masticatory difficulties, and aesthetic concerns.
Interventions: A modified Nance palatal space maintainer addressed space loss. The appliance featured bilateral acrylic teeth for function and an anterior acrylic tooth for aesthetics.
Outcomes: The space maintainer preserved the dental arch, supported masticatory function, and enhanced the patient's smile. It effectively addressed functional, aesthetic, and masticatory concerns, preventing malocclusions.
Conclusion: The modified Nance palatal space maintainer offered a comprehensive solution for managing space loss from early primary tooth extraction, and maintaining dental arch integrity, function, and aesthetics. This underscores the importance of effective space management in pediatric dentistry.

Keywords: Space maintainer, Pediatric Orthodontics, Nance palatal, Esthetics, Primary Teeth and Malocclusion

1. Introduction

Deciduous teeth are essential for a child's growth, aiding in speech, chewing, aesthetics, and function. They guide and hold space for permanent teeth until eruption. Premature loss due to caries, trauma, or other causes can disturb this process, leading to undesirable tooth movement and loss of arch length. This can increase the severity of malocclusions such as crowding, rotations, impactions, and crossbites. The best prevention is to maintain primary teeth in the arch until natural exfoliation, as they are the most effective space maintainers for permanent teeth [1].

Retaining the primary teeth until they naturally exfoliate helps to prevent arch length loss and reduces the need for complex future orthodontic treatments. However, if early extraction or loss of a tooth is unavoidable due to severe caries or other factors, according to Boucher fixed or removable orthodontic appliance are used to preserve the space created by the premature loss of a primary tooth or group of teeth. So, the best approach to preserving arch space is to use a space maintainer [2, 3].

Fixed space maintainers are commonly recommended to retain the space left by the unilateral or bilateral premature loss of primary teeth in either arch.[4]Traditionally, the treatment of choice for bilateral loss of teeth in the maxilla is a Nance appliance [5].

The aim of this case report is to demonstrate the use of a modified Nance palatal space maintainer to preserve dental arch integrity. This appliance includes bilateral acrylic teeth for masticatory support and an anterior acrylic tooth for aesthetics, providing functional and aesthetic benefits by maintaining arch space, aiding in chewing, and enhancing the smile's appearance.

2. Case Report

A six-year-old male patient reported to the OPD of department of pediatric and preventive dentistry presented with a chief complaint of pain in both the upper and lower front and back tooth regions in the past 4 months. On intraoral examination root stumps seen in relation to 51, 61, 64, and 55, along with severe caries in relation to 52, 62, 54, 74, and 84. Additionally, proximal caries was observed in relation to 63, 73 and 83.

To come to a definitive treatment plan, an Intraoral Periapical radiograph was taken for the teeth specific to patient's chief complain to assess the status of the permanent dentition. The proposed plan included the extraction of teeth 51, 61, 55, and 64 dues to pathologic root resorption. Additionally, pulpectomies were planned for teeth 54, 74, and 84, followed by the placement of stainless-steel crowns. For Teeth 52 and 62 composite restorations with strip crowns was planned, while for teeth 73 and 83 restoration with glass ionomer cement (GIC) was planned.

Due to the parent's concern about their child's teeth, particularly regarding esthetics and the missing space resulting from the extraction of anterior teeth 51 and 61, a modified functional Nance palatal space maintainer was planned. The appliance will include acrylic teeth bilaterally to support masticatory function and an acrylic tooth in the anterior region to address aesthetic concerns.

3. Intervention

3.1 Construction of the modified Nance palatal space maintainer

3.1.1 Design and Construction

To address the space loss resulting from the premature extraction of primary teeth, a modified Nance palatal space maintainer was designed and fabricated. This appliance was specifically developed to preserve arch integrity, support masticatory function, and enhance aesthetics.

3.1.2 Armamentarium

- Stainless steel band material or preformed bands.
- Pliers contouring pliers, band forming pliers, band seater or pusher, band adapter, hoe pliers (straight and curved), band cutting scissors, bird beak pliers, crimping pliers, three-pronged pliers, universal pliers.
- Stainless steel wires (round) for primary molars: 0.005 × 0.180 × 2 inch.
- Spot welding unit, soldering unit, silver solder, flux.
- Wire cutter.
- Finishing burs, polishing stone.

3.1.3 Construction Procedure

1. **Band Preparation:** Stainless steel bands were adapted to fit the first molars. The bands were contoured and seated using appropriate pliers.
2. **Arch Wire Design:** The arch wire was extended anteriorly, ensuring it did not contact the surfaces of the primary molars to prevent displacement of the successor bicuspids. A small U-shaped bend, approximately 1–2 mm from the soft tissue at the rugae area, was incorporated to enhance acrylic retention. Additional U-shaped bends were created and soldered around teeth 55 and 64 to stabilize the acrylic teeth for masticatory function.
3. **Acrylic Button Placement:** An acrylic button, measuring 0.5 inches in diameter, was placed on the descending portion of the palatal vault, approximately 1–2 mm below the incisive papilla. This button extended anteriorly to support the acrylic teeth related to teeth 51 and 61, addressing aesthetic concerns.
4. **Acrylic Teeth Fabrication:** Bilateral acrylic teeth were attached to the appliance to support masticatory function. An anterior acrylic tooth was included to improve aesthetics.
5. **Final Adjustments:** The appliance was soldered, finished, and polished to ensure a smooth and comfortable fit.

3.1.4 Post appliance Delivery and follow-up

3.1.4.1 Post-Insertion Instructions for Space Maintainers

After delivering the space maintainer, the patient is instructed to avoid sticky or hard foods. Oral hygiene maintenance by brushing and flossing regularly. Are to be taken care of patient is informed about minor discomfort, in case of severe incompetency they need to contact their treating pediatric dentist. Attend follow-up appointments, and report any issues like looseness or damage of appliance. Avoid excessive pressure, while the appliance is in use and seek prompt care if the appliance is dislodged or broken.

3.1.4.2 Outcome and follow up

During the 1-week and 4-week follow-up visits, the patient reported being comfortable with the appliance and expressed great satisfaction with the aesthetic results. The patient was instructed to return for monthly follow-up appointments to monitor the eruption status of the permanent central incisors.

As the patient is currently six years old, the upper permanent central incisors are expected to erupt within the next two years. At that time, the space maintainer will be adjusted: it will be removed, and the anterior segment, along with the anterior acrylic tooth, will be trimmed and replaced in the same position. This adjustment will transform the appliance into a conventional functional Nance palatal space maintainer, which will continue to support the integrity of the dental arch and facilitate proper alignment of the emerging permanent teeth.

4. Discussion

Throughout the treatment process, various procedures were performed to address the patient's dental needs, including composite restorations, extractions, pulpectomies, stainless steel crowns, and Glass Ionomer Cement (GIC) restorations.

For the space maintainer, bands were adapted on the first molars, and an alginate impression was taken. After a satisfactory try-in, the appliance was cemented in place. The patient was also instructed on proper oral hygiene practices.

Various types of space maintainers have been developed to preserve space in the dental arch in which, the primary consideration while choosing a space maintainer should be its longevity. Ensuring that the maintainer provides durable and effective space preservation is essential for optimal outcomes & for the overall child's dental development [6]. According to H.N. Nance in 1947, a bilateral, non-functional, passive, maxillary fixed appliance consists of a heavy gauge stainless steel wire soldered to the palatal aspect of the first permanent molar bands. An anteriorly approximates rugae area via acrylic button [1]. It has been observed that if a space maintainer is not placed shortly after the loss of a primary tooth, the opportunity to prevent space loss at the extraction site is missed. Reports indicate that there is an immediate space loss of 1.5 mm per arch side in the mandible and 1 mm in the maxilla. Hence, there is a need for an appliance that can address both preventive and interceptive orthodontic needs simultaneously [5].

In present case report, a modified Nance space maintainer was fabricated to address the challenges presented by the premature loss of primary teeth in a six-year-old male patient. The case highlights the importance of maintaining arch integrity, function, and aesthetics in pediatric dentistry through the strategic use of orthodontic appliances.

a. **Importance of Space Maintenance:** Premature loss of primary teeth can lead to drifting of adjacent teeth, loss of arch length, and misalignment of erupting permanent teeth. A modified Nance space maintainer preserves arch space and guides the permanent teeth into proper positions, preventing long-term orthodontic issues. This intervention facilitates the movement of both deciduous and permanent teeth, preserving arch perimeter and avoiding ectopic eruptions.
b. **Design and Functionality:** The modified Nance space maintainer features an arch wire extended anteriorly without contacting primary molars to avoid displacing successor bicuspids. U-shaped bends in the wire and bilateral acrylic teeth stabilize the appliance and ensure masticatory function. An acrylic button in the palatal vault supports anterior acrylic teeth, contributing to function and aesthetics. The design is easy to fabricate and allows for proper oral hygiene.
c. **Aesthetic Considerations:** The design addresses aesthetic concerns with an acrylic tooth in the anterior region, improving the patient's smile and providing a natural appearance, essential for self-esteem, Proper speech and psychological well-being. Composite restorations and strip crowns enhance the aesthetic outcome. Space maintainers must not interfere with masticatory function or dentoalveolar growth. Regular dental check-ups and Investigation like IOPA helps to monitor the eruption of permanent teeth and allows analysis of current status of the space maintainer.

Space maintainers come with various advantages and disadvantages. It is crucial that these devices do not interfere with the patient's masticatory function or hinder dentoalveolar growth [6]. Similarly, such modifications of the Nance palatal space maintainer here reported by various authors includes:

- In 2013, Sethi N, *et al.* [7] modified the Nance palatal arch appliance for post-extraction replacement of maxillary central incisors, using natural teeth as Pontics.
- In 2015, Arora N, *et al.* [8] modified the Nance palatal button to create a habit-breaking appliance for tongue thrusting, incorporating an acrylic button and features for distalization.
- In 2020, Gawali PN, *et al.* [6] introduced a novel technique with the modified Nance palatal arch for space preservation after tooth loss and correction of anterior crossbite.
- In 2023, Thakkar SV, *et al.* [5] presented a case series detailing their modification of the Nance palatal space maintainer for crossbite correction.

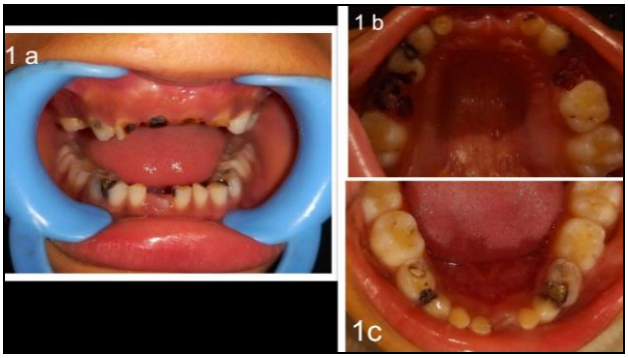

Fig 1: (a) Preoperative image - Frontal View, (b) Pre-operative maxillary occlusal view, (c) Mandibular occlusal view

Fig 2: Appliance design, modified Nance palatal arch appliance

5. Conclusion

The present case report showed that the newer modification of the Nance palatal space maintainer is an effective option for preserving space in cases of premature tooth loss and maintaining dental arch integrity. This appliance design successfully addresses both functional and aesthetic considerations, proving to be a valuable tool in pediatric orthodontics. Continued evaluation of the long-term use of such appliances will be beneficial for refining and enhancing treatment strategies for similar challenges. For successful space maintenance, a pediatric dentist must not only have a solid understanding of space management principles and the dynamic development of occlusion but also ensure regular follow-up and recall visits.

6. Informed consent Statement

Informed consent was obtained from the patient's guardians for the proposed treatment and the use of the modified Nance palatal space maintainer. All risks, benefits, and alternative treatment options were thoroughly discussed.

Fig 3: (a) Post-operative maxillary occlusal view showing a pulpectomy followed by the placement of a stainless-steel crown on tooth 54, composite restorations with strip crowns on teeth 52 and 62, and extractions of teeth 55 and 64, (b) Post-operative mandibular occlusal view showing a pulpectomy followed by the placement of stainless-steel crowns on teeth 74 and 84, and GIC restorations on teeth 73 and 83

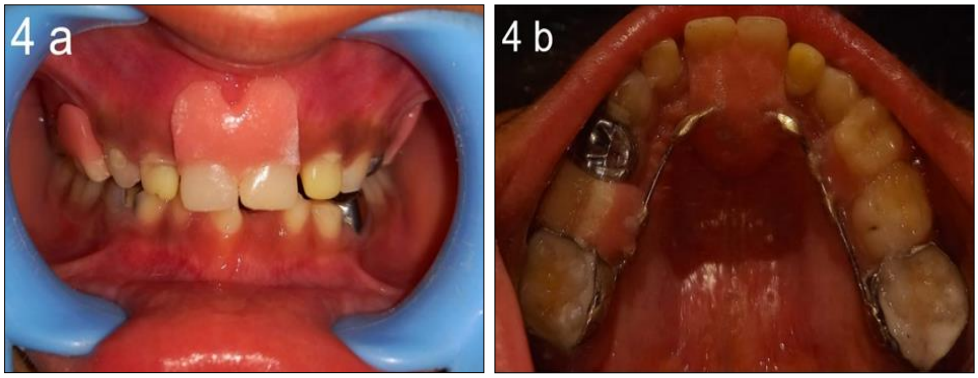

Fig 4: (a) and 4(b) cementation followed by delivery of the appliance, a) Frontal view, b) Occlusal surface of maxilla with appliance

Conflict of Interest
Not available

Financial Support
Not available

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