

3D Space Management In Mixed Dentition

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Abstract

Despite the best preventive efforts, premature loss of deciduous teeth remains a common problem in pediatric dentistry, leading to loss of arch circumference, malpositioning and even impaction of permanent tooth. Space maintainers (SMs), is a special appliance used for maintaining spaces created by premature loss of deciduous teeth. Band and loop space maintainers are indicated whenever there is premature molar loss. These two case reports were conducted to summarize the limitations of commonly used conventional band & loop space maintainers and to provide insight into technical advances in the field to overcome them. Digital workflows are not a new concept in dentistry, but they are just beginning to be used in pediatric dentistry. It seems to be suitable for use with children, as it has impressive advantages in terms of accuracy, comfort and time savings. This workflow helps reduce anxiety and improves cooperation and enthusiasm for children's dental appointments by reducing chair time and shortening procedures.

Key Words: Space maintainers, 3D space maintainer, Band and loop space maintainer.

INTRODUCTION

The primary dentition plays a crucial role in the child's growth and development. Apart from its effects on speech, mastication and esthetics it also aids in the eruption and guidance of permanent teeth.¹

Exfoliation of primary teeth and eruption of permanent teeth is considered to be a normal physiological process,² any disruption of this normal process leads to the loss of arch length which further can manifest as malocclusions within the permanent dentition in the form of crowding, tooth impaction and supraeruption of opposing teeth.³ Effective maintenance of the edentulous space is necessary to eliminate these negative effects.⁴ The safest approach for maintenance of space is by placing a space maintainer (SM) appliance.

Space maintainers are categorized as removable or fixed, active or passive, functional or non-functional and unilateral or bilateral.⁵ The fixed space maintainers are usually indicated in cases of unilateral/bilateral premature loss of primary teeth

in either of the arches to maintain the space. Amongst the various fixed space maintainers, band and loop are one among the foremost frequently used appliances with high success rates.⁶ In spite of good patient compliance, conventional appliances have certain limitations *viz.*, (1) requiring multiple appointments; (2) impression making which may be difficult in a young or an uncooperative patient or in patients with innate reflex; (3) long construction time; (4) breakage of solder joint; (5) technique sensitive procedure.⁷

As technology is advancing, these limitations can be overcome by the newer modality known as 3D printing also known as additive manufacturing, desktop fabrication or rapid prototyping.⁸ 3D printing is a process for making a physical object from a three-dimensional digital model. It's a single unit fabrication where no solder joint is required which results in reducing the breakage of the appliance and further eliminates the chair side and laboratory work time. It also replicates the dental models in the most accurate forms and allows for supreme position, thus minimizing human error.⁹

APPLIANCE DESIGN AND FABRICATION PROCEDURE

- 1) Digital impression is made via intraoral scanner (Omniscam)
- 2) The data is stored in STL format.
- 3) The file is sent to laboratory via internet.
- 4) With the help of CAD software desired appliance is designed and manipulated as per requirements.
- 5) The designed appliance once finalized is printed using 3D printer.
- 6) Finishing and polishing of the appliance is done.
- 7) Fabricated appliance is then cemented inside patient's mouth using Type 1 GIC.

CASE REPORT

CASE NO. 1

A 7-year-old female child reported to the Department of Pediatric and Preventive Dentistry with a chief complain of missing tooth in the mandibular right posterior tooth region (tooth no 84). Intraoperative periapical radiograph was advised to confirm the position of erupting premolar. For maintaining the space, "3D Printed Band and Loop" SM was fabricated and delivered FIG 1(A-D).

Instructions on oral hygiene and appliance maintenance were given to both children and parents. The patient was recalled after 3, 6 & 9 months.



FIG 1(A) PRE-OPERATIVE INTRAORAL VIEW

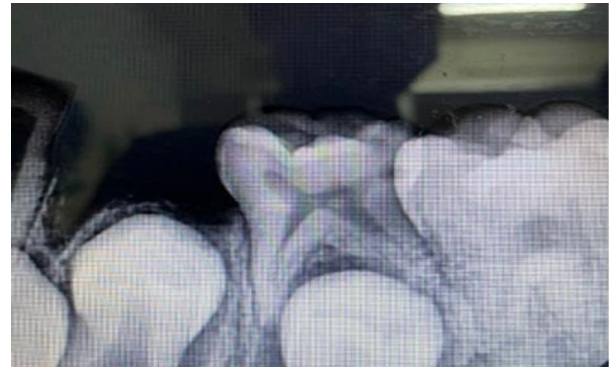


FIG 1(B) PRE-OPERATIVE INTRAORAL PERIAPICAL RADIOGRAPH



FIG 1(C) POST-OPERATIVE CEMENTED 3D PRINTED APPLIANCE



FIG 1(D) POST OPERATIVE 3D PRINTED APPLIANCE INTRAORAL PERIAPICAL RADIOGRAPH

CASE NO. 2

A 8-year-old female child reported to the Department of Pediatric and Preventive Dentistry with a chief complain of pain in the mandibular right posterior region for the past 7 days. Clinical examination revealed deep proximal caries with 84. Intraoperative periapical radiograph was advised to confirm the diagnosis. Considering the poor prognosis, extraction of the tooth was planned and to maintain the space, "3D Printed Band and Loop" SM was fabricated and delivered FIG 2(A-D).

Instructions on oral hygiene and appliance maintenance were given to both children and parents. The patient was recalled after 3, 6 & 9 months.



FIG 2(A) PRE-OPERATIVE INTRAORAL VIEW

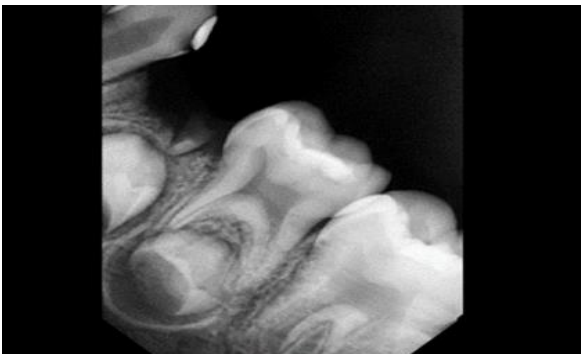


FIG 2(B) PRE-OPERATIVE INTRAORAL PERIAPICAL RADIOGRAPH



FIG 2(C) POST-OPERATIVE CEMENTED 3D PRINTED APPLIANCE



FIG 2(D) POST OPERATIVE 3D PRINTED APPLIANCE INTRAORAL PERIAPICAL

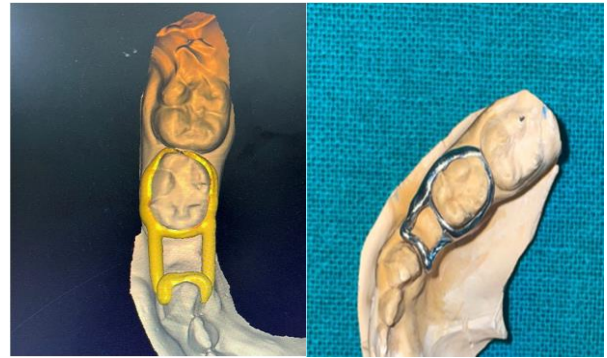


FIG 3 DESIGNING OF 3D PRINTED BAND AND LOOP SPACE MAINTAINER USING 3D DIGITAL DENTAL SCANNER

DISCUSSION

Loss of space in the primary and mixed dentition is fairly common presentation. Early prevention would be of great benefit to the patient by limiting the length and extent of comprehensive orthodontic treatment needed later. Causes of space loss are multifold that include trauma, idiopathic or as a result of extractions etc.⁴

Space maintenance can be defined as preservation of space left by the loss of primary incisors, primary canines, and primary molars and sometimes the primate spaces and the appliances used for maintaining space are known as space maintainers. Space maintainers can be removable or fixed, active or passive, functional or non-functional and unilateral or bilateral.¹⁰

Amongst the various fixed space maintainers, Band and Loop appliance is a versatile space maintainer for maintaining space due to premature loss of a single tooth. Though this Conventional Band and Loop space maintainer appears simple and easy both for the dentist and the patient, various disadvantages have been reported¹¹ viz. impression making, tedious laboratory work, multivisit procedure, dislodgment due to decementation of bands and solder breakage.¹⁰

Introduction of prefabricated bands in a variety of sizes overcome these disadvantages with limitations being the same that indicates the need for newer designs and materials of appliance.¹²

One such recent technology is 3D printing which involves the process of constructing a 3D solid object from a digital file⁹ (FIG 3). The present design of the space maintainer offer several advantages over conventional band and loop space maintainer viz. no need of taking impression of patient, pouring cast, the extensive laboratory work and most importantly soldering the loop on band at

two places is also not required which saves the chair side time.⁹ Further it's a single unit fabrication, thus reducing the failure of the appliance.⁸ 3D printing with the help of 3D printer increase the precision of the appliance to the next level & minimizing the human error. The advent of intraoral scanners and the availability of 3D printers with compatible biomaterials has enhanced the use of 3D printing technology. 3D printing is an advance technology that enables the creation of physical 3D products from digital images to meet the unique needs of patients.

Despite all the benefits of digital impressions that contribute to increased patient comfort and compliance, acquiring the equipment can be expensive and requires training of the dental team so that the equipment can be used predictably and cost effectively.¹³

In the present cases of 3D printed band and loop space maintainer, it was noted that survival time, gingival health and patient/parent satisfaction was improved remarkably as compared to conventional band and loop SM as there is no decementation and solder breakage. There was a positive correlation with gingival health. The smooth surface texture exhibited by the SM printed by 3D printers resulted in less accumulation of plaque and thereby gingivitis.

CONCLUSION

Conventional band and loop have long been used for maintaining space, but certain disadvantages make it a cumbersome procedure. The presented case of innovative digital design of 3D Printed Band and Loop Space Maintainer is precise, quick and reliable. In pediatric dentistry, 3D printing has gained popularity with the advent of intraoral scanners as a child-friendly practice tool. This 3D printing plays multiple roles in taking pediatric dentistry into the next era (the digital age), leading to customized, child-friendly, pain-free and comprehensive pediatric dentistry practices.

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