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Case report

Space maintainer 'Y model' as a preventive orthodontic treatment for paediatric patients: a case report

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ABSTRACT

Background: *Caries is one of the most common oral diseases that occur among children. Caries and dental trauma in children may cause early tooth loss, also known as premature loss, and result in occlusion abnormalities caused by the dental arch narrowing. A space maintainer is a preventive orthodontic appliance designed to maintain a narrow arch to prevent premature loss.* ***Purpose:*** *This study aims to describe the treatment of a case of space management in a patient with premature loss by using the space maintainer 'Y model'.* ***Case:*** *An eight-year-old boy was accompanied by his mother, complaining that the lower posterior right tooth had been extracted. The mother was worried that the new tooth would have an overlapping growth.* ***Case Management:*** *The diagnosis was mandibular primary molar loss. The study cast was analysed based on Moyers 2.62 cm, Huckaba 2.24 mm, and curve determination 2.40 mm. The mandibular removable space maintainer treatment was performed on the patient and was followed by nine control visits every week. The outcome was a successful treatment from the use of the space maintainer 'Y model'.* ***Conclusion:*** *The space maintainer treatment with the Y model in the paediatric patient showed a good result, evidenced by the tube opening of 1.2 mm, showing that the appliance followed lateral jaw growth.*

Keywords: *paediatric; premature loss; preventive; space maintainer; space management*

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INTRODUCTION

A primary dentition tooth is a tooth that commonly grows in a child at the age of 6 months and is replaced by the time the child is 6 years old.[1] The majority of posterior primary dentition tooth losses are caused by dental caries. In addition, it may also be caused by tooth-related accidents.[2] The definition of premature loss is to lose primary dentition teeth too early, meaning that the primary dentition teeth have fallen out but the new teeth have not grown yet.[3] This condition is frequently found in children and increases in frequency with age.[4] According to Mc Donald, the prevalence of premature loss of primary dentition teeth, as reported in a study, ranges from 4.30% to 42.60%.[5] As seen recently, one issue is that the primary dentition molar teeth are extracted or fall out earlier, and both sides of the mesial or distal areas tend to shift or move in the direction of the open space. This shift hinders the permanent teeth that have not grown yet.[5] Preventive orthodontic treatment on children's mixed dentition age is necessary, as losing primary dentition teeth hampers jaw growth.[6]

A space maintainer (SM) is a preventive orthodontic appliance that maintains the resultant space in the case of primary dentition tooth loss. A diagnosis for paediatric patients is important to decide if an SM is needed. SMs are vital for cases of premature loss of primary dentition teeth to prevent malposition, supraeruption, impaction, or permanent dentition crowd.[7] An SM can be used if there is a lack of space on one side of the jaw of 2–4 mm.[5] Removable SM devices, also known as preventive orthodontics, can be used to maintain the space for paediatric patients for the prevention of dental crowding problems.[2]

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A removable SM is disadvantageous because of its interference with lateral jaw growth and stoppage of the growth of the intercanine jaw arch. This is because conventional SMs do not split in the middle of the acrylic plate[1]. In addition, it is common for SMs to fail, resulting in the shifting and movement of adjacent teeth. It can also lead to drifting, resulting in a more complicated treatment and appliance.[2] Furthermore, the aim of this case report describes the space maintainer 'model Y', which uses a double tube in the middle of the appliance, and can follow growth and develop the mandibular jaw in line with lateral and anteroposterior angles.

CASE

The patient was an eight-year-old boy in the dental hospital. The patient came after being motivated by the operator and his mother to take care of the tooth that had been extracted. The patient's mother complained that her child's teeth were crowded and that she was worried that there was not enough space for the new teeth to grow. The unique part of this case was the installation of a modified preventive orthodontic appliance that would follow the growth of the jaw laterally and anteriorly, without the need to change tools every month. It is shown in Figure 1 and Figure 2.

Dental history showed that the patient admitted that there was empty space in the lower right molar after the extraction was done. Before it was extracted (about a year ago) the patient felt pain that interfered with his eating, but the patient did not go to the dentist for examination. About two months ago, the patient came to the Oral and Dental Hospital Universitas Muhammadiyah Yogyakarta to have the tooth filled. The last oral medical record indicates that the patient went to the dental hospital for tooth filling and tooth extraction. The patient was instructed to brush his teeth regularly (2–3 times every day); however, the patient's way of brushing his teeth was incorrect. The patient chewed food on both sides. There was no bad habit related to the patient's complaints in terms of type of habit, duration, frequency, or intensity. The patient's oral hygiene was good.

The family's medical record showed that the patient has a father with moderate jaw size, neat teeth, and no apparent history of systemic disease. The patient's mother also has moderate jaw size, neat teeth, and no suspicion of having a history of systemic disease. The patient was quite cooperative and lives in his home with his parents. The patient's parents run a laundry business, which is crowded with customers every day; thus, they don't have much time to care for their children's teeth. The patient has never been hospitalised. Currently, the patient is in good health.

The dental analysis showed that the dental age was early-mixed dentition. The curved shape of the teeth of the maxilla was parabolic and the mandible was parabolic. The malposition of individual teeth showed that in the upper jaw there were 12 and 21 (mesiopalatotorsiversions). The lower jaw showed 31 and 74 (mesiolinguotorsiversions), and 83 distolinguotorsiversions. The relation of occluded teeth was in the centric occlusion. From the anterior view, there was an overjet of 3.8 mm (distal tooth 21 and mesial 32) and an overbite of 2.10 mm (distal tooth 21 and mesial 32). The posterior view (permanent molar relation) on the left showed a class II angle malocclusion and on the right showed a class I angle malocclusion. The occlusal view of the lower jaw is shown in Figure 1 and the space maintainer appliance can be seen in Figure 2. The maxillary midline and the lower jaw were aligned. This condition is shown in Figures 3A, 3B, 3C, 3D, and 3E. Figure 4 shows the schem space maintainer appliance with triple tube junction.

CASE MANAGEMENT

The treatment for this case started with the implementation of the SM case based on the completed calculations (Table 1). The measurement of the mesio-distal width gained from the study model resulted in the measurement of available spaces 63, 64, and 65, using callipers and measuring from the lateral incisivus distal surface to the mesial of the first permanent molar in each quadrant. The following data was obtained: the right lower jaw was 20.80 mm, and the left lower jaw was 21.80 mm.

First, a measurement of the size of the mesio distal of the canines and permanent premolars was taken. It was determined that all lower premolars and canines were 7.00 mm and the upper canines 8.00 mm, respectively. The upper jaw (canines, premolar 1, and premolar 2 [CPP])

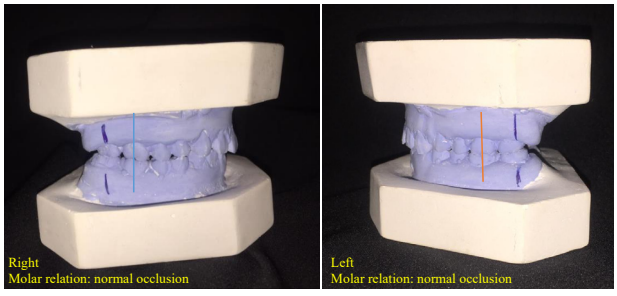

Figure 1. Occlusal view of lower jaw (source: author's document).

Figure 2. Space maintainer appliance.

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was 22.00 mm, while the lower jaw's CPP was 21.00 mm. In order to find the either adequacy or lack of space for CPP teeth in each quadrant, the space available in each quadrant was compared to the mean distal mesio CPP. Based on this method, it was apparent that the right (20.80 mm–21.00 mm) = - 0.20 mm and the left (21.80 mm–21,00 mm) = 0.80 mm.

Second, a measurement of the size of the mesio distal of the four lower incisors (Moyers) was taken. With the Moyers method, the teeth are used as predictors of the four lower incisors. The measurement of the mesio distal width of the four lower incisivus teeth was done in a straight line. The result was 24.30 mm. The predicted mesio distal width of canines and premolars number is determined using a Moyers table. In the Moyers table, it is shown that the mesio distal width of the lower incisivus was 4.3 mm, the mesio distal width of teeth C, P_1, P_2 was 23,42 mm for the right lower jaw and 22.42 mm for the left lower jaw. The measurement of the available space in the arch for the canines and premolars, which have not yet erupted, was completed and the results were compared. The right lower jaw was 20.80 mm–23.42 mm = - 2.62 mm and the left lower jaw was 21.80 mm–22.42 mm = - 0.62 mm.

The third measurement used panoramic rongten and was a measurement of the teeth that have not yet erupted,

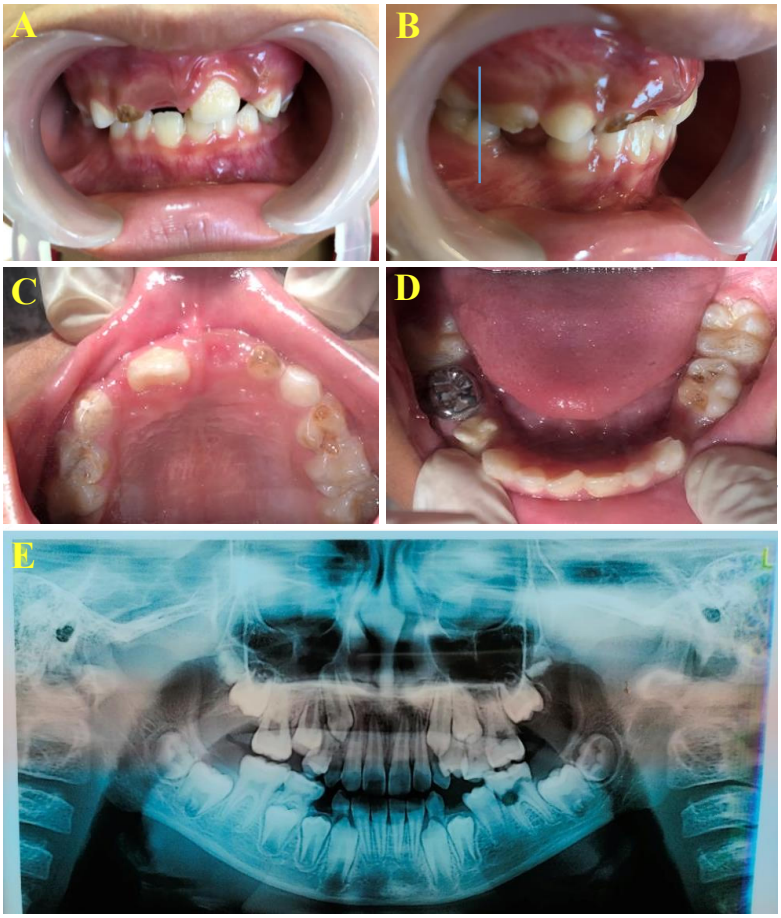

Figure 3. (A) Anterior; (B) molar relation; (C) maxilla-occlusal; (D) mandibular-occlusal; (E) panoramic radiograph.

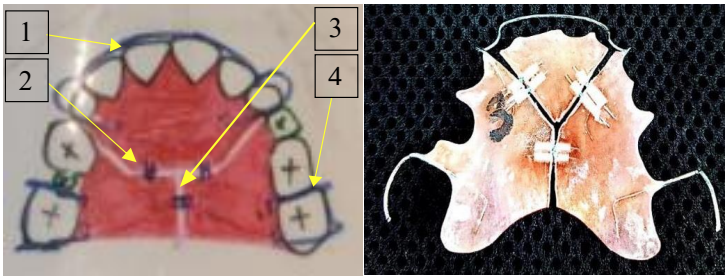

Figure 4. Schem space maintainer appliance: (1) labial arch; (2) acrylic plate; (3) triple tube junction; (4) Adam's claps (source: author's document).

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Table 1. The width of the mesiodistal teeth (mm)

Tooth	Upper jaw				Lower jaw			
	Right		Left		Right		Left	
	Primary dentition	Permanent	Primary dentition	Permanent	Primary dentition	Permanent	Primary dentition	Permanent
1	-	-	-	9.4	-	6	-	6.1
2	2.6	-	-	-	5.2	7.1	5.1	6.8
3	7.7	-	7.6	-	6.1	-	6.3	-
4	8.1	-	8.2	-	-	-	6.2	-
5	9.6	-	9.6	-	10.4	-	10.1	-
6	10.2	-	-	-	12.1	-	-	

Table 2. Huckaba measurement

Huckaba	Description
Mesio distal width of tooth 43 $X = \frac{(X' - 10\%\ X')}{(Y' - 10\%\ Y')} \cdot Y$ $= \frac{(10.7 - 1.07)}{(14.3 - 1.43)} \times 9.2\ mm = 7.59\ mm$ Thus, the mesio distal width of tooth 43 is 7.60 mm. Mesio distal width of tooth 44 $X = \frac{(X' - 10\%\ X')}{(Y' - 10\%\ Y')} \cdot Y$ $= \frac{(11.5 - 1.15)}{(14.3 - 1.43)} \times 9.2 = 7.40\ mm$ Thus, the mesio distal width of tooth 44 is 7.40 mm. Mesio distal width of tooth 45 $X = \frac{(X' - 10\%\ X')}{(Y' - 10\%\ Y')} \cdot Y$ $= \frac{(10.9 - 1.09)}{(14.3 - 1.43)} \times 9.2 = 7.01\ mm$ Thus, the mesio distal width of tooth 45 is 7.01 mm	Y : mesio distal width of upper left M1 tooth in the study model = 9.20 mm Y' : mesio distal width of upper left M1 tooth in the ro photo = 14.30 mm X : mesio distal width of teeth that are looked for X' : mesio distal width of teeth that are looked for in ro photo 10% : refraction in radiograph

Table 3. The results of various analytical calculations

Method	Lower jaw (mm) Right
Average Method	- 0.20
Moyers	- 2.62
Huckaba	- 2.24
Arch	-2.40

based on the Huckaba method, as shown in Table 2. The extension was calculated due to a radiographical error by measuring the erupted teeth in the radiograph and the same teeth in the mouth or in the study model. Here, the tooth used was the upper left molar (M_1). The mesio distal width of the teeth were calculated, which have not yet erupted in each quadrant. The sum of the radiograph width x Y and was reduced by 10% of the mesio distal width of teeth, which have also not yet erupted. The 10% here was for the refraction found in the radiograph. The calculation was completed by comparing the Ro photo of the lower right jaw. The prediction of CPP teeth size, which will still erupt, was (7.6 + 7.43 + 7.01) = 22.04 mm. The available space for eruption is 20.8 mm. Thus, the right upper jaw is 20.80 mm–23.04 mm = -2.24 mm (lack of space).

Based on the previous arch determination, it could be concluded that there was an excess and a lack of space in the lower right jaw, which was 2.40 mm (Table 3). Three calculations show the lack of space, ranging from 2.00 mm to 4.00 mm. Thus, the patient needed the space maintainer treatment (refer to the standard of the lack of space to determine the use of orthodontic preventive appliance). Furthermore, based on the results of the calculations from the various above methods, it can be concluded that the patient's right lower jaw had a lack of space for the growth of CPP teeth. Therefore, after considering the jaw growth and development and the patient's age, it could be concluded that the appliance to be used was a space maintainer. The complementary examination that supports the periapical radiograph showed that tooth 44 had not yet erupted. Tooth 45, which is a tooth that will replace tooth 85, was estimated to grow at the age of 11 or 12 years. The patient's age at the time of this study was 10 years. The growth direction of tooth 25 on X-ray showed normal growth. Tooth 23, which is a tooth that will replace tooth 83, was estimated to grow at the age of 9 or 10 years. The growth direction of tooth 23 on X-rays showed normal growth. In order to replace the tooth and acquire space, the maintenance, namely the space maintainer, was implemented to maintain that space.

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DISCUSSION

The steps for treatment include motivating the patient to take care of his teeth and to continue to take care of space management for the permanent teeth on the lower right. The assessment of this case was premature loss of tooth number 84, and the prognose was good. There was an edentulous area in tooth number 84. The patient came to perform space maintainer insertion. There were no complaints from the patient. In his second aftercare (6 February 2019) the patient came over to manage the space for his permanent teeth. The primary teeth were lost and had no replacement yet. In his eighth aftercare (3 July 2019) the patient again came over for continued care of the space management for his permanent teeth on the lower right. The retentive space maintainer appliance did not suppress the surrounding soft tissue. The measurement of the intertube was 1.20 mm, and the space for permanent teeth 64 and 65 was 15.60 mm. The conclusion of the treatment was a 1.20 mm tube opening, meaning that the appliance followed the growth and development of the jaws.

Severe caries conditions are unable to be treated and the teeth eventually have to be extracted.[1] Premature loss is often found in children and increases in frequency with age.[4] This can also happen due to premature loss of primary teeth, which commonly happens with children. Permanent teeth are more often disrupted in the eruption process when compared to the primary teeth. Disruption of the growth process of both the baby and their permanent teeth can affect the time of eruption.[8] This patient needed space maintainer treatment because his permanent replacement teeth still needed time to grow.

A space maintainer is an appliance that is installed to maintain the space of primary teeth that undergo premature loss or premature extraction. This appliance aims to avoid narrowing space from the shifting of neighbouring teeth and also the extrusion or elongation of the patient's teeth.[5] This patient had a deficiency of space between 2.20 mm to 2.40 mm (according to the calculation of Moyers, Huckaba, and curved determination, it is an indication that a space maintainer is needed for the treatment. If the deficiency is >4 mm, the treatment is a space regainer). Indications and counter indications about the use of space maintainers must be thoroughly considered in order for the treatment to be as successful as expected, without causing negative effects to the surrounding tissues.[9]

The advantages of a removable space maintainer are that it is easy to make, requires little time, is easy to widen, exerts little pressure on the remaining teeth because it does not hurt the soft tissue, is more aesthetic, is easily to clean, and can be made as a space maintainer.[9] The drawbacks of using a removable space maintainer are that it can be easily lost, patients may not use it regularly, it is easy to brake, it can limit growth in the lateral direction of the jaw if the grip is not suitable, and can irritate soft tissues. The patient in this case required treatment and was approved for treatment with a removable space maintainer appliance.[1]

In addition, other disadvantages of the use of a removable space maintainer include when the patient has an allergy to resin materials used for making the appliance, when the patient is less cooperative the use of a removable space maintainer is not recommended, and when permanent teeth are expected to erupt as soon as the device is paired in the mouth.[9] This patient had no allergies based on anamnesis and general examination. Related to the material used in the space maintainer, toxicologically, there is no evidence to prove that commonly used dental resins produce systemic toxic effects in humans.[10] This patient was treated with acrylic resin material, as this material is often used and recommended in the field of dentistry.

In addition to being caused by dental caries, that the majority of posterior primary dentition tooth loss can also be caused by trauma (a collision or accident) that occurs in the teeth.[2] In such a case, it is important that the initial condition that affects the development of the permanent teeth is followed by early treatment interventions and that orthodontic preventive measures are carried out to prevent the occurrence of severe dental malocclusion.[11]

The premature loss of primary dentition teeth can result in mesial-distal (mesial drifting) and vertical tooth migration causing the loss of jaw arch width, a deficit in dento-alveolar, dento-alveolar-maxillary development, permanent teeth growth disorders, inter maxilla relationship disorders, or dynamic occlusion.[12] The installation of a space maintainer appliance in the patient aims to prevent the occurrence of mesial drifting of the surrounding teeth. This treatment needs to be done early. The space maintainer treatment for teenagers is done to keep the space from narrowing.[13] Space reduction increases when premature extraction is done two months too early.[14] This patient came for the treatment after performing an extraction on his primary teeth.

Caring for the treatment is important. Individual concern for the appearance and health of the teeth will increase with age. Thus, awareness to perform treatment for teeth that have aesthetic and functional abnormalities will increase.[15] This patient, supported by his parents, understood and knew that dental health was important for preventive care. The successful use of a space maintainer appliance was as a result of good cooperation between the dentist and the patient.[16] The patient's parents followed the instructions given and the purpose of using and installing the preventive orthodontic device was understood.[17] In addition, it is important that there is parental support to motivate the child to use the space maintainer.[18] The parents of this child patient were very supportive of this treatment.

Another supporting factor is related to the presence of dental health facilities, which affects severe malocclusion and orthodontic prevention treatment needs.[19,20] The patient lived in Yogyakarta, which is relatively close to the dental hospital. In addition, the effects of being far from dental clinics is a discouraging factor for people when utilising their chosen health services.[21] The patient lived close to the

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dental health centre; this supported his treatments, which required multiple aftercare visits. The treatment was done in accordance with the space maintainer care standard, which states that if there is a space loss of about 2.00 mm to 4.00 mm then the treatment using a space maintainer must be done. If the loss of space is more than 2.00 mm to 4.00 mm and is accompanied by permanent M1 mesial drifting, then the treatment must be carried out using a space regainer. The patient meets the standards of space maintainer care.[5]

The space maintainer had a modified centre split plate with a double tube, a labial arch was used to maintain the arch of the teeth, and a clasp was on its right and left sides as retention. The presence of the double tube was expected to be more stable in the function of orthodontic prevention appliance. This space maintainer can follow development in a lateral direction.[18,22] The patient was treated using a modified space maintainer, aimed at following the growth and development of the jaw. The patient underwent routine aftercare visits and records were completed about the changes in his jaw's growth and his teeth condition, as the patient was still in his growing age.[23] One problem encountered by the operator while treating the patient was that the patient needed a large amount of motivation from the parents and the operator for him to diligently use the appliance.

The treatment plan is to continue regular examination and aftercare visits to see how the child's teeth are progressing, as tooth number 44 has not erupted. It is recommended that the treatment proceeds, considering the age of the patient and that he is still in a development phase as the patient's teeth have not yet erupted. Thus, the treatment by means of the space maintainer should be continued and will require good cooperation between the patient, the operator, and the patient's parents. Finally, it can be concluded that space maintainer treatment for this patient has had good results, as indicated by the existence of intermolar and intercaninus growth. Their growth can be monitored from the initial model and the final model. Both can also be seen from the middle tube opening of 1.20 mm. It was apparent that there was development and growth of the mandibular jaw. A suggestion for further study is that further research could use more patients, with different ages and different genders.

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