Republic of Iraq
Ministry of Higher Education
and Scientific Research
University of Baghdad
College of Dentistry

Premature loss of primary molars

A Project Submitted To

The College of Dentistry, University of Baghdad, Department of Pedodontics and Preventive Dentistry in Partial Fulfillment of the Requirement for The Degree of Bachelor of Dental Surgery.

Submitted By:

Maryam Ali Abdulhafedh

Supervised by:

Assit. Lectu. Asmaa Khamas

B.D.S, M.Sc

April, 2022

Certification of the supervisor

I certify that this project entitled " **Premature loss of primary molars** " was prepared by the fifth-year student **Maryam Ali** under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Supervisor's name:

Assit. Lectu. Asmaa M. Khamas

Date:

Dedication

I dedicate this project to my family who supported me throughout my study career, and who were the first and only reason for me to reach this stage and to become a doctor.

Acknowledgment

I would like to thank “The Greatest Allah” for inspiring me with the strength, willingness and patience to accomplish this work and I will pray that this blessing upon me would continue throughout my life. Special peace to his messenger Mohammed (The bless and mercy up on him and his best progeny and best companions).

I am very much thankful to **Prof. Dr. Raghad A. AL-Hashimi**, the dean of College of Dentistry, University of Baghdad, for his unlimited support throughout the study.

Deep thanks to **Prof Dr. Ali I. Al-Bustani**, the associate dean for scientific affairs and post graduate studies.

A special thank for **Prof. Ahlam Taha Mohammed**, Head of the Department of Pedodontics and Preventive Dentistry, for her support.

This thesis is the result of easy and friendly collaboration with my supervisor **Assit. Lectu. Asmaa M. Khamas**, for her ideas, advices, support and guidance throughout the study. So, I ask Allah to reward her best reward.

Special thanks to all members of Pedodontics and Preventive Dentistry.

Special thanks to my friends for their support and assistance in completing the project.

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Introduction

One of the important functions of the primary teeth is to occupy the physiologic space and guide the eruption of its permanent successor, so that a primary tooth with proper mesiodistal width is considered as the best space maintainer **(Nayak *et al.*, 2004).**

Premature loss of the primary molars can lead to multiple occlusal problems such as space loss, migration of adjacent teeth into the space created, non-eruption or altered path of eruption of the succedaneous tooth, tongue thrusting may develop, it can result in abnormal axial inclination of teeth, spacing between teeth, shift in the dental midline and over eruption of opposing tooth. however, these problems can be prevented with proper space maintenance. Failure to hold the space for the premolars often leads to significant ectopic eruption or impaction of these teeth. **(Moursi and Tesdale, 2012).**

Prevalence of early loss of primary teeth was higher in boys than girls, higher at 8 years of age, more number of teeth was lost in the right side when compared with the left and lower first primary molars were most commonly affected by early loss followed by upper first primary molars. **(Ahmed, 2012).**

Maintenance of arch length during the primary, mixed and early permanent dentition is of great significance for the normal development of future occlusion. Loss of arch length has been related mainly with migration of teeth following early loss of primary teeth. To prevent closure of space and arch length deficiency, some appliances are placed to retain the space resulting from early loss of teeth. **(Muthu and Sivakumar, 2011).**

So corrective procedure may require some type of passive space maintainers, active tooth guidance or a combination of both, depending on the present problem. Space maintainer, is a device used to maintain the space created by the loss of a deciduous tooth. An important part of preventive orthodontics is the correct handling of spaces created by the untimely loss of deciduous teeth. **(Marwah, 2014).**

Aim of the study

The aim of this study is to review the literature concerning the effect of premature loss of primary molar and their management and the type of space maintainer.

Chapter (1)

Review of literature

1.1 Primary teeth:

There are 20 primary teeth and they are typically erupt in the following order: (1) central incisor, (2) lateral incisor, (3) first molar, (4) canine, and (5) second molar **(Ash *et al.*, 2003).** Although a child's primary teeth begin to calcify in utero (before the child is born), they are invisible in the mouth until about the age of 6 months. **(Liversidge and Molleson, 2004).**

1.1.1 Primary teeth eruption

Eruption of primary dentition starts at 6 months and continues until approximately 30 months. The roots are completed by 3 years of age. Therefore, a primary tooth will be functional for approximately 5-10 years. The time of teeth eruption seen in table (1.1) **(Badrinatheswar, 2010).**

1.1.2 Primary teeth Shedding

Shedding is the exfoliation of the primary teeth caused by physiologic resorption of their roots and its supporting structures. Usually, teeth exfoliate at 6-12 years of age. This mechanism is brought about by the pressure exerted by the underlying tooth and also the activation of the osteoclastic and odontoclastic cells. As hard tissue resorption takes place the tooth loses its attachment apparatus of the periodontal ligament. The developing musculature of the oral structures and increasing masticatory load on the primary dentition also influence and further weaken the dentition and aid in exfoliation. The time of teeth shedding seen in table (1.1) **(Muthu and Sivakumar 2011).**

Table (1.1) Primary teeth eruption & shedding time (Dean *et al.*, 2022).

Tooth type	Lower arch	Upper arch
Eruption of first molars	12-16 months	12-16 months
Eruption of second molars	20-30 months	20-30 months
Shedding of first molars	9-11 years	9-11 years
Shedding of second molars	10-12 years	10-12 years

1.2 premature loss of primary molars

Premature loss of primary teeth would result in sagittal, vertical, as well as transverse malocclusion. The pathology of premature loss of primary teeth, especially the molars is a complex issue with profound impact on dental and facial harmony, thus urging the clinician's interest for an optimal therapeutic approach to attain a proper occlusion of the permanent dentition. **(Raja *et al.*, 2018).**

1.2.1 Causes of premature loss of primary molars

Premature loss of primary teeth is a significant diagnostic event. Most conditions that present with early loss are serious and a child presenting with unexplained tooth loss warrants immediate investigation. **(Cameron & Widmer, 2003).**

- Caries.
- Severe periodontal disease.
- Metabolic disorders:

Hypophosphatasia.

- Connective tissue disorders:
  - Scurvy.
- Neoplasia:
  - Acute myeloid leukemia.
- Self-injury:
  - Psychotic disorders.
- loss of alveolar bone support.
- If ectopic eruption of permanent molar left untreated, it may result in various complications, including early loss of the second primary molar, space loss, and impaction of second premolars.**(soxman J.A., 2022).**

1.2.2 Consequences of premature loss of primary molars:

Premature loss of primary molars leads to several negative consequences as illustrated in table (1.2).

Table (1.2) The Consequences of premature loss of primary molars are: (Litsas, 2018).

Teeth type	Consequences
maxillary deciduous 1st molar	1) The primary cuspid shifts distally (1st year after the premature exfoliation). 2) The primary second maxillary molar could shift mesially (depending on the age and the duration of tooth loss). The erupting 1st bicuspid could erupt mesially because of the mesial shifted second primary molar.

	3) Space loss and possible impaction for the maxillary canine.
maxillary deciduous 2nd molar	1) Mesial crown-root movement as well as mesial rotation of the first permanent molars around the palatal root. 2) Distal eruption of the first bicuspid. 3) Impaction of the second bicuspid.
mandibular deciduous 1st molars	1) Distal movement of the primary cuspid towards the extraction space. 2) Mesial movement of the second primary and the first permanent molar.
mandibular deciduous 2nd molars	1) Mesial tipping of the first permanent molars. 2) Distal eruption of the first bicuspid. 3) Impaction of the second bicuspid.

1.2.3 Influence of premature loss of primary molars on eruption time of their successors:

Eruption of the premolar teeth will be delayed in children who lose their primary molars at 4 or 5 years of age and before. If extraction of the primary molars occurs after the age of 5 years, there is a decrease in the delay of premolar eruption. At 8, 9, and 10 years of age, premolar eruption resulting from premature loss of primary teeth is greatly accelerated. **(Dean *et al.*, 2016).**

1.3 Space maintainer

Premature loss of primary teeth can result in the loss of arch length, leading to malocclusion. Early interception and prevention of malocclusion in deciduous and early mixed dentition prevents the development of pronounced anomalies in the late mixed dentition and permanent dentition, thereby, reducing or eliminating

the need for later comprehensive orthodontic treatment. Space maintenance forms an integral part of preventive and interceptive orthodontics. **(Jitesh, S. & Mathew, M.B., 2019).**

1.3.1 Indications of space maintainer

As reported by **(Marwah, 2014)** the indications of space maintainer are:

- If the space after premature loss of deciduous teeth shows signs of closing.
- If the use of space maintainer will aid in or make the future orthodontic treatment less complicated.
- If the need for treatment of malocclusion at a later date is not indicated.
- When the space for a permanent tooth should be maintained for two years or longer.
- To avoid supra-eruption of a tooth from the opposing arch.
- To improve the physiology of a child's masticatory system and restore dental health optimally.

1.3.2 Contraindication of space maintainer

According to **Muthu and Sivakumar in 2011** the contraindications are:

- When there is general lack of sufficient arch length and where space maintainer would further complicate the existing malocclusion.
- If the radiograph of extraction region shows one third of the root of succedaneous tooth is already calcified.
- When the space left by prematurely lost primary tooth is greater than the space needed for the permanent successor as indicated radiographically.
- If the space shows no signs of closing.
- When succedaneous tooth is absent.

1.3.3 Requirements of ideal space maintainers

For the ideal space maintainer according to **(Asnani, 2010, Jitesh, S. & Mathew, M.B., 2019)** the requirements are:

- They should maintain the mesiodistal dimension of the space created by the lost tooth.
- They should be functional, if possible, at least to the extent of preventing the over-eruption of the opposing tooth.
- They should be simple in construction.
- They should be strong enough to withstand occlusal forces.
- They must not endanger the remaining teeth by imposing excessive stresses on them.
- They should not interfere with normal vertical eruption of the adjacent teeth.
- They should be easily adjustable.
- It must permit maintenance of oral hygiene.
- It should be biocompatible.
- Their construction should be such that they do not restrict normal growth and developmental processes.
- They should not interfere with functions such as mastication, speech or deglutition.
- They must be easily cleansable and not serve as traps for food debris, etc. which might enhance dental caries and soft tissue pathology.
- Durable and corrosion resistant.

1.3.4 Objectives of Space Maintenance

According to **(laing *et al.*, 2009, Muthu and Sivakumar in 2011)** the objectives of space maintenance are:

1. Preservation of primate space.

2. Preservation of the integrity of the dental arches.

3. Preservation of normal occlusal planes.

4. Aid in esthetics and phonetics (in case of anterior space maintenance).

1.3.5 Factors affecting planning for space maintenance

According to **(McDonald and Avery's, 2004)** their are some factors affect the planning for space maintenance:

- Time elapsed since tooth loss.
- Dental age of the patient.
- Thickness of bone covering the unerupted teeth.
- Sequence of eruption of teeth.
- Delayed eruption of permanent teeth.
- Congenital absence of permanent tooth.

1.4 Classification of space maintainers

Space maintainer are classified as:

1.4.1 Fixed space maintainers

Fixed space maintainers are the appliances, which are fixed onto the teeth and utilize bands or crowns for their construction.

According to **(Marwah N., 2019)** the advantages and disadvantages are as follow:

A. Advantages:

- Bands require no tooth preparation.
- Do not interfere with eruption of abutment teeth.
- Jaw growth is not hampered.

- Succedaneous tooth is free to erupt.
- Can be used in uncooperative patients.

B. Disadvantages:

- Elaborate instrumentation and skills required.
- Banded tooth is more prone to caries and decalcification.
- Supraeruption of opposing tooth.

C. Types of fixed Space maintainers

According to **Muthu and Sivakumar 2011** the types are:

1. Band and loop.

2. Crown and loop.

3. Distal shoe.

4. Lingual arch.

5. Nance palatal holding arch.

6. Transpalatal arch.

1.4.1.1 Band and loop

One of the most common appliances used in the primary dentition is the band and loop, as shown in fig. (1.1). It is frequently used to maintain space for unilateral loss of the primary first molar before or after eruption of the permanent first molar. **(Nowak *et al.*, 2019).**

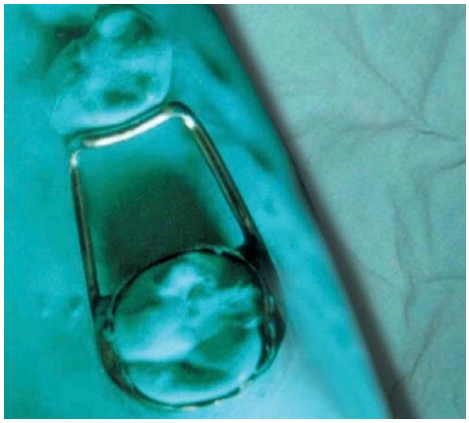

Fig (1.1) Band and loop space maintainer. **(Rao, A. 2012).**

According to **(Muthu and Sivakumar 2011),** the **advantage** are:

1. Easy and economical to construct.
2. Takes little chair time.
3. Adjusts readily to accommodate the changing dentition.

While the **disadvantage** are:

1- Decalcification under bands.
2- Does not prevent the continuing eruption of opposing teeth.
3- Does not restore chewing function.
4- Limited to maintenance of single tooth loss.

1.4.1.2 Crown and Loop Appliance

It is similar to the band and loop space maintainer in all respects except that stainless steel crown is used for the abutment tooth that need to prepare the tooth. As shown in fig. (2) **(Ulusoy, 2008).**

Fig. (1.2) Crown and Loop Appliance. **(Rao, A. 2012).**

The **advantage** is increased stability and retention. While the **indications** are 1. If the primary molar has extensive caries. 2. If the tooth has had vital pulp therapy.**(Dean *et al.*, 2016).**

1.4.1.3 Distal shoe

A distal shoe appliance is the appliance of choice in premature loss of a second primary molar in both the maxilla and mandible with an unerupted first permanent molar, as shown in fig. (1.3)I- Parents/guardians should be informed at the outset that a second appliance may be required if the second premolar is unerupted and the first primary molar is mobile or exfoliated, and that dental insurance may not cover the second appliance. The subgingival blade of the distal shoe guides the eruption path of the first permanent molar, preventing mesial drift that would result in blocking out the second premolar. **(Soxman, 2022).**

Fig. (1.3) Distal shoe. **(Cameron & Widmer 2013).**

According to **(Muthu and Sivakumar 2011)** the **contraindications** are:

1. Inadequate abutments due to multiple loss of teeth.
2. Poor oral hygiene or lack of parent and patient cooperation.
3. Medically compromised patients like, patients with congenital diseases, kidney problems, juvenile diabetics, history of rheumatic fever and hemophilia.
4. Congenitally missing first permanent molar (rare).

1.4.1.4 Lingual arch

The lower lingual holding arch is commonly used in the mandibular arch during the mixed dentition period, as shown in fig. (1.4) However, because the permanent incisor tooth buds develop and erupt lingual to their primary precursors in the lower arch, a mandibular lingual arch is not recommended in the primary dentition; the wire resting adjacent to the primary incisors might interfere with the eruption of the permanent dentition. Instead, two band and loop appliances are recommended when there is bilateral tooth loss in the mandibular arch. When the permanent molars and incisors erupt, a lower lingual holding arch can be considered as a replacement for the band and loop appliances. **(Nowak *et al.*, 2019).**

Fig (1.4) Lower lingual arch. **(Rao, A. 2012).**

According to **(Litsas, 2018)** the **advantages** are:

1. Easy construction and insertion.
2. Minimal breakage problems normal oral hygiene needs.
3. No child cooperation concerns.
4. low cost.

While the **disadvantages** are:

1. Lower lingual arch appliance could provoke forward movement and proclination of lower incisors.
2. Preventing the late mesial shift through preservation of the E-space, eruption of the mandibular second molars could also be affected if the intermolar angulation is greater than 24 degrees.
3. Possible decalcification of the banded teeth.

1.4.1.5 Nance palatal arch

Nance appliance is used for unilateral or bilateral loss of maxillary second primary molars, as shown in fig. (1.5) The first permanent molars are banded, and a transpalatal wire, embedded in an acrylic button to provide resistance to mesial

movement, contacts the palatal rugae. If using for premature loss unilaterally of a second primary molar and if there is any concern regarding the possibility of early extraction of the contralateral second primary molar, the Nance appliance should be the appliance of choice. **(Soxman, 2022).**

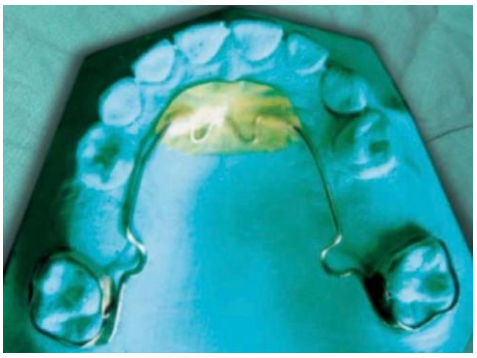

Fig. (1.5) Nance appliance with U loop. **(Rao, A. 2012).**

According to **(Muthu and Sivakumar 2011) the** advantage of transpalatal arch is effective. While the disadvantage is Soft tissue irritation.

1.4.1.6 Transpalatal arch

A fixed palatal arch appliance used to maintain space following bilateral loss of maxillary teeth, as shown in fig. (1.6) The transpalatal arch is easier to construct and more hygienic than the Nance appliance because it consists of only the 36-mil palatal wire, but it can allow the abutment teeth to tip mesially in some cases, resulting in space loss. **(Nowak *et al.*, 2018).**

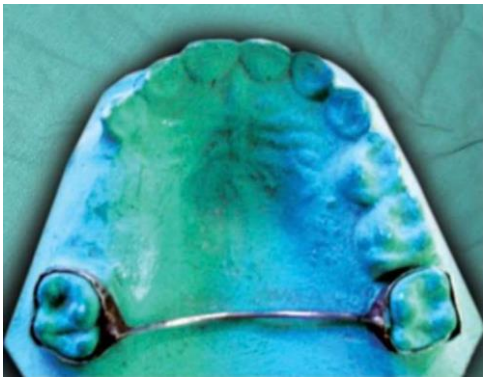

Fig. (1.6) Transpalatal arch. **(Rao, A. 2012).**

The **indications** of Transpalatal arch in the mixed dentition period according to **(Litsas G. 2018**) are:

- Establish and maintain arch widths.
- De-rotate unilaterally or bilaterally rotated molars.
- Control their vertical position (tongue pressure on the appliance's loop).
- Correct unilateral cross-bites for maxillary expansion.
- Create buccal root torque of upper 1st molars.

1.5 Removable appliancey

Removable appliances also can be used to maintain space in the primary dentition, as seen in fig. (1.7). The appliance is typically used when more than one tooth has been lost in a quadrant. They can be removed and reinserted into the oral cavity by the patient. Removable maintainers can be classified as:

- Functional space maintainers: They incorporate teeth to aid in mastication, speech and esthetics.
- Nonfunctional space maintainers: They have only acrylic extension over the edentulous area to prevent space closure **(Laing, 2009).**

Removable acrylic partial dentures have been used successfully in either arch after the loss of multiple teeth. If artificial teeth are included, an essentially normal degree of function and acceptable aesthetics can be restored. The disadvantages lie in their unpredictability outside the clinician's control because the appliances require patient cooperation. During the transitional stages of exfoliation and eruption, stability of removable appliances is often difficult to sustain with the loss of abutments. The wire clasps and resin contact areas may present "food traps" for plaque accumulation, with increased potential for soft-tissue irritation and dental caries. **(Dean *et al*., 2016).**

Fig. (1.7) Removable appliance. **(Rao, A. 2012).**

According to **(Muthu & Sivakumar 2011)** the **advantages** are**:**

1. Easy to clean and permit the teeth to be cleaned.
2. Maintains or restores the vertical dimension.
3. Used in combination with other preventive procedures.
4. Worn part time allowing circulation of the blood to the soft tissues.
5. Serves important functions like esthetics, phonetics and mastication.
6. It helps keeping the tongue in bounds.
7. Stimulates the eruption of permanent teeth.
8. Band construction is not necessary.

9. Dental checks for caries detection can be made easily.
10. Room can be made for permanent teeth to erupt without changing the appliances.

While the **disadvantages** are:

1. May be lost or can be broken.
2. May not wear it.
3. Jaw growth may be restricted, if clasps are incorporated.
4. Irritate the underlying soft tissues.

1.6 Space maintenance in the primary dentition

According to **(Litsas G. 2018)** the appliances that used in primary dentition period are**:**

- **First primary molar:** Band and loop on the second primary molar or the first permanent molar.
- **Mandibular second primary molar:** Lower Lingual Arch on the first permanent molar or distal shoe on the first primary molar, if it is lost before the eruption of the first permanent molar.
- **Maxillary second primary molar:** Transpalatal arch or Nance Orthodontic appliance.

1.7 Management in mixed dentition

According to **(Marwah N., 2019)** the appliances that used in mixed dentition period are:

- **For unilateral loss:** Band and loop spacer.
- **For bilateral loss:**

- *prior to eruption of the permanent incisors:* Bilateral band and loop spacers (concerns about the anterior portion of the lower lingual arch wire precludes consideration of this appliance until the incisors erupt).
- *after eruption of the permanent incisors:* Lower lingual arch or acrylic partial denture.

1.8.1 Space closure

If the space was left without using any space maintainer after premature loss of primary molars, then this space will be lost. So, the rate of closure in maxillary spaces have a higher average rate of closure than mandibular extraction spaces. Space loss after premature loss of maxillary second molar is greater than premature loss of first primary molar. In the mandibular arch, the rate of closure after premature loss of primary first and second molar is similar to that of maxilla. However, the space closure is fairly constant with a slight tendency for closure rate to slow after first year. Also the amount of closure in the maxilla is more than the mandible. **(Muthu & Sivakumar 2011).**

1.9 Active space maintainer or space regainer

This type of space maintainer as the name suggests is active and brings about the movement of the tooth/ teeth. It can be a removable or fixed, unilateral or bilateral appliance. The goal of space regaining intervention is the recovery of lost arch width and perimeter and/or improved eruptive position of succedaneous teeth. Space regained should be maintained until adjacent permanent teeth have erupted completely and/or until a subsequent comprehensive orthodontic treatment plan is initiated. **(Rao, A. 2012).**

1.9.1 Type of appliances used to regain space

According to **(Rajasekaran *et al*., 2015)** the types of space regainer are**:**

- **Fixed space regainers:**

1. Pendulum appliance.
2. Herbst space regainer.
3. Lip bumper.
4. Hotz lingual arch.
5. Sectional arch technique.
6. Anterior space regainer.
7. Gerber space regainer.

- **Removable space regainers:**

1. Jack screw space regainer.
2. Split saddle /split block space regainer.
3. Sling shot space regainer.
4. Free end loop space regainer.

★ According to **(Marwah N., 2014)** the commonly used space regainer are Gerber and Jackscrew space regainers.

1.9.1.1 Gerber space regainer

Gerber space regainer is similar in principle to open-coil and sliding loop regainer, as shown in fig. (1.8). In this appliance, weldable tube stops are soldered on the U bend of the wire and open coil spring sections are cut to fit over the wire between “stops” and ends of “U” loop. The springs are loaded and floss is tied through eyelet and over “U” wire to hold stored force in compressed spring. The springs are compressed so that the assembly should fit in the edentulous space. The assembly is cemented in place. After cementation, the floss is cut and removed to activate regainer. **(Winnier, 2018).**

According to **(Thosar N., 2017)** the advantages are:

1. Can be fabricated directly in the mouth.

2. Relatively short appointments.
3. Requires no lab work.

Fig. (1.8) Gerber space regainer. **(Marwah N. 2019).**

1.9.1.2 Jackscrew space regainer

The jackscrew space regainer is used to recover the loss of space caused by drifting of tooth into an edentulous area. It consists of 2 banded adjacent teeth and a threaded shaft with a screw and a locknut, as shown in fig. (1.9). This is activated regularly to exert a consistent force against the banded teeth. This appliance produces rapid results. **(Rao, 2012).**

Fig. (1.9) Jackscrew space regainer. **(Marwah N. 2019).**

Chapter (2)

Conclusion

- One of the most important functions of primary molars is to maintain space and guide the eruption of its permanent successor.
- When the primary molars are lost before their normal exfoliation time (premature loss), usually their is need to use passive space maintainers to maintain the space for the permanent teeth.
- When premature loss of primary tooth occurs, and the space was left without using any space maintainers for a long period, then this space will be lost.
- The consequences of space closure are impaction or alteration in the path of eruption of the successor teeth and may lead to crowding, misalignment and malocclusion.
- To avoid these problems that occur with space closure, we must use active space maintainers (space regainers) to regain the space for permanent teeth to erupt freely.

References

(A)

- Asnani, K.H. (2010). Essentials of Pediatric Dentistry. New Delhi, Jaypee Brothers Meical Publishers. Pp. 111-124.
- Ash, M., Stanley, J. and Nelson (2003). Dental Anatomy, Physiology and Occlusion. Missouri: Saunders Elsevier inc. P. 38.

(B)

- Babu, N.A., Anand, V., Rajasekaran, S. and Masthan, K.M.K. (2015). Space Regainer in Pediatric Dentistry. *Biomedical & Pharmacology Journal*, 8, p. 1.
- Badrinatheswar, G.V. (2010). Pedodontics practice and management. New Delhi: Jaypee Brothers Medical Publishers. P.65.

(C)

- Cameron, A. C. and Widmer, R. P., (2008). A handbook of pediatric dentistry. Edinburgh, Mosby. Pp. 199-349.

(D)

- Dean, J., Jones, J., Vinson, L., Sanders, B. and Yepes, J., n.d., (2016). McDonald and Avery's dentistry for the child and adolescent. Patricia Tannian. Pp. 427-432.

(J)

- Jitesh, S. and Mathew, M.B. (2019). Space Maintainer: A Review. *Indian Journal of Forensic Medicine & Toxicology*, 11(1), p. 21.

(L)

- Litsas, G. (2018). Pediatric Orthodontics: Theory and Practice. Sharjah, UAE: Bentham Science Publishers. Pp. 105-110.
- Liversidge, H.M. and Molleson, T. (2004). Variation in crown and root formation and eruption of human deciduous teeth. *American Journal of Physical Anthropology*, 123(2), pp. 172-180.
- Laing, E., Ashley, P., Naini, F.B. and Gill, D.S. (2009). Space maintenance. International Journal of Paediatric Dentistry, 19(3), pp.155–162.

(M)

- Marwah, N., (2014). Textbook of Pediatric Dentistry. DL: Jaypee Brothers Medical Publishers. Pp. 380-416.
- McDonald, R., Avery, D. and Dean, J., (2004). Dentistry for the child and adolescent. St. Louis, Mo.: Mosby. Pp. 632-633.
- Moursi, A. and Truesdale, A., n.d. (2012). Clinical cases in pediatric dentistry. Wiley blackwell. P. 213.
- Muthu, MS. and Sivakumar, N. (2011). Pediatric Dentistry Principles and Practice. Elsevier. Pp. 186-1024.

(N)

- Nowak, A.J., Christensen, J.R., Mabry, T.R., Townsend, J.A. and Wells, M.H., (2019). Pediatric dentistry: Infancy through adolescence. Philadelphia, PA: Elsevier. Pp. 380-382.
- Nayak, UA., Louis, J., Sajeev, R. and Peter, J. (2004). Band and loop space maintainer--made easy. *Journal of the Indian Society of Pedodontics and Preventive Dentistry*, 22(3), pp. 134-136.

(R)

- Rao, A., (2012). Principles and practice of pedodontics. New Delhi: Jaypee Brothers Medical Publishers. Pp. 146-156.

- Raja, S.M., Jeevanandan, G. and Mohan, M. (2018). Premature loss of primary teeth and developing malocclusion: A review. *Journal of Pharmacy and research*, 12(2), pp. 190.

(S)

- Soxman, J., n.d. (2022). Handbook of clinical techniques in pediatric dentistry. wiley blackwell. Pp. 51-234.

(T)

- Thosar, N., Baliga, S. and Chandak, P. (2015). Space regainers in pediatric dentistry. *International Dental & Medical Journal of Advanced Research*, 1(1), p. 3.

(U)

- Ulusoy, A.T. and Cehreli, Z.C. (2008). Provisional use of a natural tooth crown following failure of replantation: a case report. *Dental Traumatology*, 24(1), pp. 96–99.

(W)

- Winnier, J., (2018). Space regainers. *European journal of biomedical and pharmaceutical sciences*, 5(7), p. 213.