Primary and early dentition treatment

The function of primary dentition is to provide mastication, as well as to maintain the occlusion, and to maintain space for permanent teeth eruption. The primary teeth exfoliation and permanent successors eruption is a physiological process (Rao and Sarkar, 1999). In recent decades even after the advanced dental care that increased with intact dentition, early loss of primary teeth still remain a major concern (Bach and Manton, 2014). Early loss of primary teeth result majorly from dental caries. Other causes include trauma, infection, ectopic eruption, arch length deficiencies leading to resorption of primary teeth and congenital disorders (Brothwell, 1997). Consequences of early loss of primary teeth includes unwanted tooth migrations of primary or permanent teeth with associated loss of arch length. Deficiency in arch length can lead to malocclusion with crowding, rotations, ectopic eruption, unfavourable molar relationship, overbite, overjet, and cross bite (Brothwell, 1997). The problems accompanying with early loss of primary teeth have been a subject of concern in many studies.

Early loss of teeth in the primary dentition has different impacts depending on which teeth are lost, child’s age, existing alignment and occlusion (Rock and British Society of Paediatric, 2002). Potential consequences must be considered during the clinical examination and treatment planning to determine whether space maintenance is required and what type of space maintainer would be most appropriate (Ngan et al., 1999)

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Early loss of primary canines or molars is more serious since space loss may follow. In each quadrant the primary canine and molars together are larger than the succeeding permanent canine and premolars, the difference in tooth sizes between the two dentitions being the ‘ Leeway space’ [10]. This can be assessed with reasonable accuracy by the size difference between first and second primary molars, since the primary first molar is equal in size to the premolar that will replace it, while the primary second molar is much larger than the second premolar. For this reason the Leeway space is also known as the ‘ E space’.

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Impact of early loss of primary molars:

Primary second molar is most often prone to get caries and results in early loss. Early loss of primary second molars can lead to decrease in arch length prominently in maxilla than in mandible (Ngan et al., 1999). The loss of second primary molar lead to mesial migration of adjacent first permanent molar, loss of space for second premolar eruption and early eruption of second permanent molar. The decrease in arch length is more severe when primary second molar loss occurs prior to eruption of first permanent molar as second primary molar serve as a guide for erupting first permanent molar (Ngan et al., 1999). However no substantial change in midline coincidence

(Rock and British Society of Paediatric, 2002). Henceforth, it is generally agreed that reduction in space after early loss of primary second molar is more significant than primary first molars and require space maintenance (Ngan et al., 1999).

A long term study conducted in Canada to investigate the effects of early loss of primary molars in 107 children over six years of age, 66% of these children had early loss of primary molars majorly because of caries. These children were followed for approximately six years with yearly assessment for space loss. This study reported that loss of space was more when second molar was lost early and its effect is more in maxilla than in mandible, and had detrimental effect on molar relationship. When first and second molars are lost, the arch length was significantly effected in maxilla than mandible. The space loss was mainly due to the drifting of first permanent molar while canine distal migration was significant until 9 years in mandible and 8-11 years in maxilla. Relatively more space was lost in first year following the extraction with rate of space loss age related in maxilla but not in mandible (Northway et al., 1984).

Macena et al., 2011, conducted a study to evaluate the space changes after premature loss of deciduous molars among 55 Brazilian children of age between 6 and 9 years and followed for 10 months. This study reported that early loss of second primary molar lead to significant changes in the space left in both arches. The major decrease in space occurred in the first 3 months after the extraction of the deciduous molars. The decrease in space after second primary molar occurred majorly because of mesial movement of first permanent molar and which may lead to impaction of permanent

second premolar or future crowding. They suggested that a space maintainer is needed in such cases especially when it occurs in children with malocclusion and crowding (Macena et al., 2011).

Recently a study conducted to determine the space loss after early loss of second primary molar before eruption of permanent molar and after eruption of permanent molar in 87 children and followed for 48 months. They reported that significant space loss occurred in the first six month (P <0. 001) and no statistical significance at 12 and 24 months. There was significant space loss in children with unerupted first permanent molars than with erupted first permanent molars at 6 months (P <0. 001) and 12 months (P <0. 05). They concluded that to prevent space loss space maintainers should be placed as soon as possible after the extraction and delayed placement of space maintainers after one year has minimal benefit (Alnahwi et al., 2015).

There is paucity of studies on evaluating the space changes in premature loss of second primary molars in literature (Macena et al., 2011). However many researchers agreed that there is significant decrease in space after early loss of second primary molar and they suggested space management in these cases (Brothwell, 1997; Macena et al., 2011; Northway et al., 1984; Rock and British Society of Paediatric, 2002).

Early loss of second primary molar requires a space maintainer (Alnahwi et al., 2015). If the first permanent molar erupted at the time of second primary molar loss then a band and loop space maintainer is appropriate, with band cemented to first permanent molar and loop connecting to the first primary

molar. If multiple primary molars lost in same arch then bilateral fixed appliance like lingual holding arch or transe palatal arch are idle. However if the first permanent molar not erupted at the time of tooth loss then a distal shoe or removable appliance should be considered (Alnahwi et al., 2015; Brothwell, 1997; Ngan et al., 1999; Rock and British Society of Paediatric, 2002).

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Space loss related with early loss of first primary molar is debated in literature. Earlier a Scandinavian study reported that space loss after the premature loss of primary first molar is clinically insignificant and the space was regained when the dentition was developed into permanent dentition (Ronnerman and Thilander, 1977). They concluded that no space maintenance is required in premature loss of primary first molar.

Later in Northway et al., 2000 conducted a study to observe the adjacent tooth movement after early loss of primary first molar and compared to control group in children aged 6 -10 years. This study concluded that the

successor permanent teeth eruption direction changes which lead primary canine drifts distally until one year, first permanent molar and second primary molar tilts mesially depending on age of the patient and more mesial and labial eruption of permanent canines. The sample size in this study was 13 and in that two cases didn’t show canine mesial and labial eruption (Northway, 2000).

A recent long term study conducted in china on 9 children aged around 6 years for evaluating the long term changes after early loss of unilateral maxillary first primary molar and are followed for 81 months. This study showed that at six months 1 mm space loss at extraction site which has no clinical significance to warrant the use of space maintainer. At 12 months, the intercanine width and length anterior segment were increased. At 81 months, eight out of nine cases did not show the crowding in permanent dentition or canine block outs as mentioned in the earlier studies (Northway et al., 1984). Moreover on the control site more crowding were noted when compared to extraction site. The arch width, arch length, intercanine width and length were significantly increased at 81 months ($p < 0.05$). However this study has very small sample size which may limit its validity. This study concluded that no space management is required in unilateral loss of primary first molar in patients in whom the permanent first molar had erupted unless the leeway space was to be preserved (Lin YT et., al 2016).

A study conducted in India on forty children age group of 6-9 years for evaluating the space changes after unilateral extraction of mandibular first primary molar with follow of 8 months. the study reported that at extraction site space loss was 1. 3mm at 2 months, 1. 69mm at 4 months, 1. 41 mm at

6 months and 1. 22 mm after 8 months. This results showed that greatest space loss occurred in first four months. the space loss in the mandible is mostly due to distal movement of primary canines caused by erupting anteriors than first permanent molar did on the second primary molar towards the mesial. However the arch width, arch length and arch perimeter did not change significantly at all follow-up visits. With these results the authors of this study challenged the use of space maintainers in early loss of mandibular first primary molar (Padma Kumari and Retnakumari, 2006).

In conclusion above studies suggest that patients with full primary dentition and those with mixed dentition with good intercuspation of permanent first molars are less prone for space loss (Lin YT et., al 2016) (Northway, 2000; Padma Kumari and Retnakumari, 2006). So many of these authors challenge the use of space maintainers following early loss of primary first molars. However, in children with crowded dentition space management is commonly considered to be important during mixed dentition (Law CS 2013). Band and loop space maintainers are ideal for unilateral loss of first primary molar, whereas lingual holding arch or Nance appliance or Transpalatal arch or removable appliance are appropriate in multiple teeth loss cases.

Impact on early loss of primary canines:

Early loss of primary canines results in patients with crowded anterior dentition associated with ectopic eruption of permanent lateral incisor leading to their mobility and loss (Ngan et al., 1999). In case of unilateral loss of primary canine, incisors will migrate towards the effected side which results to midline discrepancy (Ngan et al., 1999; Sayin and Turkkahraman,

2006). For preventing midline discrepancy and to have balance in occlusion UK national clinical guidelines of paediatric dentistry suggest to extract contralateral side primary canine (Rock and British Society of Paediatric, 2002). However, when bilateral loss of primary canines may lead lingual tipping of incisors (Sayin and Turkkahraman, 2006). Lingual holding arch is appropriate for maintaining the space for successor teeth and to prevent lingual tipping of incisors (Ngan et al., 1999).

In 2006 A study conducted on thirty two children at early mixed dentition with crowding in the lower anterior segment to evaluate the effects of primary canine extractions in the mandibular. In treatment group 16 participants had bilateral mandibular primary canines were extracted, whereas remaining 16 participants in control group did not had primary canine extractions. At one year follow up the lingual tipping of lower incisors were noted in treatment group, whereas no change detected in control group. Meanwhile, no change observed in arch length, arch perimeter and alveolar width. This study concluded that for preventing lower incisor lingual tipping in early loss of primary canine will require space management with lingual holding arch (Sayin and Turkkahraman, 2006).

Early loss of primary incisors predominant results from dental caries and trauma. The impact on space loss is very minimal except in cases where more crowding or loss of teeth at very young age or with too much overbite and overjet. Space maintainers are generally not required, however in multiple incisor teeth are loss then for aesthetic reasons removable partial denture or lingual holding arch with pontic (Brothwell, 1997; Ngan et al., 1999).

In conclusion, space loss related to early loss of second primary molars is more significant in a developing dentition as compared to first primary molars thus the second primary molar is regarded as the ‘ key’ tooth in the primary dentition (Alnahwi et al., 2015; Ngan et al., 1999; Rock and British Society of Paediatric, 2002; Ronnerman, 1977). Space loss associated with premature loss of primary first molars is controversial, clinically insignificant and is regained as the dentition developed to mixed and eventually to full permanent dentition (Ronnerman and Thilander, 1978). Unilateral loss of a primary canine is usually accompanied by a shift of the incisors towards the affected side and results in midline discrepancy (Ngan et al., 1999). Bilateral loss reduces the lateral shifting, but can result in lingual tipping of mandibular incisors and a decrease in the space available in the arch. While space loss is usually minimal when primary incisors are lost earlier (Ngan et al., 1999). Age at the time of loss of primary teeth has been shown to be an important factor with more space loss associated with younger children (Alnahwi et al., 2015; Tunison et al., 2008). The rate of space loss is more in first six months following the loss of primary teeth (Tunison et al., 2008). Crowded dental arches showed more space loss following early loss of primary teeth as compared to spaced arches (Tunison et al., 2008).