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Management of Congenitally missing teeth (hypodontia)

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Certification

I certify that this project entitled "Management of congenitally missing teeth"

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Dedication

For my mom and dad who taught me about dreams and how to reach them, who always support me, encourage me on every adventure and believe in me even when I don’t.

For my sisters and my brother who always support me and remind meof my potentials.

For all my friends who walked with me all the way, all these years.

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1-CMT	Congenitally Missing Teeth
2-TGFA	Transforming growth factor– alpha
3-FPD	Fixed partial denture
4-MLIA	Maxillary lateral incisor agenesis
5-TAD	Temporary anchorage device
6-RBFPD	Resin-bonded fixed partial denture
7-MSX	Msh Hormebox 1
8-PAX	Pleomorphic xanthoastrocytoma

INTRODUCTION

Congenitally missing teeth (CMT), or as usually called hypodontia, is a highly prevalent and costly dental anomaly. Besides an unfavorable appearance, patients with missing teeth may suffer from malocclusion, periodontal damage,insuffcient alveolar bone growth, reduced chewing ability, inarticulate pronunciation and other problems. Treatment might be usually expensive and multidisciplinary. This highly frequent and yet expensive anomaly is of interest to numerous clinical, basic science and public health fields such as orthodontics, pediatric dentistry, prosthodontics, periodontics, maxillofacial surgery, anatomy. This essay reviews the findings on the etiology, prevalence, risk factors, occurrence patterns, skeletal changes and treatments of congenitally missing teeth. It seems that CMT usually appears in females and in the permanent dentition. It is not conclusive whether it tends to occur more in the maxilla or mandible and also in the anterior versus posterior segments. It can accompany various complications and should be attended by expert teams as soon as possible**. (Goya *et al,* 2008) (Amini *et al*, 2012)**

One of them is congenitally missing teeth (CMT), congenital absence of teeth, congenital dental aplasia, or dental agenesis. It is one of the most common dental anomalies **(De coster *et al,* 2009).** It might negatively affect both the esthetics and function. **(Amini *et al,* 2012) E**sthetics itself is an important factor and its problems might affect patients' self-esteem, communication behavior, professional performance and quality of life**. (Behr *et al,* 2011)** Patients with missing permanent teeth may suffer from complications such as malocclusion (which itself can lead to mastication problems), **(Khosravanifard *et al,* 2012)** periodontal damage, lack of alveolar bone growth, reduced chewing ability, inarticulate pronunciation, changes in skeletal relationships and an unfavorable appearance **(Kumar *et al,* 2013)**, most of which need rather costly and challenging multidisciplinary treatments **(Shimizu and Maeda , 2009).**

The aims of study

1-To study the diagnosis, classification and the etiology of congenitally missing teeth.

2-To study the prevalence of congenitally missing teeth.

3-To study the management of the arches with congenitally missing teeth.

Chapter One: Review of Literature

1.1. ETIOLOGY OF DENTAL AGENESIS

CMT is a result of disturbances during the early stages of development **(Aktan *et al,* 2010)** and is suggested as a mild dysplastic expression of the ectoderm. **(Galluccio and Pilotto , 2008)** When a primary tooth is congenitally absent, its permanent counterpart might also be missing. **(Fekonja , 2005)** Genetics plays a crucial role in congenital dental aplasia, as confirmed by studies on monozygotic twins. **(Varela *et al,* 2011)**

This multifactorial etiology can include environmental factors as well, since a combination of environmental and genetic factors might contribute to the occurrence of dental agenesis. **(Chung *et al,* 2008)** The environmental factors include infection, trauma and drugs, as well as genes associated with about 120 syndromes, **(Alshahrani *et al,* 2013)** such as cleft lip, cleft palate or both, ectodermal dysplasia and Down, Rieger and Book syndromes.

CMT has greater occurrence likelihood when the dental germ is developing after the surrounding tissues have closed the space needed for the tooth development. Other investigations demonstrated that delays in tooth development and reductions in tooth size correlate with advanced CMT. Both of these might accord with the terminal reduction theory. Furthermore, it is suggested that anterior agenesis may depend more on genes while posterior missing might be sporadic.

The most supported etiological theory suggests a polygenic mode of inheritance, with epistatic genes and environmental factors exerting some influence on the phenotypic expression of the genes involved, **(Varela *et al,* 2009)** which this can disturb the tooth germ during the initial stages of formation, i.e., the initiation and proliferation. The exact genetic mechanism is not known. Separate mechanisms might as well account for missing of each tooth. CMT can

form in isolation as well. Isolated cases are more common than syndromic type and might be familiar or sporadic **(Fekonja , 2005)** The isolated condition can follow autosomal dominant, autosomal recessive or X-linked patterns of inheritance, with remarkable variation in both penetrance and expressivity.

Different sub-phenotypes of dental agenesis might be probably caused by various genes. **(Kuchler *et al,* 2008)** Mutations in genes such as MSX, PAX9 or TGFA might cause CMT in different racial groups. **(Gomes *et al,* 2010)**Among the homeobox genes, MSX1 and MSX2 play an important role in mediating direct epithelial-mesenchymal interactions during craniofacial bone and tooth development. The autosomal-dominant CMT might be correlated with a mutation in the MSX1 and PAX9 genes. MSX1 mutations affect predominantly the second premolars and third molars, sometimes in combination with other types of teeth like the first molars. **(Shimizu and Maeda , 2009)** On the other hand, in more common cases of incisor-premolar type of dental agenesis, MSX1 is less likely to play a role as the causative locus for this type of CMT. In addition, PAX9 and TGFA are associated with congenital missing by interacting between MSX1 and PAX9. **(Chung *et al,* 2008)**

A recent study showed a novel mutation in MSX1 gene responsible for CMT of the second premolars and third molars only. **(Mostowska *et al,* 2012)**

1.2. DIAGNOSIS AND CLASSIFICATION OF CONGENITALLY MISSING TEETH

Dental aplasia is classified based on the number of missing teeth. **(Rakhshan , 2013)** Mild and moderate cases have usually less than three and less than six teeth missing, respectively. The definitions of hypodontia, oligodontia and anodontia differ in the number of missing teeth as seen in figure (1.1). An ideal CMT diagnosis requires radiographic, clinical and dental cast examinations, **(Kim , 2011)** but in any case, radiographic examination is a must. ***(Durrani et al,* 2010)** Since radiographic evidence of tooth germs needs certain level of

calcification to appear, inclusion of too young individuals might enter insufficiently calcified tooth buds into the sample, which can be mistakenly diagnosed as missing teeth on the radiograph. It can be of a greater concern for the mandibular premolars and boys, both with more delayed eruption odds**. (Amini *et al,* 2012)** Therefore, scientists should take into consideration the late development of the lower second premolars in boys; and should not include subjects without the canines and premolars neither erupting nor fully erupted, **(Kim , 2011)** or at least under 6 years. Some authors have recommended the exclusion of children younger than 9 or 10 or even 12 years old. The third molar bud calcification begins at the age of about 7.5 only in very few people; however, the average age for the initiation of its calcification is about the age 9.5. Therefore, by including patients younger than 9, or even 11 (as the 85th percentile for initiation of calcification), researchers might considerably overestimate the third molar missing rate. This might explain the very high prevalence reported by some studies (34.8%).

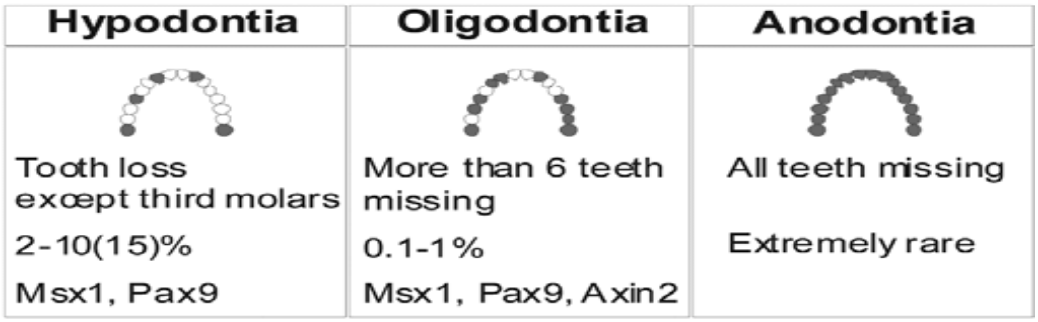

Figure 1.1:- Classification of CMT(Alanson *et al.*2009).

1.3. THE PREVALENCE OF DENTAL AGENESIS

In the primary dentition, the CMT is not frequent, being between 0.1% and 2.4%. **(Alshahrani *et al,* 2013)** However, primary dental aplasia is usually followed by permanent tooth missing. The prevalence of CMT in the permanent dentition excluding the third molars ranges between 0.15% and 16.2%. **(Guttal *et al,* 2010)** Japanese people showed the highest rates both in deciduous and

permanent dentitions. The CMT prevalence was found to differ between continents and races, but unlikely over time. The CMT prevalence in third molars has been reported over a rather broad range, between 5% and 37%. **(Fekonja , 2005)**. Nevertheless, some authors suggest that it might be evolutionary to adapt with the gradually shrinking size of the jaws. Some researchers state that evolution needs much more time to happen; whereas some account for the rapid environmental changes as the causes of CMT.

1.4. THE ASSOCIATION OF CMT WITH OTHER DENTAL ANOMALIES

CMT can accompany other conditions such as delayed eruption of other teeth, reductions in coronal or radical dimensions, retained primary teeth, ectopic canine eruption and abnormal dental morphologies such as taurodontism as seen in figure (1.2) and peg-shaped maxillary lateral incisors. **(Gomes *et al,* 2010)** While some researchers have reported that the size of teeth and the width of the dental arch are not related to dental agenesis, some others reported conflicting results indicating that CMT is associated with dental anomalies such as microdontia and decreases in the size of the incisors and canines as well as conical or tapered teeth such as peg lateral. **(Gungor and Turkahraman, 2013)** However,

some investigators did not find a link between tooth agenesis and microdontia but with peg laterals. They concluded that CMT was not associated with changes in the overall tooth size, while changes in tooth morphology especially in the maxillary lateral incisors might still be possible **(Chung *et al,* 2008).** This might be in line with other studies finding correlations between severe CMT and taurodontism **(Kan *et al,* 2010)** especially in boys. Both CMT and taurodontism seem to be a part of syndromes characterized by decreased mitotic cellular activity which might also affect dental germ development. On the

other hand, some other studies found clear associations between both mild and severe CMT and reduced tooth size, **(Gungor and Turkahraman, 2013)**especially in the upper laterals (in the mesiodistal dimension) and the lower canines (the labiolingual dimension).

Figure 1.2:- Taurodontism (Gungor and Turkahraman, 2013).

1.4.1.ASSOCIATIONS WITH SKELETAL CHANGES IN THE HORIZONTAL PLANE

The results pertaining to skeletal changes are controversial. Some authors did not find a significant correlation between malocclusions and CMT prevalence, although suggested a link between CMT and Class II division 2 as seen in figure (1.3). **(Kim , 2011)** While according to others, there could be significant links. CMT might accompany reduced inter-canine and intermolar widths. **(Oztek *et al*, 2010)** Anterior missing can accompany retrognathic maxillae, prognathic mandibles and smaller lengths of posterior cranial base. **(Kumar *et al*, 2013) I**t also might be more common in the skeletal Class III malocclusion due to smaller or retrognathic maxillae as seen in figure (1.4) **(Amini *et al*, 2010)**. In some studies, Class III was associated merely with severe CMT.CMT might be also significantly less frequent in Class II cases. A study by Hirukawa et al. concluded that Class III might be the most common malocclusion observed among the subjects who had missing teeth only in the maxilla, while when teeth were missing only in the mandible, it was frequently associated with

Class II malocclusion **(Hirukawa *et al*, 2000)**. Perhaps the tendency towards a Class III relationship is caused by decreased maxillary and mandibular angular prognathism and the effect might be greater on the maxilla

than on the mandible. **(Moles *et al*, 2010)**

Figure 1.3:- patient with class II division 2 (horizontal changes) (Kumar *et al*, 2013).

Figure 1.4:- patient with class III (horizontal changes) (Carriere 2016).

1.4.2.ASSOCIATIONS WITH VERTICAL SKELETAL CHANGES

According to some studies, dental aplasia is not correlated with the vertical relationship of the jaws. **(Oztek *et al*, 2010)** However some investigators have found significant associations between the CMT occurrence with reduced anterior

lower facial height and increased overbite as seen in figure (1.5), **(Fekonja , 2005)** which intensifies by increasing the severity of CMT, or less severe deep bite in CMT patients and decreased maxillary to-mandibular-planes angle, which was clinically relevant only in severe CMT. **(Moles *et al,* 2010)** Furthermore anterior CMT might have a significant effect on the vertical skeletal relationships with increasing severity of CMT. It also might contribute to a more acute mandibular angle and flatter chin. **(Kumar *et al,* 2013)**

Figure 1.5:- patient with reduced anterior lower facial height and increased overbite (Vertical changes) (Zitzmann 2015).

1.5.SEX DIMORPHISM

Gender might act as a dental agenesis risk factor. **(Amini *et al,* 2012)**Women are usually more affected and the male-to-female ratio is about 2:3 **(Medina , 2012)**. according to some studies there are significant intersex differences only for the lateral incisors and third molars (without indicating the predominant gender). Significant differences only for the lateral incisor missing cases, being more common in females. **(Amini *et al,* 2012)** The higher rates observed in females might be associated with biological differences such as smaller jaws which might trigger environmental factors as seen in figure (1.6). This might be confirmed by the suggestion that teeth might be absent also when the development of dental germs is delayed and thus the needed space has been

compromised by the surrounding tissues. As well, another factor can contribute to the higher rates of CMT in females: The existence of a probable higher orthodontic treatment need in females with the tooth missing due to their higher concern regarding the appearance and the higher value that society gives to esthetics in females **(Varela *et al,* 2009)**.

Moreover, some other studies did not find such a difference in orthodontic patients, **(Chung *et al,* 2008)** or even reported higher prevalence rates in male orthodontic patients and male patients of the public health services**. *(Kuchler et al,* 2008)** showed that the M:F ratio of incisor agenesis was 1.4:1, while in the case of the upper lateral incisors, this ratio was 2:1 and for the lower incisors, the M:F ratio was 1:1. On the other hand, the M:F ratio of premolar missing was 0.5:1 (0.3:1 for the upper second premolar ratio and 0.5:1 for the lower second premolar ratio). Thus a combination of various M:F ratios for different teeth can disallow to easily identify significant differences in the whole dentition.

Based on the differences in sex ratios depending on the specific tooth types affected, Küchler et al. **(Kuchler *et al,* 2008)** suggested a continuous variable, "liability," with a threshold value, beyond which individuals might be affected. This system is called multifactorial because both genetics and environmental factors determine liability. Based on this concept, they concluded two possibilities: Either the same genetic model might have different thresholds for males and females, or each gender is influenced by an independent genetic model, each having its own threshold.

Another factor contributing to the controversy might be the ethnicity. There is no consistent finding as to which sex is predominant in regard to having more missing teeth per child. **(Aktan *et al,* 2010)** In one research, each male had an average of missing teeth per person higher than that of each female (2.32 compared to 1.40). **(Amini *et al,* 2012)**However, in another one, the average numbers of missing per person dentition were almost similar for both genders

with a slight increase in boys (2.5 for boys, 2.4 for girls) **(Endo *et al,* 2006)** and in some others, girls had a higher chance for having more missing teeth per person.

Figure 1.6:- patient with smaller jaws (Samizadeh 2019).

1.6.THE MOST FREQUENTLY MISSING TEETH

Clinicians could be assisted by knowing the CMT risk factors and its pattern of occurrence. **(Amini *et al,* 2012)** As a general rule, if only a few teeth are missing, the absent tooth would be the most distal tooth of any given type. **(Sisman *et al,* 2007)** This applies to the maxillary laterals and the mandibular second premolars. On the other hand, it is suggested that the permanent maxillary first premolars, canines and first molars, which are likely to be more stable, have a relatively greater rate of CMT in children with five or more teeth missing. **(Shab *et al,* 2010).**

1.6.1.UNILATERAL VERSUS BILATERAL DENTAL AGENESIS

Most authors observed predominance of bilateral CMT to extents such as about as twice as unilateral missing **(Peker *et al,* 2009)** or even as trice as unilateral missing as seen in figure (1.7). have reported that in 89% of patients, the teeth were bilaterally missing. **(Medina , 2012)** This author further evaluated the values and it was implied that many patients had more than only a pair of bilaterally missing teeth and that if the number of teeth was to be compared, bilateral missing would be as double as unilateral missing in their study. **(Chung**

***et al,* 2008)** Furthermore, it is suggested that unilateral agenesis might be more common in the case of the upper and lower second premolars, whereas, bilateral missing might be more common in the maxillary laterals. **(Aktan *et al,* 2010)** Except for the first molars in both jaws and the maxillary centrals, bilateral agenesis was significantly more common than unilateral aplasia. **(Aktan *et al,* 2010)**

Figure 1.7:- patient with bilateral congenitally missing upper lateral incisor (Elizabeth 2017).

1.6.2.WHICH TEETH ARE MOSTLY SYMMETRICALLY MISSING?

This question is not assessed thoroughly. Medina **(Medina , 2012)** stated that while symmetrical dental missing affects the maxilla, the mandible shows mostly unilateral agenesis. According to some other reports, the most common symmetric missing tooth could be the mandibular second premolar agenesis, followed by the absence of the maxillary second premolar or maxillary lateral incisor. **(Endo *et al,* 2006) A**ccording to a meta-analysis, the maxillary lateral incisor might be the most common bilateral missing tooth. found a similar pattern in children other than those with two missing teeth. However, in children with two missing teeth, the mandibular lateral incisor agenesis had a higher prevalence rate. **(Endo *et al,* 2006).**

1.6.3.THE RIGHT VERSUS THE LEFT SIDES

No studies so far have found a significant difference between missing teeth located in the left and right sides **(Kositbowornchai , 2011)**. Even a study on more than 100,000 dental patients showed that the number of missing teeth on the left and right sides was almost identical (1574 vs. 1573). **(Aktan *et al,* 2010)** the missing teeth were more commonly absent on the right side (26 teeth, 54.2%) than on the left side (22, 45.8%) as seen in figure (1.8).

Figure 1.8:- patient with congenitally missing of upper right lateral incisor (Zitzmann 2015).

1.6.5. THE OCCURRENCE OF CMT ACROSS THE ANTERIOR/POSTERIOR REGIONS

Few studies have evaluated the difference between CMT rates in the anterior and posterior segments **(Oztek *et al,* 2010)** and this should be considered in future studies. Most studies showed higher prevalence in the anterior segment **(Amini *et al,* 2010)** and the few remaining researches found no significant differences. Some investigators suggest that in mild cases of CMT, the anterior segment might be more involved while the posterior segment might be predominant in severe cases. **(Shab *et al,* 2010)** investigated two groups: Nine families exhibited dental missing likly as a function of autosomal dominant genetic transmission. In these families, CMT mainly involved the maxillary lateral incisors. Since other dental anomalies were present, CMT seemed one of

the manifestations of an anomaly of the dental lamina. Six families had CMT as a sporadic condition. In this group, CMT was seen only in orthodontic patients and it most often involved the second molars and second premolars**. (Galluccio and Pillotto , 2008)**

1.6.6.THE OCCURRENCE OF CMT ACROSS THE ARCHES

The results as which arch is predominant are not conclusive. **(Amini *et al,* 2012)** Some investigators found that congenital tooth agenesis was more common in the maxilla **(Sisman *et al,* 2007),** and some others reported a higher rate of missing teeth in the mandible.

1.7.Treatment of congenital missing teeth

1.7.1Management of missing central incisor

There are basically three approached to manage missing incisors:

1. Space closure.
2. Space maintenance or opening.
3. Auto-transplantation.

4-implant.

1.7.1.1.Auto transplantation

This is a surgical repositioning of a tooth into a surgically created socket within the same patient .It is successful to transplant open apex premolars from crowded arch into the sockets of avulsed central incisors as seen in figure (1.9). The upper 2nd premolar and lower premolars are the best choice for transplantation in the anterior segment because of their single root. **(Rodriguez-ciurana , 2009)**

Figure 1.9:- auto-transplantaion for upper central incisor . (Rodriguez-ciurana , 2009).

1.7.1.2.Requirements for the placement of implant to replace missing upper incisor

- Growth rate slowed to adult levels.
- Adequate bone height.
- Adequate bone width.
- Adequate space between roots of adjacent teeth.
- Adequate space for crown between adjacent crowns and occlusally.

As seen in figure (1.10).

(Gribel *et al* , 2013)

Figure 1.10:- implant for upper central incisor (Gribel *et al* , 2013).

1.7.2.Management of missing lateral incisor

Among the options available to the clinician are the posibility of space closure with mesial repositioning of canines, followed by teeth recontouring (camouflage) as seen in figure (1.11).; or a combination of space opening and prosthetic replacement of the missing lateral incisor **(Pini *et al,* 2012)** .

Different restorative approaches may be employed in the agenesis area, such as resin bonded fixed partial dentures (FPD), cantilevered FPDs, and conventional full-coverage FPDs.

A recent study that assessed five treat- ment alternatives for maxillary lateral incisor agenesis where space maintenance and tooth replacement were indicated ranked in the following order from most to least cost- effective: auto-transplantation as seen in figure (1.12), cantilever FPDs, resin-bonded FPDs, single-tooth implants and implant-supported crowns, and full-coverage FPDs **(Antonarakis *et al,* 2014)** . However, the primary consideration when deciding which option to choose is the conservation of tooth structure **(Pinho *et al,* 2012)** . Other factors such as patient age, the state of the dentition, and occlusion should also influence the choice of the restoration. clinicians should treat MLIA patients with extreme caution based on their own clinical skills and experience, the clinical conditions of each patient, and patients' expectations **(Kokich *et al,* 2011)** .

Figure 1.11:- Bilateral missing lateral incisors and make a camouflage for bilateral canines to look like laterals (Kokich *et al,* 2011).

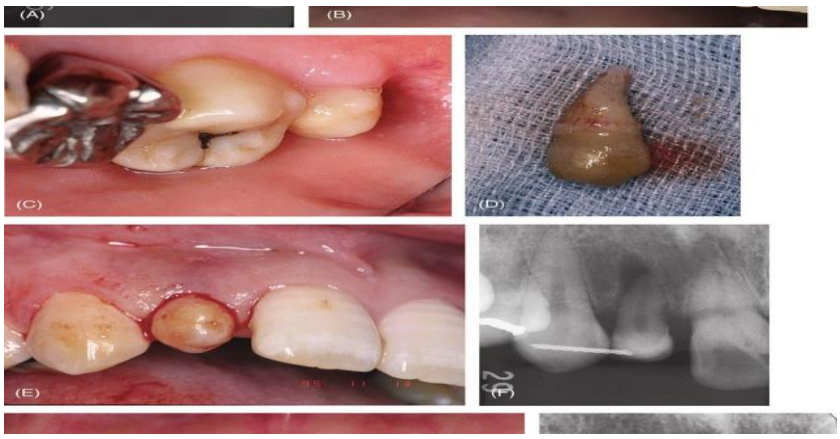

Figure 1.12 :-Autotransplantation for missing lateral incisor (Pini et al, 2014).

1.7.3.Management of missing canine

The congenital absence of a maxillary permanent canine has a prevalence of less than 0.5%, and three recent studies reported the prevalence to be zero **(Kambalimath et al, 2015)**.8-10 Previous studies have reported a greater frequency of congenitally missing maxillary canines to occur in females compared to males, and in black compared to white populations. **(Harris *et al,* 2008) (Shetty *et al,* 2012)**

Possible approaches to manage congenitally missing teeth include space closure using orthodontic therapy, opening the space for implant placement, auto transplantation, or prosthetic restoration. **(AL-Ani *et al,* 2015)** The restoration of the missing tooth is often complicated by the remaining teeth being in unfavorable positions. Common issues faced in treating hypodontia patients include aligning displaced teeth, space management, tooth up-righting, the management of a possible deep overbite, and post-treatment retention. Orthodontic treatment may facilitate restorative care but the final treatment plan will be dependent on factors related to patient age, the degree of inherent crowding, the condition of the retained deciduous teeth, the type of malocclusion, and the patient's preference. **(GunaShkhar *et al,* 2011)**

1.7.4.Management of missing 2nd premolar

After the third molars, the second premolars have the highest incidence of congenital absence. **(Suprabha *et al,* 2009) (Manjunatha *et al,* 2011)** The problem resides not in the prevalence of congenitally missing premolars but in the selection of a treatment plan that will yield the best results over the long term. Today,

two different treatment approaches to resolve this problem are available:

1- Extract the deciduous second molar, allow the permanent first molar to drift mesially and then complete the case orthodontically. **(Northway , 2007)**

2- Retain the deciduous molar for as long as possible and then seek a prosthetic solution.as seen in figure (1.13) **(Bjerklin *et al,* 2008)**

The reasons to extract the deciduous second molars when a second permanent premolar is missing are: Pulpal pathology, large restoration, carious lesions close to the pulp, normal or pathologic root resorption, crowding in the permanent dentition, ankylosis and differences in tooth sizes between deciduous and permanent teeth. **(Valencia *et al,* 2004)** However, caries free deciduous second molars with long roots pose a serious dilemma. In such cases, we might try to maintain the deciduous molars, suggesting they could last for few years, thus avoiding the complexity of closing the spaces without tooth inclination and possibly creating periodontal problems in future. Also, physiologic resorption of the deciduous molars without the second premolar occurs on an average of 10 years after the normal exfoliation. **(Das *et al,* 2006)** Maintaining the deciduous molars could pose a Bolton tooth size discrepancy due to mesiodistal crown size difference between the deciduous second molar and the permanent second premolar, altering the occlusion if the space is not properly managed. This phenomenon becomes more important when only the maxillary or mandibular missing premolars are involved. **(Manjunatha *et al,* 2011)**

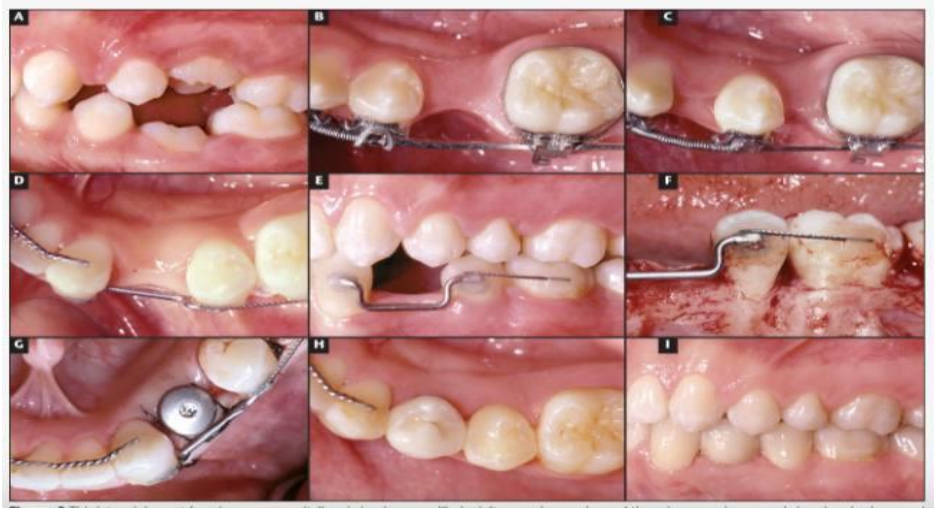

Figure 1.13:-This late adolescent female was congenitally missing her mandibular left second premolar and the primary molar was ankylosed and submerged (A). The primary molar was extracted, which resulted in a significant narrowing of the edentulous ridge (B). The first premolar was pushed distally (C,D,E) into the second premolar position. This orthodontic movement allowed an implant to be placed in the newly regenerated bone (F,G). After restoration of the first premolar implant in the second premolar position (H), it is difficult to recognize any difference (Manjunatha *et al,* 2011).

1.7.5.Management of missing Molar

1.7.5.1.TREATMENT OPTIONS:

When considering treatment options for missing molars, the subsequent change in vertical dimension should also be kept in mind.the various treatment options include: implant insertion as seen in figure (1.14), autotransplantation, and prosthetic restoration and space closure. Prosthetic bridges offer the advantage of short treatment time but must be accompanied by significant tooth preparation. Dental implants permit conservation of tooth structure but require surgery. Auto-transplantation also requires surgery, and successful transplantation cannot be guaranteed. It that both closure and space opening alternatives have their advantages as well as disadvantages, but the evidence base is weak, with currently no randomized trials reporting on the outcome of different interventions.

The amount of crowding, type of malocclusion, facial profile, age of the patient, periodontal conditions, bone volume in alveolar process, vertical or horizontal growth pattern, the number of missing teeth, and the available space should be considered in treatment plan. **(Bondemark and Tsiopa , 2007) (Nagaraj *et al,* 2008)**

Figure 1.14:- implant insertion for congenitally missing molar (Saber *et al,* 2018).

1.7.5.1.1.Space closure:

The main whole treatment can be finished immediately after completion of orthodontics which is the main advantage with this procedure. This procedure is preferred because of its better long-term outcome without other side effects like infra-occlusion, blue coloring of the gingiva, or periodontal problems as seen when implant is placed. Reduced financial burden on the patient is one other advantage with this procedure. This procedure is preferred in crowded cases as the space from the missing molar can be utilized to resolve crowding. **(Wishney, 2017)**

Space closure is not indicated in all cases. Like in hypodivergent patients, because of the muscular and cortical anchoring, making it difficult to close extraction space. The aim is to maintain the occlusal relationships and arch symmetry. A compensating extraction is the removal of a permanent molar from the opposing quadrant, while a balancing extraction signifies the extraction of a

permanent molar from the opposite side of the same dental arch. Other factors like developmental status of the dentition, the third molars, prognosis of the remaining molars, underlying malocclusion play a role in deciding treatment plan. The age also plays an important role in deciding the treatment plan. **(Bondemark and Tsiopa , 2007)**

Direct protraction from a mini-screw placed lateral and inferior to the arch-wire can create posterior crossbite and open bite. To counteract these effects, the following steps should be considered:

1. Protraction with a balancing lingual force, such as an elastic thread tied from the lingual cleat of the molar to the arch-wire. When tying the lingual elastic to the arch-wire, the incisors and canines must be ligated to prevent rotation of the anterior teeth.

2. Incorporating the second molar into the arch-wire to minimize arch expansion.

3. Using a rectangular arch-wire to prevent the molar from rolling out buccally.

4. Placing an occlusal gable bend (upward V-bend) in the arch-wire mesial to the edentulous space to counteract molar intrusion. Alternatively, if an auxiliary slot is used, a buccal hook can be fabricated from a wire segment to protract the tooth at its center of resistance. As seen in figure (1.15). **(Saber *et al,* 2018) (Aghoutan *et al,* 2019)**

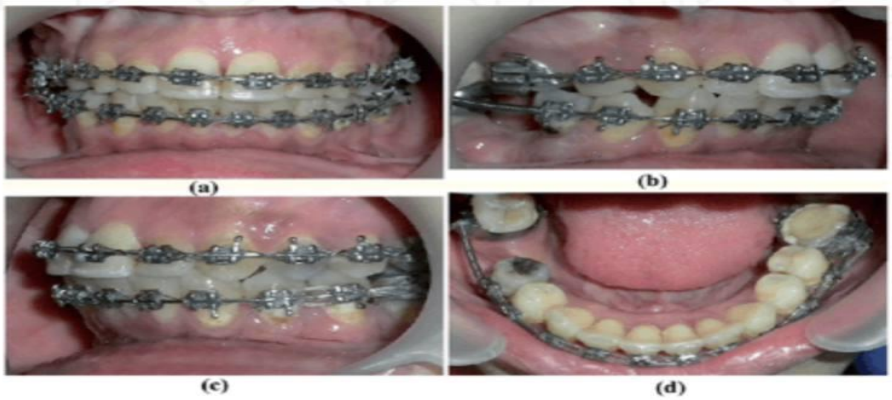

Figure 1.15 :-space closure for congenitally missing molar.

Chapter Two: Discussion

Comprehensive treatment of patients with missing teeth and/or hypodontia is difficult. It requires a teamwork including an orthodontist, a prosthodontist, and a surgeon (in case of implant insertions) to achieve ideal results.

Dental implants may be considered as the best treatment option for patients with hypodontia. However, using dental implants in patients with hypodontia may be challenging due to some limitations such as reduced mesiodistal space, poor bone quality and quantity (especially after orthodontic treatment), and compromised implants positions.

The orthodontist plays an important role in determining and establishing the space requirements for patients with missing teeth **(Kinzer, 2005)**. Then the prosthodontist should reassess the available space required for the implant fixture using the appropriate radiographs.

In patients with congenitally missing permanent teeth, orthodontic treatment is the gold standard **(Kinzer, 2005)**. However, orthodontic treatment can cause some potential risks and complications, because teeth undergone orthodontic movement may have resorption of cementum and dentine **(Wishney, 2017)**. When adjacent teeth have been orthodontically moved in order to gain adequate space, radiographic examination often reveals either insufficient interradicular space available for an implant fixture or an absence of root parallelism. Tooth reduction is conservative for RBFPDs preparation because of remaining in the enamel. This is one of the numerous advantages of this restoration; however, the three most common complications associated with RBFPDs are debonding (21%), tooth discoloration (18%), and caries (7%).

Chapter Three: CONCLUSION and SUGGESTIONS

CONCLUSION

1. CMT is prevalent multifactorial dental anomaly.

2.CMT usually appearing in females and in the permanent dentition.

3. It is not conclusive whether CMT tends to occur more in the maxilla or mandible and also in the anterior versus posterior segments.

4. CMT can accompany various dentoskeletal deformities, anomalies, or simply complications .

SUGGESTIONS

- Studies should be made for possible means of prevention of hypodontia
- Studies should be made to determine the familial tendency of hypodontia with methods of its prediction
- More studies should be made on the possibility of regenerative therapy and cloning to replace the tooth lost due to absent formation

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