Jean Bassil

Prosthetic Management of Deciduous Teeth

Universidade Fernando Pessoa

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Mestre em Medicina Dentária

Abstract

Introduction: Situations of single or multiple edentulous are not an exception during childhood. Prosthetic management is necessary in case of absence of replacing tooth or when its eruption is planned too far in time. Indications of prosthetic rehabilitation for children are multiple and rise from the etiologic factors causing the situations of edentulous or loss of normal dental relation. These factors can be acquired or congenital.

Prosthetic restorations aim to restore esthetics and to maintain masticatory and phonetic functions as well as the length of the arcade and the vertical dimension of occlusion. The other objectives are to prevent a possible psychological trauma due to loss of the teeth and the appearance of bad habits such as the interposition of the tongue and the maintenance of infantile swallowing.

In their daily practice, dentists are often confronted with edentulous situations and in order to provide optimal care for his patients, dentist should opt for a suitable therapeutic choice.

Objective: This literature review aim to enumerate and describe the different treatments for dental loss in children and their respective indications. Treatments include fixed or removable prosthetic rehabilitation.

Materials and methods: For this purpose a research has been done and data was obtained from online resources: Scielo, Medline, Bireme, Pubmed, Bon, books and specialized magazines which was conducted between December 2014 and June 2015. The key words used were temporary denture, eruption and occlusion in temporary denture, eruption in permanent denture, caries and tooth loss etiologies, space maintainers, prosthetic management in temporary teeth.

Conclusion: Prosthetic rehabilitation in children is an essential therapeutic which must be implemented in the earlier stage in the earlier stage and according to the child's abilities and monitoring must be done over several years.

Resumo

Introdução : Situações de falta de um ou mais dentes não são raras durante a infância. A colocação de uma prótese pode ser necessária para a substituição dos dente ou quando para a sua erupção ainda falta algum tempo. As indicações de reabilitação protética para as crianças são múltiplas e os fatores etiológicos que causam as situações de perda de dentes ou perda de relação dentária normal, aumentam. Esses fatores podem ser adquiridos ou congênitos.

As restaurações protéticas visam estabelecer a estética e manter as funções mastigatórias e fonéticas, bem como o comprimento da arcada e da dimensão vertical de oclusão. Outros objectivos são evitar um possível trauma psicológico, devido à perda dos dentes e ao aparecimento de maus hábitos, tais como, a interposição língual e a manutenção da deglutição infantil.

Diariamente, os dentistas são muitas vezes confrontados com pacientes desdentados e a fim de proporcionar os melhores tratamentos para seus pacientes, devem optar por uma reabilitação adequada.

Objetivo : Esta revisão da literatura tem como objetivo enumerar e descrever os diferentes tratamentos e suas respectivas indicações, para a perda dentária em crianças. Os tratamentos incluem reabilitações protéticas fixas ou removíveis.

Materias e metodos : A pesquisa foi feita com recurso a bases de dados online: Scielo, Medline, Bireme, Pubmed, Bon, livros e revistas especializadas, entre os meses de dezembro de 2014 e junho de 2015. As palavras-chave utilizadas foram dentição decídua, erupção e oclusão na dentição decídua, etiologias da cárie e da perda dentária, mantenedores de espaço, prótese dentária para dentes decíduos.

Conclusão : A reabilitação protética em crianças é uma terapêutica essencial que deve ser implementado na fase precoce e de acordo com a prática do medico dentista e o acompanhamento da criança deve ser feito ao longo de vários anos.

ACKNOWLEDGMENTS

I would like to thank my dissertation supervisor, Dra. Rita, for her input, valuable discussions and accessibility. Her support has been invaluable throughout my work on this Thesis.

I am very grateful for the support and motivation from my friends and family, particularly the help and support my friends Bakhos Fares & Fida Tawil.

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INTRODUCTION

Pediatric dentistry is an integral part of the daily practice in dentistry. As in regular practice for adults, pediatric dentistry can be divided into several categories such as surgery, conservative dentistry or prosthetic. All these are most often linked together.

Although less common than in adults, the pediatric prosthesis should not be excluded from child's dental treatment, which is often the case. In fact, dental care for children is not only limited to conservative dentistry, especially when the tooth is largely broken or even lost.

Moreover, in some cases, the dentist is led to achieve prosthesis on children with large syndromes. Like the conventional prosthesis, the pediatric prosthesis has different forms: removable prosthesis and fixed prosthesis.

The choice of the theme of this thesis is the result of a long reflection. The author intended, considering his passion for pediatric dentistry, helping practitioners has the necessary knowledge in order to face frequent situations of edentulism in children and provide adequate rehabilitation therapeutic in order to avoid eventual complications on functional, esthetic and psychological levels.

The objective of this study, through a literature review, is to deepen the dentist's knowledge about the denture in children, its specificities, tooth loss etiology in temporary denture, the multiple prosthetic treatments and their indication. This work highlights the importance of an early management of tooth loss in order to avoid all kinds of complications.

The research has been done on internet by consulting articles in 5 databases, on proposed subject with recourse to keywords.

Tooth loss in children is of multifactorial etiology and the indications for pediatric prosthesis are multiple. Orofacial growth and dental eruptive sequences and occlusal

relationship during childhood are detailed. Stable prosthetic restoration must integrate a dynamics context of growth. The goal of prosthetic rehabilitation in children is to restore orofacial functions and normal occlusal relationships; this balance is essential to the proper conduct of the growth in children.

DEVELOPMENT

Materials and Methods

The analysis and preparation of this bibliographic review were based on the scientific material duly published in books, articles and publications. The bibliographic research was conducted via online using the Medline, Scielo, Bireme, Pubmed, Bon search bases.

The key words used in the research are: temporary denture, eruption and occlusion in temporary denture, eruption in permanent denture, caries and tooth loss etiologies, space maintainers, prosthetic management in temporary teeth.

200 articles have been obtained in English and French published between 1972 and 2014. 40 were used which were relevant and useful for this bibliographic review. The selection was made after reading the abstract, the excluded articles were mainly related to prosthetic rehabilitation in adults.

I. DENTURE OF CHILDREN

The denture means all the teeth from the primitive dental lamina and there are three types of denture: the primary denture that be replaced by the mixed denture itself substituted by the definitive denture (Boritta, 2010).

1. Evolution of the denture in children

i. Primary denture

The primary denture consists of twenty teeth distributed in four quadrants of five teeth each: two incisors, one canine and two molars per quadrants (Fig.1), (Bailleul-Forestier et al., 2008), (Courson et al., 2005).

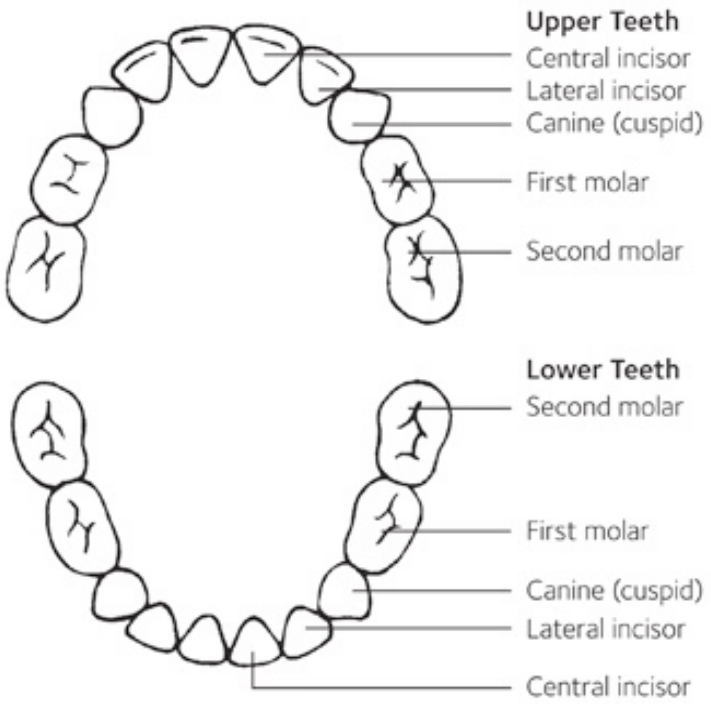


Figure 1: Dental chart in deciduous teeth, adapt (Borutta, 2010).

Its starts from the beginning of the calcification of the central incisors around the 4^{th} /5^{th} month of intra-uterine life, until the establishment of the second deciduous molars at the age of 30 months (Aknin, 2007), (Courson et al., 2005).

Several authors have described the physiologic eruption pattern. This eruption happens between six months and two years. It should be noted that the mandibular teeth erupt earlier than maxillary teeth and the dental occlusion is locked around the first year due to the occlusion of the first molars (Courson et al., 2005), (Aknin, 2007).

The eruption sequence and the mineralization ages of deciduous teeth are as follows in the table 1 (Delbos, et al., 2009).

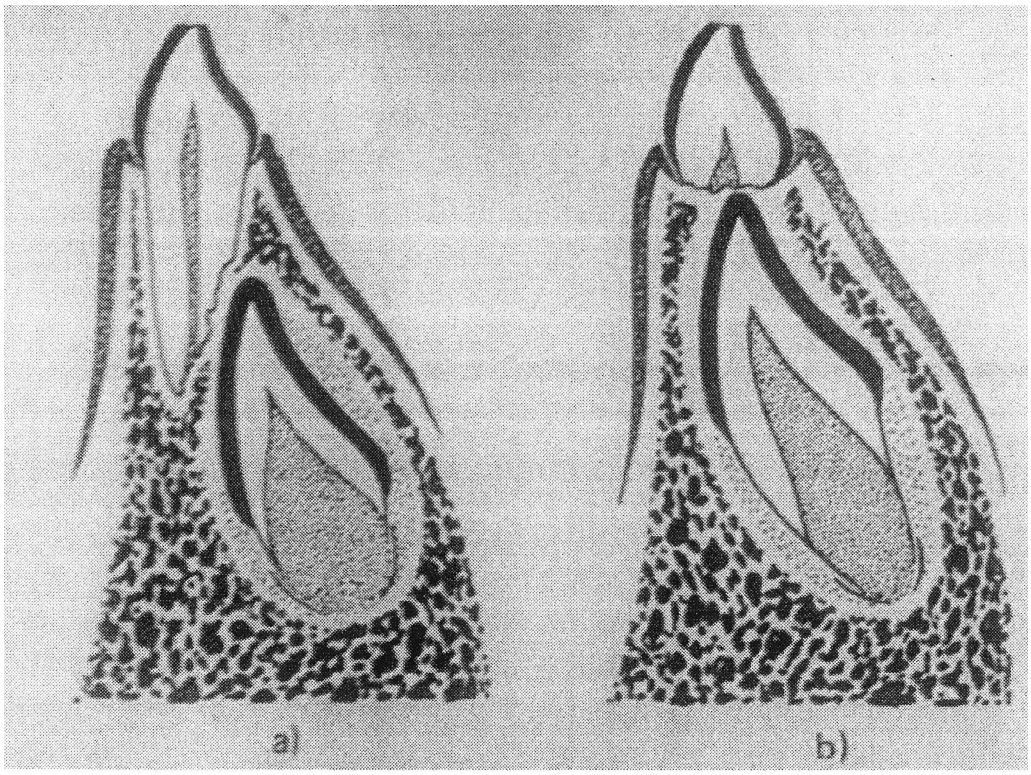
The eruption represents all the movements that the tooth will perform throughout its presence in the dental arch: this includes physiologic mesial drift as well as all movements linked to the adjustment of the position of the tooth relative to its environment - egression, version, rotation… (Aknin, 2007).

Table 3 Eruption and mineralization age of deciduous teeth, adapt (Delbos, 2009).

		central inc	lat inc	canine	1st molar	2nd molar
	germ implementation	8th wk IU	8th Wk IU	8th Wk IU	9th WK IU	10th WK IU
	begining of calcification	5th months IU	5th months IU	6th months IU	5th months IU	6th months IU
	crown completion	3-4 months	4-5 months	9-12 months	6-9 months	12 months
Stade I 1,5 years	Eruption	6-7 months	7-9 months	18 months	12 months	24 months
Growth	Apex closure	2 years	2-2,5 years	3 years	2,5-3 years	3,5-4 years
Stade II 2-3 years Stability	Rhizalisis start	5 years	5-5,5 years	6-7 years	5,5 years	6,5 years
Stade III 2-3 years Rhizalise	Exfoliation	7 years	8 years	11 years	9 years	10 years

The eruption is divided into three phases: the first one is the pre-clinical phase of eruption, it represents all movements realized by the tooth germ in its bony crypt and the movement of the germ in the jaw to reach the contact with the oral mucosa. The active phase of clinical eruption is the second phase, it represents all movements realized by the tooth from its emergence from the oral mucosa to the establishment of

contact with its antagonist (Fig.2). The final phase is the phase of adaptation to occlusion, it represents all the movements that the tooth will perform throughout its presence in the dental arch; this includes physiologic mesial drift as well as all the movements linked to the adjustment of the position of the tooth relative to its environment (Okeson, 1993).



a) Beginning of root resorption(rhizalyse) b) Exfoliation of deciduous teeth

Figure 2: Diagram of exfoliation process of deciduous teeth, adapt (Aknin, 2007).

a. The primary denture and its occlusion

Around the age of two years, all primary teeth have erupted. This state will last until the age of 6 years. These teeth will be functional for three to four years until the appearance of the first permanent molar around the six years old (Bassigny et al., 1991), (Safont, 1994).

The primary denture is characterized by that the dental arch has a U-shaped and has no compensative curve, the engrainement is unstable because the deciduous teeth are

slightly cusped, mandibular teeth are half tooth mesialed from maxillary teeth, anterior teeth are often edge to edge or slight overhang, mesial surfaces of the mandible and maxillary central incisors are aligned with each other and lie on line of the medial sagittal plane. The contact points on temporary teeth are rare, but diastemas are often current. These diastemas aim to ensure a good position for permanent teeth when they erupt (Bassigny et al., 1991), (Courson et al., 2005).

The posterior occlusion is the relation between the distal surfaces of the second deciduous molars, it is called Chapman plan. It can be straight in most of the cases - 76% of cases, it foreshadows a class I (Fig.3-a), or it can be mesialed -14% of cases, it foreshadows a class I or III (Fig.3-b), or finally distaled -10 % of cases, it foreshadows a class II (Fig.3-c).

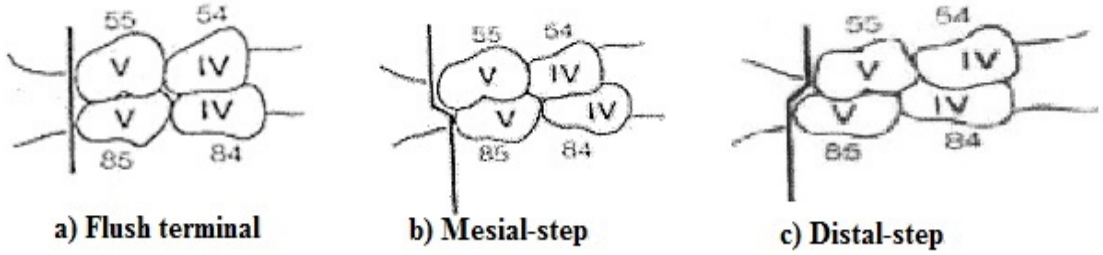


Figure 3: Deciduous molar relationship, adapt (Bassigny et al., 1991).

ii. Mixed denture

The mixed denture stage lasts from the age of 6 years with the eruption of the mandibular permanent first molar to the loss of the temporary tooth, usually the maxillary deciduous second molar around the age of 12 years. During this period, the child loses these primary teeth that will be replaced gradually by the permanent teeth (Safont, 1994), (Jacquelin et al., 2009).

Some dental disorders may occur at this stage, because the dental eruption is concomitant with the bone growth of the maxilla and the mandible (Aknin, 2007).
Loss of deciduous teeth is due to their root resorption caused by the eruption of the underlying permanent teeth (Jacquelin et al., 2009).

This root resorption is accompanied by characteristic dental wear. In fact, they are very fast and affect the incisial edges and occlusal surfaces and can lead to a complete leveling or even maybe a pulp exposure (Aknin, 2007).

iii. Permanent denture

The permanent denture phenomenon is longer, because it runs from the beginning calcification of mandibular permanent first molar at birth, until the end of the root edification of the third molar around the age of 25 years (Aknin J-J., 2007).

The eruption sequence and the mineralization ages of permanent teeth are as follows in the table 2 (Delbos et al., 2009).

Table 4: Chart of permanent teeth mineralization ages, adapt (Delbos, et al. 2009).

		Cent inc	lat inc	Canine	Ist premolar	2nd premolar	1st molar	2nd molar	3rd molar
	Germ installation	4th month IU	4 month IU	5th month IU	Birth	9th month	4th month IU	12 month	5 years
	Begining of calcification	3rd month	4th month	5th month	18 month	24th month	Birth	3 years	9th years
	Crown completion	4 years	5 years	7 years	6 years	7 years	3 years	7 years	12 years
GROWTH	Eruption	7 years	8 years	11 years	9 years	10 years	6 years	12 years	18 years
3 YEARS	Apex closure	10 years	11 years	14 years	12 years	13 years	9 years	15 years	? ?

There is a wide variability of tooth eruption ages, but could be note some general points: the mandibular teeth almost always erupt before their antagonists; the girls are ahead of boys and this gap increases gradually as the sequence proceeds; the incisors and the first molar are announcing growth surge of the dental system and the first molar erupts before the incisors. However, it is not unusual to encounter central incisors earlier than molars and at the age of 7 years, the central incisors and the first molars are

usually on dental arch, at 8 years, the lateral incisors make their eruption. The final or permanent denture takes place with the end of eruption of the thirds molars around 17 to 21 years until the end of life (Delbos, 2009).

The mesio-distal positioning of the mandibular teeth is ahead of half tooth on the maxillary teeth and the maxillary teeth overhang manbibular teeth. Occlusion is said to be stable (Okenson, 1993), (Aknin, 2007).

Unlike deciduous teeth, permanent teeth shows compensation curves: the curve of Spee and the curve of Wilson (Okenson 1993).

The curve of Spee is a concave curve with cranial opening antero-posterior and passing through the supporting cusps (Fig.4), (Aknin, 2007).

The curve of Wilson is a superior concavity curve in the transverse direction passing by the cusps of the posterior teeth, this curve is due to the vestibular version of the maxillary teeth and the lingual version of the mandibular teeth (Fig.5), (Okenson, 1993).

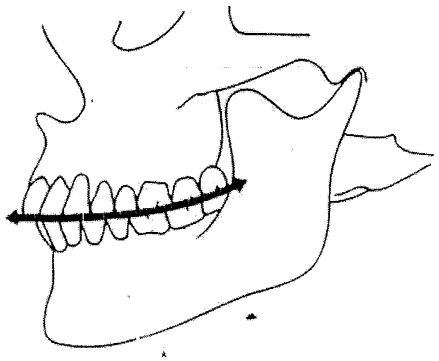


Figure 4: The curve of Spee, adapt (Aknin, 2007).

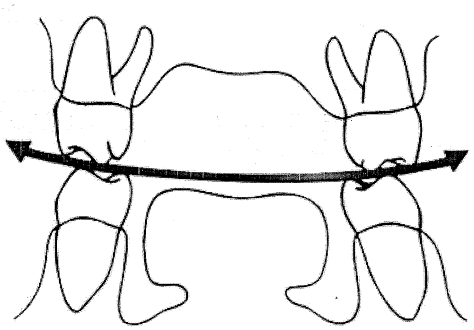


Figure 5: The curve of Wilson, adapt (Okenson, 1993).

2. Deciduous teeth

i. Physiological evolution

According to many authors (Fortier et al., 1987), deciduous teeth grow and evolve according to three stages.

Fist stage

Phase of growth and development, crown and root are build-up. This period lasts about a year. The physiology of dentin-pulp tissue is oriented to repair due to with an important neurovascular bundle and the opening of apex. This process is called dentinogenesis.

Second stage

Stage of maturation and stability, which extends from the complete build up of the root to its clinically detectable resorption. This period lasts three years or less than six months. Dentinogenesis is preserved.

Third stage

Regression phase, there is a phenomenon where physiologic root resorption leads to the fall of the deciduous tooth: it is the dental apoptosis. This period lasts three to four

years. Dentinogenesis is compromised. This phase includes structural modifications for the root, the bone and the tissue.

ii. Functions of deciduous teeth

Deciduous teeth have a crucial aesthetic role as they harmonize the lower floor of the face maintaining occlusion height promoting mandibular growth catch-up. They ensure essential and necessary function for the child for its growth and its physiological, psychological and intellectual development in its environment. These functions include chewing and speaking. Moreover the temporary teeth promote the evolution of swallowing from a primary state into a mature and physiological state. They are also part of the lower face growth process and occupy a essential role in the development of anterior facial bones (Courson et al., 2005).

iii. Periodontal tissues around deciduous teeth

As that of the adult, the child's periodontium is made up of four tissues: gingival, periodontal ligament, alveolar bone and cementum. However, there are notable differences between the child's periodontal and that of the adult (Bailleul-Forestier, 2008).

The gums are often described as being redder, because of more abundant capillary network and thinner epithelium, more translucent, the marginal gingival in stable temporary denture is pink, stiff and elastic, with smooth as peck or finely granite. The cervical anatomy of deciduous teeth and prominence of vestibular wall give it a hemmed thick appearance. The height of the attached gingival is more important in the maxilla than in the mandible and it increases with age. At the diastema, can be observed a gum coated with ortho or para-keratinized sloughing epithelium. The functional epithelium seems less high than the permanent teeth. The width of the periodontal space is increased with of fewer collagen fibers and more important vascularization. The cementum is less dense and thinner, it is acellular in the coronal part of the root and cellular in the apical part. Alveolar bone appears with a less dense mineralization and

fewer trabeculae. It has a dense blood supply and the lamina dura is also thinner (Bailleul-Forestier, 2008).

II. ETIOLOGIES AND CONSEQUENCES OF TOOTH LOSS IN CHILDREN

1. Etiologies of tooth loss in children

The causes of tooth gaps among the children could be due to a trauma, a pathology or a congenital problems (Andreasen, 1987), (Derbanne et al., 2005), (Koch et al., 2009).

i. Dental trauma

According to Andreasen (1987), 60% indergoes at least one trauma tooth during its growth. He also specifies that three out of ten children suffer trauma in deciduous teeth and two out often in permanent teeth. Note that the maxilla is affected in 97% of cases and the upper central incisors represent 68% of traumatized teeth.

Trauma can be the result of a direct or indirect shock. A direct shock occurs when the tooth is in direct contact with the ground for example. While an indirect shock can be a shock of the lower with the upper jaw during a hit on the jaw. The injuries occur from falls during learning to walk among the little ones (poor neuro-muscular coordination), (Derbanne et al., 2005).

In older children, shocks occur on the street or in the school and during the practice of a sport. The different factors influencing the shocks impacts are the energy of the impact, the object hardness, the object shape and the angle and direction of impact (Derbanne et al., 2005).

The consequences of these injuries will depend on the age, the child cooperation and diagnosis. If the trauma is affecting a permanent tooth, therapy must be oriented to maintain the vitality or at least the tooth. If the shock is located on a deciduous tooth, it must first think of the underlying germ which may be damaged upon contact (Derbanne et al., 2005), (Cameron et al., 2008).

ii. Infectious etiologies

They are mainly represented by tooth decay, but in some situations lead us to extract teeth. In fact, during conditions with bacteremic risks, it will be necessary to remove infectious sites. Patient with acquired or congenital heart disease, holders of endo-osseous prosthesis or vascular prosthesis as well as children with impaired immune defenses present a risk of infection (Beyaret et al., 1991), (Charland et al., 2001), (Keyes, 1962), (Naulin-Ifi, 2011).

Dental decay is a post eruptive infectious disease of the hard tissue of the tooth. It is characterized by alternating demineralization and remineralization periods, it is located, from the outside to the inside of the tooth. It affects the hard tissues of the tooth at different degrees, from simple mineral loss, undetectable to the naked eye, to a complete destruction of the tooth (Charland et al., 2001), (Naulin-Ifi, 2011).

The process is generally reversible in early stages and in favorable conditions, while it is irreversible in advanced stages. According to the World Health Organization, tooth decay affects approximately five billion people in the world. Decay has consequences in the mounth, but also at the systemic level, this depends on the overall health of patient, depth and location of the lesion (American academy of pediatric dentistry, 2014).

In children, tooth decay is in the form of rampant caries or baby bottle tooth decay. In the terminal stage, the result of these cavities will lead to multiple extractions. Due to the lesser mineralization and lower thickness of the tissues, carious lesions develop faster in children than in adults (Charland et al., 2001), (KEYES, 1962).

a. Etiology of decay

The etiology of dental decay is multifactorial. It occurs in the simultaneous action of several factors: the host, the microbial flora, diet and time (Fig.6) and it shows itself only when all these factors are involved. However, it may be inactivated by the absence

of one of these factors, in a more contemporary concept it also includes socio-economic aspect as well as psychological and biological factors (Borutta et al., 2010).

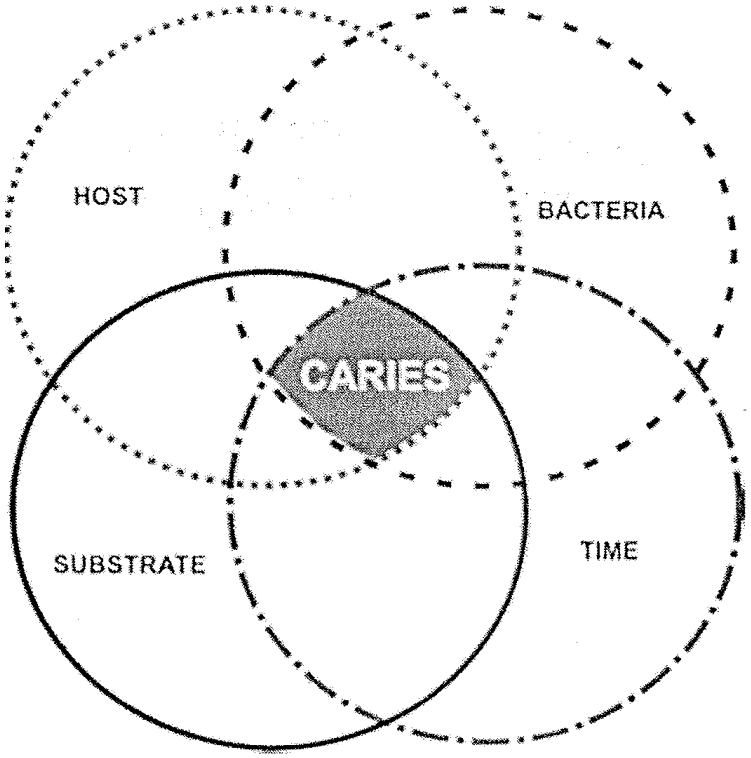


Figure 6: Keyes Schema, font (Borutta et al., 2010).

Bacteria responsible for decay formation are called cariogenic bacteria. These are mainly bacteria such as *Streptococcus, Lactobacillus and Actinomyces*. The dietary factor has two components, the sugar content of food on one side and the frequency of food intake on the other side (Charland et al., 2001).

Other than carbohydrates, no other food component has a cariogenic potential. The sugar considered as cariogenic, the sucrose is considered the most cariogenic, because it is easily metabolized by the cariogenic bacteria, which subsequently will release organic acids resulting in a salivary pH drop which is causing the demineralization process of the tooth. An important factor that is involved in the caries process is the frequency of food intake. In fact, a salivary drop is observed after each feeding (Charland et al., 2001).

This risk is shown by Stephan curve (Fig.7). The area above critical pH line corresponds to an area of low risk or no risk, while the area below the critical pH line is a risk area where there is high enamel solubility. This pH lowering takes about 40 minutes from ingestion. If intakes are too close, the pH does not find its original location and demineralization process predominates over remineralization which causes tooth decay (Courson et al., 2005).

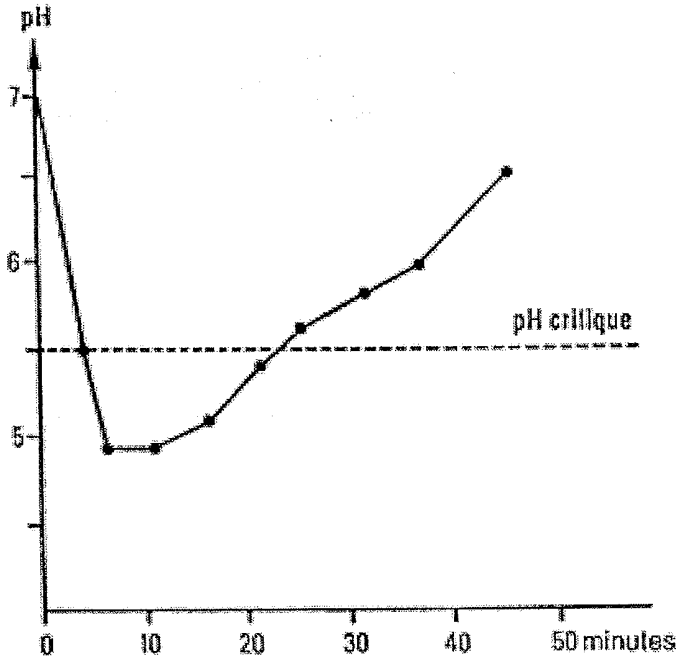


Figure 7 : Stephan curve, font (Courson et al., 2005).

The host is important, because we are not all equal facing the decay. On the one hand, because the anatomy of the teeth which is highly variable from one individual to another, some grooves or cusps are very pronounced and not others at all; some teeth are more fragile than others, because of lack in mineralization in enamel structure, for example; misalignment may result in plaque retention and thus promote tooth decay. On the other hand, the quality and quantity of saliva also vary from individual to another (Deblos et al., 2009).

b. Different types of decay

There are three different types of decay: Acute decay, stopped decay and early childhood decay. This classification is based on progress, extend of decay and on tissue involvement (Naulin-Ifi, 2011).

Acute decay

The enamel damage in this form of decay is low, it develops deeply relatively quickly and may cause pulp necrosis. There reactionary dentine has no time to be formed, so affected tissues have a soft texture, there is no obvious symptoms during the formation of these caries, lesions are brownish yellow (fig.8), (Naulin-Ifi, 2011).

Figure 8: Acute decay, font (Naulin-Ifi, 2011).

The acute decay develops on the proximal surfaces as well as on occlusal surfaces in dental grooves. The most affected sites are distal surfaces of the first deciduous molar and the mesial surface of the second deciduous molar. In the most important advanced stage of these cavities collapse of marginal ridges may occur, because there is no more underlying support. In case of collapse of the marginal ridge, it can appear pain during

meals characteristics of the septum syndrome due to food stuffing in the inter-dental space (Naulin-Ifi, 2011), (Cameron et al., 2008).

Arrested decay

This is due to an interruption of decay process. There is formation of reactive dentin that can be observed clinically and radiologically. The tissues are of hard consistency and dark, there are no symptoms in these lesions (Fig.9). This type of lesion, it can be found on the occlusal surface of the molars and on the proximal surfaces of anterior teeth (Cameron et al., 2008), (Koch et al., 2009).

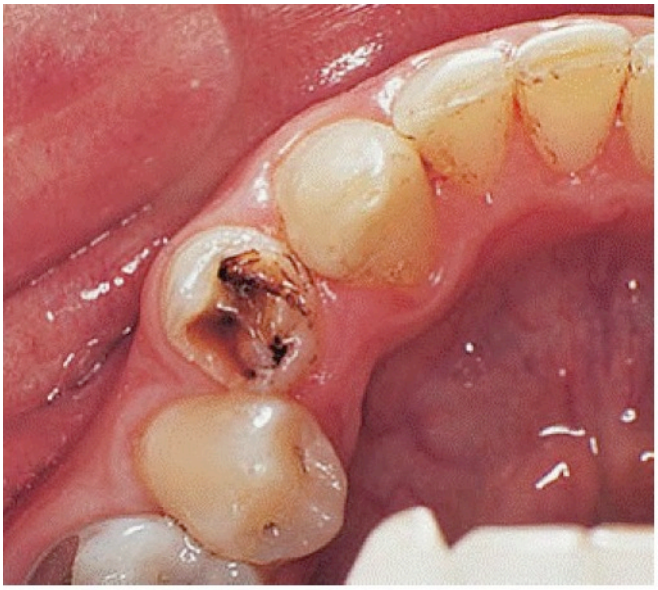


Figure 9: Arrested decay, font (Cameron et al., 2008)

Early childhood decay

It is formerly known as rampant caries or baby bottle syndrome. It is characterized by a widespread damage of the teeth with the caries process, it appears very early between two and six years and evolves very quickly (Fig.10), (Koch et al., 2009).

It is due to the presence of several factors as repeated carbohydrates intake associated with poor hygiene or taking bottle at night before sleep. It is found first on the incisal

block of the maxilla, because it is directly exposed to sugar drinks. Decay is rampant or circular and evolutive that can cause crown facture. When the sugar intake or poor eating habits continue, caries appear on the occlusal surfaces of molars (Cameron et al., 2008).

The mandibular incisors are less affected by this type of decay, because they are in parts protected by the tongue and salivary flow (Koch et al., 2009).

Figure 10: Early childhood decay, font (Koch et al., 2009).

iii. Congenital etiologies

These etiologies include the anomalies of number, shape, size or structure of the teeth. This may be caused exclusively by a genetic problem, but also the influence of local and systemic factors or combination of all of them (Bonin et al., 2001), (Koch et al., 1996).

For abnormalities of number of teeth, the terms agenesis or hypodontia are used when the patient has missing teeth due to their non-development. This defect is found mainly in permanent teeth and is rarer in primary dentition (Bonin et al., 2001), (Koch et al., 1996).

The anodontia described the absence of all the teeth of one or both dental arches (Fig.11, a). However the mandible is more affected by the anodontia than the maxilla. The oligodontia is used when there are at least six missing teeth (Fig.11, b), (Bonin et al., 2001).

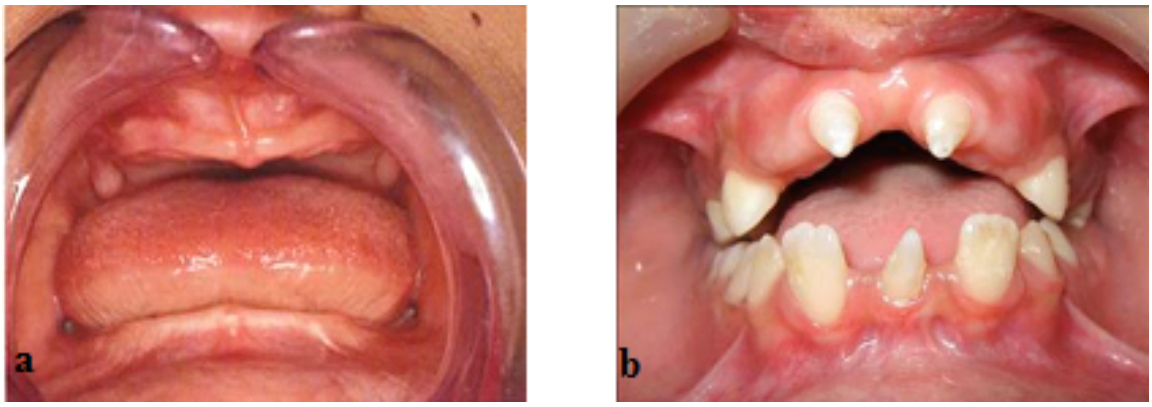


Figure 11: anodontia (a) – oligodontia (b), adapt (Bonin et al., 2001).

The abnormalities of tooth form are manifested in many different ways. The dentist can observe conoid teeth, combined, divided the micro and macrodontias. In these cases the dentist will treat the patient in the permanent dentition because it is few problems in a primary dentition (Derbanne et al., 2007), (Fosto et al., 2009).

The structural abnormalities concern attacks that can undergo constituent tissues of the teeth, enamel and dentine. These attacks are hereditary or acquired, they occur during the development of dental organ. In any case these anomalies strengthen the tooth and thus promote the formation of cavities (Courson et al., 2005).

Some anomalies reach all dental tissues such as regional odontodysplasia. It affects deciduous teeth and corresponding permanent teeth. Anterior teeth and especially maxillary are most often prone to this problem (Courson, 2005), (Fortier et al., 1987).

Other disturbances affect only one tissue either enamel or dentine. When the enamel is produced in small quantities, the result is thinner enamel, this is a hypoplasia. When there is a mineralization defect, this is a hypomineralisation. In most cases there is a combination of both. When the perturbation reached the dentin we have the

dentinogenesis imperfect, which in clinical is characterized by the opalescent teeth which has brown bluish color (Fosto et al., 2009), (Naulin-Ifi, 2011).

2. Consequences of tooth loss in children

Premature loss of one or several deciduous teeth will affect the growth and the function. That is why it is important to support those losses in order to avoid or minimize the consequences (Bulaya, 2006).

Deciduous teeth are involved in chewing, swallowing as well as the phonation. The chewing is the first stage of nutrition function. Teeth contribute to chewing by the fact that they cut, grind, crush foods, so those can be swallowed. Thus, a decrease of the chewing coefficient causes a decline in the mastication efficiency. The value of a tooth in the chewing coefficient is a function of its involvement in the chewing, for example, the first permanent molar represents quarter of the full occlusal table or the largest chewing surface. All these molars are very important during the deciduous molars loss and occlusion setting the premolars (Beyaret et al., 1991).

A child partially or fully edentulous is forced to eat with the liquid or semi-liquid food which causes digestive problems, dietary imbalance and slow growth (Beyaert et al., 1991), (Bulaya, 2006).

Swallowing allows getting the bolus from the oral cavity to the stomach. It is a progressive function, in fact the suction reflexes – primary swallowing – usually disappear than starts than starts a swallowing in maximum intercuspation with the tip of the tongue that touches the palatal surfaces of the upper incisors. The premature loss of deciduous teeth including the molars and incisors extends swallowing with interposition of the tongue between the arches. This tongue interposition causes an incisive overbite and first molars open bite by a lack of occlusal contact (Beyaert et al., 1991).

The deciduous teeth give the tongue the support needed to the pronunciation of certain phonemes during language acquisition. The lack of teeth causes significant phonation

problems: an important bilateral posterior tooth loss can cause the appearance of a “Hissing” and a significant anterior tooth loss cause a “Lisp”. These modifications cease either with the treatment or with the eruption of permanent teeth (American academy of pediatric dentistry, 2008).

As in adults, the teeth have an aesthetic role. All smile defects affects the child psychologically and aesthetically. Early tooth loss in children will affect him, because he will not anymore feel “normal” and will can see difficulties to integrate, communicate, some anxiety or aggression (Beyaert et al., 1991), (Hamza, 2011).

III. PROSTHETIC REHABILITATION IN THE CHILD

The prosthetic treatment is frequent in adults, however, in some case it is necessary to realize removable or fixed prosthesis on children. Before any proposal, assessment of risk-benefit ratio of treatment is studied, if it is beneficial, care will be continued (Courson 2005).

The objectives of prosthetic treatment in children are to restore aesthetics, maintain the space and the length of the arches as well as the vertical dimension, maintain or regain functions and prevent the occurrence of parafunction. Pediatric prosthetics must have simple design and realization, effective, fast, low cost and should allow modifications and alterations related to the growth and teething phenomenon. The materials used need to be adapted to the child (Beyaret et al., J.C., 1991), (Bulaya, 2006), (Courson, 2005).

As in any treatment the patient cooperation is very important. If at the first appointment, the dentist perceived lack of cooperation from the child even the parents, this can be a barrier to treatment. Since the controls of prostheses will be regular, therefore if the patient or the parents lack motivation, treatment will lead to a failure. The lack of hygiene may be prohibitive for the fixed or removable prosthesis, because it must avoid the risk of dental decay. Pediatric prosthesis is contraindicated for the mentally deficient patients (Courson, 2005), (Evanno, 2010), (Morrier et al., 2009).

1. Removable denture for a child

Removable denture has the characteristic of being removed and installed by the patient. Partial dentures are made of a resin base plate (in general polymethyl methacrylate), shaped steel clasps and artificial teeth in resin. Complete dentures do not include clasps. Orthodontic devices may be integrated at the prosthesis to support or stimulate the growth phenomenon. They may also be used to correct occlusion defects or dental positioning (Demars-Fremault et al., 1992), (Naulin-Ifi, 2011).

i. Description

The removable partial denture has the following components: denture base, clasps and the artificial teeth (Fig.12), (Bisson, 2000).

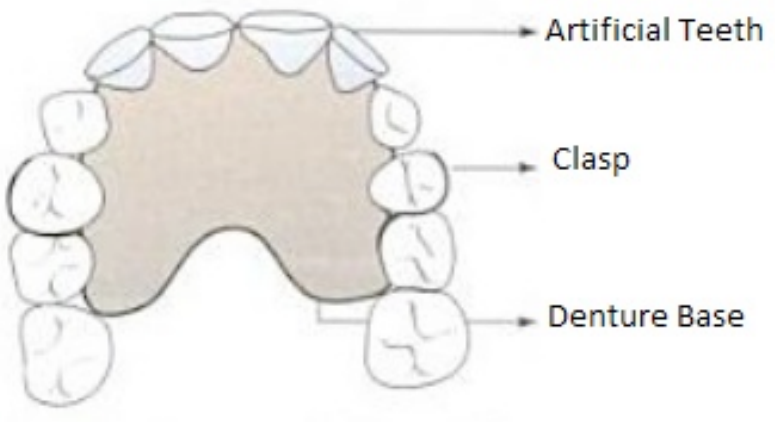


Figure 12: Components of removable partial denture, font (Bisson, 2000).

The denture base

It corresponds to the support of various prosthetic elements, it is made of polymethtl methacrylate. It ensures the stability and sustenance of the prosthetic assembly. These prostheses have the particularity to present osteo- mucous support, for that the surface must be maximized and the edges avoid prevent insertion of the muscles so as not cause disinsertion of the prosthesis during various movements (Mathewson et al., 1995).

The posterior limit is determined by the evolution of the first permanent molars. If their eruption is close - within 6months – the posterior limit must stop distally of the second deciduous molar, if their eruption is late, the maxillary tuberosity and the retromolar pad are covered (Demars-Fremault et al., 1992).

In complete denture, stabilization and retention are more difficult to obtain due to the lack of teeth and the lack of bony embosses due to the resorption (Demars-Fremault et ali., 1992), (Mathewson et al., 1995).

Clasps

Clasps are metal components which emerge out from denture and encircle the tooth. They come in various designs and are placed into undercut areas to provide an adequate fixation and retention (Evanno, 2010).

Some commonly used clasps are Adam's clasp, circumferential clasp and ball end clasp. Adam's clasp can be used even in partially erupted molars. They provide the majority of retention, they come on the mesial and distal embrasures of the molars. They are easily modifiable. The circumferential clasp is used at the canine level and sometimes can be placed on the permanent molars. They will look retention in the buccal undercuts and this retention can be completed by adding ball end clasp positioned between canine and first deciduous molar (Fig.13), (Vergo, 2001), (Evanno, 2010).

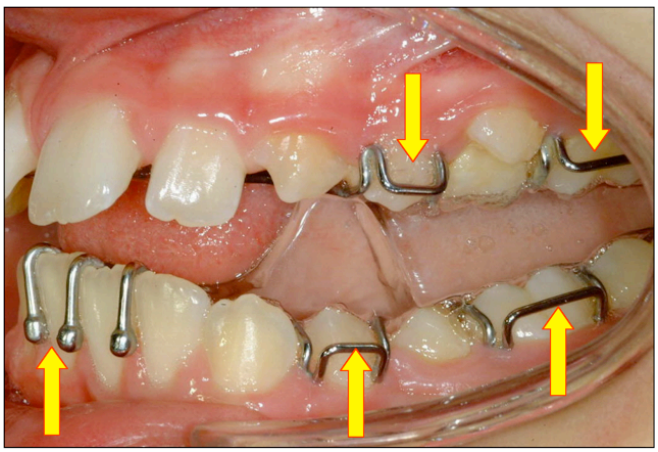


Figure 13: Adam's clasp on the molar and ball end clasp, font (Vergo, 2001).

Artificial teeth

For children, there are resin teeth, but the selection of teeth and colors is very limited. These teeth meet the requirements of occlusal child's arch as the absence of compensation curve. In some cases it would be possible to use small size adult teeth but it is not advised because they do not have the same characteristics (Muzio, 2005).

ii. Indications of removable dentures in the child

Removable dentures are indicated to replace several teeth in the same quadrant or in both quadrants of the same arch, also in case of premature loss of primary teeth and when restoration of masticatory function is important and finally in case of congenital absence of teeth. The removable denture can also serve as space maintainer. It should be noted, the ideal requirements of removable dentures. The denture should restore the lost esthetics, it should improve masticatory function, not interfere with the normal growth of dental arches. It should be easy for the child to use, cleaned easily and should allow adjustments if necessary (Bisson, 2000), (Cameron et al., 2008).

iii. Patient monitoring

After the final insertion, the patient and parents are instructed in routine oral hygiene for maintenance of dentures and recall appointments is scheduled after two days and once in the following weeks to see the difficulties encountered by the patient or make some adjustments to the denture if necessary. The denture is must be regularly controlled especially during tooth eruption to avoid any interference and for evaluating the oral hygiene status (Cameron et al., 2008), (Morrier et al., 2009).

2. The fixed prosthesis in children

Unlike removable denture, this type of prosthesis is fixed, it is placed by the dentist and the patient can not remove.

i. Indications and contraindications to the fixed prosthesis

As for removable dentures, cooperation of the child and parents is critical to the longevity of the treatment as well as the oral dental hygiene. Fixed prosthesis is indicated on deciduous teeth that need to remain more than two years in the arch, when extensive carious lesions undermine cusps and expand beyond line angles. This

prosthesis is also indicated following pulpotomy or pulpectomy or to replace failure of other available restorative materials (Duggal et al., 2013), (Evanno, 2010).

However when the damage from caries is just occlusal with no proximal involvements, conservative restorations as composite or amalgams is indicated. Fixed prosthesis is contraindicated when the tooth exhibits mobility, when there is clinical and/or radiographic evidence of radicular pathology (Duggal et al., 2013), (Evanno, 2010).

ii. Different types of fixed prosthesis

Dentist nowadays, uses different types of pediatric crowns: stainless steel, composite strip, polycarbonate, resin-veneered and zircon ceramic. Each of these crown types has advantages and disadvanges that dictate its suitability for different applications. Some of the most important factors considered by dentists when choosing a crown type are durability, aesthetics, retentiveness adaptability, placement time, allergenicity, and cost (Duggal et al., 2002)

a. Stainless Steel crowns

Stainless steel crowns restorations are indicated for the restoration of primary and permanent molar teeth (Fig.14). They are used for molars having extensive carious lesions which undermine cusps and expand beyond line angles, other indications for stainless steel crown are cervical decalcification, developmental defects such as hypoplasia and hypocalcification, following pulpotomy or pulpectomy and for restoring a primary molar tooth to be used as an abutment for a space maintainer (Duggal et al., 2002).

Crown Shape	Number of sizes available	Width range mm
Central/Lateral	12	4.2 to 8.0
Upper Cuspids	6	6.2 to 8.2
Lower Cuspids	6	4.8 to 6.8
Upper 1st primary molar	7	6.6 to 9.0
Upper 2nd primary molar	7	8.5 to 11.0
Lower 1st primary molar	7	6.9 to 9.3
Lower 2nd primary molar	7	8.5 to 11.5

Figure 14: Different sizes of stainless steel crown, adapt (Duggal et al., 2002).

The stainless steel crown is a durable restoration and its clinical success is predicated upon the following: smoothness of the surface, polished and remains intact. The crown margins are closely adapted to the tooth and do not cause gingival irritation, all excess cement is removed from around the margins, contact with adjacent teeth is appropriately established, crown is in proper occlusion, the restoration should not interfere with the eruption of succadaneous tooth and finally the restoration enables the patient to adequately maintain oral hygiene (Fuks et al., 1999).

b. Composite strip crowns

They are used primarily on anterior teeth (Fig.15). It is applied using a hardening composite and a clear plastic form of mold. Although these materials provide an aesthetic restoration, they are also susceptible to fracture, because the hardening composite inside composite strip crown forms must adhere to dentin and enamel, their placement is sensitive to hemorrhage and moisture (Duggal et al., 2002).

Figure 15: Composite strip crowns, font (Duggal et al., 2002).

c. Polycarbonate crowns

They are formed form acrylic or polycarbonate resin shells and cemented with self adhesive resin, polycarbonate crowns provide an aesthetic, tooth colored restoration at a low cost. This type of crowns is used primarily on anterior teeth, their durability varies from application to application, but they are most often used to temporary restorations (Fig.16). Polycarbonate crowns come in one universal shade, which can be modified with cements and liners (Fuks et al., 1999).

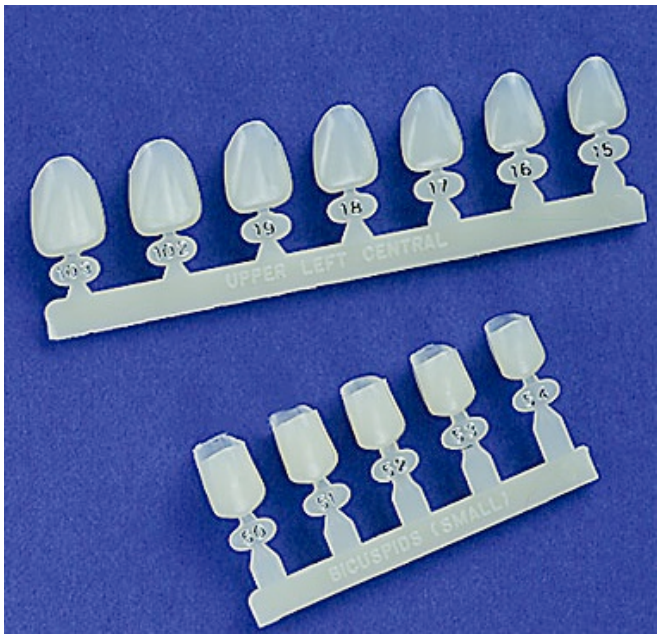


Figure 16: Polycarbonate crowns, font (Fuks et al., 1999).

d. Resin veneer crowns

They are stainless steel with resin overlay, anterior and posterior use. Resin veneered stainless steel crowns combine the durability of a stainless steel crown with the aesthetics of a resin facing (Fig.17). Although they are less sensitive to hemorrhage and moisture during placement, their limited crimpability requires a greater removal of tooth structure. Resin veneered crowns are typically more expensive than stainless steel, composite strip and polycarbonate crowns (Muzzio, 2005), (Cameron et al., 2008).

Figure 17: Resin veneered crowns, font (Muzzio, 2005).

e. Zirconia ceramic crowns

They are made from zirconium oxide stabilized by yttrium oxide, thus giving them the name yttria-stabilized zirconia -YSC- (Fig.18). Some zirconia ceramic crowns may contain porcelain layered within their substructure or on their outer surface. They are extremely strong, and typically cost more than many other crowns. Zirconia ceramic crowns are used for anterior and posterior teeth. Their great advantages are the exceptional durability and the excellent aesthetics (American academy of pediatric dentistry, 2012), (Journal of dental research, 2012).

Figure 18: Zirconia ceramic crowns, font (Muzzio, 2005).

3. The space maintainers

i. Generalities

Children may need space maintainers if they lose a tooth early or have deciduous teeth extracted due to dental decay. If either is the case, it is important to know the benefits of using a space maintainer and how it can help support your child's dental health (Chafae, 2010).

A space maintainer is an appliance that is custom-made by a dentist in acrylic or metal material. It can be either removable or cemented in a child's mouth. Its purpose is to keep the space open to allow the permanent tooth to erupt and come into place. Deciduous teeth are important to the development of the teeth, jaw bones and muscles and help to guide permanent teeth into position during their eruption. If a space is not maintained, then teeth can shift into the open space and orthodontic treatment may be required (Chafae, 2010), (Courson et al., 2005).

There are two types of space maintainers for children, removable and fixed. The removable space maintainers are similar to orthodontic appliances and are usually made of acrylic. In some cases, an artificial tooth may be used to fill a space that must remain open for the unrepted tooth. About fixed maintainers, there are four different kinds: unilateral, band and loop, crown and loop, distal shoe and lingual (Bisson, 2000), (Chafae, 2010), (Courson et al., 2005).

ii. Removable space maintainer

The removable space maintainers or partial denture maintainers are useful when there is bilateral premature loss of deciduous molars or unilateral loss of multiple deciduous teeth, and the permanent incisors have not yet erupted. In this case, a lower lingual holding arc is contraindicated due to the likelihood of the mandibular permanent incisors erupting lingual to the wire (Fig.19), (Bisson, 2000).

Removable space maintainers are avoided if possible, because of the lack of compliance in younger patient. They are frequently misplaced, lost and broken. Unilateral removable space maintainers should never be used due to their small size and the danger of swallowing (Bisson, 2000).

Its advantages are to maintain the leeway space via incorporation of false teeth and since there are false teeth incorporation into the appliance, occlusal function is restored. Anterior esthetics can also be restored when there is premature loss of deciduous

anterior teeth in conjunction with premature loss of deciduous posterior teeth (Bisson, 2000).

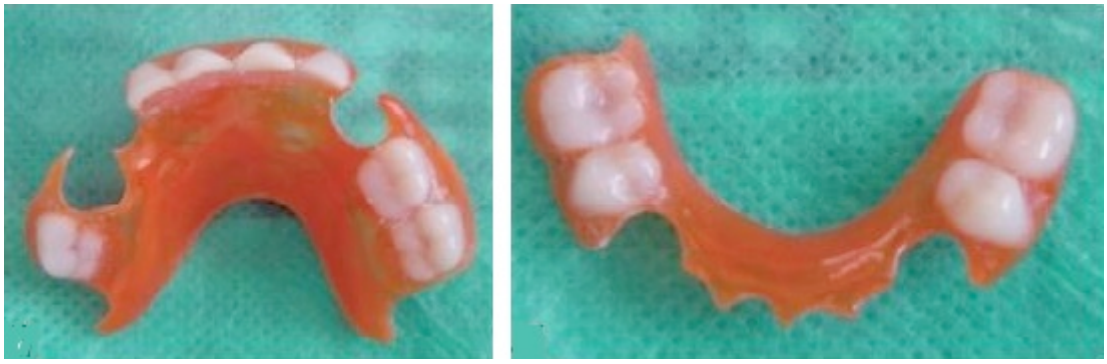


Figure 19: Removable space maintainer, font (Bisson, 2000).

iii. Fixed space maintainers

Fixed appliances are less bulky, easier for patients to accept and manage and require less regular care. Follow-up at appropriate intervals is crucial to the removal of the appliance in accordance with eruption of the permanent successor. They can be classified as unilateral or bilateral, maxillary or mandibular (Cameron et al., 2008).

a. Unilateral space maintainers

There are several types of unilateral space maintainers, each of it is used in specific situations.

Band and loop maintainer

It is indicated to hold molar position when there is a premature loss of 1st or 2nd deciduous molar. The appliance includes a band on the abutment tooth and a wire loop that traverses the edentulous space (Fig.20). The wire touches the tooth on the other side of the space to hold both teeth in place and should be wide enough to allow eruption of the permanent tooth. There are various modifications that can be done for this appliance, such as of an occlusal rest the prevent mesial tipping of the adjacent tooth. This rest could also be bonded into position for added retention (Bijoor et al., 2005).

This appliance is easy for the patient to maintain and easy to realize by the dentist. However the disadvantage is the opposing tooth may be super erupt. It could be prevented by using an occlusal bar or and occlusal pad to provide a functional surface for the opposing teeth (Bijoor et al., 2005).

Figure 20: Band and loop space maintainer, adapt (Bijoor et al., 2005).

Crown and loop maintainer

It is a variation on the band and loop used when there is premature loss on the 1st or 2nd deciduous molar (Fig.21). The abutment tooth often has inadequate tooth structure, or has been restored after a pulpotomy, the crown being either fitted or provided separately with the impression by the dentist. A stainless steel wire is soldered to the stainless steel crown and the wire again should be wide enough to accommodate the eruption of the permanent tooth (Bijoor et al., 2005).

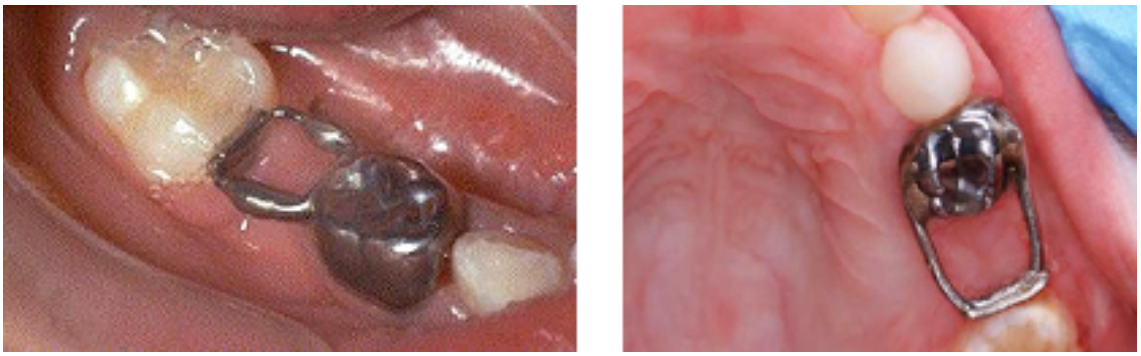


Figure 21: Crown and loop space maintainer, adapt (Bijoor et al., 2005).

Distal shoe maintainer

It is indicated in cases where the second deciduous tooth is lost prematurely prior to the eruption of the first permanent molar. This appliance guides the first permanent molar into place and prevents mesial drifting of the tooth. The distal shoe han an extension going subgingivally to a location mesial to unerupted first permanent molar (Fig.22). It is a succeful appliance in guiding unerupted permanent teeth into the arch, but it needs careful supervision. Once erupted, the position of the molar may not always be favorable. However, this is less of a problem compared to the correction of molar position that has erupted mesioangularly when no guiding appliance is placed (Wa-Brill, 2002).

The distal shoe maintainer is contraindicated in the following cases: poor patient or parental cooperation, missing permanent first molar, systemic diseases that affect healing such as diabetes mellitus and cardiac anomalies that require antibiotic prophylaxis prior to dental treatment (Wa-Brill, 2002), (Naulin-Ifi , 2011).

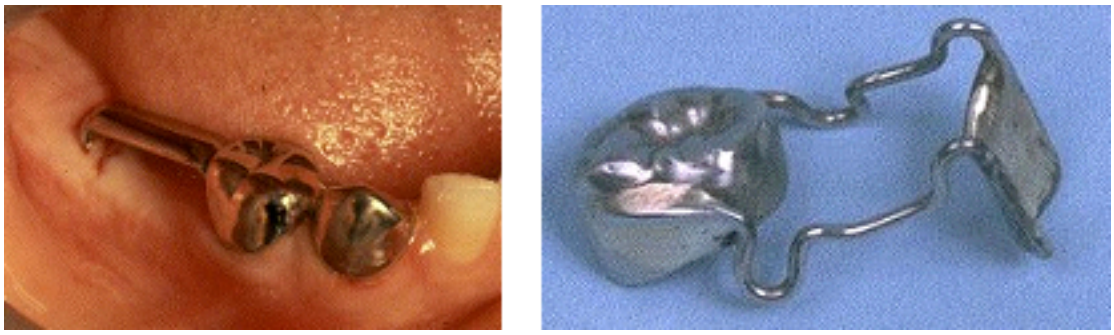


Figure 22: Distal shoe space maintainer, adapt (Wa-Brill, 2002).

b. Bilateral space maintainer

The bilateral space maintainer is indicated for loss of more than one tooth in a quadrant or loss of a second deciduous molar. Three examples of bilateral space maintainers are the lingual arch space maintainer, the Nance appliance and the transpalatal arch space maintainer (Proffit, 2000).

Lingual arch space maintainer

It is indicated when there is bilateral loss of mandibular deciduous teeth or loss of multiple mandibular primary teeth unilaterally. The permanent incisors must be erupted. A lingual holding arch can be used in the maxilla as long as the bite is not deep enough that the lower incisors contact the wire on the lingual of the maxillary incisors (Fig. 23). Its advantages are to prevent the loss of leeway space by maintaining the position of the molars, also supports the incisors and prevents them from moving lingually (Bijoor et al., 2005), (Proffit, 2000).

Figure 23: Lingual arch space maintainer, adapt (Bijoor et al., 2005).

Nance appliance and Transpalatal bar

They are the appliances used for the upper arch. These appliances use a large wire to connect banded deciduous teeth on both sides of the arch that are distal to the extraction site (Naulin-Ifi, 2011).

The difference between the two is that the Nance appliance incorporates an acrylic button that rests directly on the palatal rugae and the transpalatal bar is made from a wire that runs directly across the palatal vault, avoiding contact with the soft tissue (Wa-Brill, 2002).

The indications for a Nance appliance are bilateral loss of the maxillary deciduous molars or unilateral loss of more than one tooth in the maxillary arch. Its design is of bilateral band on molars that are connected by a heavy wire (Fig.24). Connecting the bands with a heavy arch wire that rests on the cingulums of the anterior incisors, in a manner similar to the lingual arch, would interfere with the occlusion of the mandibular incisors. Instead, the arch wire is directed toward the palatal rugae and is embedded in an acrylic button resting on the soft tissue (Wa-Brill, 2002).

Figure 24: Nance appliance, font (Wa-Brill, 2002).

A transpalatal arch is indicated for bilateral loss of maxillary deciduous molars or unilateral loss of more than one tooth in the maxillary arch. Its design is of bilateral bands on molars that are connected by a heavy wire that transverses the hard palate without touching soft tissue (Fig. 25), (Wa-Brill, 2002).

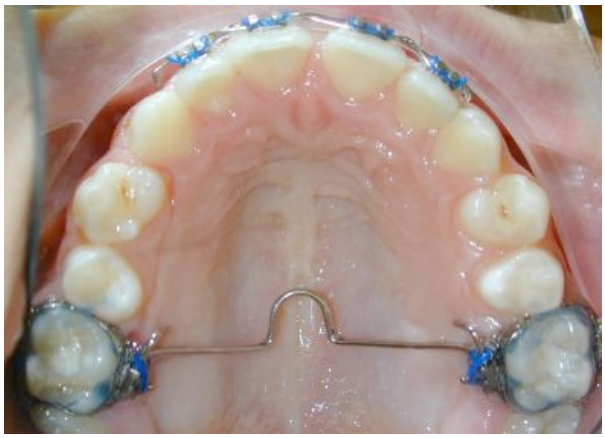


Figure 25: Transpalatal arch, font (Wa-Brill, 2002).

However, when deciduous molars have been lost bilaterally, both permanent molars tip mesially with a transpalatal arch, a nance appliance is preferred in this situation (Naulin-Ifi, 2011).

The advantage of a Nance appliance is the resistance to anterior movement of the posterior teeth. However the Nance appliance represents some disadvantages such as less hygienic, may cause soft tissue irritation and finally the acrylic portion can become

embedded in the soft tissue if the palatal tissue hypertrophies because of poor oral hygiene (Naulin-Ifi, 2011).

Transpalatal arch is more hygienic and easy to fabricate, the disadvantages are that he allows teeth to move and tip mesially and his failure to adequately maintain space and remain passive (Naulin-Ifi, 2011).

iv. Monitoring

Once the space maintainer has been placed, it may take the child a few days to get accustomed to wearing the appliance whether it is removable or fixed. The parents should be carefully monitor the child to make sure is wearing it, if the maintainer is removable and ensure he is following a proper oral hygiene routine (Barberia et al., 2007).

The dentist should review with the child and parent the proper ways to clean the space maintainer thoroughly in order to keep the gum tissue healthy and free of dental plaque. Proper instruction for tooth brushing and flossing should be considered for improved oral hygiene (Laing et al., 2009).

If the space maintainer is fixed, it will be important to avoid chewy, gum or candy , which may loosen or get caught on the appliance. Also the space maintainer should not be pressed or pushed with the tongue or fingers, because it could loosen or bend the appliance (Laing et al., 2009).

The child should be seen by the dentist regularly to make sure that the development and growth of the new tooth or teeth is on track and following the path that the space maintainer has allowed. Once the permanent tooth or teeth are growing in properly, the space maintainer can be removed (Barberia et al., 2007).

CONCLUSION

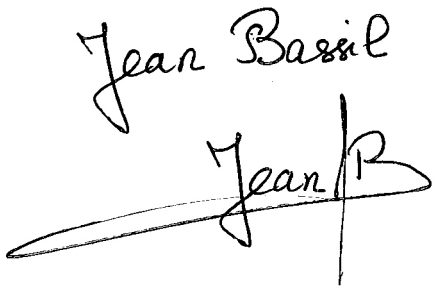
The loss of a tooth could be caused by trauma, decay process or can be genetic. This loss causes functional, aesthetic as well as psychological problems. To overcome these adverse consequences for the child, the dentist has several prosthetic therapeutic devices, whether fixed or removable.

Nowadays, most dentists do not treat this dental loss as they should. Although pediatric prosthesis is not yet rooted in the habits of dentist's daily practice, it remains essential in order to avoid problems resulting from a big loss of teeth.

Often, the parents do not realize the importance to cap or replace a tooth that will be soon exfoliated or replaced by a permanent tooth; this is why it is very important to inform the patient and their parents about the risks of a lack of treatment. The interest of the child must be the first motivation of the dentist.

Like any dental treatment, prosthetic treatment plans in children follow a rational therapeutic approach taking into consideration the patient's motivation as well as that of his parents, oral hygiene ant the clinical situation.

Finally all types of pedodontic treatment require a regular monitoring and control.



BIBLIOGRAPHY

1. Aknin, J-J. (2007). *La Croissance Cranio-Faciale*. Lyon, Sid.

2. American Academy of Pediatric Dentistry. (2008, 2012, 2014). *Guideline on Pediatric Restorative Dentistry*.

3. Andreansen, J. (1987). Communication des 15 et 16 mais 1987. *Revue Française Endodontique*, 6(3), pp. 43-47.

4. Bailleul-Forestier I., Naulin-Ifi C. (2008). Parodonte de l'Enfant, *EMC Odontologie,* (23-415-C-10).

5. Barberia E., Lucavechi T., Cardenas D. (2007). Free- End Space Maintainers: Design, Utilisation and Advantages, *Journal of Clinical Pediatric Dentistry,* 31(1), pp.5-8.

6. Bassigny F., Canal P. (1991). *La* Croissance Normale du Massif Cranio-Facial, *Manuel d'Orthopédie Dento-Faciale*, Paris, Masson.

7. Berry A. (1979). Croissance Staturale et Mandibulaire. *Revue Orthopédique Dento Faciale*. 13, pp. 279-297.

8. Beyaret J.C., Druo J.P., Arttaud C. (1991). La Prothèse Amovible Chez l'Enfant en Pratique Quotidienne*, Actualité Odonto-Stomatologique*. 45 (174), pp. 279-293.

9. Bisson J.M. (2000). *La prothèse Amovible en Pédodontie*, Conception et Réalisation en Pratique Quotidienne. Thèse pour le diplôme d'état de docteur en chirurgie dentaire. Université Paris V. 2000.

10. Bijoor R., Kohli K. (2005). Contemporary Space Maintenance for The Pediatric Patient. *New York State Dental Journal*. 71, pp. 32-5.

11. Bjork A. (1972). Timing of Interceptive Orthodontic Based of Stages of Maturation, *Trans. Eur. Othod. Soc.,* 48, pp. 61-74.

12. Bonin B., Saffarzadeh A., Picard A. (2001). Early Implant Treatment of a Child With Anhidrotic Ectodermal Dysplasia, *Revue Stomatologie et De Chirurgie Maxillo-Faciale,* 102, pp. 313-318.

13. Borutta A., Wagner M. *(*2010). Early Childhood Caries: A Mul-Factorial Deasese. *OHDMBSC*, vol. IX (1).

14. Bulaya L. (2006). *Les reconstitutions prothétiques en odontologie pédiatrique*. Thèse pour le diplôme d'état de docteur en chirurgie dentaire. Université de Montpellier.

15. Cameron A., Widmer R. *Handbook of pediatric dentistry*. Australie, Angus, 3rd edition, pp. 482-485.

16. Chafae A. (2010). Du Maintien A la Gestion De l'Espace. *Information Dentaire*, 92(9), 14-18.

17. Charland R., Voyer P. (2001). Dental Caries. Diagnosis and Treatment*, NY State, Dental Journal*, 68(2), pp. 38-40.

18. Chateau M. *Orthopédie dento-faciale* – Tome I. Base scientifiques, croissance, embryologie, histologie, occlusion, physiologie. Paris CDP 1998.

19. Courson F., Landru M-MO. *Odontologie pédiatrique au quotidien*. Paris CDP, pp. 171-176.

20. Delbos Y., Vaysse F., Jacquelin L.F. (2009). *Physiologie Dentaire Appliquée*. Université de Bordeaux Odonto Pédiatrique.

21. Demars-Fremault C., Pilipili M.C. (1992). Réflexions sur la Restauration Prothétique Chez l'Enfant, *Rev. Bel. Med. Dent.* 91, pp. 48-60.

22. Derbanne M.A., Landru M.MO. (2005). Réhabilitation Globale Chez l'Enfant, *Actualités Odonto- Stomatologique*. 229, pp. 7-15.

23. Derbanne M.A., Landru M.MO. (2007). La Prothèse Dentaire Pédiatrique : Quand, Pourquoi, Comment ?, *Rev. Francoph. Odonto. Pediatr.*, 2(4), pp. 167-177.

24. Duggal M.S., Curzon M. (2002). *Restorative Technique in Paediatric Dentistry*. CRC Press, Second edition, pp. 174.

25. Duggal M., Cameron A., Toumba J. (2013). *Pediatric dentistry at a glance*, Willey-Blackwell, (UK).

26. Enlow DH. (1982). *Essentials of Facial Growth.* Philadelphia, Subsequent.

27. Evanno J. (2010). *Réhabilitation Prothétique Chez l'Enfant et l'Adolescent, En Denture Temporaire et Mixte.* Thèse pour le diplôme d'état de docteur en chirurgie dentaire. Université de Reims.

28. Fortier J-P., Demars CH. (1987). *Abrégé de Pédodontie.* Paris, Masson.

29. Fosto J., Hugentobler M., Kiliaridis S. (2009). Dysplasie Ectodermique Anhidrotique. Rehabilitation, *Revue de Stomatologie et de Chirurgie Maxillo-Faciale*, 110(1), pp. 50-54.

30. Fuks AB., Ram D., Eidelman E. (1999). Clinical Performance of Esthetic Posterior Crowns in Primary Molars, *Pediatric Dentistry*, 21(7), pp. 445-448.

31. Hamza F. (2011). *La Prothèse Dentaire Chez l' Enfant*, Thèse pour le diplôme d'état de docteur en chirurgie dentaire. Université de Nantes.

32. Jacquelin L.F., Delbos Y. (2009). Croissance Cranio-Faciale et Morphogénèse des Arcades. *UFR Odontologie*, Université de Bordeaux Odonto Pédiatrique.

33. Journal of Dental Research (2012), 91(1), pp. 305-310.

34. Keyes P.H. (1962). Recent Advances in Dental Caries Resarch, *The Journal of American Dental Association*, 86(1), pp.

35. Koch G., Poulsen S. (2009). *Pediatric Dentistry: A Clinical Apprach*. UK, Wiley-Blackwell.

36. Laing E., Ashley P., Farhad B. (2009). Space Maintenance, *International Journal of Paediatric Dentistry*, 19(3), pp. 155-162.

37. Langlade M. (1983). *La Croissance Céphalométrique Tridimentionnelle*. Paris, Elsevier.

38. Mathewson RJ., Primosch RE. (1995). *Fundamentals of Pediatric Dentistry*, USA, Quintessence Books.

39. Morrier J.J., Leheis B., Hartman C., (2009). Prothèse chez l'Enfant, *EMC*.

40. Muzzio LL. (2005). Prosthetic Rehabilitation of a Child Affected from Anhydrotic Ectodermal Dysplaia, *J.Contemp Dent Prac*, 6(3), pp. 120-126.

41. Naulin-Ifi C. (2011). *Odontologie Pédiatrique Clinique.* France, CDP.

42. Okeson JP. (2012). *Managment of Temporomandibular Disorders and Occlusion.* Canada, Elsevier.

43. Tarjan I., Gabris K., Rozna N. (2005). Early Prosthetuic Treatment of Patients with Ectodermal Displasia, *Journal of Prosthetic Dentistry*, 93(5), pp. 419-424.

44. Vergo TJ. (2001). Prosthodontics for Pediatric Patients with Congenital/ Developmental Orofacial Anomalies, *J Pros Dent*, 86, pp. 342-347.

45. WA-Brill (2002). The Distal Shoe Space Maintainer Chairside Fabrication and Clinical Performance, *Pediatric Dentistry*, 24(6), pp. 561-565.

46. Welbury R.R., Duggal M.S., Hosey M.T. (2008). *Paediatric Dentistry*. UK, Mosby.