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Serial Extraction in Orthodontics

A Project Submitted to
The College of Dentistry, University of Baghdad, Department of Orthodontics in Partial Fulfillment for the Bachelor of Dental Surgery

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Certification of the Supervisor

I certify that this project entitled “Serial Extraction in Orthodontics” was prepared by **Zahraa Mohammed Ghazi**, under my supervision at the College of Dentistry/University of Baghdad in partial fulfillment of the graduation requirements for the Bachelor Degree in Dental Surgery.

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Supervisor

Date:

DEDICATION

This project is dedicated to Allah, My self and my lovely family for their love, support and prays

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Introduction

The term serial extraction can be defined as "the correctly timed, planned removal of certain deciduous and permanent teeth in mixed dentition cases with severe crowding to allow the unerupted teeth to guide themselves into improved positions and eliminate the long period of fixed appliance therapy" **(Naragond *et al.*, 2012)**.

It also defined as a sequential plan of premature removal of one or more deciduous teeth so as to enhance alignment of succedaneous permanent teeth with eventual removal of permanent teeth to take care of the right ratio between tooth size and available bone **(Ray and Thomas, 1982)**.

Serial extraction cases should be diagnosed in the early mixed dentition period. It is most effective in Class I malocclusions, especially where we find marked irregularity of 10 mm or more with normal bite. In such cases, the decrease in tooth mass improves the alignment of anterior teeth and the gingival tissue, thus shortens the orthodontic fixed appliances treatment in later stages **(Chalakkal *et al.*, 2013)**.

Dental crowding exists when there is more tooth material in relation to the basal and alveolar bone that supports the teeth. This procedure is typically done at an early mixed dentition period. This text presents a review regarding the serial extraction, its limitations and various adjuncts that are required to get good results (**Dewel *et al*, 1954).**

Aims of The Study

1. This review is an attempt to organize the existing literatures regarding the core principles of serial extraction in orthodontics.

2. To review the effectiveness of serial extraction in decreasing severity of malocclusion, duration and improve treatment outcomes

Chapter One: Review of Literature

1.1History:

Bunon (1743) made the first reference to the extraction of deciduous teeth to achieve a better alignment of permanent teeth.

Kjellgren of Sweden used the term "serial extraction" for the first time in 1929. The technique gained popularity in the United States in the 1940s by Hayes Nance under the term “planned and progressive extraction”. Nance is commonly known as the father of serial extraction in the United States.

Hotz of Switzerland called the procedure the "supervision of teeth by extraction" in 1970. It was advocated originally as a method to treat severe crowding by their own dentists without or with only minimal use of appliance therapy, thus minimizing demands upon the orthodontic service.

Although serial extraction makes later comprehensive treatment easier and often quicker, by itself it almost never results in ideal tooth position or closure of excess space. Also, the patients must be chosen carefully and supervised carefully as they develop. **(De Gouyon Matignon de Pontouraude *et al.*, 2020).**

1.2Diagnosis

Correcting the crowding of the posterior segment **(Kale *et al.*, 2004)**.

1) Proportional Facial Analysis

According to Graber (1971) the face is split into Standard or orthognathic face i.e. the relationship between maxilla and mandible, maxilla and maxillary dentition, mandible and mandibular dentition and maxillary dentition and mandibular dentition are normal.

2) Alveodental Protrusion

In class I maxillary-mandibular alveodental protrusion the facial pattern is normal with the dentition arc relatively forward. This facial pattern responds well to serial extraction.

In class II maxillary alveodental protrusion the maxillary dentition is forward and can be treated with serial extraction in maxilla only.Where as in class III not suitable for serial extraction **(Mills,1987).**

3) Alveodental Retrusion

In class I maxillary mandibular alveodental retrusion Patients should be treated without extractions.

• Extractions create a dished in face. **(Mills ,1987)**

Whereas, in Class II mandibular alveodental retrusion serial extraction not indicated.

4) Prognathism

Class I maxillary mandibular prognathism: Indicated if,

- Teeth are severely crowded Because of the increase in size of jaws, extraction usually not indicated.

Class II maxillary prognathism:

- Fault in the maxillary base itself
- Long anterior cranial base
- The cranial base being flat creates a downward and forward position of the nasomaxillary complex
- Difficult to treat with serial extraction **(*Daniel et al., 2018*)**.

5) Retrognathism

Class I maxillary-mandibular retrognathism

• As the maxilla and mandible are placed relatively backwards, extractions are contraindicated.

Class II mandibular retrognathism:

• Small corpus of mandible or small ramus or due to excess vertical developmental of nasomaxillary complex.

• In such cases, the mandible rotates backwards and creates an open bite.

• Not a good case for serial extraction **(Camacho and Velásquez Cujar, 2014)**.

Diagnostic pre_requisites

1)Examination And Consultation

2)Diagnostic Records

3) Photographs: Pre, mid and post-treatment intra and extra oral photographs are taken. They act as permanent records of pretreatment state, improvements during the procedure and also help in patient motivation.

4)Radiographs

- Intraoral periapical view
- Lateral cephalogram
- Orthopantomograph (OPG) - Helps to detect congenitally missing teeth

and supernumerary teeth, to carry out radiographic and mixed dentition analysis, to assess dental age and amount of root development and possible eruption pattern and to detect any bony pathologies **(Djoumerska-Alexieva et al., 2015)**.

5) Orthodontic study models Required for assessing the morphology of teeth and dental arch form and evaluation of occlusion as also to perform model analysis namely, Carey's analysis in the lower arch and Arch perimeter analysis in the upper arch **(Koffi et al., 2021)**.

Overview of dental development:

1) ***Incisor liability:*** The four maxillary permanent incisors are, on the average, 7.6 mm larger than the primary predecessors. For the mandibular incisor segment, the permanent successors are 6.0 mm larger. This difference was termed the Incisor Liability by Warren Mayne and it varies greatly from person to person **(Andrade et al., 2009; Taddei et al., 2012; Lee et al., 2015)**.
2) ***Interdental spacing:*** One of the first observation to be made on young patient. Interdental spacing may range from 0 to 10.0 mm in the maxillary arch, but averages about 5.0 mm. In the mandibular arch interdental spacing can range from 0 to 6.0 mm, averaging 3.0 mm. Lack of interdental spacing must be considered a serious handicap in achieving normal alignment **(Taddei et al., 2012)**.
3) **Intercanine width changes**: Between the primary and mixed dentitions there is an increase in arch width between the primary canines. For the maxillary arch, After 10 years of age there is little mandibular intercanine width change to be expected in either boys or girls **(Taddei et al., 2012)**.
4) ***Arch length changes:*** Distance around the arch from the mesial surface of one first permanent molar to the counterpart on the other side. Arch length may and generally does, change during the growth period. Changes vary considerably between individuals and between the maxillary and mandibular arches. In most cases, arch length actual decreases in the mandibular arch during the growth period **(Andrade et al., 2009)**.

1.3Type of serial extraction

1.3.1Serial extraction in cl I malocclusion

1.3.1.1 Removal Of Deciduous Canine

1.Purpose to permit eruption and optimal alignment of lateral incisors

2.Prevents mesial migration of canines into severe malpositions

3.Deciduous canines are removed as upper permanent lateral incisors are erupting (at 8.5 years of age). **(Naragond A, Kenganal, 2012).**

1.3.1.2 Removal Of 1st Deciduous Molars

1. 1st deciduous molars removed for early eruption of 1st premolar

2. Best is if premolar roots are half formed (9.5 years). Desirable is 1st premolar to erupt in advance of canines, though often not seen

3. If mandibular canine is erupting ahead of mandibular 1st premolar, either of two procedures

First if combined procedure, extract deciduous mandibular 1st molars & remove surgically unerupted permanent 1st premolar,

Second to avoid surgical procedure extract deciduous mandibular 1st molars & six months later remove mandibular 2nd molars. **(Ralph e. Mcdonald,2004).**

1.3.1.3 Removal Of Erupting 1st Premolars

1. When upper permanent canine has just erupted, 1st premolar to be extracted.

2. Most important stage of serial extraction procedure and it is essential to recheck that case is suitable for treatment by extraction of 1st premolars.**(Naragond *et al.,* 2012).**

1.3.1.4 Indication

1. Class I malocclusion with an arch size-tooth size deficiency of 5 mm or more per quadrant (10 mm or more for arch), normal eruption sequence as assessed radiographically and a skeletal pattern within normal limits
2. Tooth size- jaw size discrepancy with severe arch length deficiency which could be:
   - True (hereditary) (non-pathologic)
3. Environmental (pathologic) which is indicated by: tooth ankylosis, mesial migration of permanent 1st molar following premature loss of deciduous molar or due to severe interproximal caries or improper filling that does not restore the ideal contour mesiodistally **(Daniel et al., 2018)**, unilateral or bilateral premature loss of deciduous canine, midline shift of mandibular incisors due to displaced lateral incisors, localized gingival recession in the labial aspect of lower anterior region, ectopic eruption of teeth, crowding of the anterior segment of arch, canine being blocked out labially.
4. Cl I malocclusion cases with maxillary mandibular alveolodental protrusion (bimaxillary alveolodental protrusion).
5. In mesial step terminal plane in mixed dentition developed in to cl I permanent relationship with malocclusion **(Diravidamani, 2012)**.

Figure 1: Absence of physiologic spacing (Arif *et al,* 2020)

Figure 2: Permanent lateral incisors erupting lingual to the retained primary lateral incisors (Arif *et al,* 2020)

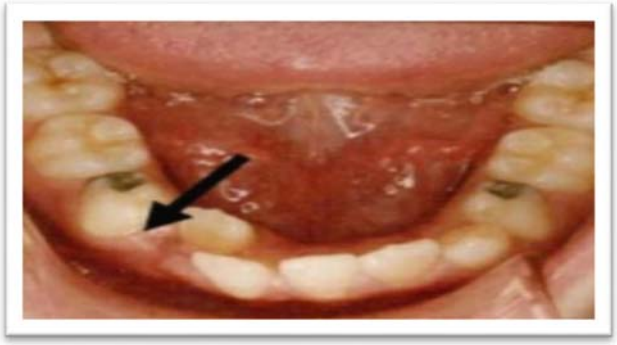

Figure 3: Unilateral loss of deciduous canine with incisor crowding leads to midline shift and loss of space for permanent canine. (Arif *et al,* 2020)

1.3.1.5 Contraindications

(Bikle *et al.*, 2002).

- Congenitally absent/missing lower 2nd premolars
- Extensive caries of permanent 1st molars
- Unilateral congenital absence of teeth
- Abnormal tooth size, shape, colour etc
- Cleft lip and cleft palate cases.
- Reverse overjet, deep bite, open bite, rotation, gross malposition, cross bite, etc.
- Spaced dentition
- Class I malocclusion with minimal space deficiency
- Mild disproportion between arch length & tooth material **.**

1.3.2 Serial extraction in cl II malocclusion

Class II malocclusions can require different types of treatment when severity of the antero-posterior discrepancy, crowding, age, and patient compliance are considered **(Rock, 1990; Bishara et al., 1995).** Options for correction of Class II malocclusions include headgear, fixed and removable functional appliances, and fixed appliances with Class II elastics, extractions, and orthognathic surgery **(Proffit et al., 1992; Aelbers and Dermaut, 1996).** Most often, extractions can involve two maxillary premolars **(Cleall and BeGole, 1982)** or two maxillary and two mandibular premolars **(Strang, 1950).** It is known that the number of teeth extracted and malocclusion severity can influence treatment time, So treatment of the complete Class II div1 malocclusions by extracting only 2 maxillary premolars can accelerates the results and it requires an anchorage to avoid a mesial movement of the posterior segment during the retraction of the anterior teeth. To reinforce the anchorage, a second molar banding is done to prevent the mesial movment of the molars.

The treatment protocol in malocclusion class II div2 includes extraction of upper premolars to relieve crowding, with simultaneous correction of the deep bite by intrusion of the upper and/or lower incisors.

1.3.2.1 Indication of serial extraction in Cl II malocclusion

if there is maxillary alveolodental protrusion while the mandibular dentition is normal, the serial extraction is indicated in upper arch only. extraction for self-correction.

perform the correction of class II malocclusions in young patients (early and late mixed dentitions) ,extractions may include two maxillary premolars and two mandibular premolars. Extractions of only the upper premolars are indicated when there is no crowding or cephalometric discrepancy in the mandibular arch.

***(*Daniel *et al.*, 2018)**.

1.3.2.2 Contraindication of serial extraction in cl II malocclusion

Serial extraction should not be performed in the Class II malocclusions where the lack of space is slight.
When teeth show only mild crowding.
Congenitally absent/missing lower 2nd premolars.

Abnormal tooth size, shape, colour etc.

Cleft lip and cleft palate cases.

Spaced dentition .

Where there is a skeletal discrepancy in the dental arches. ***(*Bikle *et al.*, 2002)**.

1.3.3 Serial extraction in Cl III malocclusion

For correction for skeletal Class III malocclusion, there are many treatment options: growth modification, orthodontic camouflage therapy, and surgical-orthodontics. Growth modification by dentofacial orthopedic appliances is an effective method to resolve skeletal Class III jaw discrepancies.

To accelerates the outcome of treatment we can perform extraction ,the most commonly extraction is the right and left first premolars in the lower jaw and the right and left second premolars in the upper jaw. However, in certain considerations other teeth such as the lower jaw incisor or the first permanent molar may have been selected. **(Proffit *et al.,* 1992; Aelbers and Dermaut, 1996).**

1.3.3.1 indication of serial extraction in Cl III malocclusion

To perform the correction of class III malocclusions in adult patients, Extractions of only the lower premolars are indicated when there is no crowding or cephalometric discrepancy in the maxillary arch **(Daniel *et al.,* 2018)**.

1.3.3.2 Contraindication of serial extraction in Cl III malocclusion

Congenitally absent/missing lower 2nd premolars.

Extensive caries of permanent 1st molars.

Abnormal tooth size, shape, colour etc.

Cleft lip and cleft palate cases.

Spaced dentition .

Serial extraction should not be performed in the Class III malocclusions where the lack of space is slight.When teeth show only mild crowding.

Where there is a skeletal discrepancy in the dental arches **(Bikle *et al.,* 2002)**.

1.4 Serial extraction in action

This procedure is typically done at an early mixed dentition period. This text presents a review regarding the serial extraction, its limitations and various adjuncts that are required to get good results as shown in **figure (4).**

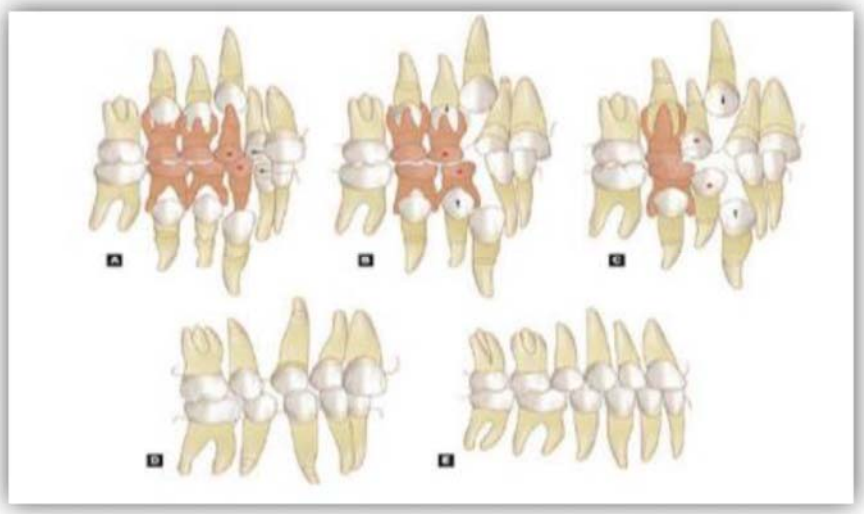

Figure 4: Planned extraction of certain deciduous teeth & later specific permanent teeth in an orderly sequence (Proffit *et al.*, 2007).

The treatment consistent of selective removal of the mandibular teeth only (C, D, and E) and no permanent premolar removal. However, the space of the missing second premolars utilized to resolve the anterior crowding along with the spontaneous closure of the extra spaces by physiologic of the permanent mandibular teeth. Whereas in the movement upper arch conventional serial extraction was performed **(Proffit *et al.*, 2007)**.

Serial Extraction Pattern

- ***Stage I:*** (Extraction of all deciduous lateral incisors). This stage helps in the alignment of central incisors
- ***Stage II:*** (Extraction of all deciduous canines after 7–8 months). This stage helps in the alignment of lateral incisors by providing space for them
- ***Stage III:*** (Extraction of all deciduous first molars). This stage stimulates the eruption of all first premolars
- ***Stage IV:*** (Extraction of all first premolars after 7–8 months). This stage provides the space needed for canines and stimulates their eruption.

Stage I is preformed when the patient has severe crowding in the central incisor's region and the deciduous lateral incisors are not yet exfoliated, otherwise stages II to IV are usually the common pattern of serial extraction cases **(Bhalajhi *et al.*, 2018).**

A short period of fixed orthodontic appliance treatment is frequently required following serial extraction for controlled residual space closure and position the teeth into proper occlusion since permanent teeth could erupt with minor malalignment **(Dandajena *et al.*, 2012)**.

1.5 Rational

Serial extraction is based on 2 basic principles: -

Arch Length tooth material discrepancy:(arch length: the perpendicular distance between from one mesial contact of first permanent molar to the line connecting the mesial contact of the contralateral) **(Kale *et al.*, 2005)**.

Whenever there is an excess of tooth material as compared to the arch length a selective extraction of some teeth is done so that rest of the teeth can be guided to normal occlusion **(Kale *et al.*, 2005)**.

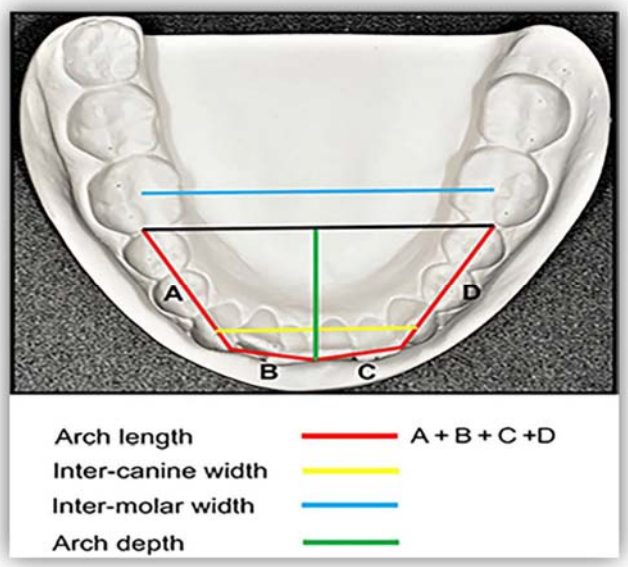

Figure 5: Arch length (kale *et al.* ,2005).

Physiologic tooth movement

Human dentition shows a physiologic tendency to move towards an extraction space.

Thus, by selective removal of some teeth the rest of the teeth which are in the process of eruption are guided by the natural forces into the extraction spaces.

- If primary teeth are extracted prematurely 1½ years or more before the time of normal exfoliation, the eruption of the permanent teeth will be delayed. Conversely, the eruption rate can be accelerated if the primary tooth overlying the permanent tooth is extracted less than a year before the time of normal exfoliation.
- Crowded teeth adjacent to an extraction site tend to align themselves.
- Inter canine width (The distance between cusp tips of the right and left maxillary and mandibular permanent canines increases in the mandible up to 9 years of age by an average of 3mm. In maxilla, it increases up to 12 years in females and 16 years in males by about 4.5mm.

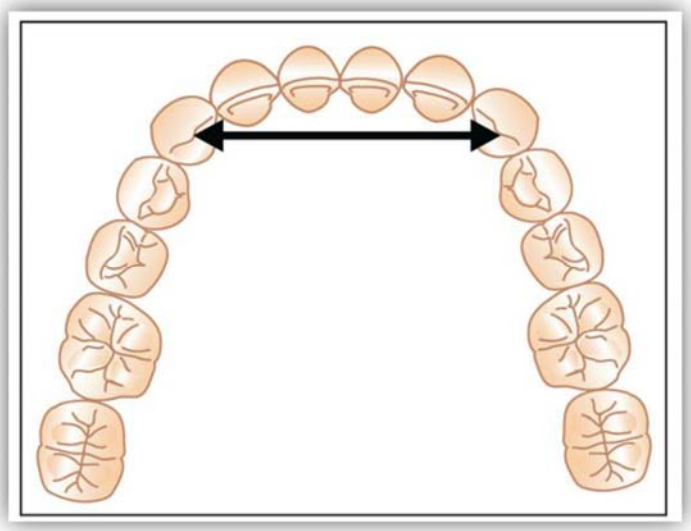

Figure 6: Intercanine width (Daniel et al., 2018).

- Serial extraction allows the teeth to erupt over the alveolus and through keratinized tissue, rather than being displaced buccally or lingually.
- It is normal for children to have more prominent lips which flatten out with growth, so lip fullness is not a reliable criterion for extraction in the mixed dentition. Also, the growth of the nose and chin are unpredictable and continue to grow long after other facial parts. Therefore, extraction in an attempt to end with straight profile may actually end with a concave one **(Daniel et al., 2018)**.

1.6 Advantages and disadvantage

1.6.1 Advantages

• More physiologic treatment as teeth are guided into normal positions using physiologic eruptive forces.

• Removal of spontaneous alignment of crowded

• incisors

• Extraction of first premolar before crowding allows permanent canines to drift into natural alignment

• Lessens period of future appliance therapy and cost of treatment.

• Physiologic trauma associated with malocclusion can be avoided by treatment of malocclusion at an early age

- Better oral hygiene reduces risk of caries
- Health of investing tissues is preserved
- Serial extraction allows the teeth to erupt over the alveolus and through - keratinized tissue, rather than being displaced buccally or lingually.
- Reduce the duration & cost of active orthodontic treatment at later stage.
- Health of investing tissues is preserved with less potential for iatrogenic orthodontic damage like root resorption, enamel decalcification.
- More stable result **(Kalia et al., 2004)**.

1.6.2 Disadvantage

- Procedure cannot be applied in class II and class III malocclusion cases.
- Psychological trauma: unpleasant for a child to have 4 teeth extracted each time of 4 occasions.
- Treatment time is prolonged as it is carried out in stages over 2-3 years , thuds patient cooperation is needed.
- If extraction is carried out too early, may result in space loss or delayed eruption or permanent successor.
- Lower permanent canines erupt ahead of 1st premolar into extraction space.
- No single approach that is applied universally
- Tendency to develop tongue thrust.
- Tendency to increase over bite (deepening of the bite).
- Residual spaces can remain between the canine and 2nd
- premolar.
- Patient cooperation is very important (**Kale *et al.,* 2004)**.

1.7 Different sequence of extraction

There are mainly three methods:

a) Dewel's method (CD4) - 1954

b) Nance method (D4C)

c) Tweed's method (D4C) – 1966

d) Moyer's method (BCD4)

1.7.1 Dewel's Method:

3 stages in Serial Extraction Therapy:

• Removal of deciduous canines : at 8-9 years for alignment of incisors.

• Removal of first deciduous molars: after 1 year so that eruption of 1st premolars is increased.

• Removal of 1st premolars: to permit permanent canines to erupt into place.

Indications of Dewel's method: • Mild crowding in anterior region. Early exfoliation of uni or bilateral deciduous canines.This maneuver is seldom successful in the lower arch because the normal sequence is for the canine to erupt ahead of the first premolar In class I malocclusions, especially the 1st premolar may be partially impacted between canine and 2nd deciduous Molar .

• Hence the orthodontist may vary the first procedure of extracting the lower deciduous canines and extract the first deciduous molars in lower arch to tip the eruption scales in the direction of first premolar.**(jimmy ,2002)**

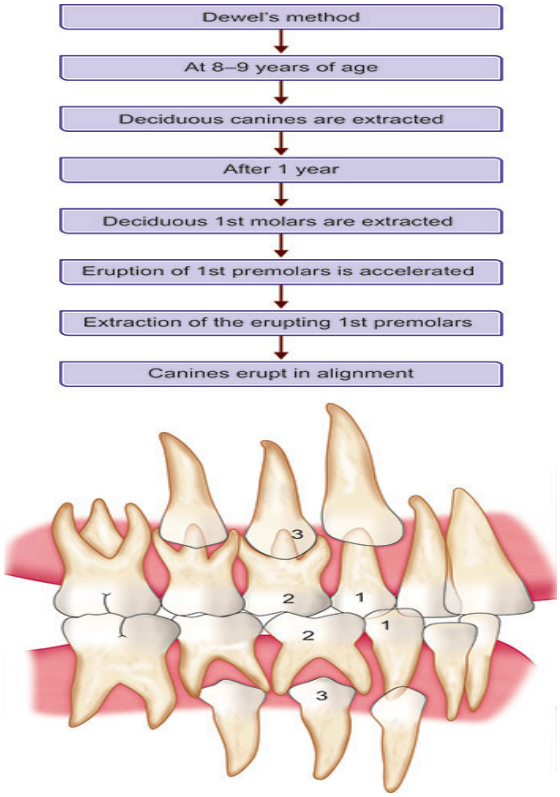

Figure 1:Dewel's method a 3-step serial extraction procedure. (jimmy,2002)

1.7.2 Nance Technique:

a. All deciduous first molars are extracted (8 years)
b. First premolar erupted
c. First premolar extracted
d. Deciduous canine extracted
e. Permanent canine erupts (Fig 8)

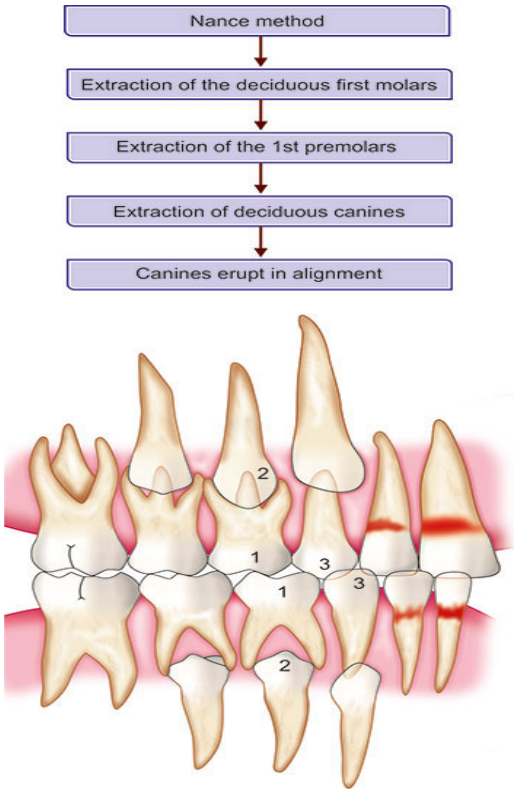

Figure 2:Nance method **(jimmy,2002)**.

Complications

The complications of serial extraction are: anterior crossbites. Results in flat face with prominent chin. Patient may look aged, resulting in lingual inclination of incisors. The anterior crossbites can present themselves as:

- Dento – alveolar ant. crossbites
- Skeletal ant. crossbites
- Functional ant. crossbites / pseudo class III malocclusion **(jimmy ,2002)**.

1.7.3 Tweed's Method:

Tweed (1966)- if diagnosis shows discrepancy exists between teeth and basal bone ; and if patient is between 7 1⁄2 to 8 1⁄2 years, Serial Extraction to be carried out.

Extraction Sequence is:

• At 8 years all deciduous molars are extracted.

• Maintain deciduous canines to retard eruption of permanent

canines. **(Ralph e. Mcdonald,2004).**

• After 4-10 months, Extraction of all four 1st premolars followed by deciduous canines be done, 4-6 months prior to eruption of permanent canines.

• Any irregularities in mandibular incisors if not too severe, get corrected themselves.

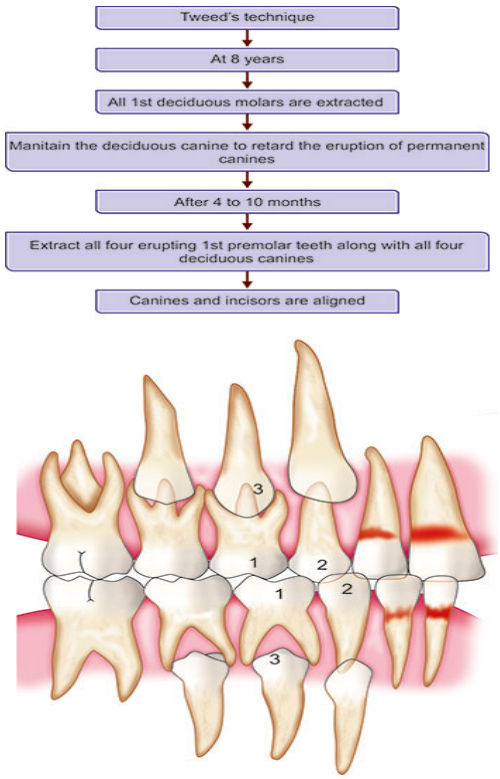

Figure 3: Tweed method*(Ralph e. Mcdonald,2004).*

1.7.4. Moyer's method (BCD4)

Indications: When crowding seen in central incisor region

– Stage I (Extraction of all deciduous lateral incisors). For alignment of central incisors.

– Stage II (Extraction of all deciduous canines after 7-8 months). For alignment of lateral incisors and provides space for lateral incisors.

– Stage III (Extraction of all deciduous first molars). For eruption of all first premolars.

– Stage IV (Extraction of all first premolars after 7-8 months). Provides space for canines. (fig10) **(Naragond A, Kenganal, 2012).**

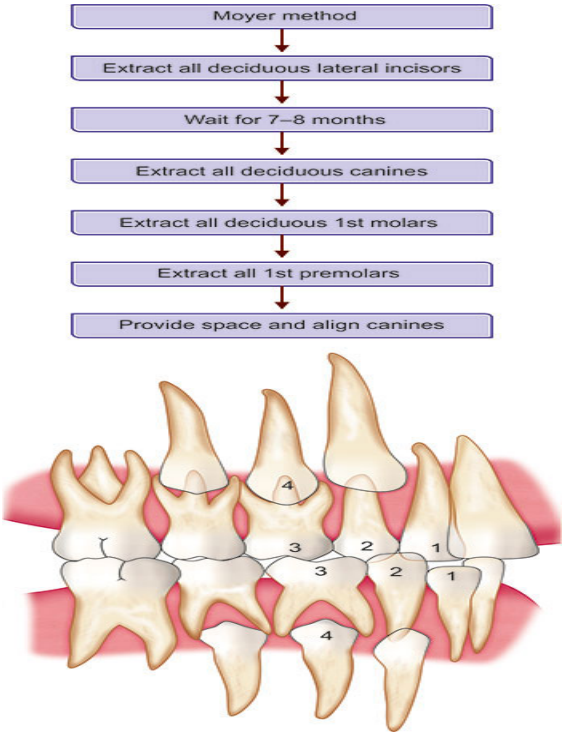

Fig10 : Moyer's method(Naragond A, Kenganal, 2012)

Chapter Two: Discussion / Comments

Correction of occlusal anomalies constitutes an exceedingly large problem in the modern age, which cannot always be solved through appliance treatment alone. The modern person, at least those of Northern European race, seem to be more and more afflicted with a congenital tendency toward anomalies of the common contraction type, and as a result, nearly ¼ of all children are in need of some auxiliary treatment to improve the occlusion functionally and aesthetically. Consequently, the entire need of treatment is and will be very extensive. Every facilitation of the therapy problems should, accordingly, have a significant social value. Therefore, the therapeutic intervention, discussed here and widely used, ought to have some value in the treatment of occlusion anomalies. Even the private practising dental orthopaedist may find these viewpoints to be of important value, since they give a possibility of treating a large number of cases, without the need of choosing between two alternatives: either to attempt to carry out a long-lasting, risk-involving, detailed treatment, or no attempt at improving the malocclusion.

In serial extraction, pedodontist and orthodontist should have mutual understanding for treatment planning. A pedodontist should observe the problem, provide appropriate treatment planning for serial extraction,convince the patient or parents, and refer the case to the orthodontist for future correspondence.

Chapter Three: Conclusion and Suggestions

3.1 Conclusion

Serial extraction is a matter of time, patience, proper implementation of knowledge and clinical skill for accurate diagnosis, and most importantly follow up. Along with this deficient arch length,the amount of crowding, and health of the remaining hard and soft tissues must be considered. The objective of this technique is to intercept the developing malocclusion at an early mixed dentition period so that further malocclusion can be interrupted. Although this procedure does not eliminate the need for comprehensive orthodontic treatment, however, it can lessen the duration of treatment. Treatment can't be avoided for midline diastema, root parallelism, incisor angulation, and other malalignments. Thus serial extraction helps in rectifying these irregularities to some extent.

3.2 Suggestions:

Establishment of other studies to:

1. Involving reviewing other up to date types studies on serial extraction methods
2. Conducting a questionnaire for orthodontist about their serial extraction protocols during the orthodontics treatment.
3. Involving reviewing of new technologies that can replace serial extraction

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