

Serial Extractions – A Review

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Abstract: *It is a sequential plan of premature removal of one or more deciduous teeth in order to improve alignment of succedaneous permanent teeth and finally removal of permanent teeth to maintain the proper ratio between tooth size and available bone". Thus it is one of the positive interceptive orthodontic procedure generally applied in most discrepancy cases where supporting bone is less than the total tooth material*

I. Introduction

The term serial extraction describes an orthodontic treatment procedure that involves the orderly removal of 'selected deciduous and permanent teeth in a predetermined sequence (Dewel 1969). Serial extraction can be defined as "the correctly timed, planned removal of certain deciduous and permanent teeth in mixed dentition cases with dento-alveolar disproportion in order to:

Alleviate crowding of incisor teeth. Allow unerupted teeth to guide themselves into improved positions (canines in particular). Lessen (or eliminate) the period of active appliance therapy. OR

"It is a sequential plan of premature removal of one or more deciduous teeth in order to improve alignment of succedaneous permanent teeth and finally removal of permanent teeth to maintain the proper ratio between tooth size and available bone".

Thus it is one of the positive interceptive orthodontic procedure generally applied in most discrepancy cases where supporting bone is less than the total tooth material.

II. Historical Development

Serial extraction is not new. It has been of interest to dentist for many years. Throughout the history of dentistry it has been recognized that the removal of one or more irregular teeth would improve the appearance of the remainder.

Paisson was the first person who pointed the extraction procedure in order to improve the irregular alignment and crowding of teeth. Bunon in 1743, in his "Essay on the Diseases of the teeth" proposed the removal of deciduous teeth to achieve a better alignment of permanent teeth. The interest on serial extraction increased following World War II. The names that stand out particularly for the modern development of the serial extraction concept are Kjellgren of Sweden Hotz of Switzerland, Heath of Australia and Nance, Hoyd, Dowel and Mayne of the United States.

Nance presented clinics on his technique of 'progressive extraction' in 1940 and has been called as the father of 'serial extraction' philosophy in the United States. Kjellgren in 1940 termed this extraction procedure as 'planned' or 'progressive' extraction procedure of teeth.

Hotz named the same procedure on "Guidance of eruption". According to him the term guidance of eruption is comprehensive and encompasses all measures available for influencing tooth eruption. Widespread adoption of serial extraction as a corrective treatment procedure continues to be a source of concern to all Pedodontists who are aware of its limitations as well as of its possibilities. The principle reason is that its application involves growth prediction. Every serial extraction diagnosis is based on the promise that future growth will be inadequate to accommodate all of the teeth in a normal alignment.

Serial Extraction should be diagnosed in the early mixed dentition period. It is most effective in Class I malocclusions. Especially where we find marked irregularity of anterior teeth, premature loss of one deciduous canine, mid line deviation, displaced lateral incisors, gingival recession and alveolar destruction of labial surface of anterior teeth. In such cases decrease in tooth mass improves the alignment of anterior teeth and the gingival tissues.

Justification for serial extraction:

Dental crowding – The result of inadequate arch size, insufficient basal bone, and / or excessive tooth material – is epidemiologically the most common type of malocclusion. It can be eliminated by making the dental arch larger or reducing the amount of tooth material. Expansion of the dental arches by orthodontic

alignment may be possible if the tooth material is not too excessive. However, the stability of expansion may well be compromised by the insufficient alveolar basal bone.

Physiologic tooth movement – If primary teeth are extracted prematurely, this will influence the eruption rate and position of the permanent successors. In general, the eruption will be delayed if the primary tooth overlying the permanent tooth is extracted 1 ½ years or more from the time the primary tooth would normally exfoliate. Conversely, the eruption rate can be accelerated if the primary tooth overlying the permanent tooth is extracted less than a year before the primary tooth would normally exfoliate. Biologic variation in eruption rates will affect these time tables, as will periapical inflammation of the primary tooth. Another useful principle is that crowded teeth adjacent to an extraction site tend to align themselves.

Normal dental, skeletal and profile development – influences the rationale for serial extraction. The work of Moorrees and Moorrees et al on arch dimensions and serial extractions indicates that there is minimal increase in mandibular intercanine width between 8 and 18 years, occurring usually around the time the permanent mandibular canines erupt. The maxillary intercanine width increases slightly more and over a longer time. The dental arch perimeter from the distal of the mandibular primary second molar to its antimeres is less in the permanent dentition than in the primary. Also the principles of leeway space, interrelationship of overjet, overbite, axial inclinations, and mesial shift, and arch-length analysis must be considered in determining whether to institute a serial extraction procedure.

The skeletal and profile factors that influence serial extractions are the another-posterior, vertical, and transverse relationships as well as the developmental pattern. Specifically the relation of the maxilla to the mandible and of the both to the cranial base must be determined to identify protrusions, retrusions, hyperdivergences, hypodivergences, crossbites, and asymmetries. Also rotational, vertical, and transverse growth patterns need to be integrated into the decision-making process.

III. Indications

When an Pedodontist sees a child 5 or 6 years of age with all the deciduous teeth present in a slightly crowded state or with no spaces between them, he can predict, with a fair degree of certainty, that there will not be enough space in the jaws to accommodate all the permanent teeth in their proper alignment (Lysell 1960). As Nance (1940), Mooress (1963), Dewel (1954), and others have pointed out, after the eruption of the first permanent molars at 6 years of age, there is probably no increase in the distance from the mesial aspect of the first molar on one side around the arch to the mesial aspect of the first molar on the opposite side. If there is any change, it may be an actual reduction of the molar-to-molar arch length, as the "leeway" space is lost through the mesial migration of the first permanent molars during the tooth-exchange process and correction of the flush terminal plane relationship.

The following is a list of possible, clinical clues for serial extraction, occurring singly or in combination:

Premature loss of deciduous teeth. Arch-length deficiency and tooth size discrepancies. Lingual eruption of lateral incisors. Unilateral deciduous canine loss and shift to the same side. Mesial eruption of canines over lateral incisors. Mesial drift of buccal segments. Abnormal eruption direction and eruption sequence. Flaring of incisors. Ectopic eruption of mandibular first deciduous molar. Abnormal resorption of II deciduous molar. Ankylosis. Labial stripping, or gingival recession, usually of lower incisor.

Limitations and Contraindications:

According to Dewel (1967), the most serious side effect is tendency of bite to close following loss of posterior teeth. A normal overbite depends on adequate vertical growth and Serial Extraction involves removal of strategically located deciduous and permanent teeth. Vertical and horizontal growth depends great part on normal proximal and occlusal function in maintaining arch length and normal overjet and overbite.

Second side effect is premolars that fail to reach their normal occlusal level. In normally developing dentition, the premolars are ready to emerge soon after the loss of the deciduous molars and then proceed occlusally with no delay. But in Serial Extraction cases the premolars have to travel a long way before penetrating the gingival tissues. Prolonged absence of teeth in the posterior segment of arches permits the tongue to flow into remaining spaces and this may remain as a tongue thrusting habit. This in turn prevents premolars from attaining full eruption.

Third: Effect of Serial Extraction on facial esthetics. Most of us over emphasize on straight profile which has led to extraction of teeth in mixed dentition because the lips appear to be prominent. Its normal for lip line to have greater convexity during early transitional stages than it will have in mature dentition. Lip fullness is not a reliable criterion for extraction in early mixed dentition. The straight profile must be viewed with greater concern because early removal of premolars is likely to cause a concave profile.

Fourth: Nasal development is another unpredictable hazard. The nose is one structure that continues to grow long after other facial parts have reached maturity. Unrestrained extraction will accentuate its prominence by

reducing skeletal development in dental area. Moreover growth of chin is unpredictable. If growth in nose and chin exceeds normal range a concave profile is obtained.

Contraindications:

- Congenital absence of teeth providing space
- Mild to moderate crowding
- Deep or open bites
- Severe Class II, III of dental/Skeletal origin
- Cleft lip and palate
- Spaced dentition
- Anodontia / oligodontia,
- Midline diastemia
- Dilacerations
- Extensive caries
- Disportion between arc length and tooth material which can be treated by serial extraction.

Advantages of Serial Extraction:

- Psychological trauma can be avoided by treatment
- Reduces the duration of the multi banded treatment
- Physiologically treatment as it involves the guidance of teeth into normal positions making use of physiological forces
- Better oral hygiene
- More stable results

Disadvantages of Serial Extraction:

- Patient co-operation is needed Risk of arch length reduction is present
- Requires proper professional and clinical judgment As extraction spaces are created the patient may develop the tendency of tongue thrusting. Spacing may develop between canine and second premolar.
- Complication of serial extraction – when premature eruption of permanent canines occur, the first premolars are impacted between the canines and the second premolars. (Fig.)

It must be emphasized that any planned program of serial extraction is dependent on the maxillomandibular relationship. If, it is normal, as evidenced by the correct interdigitation of the buccal segments (class I malocclusion), chances of success are relatively good, with proper guidance and patient cooperation. If the maxillomandibular relationship is abnormal (Class II and Class III malocclusions), a serial extraction program must be approached with great caution, with considerable reservation and with the expectancy that the basal malrelationship must be adjusted by appliances prior to completion of the permanent dentition. Dewel (1967) writes: “Severe Class II discrepancy irregularities are treated primarily with Class II mechanics, with serial extraction more or less as an accessory to mechanical therapy”. The classic serial extraction technique must apply largely to Class I malocclusions.

Mayne (1959), points out that serial extraction should be limited largely to those cases that have good faces, those that present harmony and balance of two tissue systems, bone and muscle, and varying degrees of disharmony in the third, tooth size, In these cases, the apical bases are located directly under one another and the incisor teeth are upright to these bases. They are reasonably well over the ridge and so related to facial anatomy as to produce the most complimentary facial esthetics”.

Serial extraction is indicated primarily in the treatment of severe Class I discrepancy malocclusions in the early in mixed dentition. The term discrepancy implies a continuing lack of correlation between potential supporting bone and a known amount of tooth material.

Reduction of tooth mass usually results in an improvement in the gingival tissues and in the alignment of the incisors. In the authentic serial extraction, the extraction sequence is first, the deciduous cuspids, then the first deciduous molars, and finally, the first premolars. The interval between extractions varies from 6 to 15 months. The objective is to permit a measure of self correction by balancing or equalizing total tooth material with ultimate arch length.

Despite the foregoing, there is a place for serial extraction in orthodontics, provided the diagnosis is certain and the post extraction movement of teeth is controlled by mechanical means.

IV. Diagnosis

1. Proportional facial analysis :

According to Graber (1971), the face is divided into,

1. Standard or orthognathic face i.e. the relationship between maxilla and mandible, the maxilla and maxillary dentition, mandible and mandibular dentition and maxillary dentition and mandibular dentition are normal.

2. Alveodental protrusion

Class I maxillary mandibular alveodental protrusion: The facial pattern is normal, dentition arc, relatively forward. This facial pattern responds well to Serial Extraction.

Class II maxillary alveodental protrusion: The maxillary dentition is forward can be treated with Serial Extraction in maxilla only.

Class III: Not suitable for Serial Extraction.

3. Alveodental retrusion:

Class I maxillary mandibular alveodental retrusion : Such patients should be treated without extractions. Because extractions create a dish in face.

Class II: Mandibular alveodental retrusion : Serial Extraction not indicated.

Prognathism:

Class I Maxillary mandibular prognathism - Serial Extraction indicated if teeth are severely crowded. Because of the increase in size of jaws, extraction usually not indicated .Class II Maxillary prognathism : Maxillary prognathism may be due to fault in the maxillary base itself or due to a long anterior cranial base, or the cranial base being flat creating a downward and forward position of the nasomaxillary complex. Difficult to treat with Serial Extraction.

5. Retrognathism :

Class I maxillary mandibular retrognathism : As the maxilla and mandible are placed relatively backwards, extractions are contraindicated.

Class II mandibular retrognathism : May be due to small corpus of mandible or small ramus or due to excess vertical development of nasomaxillary complex. In such cases the mandible rotates backwards and creates an open bite. Not a good case for Serial Extraction.

V. Dental Analysis:

Incisors :

Incisor crowding may be assessed by:

Favourable situation i.e. when there is sufficient primary spacing to allow for eruption of permanent incisors without crowding.

Precarious situation:

When there is closed primary dentition and it is necessary to have secondary spacing so that incisors can erupt without crowding. In such patients it is better to avoid extraction of primary canines or interproximal reduction.

Impossible situation:

where there is hereditary crowding and incisor liability cannot be compensated by interdental spacing, increase in intercanine width or labial positioning of incisors. Such cases can be treated by Serial Extraction.

Molars

If permanent maxillary first molars emerge before the mandibular 1st molars, a mesial shift of 6 takes place especially in spaced dentition resulting a class II molar relationship reduction in maxillary arch length.

If extensive interproximal caries is allowed to develop in maxilla. A Class II molar relationship with reduction in arch length and crowding will occur.

Premature loss of primary molars will cause crowding. Ectopic eruption of permanent 1st molars causing premature exfoliation of deciduous 2nd molars is an indication of lack of development of tuberosity - results in class II molar relationship and crowding. Canines premolars and 2nd molars

The most favourable sequence of eruption is 6,1,2,4,5,3, and 7 in maxillary arch and 6,1,2,3,4,5,7 in mandibular arch. An unfavourable sequence may cause crowding e.g. If 2nd molars erupt relatively early they may impact canines in maxilla and 2nd premolars in mandible.

If the maxillary 2nd molars erupt ahead of their mandibular counterparts it leads to the development of class II molar relationship. Early exfoliation can cause reduction in arch length and lead to crowding. Prolonged retention of deciduous teeth can also lead to crowding.

Basically the deciduous 2nd molars resist mesial migration after early loss of deciduous 1st molars thereby preventing mesial migration of permanent 1st molars. But when deciduous 2nd molars are lost prematurely, the permanent 2nd premolars are usually deep in the bone and it encourages the permanent 1st

molar to lip giving the permanent 1st molar an exaggerated mesial inclination thereby impacting the 2nd premolars.

Selection of teeth for extraction:

1) Extracting $\frac{C}{C} \mid \frac{C}{C}$ will produce maximum amounts of self improvement in crowding with

greatest inter-ception of lingual cross bite. $\frac{21}{21} \mid \frac{12}{12}$

2) Extracting $\frac{D}{D} \mid \frac{D}{D}$ produces earliest eruption of $\frac{4}{4} \mid \frac{4}{4}$ but reduces speed and

amount of improvement in $\frac{21}{21} \mid \frac{12}{12}$ crowding and position due to retention of C that it has limited application.

3) Extracting $\frac{DC}{DC} \mid \frac{CD}{CD}$ is a compromise between rapid improvement in and desired early

eruption of $\frac{21}{21} \mid \frac{12}{12}$ due to simultaneous $\frac{4}{4} \mid \frac{4}{4}$ eruption of with this extraction sequence

reduced distal translation occurs and $\frac{43}{43} \mid \frac{34}{34}$ are often impacted, as with extraction only.

4) Enucleation of $\frac{3}{3} \mid \frac{3}{3}$ buds permits maximum distal translation of. $\frac{4}{4} \mid \frac{4}{4}$ Which undesirable in

certain cases because it produces excessive chin and reduces resistance value of anterior teeth for final space closure.

There is no single technique for Serial Extraction. It is a long-range guidance program and it may be necessary to reevaluate and change tentative decisions several times.

Usually the child is 7-8 years of age when he/she brought to the pedodontist. At this time the maxillary and mandibular central incisors are usually erupted, but there is inadequate space in anterior segments to allow normal eruption and positioning of lateral incisors. In some cases, mandibular lateral incisors have already erupted but they are usually lingually positioned and rotated. The same is with the maxillary lateral incisors. Complete diagnostic records should be made and studied. To gain sufficient arch length, to provide a stable and healthy occlusion the orthodontist must turn to guided tooth material.

Dewel’s Method:

There are 3 stages in Serial Extraction Therapy:

Removal of deciduous canines : with exfoliation and removal of deciduous canines the immediate purpose is to permit eruption and optimal alignment of lateral incisors. There is some amount of improvement in position of central incisors also.

Removal of first deciduous molars: The orthodontist hopes to accelerate eruption of 1st premolars ahead of canine if possible. 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.

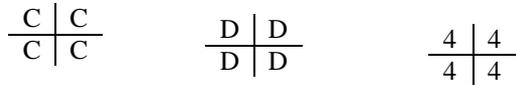
Removal of erupting first premolars: Before the 1st premolars are extracted, all the diagnostic criteria must again be evaluated. The status of developing 3rd molars must be evaluated, because if the 3rd molars are congenitally missing then extraction of 1st premolars would be unnecessary because there would be enough space.

Indications of Dewel’s method:

Mild crowding in anterior region. Early exfoliation of uni or bilateral deciduous canines.

In short:

Step I ----- → II ----- → III



Tweed’s Sequence of Extraction:

According to Tweed, if diagnosis shows the discrepancy exists between teeth and basal bone structures and if patient is between 7 ½ to 8 ½ years, Serial Extraction program is should be carried out.

Sequence is:

At approximately 8 years all deciduous 16-1 molars are extracted. It is preferable to maintain in deciduous canines to retard eruption of permanent canines, 4-10 months of following extraction of deciduous 1st molars, the 1st premolar will have erupted upto gingival level. Do not extract till the crown arc, above the alveolar bone. Extraction of 1st premolar and deciduous canines should he done 4-6 months prior to eruption of permanent canines when they erupt they migrate posteriorly into good position. Any irregularities in mandibular incisors if not too severe, get corrected themselves and they are also tipped lingually due to normal muscular forces.

VI. Moyers Method

Indications:

When crowding seen in central incisor region. Fairly eruption of lateral incisors.

Stage I (Extraction of all deciduous lateral incisors). It helps in alignment of central incisors.

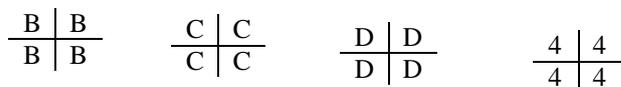
Stage II (Extraction of all deciduous canines after 7-8 months). It helps in alignment of lateral incisors and provides space for lateral incisors.

Stage III (Extraction of all deciduous first molars). It stimulates eruption of all first premolars.

Stage IV (Extraction of all first premolars after 7-8 months). It provides space for canines and stimulates eruption of canines.

In short:

Step I ----- → II ----- → III ----- → IV



Points to be considered when handling a case in mixed dentition: (Warren Mayne’s four principles)

Incisor liability on an average is 7.6mm in maxillary. 6mm in mandibular

Interdental spacing of 0.10mm in maxilla – avg 4mm 0.6mm in mandible – avg 3mm

Inter canine width increased in mandible upto 9 years for male and female it increases by average 3mm. In maxilla it increases upto 12 years in female and 16 years in male. It amounts to 4.5mm.

Permanent incisors erupt labial to primary incisors by 2.2mm in maxilla and by 1.3mm in mandible.

Thus, to overcome problems associated with unfavourable eruption sequences and to counteract varying degrees of dentoalveolar disproportions many extraction sequences have been suggested:

a) C ----- D ---- 4

b) C + D ----- 4

c) D ----- C + 4

d) C ---- D + Enucleation of 4

e) C ---- D ---- E ---- 4

f) C ----- D ----- No permanent tooth extraction

g) Occasionally some or all the permanent 2nd premolars are substituted for first premolar.

Where,

C is the deciduous canine.

D is the deciduous 1st molar

E is the deciduous 2nd molar

4 is the first premolar

The list indicates that there is no ideal extraction sequence and that serial extraction treatment, is not an uncomplicated procedure.

Precautions:

Operator must always check that the permanent successors:

Are present. Of good quality. Of adequate morphology i.e. size and shape. At proper position.

Have a sound, well-formed premolar when removed.

Enucleation:

There are times when there is unilateral loss of deciduous canine, in such cases the other deciduous canine is extracted and the 1st premolar is enucleated. Enucleation has been defined as surgical removal of unerupted teeth usually premolar to minimize crowding. Most common disadvantage are loss of buccal or lingual cortical plates of bone or clefting associated with incomplete closure of extracted site.

Advantages of enucleation:

Fewer visits to the orthodontics therefore decrease in trauma and emotional disturbance.

Fewer followup visits. In mandibular arch 3 usually erupts before 4. So if it is found that the 3 is erupting labially then premolar may be enucleated. (Diagnosis for 3 erupting labially-gingival recession of anterior and canine bulge on labial surface). In severe maxillary anterior crowding and excessive protrusion, enucleation provides space for retraction of 1 and 2 proper eruption of 3.

Retraction of 3 easier In crowded high angle cases, enucleation especially of 5 causes mesial migration of posterior segment.

Orthodontic Appliance Utilized with Serial Extraction

The most frequently used orthodontic appliance with serial extraction are: Maxillary and mandibular lingual arches. Fixed or removable headgears. Removable Hawley appliance.

Fixed as removable lingual arches can prevent as minimize the normal physiological mesial migration of permanent first molars. The mandibular lingual arch is used where there is a severe amount of crowding, excessive protrusion and maximal anchorage requirement.

The maxillary transpalatal holding arch (Nance arch) prevents or minimizes any mesial migration of the maxillary first molars. These holding arches are most useful in allowing proper interdigitation to occur during the interchange of mandibular and maxillary primary molars (second).

Head gear therapy, a form of extraoral anchorage is useful in maintaining or achieving a Class I buccal interdigitation. It includes posterior cervical head gear and it is directly attached to anterior teeth.

The removable Hawley appliance used with serial extraction will reduce an excessive amount of overjet and where spacing exists align rotated teeth i.e. incisors. It may be modified to include a bite plane for deep overbite. The success of Hawley appliance is limited to tipping movements and cannot control root positioning in all planes of space as does the edgewise technique.

Thus, the parents must be informed that without follow-up orthodontic treatment, the serial extraction procedure may not result in a favourable occlusion.

VII. Summary & Conclusion

The procedure known as serial extraction has been essentially a program of patience, of continuous observation and study, of proper timing and of delay and postponement until growth and development have accomplished their mission. Much greater importance is (1) that the developing dentition receives competent supervision, (2) that no -teeth of any kind be removed prior to a most precise and exacting case analysis, (3) that the case analysis be repeated preceding and subsequent extraction and (4) that when indicated, competent orthodontic treatment be provided. The technique is biologically sound proven, and should not be considered a compromise. In almost all instances, conventional orthodontic therapy is required to complete the alignment of teeth, to parallel the roots on either side, of the extraction space, to eliminate overbite, and to effect residual space closure. However, such mechanotherapy is usually of significantly shorter duration it is less likely to produce less damage and the results are more stable. However, it must be remembered that, once teeth have been extracted, they cannot be replaced if an error in judgement must be made, it is more expedient to error in a conservative manner without extraction, for the teeth can always be extracted at a later date, its subsequent development remains unsatisfactory. This of course, might mean delaying all treatment until the permanent

dentition conversely, no one has devised suitable treatment procedures when growth exceeds expectations following an improper extraction programme.

As in all facets and treatment guidance of eruption has its limitation our speciality must assume its responsibility for educating the undergraduate student in the science of guidance of eruption. With such knowledge, the general practitioners with the Pedodontist as consultant, will be able to bring the benefits for orthodontists to correct the deformity easily. Here in, lies the true meaning of preventive and interceptive orthodontics philosophy.

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