The Journal of Dental Panacea 2024;6(1):14–19

Content available at: https://www.ipinnovative.com/open-access-journals

The Journal of Dental Panacea

Journal homepage: https://www.jdentalpanacea.org/

Review Article

Modalities used to gain space in dental arch

Sukhpal Kaur[1]*, Amandeep Kainth[2], Amritpal Kaur [3], Manbir Kainth[4], Sankalp Bansal[5], Riponjot Singh [6], Ramandeep Kaur [7]

[1]*Desh Bhagat Dental College & Hospital, Fatehgarh Sahib, Punjab, India*
[2]*Registered Dental Hygienist, Calgary, Alberta, Canada*
[3]*Private Practitioner, Punjab, India*
[4]*Private Practitioner, Calgary, Alberta, Canada*
[5]*Genesis Institute of Dental Sciences & Research, Ferozpur, Punjab, India*
[6]*Western University, Ontario, Canada*
[7]*Private Practitioner, Punjab, India*

ARTICLE INFO

Article history:
Received 06-02-2024
Accepted 25-02-2024
Available online 05-04-2024

Keywords:
Malocclusion
crowding
extraction
rotation of teeth
expansion

ABSTRACT

Most of orthodontic patients seek treatment to improve their facial and dental esthetics which is compromised due to variety of malocclusions. Malocclusion can be caused by skeletal or dental factors. Dental malocclusion includes crowding, spacing, increased overjet, and overbite, rotations of teeth etc. Correction of some malocclusions like crowding and increased overjet needs space in the dental arch. There are various methods for creating space in the dental arch such as proximal stripping, distalization of molars, extractions, expansion of arch, and proclination of anterior teeth, and derotation of posterior teeth. In this article, we will briefly discuss about these methods.

1. Introduction

Most of orthodontic patients seek treatment to improve their facial and dental esthetics which is compromised due to variety of malocclusions. Malocclusion can be caused by skeletal or dental factors. Skeletal malocclusion involves discrepancy in position or size of jaws while dental malocclusions are due to malalignment of teeth. Skeletal Class II malocclusion may be caused by retrognathic mandible, prognathic maxilla or combination of both. Skeletal class III malocclusion may be caused by prognathic mandible, retrognathic maxilla or combination of these two conditions. Dental malalignment of teeth includes crowding, spacing, rotations, discrepancy in overjet and overbite, proclination and retroclination of teeth. Treatment of any type of malocclusion depends on type of malocclusion and age of patient. Skeletal malocclusion may be treated by growth modulation treatment in growing patients by using functional appliances. These functional appliances reposition the mandible to correct malocclusion. These can be removable or fixed appliances fabricated in such a way that these change the position of mandible in sagittal and vertical direction and produce lengthening of mandible as they stimulate condylar growth.[1]

Treatment of dental malocclusion such as crowding, proclination etc needs space to correct these malocclusions. Crowding of the teeth within dental arches and occlusion of teeth in human has been observed many years back as Neanderthal man of 50,000 to 60,000 years ago. Evolutionary changes from ancestors to the present man, leads to decrease in facial dimensions. Genetic drift also causes reduction in facial skeletal dimensions and also the teeth size. Reduction in facial dimension is occurring more

* *Corresponding author*.
E-mail address: docs284@gmail.com (S. Kaur).

https://doi.org/10.18231/j.jdp.2024.005

as compared to reduction in teeth size. This leads to higher tendency of crowding in dental arches and protrusion of teeth. Foundation of literature for gaining space in dental arches has been started as early as 1723, when Pierre Fauchard fabricated an appliance called "Bandelette" which is used to produce expansion of dental arches. Later, the concept of extracting teeth for treatment was introduced by Robert Bunon in 1743.[2]

Space gaining in dental arches has prime contribution as it helps to treat various types of dental malocclusions. Space in dental arch can be achieved by two types of methods. The first type of methods includes procedures of space gaining by the reducing tooth material which is done by stripping of teeth and extraction of teeth. Second type of space gaining methods achieves space without reduction of tooth material. These methods are expansion, derotation, and distalization etc.[3]

2. Methods of Gaining Space

1. Proximal stripping
2. Arch expansion
3. Distalization
4. Uprighting of teeth
5. Derotation of teeth
6. Proclination of anterior teeth
7. Extraction of teeth.

2.1. Proximal stripping

It is reduction of mesiodistal dimension of teeth to gain space in the dental arch. It is also called as interproximal enamel reduction, interproximal stripping, enamel approximation, and slenderizing. Ballard[4] was the first person who used proximal stripping for the mandibular anterior region for achieving harmony in tooth size. Later on, Hudson[5] explained stripping procedure in detail using metallic strips and he also described polishing of teeth and application of fluoride preventive measures after doing stripping of teeth.

2.1.1. Indications

In comprehensive orthodontic treatment proximal stripping is used as an adjunct method to achieve ideal occlusion. It is done:

1. For esthetic alignment of malaligned teeth and provide long-term stability for aligned teeth.
2. To establish ideal Bolton's ratio.
3. Used to treat malocclusions which need minimum space for their correction.
4. It is used in mixed dentition for spontaneous correction of crowded teeth.
5. For treating black triangles[6]

2.1.2. Contraindications

1. In patients with poor oral hygiene, as they are at higher risk of developing interproximal caries.
2. Not recommended in patients having gingivitis.
3. Not indicated in young patients, because their pulp chambers are large so there is higher chance of pulpal exposure[7]

2.1.3. Advantages

1. Proximal stripping results in minimum loss of tooth material.
2. After stripping, tooth movement needed is less.
3. Treatment duration is short as compared to extraction cases.
4. It results in stability of the dental arches as it produces contact surfaces rather than contact points.
5. Residual extraction spaces after orthodontic treatment are avoided.[8]

2.1.4. Disadvantages

1. After doing proximal stripping, it is difficult to clean interproximal areas which may need special adjuncts to achieve good oral hygiene.
2. It may create esthetic problem due to square shape appearance of the teeth
3. Due to loss of enamel, it may result sensitivity of the teeth
4. It also increases chances of tooth decay[8]

2.2. Arch expansion

In year 1860, Emerson C Angell[9] firstly used a double jackscrew type of an appliance for expansion of maxillary arch in a 14.5 year old girl. Expansion is usually needed to correct the transverse discrepancy by combined use of orthopedic and orthodontic tooth movements. Three types of expansion modalities are used:

1. Rapid maxillary expansion (RME)
2. Slow maxillary expansion (SME)
3. Surgically assisted maxillary expansion[9]

2.2.1. Rapid maxillary expansion

The objective of RME is to correct narrow maxillary arch. Its impact is not limited to maxilla only as maxilla is associated to other facial bones. Effects of RME are:

1. Opening of midpalatine suture, more opening in anterior area and progressively decreasing towards posterior region of palate.
2. Lateral bending of alveolar processes take place which later rebounds back after a few days.
3. Appearance of diastema between maxillary incisors.
4. Buccal tipping and extrusion of maxillary molars occur.
5. Mandible rotates downwards and backwards.

6. With arch expansion, width of nasal cavity increased resulting in improvement in breathing.[10]

2.2.1.1. Appliances used for RME[11].

1. Tooth borne
   (a) Isaacson expander
   (b) Hyrax expander
2. Tooth and Tissue borne
   (a) Derichsweiler
   (b) Hass

2.2.2. Indications and contraindications of RME

It is indicated for patients having narrow maxillary arch with a transverse discrepancy equal to or more than 4 mm, and also there is compensatory buccal inclination of molars present. It is also used in class III patients to facilitate protraction of maxilla by disrupting sutures, which are connecting maxilla to other bones. RME is also useful in patients with cleft lip and palate having collapsed maxillary arch. Sometimes, also indicated to achieve arch length in patients, with moderate maxillary arch crowding. RME is not recommended in patients who have passed the growth spurt, patients with recession on the buccal aspect of the molars, anterior open bite cases, patients having convex facial profile and in poor compliance patients.[10]

2.2.3. Slow maxillary expansion (SME)

In SME, light force is used for long duration which mainly generates dentoalveolar expansion. It generates low-level tissue resistance around the circummaxillary structures, leading to better bone formation in the intermaxillary suture. It was observed that it promotes more stable results of expansion if provided with an appropriate retention period. It delivers a constant physiologic force until the required expansion is obtained. In SME, the maxillary arch is expanded at slow rate of 0.5-1 mm/week. Low force is used that is 2-4 pounds and expansion is completed in 2-5 months.[12,13]

2.2.4. Surgically Assisted Rapid Palatal Expander (SARPE)

It is an alternative method of expansion which helps to produce maxillary arch expansion in non-growing patients. Indications for SARPE:[14,15]

1. To increase maxillary arch perimeter, to correct posterior cross-bite, and when no additional surgical jaw movements are planned.
2. It is used as a preliminary procedure, when orthognathic surgical treatment is planned to prevent increased chances of, inaccuracy, and instability linked with segmental maxillary osteotomy.
3. Used to create space in maxillary arch for alignment of crowded teeth when extractions are not part of treatment.
4. For expanding hypoplastic maxilla associated with clefts of the palate.
5. For expansion of maxillary arch to reduce buccal corridor space[11]

2.3. Distalization

Molar distalization is an orthodontic treatment procedure used to increase length of the dental arch by moving posterior teeth in backward direction.

2.3.1. Indications

Molar distalization is not an option for all malocclusions. So appropriate case selection is needed. Molar distalization is recommended in following cases:

1. Class II or end on molar relationship.
2. Well-aligned arches with mild to moderate crowding.
3. Long distal bases.
4. Mesially positioned maxillary first molars due to caries and early loss of deciduous second molars.

2.3.2. Contraindications

1. Skeletal or dental open bites.
2. Increased mandibular plane angle.
3. Increased lower facial height.
4. Increased overjet with proclination of maxillary incisors.[16]

2.3.3. Appliances used for molar distalization[17]

1. Extraoral appliances
   (a) Headgear
2. Intraoral appliances
   (a) Intraarch:
      i. Removable appliances:
         A. ACCO (acrylic cervical occipital appliance
         B. Removable molar distalization splint
         C. Segmental removable appliance in molar distalization
      ii. Fixed appliances
3. Maxillary Arch
   (a) Flexible palatally positioned distalization force system
      i. Pendulum appliance and its modifications
      ii. Distal jet and its modifications
      iii. Intraoral bodily molar distalizing appliance (IBDA)
      iv. Simplified molar distalizer

(b) Flexible bucally positioned distalization force system
   i. Repelling magnets
   ii. NiTi wire
   iii. Jones jig
   iv. Sectional jig assembly
   v. K Loop

(c) Flexible bucally and palatally positioned distalization force system
   i. Fixed piston appliances

(d) Hybrid appliances (rigid bucally and flexible palatally positioned distalization force system)
   i. First class appliance for molar distalization

(e) Implant supported appliances
   i. Graz Implant Supported Pendulum Appliance
   ii. Skeletal anchorage system
   iii. Midpalatal Miniscre

4. Mandibular Arch appliances
   (a) Lip bumper
   (b) Franzulum appliance
   (c) Unilateral Crozat Appliance
5. Interarch
   (a) Rigid intermaxillary appliances
      i. Herbst appliance
   (b) Flexible intermaxillary appliances
      i. Jasper jumper
      ii. Churro jumper
   (c) Hybrid appliances
      i. Eureka springs

2.4. Uprighting of molars

In adult patients the common problem in patients is loss of posterior teeth, commonly first permanent molar. The problems associated with this loss of teeth depend on number of teeth lost, location of tooth and time duration since the tooth was lost and age of patient at which tooth loss occurred. If the first permanent molar is lost, then mesial tipping of second molar can be seen. It affects periodontal health of teeth and also restorative procedures. Also, the premolars can move in distal direction leading to open contacts. The teeth in the opposite arch can also supra erupt in the space created by loss of tooth which also makes restorative procedure difficult to carry out and cause occlusal interferences in mandibular movement. In such cases the uprighting of teeth is needed prior to prosthetic replacement of lost tooth/teeth. Uprighting of molars is one of the procedures in orthodontics used for gaining space needed to relieve crowding of teeth.[18]

In year 1981, Louis Norton[18] described that removable appliance can be used for uprighting if only one tooth is to uprighted which is tipped to less than twenty degrees from vertical. There must be maximum tissue and tooth contact of appliance with all the teeth which are not to be moved. Clasp should be properly designed to prevent the displacement of appliance.

He described three types of removable appliances that can be used for molar uprighting. These are:

1. Recurved helical coil finger spring
2. Dumbbell-shaped spring in split saddle space retainer
3. Slingshot appliance

If the tooth is tipped more that is to sixty degrees from vertical and when more control is needed, fixed appliances are used for tooth uprighting. In fixed appliances uprighting is done with various methods such uprighting with minimum molar extrusion, Molar Uprighting Simple Technique (MUST) without extrusion, given by Elie Capelluto et al.[19], and lower terminal molar (LTM) uprighting whip.[20]

2.5. Derotation of teeth

Rotation of a tooth is displacement around its long axis. It may be in mesiolingual or distobuccal direction. Rotated anterior teeth occupy less space than their dimension so there is need of space in dental arch for correction of rotation of anterior teeth. Posterior teeth when rotated, occupy more space than their actual dimension, so space is created in the dental arch when posterior teeth derotated. Thus, this space can be used to correct crowding of teeth. Teeth can be derotated by applying single or couple force. Appliance used for rotation correction can be removable, semi fixed, or fixed on the basis of severity of rotation.[21]

Rotations of molars can be evaluated from patient models. Diagnosing molar rotations is very important for proper treatment planning and establishing more corrected occlusion.

Andrews (1972) has described three contacts of maxillary and mandibular molars which are:

1. Mesiobuccal cusp of upper first molar occludes with mesiobuccal groove of the lower first molar.
2. Distal marginal ridge of the upper first molar contacts the mesial marginal ridge of lower second molar.
3. Palatal cusp of upper first molar occludes with the central fossa of lower first molar.

According to Cetlin in an ideal occlusion, the buccal surfaces of the maxillary first molars usually are parallel to each other.

Nanda (1997) stated that mesiobuccal cusp of the maxillary molar is positioned mesially when the molars are rotated along an axis lingual to the central fossa.[18]

2.6. Extractions

Extractions in orthodontics are done to correct various types of malocclusions. Variable extraction patterns are followed for successful and stable correction of malocclusion. The decision of extraction of tooth depends on various factors such as type of malocclusions and treatment planning. Extraction of teeth also depends on medical condition of patient, patient's attitude and agreement for the extraction treatment plan, oral hygiene conditions, rate of occurrence of caries, and the status of dentition.[22]

In class I cases with moderate to severe crowding the most extracted teeth are first premolars in both arches as extraction of these teeth provides maximum space for correction of crowding and efficient support in posterior segment to retract anterior teeth. Extraction of maxillary and mandibular first premolars on one side and second premolars on other side or variations of this pattern are recommended in specific conditions depending on malocclusion and treatment planning.[23]

In class I with moderate to severe crowding cases, all second premolar extraction is usually indicated in following conditions:

1. Extraction of all 2^{nd} premolars is advised when second premolars are carious with poor prognosis, have large restorations filled, or periodontally compromised.
2. There is moderate crowding in the anterior region and crowding is also present in posterior part of arch.
3. In patients having anterior open bite, extraction of 2^{nd} premolars helps in deepening of bite.
4. For correction of midline deviations.
5. Also in cases where orthodontist do not want to change facial profile of patient.[24,25]

In class II division 1 cases, the most common extraction pattern is extraction of maxillary first premolars (59%), followed by extraction of second premolars in 13% cases and permanent molars 19%.Extraction of permanent incisors was done in only 1%.[26]

In patients with increased overjet and mild crowding in lower arch, extraction of upper first premolars and lower second premolars is advised. This pattern of extraction helps on reduction of overjet, relieving crowding and moving lower molar forward to establish class I molar relationship.

Extraction of maxillary first permanent molars is indicated when the molars are severely decayed with poor restorative prognosis and significant crowding or ectopically erupted canines.[24]

In patients with significant crowding, extraction in buccal segment is needed to correct crowding. In most of class II division 2 cases extraction is not needed and they are treated by distalization and stripping.

In Orthodontic treatment of class III cases, extraction of mandibular first premolars and maxillary second premolars are advised when there is crowding in mandibular arch or edge to edge incisor relationship. Another pattern of extraction includes extraction of one of mandibular central incisor when there is mild crowding or Bolton discrepancy. In some cases, with severe crowding or class III with anterior open bite, extraction of all first premolars is indicated. In high angle cases when third molars are present, extraction of permanent first molars may be a good option to correct crowding and vertical growth.[27,28]

3. Conclusion

In many of orthodontic cases, treatment requires space in the dental arch to align the teeth in appropriate position for better aesthetics, function and stability. There are various methods for creating space in the dental arch such as proximal stripping, distalization of molars, extractions, expansion of arch, and proclination of anterior teeth and derotation of posterior teeth. The selection of one method in any case depends on variety of factors including type of malocclusion, arch length discrepancy, condition of teeth, treatment plan for malocclusion etc. For appropriate selection of method, proper diagnosis and treatment is needed to provide best results to the patient. In today's time, digital technology helps in more precise diagnosis, thus helping in choosing right option for any case.

4. Source of Funding

None

5. Conflict of Interest

None

References

1. Kaur S, Soni S, Prashar A, Bansal N, Brar JS, Kaur M. Functional appliances. *Ind J Dent Sci*. 2017;9(4):276–81.
2. Proffit WR, Fields HW, Ackerman JL, Bailey LT, Tulloch JF. Contemporary orthodontics. 3rd ed. St. louis: Mosby Inc; 2000.
3. Method of Gaining Space in Orthodontics. *Dentistryzone Updated on 21 may, 2021*. 2021;Available from: https://www.thedentistryzone.com/2021/05/method-of-gaining-space-in-orthodontics.html..
4. Ballard ML. Asymmetry in tooth size: A factor in the etiology, diagnosis, and treatment of malocclusion. *Angle Orthod*. 2009;14:67–71.
5. Hudson AL. A study of the effects of mesio-distal reduction of mandibular anterior teeth. *Am J Orthod*. 1956;42:615–39.
6. Yashwant VA, Arayambath B. Proximal Stripping and the Apprehension to Implement it in Contemporary Orthodontics: A Review. *IJSS Case Reports & Reviews*. 2016;2(12):18–21.
7. Harfin J. Interproximal stripping for treatment of adult crowding. *J Clin Orthod*. 2000;34(7):424–57.
8. Interproximal Enamel Reduction (Stripping). Available from: https://pocketdentistry.com/interproximal-enamel-reduction-stripping/.
9. Agarwal A, Mathur R. Maxillary expansion. *Int J Clin Pediatr Dent*. 2010;3(3):139–46.
10. Agarwal A, Mathur R. Maxillary expansion. *Int J Clin Pediatr dent*. 2010;3(3):139–185.
11. Joy J, Anilkumar. Methods of maxillary arch expansion in orthodontics: A literature review. *Int J Appl Dent Sci*. 2021;7(2):251–4.

12. Cleall JF, Bayne DI, Posen JM, Subtelny JD. Expansion of the midpalatal suture in the monkey. *The Angle Orthodontist*. 1965;35(1):23–35.
13. Hicks EP. Slow maxillary expansion. A clinical study of the skeletal versus dental response to low-magnitude force. *Am J Orthod*. 1978;73(2):121–41.
14. Woods M, Wiesenfeld D, Probert T. Surgically-assisted maxillary expansion. *Aust Dent J*. 1997;42(1):38–42.
15. Koudstaal MJ, Poort LJ, Van Der Wal K, Wolvius EB, Prahl-Andersen B, Schulten AJ. Surgically assisted rapid maxillary expansion (SARME): a review of the literature. *Int J Oral Maxillofac Surg*. 2005;34:709–23.
16. Kaur S. Pendulum appliance and its modifications-A review. *Int J Curr Re Med Sci*. 2018;4(3):1–9.
17. Vijayalakshmi K. Molar distalization. *J Sci Dent*. 2011;1(1):1–14.
18. Khan W. Essential of gaining space in Orthodontics. LAP Lambert Publication; 2019.
19. Capelluto E, Lauweryns I. A simple technique for molor uprighting. *J Clin Orthod*. 1997;31(2):119–25.
20. Orton HS, Jones SP. Correction of mesially impacted lower second and third molars. *J Clin Orthod*. 1987;21(3):176–81.
21. Goutham B, Muddaiah S, Somaiah S, Shafad M, Jolly J, GTechnique. An effective and precise method for rapid derotation of teeth. *Journal of multidisciplinary dental research*. 2021;6(2):47–9.
22. Travess H, Roberts DH, Sandy J. Orthodontics part 8: extractions in orthodontics. *Br Dent J*. 2004;196(4):195–203.
23. Muhammadali Q, Rakhmonov U. Extraction planning in orthodontics. *Int J Multidisc Res and Develop*. 2023;10(2):377–81.
24. Williams R, Hosila FJ. The effect of different extraction sites upon incisor retraction. *Am J Orthod*. 1976;69(4):388–410.
25. Thompson FG. Second premolar extraction in Begg technique. *J Clin Orthod*. 1977;11(9):610–3.
26. Janson G, Dainesi EA, Henriques JF, de MF, de Lima K. Class II subdivision treatment success rate with symmetric and asymmetric extraction protocols. *Am J Orthod Dentofacial Orthop*. 2003;124(3):257–64.
27. Kochel J, Emmerich S, Meyer-Marcotty P, Stellzig-Eisenhauer A. New model for surgical and nonsurgical therapy in adult with class III malocclusion. *Am J Orthod Dentofacial Orthop*. 2011;139(2):165–74.
28. Ruellas AC, Baratieri C, Roma MB, Ade MI, Boaventura L, Rodrigues CS, et al. Angle Class III malocclusion treated with mandibular first molar extraction. *Am J Orthod Dentofacial Orthop*. 2012;142(3):384–92.

Author biography

Amandeep Kainth, Registered Dental Hygienist

Manbir Kainth, Private Practitioner

Sankalp Bansal, BDS student

Riponjot Singh , Dental Hygienist

Ramandeep Kaur , Private Practitioner

Cite this article: Kaur S, Kainth A, AK, Kainth M, Bansal S, RS, RK. Modalities used to gain space in dental arch. *J Dent Panacea* 2024;6(1):14-19.