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Non-extraction methods for space creation in Orthodontic Treatment

A Project Submitted to

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Certification of the Supervisor

I certify that this project entitled **"Non-extraction methods for space creation in Orthodontic Treatment**" was prepared by the fifth-year student (Ali Jabbar Majli) under my supervision at the College of Dentistry/University of Baghdad in partial fulfillment of the graduation requirements for the Bachelor Degree in Dentistry.

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Dedication

To my family, I could never do this without your faith, support, and constant encouragement. Thank you for teaching me to believe in myself and in my dreams. To my supervisor ***Dr. Hiba M. Hussien*** *who believed in my abilities and was always there for me whenever I needed , To all people who supported and encouraged me Family, Friends, Teachers and Colleagues. Many thanks to all of you.*

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I would like to present special thanks for teaching staff for their great ethics and to all colleagues and all members of orthodontics Department for their helpful assistance.

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List of Abbreviation

Abbreviation	The words
IER	Interproximal enamel reduction
RME	Rapid maxillary expansion
Ni-Ti Expanders	Nickel titanium expanders
SARPE	Surgically assisted rapid palatal expander
MARPE	Mini-implant assisted rapid palatal expansion
OME	Orthopedic maxillary expansion
TMA	Titanium molybdenum alloy

Introduction

The orthodontist is primarily an architect of the face. He is at the same time an engineer who has to implement his architectural design in the correct biomechanical sense. Irregularities of the teeth and their occlusion have been found in human skulls dating as far back as Neanderthal man of 50,000 to 60,000 years ago. From our ancestors to the present man, the evolutionary trend has been one of reduction of facial dimensions. Genetic drift has allowed for diminution in both the skeletal framework of the face and the dentition. Man's facial dimensions however, are getting smaller at a greater rate than his teeth and these results in an increasing tendency towards dental crowding and protrusion of teeth so the orthodontist requires more space while treating various malocclusions to move the teeth into a more ideal position **(Parkar *et al*, 2020).**

When crowded teeth were aligned in correct relation to each other, improved function of the masticatory apparatus would result in growth of the jaws, creating enough space for the dentition **(Singh, 2007).**

Consequently, from an orthodontic viewpoint, a perfect occlusion could never be achieved by extracting teeth. Every person has the prospective to attain an ideal relationship of all thirty two natural teeth, and therefore extraction for orthodontic purposes would never need. So accordingly, **Angle's (1907)** treatment for every patient involve expansion of the dental arches and elastics as needed to bring the teeth into occlusion, and extraction is not necessary for stability of result or esthetics, so each individual, ideal facial esthetics would result when the teeth were placed in ideal occlusion **(Khanum *et al* 2018).**

Non-extraction methods for space creation are becoming increasingly popular in orthodontic treatment due to their potential to achieve stable, esthetic, and functional outcomes while avoiding the potential negative consequences of tooth extraction. Orthodontists must carefully evaluate each

patient's individual needs and determine the most appropriate treatment plan for them **(Pedrin and Almeida, 2019).**

The extraction of teeth can lead to undesirable outcomes such as compromised facial esthetics and unstable dental arches. Expansion and extraction were the only methods that ruled the 18th and 19th century as the methods of gaining space. Later, several methods were introduced **(Proffit *et al,* 2019).** These methods include extraction, mesiodistal dimension reduction, distalization, derotation of posteriors, and uprighting molars **(Harini *et al,* 2020).**

Aims of the study

This study aims to review and discuss the non-extraction methods for space creation in orthodontic in order to identify the most conservative method of space creation, in addition to highlight the modern concepts that provides enough space to treat malocclusion while preserving the whole dentition.

Chapter one

Review of literature

1.1 Space Analysis

Space analysis is a process that allows an estimation of the space required in each dental arch to fulfill the treatment aims. Planning involves initially visualizing the tooth movements that will be needed and assessing what space is required to bring them about. It can greatly assist in the process of treatment planning because it provides numerical value for the space required within each dental arch **(Cobourne and DiBiase, 2016)**.

Space available refers to the amount of space present in the dental arch for the proper alignment and positioning of teeth. Space available is an important consideration in orthodontic treatment planning, as it determines the amount of correction that can be achieved without interventions **(Verma, 2015).**

The concept of space requirement refers to the amount of space needed in the dental arch to properly align and position the teeth **(Pellegrini, 2017).**

For achieving majority of the treatment objectives space has to be created within the jaws. Space is required for (**singh, 2007):**

1. Alignment of crowded teeth.
2. Retraction of proclined teeth.
3. Correction of molar relationship.
4. Derotation of anterior teeth.
5. Leveling the curve of Spee.
6. Intrusion.

1.2 Crowding of the teeth

The condition where the teeth are too close together in the mouth, causing them to overlap or become twisted **(Essig, 1905).** The crowding is much more prevalent in modern populations than it was in prehistoric times, this may be

due to the introduction of a less abrasive diet, so that less interproximal tooth wear occurs during the lifetime of an individual **(Graber *et al*, 2017).**

The crowding occurs where there is a discrepancy between the size of the teeth and the size of the arches. Approximately 60% of Caucasian children exhibit crowding to some degree. Crowding where one or more teeth are pushed buccally or lingually out of the alveolar bony trough, resulting in reduced periodontal support and localized gingival recession **(Littlewood and Michell, 2019).**

1.2.1 Types of crowding:

Crowding is divided on the basis of etiology into

1. Primary crowding (hereditary primary crowding) is defined as an inherent discrepancy between tooth size and jaw size mainly of genetic origin **(Van der Linden, 1974).**
2. Secondary crowding: acquired anomaly caused by environmental factors acting on the dentition like mesial drift of the posterior permanent teeth after resorption of the primary first molars by the permanent first molars or by early loss of the primary second molars due to caries **(Al-Joubori and Alhuwaizi, 2006).**
3. Tertiary crowding: is an anomaly in adult patients and relates to anterior crowding, particularly in the mandible. The causes are multifactorial and not entirely clear yet **(Wichelhaus and Eichenberg, 2018).**

1.3 Creating space **(Littlewood and Michell, 2019)**

The amount of space that will be created during treatment can also be assessed. The aim is to balance the space required with the space created. Space can be created by one or more of the following:

• Distal movement of molars.

• Interproximal reduction.

• Expansion.

• Proclination of incisors.

• Extractions.

• A combination of any or all of the above.

1.4 Dental Crowding: To Expand or Extract?

In a rational view, the majority of orthodontic patients can and should be treated without removal of teeth, but some will require extraction to compensate for crowding and/or incisor protrusion that affects facial esthetics. In extraction, the loss of a tooth or teeth is a disadvantage, but with greater stability. For any individual patient the decision is a value judgment. It is not only appropriate but also necessary to discuss the pros and cons with the patient and parent before making the expansion–extraction decision **(Proffit *et al*, 2019).**

1.5 Nonextraction Approach:

1.5.1 Inter proximal stripping

Also named slenderization of the teeth and can be defined as a clinical procedure involving reduction of the mesiodistal width with anatomic reshaping. The teeth that are usually involve are the mandibular incisors, maxillary anteriors and the premolars of both the arches **(Singh, 2007)**

Interproximal reduction (IER) is a clinical procedure involving the reduction, anatomic recontouring, and protection of proximal enamel surfaces of permanent teeth**.** The use of this procedure has increased in recent years by orthodontists with the desire to treat variety of malocclusions with less of extractions provide space to correct malocclusions **(Harini *et al*, 2020).**

All methods of interproximal reduction do not influence enamel surface significantly with and without polishing. Polishing resulted in significant reduction of surface roughness only **(Butrus and Chawshli, 2022).**

1.5.1.1 Indications of proximal stripping (**Phulari, 2011):**

1- Relieve crowding of lower anterior most commonly and to some area in upper anterior segment.
2- When arch discrepancy less than 2.5 mm
3- Mild discrepancy of tooth material excess.

1.5.1.2 Contraindications of proximal stripping:

1. Patients with high-risk of proximal dental caries **(Phulari, 2011).**
2. Young patients with large pulp chambers **(Phulari, 2011).**
3. Severe crowding (more than 8 mm per arch as this would lead to excessive loss of enamel) **(Premkumar, 2015).**
4. Severe periodontal disease teeth with highly mobile **(Premkumar, 2015).**
5. Should not be used in hypersensitive teeth or at the risk of the appearance of dental sensitivity is great **(Premkumar, 2015).**
6. Multiple restorations and poor oral hygiene. **(Harini *et al*, 2020).**

1.5.1.3 The procedure for undertaking proximal stripping:

Proximal stripping can be done using any of the following **(Phulari, 2011):**

A- Abrasive strips (single/double sided) (Figure 1).

- Single sided abrasive strip: is used when reduction of one proximal surface either mesial or distal of a tooth.
- Double sided abrasive strip**:** is used when reduction of two teeth (distal surface of one tooth whereas mesial surface of another tooth).

Figure 1. Manual stripping with small metallic strips for inter proximal reduction (Premkumar, 2015)

B - Use of long thin tapered fissure burs or files. (Figure 2)

Figure 2. Use of fissure for interproximal stripping (Premkumar, 2015)

C - Use of safe-sided carborundum disk. (Figure 3)

Figure 3. Use of disk for interproximal stripping (Premkumar, 2015)

1.5.1.4 Advantages of proximal stripping **(Premkumar, 2015):**

- Avoid over expansion of the dental arch that led to keep greater post treatment stability.
- Provides the esthetic appearance and improved the gingival papillae health because the extraction of teeth is greatly reduced.
- Less treatment time needed**.**

1.5.1.5 Disadvantages of proximal stripping **(Premkumar, 2015):**

- Potential risk of caries.
- Periodontal inflammation.
- Increased sensitivity due to excessive enamel reduction.

1.5.2 Arch expansion

It is one of the methods of gaining space in orthodontics. **Angel** (1822-1903) is considered as the father of expansion appliances, He is considered the first to provide an illustration of the expansion of arches. Arch expansion can be divided into: Slow expansion and Rapid expansion **(Phulari, 2011).**

1.5.2.1 Slow Arch Expansion

It uses lighter forces for a longer period of time to expand the maxillary arch. It is primarily planned to produce dento-alveolar expansion or changes **(Cleall *et al*, 1965).** Slow expansion involves the use of relatively lesser forces (2 to 4 pounds) over longer periods (2 to 6months) to achieve the desired results. Slow expansion has been at times termed dentoalveolar expansion **(Singh, 2007).**

1.5.2.1.i Classification of Slow Expansion Appliances:

A- Removable slow expansion

- Jackscrew**:** Used to expand both arches as use in RME but with smaller pitch and less frequent activity as compared to screws used for RME **(Phulari, 2011)**. Indicated with mild crowding in the lower anterior or when there is significant lingual tipping of the posterior teeth (Figure 4) **(Premkumar, 2015)**. Activated by turning the screw 1-2 quarter turn (0.25-0.5 mm) /week. **(Proffit, 2019).**

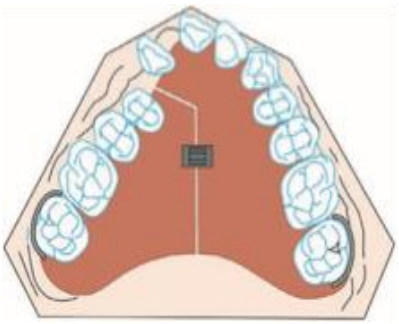

Figure 4. Jack screw in removable orthodontic appliance (Premkumar, 2015).

- Coffin spring: It is a removable appliance capable of slow dento alveolar expansion. The appliance consists of an omega- shaped wire of 1.25 mm thickness, placed in the midpalatal region. The free ends of the omega wire are embedded in acrylic covering the slopes of the palate. The spring is activated by pulling two asides apart manually (Figure 5) **(Padmavati *et al*, 2020).**

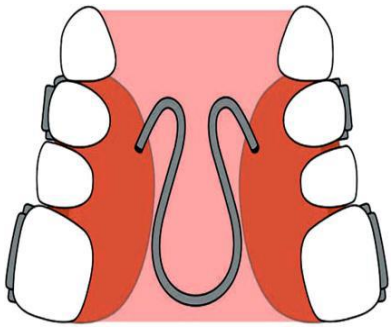

Figure 5. Coffin spring (Premkumar, 2015)

- Removable Quad Helix: It has the same design as a fixed quad helix appliance. (Figure 6)

Figure 6 removable quadhelix appliance secured with blue separating elastics (Littlewood and Michell, 2019).

B- Fixed slow expansion appliance

- Quad Helix Appliance**:** Form of this appliance is similar to the Crozat appliance (figure 7), and the W arch appliance was it incorporates four helices or coils to increase flexibility which was later modified by Ricketts (1975) by adding loops use for crossbite, class II, III where upper arch need effective widening, in tongue thrust and unilateral or bilateral cleft palatal arch (Figure 8) **(Boysen *et al*, 1992; Premkumar, 2015).**

Figure 7 Crozat appliances for the upper and lower arch, (Proffit *et al* , 2019)

Figure 8 quad helix is being used to correct a bilateral maxillary constriction in the primary dentition. (Proffit *et al*, 2019)

- Ni-Ti Expanders: The latest in the series of expanders are the nickel-titanium expanders. This produces gentle expanding forces in the range 300-350 gm. (Figure 9) **(Singh, 2007).**

Figure 9. Niti expander (Premkumar, 2015)

1.5.2.2 Rapid maxillary expansion (RME)

It involves applied rapid force to the posterior teeth, which are not given enough time for the posterior teeth to move this occur by split opening of the maxillary suture and the movement of the palatal shelves away from each other **(Premkumar, 2015).**

RME devices can be made of acrylic, silver and soldered to bands on first permanent molars and usually pre-molars they cannot be remove by the patient **(Grist, 2020).**

1.5.2.2.i Indications of RME **(Bishara and Staley, 1987):**

1. Dental or both dental and bone combination discrepancy of maxillary arch.
2. Class II division 1 malocclusions or class III with posterior crossbite.
3. Patients with cleft lip and palate with collapsed maxilla.
4. Improve the poor nasal airway, septal deformity, recurrent ear, nasal or sinus infection, allergic rhinitis, asthma and before septoplasty

1.5.2.2.ii Contraindications of RME

1- When more than half of roots of primary teeth are resorbed, because it cannot provide retention **(Phulari, 2011).**

2- Severe anteroposterior and vertical skeletal discrepancies **(Bishara and Staley, 1987).**

1.5.2.2.iii The side effects of the RME

- Effect of RME on maxilla

  It causes the posterior teeth to be buccally tilted and cause tipping or extrusive orthodontic movement of the posterior teeth **(Singh, 2007)**. Also cause the appearance of midline diastema between the anterior teeth within days of initiating RME therapy. This diastema is reported to close simultaneously within 6 months due trans-septal fiber traction **(Herold, 1989).**

- Effect of RME on Mandible

Due to extrusion of maxillary posterior teeth when activated the RME this lead to downward and backward rotation of the lower arch **(Phulari, 2011).**

- Effect of RME on Nasal Cavity

When activated the appliance lead to increased intranasal space due to separation of outer walls of the nasal cavity **(Phulari, 2011).**

1.5.2.2.iV Types of RME appliances:

There are two types of RME: Removable RME and fixed RME appliances; Removable appliances are used in the deciduous or early mixed dentition, Their reliability in producing skeletal expansion is highly questionable when used in older adults. The rate of expansion is about 0.2-0.5 mm per day **(Phulari, 2011).** They include a split acrylic plate with a jackscrew **(Premkumar, 2015).** While Fixed RME which cannot remove by the patient and divided to:

1-Tooth and tissue borne RME appliances:

- Derichsweiler expander: rarely use nowadays, consists of molar bands placed on permanent first molars and premolars on both sides with wire embedded on palatal aspect of teeth except anterior region (Figure 10) **(Phulari, 2011).**

Figure 10. Derichsweiler expander (Premkumar, 2015)

- Hass expander: has a rigid wire (1.2mm) framework which is soldered to the first premolar and molar bands both buccally and palatally. This rigidity makes the force transmits directly to the palatal shelves (Figure 11) **(Singh, 2007).**

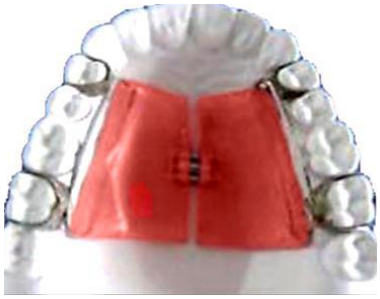

Figure 11. Haas expander (Premkumar, 2015)

2-Tooth born (most common than tooth tissue borne):

- Isaacson expander: more flexible than other type and has a spring-loaded screw directly adapted to the bands also the acrylic plates is not used (Figure 12) **(Isaacson and Murphy, 1964).**

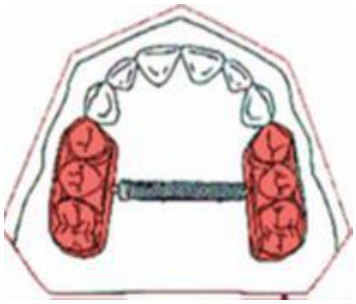

Figure 12. Isaacson expander (Premkumar, 2015)

- Hyrax expander: This type uses the Hyrax (hygienic rapid expansion) screw. It has heavy wires that are adapted welded to the palatal aspects of the bands **(McNamara and Brudon, 1995).** Each activation of the screw produces approximately 0.2 mm of lateral expansion and it is activated from front to back **(Agarwal and Mathur, 2010)** (Figure 13).

Figure 13. Hyrax expander (Premkumar, 2015)

1.5.2.3 Arch expansion using fixed orthodontics appliances:

Mild degree of arch expansion can be brought about by using expanded arch wires with fixed mechanotherapy. Appliances such as quad helix or transpalatal arch can be used with fixed mechanotherapy (Figs 14) **(Phulari, 2011)**.

Figure 14 Mild degree of arch expansion using expanded arch wires and appliances, such as transpalatal arch with fixed mechanotherapy (Phulari, 2011).

1.5.3 Mini-implant assisted rapid palatal expansion (MARPE):

MARPE is a simple modification of a conventional RPE appliance. The main difference is the incorporation of micro-implants into the palatal jackscrew to ensure expansion of the underlying basal bone, minimizing dentoalveolar tipping and tooth movement **(MacGinnis *et al*, 2014).**

Bone screws in the palate provide better anchorage and significantly less tooth movement. The location of the skeletal anchors for palatal expansion is important **(Hourfar *et al*, 2016).**

For older (more mature) adolescents, heavier force is needed to fracture the suture with heavier force, tooth- supported expanders will just move teeth rather than open the suture due to increasing in the bone maturity. The goal of treatment with skeletally anchored expanders is not so much to provide heavy force as to apply the force directly against the bone so that there is little or no pressure against the teeth. The implant anchorage needs to remain in place for 2 to 3 months after the expansion is completed because, the teeth do move apart as the suture expands, and that the possibility of tooth movement allowing skeletal relapse. This provides a way to expand the maxilla in a patient with

anodontia or severe hypodontia, and would maximize skeletal change and minimize tooth movement (Figure 15) **(Proffit *et al*, 2019).**

Figure 15 bone-anchored expanders, with the MARPE technique. (Proffit *et al*, 2019)

1.5.3.1 The effects of (MARPE) on the nasomaxillary complex **(MacGinnis *et al*, 2014):** The stresses distributed from forces applied to the maxillary teeth are distributed mainly along the three maxillary buttresses, while in the conventional hyrax displayed a rotation of the maxilla around the teeth as opposed to the midpalatal suture of the MARPE**.**

The MARPE causes the maxilla to bend laterally, while preventing unwanted rotation of the complex, this may be beneficial for hyperdivergent patients, or those that have already experienced closure of the midpalatal suture, who require palatal expansion and would worsen from buccal tipping of the teeth or maxillary complex.

1.5.3.2 The advantages of MARPE **(Fang Yi *et al*, 2022):**

MARPE is used in teenagers and adults, which reduce the risk of SARPE and the side effects of traditional RME, such as eliminating unwanted dental tipping. MARPE appliance is beneficial for adults with more resistance to skeletal expansion.

1.5.3.3 The disadvantages of MARPE **(MacGinnis *et al*, 2014):**

1-Difficulty in keeping the area clean.

2- The invasiveness of the micro-implants.

3-Increased risk of infection.

1.5.4 Surgically Assisted Rapid Palatal Expander (SARPE):

It is an alternative method which reduces resistance of the closed midpalatal suture to correct maxillary constriction in an adult. It helps to achieve effective maxillary expansion in a skeletally mature patient **(Padmavati *et al*, 2020).** SARPE has proved to be clinically effective and stable for the correction of transversely deficient maxilla after cessation of growth in adult patients **(Jha and Adhikari, 2022).**

1.5.4.1 The procedure of (SARPE) **(Rachmiel et al, 2020)**

Performed under deep sedation with the administration of local anesthesia, then horizontal incisions were made in the maxillary vestibule above the attached mucosa, using fine periosteal elevators, the gingival mucoperiosteal flaps were reflected carefully over the relevant teeth to perform a vertical osteotomy between the second incisive and canine teeth.

Using a reciprocating saw, a horizontal maxillary osteotomy on the lateral wall of the maxilla was performed at least 5 mm above the apex of the teeth from the pterygoid plate posteriorly toward and above the apex of the canine anteriorly, a vertical osteotomy starting from the alveolar crest was performed between the lateral incisive and canine teeth toward the horizontal osteotomy on both the sides. To complete the vertical osteotomy, a fine osteotome was introduced and a manual pressure was applied until the slight movement of the lateral maxillary segments on both the sides was created.

1.5.4.2 Indications for SARPE **(Woods *et al*, 1997; Koudstaal *et al*, 2005).**

1- To increase perimeter of arch, to treated posterior crossbite.

2- To avoid the instability and inaccuracy of orthognathic surgery so use SARPE to widen the arch.

3- To overcome the resistance of the sutures when orthopedic maxillary expansion (OME) has failed

1.5.5 Molar Distalization

Distalizing of molars gained popularity, as it was sometimes difficult to convince the patient for extraction of otherwise healthy teeth. Favor to use this technique before eruption of second permanent molars **(Singh, 2007).**

1.5.5.1 Advantages of Molar Distalization **(Phulari, 2011).**

- Helps in avoiding the extraction of teeth.
- It prevents arch collapse.

1.5.5.2 The disadvantages of Molar Distalization

- Potential for anchorage loss, lead to unwanted changes in the overall position of the teeth, which compromise the outcome of the treatment **(Kinzinger *et al*, 2007)**
- The length of treatment time, which can be longer than other orthodontic treatments **(Keles *et al* 2006)**

1.5.5.3 Intraoral Distalization Appliances; includes the following:

1-Schwartz appliance**:** It is rarely used nowadays, was also referred to as the 'Y' plate because of the shape of the cuts on the base separating the plate into its component parts It has two expansion screws along each side of the midline and The appliance is activated once a week and produces an expansion of 0.25 mm (figure 16) **(Singh, 2007).**

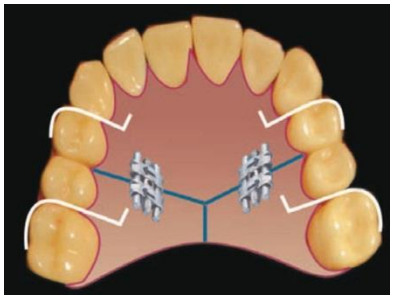

Figure 16 the 'Y' plate (Singh, 2007)

2-Sagittal appliance: This is a removable appliance with a screw incorporated for the distalization of the first permanent molars; the activation of the screw causes a 0.1 mm movement of the molars in a distal direction (Figure 17) (**Singh, 2007).**

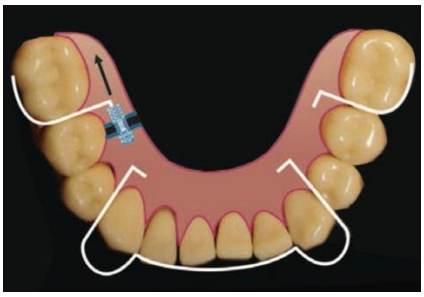

Figure 17 the sagittal appliance (Singh, 2007).

3-Wilson's distalizing arch: Wilson introduced the bimetric arch into the orthodontic. The appliance consists of a labial arch made of a 0.040-inch posterior section and a 0.020-inch anterior section. Is activated by placement of an open coil spring between the omega loop and the maxillary first molar (Figure 18) **(Wilson, 1955).**

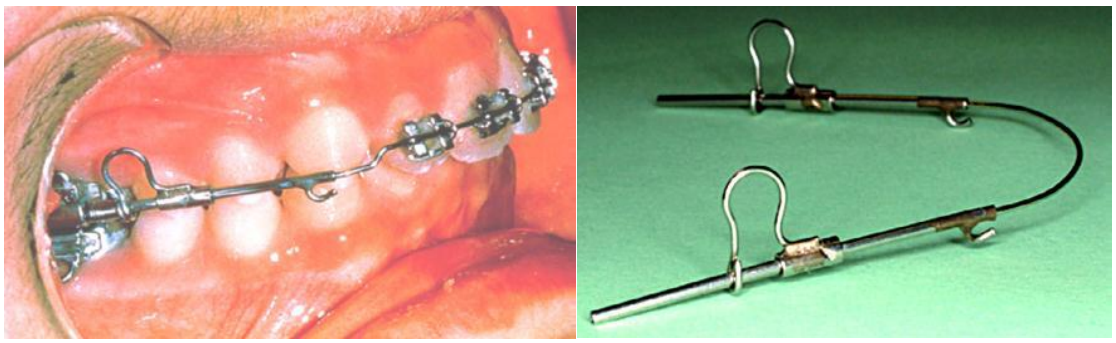

Figure 18. Wilson`s molar distalizing appliance (Nanda, 2015)

4-Pendulum appliance: This was described by Hilgers in 1992. The TMA distalizing finger springs are inserted into palatal sheaths on the molar bands. As with the majority of these appliances, the anchorage loss was resisted by a Nance button bonded to the first premolars. The advanta of the applince less complicated wearing. 3.4mm distalization can achieve in 6 months (Figure 19) **(Birnie and Harradine, 2012).**

Figure 19. Pendulum appliance (Premkumar, 2015)

5-Veltri bilateral sagittal and Monolateral sagittal screw**:** The bilateral sagittal screw is used to achieve bilateral distalization of the maxillary first permanent molars, the monolateral screw design is different, but the appliance is constructed in the same manner (Figure 20) **(Singh, 2007)**.

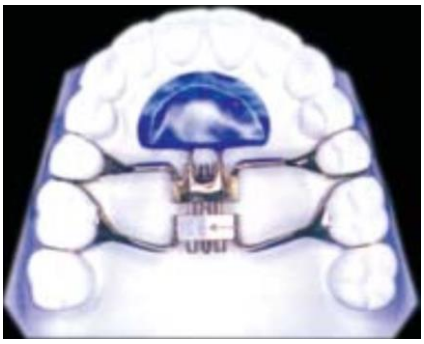

Figure 20 the Veltri-sagittal screw appliance (Singh, 2007)

6-Magnets: Magnets have been used along with the fixed orthodontic appliances for the purpose of space closure as well as regaining lost space (Figure 21) **(Singh, 2007).**

Figure 21. Occlusal view of two repelling magnets (Premkumar, 2015)

7-Jones jig and distal jet appliances: There are several named versions of compressed coil spring devices including the distal jet (placed on the palatal) and Jones jig (buccally placed). They vary slightly in their force level but have

same effect .Jones jigs use an average of 75 gm. and distal jets 240 gm. (Figure 22) **(David and Harradine, 2012).**

Figure 22. Jones jig and distal jet appliance (Premkumar, 2015)

8-Fast back appliance: The fast back appliance is a type of open coil spring appliances, the appliance also has a self-locking terminal stop, which makes the appliance fully programmable and considerably increases its safety during use **(Singh,2007).**

9- Lip bumpers**:** is similar to labial shield of Frankel appliance in action this use to inhibiting the excessive force of the lips on anterior teeth (Figure 23) **(Yanez, 2008).**

Figure 23. Lip bumper (Premkumar, 2015)

1.5.5.4 Extraoral Distalization Appliances (Headgears)

Kingsley (1880) first introduced the extraoral method of applying traction to the maxillary arch to retract maxillary incisors (Figure 24). Later, Angle (1907) described and illustrated the headgear he used in the treatment of patients with Class II, Division 1 malocclusion **(Nanda, 2015).**

The use of headgear become less over many years because slight shift in average treatment goals and others to availability of better technology for Class II correction **(Birnie and Harradine, 2012)** and patient's presenting complaint

cause come tipping down or up and impinging with lower or upper lip **(Mitchell, 2013).**

The nighttime wear of headgear has been shown to be as effective as full-time and to avoid potential social stigma **(pancherz et al, 1996)**. Headgear is used it only in bed at night **(Birnie and Harradine, 2012).** Wear 1 hour before going to sleep. 1 mm month of Tooth movement take about 3 to 6 months this is a reasonable treatment period of time **(Wichelhaus, 2018).**

Figure 24. Headgear (Mitchell, 2013)

1.5.5.4.i Indications of headgear **(Wichelhaus and Eichenberg , 2018):**

1- Dental Class II.
2- Horizontal / neutral growth pattern.
3- Distalization ≤4 mm, symmetric headgear.
4- Distalization ≥4 mm, asymmetric headgear, this is for single side.

1.5.5.4.ii Contraindications of headgear **(Wichelhaus and Eichenberg , 2018):**

1- Skeletal Class II caused by the mandible.
2-Vertical growth pattern

1.5.5.4.iii Component of headgear

1-Face-bow. The face-bow slots into the headgear tubes. Currently the face-bow of choice is a NiTom locking face-bow produced with a specialized safety catch.

2-Headcap or neck strap. the Headcap produces intrusive forces and will affect the vertical element by intrusion of the molars uses the headcap and neck strap together, In this situation it is anticipated that the movements of the molars will be more translational with no intrusive or extrusive effects. Greater forces are applied with the headcap (250–300 g) than the neck strap.

3- Module or force element**:** used to apply stretch force (figure 25) **(Premkumar, 2015).**

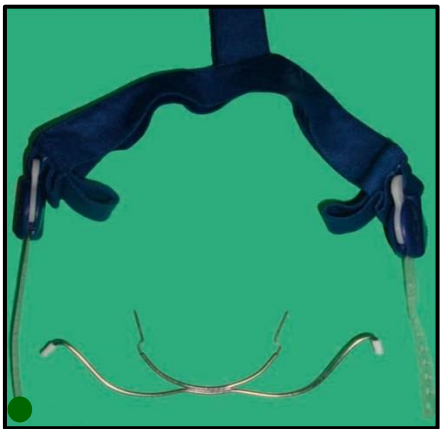

Figure 25. Components of headgear: headgear strap, force module and face-bow (Premkumar, 2015)

1.5.5.4.iV The direction of force of headgear:

1-High or occipital-pull headgear: which helps to control the vertical as well as anteroposterior anchorage and is typically used in cases with increased vertical proportions (Figure 26A) **(DeBerardinis et al, 2000)**

2-Straight or combi-pull headgear which controls the anteroposterior and is typically used in cases with average vertical proportions (Figure 26B) (**Nanda, 2015)**

3-Cervical pull headgear: used most frequently in patients with normal or decreased vertical facial dimensions. The inner bow of the facebow is anchored

to tubes that are placed on the buccal surface of bands that are attached to the upper first molars. The outer bow is connected to a safety release elastic strap that extends to the cervical region and is anchored against the dorsal aspect of the neck (Figure 26C) **(Graber et al, 2017).**

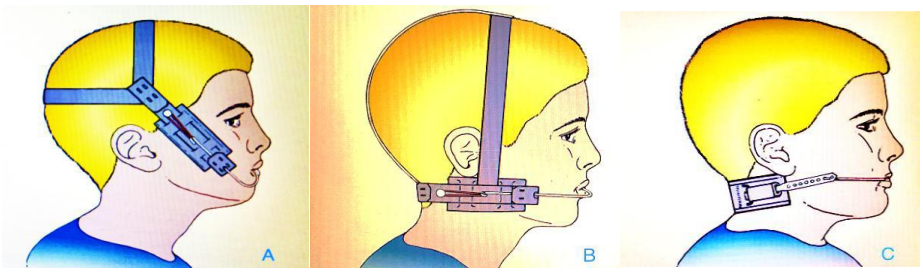

Figure 26. Direction of force in headgear: A high pull, B straight and C cervical pull. (Graber *et al*, 2017)

1.5.5.4.V Clinical Application of Headgear

Using symmetric headgear provides about 4mm distalization and can be achieved with unerupted second molar. The headgear therapy has two phases: first one without angulation with crown distalization and the second phase is root distalization **(Wichelhaus and Eichenberg, 2018).**

The Canine hooks an be added to increase the distalization effect of the extraoral force on the maxillary molar, Hooks soldered on the facebow at the level of the canines (called canine hooks) **(Nanda and Tosun, 2010).**

1.5.6 Uprighting of tilted teeth

When the deciduous second molars are lost early, this lead to delayed eruption of the first or the second molars or may cause mesially tilted of posterior teeth that is always occupy more space lead to crowding (figure 27). So gaining space and relive the crowding, this done by up righting of molars that gained 1-1.5mm space **(Premkumar, 2015).** This is done by:

1-use of cantilevers, known to provide best controlled movement straightwire associated with spring coil **(Shellhart and Oesterle, 1999),** and then the use of miniscrews associated with straightwire **(Viecilli et al, 2009).**

2-Space regainers or the various screw appliances are also used frequently, the lip bumper and its modifications can also achieve good results **(Premkumar, 2015).**

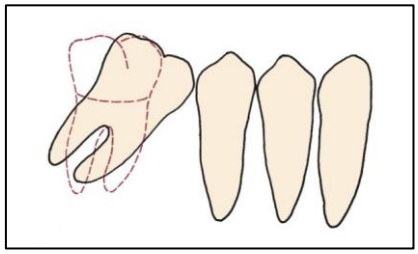

Figure 27 Uprighting a tipped molar by distal crown movement (Proffit *et al* 2019)

1.5.7 Derotation of Posterior Teeth

A rotated posterior tooth occupies larger space and thus may cause crowding in the arch. Correction of rotated posterior teeth not only helps in relieving crowding but also aids in the prevention of dental caries and periodontal diseases. Correction by fixed mechanotherapy using a force couple (Figure 28) **(Phulari, 2011).**

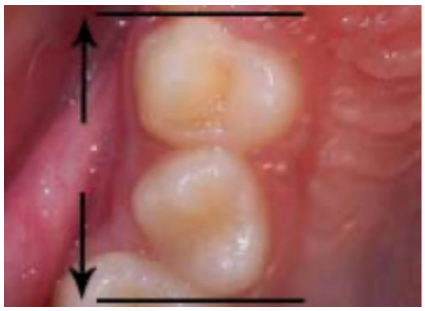

Figure 28 Rotated posterior teeth occupy more space (Singh, 2007).

1.5.8 Proclination of anterior teeth

Proclination of anterior teeth can be undertaken in cases where these teeth are retroclined or their proclination will not affect the soft tissue profile of the patient adversely or the stability of the results achieved. Any of the proclining springs ('Z' spring mattress spring, etc.) or screws (medium-, mini-, or micro-

screws) or fixed appliances can be used for the purpose (Figure 29) **(Singh, 2007).**

Figure 29 Space gained by proclining the anterior teeth (Singh, 2007).

Chapter two

Discussion and Comments

Today, with the use of digital technology and a more customized treatment plan procedure; the orthodontist has at his disposal several methods for space creation and correcting the malocclusion depending on individual case requirements. Orthodontists are free to consider any solution to this problem as long as its helps reach their objective and give the patient the “smile” they want, in order to finish the case with the best possible results in terms of function and aesthetics, hence fulfilling the modern day criteria of face-centered treatment the Nonextraction methods is preferred over extraction methods for space creation in the treatment of mild to moderate cases of crowding.

There are several methods for gaining space in the non extraction approach and the studies are varied and not always constant about which method of the nonextraction approach is better and to determine the best methods it is depending on the specific case and its needs.

Interproximal stripping is the best method for space creation in mild to moderate crowding by removing 0.5 mm from the enamel surface of the tooth without compromising the health of the teeth and with less effort you need to do with another method that needs appliance to create space like expansion in interProximal stripping we use instrument that available in all clinic like Dimond bur and dental stripe. In addition, the interproximal stripping used to recounting misshaped tooth that have a magic effect in smile design **(Harini *et al*, 2020).**

Expansion of the maxilla and the maxillary dentition may be accomplished in numerous ways, the type of skeletal and dental pattern greatly influences the type of expansion chosen and the type of expansion selected can greatly facilitate the overall treatment objectives **(Joy, 2021).**

Chapter three
Conclusions and Suggestions

3.1 Conclusions:

Different methods for space creation like arch expansions appliance, distalization and uprighting was found to be very beneficial in the treatment of crowding and we found the interproximal reduction might be less traumatic than other methods.

The expansion and distalization and uprating are conventional ways but with limited problem resolving so the dentist should be aware to determine the best way to gain space depend on the condition of the patient.

3.2 Suggestions:

For further research, doubts remain about which methods of space creation are better, more beneficial, and more stable; Thus more studies might be needed to verify the applicability of the various nonextraction methods of space creation as well as the stability of the achieved result.

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