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The factors affecting the outcome of treatment with orthodontic removable appliance

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المجادلة 1

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BEST OF WISHES AND SUCCESS

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Introduction

Removable appliances are not permanently attached to the teeth and can be taken out of the mouth by the patient. During the first half of the twentieth century, orthodontic practice in Europe was based largely on the use of removable appliances. In modern orthodontic practice there has been a significant decline in their use, primarily as a result of more efficient fixed appliances being available and an increase in numbers of orthodontic specialists able to use them. However, simple removable appliances retain a place in modern orthodontic practice, usually as an adjunct to fixed appliance therapy or foruse in the retention phase of treatment. In particular, a group of predominantly removable functional appliances, used primarily in the management of class || malocclusion, have enjoyed a considerable resurgence in popularity in recent years. In addition, new treatment systems using vacuum-formed removable appliances, not only for retention, but also for active tooth movement have been developed. [(1)]

The aim of the study

To determine the factors that affect on the duration and outcome of removable orthodontic treatment

REVIEW OF LITERATURE

Orthodontic appliances can be defined as devices, which create and/or transmit forces to individual teeth/a group of teeth and/or maxilla-facial skeletal units so as to bring about changes within the bone with or/without tooth movement which will help to achieve the treatment goals or functional efficiency, structural balance and aesthetic harmony [(2)].

The are many types of orthodontic appliance:

Removable

Fixed

Removable-fixed (semi fixed)

1.1 Removable appliance: [(3)]

The term removable appliance is used to indicate an appliance which can be removed for cleaning by the patient or for adjustment by the Orthodontist.

These appliances can be taken out of the mouth by patient when required.

Removable appliances are three types:

1. Passive appliances These appliances remain passive in the mouth andexert no active pressure. Example as

- Space maintainer
- Retention appliances
- Tongue guard

2. Functional appliances: These appliances work by transmitting or modifying muscle forces to the teeth and their supporting tissues. Example as:

- Andersen appliances
- Frankles functional regulators

3-Mechanical appliances: These appliances carry some active components which are activated to exert active forces.

1.2 IDEAL REQUIREMENTS FOR AN ORTHODONTIC APPLIANCE:[3]

- It should be easy to remove and insert.
- It should be easy to clean.
- It should be easily repairable.
- It shouldn't be heavy or bulky.
- It shouldn't cause any damage to the teeth or other tissue.
- It should be comfortable to use and be aesthetically acceptable.
- It should exert desired force in desired amount and direction.
- Design of the appliance should be simple
- Tt shouldn't interfere with normal function and growth.
- It should have adequate retention.

1.3.1 ADVANTAGES:[3]

- The patient can continue with routine oral hygiene procedures without any hindrance.
- The oral cavity as well as the appliance can be kept clean.
- All restorative procedures can also be done during such an orthodontic appliance therapy.
- Most sorts of tipping movement can be carried out successfully.
- These appliances are less conspicuous than fixed appliances and hence, generally more acceptable to the patients.
- Since these are relatively simple appliances they can be delivered and monitored by the general dentist
- Appliance fabrication is done in specialized labs and hence the chair side time for appliance delivery is considerably less as compared to the fixed appliances.
- Since only a few movements are carried out simultaneously with these appliances the time required by the clinician to activate an appliance is less. This allows the clinicians to see more patients in a lesser time.
- These appliances require a limited inventory to be maintained as compared to more complex fixed appliances.
- These appliances are relatively cheap as compared to the fixed appliances.

1.3.2 DISADVANTAGE:[3]

- Patient cooperation is that the keyword in removable appliance therapy. The duration for which the appliance is worn is the duration for which the appliance is able to act. Hence, the treatment can become prolonged depending on patient compliance.
- These appliances are capable of only certain types of movements; they do not give three-dimensional control over the teeth to be moved. This limits their utility.
- Multiple movements are difficult, if not impossible to carry out. Since all corrections cannot be carried out simultaneously the treatment time may be increased considerably.
- The patient has to have a certain amount of skill to be able to remove and replace the appliance for successful treatment to be possible.
- The chance of appliance loss and/or breakage is more.

1.4 COMPONENTS:

The removable orthodontic appliances are made up of three components:[4]

1. Force or active components - comprises of springs, screws or elastics.

2. Fixation or retentive components - usually include clasps.

3. Base plate or framework - can be made of cold cure or heat cure acrylic.

1.4.1 ACTIVE COMPONENTS:

These constitute the components of the removable appliance, which apply forces to the teeth to bring about the desired tooth movement.

The active components include:

a. Springs

b. Bows

C. Screws.

d. Elastics

1.4.2RETENTIVE COMPONENT:

This part of removable orthodontic appliance holds the appliance in position and is referred to as clasp. It can also known to as the anchor unit of the removable orthodontic appliance.

1.4.3 BASEPLATE:

The material most frequently used for base plate is cold cure or heat cure acrylic. It forms a major part of the removable appliance.

Base plate acts as support for pressure sources and distributes the reaction of these forces to the anchorage areas

1.4.4Anchorage component: [5]

Anchorage is defined as the source of resistance to the reaction from the active component(s) in an appliance. Anchorage reinforcement can be achieved with removable appliances, using extra oral traction, arch wires or bands, and possibly inclined bite planes

1.5 Most common types of tooth movement that can be achieved by removable appliance:

1.5.1 Tipping Movement:

is the movement of the crown of the tooth more than the root. A fulcrum is established (usually within the root of the tooth) such that the crown moves in the direction of the applied force (about 35-60gm) and the apex in the opposite direction. The center of rotation of motion is apical to the center of resistance. It can be further classified on the basis of the location of the center of rotation into uncontrolled and controlled tipping

The main two types of tooth movements are:-

1.5.1.1Uncontrolled Tipping:-

Uncontrolled Tipping is the simplest tooth movement to carry out and is

achieved by application of a force at one point on the crown of a tooth and the force is act upon a fulcrum which lies near the junction, between the apical one third and the coronal two- thirds of the root (the center of rotation close to the center of resistance) such that the crown moves in the direction

of the applied force and the apex in the opposite direction. With the tipping movements, areas

of maximal pressure and tension are set up at their apical and cervical regions of the root.

Movement is indicated when we want to change the inclination of the tooth and this tooth may be tipped mesially, distally, buccally or lingualy. This type of tooth movement can be performed by removable appliances.

Force being applied by means of relatively simple springs acting directly upon the crown of the teeth being moved (like Z-spring, Recurved Z spring), also fixed appliance can perform it by application force upon a point contact to the crown of the tooth.

1.5.1.2 Controlled tipping:

In this case, the center of rotation lies close to the apex. Here the crown moves in one direction but the root position remains the same or gets minimally displaced.

This is referred to as controlled tipping. This type of movement can't be achieved by removable appliance because it requires moment of couple.

The difference between tipping and torque movement in orthodontics:

The tip being the angle formed between the long axis of the clinical crown (LACC) and a line perpendicular to the occlusal plane whereas for the torque, it was the angle between a line that is parallel and tangent to the LACC at it is midpoint (LA) and the line perpendicular to the occlusal plane

Difference between tipping and bodily movement in orthodontics:

Although there was no significant difference between the bodily and tipping groups with regard to hi the volume of alveolar bone resorption around the mesial root, the bone resorption of the cervicalarea of the tooth was greater in the tipping group than in the bodily group.

Compared to bodily tooth movement, tipping tooth movement may destructively influence the periodontal tissue of the cervical area, and therefore bodily tooth movement may be more advantageous in terms of maintaining the height of the alveolar bone.

1.5.2 Rotation movement :

A rotation is a modification of a singular tooth in which the tooth rotates around its long axis of 90° that intersects with the tooth in its totality (crown and root). Rotation is a movement that frequently tends to relapse due to the periodontal structures and insufficient use of contention devices.

Finite element analysis is a non-invasive technique for testing a particular design, especially the teeth movement induced by orthodontic forces.

The center of rotation is an arbitrary point located at a distance from the center of resistance – the center of mass of the tooth – around which the tooth rotates with the application of a force applied to the crown. The position of the center of rotation never coincides with the position of the center of resistance.

Now, rotations are a common cosmetic complaint made by patients who visit orthodontic practices the world over. If the rotation is present in the upper anterior teeth, it is very visible and a cause of concern for the patient. That may be the patient's chief complaint.

Fortunately, this problem is correctable using a plethora of options from orthodontics and cosmetic dentistry.

There are broadly two types of rotations that we are discussing in this article:

- Mesiolingual or distobuccal
- Distolingual or mesiobuccal

1.5.3Arch expansion :

Arch Expansion is a method of gaining space in Orthodontics.

- It is one of the oldest and most conservative methods of gaining space.
- It can be used to correct intermaxillary and dental arch relationships primarily in the transverse direction.
- It also enables correction of crossbites early in treatment.

Orthodontic or dental expansion-dentoalveolar in nature and produced by various removable expansion plates and conventional fixed appliances.

There is lateral tipping of crown and lingual tipping of roots.

By using of jackscrew which is a typical expansion screw consists of an oblong body divided into two halves. Each half has a threaded inner side that receives one end of a double ended screw.

The screw has a central bossing with four holes. These holes receive a key which is used to turn the screw. The turning of the screw by 90 degree (i.e. one turn) brings about a linear movement of 0.18mm. The pattern of threading on either side is of opposite direction. Thus turning the screw withdraws it from both sides simultaneously.

1.6 Most common types of malocclusion and malalignment that can be treated with removable appliances :

1.6.1 Crossbite :

Removable orthodontic appliances represent another safe, easy and esthetically acceptable alternative for the treatment of anterior crossbite that has three major advantages: The appliances are fabricated in the laboratory rather than directly in the patient's mouth, thereby reducing chair time; They can beremoved on socially sensitive occasions (when visible wires on the facial part of the teeth would be undesirable); and They are easily cleaned, providing good oral hygiene.

The amount of desired movement of the teeth can be controlled by the screw and also the base plate remains rigid despite being cut into two parts of acrylic appliances, thereby, it's management is easy and less tendency to dislodge. For these reasons, the case reported here were treated using removable acrylic appliances. The first appliance was fitted with a screw to achieve labial movement of multiple teeth, whereas the second appliance used a labiolingual spring to tip a single maxillary lateral incisor. The patient did not report any discomfort during the course of treatment. Treatment resulted in successful correction of the malocclusion and an esthetic smile.

Based on the results presented here, a removable appliance with a screw may be considered the first choice of treatment to correct anterior dental crossbite of more than one incisor, whereas a removable appliance with a labiolingual spring may be considered the first choice of treatment for correction of crossbite of one incisor tooth.

To align the maxillary anterior teeth and correct the crossbite, a removable acrylic appliance with a posterior bite-opening platform was used . A screw incorporated in the appliance platform was activated 0.25 mm every 4 days for 16 weeks. After 2 months, the maxillary and mandibular incisors displayed an edge-to-edge bite relationship, and the crossbite was corrected in an additional 2 months . The posterior bite-opening platform was then removed, and screw activation continued every 7 days for another 2 months in order to establish a normal overjet. During the course of treatment (at 6 months), the permanent maxillary lateral incisors erupted, with the left lateral tooth in crossbite .

Accordingly, a new acrylic plate with a labiolingual spring was prepared, and the spring was activated every month for 2 months until this crossbite was resolved. At the end of 8 months of active treatment, the crossbite of all maxillary incisors was successfully corrected, and no problems were observed during 6 months of follow-up clinically and radiographically

1.6.2Protrusion :

There are several different types of malocclusion, including protrusion. When the lower front teeth protrude, this is known as negative overjet. Negative overjet is characterized by the lower front teeth protruding farther out than the upper front teeth.Protrusion of the upper front teeth, also called excessive overjet, is characterized by an excessive overlap of the top teeth over the bottom teeth. Both types of protrusion can be caused by the misalignment of the jaw or of the teeth, which can arise due to trauma to the mouth, tooth fracture, or a skeletal condition.Protrusion, whether of the upper or lower teeth, can lead to abnormal, uneven wear on the teeth and dysfunction in the jaw joints.

1.6.3Retrusion:

Dental retrusion refers to the condition where the upper or lower teeth are set further back in the mouth than normal. It can affect bite alignment and overall dental health. Treatment may involve orthodontic procedures or other dental interventions, depending on the severity and underlying causes. Dental retrusion, also known as posterior dental displacement or retrognathism, can result from various factors, including genetic predisposition, habits like thumb sucking or tongue thrusting, skeletal discrepancies, or dental crowding.

This condition can lead to problems such as difficulty chewing, speech impediments, temporomandibular joint (TMJ) disorders, and aesthetic concerns.

1.6.4 Mild rotation of teeth (less than 90) :

Rotation Tooth rotation can be defined as observable mesio-lingual or disto-lingual intra alveolar

displacement of the tooth around its longitudinal axis (at least 20°).

1. Centric rotation only rotation around the long axis. e.g. (the angulation of the long-axis of the tooth remains unaltered)
2. Eccentric rotation rotation with tipping of the tooth also.
3. Tooth protrudes from the row of teeth If the body rotates about its center of resistance, it is called pure rotation.

In his study, rotations were the most common (10.24% anomaly among the whole study group), that the majority of tooth rotations were between 45° and 90°, followed by <45° rotations. In the untreated population, the prevalence of tooth rotation is 2.1-5.1%. Rotations are more common in patients with hypodontia

The most common rotated teeth were the mandibular second premolars followed by mandibular first premolars and maxillary central incisors with the same prevalence

Etiology of Rotations

- Severe crowding
- Supernumerary teeth or odontomas
- Typical class 2 division 2 malocclusion, where the upper centrals are lingually inclined leaving insufficient room in the dental arch.
- Over retained deciduous teeth
- Ectopic canines
- Hereditary factors
- Spacing

Different types of forces acting on teeth like masticatory forces, forces from tongue, digit sucking habit, lip biting, etc.

Unilateral cleft where usually teeth lateral to the cleft are rotated.

Unerupted teeth at the base of the root of the completely erupted teeth

1.6.5 Mild buccal canine malposition :

This misalignment can occur due to various reasons such as overcrowding of teeth, abnormal growth patterns, or genetics. Buccal malpositioning of canines can lead to issues with bite alignment, difficulty in chewing, and aesthetic concerns.

Treatment typically involves orthodontic intervention to correct the positioning of the affected teeth. This may include the use of braces or removable appliances such as buccal canine retractor or finger spring

(simple or modified)

1.7 Factors that effect to success of removable appliance The factor depended to Julie Williams

1.7.1 PATIENT FACTOR: [6]

For all the patients, taken relevant data namely: age at which treatment was started, gender‹ Angle's classification of malocclusion, types of orthodontic appliance used and types of treatment, need to extractions or no. In orthodontics In order to achieve successful treatment outcomes, clinicians have to obtain patients' compliance .

1.7.1.1Complianceor adherence

is defined as "the extent to which a person's behavior coincides with medical or health advice".patients' experience pain or discomfort, negatively affecting patients' compliance .however, in the long term, the treatment would lead to an improvement in aesthetics and quality of life. t is important to tailor treatment to the level of compliance a patient is perceived to be capable of achieving fit appliances that require high-level compliance, such as extra oral traction, are going to be used, these should be fitted initially to assess the patient response prior to the extraction of teeth. tI should also be borne in mind that compliance will decline over treatment and is affected by negative experiences in treatment such as pain and discomfort.

1.7.1.2cooperation

is required throughout every phase of the therapy patients' adherence to treatment is composed of multiple variables strictly correlated with their motivation: respecting appointments, maintaining a good oral hygiene, and wearing orthodontic appliances for as long as required .A lack of compliance may affect treatment results with removable appliances. The patient's psychological profile has major role, as it determines the extent to which results can be achieved (Grembowski, 1988).

This is because certain personality traits or the patients' psychological condition might affect how they adapt to the treatment (Cooper, 2013). There is ample evidence that the patient's cooperation, compliance and motivation has a significant role in the final result of orthodontic treatments: the lack of one of these aspects might endanger the treatment, extend its duration and lead the clinician and the patient to frustration.

1.7.1.3Medical health

Certain medical conditions will preclude complex appliance therapy.

1.7.1.4 Dental health

Excellent oral hygiene and an absence of active dental disease are prerequisites prior to orthodontic treatment. Fixed appliances, in particular, can exacerbate dental problems. This does not mean precluding patients with history of periodontal disease from treatment. However, the disease must be controlled and in period of remission before treatment can be considered (Boyd et al,1989).

1.7.1.5gender

Males were found to have significantly higher pre-treatment PAR than females. This could be due to males seeking orthodontic treatment only when the malocclusion is more severe. it could also be due to Asian males' psychological perceptions where they are generally less concerned about aesthetics as compared to females. Howe ver, multiple studies have found no difference in severity of malocclusion, or treatment outcomes between genders. os " that females had better treatment outcomes

1.7.1.6 CLINICAL CONDITIONS [7]

The treatment must be selected according to the severity of the malocclusion: the more serious the clinical condition, the longer and more complex the treatment will be(sergl, 1998). The following clinical parameters, among others, must be considered: facial pattern, sagittal canine relationship (Melo,2013) molar relationship, anterior crowding, overbite, the Bolton index Guo, 2014) incisor angulations(Flores-Mir, 2014). The best treatment must be selected according the degree of alteration(Espinar, 2013) in this way, both the duration and complexity of the orthodontic treatment will largely vary depending on the severity of the occlusal alterations. For instance, the treatment will be longer fi an extraction protocol so necessary .

Likewise, extra-oral forces can be used in more complex situations such as significantly increased over-jet, or when it so necessary to retract al the teeth in the arch, to limit medial tooth displacement caused by premature extraction of temporary teeth, to redirect the growth pattern or to correct itermaxillary relationships Sergl, 1998). In cases that are even more complex, such as facial, orthognathic surgical procedures are necessary, satis impossible to solve the problem with conventional orthodontics or by modifying the growth pattern.

1.7.1.7 DENTIST-PATIENT RELATIONSHIP [8]

A favorable relationship, based no respect for the patient's autonomy, allows for joint decision-making,where the clinician helps the patient decide, and's also will got accept help from the patient and to consider their opinion regarding possible diagnostic or therapeutic options (Costa, 2008) tI so also clinically important for orthodontists to understand how patients perceive their ned for orthodontic treatment to select the best therapeutic approach, considering treatment preference and setting personalized objectives.

1.7.2 APPLIANCE FACTORS [9]

When assessing appliance factors and how they might affect treatment efficiency and occlusal outcome (Tang, 1999), it is important to consider how the various components will behave in the clinical environment.

Whilst laboratory tests aer useful for characterizing materials (Eliades, 2005).

Number of treatment phases The duration of treatment has been shown to increase with na increase in the number of treatment phases, for example wt o- phased treatment (Beckwith, 1999), such as functional therapy followed by fixed appliances to correct Class I malocclusions, increases the

total duration of treatment. (Tulloch, 1998) However, such treatments can lead to an overall reduction in the duration of the fixed appliance phase when preceded by the use of a functional appliance or headgear. Although not a distinct phase necessarily, the timing of certain parts of the overall treatment will also haven effect. For example, the banding of maxillary second molars within the first 21 months of treatment can decrease the mean treatment time by almost 2 months when compared with banding the same teeth later on in treatment(Skidmore, 2006).

1.7.3 Operator factors

1.7.3.1Number of operators

Hospital orthodontic departments aer often involved in the training of orthodontic clinicians, which may lead to any one patient receiving treatment from multiple operators(McGuinness, 1998). A study which looked at the effect of such practice on treatment efficiency and outcome found that, on average, treatment duration was extended by around 8.43 months as result of multiple operators (McDonald, 1998).

1.7.3.2 Operator experience

The total number of attendances, rather than treatment time, was found to be associated to the experience or grade of the hospital orthodontist (O'Brien, 1993) This could be attributed to a variety of variables, such as improved treatment mechanics, better time and patient management, or lower appliance failure rates.

Discussion

goal of this study was to search the literature for articles that specifically addressed the length of orthodontic treatment and the many factors that could influence it. The age of the patients; the types of malocclusions; the presence/absence of extractions; the use of removable or fixed appliances; techniques used with fixed appliances; the method of ligation; one- or two-phase treatment; provision of orthodontic services in a private office, public clinics, or university faculty, postgraduate and undergraduate health care environments; the involvement of surgery for the management of dentofacia were among the factors. Obviously, such a study can't cover everything.

There is presently no evidence-based data on the length of treatment. innovative orthodontic techniques (e.g., Invisalign and orthodontic mini-implants; (**Djeu et al., 2005).** Furthermore, in circumstances where non-conventional supplementary treatments are used, there is little scientific information to determine treatment time (**Iseri et al. , 2005)**.

There were forty-one papers that met the search criteria, indicating that more conclusive research is needed to assess the length of various types of orthodontic treatment. As previously stated, several of the reports have methodological flaws, skewed findings, and inconclusive results. Prospective studies are in the minority and are plainly more difficult to carry out, but they may help to avoid some of these issues in future study.

Conclusion

1. Extraction treatments appear to be more time consuming than non-extraction treatments. The number of extracted teeth appears to have an effect on the length of treatment.

2. It is impossible to draw valid conclusions about the duration of removable appliance treatment.

3. As long as patients are in their permanent dentition, age differences do not appear to affect the length of treatment.

4. When it comes to Class II division 1 malocclusions, there is strong evidence that the earlier orthodontic treatment is started, the longer the treatment lasts.

5. There is little evidence that different malocclusions require different treatment durations.

6. Information on the length of treatment in public health systems is contradictory in the literature.

7. The length of combined orthodontic and surgical treatment varies and appears to be operator dependent. Operators who perform a high number of surgical cases appear to finish them faster.

8. The duration of treatment appears to be influenced by a number of factors, including the technique used, the skill and number of operators involved, patient compliance, and the severity of the initial malocclusion. The contribution of each element, however, is uncertain, and this is an area that needs to be investigated.

9. There is some evidence that self-ligation can speed up treatment times.

10. Treatment time is extended due to impacted maxillary canines. Treatment length may be linked to the severity of the impaction as well as the patient's age.

11. Before precise answers can be given, new studies with robust research techniques are required.

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