European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 9, Issue 8, Autumn 2022

REVIEW ARTICLE

ADULT ORTHODONTICS- A REVIEW

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Received: 12 February, 2022 Accepted: 16 March, 2022

ABSTRACT

Adult orthodontics is becoming a larger proportion of many practices. Orthodontics for the adult patient is concerned with striking a balance between achieving optimal proximal and occlusal contact of the teeth, acceptable dentofacialaesthetics, normal function, and reasonable stability. With the adult, it is more frequently concerned with physiological adaptation and is often symptom related, whereas with the child the dealing is with the signs. In the past three decades, a major reorientation of orthodontic thinking has occurred regarding adult patients. Changed lifestyles and patient awareness have increased the demands for adult orthodontic treatment and multidisciplinary dental therapy has allowed better management of the more complicated and unique requirements of the adult patient population, thereby greatly improving the quality of care and treatment prognosis. In addition to goal clarification, adult patients desire treatment efficiency, convenience in appointment timings and good communication with other health care professionals. Almost 80% of the adult patients require interdisciplinary treatment planning and treatment execution. The purpose of this article is to review the scope, effectiveness and limitations of orthodontic treatment in adult patients.

Keywords: Adult orthodontics, orthodontic treatment, adult malocclusion, adjunctive orthodontics

INTRODUCTION

Adult orthodontics is a rapidly growing field in the practice of orthodontics. Crowded, irregular, protruded teeth and other malocclusions that include jaw discrepancies have been a problem and affecting human life since the ancient ages. Kingsley (1880) indicated an early awareness of the orthodontic potential for adult patients. However Mac Dowell (1901)[1] has described 'after the age of 16 years' as impossible ages. Lischer (1912)[2] summarized the change from the temporary to the permanent dentition as "golden age of treatment". In 1921, Case showed an appliance that he had designed to close extraction space after one or two tooth extraction in the mandibular anterior region with gingivitis.[3,4]

Orthodontic treatment has been thought for children and adolescents for a long period of time but demand for treatment of adult patients has increased over the years. According to the

statistical study made in 1997, the percentage of adult orthodontic patients was 3% in 1970 but increased to 25% in 1990. This grew to29% in 1997 and is increasing year by year.[5]

DIFFERENCE BETWEEN CHILD AND ADULT ORTHODONTIC PATIENT

1. Adult patients have no growth potentialand minimal skeletal adaptation. For this reason,camouflage or surgical treatment shouldbe done in patients with skeletal jaw discrepancies.[4,6]
2. Tissue response to orthodontic forces isslower in adults as compared toyoung patients. With increasing age, cellularactivity decreases, the tissue becomes richerin collagen and bone composition changes.In the presence of inflammation, resistance toforces decrease, so trauma of orthodontic forceincreases. Hence, good oral hygiene athome and professional maintenance visitsare important during and after active orthodontictreatment in order to control inflammation.Without plaque, orthodontic forcesand tooth movements do not induce gingivitis.[7,8]
3. With age, prevalence of periodontal diseasesand TMJ disorders increase. Sometimes, theseproblems are the reason for seeking orthodontictreatment.[6]
4. Adult patients have different motivations, different expectations and different psychology for seeking orthodontic treatment when compared with children and adolescents. A major motivation for orthodontic treatment of children and adolescents is the parents' desire for treatment. Adults, in contrast, seek treatment because they themselves desire it.Adult patients seek orthodontic treatment for aesthetic factors, psychological factors, interdisciplinary treatment (periodontics, prosthetics) and functional problems or temporomandibular joint dysfunction.[9]
5. Adult orthodontic treatment is not only an adjunctive treatment involving other branches of dentistry, but also a comprehensive part of orthodontics. Treatments with partial fixed appliances that can be completed in less than 6 months are considered as adjunctive treatment and should be done coordinated with periodontal and restorative treatment.
6. Comprehensive orthodontic treatment is a treatment that requires a complete fixed appliance and that is complex enough to require more than 6 months for completion. According to Musich,[10] 25% of 1370 adult orthodontic patients in his study needed comprehensive orthodontic treatment while 70% of them need multidisciplinary treatment. 5% of thepatients did not need any orthodontic treatment.

GOALS OF ADJUNCTIVE TREATMENT IN ADULTS

- Facilitate restorative treatment by positioning the teeth.
- Improve periodontal health by eliminating plaque and improving the alveolar ridge contour adjacent to the teeth.
- Establish favourable crown-to-root ratios so that occlusal forces are transmitted along the long axes of the teeth.[6]

In evaluating an adult patient, the initial objective should be to assess the chief complaint, medical evaluation, psychological considerations and the lifestyle. The next objectives are to progressively focus on the face, oral cavity, periodontium, teeth, and malocclusion.[11]The probability of having systemic diseases is greater in adult patients than in adolescents, therefore the relationship of these diseases and orthodontics is important for the treatment.

Myocardial infarction, valvular prosthesis, severe renal compromise, chronic alcoholism and drug addiction may be contraindications for the orthodontic treatment. Some diseases that are under control like osteoporosis, osteopenia and diabetes are not contraindications for the treatment.[11]Periodontal disease in patients with uncontrollable diabetes can result in severe bone loss. Patients should be informed about the gingival inflammation that can be seen during treatment and treatment should be carefully coordinated with a periodontist.[12]

Adult orthodontics is contraindicated in severe skeletal problems, systemic diseases that have gone far beyond control, excess bone loss, negative anchorage potential and poor motivation.

ORTHODONTICS FOR AESTHETIC PURPOSES IN ADULTS

One of the goals of adult orthodontics is aesthetics for many patients. Zachrisson[13] indicated that the patient should be evaluated not only in the rest position, but also during full smile and normal conversation to determine the smile as aesthetic. If the correct alignment of dentition is one of the factors that creates an aesthetic smile then the other one is the harmony of this alignment with the lips. In rest position young people show only a part of maxillary incisors, whereas older people show only mandibular incisors.[14]

One of the features of an aesthetic smile is the display extended till commissures. Increased amount of buccal corridors, the spaces between the facial surfaces of the posterior teeth and the corners of the lips when the patient is smiling, affects aesthetics negatively.[14-16]

The smile arc is defined as the relationship of the curvature of the incisal edges of the maxillary incisors and canines to the curvature of the lower lip in the posed smile. The ideal smile arc has the maxillary incisal edge curvature parallel to the curvature of the lower lip. Most orthodontists and dentists preferthat elevation of the upper lip for the posed smile stop at the gingival margins of the maxillary incisors but 2-2.5 mm of gingival display is considered acceptable. A complete display of gingival display is defined as "gummy smile" and is an unaesthetic feature. One should not rely only oncephalometric films and photographs for the treatment plan but a definite evaluation should be done physically not only in rest position but also with the function of the lips.[13,14]

According to Kokich[17], three unaesthetic situations may develop during orthodontic treatment; gingival margin discrepancies, ‘gummy smile’ and the ‘missing papilla’.

Gingival margin discrepancies: When deciding between various treatment options, it is important to know if the discrepancy is evident when the patient smiles. If not, correction is unnecessary. If the patient desires a change, depth of the gingival sulcus should be evaluated before coronal-lengthening or gingivectomytreatmentis performed.[18]

Gummy smile: Excessive gingival display on smiling is generally due to one of three causes. First, the patient’s maxilla may have grown excessively in the vertical dimension. In these cases, orthodontic intrusion of the teeth or periodontal plastic surgery is contraindicated, maxillary impaction is recommended. The second reason is the delayed apical migration of the gingival margins. Shortened clinical crowns and gingival tissue that is obviously thicker than normal in a labiolingual dimension is seen in these cases. Aesthetic gingival surgery is indicated as a treatment. The third reason is the over eruption of maxillary anterior teeth, and an orthodontic treatment involving intrusion of the overerupted incisors is the treatment of choice.[18]

Missing papillae: Frequently referred to as ‘black holes’, the absence of adequate papillary tissue between adjacent incisors is an unaesthetic feature of a smile.[18]They are also referred to in literature as ‘black triangles’ and may be due to a number of factors:

- Posttreatment interdental contact points that are located too far incisally
- Loss of periodontal support due to plaque-associated lesions
- Triangular-shaped or divergent crown shape
- Improper root angulations
- Improper contours of prosthetic restorations
- Poor oral hygiene

Missing papillae is a common posttreatment finding in adult orthodontic patients. According to a study on 337 adult patients, the prevalence of post treatment open gingival embrasures is 38%.[19]The contact point can be relocated apically by means of stripping or altering crown angulation.[20]

The principle of stripping is to recontour abnormally shaped teeth toward a more ideal morphology. By stripping, the contact point may be relocated gingivally and transformed to a small contact area, in an attempt to improve the stability of the treatment result.[21]

ORTHODONTICS FOR PERIODONTALLY COMPROMISED ADULTS

Poorly executed orthodontic treatment in periodontal patients can certainly contribute to further periodontal tissue breakdown. Periodontal disease is not a contraindication for orthodontic treatment but the disease has to be brought under control with pre-orthodontic periodontal treatment. According to several researchers, tooth movement in adults with reduced, but healthy periodontium did not result in significant further loss of attachment.[22,23] There are three risk groups according to the periodontal health of adult patients:

1. **Minimal Periodontal Involvement:** Successful adult orthodontic treatment for many patients will depend on the periodontal preparation (elimination of gingival inflammation and oral hygiene motivation) before treatment and the maintenance of periodontal health throughout all phases of mechanotheraphy.[4] The re-examinations should include recordings of probing depths, mobility, bleeding on probing, gingival recessions and bone levels. The level and condition of the attached gingivae should also be evaluated.[22] Labial movement of incisors in some patients can be followed by gingival recession and loss of attachment. The risk is greatest when irregular teeth are aligned by expanding the dental arch.[6]The thin, friable tissue is more prone to undergo recession during orthodontics than normal or thick tissue. It is prudent to place free gingival grafts to help control inflammation before orthodontic treatment begins.
2. **Moderate Periodontal Involvement:** Dental and periodontal disease must be brought under control before orthodontic treatment. Otherwise orthodontic treatment can accelerate periodontal destruction. Because the margins of bands can make periodontal maintenance more difficult, it is usually better to use a fully bonded orthodontic appliance for periodontally involved adults. Steel ligatures or self-ligating brackets also are preferred for periodontally involved patients. Periodontal maintenance therapy at 2-4 month intervals is the usual plan.[6]
3. **Severe Periodontal Involvement:** The general approach to treatment is the same but the treatment itself must be modified in two ways. These include more frequent intervals for periodontal maintenance (every 4 to 6 weeks) and modifying orthodontic treatment goals and mechanotherapy. Because of the reduced area of the periodontal ligament, the forces which are applied in normal limits,can affect these patients more severely. Thestrength of the force should be reduced.[6]

Occlusion is another feature that shouldbe evaluated before orthodontic treatment.here are three ways to control occlusalforcesduring appliance therapy:

1. **Disarticulation:** The Hawley bite planeis used to allow teeth to move free of occlusalforces and prevent excessive tooth mobility.
2. **Selective grinding:** After uprightingthemesially tipped molars, selective grinding isused to eliminate premature contacts and to ensuresimultaneous bilateral contact with theposterior teeth when in centric relation.
3. **Modification of mechanotherapy:**Modificationsthat minimalize the occlusaltraumalike bonding anterior teeth after aligningposteior teeth can be done.[4]

Benefits of orthodontic therapy for a periodontalpatient include:

- Aligning crowded or malposed maxillary or mandibular anterior teeth allows for better access to adequately clean all tooth surfaces in the adult patient.
- Vertical orthodontic tooth repositioning can improve certain types of osseous defects.
- Orthodontic treatment can improve the aesthetic relationship of the maxillary gingival margin levels before restorative therapy.

- Teeth can be extruded to permit adequate restoration of the root in a patient who has suffered a severe fracture of a maxillary anterior tooth.
- Open gingival embrasures in the maxillary anterior region can be corrected with a combination of orthodontic root movement and tooth reshaping.
- Improve position of teeth that have tipped and drifted into the extraction site before implant placement.[24]

EXTRUSION (FORCED ERUPTION)

Orthodontic extrusion of teeth, or so-called 'forced eruption' was first described by Ingber (1974)[25] for treatment of one-wall and two-wall bony pockets that were difficult to handle by conventional therapy alone. The extrusive tooth movement leads to a coronal positioning of intact connective tissue attachment, and the bony defect is shallowedout. Forced eruption may be indicated for shallowing out intraosseous defects and for increasing clinical crown length of single teeth as well as root fractures. Six criteria determine whether the tooth should be forcibly erupted or extracted. These are; root length, root form, level of the fracture, relative importance of the tooth, aesthetics and endo/perioprognosis.[24]

Because of the orthodontic extrusion, the tooth will be in supraocclusion. Hence, the crown of the tooth will need to be shortened, in some cases followed by endodontic treatment. Not only the bone, but also the supporting tissues will move vertically with the teeth during extrusion. For this reason, orthodontic extrusion of a single tooth that needs to be extracted is an excellent method for improvement of the marginal bone level before the surgical placement of single implants. The results indicated that the free gingiva moved about 90% and the attached gingiva about 80% of the extruded distance. 1 mm extrusion per week does not damage the periodontal ligament.[6,26,27]

There are various techniques for controlled extrusion of teeth. Itmay be accomplished by a T-loop appliance as well as an elastic thread or a steel ligature wire which is tied to the main arch.[6] In cases where there is a need of bone augmentation by extrusion for a dental implant placement, the patients have to be seen every 2 weeks to reduce the incisal surface of tooth being extruded and control inflammation. After 8 weeks of orthodontic extrusion, brackets need to be re-bonded further apically. A stabilization period of 12 weeks needs to be completed after orthodontic extrusion before an implant can be placed.[27]

TRANSLATION

Translation is the another method of bone regeneration. If an implant cannot be placed because of reduced buccolingual ridge thickness after a previous extraction, one option is to move a premolar into the edentulous space and to place the implant in the position previously occupied by the premolar.[28]To produce direct translation, a single force directed at the centre of resistance is needed. To apply a force at the centre of resistance, lever arms can be used with any bracket system.[29]This treatment is an alternative to surgical periodontal treatment and is more conservative.

INTRUSION

The orthodontic intrusion of teeth has been recommended for teeth with horizontal bone loss or infrabony pockets and for decreasing the clinical crown length of single teeth. When oral hygiene is inadequate, tipping and intrusion of the teeth may shift supragingivally located plaque into a subgingival position, resulting in periodontal destruction. When orthodontic intrusion is used for levelling of the gingival margins to desired heights, such teeth must then be provided with porcelain laminate veneers or crowns to increase clinical crown length. The gingiva moves about 60% of the distance when the teeth are intruded with a continuous force of 80- 100 g.[26]

MINOR SURGERY ASSOCIATED WITH ORTHODONTIC THERAPY

1. *Fibrotomy:* One of the retention procedures for reducing the relapse of the rotated teeth before orthodontic treatment is fibrotomy. The supracrestalfibrotomy technique consists of inserting a scalpel into the gingival sulcus and severing the epithelial attachment surrounding the involved teeth. Clinical healing is usually complete in 7-10 days.[26]
2. *Frenectomy/ Frenotomy:* Hyperplastic and inferiorly located maxillary labial frenum contributes to a midline diastema, and to reopening of diastemas after orthodontic closure. Therefore, surgical relocation of frenum is needed.[26]
3. *Gingivectomy:* The gingivectomy is a surgical technique which is indicated in gingival margin discrepancies or gummy smile.[26]

ORTHODONTICS FOR ADULT PATIENTS WHO REQUIRE RESTORATIVE TREATMENT

Missing teeth is frequently seen in adult patients. These patients need to be restoratively rehabilitated to gain a stable occlusion. Orthodontics is applied as an adjunctive treatment before restorations. Thus, function can be restored with the help of interdisciplinary treatmentapproach.

Preprosthetic adjunctive orthodontic treatments include:

Uprighting posterior teeth: When a posterior tooth is lost, the adjacent teeth usually tip and rotate to the extraction space. As the teeth move, there formsapseudopocket that may be impossible for the patient to clean. When planning molar uprighting, a number of questions must be answered:

a. If the third molar is avaliable, should the second and the third molar be uprighted together.
b. Opening of space for prosthetic restoration by tipping the second molar crown or closing the space by mesial drift of the root.
c. The question if molar extrusion may be permitted while uprighting the molars or if the vertical height should be preserved is important.

Uprighting springs, T-loops or coil springs can be used for molar uprighting.[6]

Parallelism of abutment teeth: The abutment teeth must be placed parallel with the other teeth to permit insertion of multiple unit replacements and allow for restorations that involve both the anterior and posterior teeth.[4]

Space closure-disclosure: One of the indications of adult orthodontics is the preparation of the extraction spaces for either prosthetic treatment or closing them by moving the teeth orthodontically. While deciding the treatment type, the type of the malocclusion, quality and thickness of the alveolar bone, aesthetic factors, oral hygiene and duration of the treatment should be assessed.

BIOMECHANICAL DIFFERENCES IN ADULT ORTHODONTICS

Both the goals and the stages of comprehensive orthodontic treatment for adults are the same as those in the treatment of adolescents. The orthodontic mechanotherapy, however, often must be modified. If the patient has lost some periodontal support, it is especially important to apply light forces during space closure. An appliance system without friction allows greater control of tooth movement during space closure. In adult patients with periodontal loss, higher M/F values mustbe attained. The segmented arch technique and TMA T-loops are recommended for space closure in periodontally compromised adult patients.[31]The basic idea in segmented arch treatment is to create a stable anchor unit, consisting of several teeth rigidly connected to provide precisely controlled force against the teeth whose movement is desired. To obtain higher M/F ratios, T-loop can be made as long as possible in an apical direction or the gingival horizontal length can be increased.[6,31]

In adult patients, the segmented arch technique can be considered as being superior to a conventional continuous arch wire technique if arch levelling by incisor intrusion is indicated. However intrusion of teeth may aggravate the periodontal breakdown in the presence of plaque and inflammation, it is indicated if it can be get under control with pre-orthodontic periodontal treatment.[32,41,42]

In periodontally compromised dentitions, the loss of alveolar bone results in the centre of resistance of the involved teeth moving apically. According to Choy et al,[31] the centre of resistance moves 1.1 mm apically when 2 mm of alveolar bone is lost. Thus, moment of force increases as the distance between bracket and the centre of resistance increases. Therefore light forces should be applied to these patients. Use of intermaxillary elastics in adult patients is also important for the same reason. Light forces should be applied with elastics. To decrease the vertical force, elastics can be appliedbetween second molar and canines.

Root resorption has been associated withintrusion of incisors in adult patientsshowingmarginal bone loss and deep overbite. Therefore, light forces (5-15 g per tooth) have beenrecommended when the periodontiumishealthy in adults. Orthodontic movement ofendodontically treated teeth is also possiblebecause the response of the PDL, not thepulp, is the key elementin such movement.Light interrupted forces should be used becausesuch teeth are slightly more prone to rootresorption during orthodontic treatmentthan are teeth with normal vitality.[6,7]

Adult orthodontic patients do not want their braces to be seen because of various reasons. For this reason there are several aesthetic treatment choices for adult patients like ceramic or plastic brackets, invisalign appliances and lingual orthodontic treatment.

RETENTION IN ADULT ORTHODONTIC PATIENTS

When planning retention for adult patients, the following should be considered:

- Root parallelism must be verified radiographically before appliance removal.
- Coincidence of centric relation and habitual occlusion should be evaluated clinically.
- Incisal guidance should be controlled clinically or with mounted models.
- Joint symptoms should be assessed.
- Timing of retention and restorative treatment should be coordinated.
- Periodontium should be evaluated clinically and radiologically.
- Original malocclusion should be evaluated before retention.[33,39,40]

Retention mechanics should be part of the treatment plan. Duration of retention period varies according to the original anomaly, amount and type of treatment, treatment result, periodontal condition, interdisciplinary treatment plan, and several etiologic factors.Retention planning is divided into three categories depending on the type of treatment: semipermanent or permanent retention, limited retention in terms of type and time, and no retention. The dental status and the level of the marginal periodontium are important factors in determining the type of retention. Removable retainers, operative procedures, or fixed retention can be preferred.[33]

Retention appliances that can be used includeessix retainers, Hawley retainers, positioners, fixed retention appliances (lingual retainer) and fiber retainers.[33]

SURGICAL RETENTION PROCEDURES

Fiberotomy: The supra-alveolar soft tissues contribute to the relapse of orthodontically treated teeth, specifically, rotated teeth. For this reason, intrasulcular incision is done at the end of the active treatment. According to Edwards[34,37,38] circumferential supracrestalfiberotomy reduces relaps by 30%.

Gingivoplasty: Gingival contours that are not corrected during treatment may cause relapse when the force is gone after treatment. For this reason, Edwards[34,35,36] suggests surgical excision of these gingival invaginations at the end of the active treatment.

COMPLICATIONS OF ORTHODONTIC TREATMENT IN ADULTS

- Medical problems
- Poor cooperation
- Technical problems
- Periodontitis and caries
- TMJ disorders
- Root resorption

CONCLUSION

The percentage of adult patients seeking orthodontic treatment has been increasing in recent years. Most adult patients need a multidisciplinary approach. The orthodontist should not hesitate to treat adult patients, should well evaluate the patients' expectations and should co-operate. Thus, both the orthodontist and the patient would be satisfied from the outcome of the aesthetic and functional rehabilitation by being a part of this multidisciplinary treatment approach.

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