

THE BENEFITS OF MULTIDISCIPLINARY TREATMENT ON PERIODONTAL STATUS IN ADULT PATIENTS – A NARRATIVE REVIEW AND CLINICAL CASE

Liliana Ioana Vâță¹, Cătălin Caliniuc^{1*}, Ionuț Luchian², Monica Tatarciuc³, Irina Nica²

¹Private Practice DentCenter, Iasi-Romania

²“Grigore T. Popa” U.M.Ph. - Iași, Romania, Faculty of Dental Medicine, Department of Odontology-Periodontology, Fixed Restorations

³“Grigore T. Popa” U.M.Ph. - Iași, Romania, Faculty of Dental Medicine, Department of Dental Prosthesis Technology

*Corresponding author: Cătălin Caliniuc, e-mail: catalin@caliniuc.ro

ABSTRACT

The management of adult patients requiring multidisciplinary dental care presents unique challenges, particularly when addressing the interrelationship between orthodontics, periodontics, and restorative dentistry. In many cases, the successful resolution of complex dental issues necessitates a coordinated approach that integrates these specialties. Orthodontic therapy plays a critical role in aligning teeth and correcting malocclusions, while periodontal treatment focuses on the prevention and management of periodontal diseases. Restorative dentistry, which includes procedures to restore tooth structure and function, is essential for achieving long-term dental health and aesthetic outcomes. The main motivation for referring adults to the orthodontist is the desire to improve dental and smile aesthetics, missing teeth due caries, periodontal disease or trauma and subsequently functional impairment. Pre-restorative orthodontics is necessary for the most favourable distribution of teeth, with good root parallelism to optimise future restorative treatment, correction of occlusal plane for incisal guidance, improvement or correction of mucogingival and osseous defects, and for obtaining a more favourable crown-to-root ratio for long-term maintainability of periodontally compromised teeth. Clinical examples will be used to illustrate the different indications for adult orthodontic-restorative treatment and the necessity for close collaboration of a well-orchestrated interdisciplinary team.

Keywords: multidisciplinary treatment, ortho-periodontal interface, functional rehabilitation

INTRODUCTION

Interdisciplinary, multidisciplinary and comprehensive treatment plans are now part of everyday practice. The interaction between different specialists can provide patients with better, more conservative and more pleasing results. Teamwork is a reality in today's dentistry offices. Patients demand a higher level of dental care with the need to combine treatments from different clinicians, as they are not only looking for function, but also for esthetics [1-3]. Today, a clinician cannot always achieve an ideal result by means of conservative dentistry, restorative dentistry or orthodontics alone. A high percentage of adult patients show a

combination of clinical situations that make a multidisciplinary treatment plan necessary. Long-term missing teeth often result in migration and rotation of the adjacent teeth, so therefore the replacement of them often requires the orthodontic movement of the surrounding dentition [4,5].

This paper explores the effectiveness and challenges of integrating orthodontic, periodontal, and restorative interventions in adult patients, providing a framework for clinicians to achieve optimal outcomes through collaborative treatment planning and sequential interventions.

Orthodontic treatment provides an acceptable functional and esthetic occlusion,

but tooth movements are strongly related to interactions of teeth with their supportive periodontal tissues. In recent years, due to the increased number of adult patients seeking orthodontic treatment, orthodontists frequently face patients with periodontal problems. Since the bony response is facilitated by the periodontal ligament, movement of a tooth is primarily a periodontal ligament phenomenon and requires a healthy periodontium [6,7].

Multidisciplinary treatments require continuous communication between the different specialists and understanding the different phases of the treatment is fundamental in order to achieve the desired result. These adult cases are usually time consuming and, therefore, motivation is an important key, not only to start the treatment, but also to maintain the patient involved throughout this process, which can take years until its full completion [8].

The aim of the current narrative review was to establish new clinical perspectives on the ortho-perio-restaurative relationship in adults patients.

MATERIALS AND METHODS

In this study, we used the following keywords: periodontal health, periodontal care, periodontitis, orthodontic treatment, restorative dentistry, management of adults in dentistry, complex dentistry cases. Two specialists investigated these keywords independently using the PubMed and Web of Science databases. To avoid the risk of bias, the investigators included both positive and negative papers on this topic. Only the publications selected by both independent investigators were considered reliable and included in this narrative review. As a result of this process, 87 publications were selected.

RESULTS

Adult orthodontic periodontal interface

Orthodontic treatment of adults periodontal patients with a multidisciplinary approach is increasingly frequent and should be planned individually, considering bone losses suffered by each patient. Successful orthodontic treatment usually depends on the maintenance of the health of periodontium before, during, and after orthodontic treatment [9,10].

Respecting some limitations, it is possible to improve the level of bone insertion, smile aesthetics and masticatory function, to facilitate oral hygiene through the orthodontic treatment of adult patients with little bone support. Periodontal treatment as a single therapy is not always able to correct and control the damage produced by periodontal disease and a consequent pathological occlusion, depending on the degree of tissue impairment. In these cases, orthodontic tooth movement is an important step when planning the global treatment of the patient. One of the most important factors for periodontal balance is the physiological stimulation received by the tissues during function [11,12].

Patients with periodontitis often have several sequelae, such as: inadequate angulation; excessive buccal projection; extrusion of one or more incisors; development of single or multiple diastemas in anterior teeth, with progressive spacing of incisors. This spacing is the most evident sign of pathological change in tooth positioning, occurs in a progressive manner and the most affected teeth are the maxillary incisors. Periodontal patients have traumatic occlusion, which can contribute to the development of destructive periodontal

disease, since secondary occlusal trauma may further deteriorate the supporting tissues. This occurs because it is extremely important that masticatory forces are transmitted in the axial direction of teeth, allowing the application of intense forces with less tension on the periodontal ligament [13,14].

Secondary occlusal trauma is an aggravating factor for periodontal problems and should be eliminated by orthodontic correction. It is caused by the reduced capacity of the periodontium to withstand normal occlusal loads and contributes to the progression of pathological migration of teeth, even in the absence of active periodontal disease. The first step in treating these patients is always the elimination of active periodontal disease. However, even after complete removal of the disease, the patient with pathological migration should not be considered completely treated [15,16]. Thus, recovery of the integrity and continuity of the dental arch, as well as balanced tooth positioning, is an essential step for the successful treatment of a patient with periodontitis and pathological migration of teeth [17].

Orthodontic therapy is indicated for the treatment of occlusal sequelae in patients with controlled severe periodontitis. The periodontium only responds favorably to orthodontic movement if it is healthy. Therefore, the first step in treating a patient with bone loss is to check whether periodontitis has been properly controlled by a periodontist. Orthodontic movement can only be initiated after obtaining control of inflammation and dental biofilm, with excellent cooperation from the patient regarding oral hygiene techniques. This stage can last from 3 to 9 months, depending on the severity of the problem. Intensive

periodontal treatment involves instructions for oral hygiene, removal of biofilm retentive factors, and scaling and root planing, which may include flap surgery and/or antibiotic prescription. Before the onset of orthodontic treatment, periodontal disease must be controlled [18].

In addition to the periodontal disease control, it is also essential to maintain the results obtained by periodic control by the periodontist, at intervals of 1 to 4 months. This time interval depends on the quality of biofilm control obtained by the patient. These periodontal maintenance consultations are essential for the periodontist to evaluate and control sites that may have recurrence of the inflammatory process, to maintain periodontal health and also to reinforce the hygiene instructions [19]. Patients with adequate plaque control, narrow gingival recessions, and those requiring tooth movement within the alveolar bone envelope can be treated after periodontal treatment is completed [20]. Lingual movement of the tooth into a more proper position will lead to decrease in recession and dehiscence. During postorthodontic treatment of residual periodontal disease, patients should be put on regular follow-ups and maintenance after the orthodontic tooth movement is completed. Any residual periodontal pocket or newly formed pockets should be checked and pockets with associated deep intrabony defects can be treated now using regenerative surgical techniques [21-23]. Combined ortho-periodontal treatment generates also an improvement of smile aesthetics. Excessive overjet, dental crowding or spacing; tooth discolouration; a gummy smile; gingival recession with uneven gingival margins or open embrasures; missing teeth in the posterior

area of the arch, having consequences in the reduction of the height in lower face may negatively affect self-esteem, predisposing to psychosocial problems [24-26].

Orthodontic-prosthesis relationships in adult cases

Adult patients treatment involving multidisciplinary approach consists in correcting the malocclusion which helps in improving the quality of periodontal and restorative treatment outcomes besides providing esthetic benefits. Adults are now more frequently referred for orthodontic treatment to improve the positioning and alignment of teeth prior to the replacement of missing teeth. Such tooth movements may be undertaken to achieve parallel abutments of the teeth used to hold the prosthesis, to create space for a pontic, to reduce the excessive overjet or deep bite or to make space for dental implants. It is also possible by orthodontic treatment to close spaces or reposition the remaining teeth following tooth loss using uprighting molar movements [27,28].

Adult patients have many preexisting conditions that are usually not present in adolescent patients. Although acceptable esthetics is an integral part of treatment goal, a good function, stability and health of the dentition is given paramount importance. General treatment objectives are determined to facilitate and improve effectiveness of perio-restorative treatment [29-31] by:

- Improving axial inclination of teeth – tip or angulation-, thereby improving root positioning with sufficient bone between roots for good vascular supply and proper contact area;
- Obtaining a correct torque both in the anterior area to prevent bone dehiscences during incisal retraction with tipping, but

also in the posterior area to avoid interference in mandibular dynamics

- Achieving parallelism of abutment teeth and most favorable distribution of abutment teeth to receive prosthesis for better stability;
- Uprighting and extrusion of posterior teeth with occlusal equilibration sometimes followed by endodontic treatment to improve vertical osseous defects and crown root ratio;
- Restore functional occlusion keeping in mind existing skeletal relationship;
- Achieving better lip support with correction of overjet for good anterior guidance or deep bite to avert wrinkles around the lips;
- Restoring vertical dimension with bite plate before placing prosthesis in bite collapse.

CLINICAL CASE

Patient T.A., 35 years old, presented to our clinic with multiple complicated root remnants accompanied by periapical bone lesions, as follows: 14: root remnant with a periapical osteitic lesion; 15: root remnant with a periapical cyst; 16: root remnant with a periapical osteitic lesion; 24, 25: two root remnants with periapical osteitic lesions; 36: root remnant with a periapical osteitic lesion; 38: deep root remnant complicated by radicular gangrene; 46, 47: root remnants with periapical osteitic lesions. The periodontal status was characterized by horizontal bone lysis at the incisive level and vertical at the level of the remaining mesially inclined molars, poor oral hygiene, generalized gingival inflammation, bleeding on probing. From the orthodontic point of view, the patient presented a dental class II/1 Angle with a sagittal skeletal discrepancy, mandibular retrognathism, upper jaw compression, increased overjet, accentuated overbite, absence of the anterior guidance,

traumatic occlusion and gummy smile (fig.1,2).



frontal view



lateral view



maxillar view



mandibular view

Figure 1. T.A. Initial case – intraoral aspects



Panoramic X-ray



Lateral cephalogram

Figure 2. T.A. Initial case – radiological aspects

Periodontal Stage:

Before the onset of surgical and orthodontic treatment, periodontal disease must be controlled. In addition to the periodontal disease control, it is also essential to maintain the results obtained by periodic control by the periodontist, at 1 to 4

months intervals. This time interval depends on the quality of biofilm control obtained by the patient. These periodontal maintenance consultations are essential for the periodontist to evaluate and control sites that may have recurrence of the inflammatory process, to maintain periodontal health and also to reinforce the hygiene instructions.

Surgical Treatment:

Alveoloplastic extraction was performed for teeth 14, 15, and 16, followed by curettage of the periapical granulation tissue and removal of the cyst associated with 15. The post-extraction sockets were filled with a mixture obtained from BioOss, PRP, and PRF, which was subsequently covered with BioGuide and PRF using the Open Healing Technique. The same protocol was applied to the other three quadrants. In this case, the decision to perform extractions using the open healing protocol was made with the specific goal of augmenting the level of fixed gingiva. This protocol was chosen because it offers better control over the healing process, promoting the formation of a higher level of new fixed gingiva. The open healing technique allows for natural tissue regeneration and improved soft tissue management, providing the following benefits: enhanced soft tissue thickness and keratinized gingiva formation; improved predictability of healing outcomes, as the protocol supports the stabilization of the graft material without immediate soft tissue closure; minimized risk of complications, as the open healing environment reduces tension on the surgical site. By using this protocol, we ensured that the augmented area would develop a robust and stable zone of fixed gingiva, providing better long-term outcomes for implant placement and prosthetic stability.

Orthodontic Treatment:

In the case of patient T.A, we decided for the preparation of the anchorage with two orthodontic mini-implants placed between the maxillary first and second molars associated with a transpalatal arch. The mechanics of incisive retraction was also

accompanied by their intrusion, according to the diagram (fig. 3). It is essential to use light forces and adequate biomechanics in the treatment of patients with controlled periodontitis and the treatment must be as short and simple as possible, in this case only 9 months. The orthodontic intrusion of teeth extruded by pathological migration is frequent in patients with vertical bone loss. Some biomechanical protocols can be proposed for intrusion and retraction of over-projected incisors due to severe loss of periodontal insertion. Ideally, the retraction forces should be directed, combined with an intrusive component, as close as possible to the center of resistance of the teeth affected by the loss of periodontal insertion (fig.3).

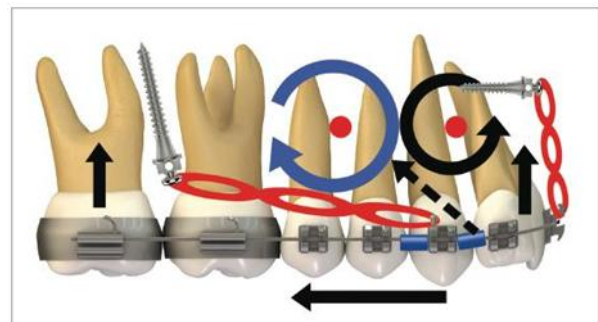


Figure 3. Orthodontic biomechanics for retraction and intrusion of upper incisor

The use of absolute anchorage with TADs is highly applicable in these cases, since it provides greater safety for movement and has become a clinical reality.

Implantology Stage:

After approximately 3 months, the patient returned for the insertion of dental implants, as follows:

- Quadrant 1: Placement of 3 implants with bone augmentation through external sinus lift.
- Quadrant 2: Placement of 2 implants with internal sinus lift performed simultaneously.
- Quadrant 3: Placement of 1 implant.

- Quadrant 4: Placement of 3 implants associated with horizontal bone augmentation.

Prosthetic Stage:

The restorative phase of the treatment of this complex case is shown in figures 4, 5, 6, which illustrate the improvement of facial aesthetics and occlusal functionality.



Figure 4. T.A. Initial vs final clinical aspects

Planning of the Supra-Implant Prosthetic Treatment

For the prosthetic treatment of patient T. A., we decided for a multi-unit connection for all multi-implant edentulous spaces. This choice provides multiple advantages, including:

-Easy access to implants → facilitating long-term maintenance.

-Managing complications → in case of peri-implant inflammation, simply removing the screw provides direct access to the contact area between the multi-unit abutment and the implant, allowing quick intervention.

-Reducing the risk of peri-implantitis → the multi-unit connection eliminates the risk of excess cement accumulation during direct intraoral cementation of restorations, preventing peri-implant inflammation.



frontal view



lateral view



maxillar view



mandibular view

Figure 5. T. A. Final case – intraoral aspects



Panoramic X-ray



Lateral cephalogram

Figure 6. T.A. Final case – radiological aspects

Pre-Prosthetic Preparation and Dental Treatments

Considering the presence of multiple carious lesions and the need to correct the angulation of some anterior teeth, the following procedures were performed:

- Devitalization and application of root posts for teeth 12, 11, 21, 22, ensuring a solid base for the prosthetic restorations and proper alignment of the dental axis.
- Devitalization and root reconstruction for teeth 34 and 35, which had extensive coronal destruction.
- Conservative dental treatments for teeth 17, 18, 37, 44, and 48 with composite restorations.

Impression and Model Fabrication

To achieve a precise adaptation of the prosthetic restorations, a rigorous impression protocol was followed:

- Open-tray impression, using fluid polyether to accurately register the peri-implant and peridental sulcus and medium-consistency polyether used as the impression base, providing superior stability during the model fabrication process.
- Gypsum model fabrication and preparation for checking the prosthetic fit.

Try-in and Verification

A critical step was the try-in, allowing the evaluation of key aspects:

- Passive fit of the supra-implant restorations ensuring the absence of tension in the restoration structure.

- Correct cervical adaptation confirming the proper fit of the restorations with the dental substrate.
- Aesthetic and functional assessment analyzing the shape and position of the teeth and verifying the accuracy of sagittal, frontal, and transverse curves.

Fabrication of Prosthetic Restorations

Based on the try-in evaluation, the following definitive restorations were made:

- Individual full zirconia crowns for teeth 12, 11, 21, 22, providing optimal strength and aesthetics.
- Fixed bridge for teeth 14-16 and 24-25, using full zirconia for long-term durability.
- Implant 36: A customized titanium abutment was used to provide a stable prosthetic connection. A full zirconia crown was fabricated in the laboratory and cemented extraorally, then delivered as a screw-retained restoration at the oral level.
- Full zirconia bridge on implants 45, 46, 47, ensuring a fixed, durable restoration.

Finalization and 8-Month Follow-Up

During the 8-month follow-up, stability parameters were assessed:

- Stability of aesthetic and functional outcomes → the patient reported optimal comfort and efficient masticatory function.
- Maintenance of peri-implant health → radiographic and clinical evaluations confirmed peri-implant bone stability, with no signs of pathological resorption or inflammation.
- Harmonious integration of restorations → the restorations blended perfectly within the dental and facial context, both aesthetically and biomechanically.

DISCUSSIONS

Harmonious cooperation between the orthodontist, the periodontist and the prosthodontist offers great possibilities for the treatment of combined orthodontic-periodontal problems. Orthodontic treatment along with patients compliance and absence of periodontal inflammation can provide satisfactory results without causing irreversible damage to periodontal tissues.

An increasing number of adult patients seen in the orthodontic offices are presenting with an ongoing degeneration caused either by loss of one or more teeth and/or progressing periodontal disease. The treatment of these patients can rarely stand alone and both diagnosis and treatment planning should be a production of a close interaction between orthodontists, periodontists and prosthodontists eventually assisted by gnathologists, implantologists and oral surgeons [32-34].

The orthodontist should update his knowledge and his thinking in this aspect of his responsibility, and should try as much as possible to co-ordinate his efforts with those of his confreres in other branches of dentistry in order to render to the population a better and more complete dental health service. The orthodontic appliances should be selected taking the periodontal status and the eventual metabolic factors into consideration. The importance of the correct biomechanical system has a crucial influence on long-term prognosis for the dentition. The spectrum of orthodontics has been widened further through the introduction of the skeletal anchorage systems [35-37]. A result characterized by an ideal occlusion may not be obtainable but the possible treatment goal should be defined and agreed upon between involved colleagues and between the therapeutic team

and the patient before initiating the treatment. When adult patients are being treated, the periodontist should be aware about the advantages of orthodontic treatment, and it is as important as it is the orthodontist's knowledge to recognize which patients need to be referred, which require periodontal evaluation, and which require possible periodontal therapy.

The approach used in the case of T. A. demonstrated the effectiveness of the multi-unit connection in rehabilitating multi-implant edentulism. The selection of biocompatible materials and a screw-retained fixation strategy allowed for optimized long-term maintenance, elimination of risks associated with direct cementation and ensured a durable aesthetic and functional rehabilitation.

There is evidence that periodontal disease cannot be cured, but it can be controlled. Therefore, patients with periodontitis must be monitored and controlled throughout their lives by a periodontist. Patients with periodontal diseases could be dealt with periodontal-orthodontic comanagement without any detrimental effects. However, there are two important prerequisites: maintenance of meticulous oral hygiene of the patient, and optimal control of inflammation before and throughout the combined treatment. With adequate plaque control, patients with reduced but healthy periodontium can undergo orthodontic treatment without aggravating their periodontal conditions [38,39]. However, when inflammation is not fully controlled orthodontic treatment may trigger inflammatory processes and accelerate the progression of periodontal destruction leading to further loss of attachment, even in patients with sound oral hygiene [40,41].

Ong, Wang and Smith summarized the utility of the orthodontics as an adjunct to overall treatment: uprighting or repositioning teeth to improve parallelism of abutment teeth, improving future pontic spaces (inadequate space), correcting cross-bites, extruding teeth (fractured teeth)/intruding teeth (hypererupted teeth), correcting crowding of teeth, achieving adequate embrasure space and proper root position, repositioning teeth for placement of implants, restoring lost vertical dimension, increasing or decreasing overjet/ overbite, closure of diastemas [42].

CONCLUSIONS

1. The combined approach of orthodontics, periodontics and restorative treatment, often referred to as "ortho-perio-restorative" treatment, has become increasingly recognized as a comprehensive strategy for adult patients.
2. The planning of movement anchorage is critical in patients with controlled periodontitis. It is difficult to obtain adequate anchorage for orthodontic movement in patients with partial edentulism and reduced alveolar bone support. As in most cases, there is a need for intrusion and retraction of the extruded and projected incisors, with diastemas and changes in angulation. It is mandatory to analyze if the posterior teeth of the patient have enough periodontal insertion to allow them to anchor the movement.
3. This approach not only addresses functional and aesthetic concerns but also ensures the maintenance of periodontal health, the orthodontic tooth movement and the stability of dental restorations.

REFERENCES

1. Spear FM, Kokich VG, Matthews DP. Interdisciplinary management of anterior dental esthetics. *J Am Dent Assoc* 2006; 137(2):160–169.
2. Spear FM, Kokich VG. A multidisciplinary approach to esthetic dentistry. *Dent Clin North Am*. 2007; 51(2):487-505.
3. Raj V. Esthetic paradigms in the interdisciplinary management of maxillary anterior dentition-a review. *J Esthet Restor Dent*. 2013; 25(5):295-304.
4. Petridis HP, Tsiggos N, Michail A, Kafantaris SN, Hatzikyriakos A, Kafantaris NM. Three-dimensional positional changes of teeth adjacent to posterior edentulous spaces in relation to age at time of tooth loss and elapsed time. *Eur J Prosthodont Restor Dent*. 2010; 18(2):78–83.
5. Craddock HL, Youngson CC, Manogue M, Blance A. Occlusal changes following posterior tooth loss in adults. Part 2. Clinical parameters associated with movement of teeth adjacent to the site of posterior tooth loss. *J Prosthodont*. 2007; 16(6):495-501.
6. Spear FM. Editorial - The Importance of Commitment and Communication in the Generalist/Specialist Relationship. *Advanced esthetics and interdisciplinary dentistry* 2007; 3:2.
7. Gragg KL, Shugars DA, Bader JD, Elter JR, White BA. Movement of teeth adjacent to posterior bounded edentulous spaces. *J Dent Res*. 2001; 80(11):2021-4.
8. Norton LA. Biology of tooth movement. In: Bhalaji SI, ed. *Orthodontics: The Art and Science*. 3rd ed. New Delhi: Arya Publishing, 2006, 185-201.
9. Maria L, Geisinger ML, Abou-Arrej RV, Souccar NM, Holmes CM, Geurs NC. Decision making in the treatment of patients with malocclusion and chronic periodontitis: scientific evidence and clinical experience. *Semin Orthod*. 2014; 20:170-176.
10. Davis SM, Plonka AB, Fulks BA, Kyle L, Taylor BS, Bashutski J. Consequences of orthodontic treatment of periodontal health: clinical and microbial effects. *Semin Orthod*. 2014; 20:139-149.
11. Thilander B. The role of the orthodontist in the multidisciplinary approach to periodontal therapy. *Int Dent J*. 1986; 36(1):12–17.
12. Erbe C, Heger S, Kasaj A, Berres M, Wehrbein H. Orthodontic treatment in periodontally compromised patients: a systematic review. *Clin Oral Investig*. 2023; 27(1):79-89.
13. Williams S, Melsen B, Agerbaek N, Asboe V. The orthodontic treatment of malocclusion in patients with previous periodontal disease. *Br J Orthod*. 1982; 9(4):178–184.
14. Palmer RM, Ide M, Floyd PD. Clinical guide to periodontology: part 3. Multidisciplinary integrated treatment. *Br Dent J*. 2014; 216(10):567-73.
15. Aimetti M, Garbo D, Ercoli E, Grigorie MM, Citterio F, Romano F. Long-Term prognosis of severely compromised teeth following combined periodontal and orthodontic treatment: A Retrospective Study. *Int J Periodontics Restorative Dent*. 2020; 40(1):95-102.
16. Choi SH, Kim YH, Lee KJ, Hwang CJ. Effect of labiolingual inclination of a maxillary central incisor and surrounding alveolar bone loss on periodontal stress a finite element analysis. *Korean J Orthod*. 2016; 46(3):155–162.
17. Zasciurinskiene E, Lindsten R, Slotte C, Bjerklin K. Orthodontic treatment in periodontitis-susceptible subjects a systematic literature review. *Clin Exp Dent Res*. 2016; 2(2):162–173.
18. Feu D. Orthodontic treatment of periodontal patients: challenges and solutions, from planning to retention. *Dental Press J Orthod*. 2020; 25(6):79-116.
19. Kwon TH, Salem DM, Levin L. Periodontal considerations in orthodontic treatment: A review of the literature and recommended protocols. *Semin Orthod*. 2024; 30(2):80-88.
20. Levin L, Einy S, Zigdon H, Aizenbud D, Machtei EE. Guidelines for periodontal care and follow-up during orthodontic treatment in adolescents and young adults *J Appl Oral Sci*. 2012; 20(4):399-403.
21. Jepsen K, Sculean A, Jepsen S. Complications and treatment errors involving periodontal tissues related to orthodontic therapy *Periodontol* 2000. 2023; 92(1): 135-158.
22. Bollen AM, Cunha-Cruz J, Bakko DW, Huang GJ, Hujoel PP. The effects of orthodontic therapy on periodontal health: a systematic review of controlled evidence *J Am Dent Assoc*. 2008; 139(4):413-422.

23. Laursen MG, Rylev M, Melsen B. The role of orthodontics in the repair of gingival recessions. *Am J Orthod Dentofacial Orthop.* 2020; 157(1):29-34.
24. Cortellini P, Bissada NF. Mucogingival conditions in the natural dentition: Narrative review, case definitions, and diagnostic considerations. *J Clin Periodontol.* 2018; 45 Suppl 20: S190-S198.
25. Park WB, Park W, Lim SW, Han JY. Periodontal phenotype modification using subepithelial connective tissue graft and bone graft in the mandibular anterior teeth with mucogingival problems following orthodontic treatment. *Medicina (Kaunas).* 2023; 59(3):584.
26. Tin-Oo M M, Saddki N, Hassan N. Factors influencing patient satisfaction with dental appearance and treatments they desire to improve aesthetics. *BMC Oral Health* 2011; 11: 6.
27. Maghaireh GA, Alzraikat H, Taha NA. Satisfaction with Dental Appearance and Attitude toward improving Dental Esthetics among Patients attending a Dental Teaching Center. *J Contemp Dent Pract.* 2016; 17(1):16-21.
28. Qualtrough A, Burke F. A look at dental esthetics. *Quintessence International.* 1994; 25(1):7-14.
29. Van der Geld P, Oosterveld P, Van Heck G, Kuijpers-Jagtman A. Smile attractiveness. Self-perception and influence on personality. *Angle Orthod.* 2007; 77(5):759-765.
30. Peck S, Peck L. Selected aspects of the art and science of facial esthetics. *Semin Orthod.* 1995; 1(2):105-26.
31. Khan M, Kazmi SMR, Khan FR, Samejo I. Analysis of different characteristics of smile. *BDJ Open.* 2020 5;6:6.
32. Sarver D M. The importance of incisor positioning in the esthetic smile: the smile arc. *Am J Orthod Dentofacial Orthop.* 2001; 120(2): 98-111.
33. Bagga DK. Limitations in Adult Orthodontics: A Review. *J Oral Health Comm Dent.* 2009; 3(3):52-55.
34. Savana K, Ansari A, Hamsa R, Kumar M, Jain A, Singh A. Interdisciplinary Therapy in Orthodontics: An Overview. *Int J Advanced Health Sci.* 2014; 1(5) :23-31.
35. Talic NF. Adverse effects of orthodontic treatment: A clinical perspective. *Saudi Dent J.* 2011; 23(2):55-59.
36. McNamara JA, Seligman DA, Okeson JP. Occlusion, orthodontic treatment and temporomandibular disorders: A review. *J Orofacial Pain.* 1995; 9(1):73-90.
37. Tayer BH, Burek MJ. A survey of adults' attitudes toward orthodontic therapy. *Am J Orthod.* 1981;79(3):305-15.
38. Artun J, Urbye KS. The effect of orthodontic treatment on periodontal bone support in patients with advanced loss of marginal periodontium. *Am J Orthod Dentofacial Orthop.* 1988; 93(2):143-8.
39. Cao T, Xu L, Shi J, Zhou Y. Combined orthodontic-periodontal treatment in periodontal patients with anteriorly displaced incisors. *Am J Orthod Dentofacial Orthop.* 2015; 148(5):805-13.
40. Bollen AM, Cunha-Cruz J, Bakko DW, Huang GJ, Hujoel PP. The effects of orthodontic therapy on periodontal health: a systematic review of controlled evidence. *J Am Dent Assoc.* 2008; 139(4):413-22.
41. Kokich VG, Ambalavanan N. Adjunctive role of orthodontic therapy. In: Newman MG, Takei HH, Klokkevold PR, Carranza FA, eds. *Clin Periodontol.* 12th ed. California: Elsevier Publishing, 2016, 631-640.
42. Ong MA, Wang H-L, Smith FN: Interrelationship between periodontics and adult orthodontics. *J Clin Periodontol* 1998; 25:271-277.