Republic of Iraq
Ministry of Higher Education
and Scientific Research
University of Baghdad
College of Dentistry

Orthodontic Interventions to Resolve Periodontal Osseous Defects (A Literature Review)

A Project Submitted to
The College of Dentistry, University of Baghdad, Department of Periodontics in Partial Fulfillment for the Bachelor of Dental Surgery

By
Alhussain Abdulsalam Muhammed

Supervised by:
Lecturer, Lubaba A. Abdulameer
B.D.S, M.Sc. periodontics

(A.D.) April, 2023 **(A.H.) 1444**

Certification of the Supervisor

I certify that this project entitled **"Orthodontic Interventions to Resolve Periodontal Osseous Defects (a Literature Review)"** was prepared by **Alhussain A.** under my supervision at the College of Dentistry/University of Baghdad in partial fulfillment of the graduation requirements for the Bachelor degree in dentistry.

Supervisor's name
Lubaba A. Abdulameer

Date
April, 2023

Dedication

To my dear parents, sisters, brother and friends for their big support and encouragement.

Alhussain

Acknowledgment

Primarily and foremost, I would like to thank the supreme power the **Almighty God** for giving me the strength, patience and endurance to complete this project with success.

I would like to express grateful thanks to dean of College of Dentistry, University of Baghdad **Prof. Dr. Raghad A. AL-Hashimi**.

Grateful thanks to **Prof. Dr. Maha Shukri Mahmoud**, head of department of **Periodontics,** who gave me the opportunity to do this project.

Special thanks, gratitude and sincere appreciation to my caring and kind supervisor **Lec. Lubaba A. Abdulameer** for her support and advices in completing this project.

I cannot express enough thanks to my loving and supporting family, with special thanks to the big support in my life, my **Mother** and **Father**.

To my friend **Bashar,** who stood beside me the whole college years and helped me complete this project.

Last but not least I would like to thank all my classmates who helped me directly or indirectly.

Table of Contents

List of Figures

Introduction

During the last decades, the number of patients seeking orthodontic treatments has increased, as also have the aesthetic demands and the request for shorter treatment times **(Hernandez and Guijarro, 2012)**.

The most common objectives of an orthodontic treatment are facial and dental aesthetics and the improvement in the masticatory function. There is a continuously increasing number of adult patients who actively seek orthodontic treatment, and it is also an undeniable fact that the incidence of periodontal disease increases with age. Therefore, the number of patients with periodontal problems that attend orthodontic practices is significantly greater than in the past **(Proffit *et al.*, 2007)**.

Periodontal care should be directed towards eliminating the bacterial infection and preventing reinfection. This involves creating an environment which encourages self-cleansing and is less conducive to harboring pathogenic bacteria. Appropriate therapy for each individual depends on the type, severity and morphology created by the specific disease, along with cooperation from the patient. Regardless, elimination of as many plaque-retentive areas should always be the primary objective of a treatment. Large number of teeth are extracted to eliminate periodontal defects (that act as bacterial reservoirs) that can be corrected by simple tooth eruption **(Vanarsdall, 1995)**.

Although orthodontic treatment may not be considered preventive or corrective of periodontitis, it is one of the solutions to reduce the local factors. Patients with predisposing periodontal health tend to experience movement in teeth, as there will be comparatively lesser periodontal support. Commonly occurring movements of teeth include migration of teeth, intrusion, extrusion and flaring of teeth. In such cases, orthodontic treatment helps in eliminating the malposition of teeth but also aids in long term maintenance **(Brown and Garci, 1994)**.

When moving teeth orthodontically, the entire periodontal attachment apparatus, including the osseous structure, the PDL, and the soft tissue components, move with the tooth. Even though the connective tissue attachment level remains unchanged along the root surface there are considerable morphological alterations to crestal bone with tooth uprighting **(Ong and Wang, 2002)**.

Aims of The Study

To focus on the role of orthodontic treatment as an adjunct to periodontal treatment in some periodontal defects.

Chapter One: Review of Literature

1.1 Benefits of Orthodontic Treatment for a Periodontal Patient:

Six factors are seen by **Newman *et al.* (2007)** as benefits of orthodontic treatment of patients with periodontal disease:

1- Alignment of crowded anterior teeth, improving access to all tooth surfaces during hygiene, which is a great advantage for patients that are prone to bone loss or that do not have the manual dexterity necessary to maintain good oral hygiene **(Fig. 1.1)**.

2- Tooth uprighting, which may correct certain bone defects and often rules out the need for osteotomy **(Fig. 1.2)**.

3- Esthetic improvement of coronal positioning before restoration, which may eliminate the need for gingival recontouring, a procedure that may require bone excision and root exposure **(Fig. 1.3)**.

4- Teeth with fracture, perforations, subgingival or intraosseous caries may be treated with adequate restorations or prostheses after forced eruption, which may even improve resistance and retention **(Fig. 1.4)**.

5- Elimination of open embrasures, which affect esthetics in the anterior region, and may be corrected by tipping the roots of adjacent teeth or by reducing interproximal distance or distance between roots **(Fig. 1.5)**.

6- The position of adjacent teeth may be improved before implants, fixed or removable prostheses are placed **(Fig. 1.6)**.

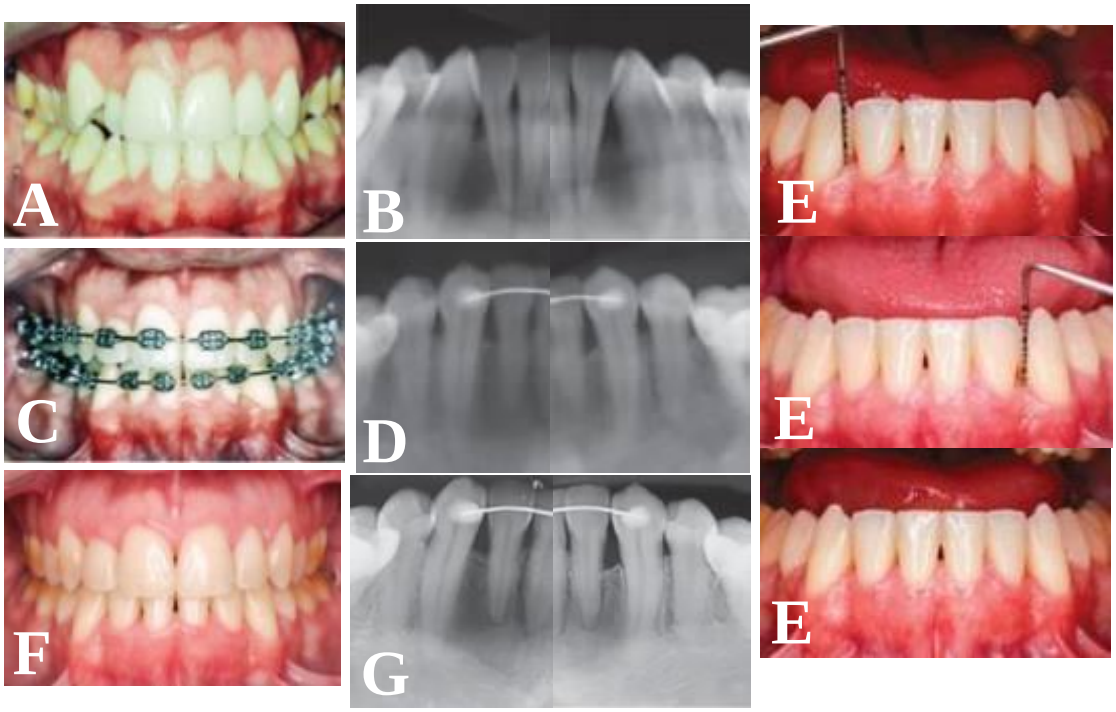

Figure 1.1: (Tondelli, 2019). A 36-year man with periodontitis in the anterior mandibular region. **(A):** Patient complained that severe crowding complicated his oral hygiene and exacerbated the problem. **(B):** Radiographs showed a periodontal disease condition between mandibular canines and lateral incisors, with bone loss and low density. **(C):** Treatment plan included the extraction of maxillary and mandibular second premolars and distalization of premolars and canines. **(D):** Radiographs after treatment showed that the roots were preserved and there was no additional bone loss. **(E):** Periodontal probing confirmed that the periodontium was healthy. **(F):** Treatment results (clinically). **(G):** Follow-up nine years and three months after treatment, radiographs revealed stability of bone structures.

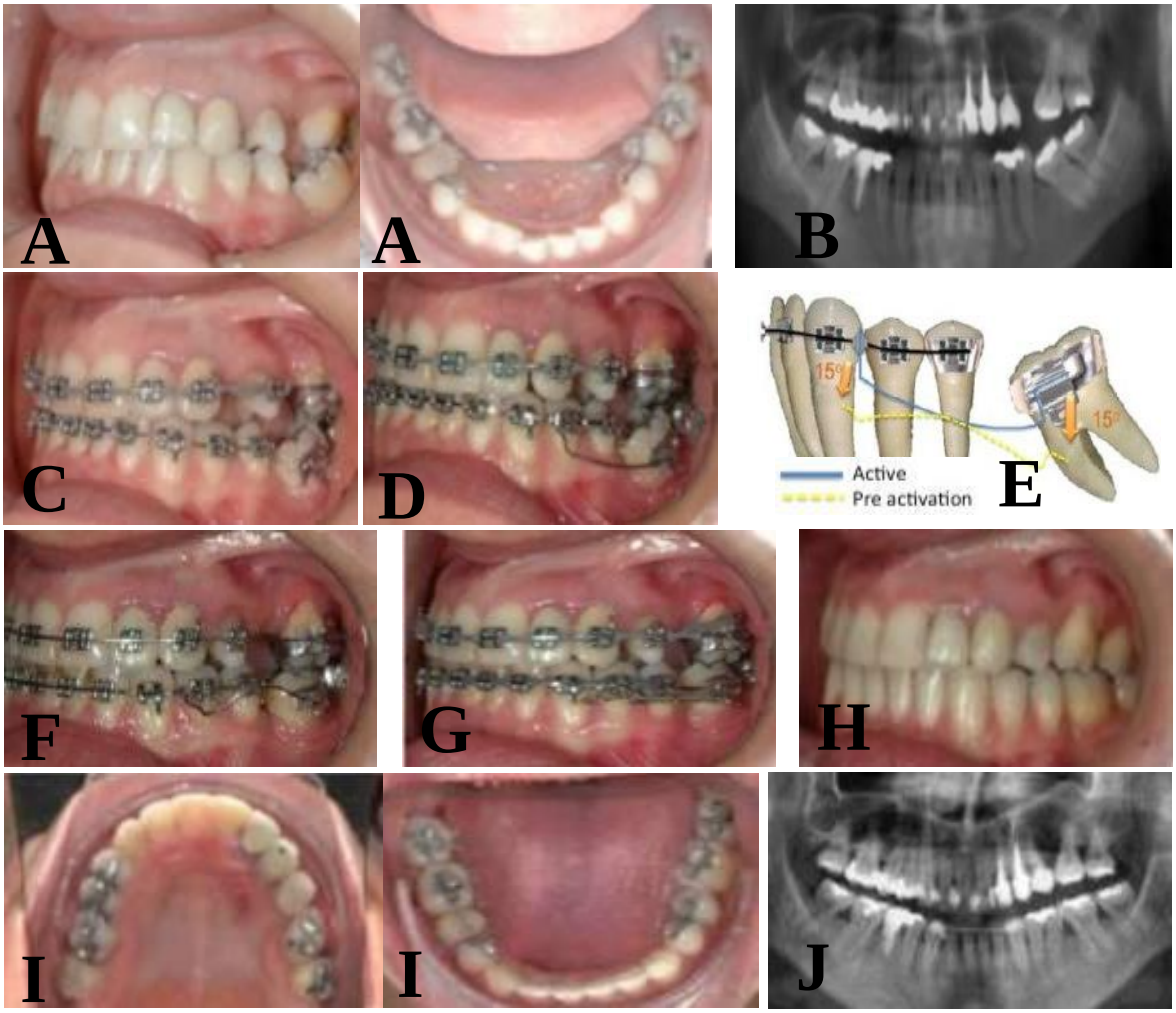

Figure 1.2: (Raveli *et al.*, 2017). Adult female patient sought orthodontic treatment in order to rehabilitate early lost teeth spaces that remained untreated. **(A):** lower left second molar was found tipped over the space that once was lower left first molar, almost entirely closing the space. **(B):** Initial OPG. **(C):** Treatment plan included that the remaining mandibular extraction site would be closed to cut out the need for additional surgical procedures or implants, and also reduce treatment expenses. **(D):** A fixed orthodontic appliance was installed for the alignment and leveling of the anterior and right posterior teeth, and once it was stabilized with stiff segmented wires, the segmented arch technique could be applied using anterior segment as anchor. A root correction spring was applied to the tooth. **(E):** Root correction spring design (uprighting spring). **(F):** Uprighting spring (after activation). **(G):** After the molar was brought to the upright position, a closed nitinol spring coil was added to close this remaining space and bring the second molar forward. **(H):** Treatment ended with a Class II of Angle molar relation for the left side because the upper left second molar was also brought forward to close space left from a lost tooth. **(I):** A 3x3 fixed retainer was provided for the lower arch and a removable appliance for the upper arch. **(J):** Final OPG.

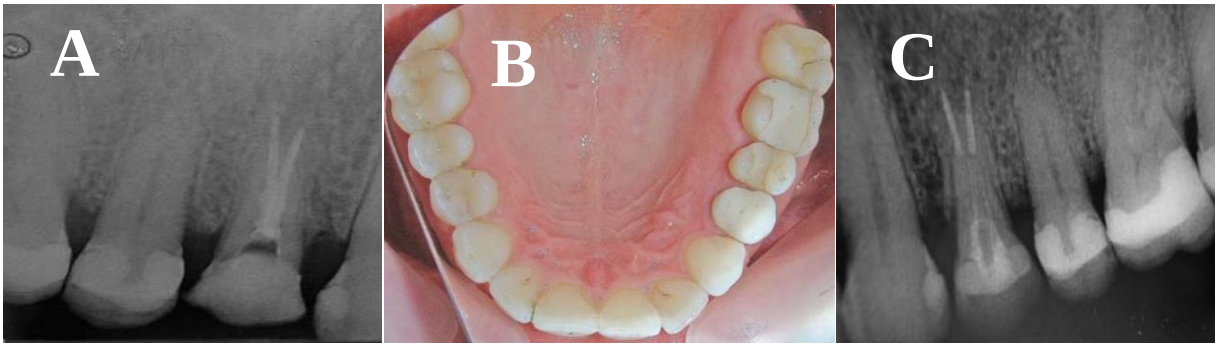

Figure 1.3: (Bielicka *et al.*, 2008). A 35−year−old patient was referred presenting dental injury in the upper left premolar tooth. Clinical examination revealed the crown fracture with remaining only buccal part of crown. The fracture line was located subgingivally in the level of alveolar crest at the palatal and mesial aspect and extending 2 mm supra−gingivally at the distal aspect. **(A):** The radiographic examination confirmed the clinical findings and also revealed that the tooth was earlier treated endodontically. In such case, due to subgingival location of the fracture line, there was not possible to properly preparate the root in order to made a post and core. Therefore, treatment plan was orthodontic treatment to extrude the dental root and move the fracture line above the alveolar bone. Then the tooth was restored prosthodontically, with a post and core, and porcelain crown. **(B):** Palatal view after prosthetic restoration of tooth. **(C):** Radiographic view of the tooth after cementation of post and core and ceramic crown.

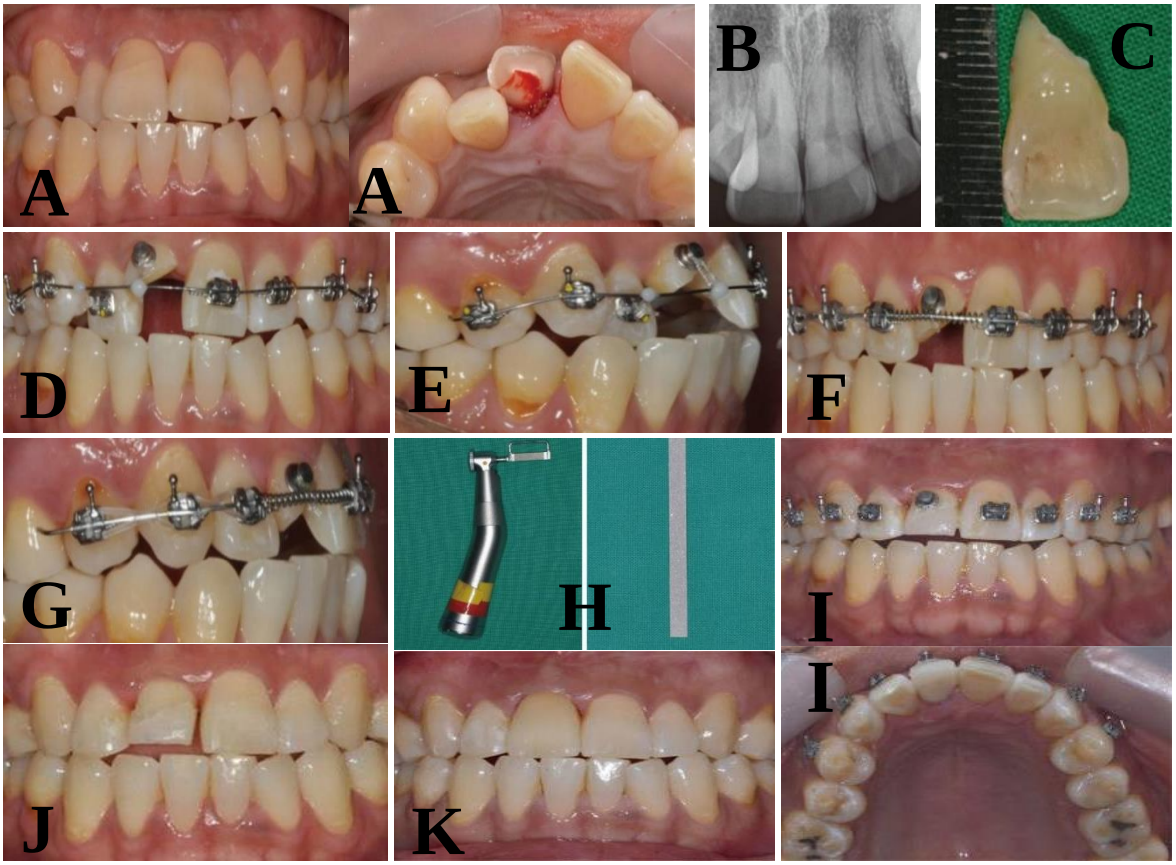

Figure 1.4: (Kang *et al.*, 2016). A 37-year-old male came to the Department of Conservative Dentistry in Korea, requesting treatment for an injured maxillary right central incisor. patient reported that he fell off a bicycle and injured the tooth 1 day previously. **(A, B):** Clinical and radiographic examinations showed an oblique crown-root fracture with pulp exposure of the maxillary right central incisor. **(C):** Fracture line extended approximately 6 mm below the cemento-enamel junction at the mesiopalatal aspect after removing the coronal segment. **(D):** Treatment plan included orthodontic extrusion, all-ceramic crown restoration of the maxillary right central incisor and orthodontic alignment combined with interproximal reduction of the crowded maxillary anterior teeth. Root canal treatment was completed. **(E):** Extrusion of the central incisor and labial movement of the lateral incisor were done with elastic threads. **(F, G):** After 12 weeks of orthodontic treatment, approximately 4 mm of extrusion had been achieved, exposing a good substrate for restoration. In addition, the palatally positioned right lateral incisor was labially re-aligned. In addition, an open coil spring was inserted between the right lateral incisor and the left central incisor to shift the left central incisor and both lateral incisors distally over 4 weeks. **(H):** Interproximal reduction was performed using an orthostrip (left) and a metal strip (right) on maxillary left central and both lateral incisors. **(I):** After 16 weeks, an appropriate space for the maxillary right central incisor had been made and a coronal restoration was performed with a fiber post. **(J):** Additional interproximal stripping was necessary

because of a size discrepancy between centrals. After the interproximal reduction and the additional 4 weeks tooth movement, tooth alignment was completed at 20 weeks of orthodontic treatment. **(K):** A porcelain-fused-to-zirconia crown was constructed over the fractured tooth.

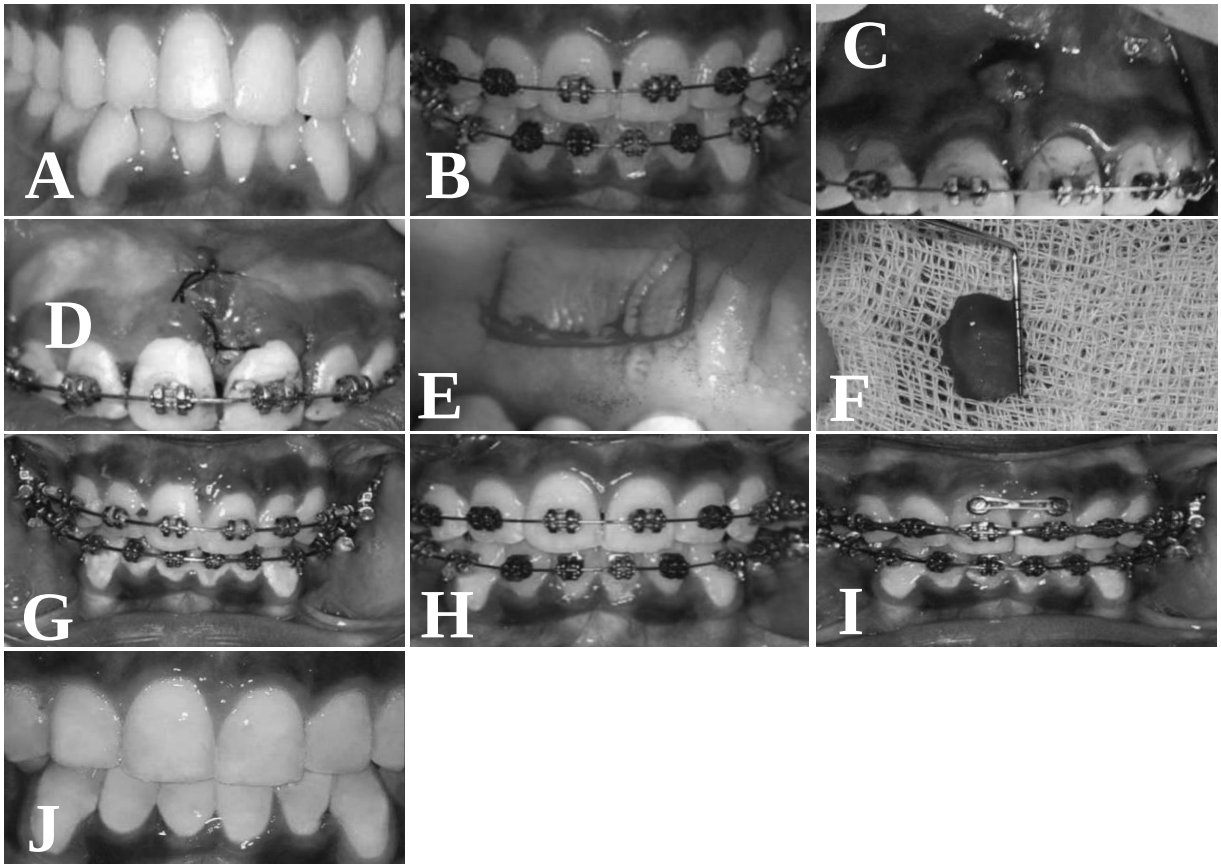

Figure 1.5: (Edathotty *et al.*, 2010). 15-year-old female patient, **(A):** She had crowded and overlapped maxillary central incisors and sought orthodontic consultation for "an improved smile". **(B):** Correction was planned orthodontically. Then an annoying black triangle resulted owing to the de-crowding of the triangular shaped incisors, which had to be corrected. **(C, D):** Periodontal intervention with semilunar coronally repositioned flap with **(E, F):** connective tissue graft from the palate was performed to achieve long term stability and success. **(G):** A frenectomy too was performed to prevent any untoward forces on the incisive papilla. **(H):** In two months of post periodontal intervention, papillary recession due to cicatricial contraction of the graft tissue was observed leading to the 50% relapse of the black triangle. **(I):** The situation was reassessed and the correction was re-planned orthodontically by altering the contour of the teeth involved. A proximal slenderization was performed at the incisal level contact area of the centrals. The space closure was continued, followed by placing bondable buttons more gingival to the brackets of both the incisors and teeth moved bodily towards each other when elastomeric chain was engaged on to the buttons. **(J):** The incisors were brought to a good proximal contact maintaining good root parallelism.

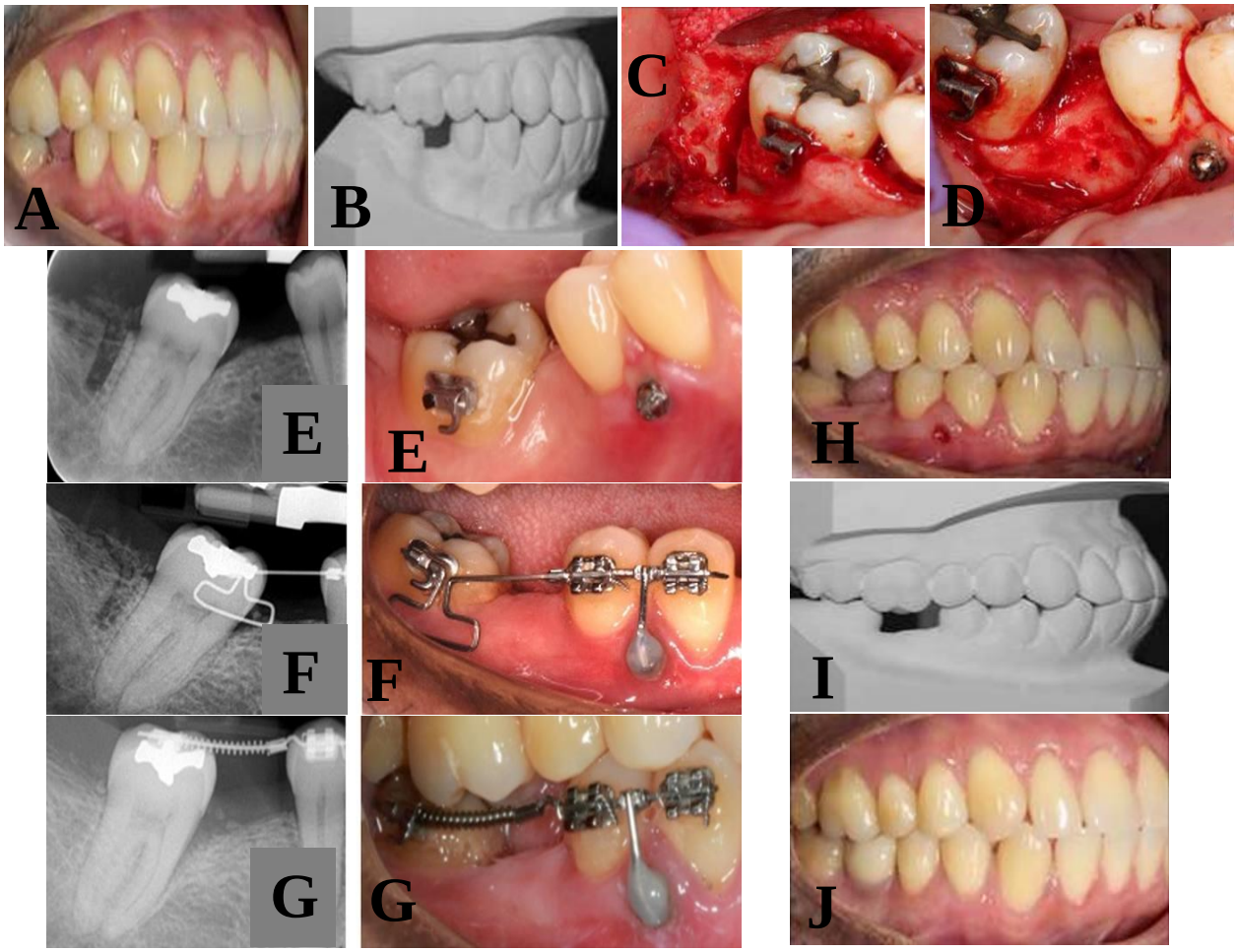

Figure 1.6: (Zhou *et al.*, 2019). A 46-year-old African American male referred to have the right molar uprighted before implant placement. **(A):** The mandibular first molars were missing and the second molars were inclined mesially. **(B):** The records indicated the edentulous spaces are 5.9mm, measured as the shortest inter-crown distance. To achieve a 9-10mm implant space, a distal crown movement was required to upright the right molar. **(C):** A 3mm wide x10mm deep buccal-lingual through cut were made 1mm distal to the molar. **(D):** On the mesial alveolar ridge, multiple perforations were placed into the bone and a miniscrew was placed between the premolars to serve as indirect anchorage. **(E):** Treatment plan included: uprighting the molar for implant site development and to minimize the treatment time prior to implant placement. **(F):** Immediately following the surgery (on the same day), the uprighting springs were delivered, T-loop from the premolars was secured by ligature ties and a crimpable stop distal to the second premolar bracket. **(G):** In the third month, the T-loop on the right side was replaced by a stainless-steel wire with nickel titanium open coil. **(H):** Orthodontic treatment was completed and the molar was uprighted after 5 months. **(I):** Post- treatment cast revealed that the edentulous space was increased by 3.2mm and second molar root angulation change was 32.9°. **(J):** After implant and crown placement.

1.2 Orthodontic Treatment for Osseous Defects

According to **Proffit *et al.* (2003)**, there are three risk groups in a population for progression of periodontal bone loss:

(a) those with rapid progression (about 10%).

(b) those with moderate progression (the majority, about 80%).

(c) those with no progression (about 10%).

Patients who have had a history with periodontal disease and bone loss, present with no contraindication to receiving orthodontic treatment if the disease has been treated and maintained adequately since. The Periodontist usually guides the Orthodontist in this regard as progression of an untreated periodontal breakdown must be anticipated, however, the patient's periodontal condition must receive attention during planning and execution of orthodontic treatment **(Nowzari *et al.*, 2008)**.

1.2.1 Hemiseptal Defects

Are vertical defects in the presence of adjacent roots and where half of a septum remains on the tooth, represents a special case of one-wall defects and the treatment is always a challenge despite the various periodontal regenerative therapies **(Reynolds *et al.*, 2003)**.

Hemiseptal defects are one or two wall osseous defects that often are found around mesially tipped teeth **(Fig. 1.7)** or teeth that have super-erupted. Usually, these defects can be eliminated with the appropriate orthodontic treatment. In the case of the tipped tooth, uprighting and eruption of the tooth levels the bony defect. If the tooth is supererupted, intrusion and leveling of the adjacent cementoenamel junctions (CEJs) can help level the osseous defect **(Brown, 1973; Ingber, 1974)**.

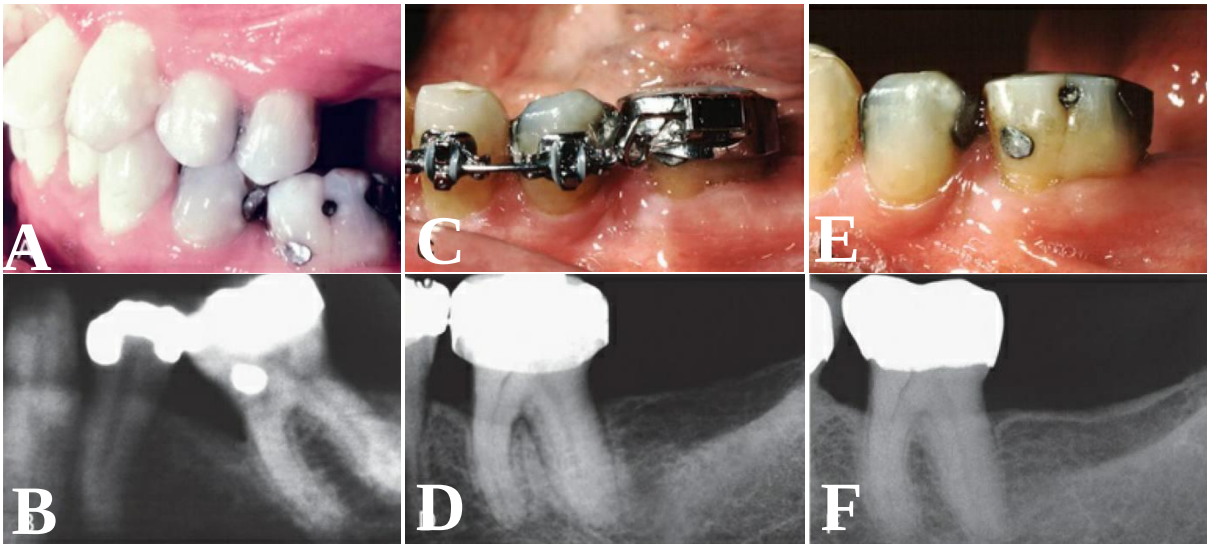

Figure 1.7: (Newman *et al.*, 2019). This patient was missing the mandibular left second premolar, and the first molar had tipped mesially. **(A):** pre-treatment intraoral photograph. **(B):** Pretreatment periapical radiograph revealed a significant hemiseptal osseous defect on the mesial side of the molar. **(C):** To eliminate the defect, the molar was erupted, and the occlusal surface was equilibrated **(D):** The eruption was stopped after the bone defect was leveled. **(E):** Post-treatment intraoral photograph **(F):** And periapical radiograph show that the periodontal health was improved by orthodontic correction of the hemiseptal defect.

1.2.2 Advanced Horizontal Bone Loss

Jayakumar *et al.* (2010) concluded that, the most common pattern of bone loss experienced is horizontal bone loss, which is also called a zero-wall defect. It results in reduced height, but the bone margins remain perpendicular to the tooth surface.

The location of the bands and brackets on the teeth is a primary determinant of outcome after orthodontic treatment has been planned. In a periodontally healthy individual, the anatomy of the crowns of the teeth determines the position of the brackets. Incisal edges and marginal ridges form a guide to position the anterior brackets and posterior bands or brackets. If the incisal edges and marginal ridges are at the correct level, the cementoenamel junction (CEJ) will also be at the same level. This relationship creates a flat, bony contour between the teeth **(Proffit *et al.*, 2003).**

In situations where the patient has an underlying periodontal problems and significant alveolar bone loss around certain teeth **(Fig. 1.8)**, using the anatomy of the crown to determine bracket placement is not appropriate. In vital teeth, the equilibration should be performed gradually to allow the pulp to form secondary dentin and insulate the tooth during the equilibration process. The main goal of equilibration and favorable bracket placement is to provide a constructive bony level as well as a more favorable crown-to-root ratio. In some of these patients, the initially apparent periodontal defects may not need periodontal surgery after orthodontic therapy **(Ogihara and Wang, 2010).**

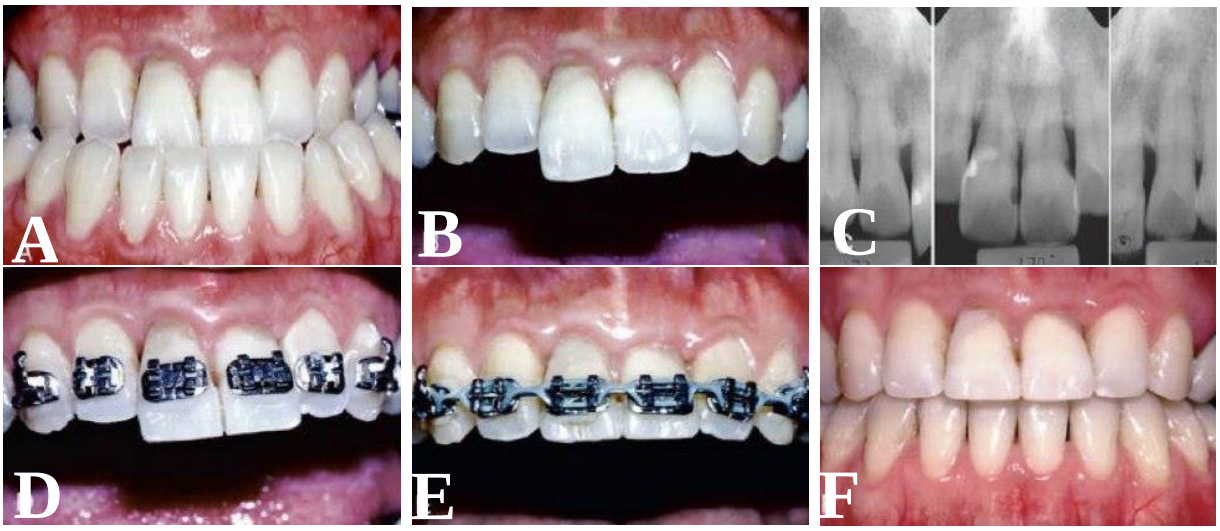

Figure 1.8: (Newman *et al.*, 2019). Before orthodontic treatment, **(A):** this patient had a significant class III malocclusion. **(B):** The maxillary central incisors had overerupted relative to the occlusal plane. **(C):** Pretreatment periapical radiography showed that significant horizontal bone loss had occurred. **(D):** To avoid creating a vertical periodontal defect by intruding the central incisors, the brackets were placed to maintain bone height. **(E):** The incisal edges of the centrals were equilibrated and **(F):** the orthodontic treatment was completed without intruding the incisors.

1.2.3 Furcation Defects

American Academy of Periodontology (2001) stated that the furca can be defined as the anatomic area of a multirooted tooth in which the roots diverge. Furcation invasion or involvement is the result of ‘‘pathologic resorption of the supporting alveolar bone within a furcation’’.

Furcation lesions require special consideration because they are the most difficult lesions to maintain and can worsen during orthodontic therapy. These patients should be maintained on a 2- to 3-month recall schedule. Detailed periodontal instrumentation and biofilm control of these furcation lesions will help to minimize further periodontal breakdown **(Kramer, 1992)**.

In some patients requiring hemisection of a mandibular molar with a class III furcation, moving the roots apart during orthodontic treatment may be advantageous **(Fig. 1.9)**. If the hemisected molar will be used as an abutment for a bridge after orthodontics, moving the roots apart orthodontically permits a favorable restoration and splinting across the adjacent edentulous spaces. In these patients, hemisection, endodontic therapy, and periodontal surgery must be completed before the start of orthodontic treatment. After completion of these procedures, bands or brackets can be placed on the root fragments, and coil springs can be used to separate the roots. This process eliminates the original furcation problem and allows the patient to clean the area with greater efficiency **(Newman *et al.*, 2019)**.

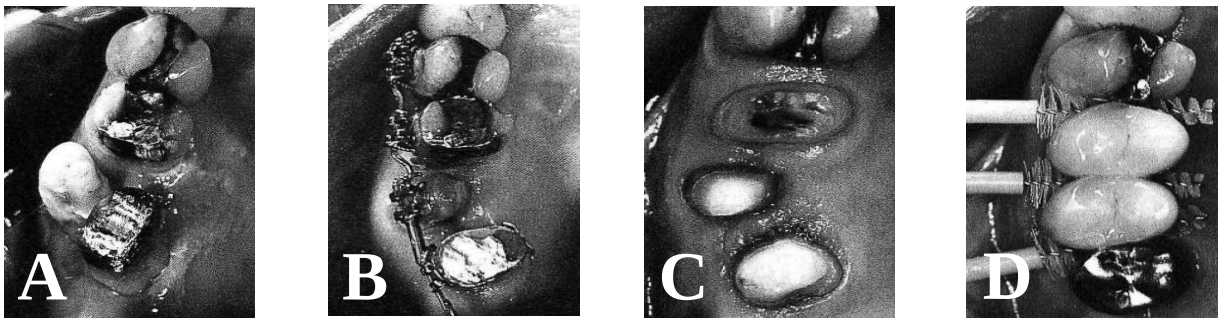

Figure 1.9: (Mayer and Basdra, 1997). A 58-year-old female patient presented with advanced periodontal disease. The first maxillary left molar showed a class-III furcation defect (through and through destruction). 2 years after starting periodontal treatment, a periodontal abscess with an endo-perio lesion had manifested at the distobuccal root of this tooth. **(A):** After endodontic therapy, the distal root was separated and extracted and the remaining mesiobuccal and palatal roots were separated. Scaling and root-planing were performed during surgical procedure. **(B):** treatment plan included moving the palatal root orthodontically and to align the two roots into the arch as if they were two separate one-rooted teeth. The left 1st and 2nd premolars as well as the mesial and palatal roots of the 1st molar were

bonded/banded. The palatal root was derotated and moved distally by orthodontic means. **(C):** When a favorable and easily accessible position of the palatal root was achieved, the roots were retained for 3 months with a temporary restoration. **(D):** This new anatomical position of the roots enabled the patient to effectively clean the former interradicular areas with an interdental brush. After several control visits, the oral hygiene of the area was optimal and the permanent restoration was inserted.

1.2.4 Root Proximity

The term ‘‘root proximity’’ refers to a situation where the distance between the roots of adjacent teeth on radiographs is ≤1.0 mm **(Trossello and Gianelly, 1979)**.

The inter-radicular distance (IRD) is of great importance because it affects the inter-root bone quality and quantity **(Årtun *et al.*, 1987)**.

Root proximity is favorable when more than 1 mm of bone is present between the roots, and unfavorable where less than 1 mm of bone is present **(Vermylen *et al.*, 2005)**.

According to **Heins and Wieder (1986)**, in case of presence of less than 0.5 mm IRD, only lamina dura without cancellous bone is present between the roots, and when the IRD is less than 0.3 mm, the adjacent roots are separated only by the periodontal ligament. It has been shown that absence of cancellous bone between two cortical bone plates leads to low regenerative capacity and consequent horizontal bone loss.

Root proximity may complicate plaque removal, and lead to deterioration of oral health **(Saad and Al Shareef, 2013)**. For this reason, root proximity is considered as one of the factors that can result in questionable periodontal prognosis **(Zitzmann *et al.*, 2010)**.

For the patient undergoing orthodontic therapy, the roots can be separated and bone will form between adjacent roots. This opens the embrasure beneath the tooth contact, provides additional bone support, and enhances the patient's access

to the interproximal region for hygiene. This approach generally improves the periodontal health of this area. If orthodontic treatment will be used to separate the roots, this plan must be understood before bracket placement. Brackets must be placed obliquely to facilitate this process. Radiographs are needed to monitor the progress of orthodontic root separation. In general, 2 to 3 mm of root separation provides adequate bone and embrasure space to improve periodontal health. During this time, patients should be maintained on recall to ensure that a favorable bone response occurs as the roots are moved apart **(Newman *et al.*, 2019)**.

1.2.5 Fractured Teeth and Forced Eruption

Restoration of a tooth fractured in the coronal-third **(Fig. 1.10)** of the root is a difficult procedure. Preservation of the gingival biologic width is critical for the long-term success of the treatment **(Padbury *et al.*, 2003)**.

Restorative, functional and aesthetic needs should be balanced with the demands of healthy periodontium. Aesthetic considerations of tooth restoration very often demand the placement of the subgingival margin. Care must be taken to involve the sulcus as little as possible in the process. Placing the margin of the restoration in the biologic width frequently leads to chronic gingivitis, the loss of clinical attachment, bony pockets and gingival recessions **(Ivey *et al.*, 1980)**.

Figure 1.10: (Koyuturk and Malkoc, 2005). A 9-year-old child had applied to clinic with complaint of tooth fracture and bad esthetic appearance of his upper right central incisor 1 day after dental trauma. **(A):** Intra-oral and radiographic examinations revealed cervical root fracture and pulp exposure of the immature central incisor. **(B):** Treatment plan included apexogenesis, orthodontic forced eruption and composite resin restoration. **(C):** Buccal view after super elastic wire on the button tying. **(D):** After extrusion. **(E):** Tooth was restored by using a hybrid composite resin system. **(F):** Patient was examined every 3 months during the follow-up period of 18 months. The patient was periodontally healthy. No relapse occurred by the end of the 18th month. The tooth did not show any signs of the root resorption during the treatment and follow-up periods. Radiograph at 18 months showed that the root formation was complete. **(G):** RCT was performed on the tooth to allow for the placement of a post. After a 3-year follow-up period, the gingival sulcus depth was normal. No relapse was present during the follow-up period, nor did the tooth show any signs of the root resorption during follow-up periods.

However, if the fracture extends too far apically, it may be better to extract the tooth and replace it with an implant or bridge. The following six criteria are used to determine whether the tooth should be forcibly erupted or extracted **(Newman *et al.*, 2019):**

1- Root Length: If a tooth fracture extends to the level of the bone, it must be erupted 4 mm. The first 2.5 mm moves the fracture margin far enough away from the bone to prevent a biologic width problem. The other 1.5 mm provides the proper amount of ferrule for adequate resistance form of the crown preparation. The length of the residual root should be compared with the length of the eventual crown on this tooth. The root-to-crown ratio should be about 1:1. If the root-to-crown ratio is less than that, there may be too little root remaining in the bone for stability. In this situation, it may be prudent to extract the root and place a bridge or implant.

2- Root Form: The shape of the root should be broad and non-tapering rather than thin and tapered. A thin, tapered root provides a narrower cervical region after the tooth has been erupted 4 mm. This could compromise the aesthetic appearance of the final restoration. The internal root form is also important. If the root canal is wide, the distance between the external root surface and the root canal filling will be narrow. In these patients, the walls of the crown preparation are thin, which could result in early fracture of the restored root. The root canal should not be more than one-third of the overall width of the root, so that the root can still provide adequate strength for the final restoration.

3- Level of The Fracture: If the entire crown is fractured 2 to 3 mm apical to the level of the alveolar bone, it is difficult, if not impossible, to attach to the root to erupt it.

4- Relative Importance of The Tooth: If the patient is 70 years of age and both adjacent teeth have prosthetic crowns, it would be more prudent to construct a fixed bridge. However, if the patient is 15 years of age and the adjacent teeth are unrestored, forced eruption would be much more conservative and appropriate.

5- Aesthetics: If the patient has a high lip line and displays 2 to 3 mm of gingiva when smiling, any type of restoration in this area will be more obvious. Keeping the patient's own tooth would be much more aesthetic than any type of implant or prosthetic replacement.

6- Endodontic/Periodontal Prognosis: If the tooth has a significant periodontal defect, it may not be possible to retain the root. In addition, if the tooth root has a vertical fracture, the prognosis would be poor, and extraction of the tooth would be the proper course of therapy.

If all these factors are favorable, forced eruption of the fractured root is indicated.

1.2.6 Hopeless Teeth Maintained for Orthodontic Anchorage

Patients with advanced periodontal disease may have specific teeth with hopeless prognosis **(Fig. 1.11)**, which usually undergo extraction before orthodontic treatment **(Newman *et al.*, 2007)**.

Graetz *et al.* (2011) reported that, the aim of periodontal treatment is to arrest periodontal disease progression and maintain patients' teeth irrespective of the prognosis. In both aggressive and chronic periodontitis patients, approximately 80%–88% of questionable and 60%–66% of hopeless teeth survived at the end of 15-year supportive periodontal therapy.

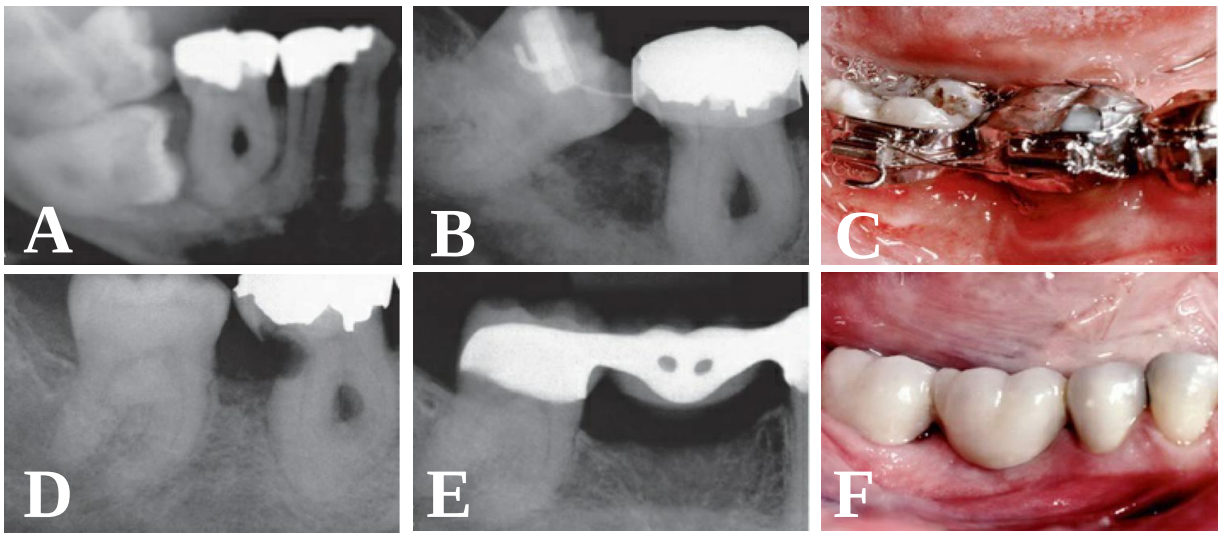

Figure 1.11: (Newman *et al.*, 2019). Before orthodontic treatment, **(A):** this patient had an impacted mandibular right second molar **(B, C, D):** The mandibular right first molar was periodontally hopeless because of an advanced class III furcation defect. The impacted second molar was extracted, but the first molar was maintained as an anchor to help upright the third molar orthodontically **(E, F):** After orthodontic uprighting of the third molar, the first molar was extracted and a bridge was placed to restore the edentulous space.

Chapter Two: Discussion

In the new era of esthetics, Orthodontic therapy has gained tremendous acceptance by adults. However, treating adults is more challenging as they present with multiple periodontal problems compromising orthodontic treatment. Hence, to provide optimal treatment to adult patients an active interaction between orthodontist and periodontist is imperative.

Orthodontic therapy can contribute in many ways to help patients with periodontal problems. Many patients have crowded, mal-aligned, and mal-positioned maxillary or mandibular anterior teeth, presenting a difficult biofilm control problem. Aligning the crowded teeth orthodontically will help patients maintain improved biofilm control. The incorporation of orthodontic therapy in the treatment of these clinical periodontal problems is a great aid to the clinician and the patient.

Chapter Three: Conclusions

1) Adjunctive orthodontic treatment for patients with periodontal disease has some unique effects.
2) It is essential for dentists to have adequate knowledge on perio-ortho interrelationship.
3) Maintaining a good oral hygiene and receiving regular basic periodontal care is of outmost importance to achieve a more effective orthodontic treatment.
4) A better outcome can be achieved along with good maintenance, through a close collaboration between the orthodontist and the periodontist.
5) Orthodontic treatment is considered as a solution to reduce local factors.
6) Orthodontic treatment helps to upright the malposed teeth and aids in long term maintenance.

References

(A)

- American academy of periodontology (2001). *Glossary of periodontal terms*. 4th ed. Chicago: American Academy of Periodontology.
- Årtun, J., Kokich, V.G. and Osterberg, S.K. (1987). Long-term effect of root proximity on periodontal health after orthodontic treatment. *American Journal of Orthodontics and Dentofacial Orthopedics*, 91(2), pp.125–130.

(B)

- Bielicka, B., Bartkowiak, M., Urban, E., & Tomasz, M. (2008). Holistic approach in the management of subgingivally fractured premolar tooth - case report. *Dental and Medical Problems*, 45(2), pp.211-214.
- Brown, I.S. (1973). The Effect of Orthodontic Therapy on Certain Types of Periodontal Defects I—Clinical Findings. *Journal of Periodontology*, 44(12), pp.742–756.
- Brown, L.J. and Garcia, R. (1994). Utilization of Dental Services as a Risk Factor for Periodontitis. *Journal of Periodontology*, 65(5s), pp.551–563.

(G)

- Graetz, C., Dörfer, C.E., Kahl, M., Kocher, T., Fawzy El-Sayed, K., Wiebe, J.-F., Gomer, K. and Rühling, A. (2011). Retention of questionable and hopeless teeth in compliant patients treated for aggressive periodontitis. *Journal of Clinical Periodontology*, 38(8), pp.707–714.

(H)

- Heins, P.J. and Wieder, S.M. (1986). A Histologic Study of the Width and Nature of Inter-radicular Spaces in Human Adult Pre-molars and Molars. *Journal of Dental Research*, 65(6), pp.948–951.
- Hernández-Alfaro, F. and Guijarro-Martínez, R. (2012). Endoscopically Assisted Tunnel Approach for Minimally Invasive Corticotomies: A Preliminary Report. *Journal of Periodontology*, 83(5), pp.574–580.

(I)

- Ingber, J.S. (1974). Forced Eruption: Part I. A Method of Treating Isolated One and Two Wall Infrabony Osseous Defects - Rationale and Case Report. *Journal of Periodontology*, 45(4), pp.199–206.
- Ivey, D.W., Calhoun, R.L., Kemp, W.B., Dorfman, H.S. and Wheless, J.E. (1980). Orthodontic extrusion: Its use in restorative dentistry. *The Journal of Prosthetic Dentistry*, 43(4), pp.401–407.

(J)

- Jayakumar, A., Rohini, S., Naveen, A., Haritha, A. and Reddy, K. (2010). Horizontal alveolar bone loss: A periodontal orphan. *Journal of Indian Society of Periodontology*, 14(3), p.181.

(K)

- Kang, S.-H., Ha, J.-H., Jin, M.-U., Kim, S.-K. and Kim, Y.-K. (2016). Esthetic enhancement of a traumatized anterior tooth with a combination of forced eruption and tooth alignment: a case report. *Restorative Dentistry & Endodontics*, 41(3), p.210.

- Koyuturk, A.E. and Malkoc, S. (2005). Orthodontic extrusion of subgingivally fractured incisor before restoration. A case report: 3-years follow-up. *Dental Traumatology*, 21(3), pp.174–178.

- Kramer, G. M. (1992). Surgical alternatives in regenerative therapy of the periodontium. *International Journal of Periodontics & Restorative Dentistry*, 12(1), pp.10-31.

(M)

- Mayer, T. and Basdra, E.K. (1997). A combined surgical and orthodontic treatment of class III furcations. Report of a case. *Journal of Clinical Periodontology*, 24(4), pp.233–236.

(N)

- Newman, M.G., Takei, H., Klokkevold, P.R. and Carranza, F.A. (2007). *Periodontia Clínica*. Rio de Janeiro: Guanabara Koogan.

- Newman, M.G., Takei, H.H., Klokkevold, P.R., Carranza, F.A. and Satheesh Elangovan (2019). *Newman and Carranza's clinical periodontology*. 13th ed. Philadelphia, Pa: Elsevier.

- Nowzari, H., Yorita, F. K., & Chang, H. C. (2008). Periodontally accelerated osteogenic orthodontics combined with autogenous bone grafting. *Compendium of continuing education in dentistry*, 29(4), pp.200-206.

(O)

- Ogihara, S. and Wang, H.-L. (2010). Periodontal regeneration with or without limited orthodontics for the treatment of 2- or 3-wall infrabony defects. *Journal of Periodontology*, 81(12), pp.1734–1742.

- Ong, M.M.A. and Wang, H.-L. (2002). Periodontic and orthodontic treatment in adults. *American Journal of Orthodontics and Dentofacial Orthopedics*, 122(4), pp.420–428.

(P)

- P, J., Edathotty, T.T. and P, R. (2010). 'The Dreaded Black Triangle' - Orthodontics: The Choice. *Journal of Indian Orthodontic Society*, 44(4), pp.89–93.
- Padbury, A., Eber, R. and Wang, H.-L. (2003). Interactions between the gingiva and the margin of restorations. *Journal of Clinical Periodontology*, 30(5), pp.379–385.
- Proffit, W.R., Fields, H.W. and Sarver, D.M. (2007). *Contemporary Orthodontics*, 4th ed. St. Louis: CV Mosby.
- Proffit, W.R., White, R.P. and Sarver, D.M. (2003). *Contemporary Treatment of Dentofacial Deformity*. St. Louis: Mosby Elsevier.

(R)

- Raveli, T.B., Raveli, D.B., Mathias Almeida, K.C. de and Pinto, A. dos S. (2017). Molar Uprighting: A Considerable and Safe Decision to Avoid Prosthetic Treatment. *The Open Dentistry Journal*, 11(1), pp.466–475.
- Reynolds, M.A., Aichelmann-Reidy, M.E., Branch-Mays, G.L. and Gunsolley, J.C. (2003). The Efficacy of Bone Replacement Grafts in the Treatment of Periodontal Osseous Defects. A Systematic Review. *Annals of Periodontology*, 8(1), pp.227–265.

(S)

- Saad, A. and Al Shareef, A. (2013). Endodontic therapy and restorative rehabilitation versus extraction and implant replacement. *Saudi Endodontic Journal*, 3(3), pp.107-113.

(T)

- Tondelli, P.M. (2019). Orthodontic treatment as an adjunct to periodontal therapy. *Dental Press Journal of Orthodontics*, 24(4), pp.80–92.
- Trossello, V.K. and Gianelly, A.A. (1979). Orthodontic Treatment and Periodontal Status. *Journal of Periodontology*, 50(12), pp.665–671.

(V)

- Vanarsdall, R.L. (1995). Orthodontics and periodontal therapy. *Periodontology 2000*, 9(1), pp.132–149.
- Vermylen, K., De Quincey, G.N.Th., van 't Hof, M.A., Wolffe, G.N. and Renggli, H.H. (2005). Classification, reproducibility and prevalence of root proximity in periodontal patients. *Journal of Clinical Periodontology*, 32(3), pp.254–259.

(Z)

- Zhou, J., She, X., Miller, P.D. and Yao, H. (2019). Selective osteotomy-assisted molar uprighting and simultaneous ridge augmentation for implant site development. *American Journal of Orthodontics and Dentofacial Orthopedics*, 156(6), pp.846–857.

- Zitzmann, N.U., Krastl, G., Hecker, H., Walter, C., Waltimo, T. and Weiger, R. (2010). Strategic considerations in treatment planning: Deciding when to treat, extract, or replace a questionable tooth. *The Journal of Prosthetic Dentistry*, 104(2), pp.80–91.