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ALTERING VERTICAL DIMENSION IN THE PERIO-RESTORATIVE PATIENT: THE ORTHODONTIC POSSIBILITIES

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*The location of the occlusal plane
limits the scope of improvement
in facial height.*



PHILOSOPHY AND BACKGROUND

In the past decade, the number of adults seeking orthodontic treatment has grown substantially. Today, in most orthodontic practices, 30% to 50% of patients in active orthodontic treatment are adults. My practice is devoted completely to adults. Although adolescent and adult malocclusions are similar, adults usually have additional problems that make their treatment more challenging. One of the most destructive is anterior tooth wear combined with compensatory eruption of the abraded teeth. When this type of patient is referred to me by a restorative dentist, the common request from the clinician is to “open the vertical” to allow adequate restoration of the teeth. What does “open the vertical” mean to you? What should it mean to the orthodontist with whom you are collaborating? Actually, there may be a distinct difference in what is necessary and what is orthodontically possible in an adult patient with worn and/or abraded anterior teeth. Although some clinicians believe that patients with anterior tooth wear are “overclosed” and need to have their vertical dimension increased, this diagnosis and the resulting treatment plan are usually inappropriate. The problem typically is compensatory eruption of the anterior teeth, secondary to incisal wear. The problem for the restorative dentist is insufficient space to restore these teeth without further tooth reduction, possible crown lengthening, and perhaps root canal therapy. However, orthodontists can intrude the maxillary incisors, mandibular incisors, or both in order to create restorative space, move the gingival margins apically, and eliminate the need for further tooth reduction. The team of orthodontist and restorative dentist must decide which teeth are to be intruded, how long they are to be held in position, and how this type of tooth movement will affect the patient’s esthetic appearance.

USING MAXILLARY AND MANDIBULAR INTRUSION TO CREATE RESTORATIVE SPACE: FOUR GUIDING PRINCIPLES

One of the most perplexing problems for general dentists is how to manage restorative treatment for the adult patient with a deep anterior overbite. In most cases, there is little or no room to prepare the anterior teeth adequately, and creating space for restorative materials often requires significant reduction of the existing teeth. Moderate to extensive wear or abrasion of the maxillary and/or mandibular incisors further complicates the overbite problem. As these teeth wear, they usually continue to erupt, bringing the bone and gingiva with them.

In order to restore these short teeth, the restorative dentist typically considers two possible treatment plans. One option involves crown lengthening of the short abraded teeth, followed by potential root canal therapy, post and core buildups, and eventual restoration of the teeth. Another option is to open the patient’s vertical dimension by restoring most of the posterior teeth in order to gain the space needed to restore the anterior teeth. However, there is a third possibility—orthodontics and/or orthognathic surgery. Orthodontists can intrude maxillary and mandibular anterior teeth to create restorative space. In some situations, orthognathic surgery of the mandible and/or maxilla can open the patient’s anterior vertical dimension to improve facial esthetics and provide restorative space. This chapter presents and illustrates the governing principles and the diagnostic techniques required to correctly analyze and prescribe the appropriate treatment for these types of problems.

Advantages of growth

In order to fully comprehend the orthodontic possibilities in resolving problems of vertical dimension, the clinician must first understand the importance of facial growth. Most orthodontic patients are treated during childhood and adolescence. There are several reasons for correcting a malocclusion early in life, but one of the most important is to take advantage of a patient's facial growth potential.

The face grows in two ways. The first is sutural growth, which occurs at the circummaxillary sutures that suspend the maxilla from the skull. But the major source of vertical change that occurs during adolescent growth is found in the mandibular condyle. As the condyle grows, the ramus of the mandible gets longer. During this process, the teeth erupt to fill the space created by ramus growth. This is advantageous in managing a deep overbite in an adolescent patient. Instead of intruding the teeth to resolve the overeruption of the maxillary and mandibular incisors, ramus growth permits space for the posterior teeth to erupt. If the maxillary and/or mandibular incisors are held in their original vertical position during this process, the deep overbite is corrected through posterior tooth eruption and relative incisor intrusion. This possibility simplifies the management of a deep overbite.

However, facial growth is essentially complete for females in the mid to late teenage years and for males by the early twenties. In an adult patient with a deep anterior overbite, growth is not a possibility. Therefore, the orthodontist must rely on intrusion of the maxillary incisors, intrusion of the mandibular incisors, or jaw surgery to correct deep overbites in adults. How do orthodontists diagnose which teeth to intrude and when to use orthognathic surgery to correct problems of vertical dimension? If the patient's anterior teeth are worn and abraded, what is the restorative dentist's role in the interdisciplinary treatment plan for the restoration of these teeth? In order to answer these questions, I will explain how the diagnostic process works and the principles I use to handle these types of patients.

Principle 1

The location of the occlusal plane limits the scope of improvement in facial height.

When I am challenged to determine how to provide restorative space in the patient with a deep anterior overbite, my first step is to determine the patient's correct occlusal plane using the fixed landmarks (ie, those that I cannot control) as my guide. To do this, I identify the occlusal contact point between the maxillary and mandibular second molars. In an adult, I cannot change this relationship. Opening the vertical dimension by extruding maxillary and/or mandibular molars is not stable in adults. Since adults are not growing, the muscles of mastication (primarily the masseter, medial pterygoid, and temporalis) do not have the capacity to stretch. Attempts to increase posterior facial height with orthognathic surgery have consistently been unstable, and the vertical dimension usually reverts to its original level.¹⁻³ So, using the contact between the maxillary and mandibular second molars allows me to realistically determine the posterior limit of the occlusal plane.

Next, I must identify a point anteriorly that will represent a realistic guide for the other end of the patient's occlusal plane. For this I use the level of the patient's upper lip at rest. Again, I cannot alter the position of the upper lip in a nongrowing adult. In addition, if a deep overbite is corrected by intruding anterior teeth, then it is important to intrude the correct teeth and provide the patient with a pleasing esthetic appearance of the teeth relative to the upper lip after treatment. So, the occlusal plane connects the occlusal contact between the maxillary and mandibular second molars and the upper lip. This is the first step in the diagnostic process.

Principle 2

The relationship between the incisors and the occlusal plane reveals the cause of the overbite.

The next step in the diagnostic process is to determine which incisor, maxillary or mandibular, has “overerupted” and is causing the deep overbite. My procedure is to identify the incisal edge of the maxillary central incisor and measure its distance from the occlusal plane. This distance will vary with age. In a 30-year-old, the distance from the occlusal plane (upper lip) to the maxillary central incisal edge at rest should be about 3 mm. However, studies of older adults have shown that this distance decreases with time, and in a 60-year-old it is not unusual for the distance from the incisal edge to the upper lip to be 0 mm with the upper lip at rest.

So, if the patient is 30 years of age, and the distance from the maxillary incisor to the occlusal plane is 5 mm, then at least part of the deep overbite problem is due to overeruption of the maxillary incisors. These teeth could be orthodontically intruded 2 mm to assist in correcting the deep anterior overbite.

Next, I identify the position of the mandibular incisal edge and measure its distance to the occlusal plane. The mandibular incisal edge should be at or near the level of the occlusal plane. If these teeth are 3 to 4 mm above the occlusal plane, then the deep overbite is most likely due to overeruption of the mandibular incisors. These teeth would need to be intruded 3 to 4 mm in order to place the incisal edge at the occlusal plane, correct the deep overbite, and allow the general dentist to complete the restorative treatment for the patient.

However, the maxillary and/or mandibular incisors could be abraded as a result of a bruxing habit. In these cases, intruding the maxillary and/or mandibular incisors would correct the incisal edge position of these teeth, but the general dentist may still need space to restore these teeth to a longer length. In other words, these teeth may need to be intruded further. The next step in the diagnostic process is to assess the gingival levels and crown proportions of the maxillary and mandibular central incisors relative to the lateral incisors and canines.

Principle 3

The correct gingival position determines whether intrusion is the right solution, and crown proportions govern the amount of lengthening that is desirable.

Once the incisal edges of the maxillary and mandibular central and lateral incisors have been positioned correctly relative to the occlusal plane, the next step is to verify their esthetic appearance (maxillary incisors) and structural integrity (mandibular incisors). If the gingival margins of the central incisors are coronal to those of the canines, this could indicate either that these teeth are abraded or that the gingival margins are positioned too far coronally. Sulcus depth helps to reveal the correct diagnosis; therefore, my next step is to measure it with a probe.

If the sulcus depth is 1 mm [**Au: or more?**] and the cementoenamel junction is located at the bottom of the sulcus, then the position of the gingival margin is correct. In this case, the patient likely has incisal wear. I confirm this suspicion by evaluating the maxillary and/or mandibular incisal edges. If I see dentin at these edges, it shows that the patient has abraded at least 2 mm and perhaps more from the incisal edges of these teeth. In this case I would intrude the maxillary and/or mandibular incisors an additional 2 mm or more to position the gingival margin at the correct level relative to that of the maxillary and/or mandibular canines. This permits lengthening of the maxillary and mandibular incisors.

The amount of lengthening desired can be determined by evaluating the width-to-length proportion of the maxillary and mandibular incisors and selecting a proportion that fits the patient's esthetic and occlusal needs as well as the structural requirements for the eventual maxillary and/or mandibular restorations.

Principle 4

The need for jaw surgery depends on facial proportions.

Most patients with deep anterior overbites can be treated in the manner described above. However, if the overbite is severe and/or if the patient's facial dimensions are extremely disproportionate, jaw surgery is another possible option for decreasing the deep overbite. In order to determine whether jaw surgery is necessary, I evaluate the patient's facial proportions, specifically the ratio of upper to lower facial height. The upper facial height is measured from the glabella region at the base of the forehead to a point just beneath the nose; the lower facial height is the distance from the point beneath the nose to a point below the chin. These measurements can be performed using a lateral facial photograph or a cephalometric radiograph.

The normal proportion is around 45% upper to 55% lower facial height. However, if a patient presents with a deep overbite and the upper to lower facial height ratio is 55% to 45%, respectively, the patient has a significant shortening of the lower facial height. Although the deep overbite could perhaps be treated with tooth intrusion, this solution may not enhance the patient's esthetic appearance. In these situations, a mandibular sagittal split osteotomy and rotation of the mandible down in the chin area will open the anterior vertical dimension while maintaining the posterior contact between the maxillary and mandibular second molars, which will maintain the posterior vertical dimension. After the surgery, an open bite is usually present between the maxillary and mandibular premolars. These teeth are then erupted into occlusion. This type of surgery reduces the complexity of the orthodontic treatment but still corrects the deep overbite and improves the facial proportions for the patient.

In some extreme situations, both maxillary and mandibular surgery are necessary to correct a deep overbite and improve facial proportions. This treatment plan is appropriate for the person who shows little or none of his or her maxillary incisors at rest and when smiling. If the patient wants to show more of the maxillary incisors, then the only realistic and stable solution is to rotate both the maxilla and mandible downward anteriorly but maintain the posterior vertical dimension at the same level. This strategy does not alter the contact between the maxillary and mandibular second molars and therefore does not increase posterior vertical dimension, hence reducing the potential for relapse.

Clinicians who apply these principles to the diagnosis of patients with deep anterior overbites and anterior tooth wear should be able to determine the appropriate treatment plan for restoring the patient. To further elucidate and demonstrate the application of these principles, I will use the following case reports to illustrate how the diagnostic process and resulting treatment should unfold.

FIG 2-1 This woman had a deep anterior overbite (*a*), retroclined maxillary and mandibular incisors (*b*), and several unesthetic existing restorations (*c*). Since the cause of the deep overbite (*d*) was shown to be overeruption of the mandibular (*e*) and maxillary incisors, they were intruded orthodontically (*f,g*). As a result, the patient's occlusion (*h*) and smile esthetics (*i*) were improved greatly (*j*).



APPLICATION OF THE PRINCIPLES

Case 1: Deep anterior overbite

This 32-year-old woman was concerned about the esthetic appearance of her maxillary anterior teeth and desired an “esthetic makeover.” She had several long-standing restorations in her maxillary anterior teeth (Fig 2-1a). Her anterior overbite was deep (Fig 2-1b), and the mandibular incisors were impinging on the palatal gingiva. She had a normal Class I posterior occlusion with good interdigitation of her posterior teeth.

I first established the occlusal plane between the occlusal surface of the second molar and her upper lip. The maxillary central incisor was 4 mm, rather than the ideal 3 mm, below the occlusal plane. The mandibular central incisor, which should be at the level of the occlusal plane, was 3 mm above it. There was no incisal wear on either the maxillary or mandibular incisors. The gingival margins of both maxillary and mandibular central incisors were coronal to those of the canines (Fig 2-1c), indicating that the anterior teeth had overerupted. Prior to the patient's restorative treatment, orthodontics was initiated to intrude the mandibular incisors by 3 mm and to intrude the maxillary incisors by 1 mm (Figs 2-1d to 2-1f). As a result, the overbite was reduced by 4 mm, leaving the patient with a good anterior occlusal relationship (Figs 2-1g and 2-1h) and improved smile esthetics (Fig 2-1i). The result after restorative dentistry is shown in Fig 2-1j.

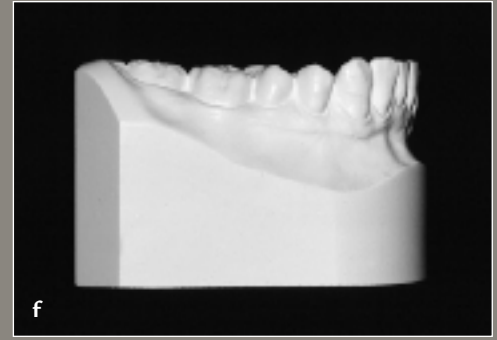
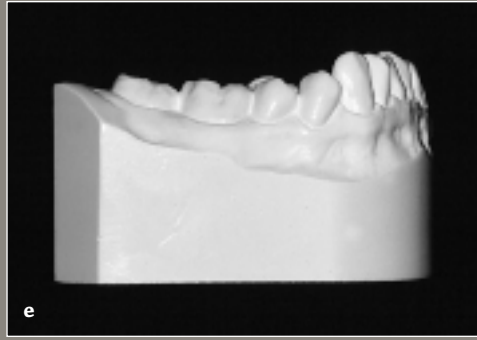


FIG 2-2 This man was unhappy with his short maxillary incisors (*a*). The deep anterior overbite (*b*) prevented the dentist from lengthening these teeth. The overbite was primarily due to overeruption of the maxillary incisors and a protrusive bruxing habit (*c*) that resulted in significant wear (*d*). Orthodontic brackets were placed (*e*) to intrude the overerupted teeth (*f*) and level the gingival margins. The teeth were provisionally restored with composite (*g,h*), and eventually restored with porcelain veneers (*i*).



Case 2: Deep anterior overbite and short maxillary incisors

This 42-year-old male firefighter was concerned about his short maxillary anterior teeth. His wife, a hygienist, encouraged him to see her employer about lengthening his maxillary incisors. The patient had a healthy periodontium and no temporomandibular joint symptoms. He had a well interdigitated Class I posterior occlusion with a deep anterior overbite (Figs 2-2a and 2-2b). The challenge was giving the patient longer maxillary incisors considering his deep anterior overbite. The first step was to determine the cause of the problem. In order to do this, I established the patient's occlusal plane on the cephalometric radiograph between the second molars and the upper lip. The maxillary central incisal edges were 3 mm below that level; at his age, they could be 2 mm from the level of the upper lip. The mandibular central incisal edges were 1 mm above the level of the occlusal plane. These findings indicated that the deep overbite was due in minor degree to the position of the mandibular incisors but was more profoundly influenced by overeruption of the maxillary incisors. However, the patient also had a severe protrusive bruxing habit (Fig 2-2c) and had worn his maxillary incisal edges into the dentin (Fig 2-2d). In particular, about 3 mm of wear was observed at the incisal edge of the maxillary right central incisor, with compensatory eruption of this tooth. Prior to initiation of restorative dentistry, orthodontic brackets were placed on the teeth (Fig 2-2e) in an arrangement that would intrude the abraded teeth (Fig 2-2f), using the gingival margins as a guide to the amount of tooth intrusion. After the gingival margins had been leveled, the incisal edges were provisionally restored with composite (Figs 2-2g and 2-2h). One year after orthodontics, the maxillary incisors were restored with porcelain veneers (Fig 2-2i). Orthodontic intrusion of the maxillary incisors not only provided restorative space but also helped reduce the deep overbite.



FIG 2-3 This man had a deep anterior overbite (*a,b*) due to wear and overeruption of both maxillary and mandibular incisors (*c,d*). The mandibular central incisors (*e,f*) and the maxillary right central incisors (*g,h*) were intruded substantially to level the gingival margins and provide restorative space for the provisional composite restoration of these teeth during orthodontics. One year after orthodontic therapy, porcelain veneers were placed on the maxillary and mandibular central incisors (*i*).



Case 3: Deep anterior overbite and abraded maxillary and mandibular incisors

This 55-year-old man had sensitivity in his mandibular incisors due to their extensive wear. He was also concerned about the appearance of his maxillary anterior teeth. His mandibular incisors needed restoration; however, there was no space to restore these teeth because of his deep anterior overbite (Figs 2-3a and 2-3b). His general dentist wanted to “open the vertical” in order to restore the maxillary and mandibular anterior teeth.

Following my standard procedure, I first established the patient’s occlusal plane between the occlusal surface of the second molars and the upper lip. The maxillary incisors were 2 mm coronal to this line, which is reasonably normal for his age. The mandibular incisal edges, however, were 2 mm above the occlusal plane, when they should be at the same level. Both maxillary and mandibular incisors had been abraded over the years, and dentin was evident at the incisal edges of the maxillary and mandibular central incisors (Figs 2-3c and 2-3d). As the incisal edges had worn, all of these teeth had overerupted and become too short; therefore, they needed to be lengthened restoratively. Prerestorative orthodontics was used to intrude the mandibular central incisors (Fig 2-3e), which were then provisionally restored with composite (Fig 2-3f). The maxillary right central incisor was also intruded 2 mm (Fig 2-3g) and provisionally restored (Fig 2-3h) in order to level the gingival margins and provide the patient with maxillary central incisors of more normal proportion. One year after orthodontic therapy, the restorative dentist placed porcelain veneers on the maxillary and mandibular central incisors to provide a more durable and esthetic restoration of these teeth (Fig 2-3i).

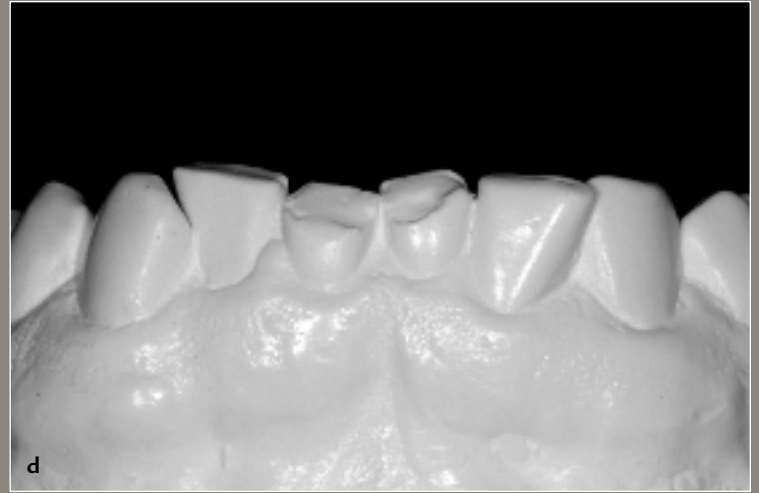
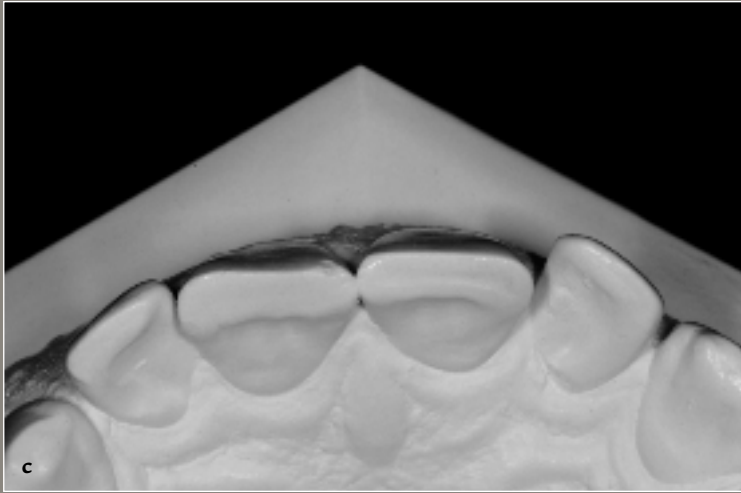


FIG 2-4 This woman had a deep anterior overbite (*a*), and her maxillary incisors were heavily restored with poor structural integrity beneath the existing restorations (*b,c*). The maxillary incisors were extracted, and immediate implants were placed in the lateral incisor sockets (*d*). After 5 months of healing (*e*), a four-unit implant-supported provisional partial denture was placed, and brackets were attached to facilitate orthodontics (*f*). Since the mandibular incisors were worn and overerupted (*g*), these teeth were intruded (*h,i*) and provisionalized with composite (*j*) during orthodontics. After 1 year, porcelain veneers were placed on the mandibular incisors (*k*), and a porcelain-fused-to-metal four-unit implant-supported partial denture replaced the maxillary incisors (*l*).



Case 4: Unsalvageable maxillary incisors and abraded mandibular incisors

This 48-year-old woman with a deep anterior overbite (Fig 2-4a) wanted to improve the esthetics of her smile. Her maxillary incisors had previously been restored, and the right central and lateral incisors had received root canal therapy (Figs 2-4b and 2-4c). She had a long history of protrusive bruxism and, as a result, had abraded the palatal surfaces of the maxillary anterior teeth and had lost nearly half the length of her mandibular incisors. The resulting overbite was deep, with the mandibular incisors over-erupting and impinging near the palatal gingival margins of the maxillary incisors. It was decided that the maxillary incisors were structurally disadvantaged and could not be restored predictably. The restorative plan involved extraction of all four maxillary incisors and placement of immediate implants in the maxillary lateral incisor sockets (Fig 2-4d) and, after 5 months of healing (Fig 2-4e), provisional restoration with a four-unit implant-supported partial denture (Fig 2-4f). However, the mandibular anterior teeth were severely worn (Fig 2-4g), and there was insufficient space to restore these teeth without further extensive tooth reduction.

The incisal edges of the maxillary and mandibular anterior teeth were appropriately related to the occlusal plane. The problem was overeruption and wear of the mandibular incisors. The solution was intrusion of the mandibular incisors, provisional restoration of the incisal edges with composite, and replacement of the orthodontic brackets (Figs 2-4h to 2-4j) to stabilize the position of these teeth. One year after orthodontic treatment was completed, the mandibular incisors were restored with porcelain veneers (Fig 2-4k), and the maxillary incisors were restored with a four-unit implant-supported porcelain-fused-to-metal partial denture (Fig 2-4l).



FIG 2-5 This man had a deep anterior overbite (*a*), retroclined maxillary and mandibular incisors (*b*), and severe attrition of the labial and incisal surfaces of the mandibular anterior teeth (*c*). The overbite was a result of wear and overeruption of the mandibular incisors. In this case, the incisors were provisionalized before orthodontics (*d*), so that brackets could be placed (*e*) for intrusion of the mandibular incisors (*f,g*). One year after orthodontic therapy, porcelain veneers were placed on the mandibular incisors (*h*), and porcelain crowns were placed on the maxillary central incisors (*i*).



Case 5: Lingually inclined maxillary incisors and severely abraded mandibular incisors

This 56-year-old man had a very deep anterior overbite with lingual inclination of the maxillary incisors (Figs 2-5a and 2-5b). Because of a vertical protrusive bruxing habit, he had severely abraded the labial surfaces of the mandibular incisors and was interested in having these teeth restored.

Again, my first step was to determine which teeth were responsible for the patient's deep anterior overbite by establishing the occlusal plane between the mandibular second molars and the upper lip. The maxillary central incisal edges were appropriately located at the level of the upper lip, which indicated that the deep overbite was not caused by the maxillary incisors. In addition, the gingival margins of the maxillary central incisors were nearly even with those of the canines. The incisal edges of the mandibular incisors were 2 mm above the occlusal plane. However, this patient had worn away an estimated 2 to 3 mm of the mandibular incisal edges (Fig 2-5c). Consequently, it is likely that the mandibular incisors had overerupted 4 to 5 mm.

The plan was to intrude the mandibular incisors about 4 mm to reduce the overbite. Composite was placed on the teeth first to simulate their pre-abraded length (Fig 2-5d). Following bracket placement (Fig 2-5e), the teeth were intruded 4 mm (Fig 2-5f). After bracket removal (Fig 2-5g), the mandibular incisal edges, as well as the gingival margins, were in a more normal relationship. One year after orthodontics, the restorative dentist placed porcelain veneers on the maxillary and mandibular anterior teeth (Figs 2-5h and 2-5i).



FIG 2-6 This man had an impinging anterior overbite (*a*), which had caused significant mandibular labial gingival recession (*b*). The overbite, which measured 15 mm on the cephalometric radiograph (*c*), resulted from 2-mm overeruption of the maxillary incisors (*d*) and 10-mm overeruption of the mandibular incisors (*e*). The treatment involved intrusion of the maxillary incisors (2 mm), intrusion of the mandibular incisors (3 mm), mandibular sagittal osteotomy with downward rotation (7 mm), and eruption of the posterior teeth to correct the mandibular curve of Spee (*f,g*). At the end of treatment, the resulting overbite was 3 mm (*h*), and the occlusion was re-established at a new anterior vertical dimension (*i*).

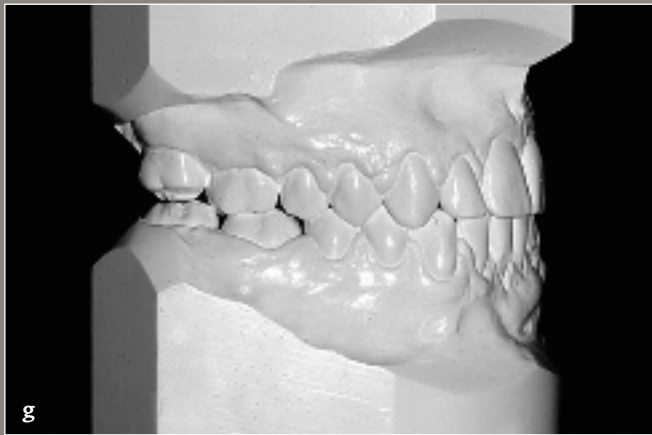
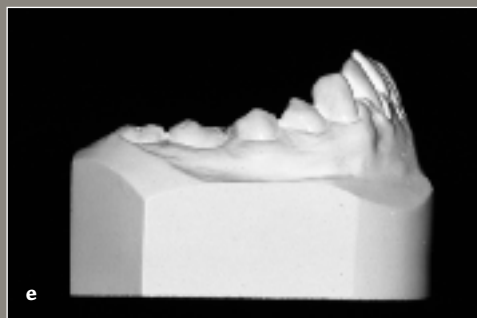


Case 6: Extremely deep anterior overbite and short lower facial height

This 34-year-old man was concerned about gingival discomfort in his palate resulting from an extremely deep anterior overbite (Fig 2-6a). In addition, he had significant recession labial to the mandibular incisors (Fig 2-6b) because of the deep overbite. The cephalometric radiograph revealed a 15-mm vertical overlap of the maxillary and mandibular incisors (Fig 2-6c).

Once again, the first step was to establish the occlusal plane from the second molars to the patient's upper lip. The maxillary central incisal edges were 5 mm, rather than the optimal 3 mm, below the level of the occlusal plane. The mandibular incisal edges were 10 mm above the occlusal plane; they should be at the same level. So it would seem that orthodontics would be necessary to intrude the mandibular incisors 10 mm and to intrude the maxillary incisors 2 mm, leaving an overbite of 3 mm. The goal for the maxillary tooth position would be reasonable (Fig 2-6d); however, the mandibular incisors could be intruded only about 3 mm (Fig 2-6e). How could the remaining 7 mm of overbite (Fig 2-6f) be corrected?

The answer was found in the analysis of the patient's facial proportions (see Fig 2-6c). The patient's upper facial height was 55%, and the lower facial height was 45%, which indicated that the lower facial height was diminished. Orthognathic surgery could be used in this patient to rotate the mandible open in the anterior without lengthening the posterior vertical dimension, thereby maintaining posterior muscle length and avoiding potential relapse. Therefore, in this patient, the maxillary incisors were intruded 2 mm, the mandibular incisors were intruded 3 mm, the mandible was rotated downward 7 mm with jaw surgery, and the posterior teeth were erupted to correct the curve of Spee. This series of movements resulted in a 12-mm reduction in the overbite, which greatly improved the patient's anterior occlusion and the health of the gingiva (Figs 2-6g to 2-6i).



Case 7: Deep anterior overbite and extremely short lower facial height

This 59-year-old woman was unhappy with the esthetic appearance of her smile. Specifically, she showed very little of her maxillary incisors upon smiling. She had a heavily restored dentition with a deep anterior overbite of 7 mm (Figs 2-7a to 2-7d).

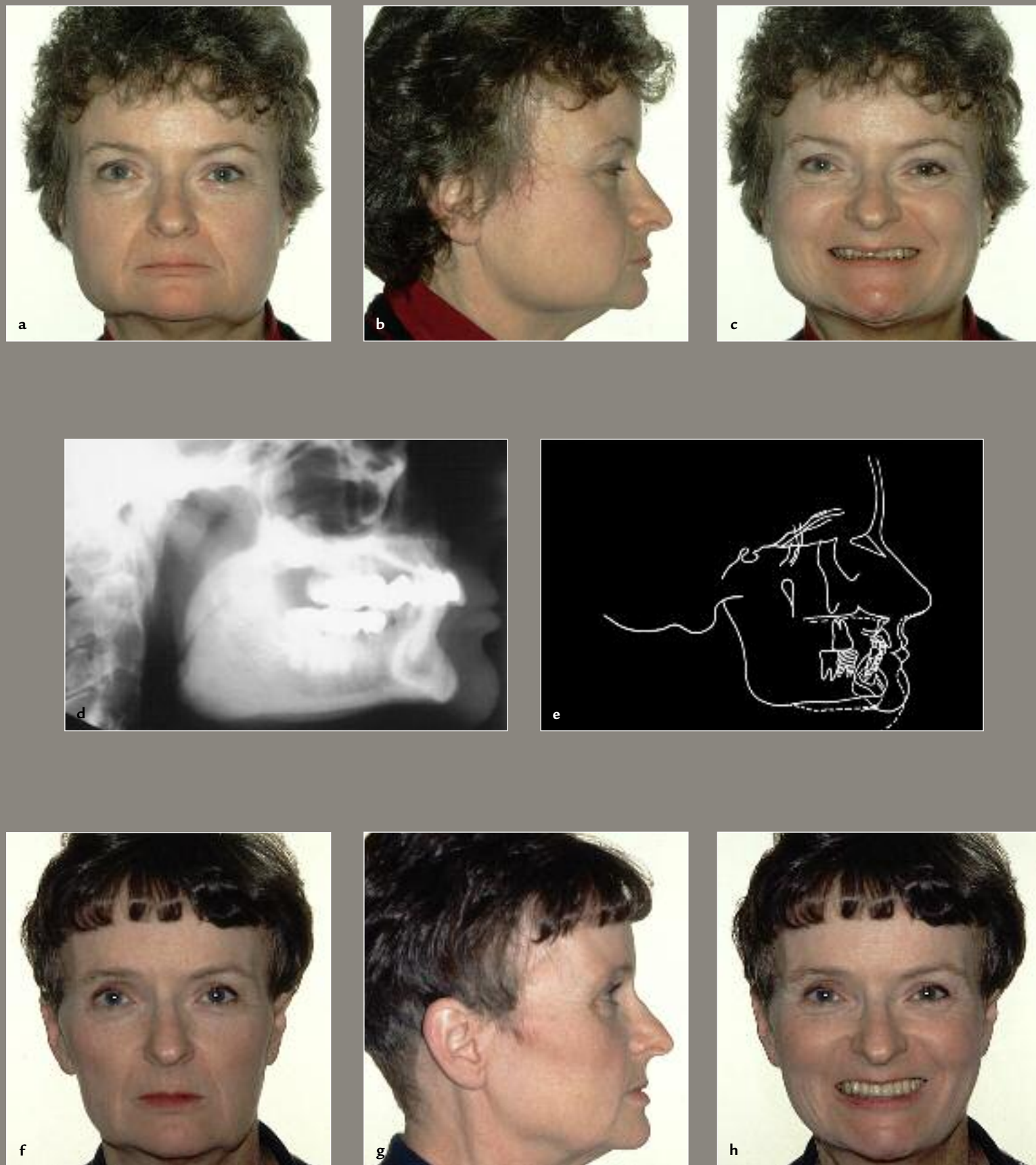
The first step was to establish the occlusal plane between the second molars and the upper lip. The maxillary incisal edges were 1 mm above, rather than 1 mm below, the level of the occlusal plane. The mandibular incisal edges, which should be at the level of the occlusal plane, were 5 mm above it. Intruding the mandibular incisors and extruding the maxillary incisors to show more of the maxillary anterior teeth would be difficult to accomplish orthodontically. However, the patient's facial proportions, ie, her extremely short lower facial height, suggested that she could benefit from mandibular surgery to rotate the mandible downward in front combined with maxillary surgery to rotate the maxilla downward in the anterior. Both of these surgeries could be accomplished without opening the posterior vertical dimension in order to avoid altering muscle length and to enhance stability (Fig 2-7e). The alteration in facial proportion in this patient after surgery vastly improved the esthetics of her smile (Figs 2-7f to 2-7h).

INCREASING THE VERTICAL DIMENSION ORTHODONTICALLY: BIOLOGIC CONSIDERATIONS

Planning restorative rehabilitation for a patient with a deep anterior overbite and significant maxillary and mandibular anterior tooth wear is a challenging and often confusing task for the restorative dentist. The typical thought process would suggest that the vertical dimension should be increased by restoratively “opening the bite,” thereby permitting space to lengthen the abraded teeth. However, if the tooth wear is limited to the mandibular incisors, then many nonabraded posterior teeth would have to be restored to open the patient's vertical dimension. In these situations, the restorative dentist must realize that when teeth wear as a result of a protrusive bruxing habit, they continue to erupt so as to maintain occlusal contact. As they erupt, they bring the gingiva and bone with them. Therefore, the most logical method of correcting this problem is to intrude the abraded teeth so that the crowns can be restored to their original length without further tooth preparation. Adjunctive orthodontics is required to accomplish the intrusion.

In some patients with severe attrition of the mandibular anterior teeth, there is insufficient crown length either to place orthodontic brackets or to permit adequate ferrule for tooth preparation, or both. In these situations, some periodontal surgery and crown lengthening prior to orthodontic intrusion may be appropriate.⁴ The key is to carefully assess the existing crown length of the abraded teeth. Is there sufficient interproximal and labiolingual tooth length to provide a minimum of 1.5 to 2 mm of ferrule? If the answer is yes, then orthodontic intrusion can be used to create the interocclusal space, and the tooth preparation requirements will be acceptable.⁵⁻¹⁰ However, if the existing crown length is insufficient, then crown lengthening surgery should be performed first to establish adequate ferrule,¹¹ then the teeth should be intruded orthodontically to create the correct vertical position prior to restoration.

FIG 2-7 This woman was unhappy with her smile because she did not show much of her maxillary anterior teeth (*a,b,c*). Her problem was caused by insufficient vertical growth of the maxilla, leaving the maxillary incisors well above the level of the lip at rest (*d*). The solution to her problem required maxillary and mandibular jaw surgery to rotate these bones downward in the front, while maintaining the posterior vertical dimension (*e*). The patient was pleased with the change in the vertical dimension of her face (*f,g*) as well as the improvement in tooth display when smiling (*h*).



What happens to the alveolar bone adjacent to a tooth when the root is intruded orthodontically? Although some have proposed that intruding a tooth will create new attachment,¹² there is little evidence to support this theory. When teeth are intruded or extruded, the alveolar bone moves with the tooth, thus maintaining the distance between the alveolar crest and the cemento-enamel junction on the tooth. In other words, the patient's biologic width stays about the same when the tooth is intruded or extruded.¹³

What happens to the gingival margin as teeth are intruded? Do the clinical crowns become shorter as the root is pushed back into the bone, or does the gingival margin move with the tooth? In my experience, when a tooth is intruded, the gingival margin moves about the same amount as the tooth.¹⁴ Again, this indicates that the patient's biologic width is maintained in spite of extrusive or intrusive movements of the teeth. The exception to this rule has been when I have intruded teeth with existing porcelain or gold crowns. In some of these situations, it appears that the bone moves to match the amount of root intrusion; however, the gingival margin does not respond in the same way. In these patients, it appears that the crown is being pushed into the gingival tissue. In the patient reported in the following case presentation, the gingival margin moved apically as the mandibular incisors were intruded, thus maintaining the patient's clinical crown length.

Does an intrusive force on the roots produce or exacerbate root shortening through root resorption? Previous research in monkeys¹⁵ shows that significant intrusive force causes extensive root resorption. However, this side effect of tooth movement does not apply to all humans. The incidence of moderate to severe root resorption in adults is about 4%.^{16,17} If a person is susceptible to root resorption, ie, has the genetic predisposition that causes root shortening during orthodontics, then intrusive forces on the teeth would exacerbate that resorptive response. However, if the patient is not susceptible to root resorption, then significant root shortening will not occur, regardless of the amount of tooth intrusion.

Is root resorption progressive? Does it continue after orthodontics in a susceptible patient? This question was answered in a study that evaluated root length in 100 patients who had moderate to severe root resorption during orthodontics.¹⁸ This retrospective assessment, conducted 14 years after orthodontic treatment, clearly showed that root shortening stops when the orthodontic force is terminated, and no further root resorption occurred long-term in their sample.

Why do the posterior teeth not extrude as the mandibular incisors are intruded? Although it is much easier to extrude a tooth than to intrude it, the mandibular posterior teeth in an adult are prevented from erupting by the muscles of mastication, primarily the masseter, temporalis, and medial pterygoid. In an adult, it is difficult if not impossible to permanently stretch these muscle fibers beyond their natural length. So, the patient's vertical dimension stays the same in spite of the extrusive force on the posterior teeth during incisor intrusion. In the patient reported in the following case presentation, the vertical dimension did not change, and the posterior teeth did not erupt, even though the incisors were intruded 3 mm during the orthodontic treatment.

Is the intrusion of anterior teeth stable long-term? The answer to this question is yes, if the teeth are stabilized or retained in the intruded position for a sufficient period of time. Experimental studies in laboratory animals^{19,20} have shown that the principal fibers of the periodontium (subcrestal collagen fibers connecting root to alveolar socket) stretch and become obliquely oriented as a tooth is intruded or extruded. However, if the tooth is held in the extruded or intruded position, the collagen fibers eventually reorient themselves perpendicular to the tooth root and socket wall. In animal studies^{19,20} this retention period was 28 days. However, in a human it would probably take a minimum of 6 months' stabilization to produce a similar reorientation of the principal fibers of the human periodontium.

How is this type of tooth correction retained? After the orthodontist intrudes the teeth, the restorative dentist should provisionalize the teeth with either bonded composite or provisional acrylic crowns. Then the orthodontic brackets should be replaced to maintain the intruded tooth position for at least 6 months, preferably longer. After orthodontic bracket removal, I recommend using a nightguard (either maxillary or mandibular) to prevent further tooth wear and to maintain the vertical position of the incisors long-term.

CONCLUSION

This chapter discussed the advantages of using adjunctive orthodontics and/or orthognathic surgery to assist the dentist in restoring the dentition of adult patients with deep anterior overbites, severe wear, and/or overeruption of the maxillary and mandibular anterior teeth. It is hoped that the guidelines and discussion presented in this section will help clinical teams provide the sequence of interdisciplinary treatment that is necessary to successfully treat these challenging situations.

Case Presentation

CASE PRESENTATION

Treating clinicians

Orthodontist: Vincent G. Kokich, DDS, MSD

Restorative dentist: Rhonda Savage, DDS

CLINICAL TREATMENT PLANNING

Age at initial presentation: 58 years [Au: Is this correct?]

Initial presentation: [Au: Please provide.]

Active treatment completed: [Au: Please provide.]

- Inadequate tooth display on smiling
- No maxillary tooth display at rest

Introduction and background

This 58-year-old man was concerned about the appearance of his maxillary anterior teeth, particularly the wear of the maxillary and mandibular incisors and the lack of tooth display when smiling. He was an architect and had the financial capability to have ideal treatment. His primary goals were to preserve his teeth and improve his smile.

TMJ and mandibular range of motion

- No joint sounds
- No history of locking or limited range of motion
- No history of muscle pain

Medical history

His medical history was noncontributory.

Dental cast analysis

- Angle Class II molar and canine relationships
- Excessive overbite
- Both mandibular permanent first molars missing
- Extreme wear of both maxillary and mandibular incisors
- History of protrusive bruxing habit

Diagnostic findings

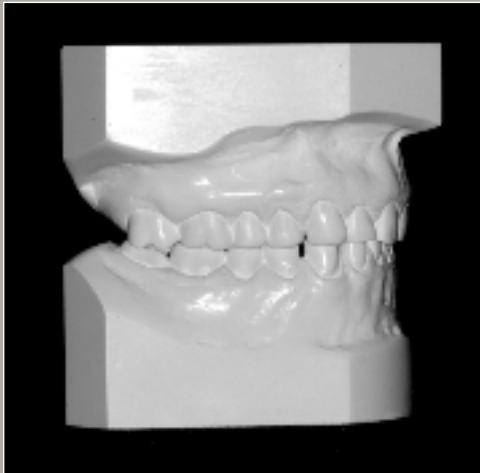
Extraoral and facial findings

- Relatively flat facial profile
- Good frontal symmetry

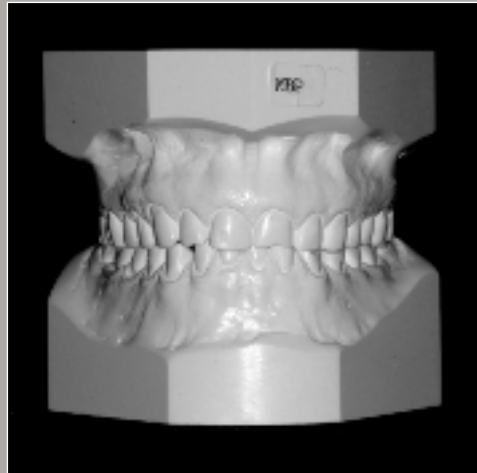
Intraoral findings

- Minimal prior restoration of teeth
- Less-than-ideal spacing in the mandibular anterior region
- Relatively healthy gingival support
- Evidence of extreme wear on the maxillary and mandibular incisors

PRETREATMENT



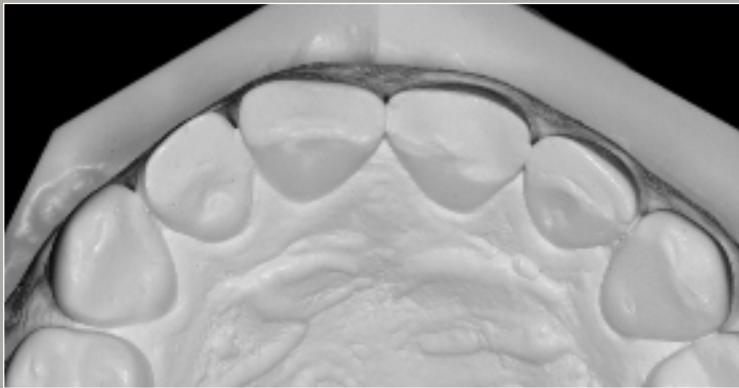
Right lateral occlusion.



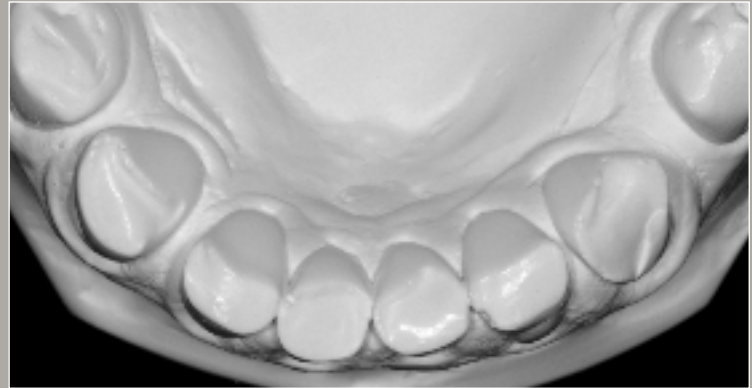
Frontal occlusion.



Left lateral occlusion.



Maxillary anterior occlusal view.



Mandibular anterior occlusal view.

Radiographic findings

- Normal bone levels in anterior and posterior regions
- No evidence of decay
- Mostly small restorations previously placed in occlusal surfaces
- Extreme anterior tooth wear well into dentin

Cephalometric analysis

- Class I skeletal pattern
- Normal relationship between maxilla and mandible
- Normal facial proportions
- Maxillary central incisal edge 1 mm above upper lip

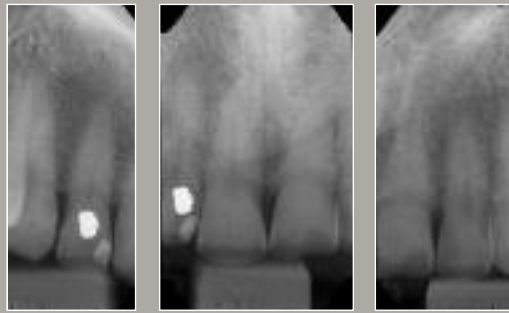
Summary of concerns

1. How would we be able to effectively address the problem of severe anterior tooth wear?
2. How would we be able to meet this patient's esthetic enhancement expectations with the present lack of display of the maxillary anterior teeth and uneven tooth spacing in the mandibular anterior region?
3. How will we be able to place anterior restorations with the lack of tooth structure and occlusal space?

PRETREATMENT



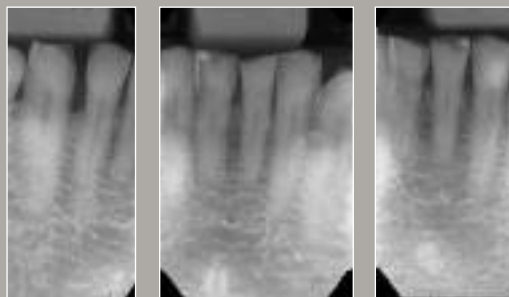
Right posterior bitewing radiographs.



Maxillary anterior periapical radiographs.



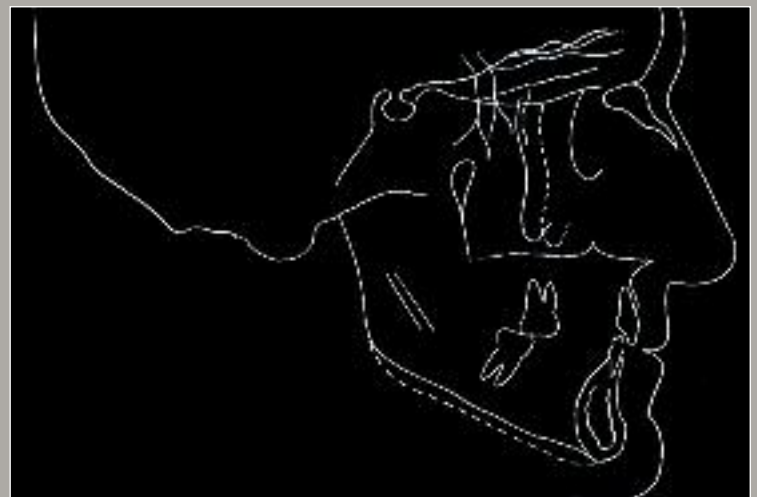
Left posterior bitewing radiographs.



Mandibular anterior periapical radiographs.



Lateral cephalometric radiograph.



Lateral cephalometric tracing.

As a learning exercise, you may now outline goals/objectives of treatment and a treatment plan.

PROPOSED TREATMENT PLAN

Goals/objectives of treatment

The original objectives for treating this patient were to create restorative space for the dentist and to manage the posterior occlusion appropriately. In order to achieve these objectives, the patient required a combination of orthodontics and restorative dentistry. The key to the treatment plan was the diagnostic waxup, which elucidated the amount of tooth movement that would be necessary to achieve the restorative space and confirm the conservative management of the patient's existing posterior occlusion.

Phase 1: Planning and preparation

- Meeting between orthodontist and restorative dentist to establish plan
- Construction of diagnostic waxup to create a vision of the result
- Patient consultations with orthodontist and restorative dentist
- Root planing and scaling prior to orthodontics

Phase 2: Initial orthodontic therapy

- Bracket placement on maxillary and mandibular teeth
- Intrusion of maxillary and mandibular incisors to level the gingival margins
- Creation of anterior space for provisionalization of the anterior teeth

Phase 3: Provisionalization of anterior teeth

- Removal of orthodontic brackets
- Provisionalization of maxillary and mandibular incisors with composite
- Replacement of brackets to stabilize vertical correction of teeth

Phase 4: Orthodontic finishing

- Establishment of alignment and occlusion with waxup
- Use of maxillary Essix retainer to retain correction and protect provisionals
- Placement of fixed bonded mandibular lingual retainer to maintain alignment

Phase 5: Final restorations

- After 1 year, placement of porcelain veneers and crowns on anterior teeth
- Placement of heat-processed nightguard on maxillary teeth for wearing at night
- Routine periodontal maintenance every 6 months

ACTIVE CLINICAL TREATMENT

Treatment progress

Initially, the restorative dentist and orthodontist met to discuss the combined treatment of this patient. The restorative dentist's initial comment was that the vertical dimension needed to be increased in order to restore the patient's abraded anterior teeth. However, it would have been impossible to increase the posterior vertical dimension with orthodontics alone, and the patient did not need restoration of the posterior teeth. Therefore, it was decided to leave the posterior teeth in their original position and to intrude the maxillary and mandibular incisors in order to create restorative space.

The orthodontist constructed a diagnostic waxup to simulate the amount of tooth movement that could be achieved. The restorative dentist wanted sufficient interproximal space between the mandibular incisors to restore these anterior teeth. The waxup showed that the posterior occlusion could remain in an Angle Class II relationship, but the anterior relationship between the maxillary and mandibular anterior teeth would result in an acceptable overbite and overjet relationship. It was decided that this would be acceptable since the patient had lived with this posterior occlusion for many years and had never experienced any temporomandibular joint symptoms.



Right lateral view of diagnostic waxup.



Frontal view of diagnostic waxup.



Left lateral view of diagnostic waxup.

The treatment began with initial root planing and scaling, followed by banding and bracketing of the maxillary and mandibular teeth. Round orthodontic archwires were used to intrude the maxillary and mandibular incisors by placing stepwise bends in the archwires. The gingival margins of the maxillary and mandibular canines were used as a guide to establish the correct amount of intrusion of the incisors. The

tooth intrusion took about 8 months to accomplish. At that time, the patient had an anterior open bite. In order to establish the proper functional relationships of the maxillary and mandibular anterior teeth during orthodontic finishing, the orthodontist removed the incisor brackets, and the restorative dentist provisionally restored the maxillary and mandibular incisors with composite.



Intrusion of mandibular incisors.



Provisional restoration of mandibular incisors.



Stabilization of mandibular incisors.



Intrusion of maxillary incisors.



Provisional restoration of maxillary incisors.



Stabilization of maxillary incisors.

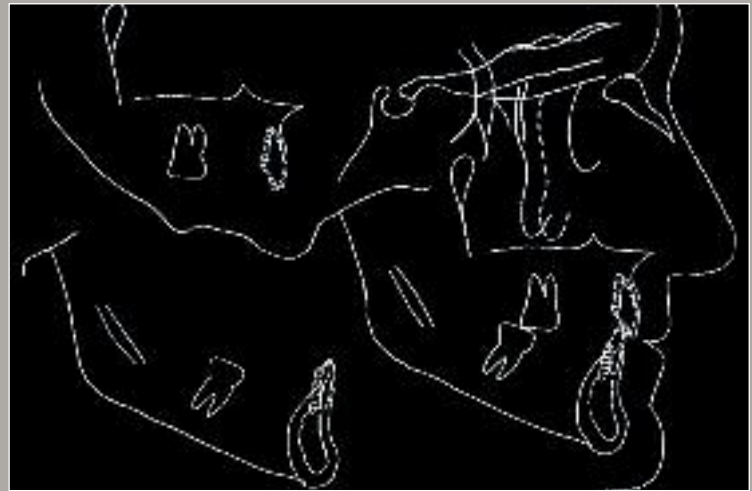
After provisionalization, brackets were again placed on the maxillary and mandibular incisors to stabilize the teeth in that position. A period of at least 6 months of stabilization is needed to prevent re-eruption of these teeth. Once the teeth had been stabilized, the finishing procedures in orthodontics were accomplished. During that time, the diagnostic waxup was used as a guide to determine the final occlusal positioning that was initially agreed upon by the orthodontist and restorative dentist.

When the restorative dentist was satisfied with the tooth positioning, the orthodontic brackets were removed, and the patient's tooth position was stabilized with a mandibular fixed bonded retainer and a maxillary Essix retainer to help hold the vertical position of the intruded incisors and to protect the composite restorations. The patient was maintained with these retainers for 1 year.

POSTTREATMENT



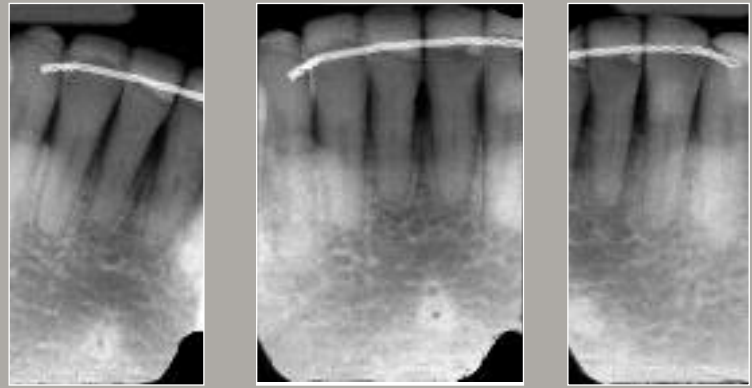
Lateral cephalometric radiograph.



Cephalometric superimposition of dental changes.



Maxillary anterior periapical radiographs.



Mandibular anterior periapical radiographs.

After 1 year of orthodontic retention, the dentist placed porcelain veneers on the previously abraded maxillary and mandibular incisors as well as on the canines. Then the restorative dentist constructed a maxillary nightguard made from heat-processed acrylic to prevent further wear and abrasion and to hold the orthodontic correction of the teeth.

Commentary

The combination of orthodontics and restorative dentistry in the management of this patient was indispensable. The orthodontic intrusion permitted space for restoration of the abraded incisal edges without significant further incisal preparation.

The final anterior periapical radiographs and intraoral photographs show that as the teeth were intruded, the gingiva and bone moved apically with the teeth. The final cephalometric radiographs and superimposition show that the patient now has the maxillary incisal edge slightly below the level of the upper lip at rest and the smile esthetics have been improved.

Orthodontic tooth intrusion of severely abraded maxillary and mandibular incisors is a viable, realistic, and appropriate method for repositioning the maxillary and mandibular incisors into their original position, so they can be restored more conservatively by the restorative dentist. This is a perfect example of the value of interdisciplinary treatment in a challenging adult restorative case.

POSTTREATMENT



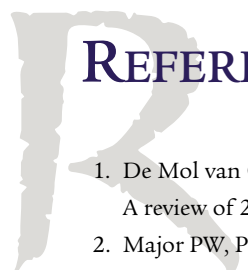
Maxillary anterior intraoral view.



Mandibular anterior intraoral view.



Frontal view of smile.



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