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CLINICAL ARTICLE

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Restoratively guided orthodontic treatment: The pre-orthodontic bonding concept

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Abstract

Objective: Communication between the orthodontist and the restorative dentist has always been difficult due to the inability of the orthodontist to achieve the desired orthodontic goals with just words in a referral note.

Clinical Considerations: A better method of communication is for the restorative dentist to create the ideal tooth anatomy either before or during orthodontic treatment to direct the orthodontic tooth movement.

Conclusion: It is the purpose of this article to present a technique, which makes the pre-restorative orthodontic treatment both more accurate and more efficient.

Clinical Significance: It is very difficult for the orthodontist to move teeth into their correct positions when the teeth are anatomically incorrect due to attrition/erosion or due to developmental malformation. When the restorative dentist makes the teeth anatomically correct with either pre-orthodontic or intermediate orthodontic bonding, the orthodontist has the benefit of ideal tooth anatomy to finalize the tooth positions. This then allows the restorative dentist to create final restorations, which are ideal, both functionally and esthetically.

KEYWORDS
intermediate orthodontic bonding, orthodontic-restorative interface, orthodontic-restorative treatment planning, pre-orthodontic bonding, restoratively guided orthodontics

Communication between the orthodontist and the restorative dentist is essential when definitive restorative dentistry is required at the end of orthodontic treatment. Traditionally, this has been accomplished with a verbal or written referral to the orthodontist either requesting specific treatment, or more often, "do orthodontic treatment." This method of multidisciplinary communication and treatment commonly results in less than an ideal final outcome.

In recent years, there has been minimal information presented regarding the pre-orthodontic bonding technique.[1,2] However, the concept of creating an actual three dimensional "blueprint" in the patient's mouth to direct the orthodontic treatment is not a new idea. In 1997, Kokich and Spear[3] wrote a definitive article on communication between the orthodontist and the restorative dentist. They presented guidelines to assist clinicians in overcoming the difficulties associated with the old style of communication. These limitations included:

1. It is difficult for both the orthodontist and the restorative dentist to visualize the final restorative outcome, when the patient presents with missing teeth, microdontia, and/or attrition/erosion.
2. Orthodontists may not be aware of the restorative requirements of the eventual restorative treatment plan.
3. The restorative dentist may not know the orthodontic possibilities for treatment.
4. The orthodontist should never be in the position to make the final restorative decisions.
5. Without definitive treatment planning, it is impossible for the specialists (orthodontist, periodontist, and oral and maxillofacial

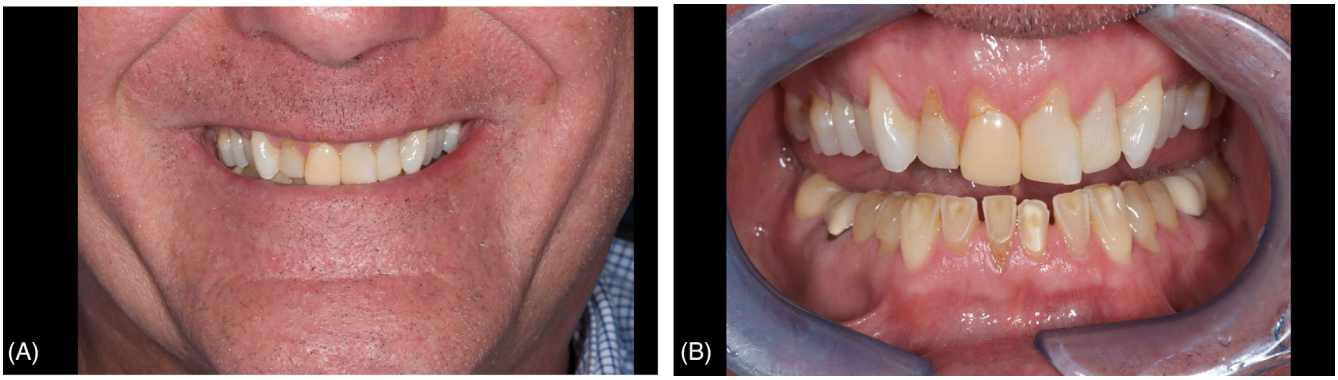

FIGURE 1 Pre-operative view.

FIGURE 2 After pre-orthodontic bonding.

FIGURE 3 After placement of orthodontic appliances.

surgeon) and the restorative dentist to create a sequenced treatment plan that maximizes efficiency.

These limitations are as relevant today as they were 25 years ago. In order to overcome these problems, Kokich and Spear[3] emphasized the importance of a diagnostic set-up/wax-up to aid in diagnosis and ultimately in the pre-orthodontic bonding, or the intermediate orthodontic bonding. They acknowledged the occasional need for this type of bonding on posterior teeth; however, their emphasis was on the anterior teeth. As these techniques have evolved, the authors propose a new guideline for this type of interdisciplinary treatment planning: Every tooth that will receive a restoration at the end of orthodontic treatment will receive an interim or definitive restoration either before or during orthodontic treatment.

The goal of this interim bonding is to make every tooth that will be restored at the completion of orthodontics, anatomically correct, in order to direct the precise positioning of the teeth with orthodontic treatment. When a small area of missing tooth structure must be replaced, that is, a cusp tip on a premolar, definitive composite bonding can be utilized. However, most of the worn teeth are restored with interim direct or indirect bonded restorations. Upon completion of the orthodontic treatment, the interim material is removed and the teeth are in the correct positions for definitive restorations. This almost universally allows the definitive restorations to be more conservative, because that which was lost due to attrition/erosion, becomes the occlusal/incisal reduction for the restorations, and minimal or no additional tooth structure is removed.

There are three reasons that a patient can present with short teeth: (1) microdontia, (2) incisal/occlusal attrition, and (3) altered passive eruption.[4] Restoring the ideal tooth size can be accomplished by

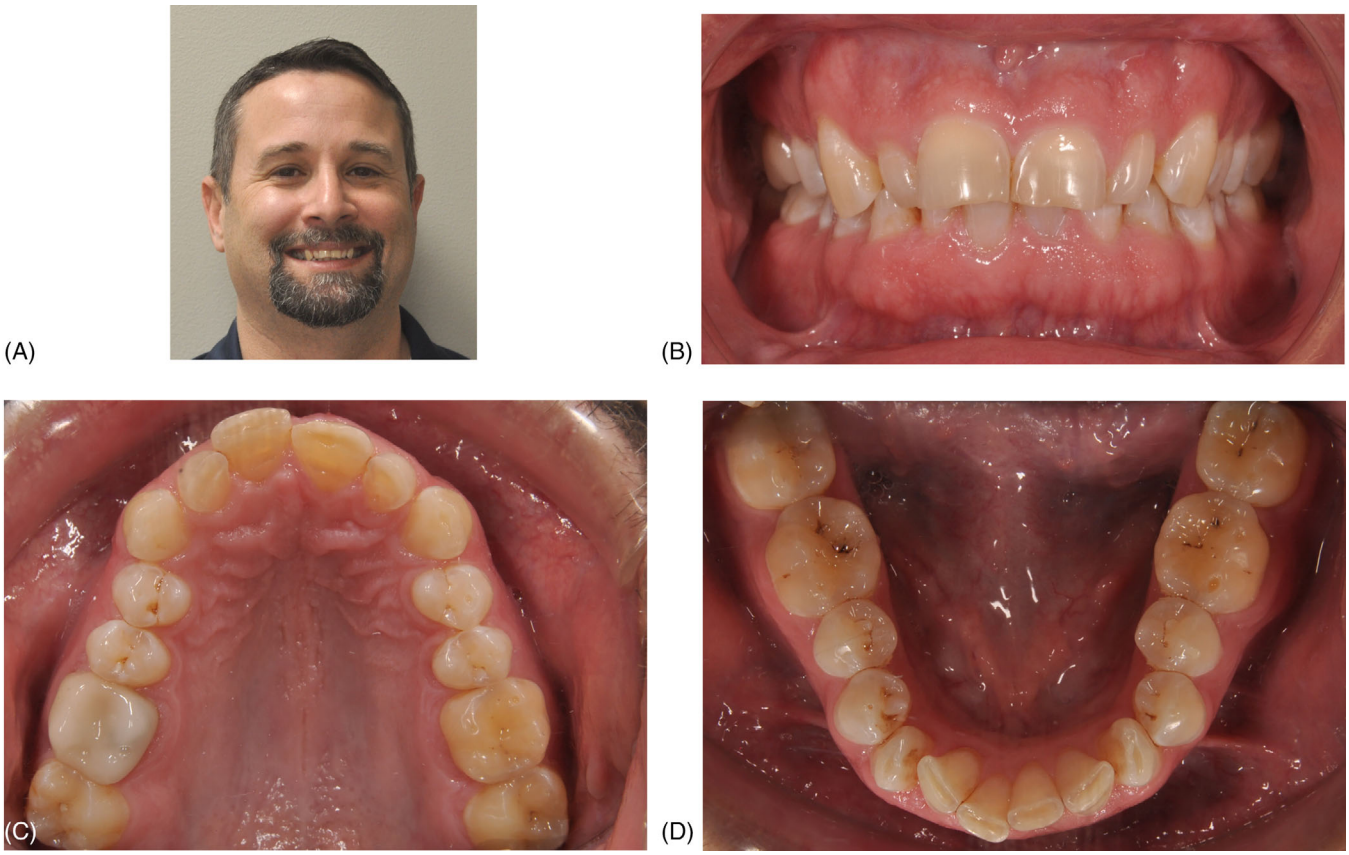

FIGURE 4 Pre-operative views.

FIGURE 5 Clinical presentation at first appointment with author (BB) after 22 months in orthodontic treatment. There was no clinical end point for the orthodontic treatment.

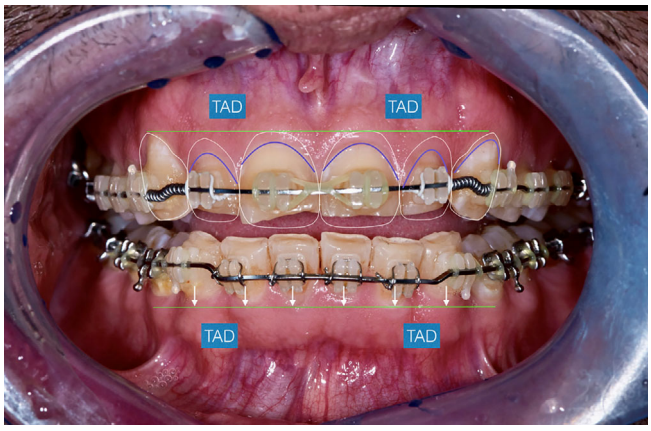

FIGURE 6 Photograph used to communicate with the orthodontist the desired treatment goals.

increasing incisal/occlusal length restoratively, crown lengthening surgery, or a combination of both. Once the diagnosis is established, the sequenced treatment plan can be developed. The primary diagnosis associated with the worn dentition is dentoalveolar extrusion.[5] As teeth wear, they supererupt, bringing bone and soft tissue with them. This results in a curved gingival line in relation to horizon. In this circumstance the teeth, the soft tissue, and the underlying alveolar bone are all in the incorrect positions for restorative dentistry.

There are three primary strategies for restoring the worn dentition[5]: (1) functional crown lengthening, (2) restoring at an increased vertical dimension, and (3) orthodontic intrusion/flairing. Functional crown lengthening surgery is used primarily to increase clinical crown height to provide adequate retention and resistance form for restorations. The restorative disadvantages of functional crown lengthening include: (1) exposed roots, which must be restored, (2) open gingival embrasures, (3) triangular shaped crowns, (4) rolled gingival margins, and (5) increased crown to root ratio.

Restoring at an increased vertical dimension is the traditional prosthodontic approach used to restore the worn dentition. When there is generalized wear of both anterior and posterior teeth, a full mouth rehabilitation is an acceptable treatment. The disadvantages are that it requires a high skill level, is very expensive, and commonly requires significant removal of tooth structure. However, when there is significant wear of the anterior teeth and minimal wear in the posterior teeth, restoring at an increased vertical dimension is seldom indicated.

The third strategy for treating the worn dentition is orthodontic intrusion/flairing. During the process of attrition and erosion, the teeth move into positions that make orthodontic treatment and restorative dentistry very difficult. Without the incisal edges of anatomically correct maxillary incisors, or appropriate gingival margins, as in the case of dentoalveolar extrusion with wear, the orthodontist has no stable landmark for correct bracket placement. Idealizing the tooth positions orthodontically allows the restorative dentist to place anatomically correct restorations with minimal tooth preparation.

Traditionally, the diagnostic process in a rehabilitation starts with clinically determining the proposed incisal edge position of the maxillary anterior teeth and then creating that position by adding wax on the articulated casts. However, this is not the case with pre-orthodontic bonding. The goal of the pre-orthodontic diagnostic wax-up is to make the teeth anatomically correct using either digital or analog waxing. Therefore, the casts are not mounted and the purpose of the wax-up is to wax each arch independently and make the teeth anatomically correct. It is also important that the clinical crowns are an extension of the long axes of the teeth, so that the orthodontist can use the bonding to guide bracket placement and axial inclinations of the teeth. Evaluation of the gingival levels is equally important. The gingival levels may be corrected with either orthodontic intrusion/extrusion, crown lengthening surgery, or a combination of the two. The ultimate goal of the interdisciplinary treatment plan is for the teeth to be in the correct positions in the patients face, between the upper and lower lips.

For many years, the most traditional technique of diagnosing tooth positions occurred near the end of orthodontic treatment. It was termed "mock bonding" and was used primarily on the anterior teeth that had been intruded for restorative purposes. The orthodontist would contact the restorative dentist to say that the patient was near the end of orthodontic treatment and asked the dentist to do an evaluation before orthodontic appliances were removed. The restorative dentist would do a quick composite mock-up on several upper and lower anterior teeth to determine if they were in the correct positions to meet the treatment goals. The four primary goals are: (1) esthetically acceptable incisal edge position of maxillary anterior teeth, (2) space to make anatomically correct maxillary and mandibular anterior teeth, (3) coupled at an acceptable interincisal angle (130–135 degrees), and (4) with an acceptable antero-posterior occlusal plane with no step-up or step-down. Upon, completion of the mock-up, seldom were the teeth in the correct positions and the restorative dentist would ask the orthodontist to make tooth movements to idealize the tooth positions. Approximately 4–6 weeks later, the patient would return to the restorative dentist and go through the same process again. This was a very inefficient method of finishing a case and commonly the patient and orthodontist became frustrated and gave up before the ideal tooth positions had been finalized. Although, the authors no longer use this technique routinely, it is still required when a restorative dentist begins treatment on a new patient, near the end of orthodontic treatment.

FIGURE 7 After intermediate orthodontic bonding and placement of TADs.

(A)

(B)

FIGURE 8 Post-operative views at completion of the restorative dentistry.

Currently the preferred techniques are pre-orthodontic bonding or intermediate orthodontic bonding. In pre-orthodontic bonding, the teeth are made anatomically correct with either direct and/or indirect interim restorations prior to the placement of orthodontic appliances (Figures 1–3). This is the most efficient and preferred method because it allows for correct positioning of the orthodontic brackets to achieve the ideal final tooth positions. However, there are some exceptions to pre-orthodontic bonding which require intermediate orthodontic bonding. (1) If a restorative dentist begins treatment on a new patient that is already in orthodontic treatment, intermediate bonding is required to direct the pre-restorative orthodontic treatment (Figures 4–8). (2) If the bonding is going to result in a very unesthetic outcome for the patient, then it is not done prior to placement of appliances. For example, pre-orthodontic bonding in a patient with either vertical maxillary excess or dentoalveolar extrusion with incisal edge wear of the maxillary anterior teeth will commonly result in teeth that are too low in the smile and will appear too long. In these circumstances, the maxillary anterior teeth will be intruded and as they are moved apically, intermediate composite bonding will be placed to direct the final orthodontic position of the teeth. (3) If there is inadequate proximal space to do pre-orthodontic bonding in the anterior teeth, the orthodontist must open spaces, and ideally create excess spacing. The appliances are removed and the intermediate bonding is accomplished so that the teeth have ideal height/width ratios. The orthodontic appliances are then replaced and the orthodontic treatment is completed. This is termed an "Orthodontic Holiday." (4) If there is significant crowding or rotation, initial orthodontic therapy is used to align the teeth prior to the intermediate orthodontic bonding. It is also important to remember that if a patient presents with altered passive eruption,[4] the esthetic crown lengthening surgery must be accomplished prior to the orthodontic bonding in order to create the correct height/width ratios in the diagnostic

FIGURE 9 Pre-operative view in maximum intercuspal position.

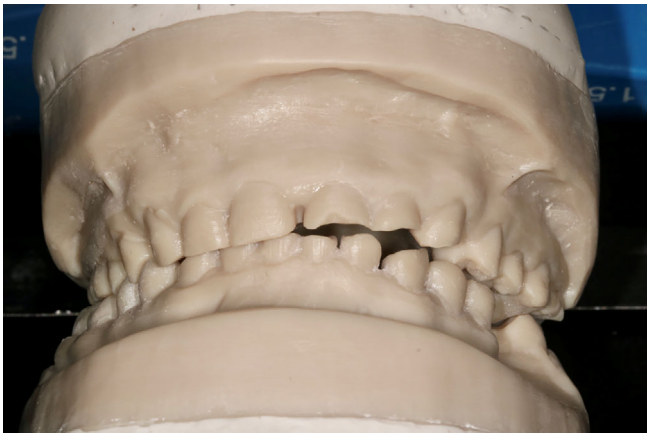

FIGURE 10 Mounted casts in a fully seated condylar position, which was obtained with a deprogrammer. Note the crossbite on the right side and the excessive overjet on the left side.

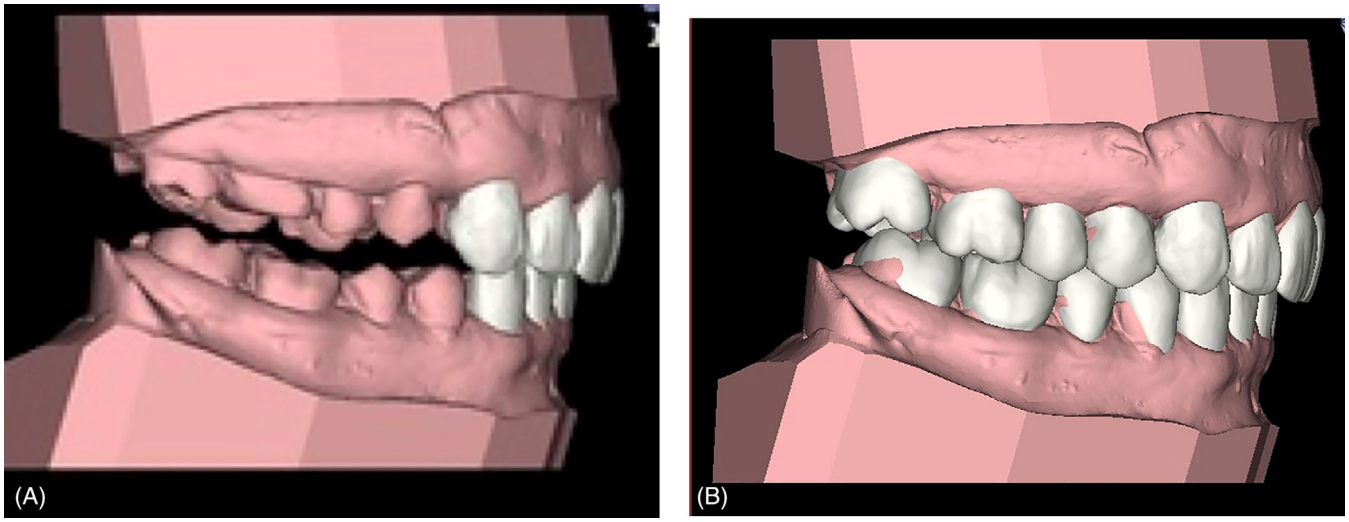

FIGURE 11 Digital wax-ups with and without posterior teeth. The clear matrix for the anterior direct bonding is made on the cast without the posterior wax-up.

FIGURE 12 Printed casts of digital wax-up demonstrating lack of occlusal harmony.

FIGURE 13 Tooth isolated with Teflon tape on adjacent teeth.

FIGURE 14 Tooth being etched with 35% phosphorous acid.

wax-up and composite restorations. Finally, aligner therapy creates a challenge because the pre-orthodontic bonding must be protected between the scanning of the case and the insertion of the aligners. The patient can wear interim clear retainers to protect the bonding during manufacture of the aligners. It is important that the patient understand this limitation during the initial case presentation. However, generally intermediate orthodontic bonding rather than pre-orthodontic bonding is used with aligner therapy, due to this limitation.

The first pre-orthodontic restorative step is to remove all existing crowns and restorations with questionable integrity. This allows the dentist to evaluate issues such as restorability, tooth vitality, retention and resistance form, and adequate space for the supracrestal attachment. Laboratory fabricated provisional crowns should be used and cemented or bonded with a permanent cement.

When planning the case, the occlusion should be evaluated in a stable condylar position (Figures 9 and 10). However, it is important for the restorative dentist to communicate with the laboratory

FIGURE 15 Bonding agent being placed on tooth.

FIGURE 16 Heated composite placed in clear matrix and placed over prepared tooth.

FIGURE 17 Composite restoration prior to finishing.

FIGURE 18 Finished and polished restoration.

FIGURE 19 Completed direct pre-orthodontic bonding on maxillary and mandibular anterior teeth.

technician, because the wax-up is not done on mounted casts (Figure 11). The purpose of the wax-up is to give each tooth ideal incisal or occlusal anatomy, which is not dictated by the opposing teeth (Figure 12). Once the diagnostic wax-up is completed, a clear matrix is made for direct bonding of the anterior teeth on the cast with anterior diagnostic wax, but with none on the posterior teeth (Figure 11). The posterior bonding can be done with either a matrix and direct composite restorations, or indirectly with laboratory fabricated restorations. When direct bonding the anterior teeth, each tooth is bonded individually. Teflon tape is placed on the teeth adjacent to the tooth being bonded (Figure 13). The tooth is etched and the bonding agent is applied and light cured (Figures 14 and 15). Heated composite is placed in the clear matrix, taken to the mouth and light cured (Figure 16). The matrix is removed and the restoration is finished with finishing burs, discs, interproximal strips and polishers (Figures 17 and 18). The process is then repeated on the remaining anterior teeth (Figure 19). When small areas, that is, cusp tips, are being added to the posterior teeth, the same process, using a clear matrix, can be used. However, when larger areas of bonding are required, the placement of indirect restorations is more efficient. These restorations can be composite or PMMA and bonded with a dual cured resin cement (Figures 20 and 21).

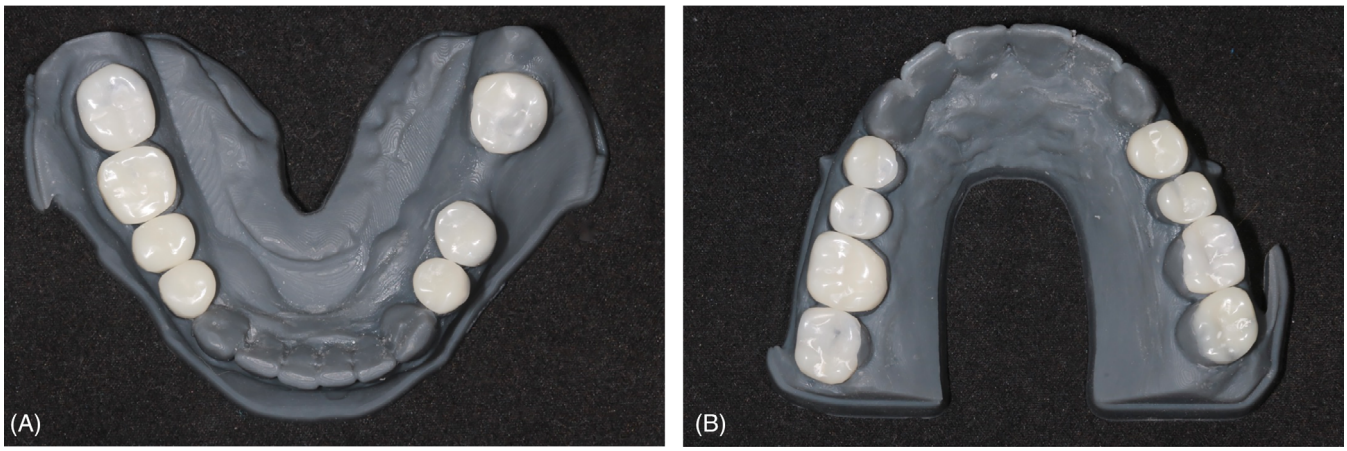

FIGURE 20 Indirect composite restorations for the posterior teeth.

FIGURE 21 Completed quadrant of indirect composite restorations bonded with a dual-cured resin cement.

FIGURE 22 Orthodontic appliances are placed immediately or, as soon as possible, after the pre-orthodontic bonding.

FIGURE 23 Post-operative view after 22 months of orthodontic treatment.

The bonding appointment should be coordinated with the orthodontic appointment for appliance placement. Once the pre-orthodontic bonding is completed, based on the diagnostic wax-up, the teeth will no longer be in a stable occlusion. Therefore, the orthodontic appliances should be placed as soon as possible after the pre-orthodontic bonding (Figure 22). The orthodontist then has two strategies to deal with the malocclusion created by the bonding. (1) Bite turbos can be placed on the lingual surfaces of the maxillary central incisors or canines. This not only takes care of the malocclusion created by the bonding, but also serves as a muscle deprogrammer. (2) Composite can be bonded to posterior teeth to give the patient a more balanced occlusion. At the completion of orthodontics, (Figure 23) the teeth are now in the ideal positions to receive conservative definitive restorations. Another advantage of this technique is the ability to stage the definitive restorative treatment over time. The interim bonded restorations can be replaced a sextant or quadrant at a time which allows the patient to receive a partial or full mouth rehabilitation over several years.

1 | CONCLUSION

It has been the purpose of this article to present a traditional, but updated approach to interdisciplinary treatment planning. In the concept of restoratively guided orthodontic treatment, pre-orthodontic

or intermediate orthodontic bonding is used to direct the orthodontic movement of the teeth into the precisely correct positions for the definitive restorative therapy.

DISCLOSURE

Dr. Norris reports a financial interest in the Norris 20/26 Orthodontic Bracket and Wire System. The other authors do not have any financial interest in companies whose materials are included in this article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in [repository name] at [DOI]. Yes

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