New clinical innovations to ensure predictable Class II posterior composite resin restorations

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Abstract

Objective: Placement of posterior composite restorations is becoming increasingly popular due to its low cost and acceptable clinical performance. Aesthetic demands, anatomically shaped interproximal contacts and proper marginal adaptation remain crucial aspects in the long-term success of these restorations. Clinical considerations: Techniques for the placement of posterior composite restorative materials with innovative filler technology in conjunction with bulk fill flowable base materials and anatomically shaped matrix systems are described in these case reports. Conclusion: Materials and techniques described provide the clinician with solutions to improve the predictability of posterior Class II composite resin restorations. Clinical significance: Advanced filler technology and bulk fill flowable base materials in conjunction with anatomically shaped matrix systems not only ensure improved aesthetics but also the overall success of posterior composite restorations.

Introduction

Direct composite restorations have been largely utilized to restore anterior teeth and have now also become the first choice for direct posterior restorations, and are becoming increasingly popular among clinicians and patients.¹

Their low cost, conservative preparation when compared to indirect ceramic restorations, as well as their acceptable clinical performance makes them an ideal choice for posterior teeth.²³ Composite restorations also demonstrate improved aesthetic properties and contribute to reinforcement of the remaining tooth structure.⁴

On an annual basis, approximately 69% of dental patients receive a direct restorative procedure and this accounts for about two thirds of the generated income of dentists. According to the American Dental Association Procedure Recap Report (2006) nearly 50% of these restorations are Class II direct restoration of which 70% will be done composite resin.⁷

Overton and Sullivan⁸ showed that the number one reason for composite failure is recurrent caries. Class II restorations also demonstrates a significantly higher rate of caries at the gingival margin when compared to amalgam restorations.⁹ Other studies also indicate the gingival margin of the proximal box in a Class II restoration as one of the most vulnerable interfaces.¹⁰ It is also the most common location of bonding failures.¹⁰¹² Bouillaguet et al.,¹¹ Spencer et al.¹⁰ and Purk et al.¹² compared the microtensile dentine bond strength of gingival and proximal cavity walls of Class II composite resin restorations. Their results showed that the dentine adhesive bond of composites to gingival walls was significantly weaker, and thus, at increased risk of failure compared to the bond to proximal walls.

Another major clinical problem with Class II direct posterior composite resin restorations is the clinician’s inability to achieve an ideal interproximal contact.¹³
According to Maitland, some of the failures of composite restorations, which are a result of manipulative deficiencies, are open contacts which lead to continuous food impaction and periodontal disease, as well as inadequate proximal contours, faulty occlusion and excessive wear.

The most time-consuming step when placing posterior composite restorations is the incremental layering technique to avoid any voids between the restoration and tooth structure. This technique has been the standard protocol in order to prevent gap formation due to polymerization stress and to achieve adequate bond strength between composite resin and tooth structure.

The presence of voids at cavity margins due to improper adaptation of composite resin materials can lead to marginal leakage, gap formation and subsequent failure. One of the solutions to the above mentioned problems is to use a flowable bulk fill material that can reduce the need for placing composite resin in multiple layers. These bulk fill materials makes the procedure faster and easier as it can be placed in layers of up to 4 mm in thickness. However, it is still recommended that a conventional paste-like composite is placed and cured on top of the 4 mm thick composite base.

Aesthetic demands of patients also dictates that dentists must place undetectable restorations. Shade selection can be challenging in certain cases. A study showed that about 50% of crown remakes are the result of failure to match shades accurately. Moser, Wozniak, Nalewaj, et al. reported that 13% of 670 dental participants who were screened for color vision acuity were found to have irregular color vision. The human eye is accurate only 27% of the time for composite shade selection. Choosing a composite resin material that demonstrates a chameleon blending effect with surrounding tooth structure can minimize human errors in shade selection to ensure optimal aesthetics results.

Recently, Dentsply Sirona launched their latest composite restorative material (Ceram.x Universal, Dentsply Sirona, Konstanz, Germany) that can be used in conjunction with a posterior bulk fill base composite (SDR, Dentsply Sirona) and a sectional matrix system (Palodent V3, Dentsply Sirona) to create aesthetically pleasing restorations with excellent interproximal contacts. The focus of this new restorative material was not only to improve mechanical strength, but also to develop an aesthetic material with innovative SphereTEC filler technology. This new filler technology provides the clinician with some unique handling properties. The material does not stick to composite placement instruments, adapts easily to the cavity walls, is very easy to sculpt occlusal anatomy and is slump resistant. It is also very fast and easy to polish the material to an outstanding gloss surface.

The aim of this article is to introduce new clinical innovations that the clinician can utilize for the successful restoration of Class II cavities in posterior teeth.

**Case Report 1: Class II and preventative resin restoration**

A 33 year old male patient reported with a main complaint of occasional discomfort on his right maxillary sextant. Radiographic examination revealed a large carious lesion on the distal aspect of the right maxillary first premolar (Figure 1). Clinical examination also revealed a small occlusal carious lesion and deep, sticky, stained fissures on the occlusal surfaces of the maxillary first and second premolars. The patient gave consent to remove the caries on the maxillary first and second premolars. The teeth were anaesthetized (Xylostat 1:80 000, Adcock Ingram, South Africa) and a rubber dam (Dermadam, Ultradent Products Inc., South Jordan, UT, USA.) placed (Figure 2).
Under microscope magnification (Global 6-Step, Global Surgical Corporation, St Louis, MO, USA) a small occlusal carious lesion and enamel craze line, extending over the distal marginal ridge was noted (Figure 3).

A size small wedge (WedgeGuard, Dentsply Sirona) was placed between the two premolar teeth to protect the mesial aspect of the second maxillary premolar against iatrogenic damage during cavity preparation (Figure 4). The defective enamel and carious lesion was removed with diamond and carbide burs. The cavity preparation of the distal proximal box of the maxillary first premolar was completed with ultrasonic instruments. The sticky fissures on both premolars were removed (Figure 5) with a fissurotomy bur (SS White Burs Inc., Lakewood, NJ, USA).

A V4 Tab Matrix band (5.5 mm) (Triodent, Katikati, New Zealand) was placed and secured with Palodent V3 wedge (size medium) (Dentsply Sirona). A narrow Palodent V3 Ring (Dentsply Sirona) was placed between the maxillary first and second premolar teeth to ensure adequate separation of the teeth. Excellent marginal adaptation at the gingival margin was observed under magnification (Figure 6).

The enamel and dentine were etched with 36% phosphoric acid (DeTrey Conditioner 36, Dentsply Sirona) for 15 seconds before application of a primer and adhesive (Prime & Bond XP, Dentsply Sirona) according to the manufacturer’s instructions. A 4 mm increment of posterior bulk fill flowable base (SDR), was applied into the distal box preparation (Figure 7) to approximately 0.5 mm lower that the anticipated contact point and light-cured for 20 seconds.

The distal proximal margin was build-up using composite restorative material (Ceram.x Universal) and sculpted using the Sculpt Condensor instrument (Hu-Friedy Mfg, Chicago,
Illinois, USA) and Occlusal Sculpt Carver before it was light-cured for 40 seconds, using the centripetal build-up technique (Figure 13). The narrow matrix ring (Palodent V3 ring) was removed and the matrix band edges deflected away from the cavity preparation margins to allow more visibility and access to the remaining Class I preparation (Figure 18). Note the anatomically contoured marginal ridges that were obtained by using a combination of a contoured sectional matrix band and manual contouring of the composite material using the sharp point of Occlusal Sculpt Carver.

Clinically it was noted that there was still space for another layer of bulk fill material (SDR) in the deepest part of the remaining Class I cavity configuration. Another 2.5 mm of SDR was dispensed (Figure 9) and light-cured for 20 seconds. An oblique increment of composite resin (Ceram.x Universal) was placed and adapted in an oblique layer using the Sculpt Condensor, extending from the palatal cusp sloping towards the middle of the pulpal floor (Figure 10). A second oblique increment of composite resin (Ceram.x Universal) was placed extending from the buccal cusp to slightly overlap the first oblique increment. The preventive resin preparation on the second premolar was filled with a small increment of composite resin (Ceram.x Universal). The final occlusal morphology for the two premolar teeth was developed with the Sculpt Carver instruments before the material was light-cured for 40 seconds.

After removal of the wedges (Palodent V3), finishing of the proximal margins was done using a medium grit disc (OptiDisc, KerrHawe SA, Switzerland) while the sectional matrix was still in place to ensure protection of the contact points. Figure 11 shows the final result illustrating the superb finish and luster of restorative composite (Ceram.x Universal) that was obtained with the diamond micro-polisher point (PoGo, Dentsply Sirona). Also note the round anatomical marginal ridge contour that was obtained by using the pre-

Figure 8: Occlusal view after the distal proximal margin was build-up using composite restorative material. The narrow matrix ring was removed and the matrix band edges deflected away from the cavity preparation margins to allow more visibility and access to the remaining Class I preparation.

Figure 9: Occlusal view after a second layer of bulk fill was placed in the deepest part of the remaining the Class I cavity configuration.

Figure 10: Oblique increment of restorative composite extending from the palatal cusp sloping towards the middle of the pulpal floor.

Figure 11: Final occlusal morphology of the two restored premolars. The superb finish and luster and the chameleon effect of the composite restoratives material results in two invisible restorations.
contoured matrix band. A post-operative radiograph (Figure 12) demonstrates the extent of the restoration on the first premolar, the anatomical contoured shape of the contact area as well as the differences in radiopacity between the bulk fill material (SDR) and the composite resin (Ceram.x Universal). Figure 13 illustrates the excellent post-operative result after the restorations were in clinical service for 4 months.

Case report 2: Restoring a defective Class II restoration with an open contact that resulted in decay of adjacent tooth

The patient, a 23 year old female, presented with an open contact between her right maxillary second premolar and first molar that was previously restored with a Class II composite resin restoration (MO). Clinically there was an active carious lesion visible on the occlusal surface of the maxillary first molar adjacent to the restoration as well as beneath the fissure in the distal fossae (Figure 14).

Radiographic examination revealed a carious lesion on the distal aspect of the maxillary second premolar, probably caused by continuous food impaction between the teeth because of the defective interproximal contact point. The teeth were anaesthetized (Ubistesin 1:200 000, 3M South Africa) and a rubber dam (Dermaidam, Ultradent Products Inc) placed. A WedgeGuard was placed between the two teeth to protect the gingival tissues against iatrogenic damage during the removal of the previously placed restoration on the mesial aspect of the maxillary first molar (Figure 15).

Access to carious dentin was achieved with a round bur and guided by a carious indicator solution (Seek, Ultradent Products, Utah, USA). The occlusal and the proximal cavity margins of the cavity preparations were finalized with ultrasonic instruments (Prep Ceramic 51 ultrasonic tip, KAVO Dental, Germany) (Figure 16).

Two matrices (Palodent V3 Tab Matrices (5.5 mm)), were placed and secured with wedges (Palodent V3 (size medium)). A universal ring (Palodent Universal V3 ring) was placed between the maxillary second premolar and first molar to ensure stabilization of the matrix bands. The decision was made to first restore the distal cavity (DO) on the premolar. The second sectional matrix was placed to establish the correct position of the two proposed marginal ridges of the new restorations.

It was noted that there was not good adaptation of the matrix band against the palatal proximal cavity margin of the maxillary second premolar. Failure to ensure excellent adaptation of the matrix band at the proximal margins can result in excess composite on the margin that is very difficult and time consuming to remove. The adaptation of the matrix was improved by packing a small piece of Polytetrafluoroethylene (PTFE) tape (commercially known as Teflon tape) between the sectional matrix and the plastic
Figure 15: After rubber dam placement, a WedgeGuard was placed between the two teeth to protect gingival tissues against iatrogenic damage.

Figure 16: Final view of the two cavity preparations.

Figure 17: Two matrices were placed and secured with wedges and a universal ring. Matrix band adaptation against the palatal proximal cavity margin of the maxillary second premolar was improved by packing a small piece of PTFE tape between the sectional matrix and the plastic footprint of the ring.

Figure 18: (a) Under high magnification it was noted that there was not good adaptation of the matrix band against the gingival cavity margin. Note the presence of crevicular fluid indicating poor matrix adaptation; (b) the adaptation of the matrix at the gingival margin was improved by simple removing the medium size wedge and replacing it with a larger wedge. Note the absence of a gap and presence of crevicular fluid.

Figure 19: After etching and bonding, a 4 mm increment of posterior bulk fill flowable base was applied into the distal box preparation to approximately 0.5 mm below the anticipated contact point, before it was light-cured for 20 seconds.

In addition, it was noted under the Dental Operating Microscope (DOM) (magnification 14X) that there was also inadequate adaptation of the matrix band against the gingival cavity margin (Figure 18a). Failure to ensure excellent adaptation of the matrix band at the proximal margins can also result in excess composite that is even more difficult and time consuming to remove. The adaptation of the matrix at the gingival margin was simply improved (Figure 18b) by removing the medium size wedge and replacing it with a large size wedge.

The enamel and dentine of the cavity preparation were etched with 36% phosphoric acid (DeTrey Conditioner 36) for 15 seconds before application of primer and adhesive (Prime & Bond XP) according to the manufacturer’s instructions. A 4 mm increment of posterior bulk fill flowable base (SDR) was applied into the distal box preparation to approximately 0.5 mm below the anticipated contact point, before it was light-cured for 20 seconds. This was followed by a 2 mm increment of composite restorative material (Ceram.x Universal) that was applied into the mesial box preparation. The mesial proximal margin was build-up using Ceram.x Universal, and sculpted using the Sculpt Condensor instrument and Occlusal Sculpt Carver before it was light-cured for 40 seconds, using the centripetal build-up technique (Figure 19). 26

The universal ring (Palodent V3) and matrix bands were removed, leaving only the large wedge still in place. Note
the anatomically contoured marginal ridge that was obtained by using a combination of a contoured sectional matrix bands and manual contouring of the composite material using the sharp point of Occlusal Sculpt Carver.

Two oblique increments of composite resin (ceram.x Universal) were placed and adapted to the cavity walls, using the Sculpt Condensor. The first increment was an oblique layer extending from the palatal cusp sloping towards the middle of the pulpal floor followed by a second oblique increment of extending from the buccal cusp to slightly overlap the first oblique increment. The final occlusal morphology was developed with the Sculpt Carver instrument and an artist brush lubricated with composite primer (Composite Primer, GC) to refine and smooth the contour of the final composite increment (Ceram.x Universal) before the material was light-cured for 40 seconds. The margins were finished with a medium grit polishing disc (OptiDisc) (Figure 21).

A new matrix (Palodent V3 Tab [6.5 mm]) was placed and secured with wedges (Palodent V3 (size large)) and a universal ring (Palodent V3 Ring) was placed. Note the excellent gingival and proximal adaptation of the matrix band against the cavity margins that was obtained without any modification (Figure 22).

The same principles, materials and techniques for the bonding protocol and restoration of the cavity were applied as previously described for restoration of the distal box on the premolar tooth. Note again the round anatomical marginal ridge contour that was obtained by using the contoured matrix (Palodent V3). Also visible is the superb chameleon effect of the composite (Ceram.x Universal) material (Figure 23).

The rubber dam was removed and the occlusion checked. The restorations were finished and polished with a micro-polisher point (PoGo). Figure 24 shows the immediate post-operative result and Figure 25 the final result after the restorations was in service for four months.
Case report 3: Class II resin restoration

A 20 year old female patient reported with a main complaint of continuous food impaction between her right maxillary first and second premolars. Radiographic examination revealed a carious lesion on the distal aspect of the right maxillary first premolar (Figure 26).

The patient gave consent to remove carious tissues on the right maxillary first premolar and to try and establish more interproximal contact between the two premolar teeth. The tooth was anaesthetized (Xylotox, 1:80 000, Adcock Ingram) and a rubber dam (Dermadam) placed (Figure 27).

An attempt was made to place a small size WedgeGuard between the two premolar teeth to protect the mesial aspect of the second maxillary premolar against iatrogenic damage during cavity preparation. Due to the strength of the interproximal contact on the buccal aspect of these teeth, it was not possible to slide in the WedgeGuard device. In cases where the operator battles to place a Palodent WedgeGuard, it is recommended to first place a ring for about one minute, to initiate separation between the two adjacent teeth in order to create a space for the placement of the wedge guard (Figure 28).

After the separation achieved by the Palodent V3 Ring it was easy to place a size small wedge guard between the two premolar teeth, before the defective enamel and carious lesion were removed with diamond and carbide burs (Figure 29).

The cavity preparation of the distal proximal box of the maxillary first premolar was completed with ultrasonic instruments (Prep ceramic 51 ultrasonic tip) (Figure 30). A sectional matrix (Palodent Tab Matrice [5.5 mm]) was placed and stabilized with a wedge (Palodent V3 [size medium]). A narrow ring (Palodent V3 Ring) was placed between the maxillary first and second premolar teeth to ensure adequate separation of the teeth. It was noted under magnification that there was inadequate marginal adaptation of the matrix band at the buccal side of gingival margin due to the irregular contour of the gingival margin after cavity preparation (Figure 31).

When these situations present clinically, the authors prefer to use PTFE tape to improve the adaptation of the matrix band at the gingival margin (Figure 32). A small piece of PTFE tape can be compacted between the matrix and wedge (Figure 33a) or between the wedge and adjacent tooth (Figure 33b) to ensure excellent adaptation at the gingival margin. In this clinical case it was decided to pack the PTFE tape between the wedge and adjacent tooth to improve the adaptation at the gingival margin (Figure 33). Figure 34a shows the immediate decrease in gap formation between the band and gingival margin and Figure 34b illustrates perfect matrix adaptation at the gingival margin after the PTFE tape was pushed in a bit deeper. Failure to improve the adaptation in these situations will result in composite overhang with increased amount of plaque accumulation in this area and may possibly result in secondary caries.

The enamel and dentine were etched with 36% phosphoric acid (DeTrey Conditioner 36) for 15 seconds before application of primer and adhesive (Prime & Bond XP) according to the manufacturer’s instructions. A 4 mm increment of posterior bulk fill flowable base (SDR) was applied into the distal box preparation (Figure 35) to approximately 0.5 mm lower that the anticipated contact point and light-cured for 20 seconds.

The distal proximal margin was build-up using restorative composite resin (Ceram.x Universal) before it was light-cured for 40 seconds, using the centripetal build-up technique. The narrow ring (Palodent V3) was removed and the matrix band edges deflected away from the cavity preparation.

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Figure 26: Pre-operative view of the right maxillary sextant. Note the open contact area on the palatal aspect between the two premolar teeth resulting in continuous food impaction.

Figure 27: Pre-operative view of the maxillary first and second premolar teeth, after placement of rubber dam.

Figure 28: Tooth separation was initiated by placing a narrow ring.
Figure 29: Initial cavity preparation after placement of a WedgeGuard to protect the mesial aspect of the second premolar against iatrogenic damage.
Figure 30: Final view of the cavity preparation of the distal proximal box.
Figure 31: Under magnification inadequate marginal adaptation of the matrix band at the buccal side of gingival margin was noted.

Figure 32: A small piece of PTFE tape compacted between the wedge and adjacent tooth to improve the matrix adaptation at the gingival margin.
Figure 33: A small piece of PTFE tape (white) can be compacted between the matrix (red) and wedge (blue) or between the wedge and adjacent tooth to ensure excellent adaptation at the gingival margin.

Figure 34: (a). Immediate decrease in gap formation between the band and gingival margin after placement of the PTFE tape; (b) Perfect matrix adaptation at the gingival margin after the PTFE tape was pushed in deeper.
Figure 35: Placement of a 4 mm increment of posterior bulk fill flowable base was applied into the distal box preparation to approximately 0.5 mm lower that the anticipated contact point and light-cured for 20 seconds.
margins to allow more visibility and access to the remaining Class I preparation (Figure 36). Note again the anatomically contoured marginal ridges that were obtained.

An oblique increment of composite resin (Ceram.x Universal) was placed and adapted in an oblique layer, extending from the palatal cusp sloping towards the middle of the pulpal floor (Figure 37). A second oblique increment of composite resin (Ceram.x Universal) was placed extending from the buccal cusp to slightly overlap the first oblique increment. The final occlusal morphology for the two premolar teeth was developed with the Sculpt Carver instrument. Final contour was achieved by using an artist brush lubricated with composite primer (Composite Primer) to refine and smooth the contour of the last composite increment, before the material was light-cured for 40 seconds.

After removal of the wedge (Palodent V3) finishing of the proximal margins was done using a medium grit disc (OptiDisc) while the sectional matrix was still in place to ensure protection of the contact points. Figure 38 shows the immediate post-operative result illustrating the superb finish and luster of composite restorative composite resin (Ceram.x Universal) that was obtained with the diamond micro-polisher point (PoGo).

**Discussion**

The long-term success of a Class II restoration is often compromised before the completion of the cavity preparation. Studies have indicated that during cavity preparation, 70% or more clinicians nicks the adjacent tooth with a bur. When a bur nicks the adjacent tooth during cavity preparation it leaves a rough surface and creates an area for bacteria accumulation and subsequent enamel decalcification and possible caries formation. In a clinical study it was concluded that iatrogenic preparation damage is a frequent side-effect during Class II cavity preparations and the damage increases caries progression and the perceived need for restorative therapy of the adjacent teeth.

To avoid the risk of iatrogenic damage during cavity preparation it is recommended to use an interproximal guard to protect the adjacent tooth. In the in-vitro study done by Milic, George and Walsh they demonstrated that dentists caused iatrogenic damage on 74% of approximal surfaces without protection, which reduced to 50% and 46% respectively when matrix bands and wedges were used as guards. The corresponding rates of damage for students were 94%, 84% and 44%. In the clinical case reports in this article the Palodent V3 WedgeGuard was used for protection of the adjacent tooth during cavity preparation. The Palodent V3 WedgeGuard comprises of a metal shield incorporated into a plastic wedge. This is an excellent tool that can be used to protect the rubber dam and interproximal gingival tissues, slightly separates the teeth from each other, while protecting the adjacent tooth surface against iatrogenic damage during cavity preparation. With this protection shield in place it is also possible to complete cavity preparation in less time.

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**Figure 36:** Occlusal view after the distal proximal margin was build-up using composite restorative material. The narrow ring was removed and the matrix band edges deflected away from the cavity preparation margins to allow more visibility and access to the remaining Class I preparation.

**Figure 37:** Oblique increment of restorative composite resin extending from the palatal cusp sloping towards the middle of the pulpal floor.
Restoring anatomical interproximal contact and contour is a critical part of the success of Class II direct resin restorations. Tofflemire matrix bands (uncontoured or contoured) are stabilized gingivally with a wedge and it will often result in open or light contact points if the clinician does not use additional separation. According to Liebenberg (2002), the clinician’s achievement of an intact proximal contact when delivering a direct Class II restoration is reliant on tooth separation greater than or equal to the thickness of the matrix band used. One of the major problems with a circumferential band is that the matrix often flattens out interproximally due to tensioning of the band and when the interproximal box preparation is very wide (bucco-lingual direction) and an open contact is the only possible outcome. Contact points created with Tofflemire matrix bands are usually very high up, close to the marginal ridge that result in flat marginal ridge with a high incidence of marginal chipping or fracture.

Tofflemire matrix bands create flat, straight proximal contour which results in contacts that are often narrow in an occluso-gingival direction. They are also positioned more occlusally than the adjacent height of contour (Figure 39). The resulting restorations tend to trap food and are structurally weak, with a high incidence of marginal chipping or fracture. The contact is also often lost when the marginal ridge height area is adjusted because the height of contour is positioned right at the occluso-proximal line angle.

The inability to properly adapt composite resin materials, the fact that they demonstrate unconstrained volumetric shrinkage of 2-5% and that the matrix band itself take up some interproximal space during the placement phase are also reasons that can contribute to open contacts with posterior composite restorations.

It is well documented in the literature that precontoured sectional matrices in combination with separating rings will result in the strongest contacts and stronger marginal ridges. The curved matrix bands of the Palodent V3 sectional matrix system (available in sizes from 3.5 mm up to 7.5 mm) are designed with a rounded gingival contour as well as with an occlusal marginal ridge contour that routinely provide the clinician with an anatomically formed contact point, excellent marginal ridge contour and restorations that require minimal finishing (Figure 40). These contact points are also wider in an occluso-gingival direction and are positioned at the same level than the adjacent height of contour. Resulting restorations trap less food and are structurally strong with a low incidence of marginal chipping or fracture. The marginal ridge height can also be adjusted without loss of the contact point.

Figure 38: Final occlusal morphology and the excellent chameleon effect of composite restorative material results in a highly aesthetic invisible restoration.

Figure 39: Tofflemire matrix bands create flat, straight proximal contours which results in contacts that are often narrow in an occluso-gingival direction. The contact is also positioned more occlusally than the adjacent height of contour.
Separating rings has become indispensable when the clinicians want to achieve tight interproximal contact. These rings are placed between the teeth adjacent to the box preparation after placement of the matrix band. The engaged ring then exerts a continuous separating force on the two adjacent teeth, creating a small space that will promote adequate interproximal contact. The Palodent V3 separating rings are available in two different sizes, a universal (light blue) and a narrow ring (dark blue) (for narrow embrasure spaces) fabricated from nickel-titanium. The nickel-titanium ring is partially covered with glass reinforced plastic tines that are V-shaped. The wide occlusal foot print of the plastic tines ensure excellent adaptation of the matrix band against the walls of the cavity preparation to minimize or eliminate any excess of composite material at the line angles. Occasionally, as noted in case report no. 2 of this article, one of the plastic tines will not adapt the matrix band completely against the cavity margin. Packing a small piece of PTFE tape between the plastic tine and the matrix can easily eliminate this problem to ensure a minimal amount or no excess to remove during finishing and polishing.

The V-shape tines allow for easy placement of the ring over the wedge. However, more important is the fact that these V-shaped tines allow the operator to move, replace or add additional wedges if needed during the procedure to ensure proper adaptation of the matrix band at the gingival margin, without disassembling the matrix setup as it is the case with many other systems.

Another significant cause for the failure of posterior composite resin restorations is secondary caries. Gap formation at the cavity margins can be a result of polymerization shrinkage of the composite resin. According to Letzel, marginal gaps can permit the ingress of bacteriogenic bacteria and oral fluids, resulting in the formation of secondary caries. It can also lead to post-operative sensitivity, staining at the margins.

The authors are of the opinion that gap formation and subsequent secondary caries formation at the gingival margin can also be a result of poor matrix management at the gingival margins of the cavity preparations. With poor matrix adaptation to the gingival margins of the preparation, crevicular fluid, blood, saliva or a combination of these fluids will contaminate the adjacent enamel, dentine or cementum. This can compromise the bond strength of the bonding system to the remaining tooth structure in this critical area of the preparation. Again, the use of PTFE tape in conjunction with the Palodent V3 matrix system can improve the matrix adaptation at the gingival margin in cases where the adaptation is not optimal.

PTFE (polytetrafluoroethylene) tape in the form of plumber’s tape is inexpensive and readily available at any hardware store. It is available in rolls with varying width, thickness and purity. The unsintered type is freely available as “thread-seal” tape that is used in domestic and industrial plumbing applications. The tape can be autoclaved without altering its chemical and physical properties.

Except for the uses described in this article the tape can also be used in restorative dentistry (1) to prevent etching or bonding resin materials to adjacent teeth, (2) to isolate teeth during indirect restoration luting procedures where the tape help to avoid the resin cement to bond to the adjacent teeth; (3) to act as an insulator between uncured composite and a prefabricated stamp manufactured from impression material or resin material to facilitate the restoration of Class I cavities using the occlusal stamp-technique.

Figure 40: The curved matrix bands of the Palodent V3 sectional matrix system are designed with a rounded gingival contour as well as with an occlusal marginal ridge contour that routinely provide the clinician with an anatomically formed contact point, excellent marginal ridge contour. The contact points are also wider in an occluso-gingival direction and are positioned at the same level than the adjacent height of contour.
resin restorations the function of the wedge is not to provide tooth separation but to seal the matrix at the gingival margin. The Palodent V3 anatomical wedges provide unsurpassed sealing capability at the gingival margin. The wedges have an inverted V-shape at the bottom to accommodate the gingival tissue and also allow the wedges to be stacked on top of each other. It is also possible to place one from buccal and one from palatal/lingual aspect to increase the gingival seal. The wave shape of the wedge also allow for optimal approximation of the wedge when placed interproximally between two teeth ensuring a broad gingival seal by optimal adaptation of the interproximal space.

Technique sensitivity of placement of posterior composite restorations is further decreased by combining Ceram.x Universal with the flowable bulk-fill composite SDR. This low stress flowable base material can be placed in layers of up to 4 mm in thickness. According to the manufacturer, a modulator was chemically embedded into one of the monomers. The visco-elastic behavior of this monomer and the overall composition of the flowable composite allow the material to dissipate much more energy than induced during curing by polymerisation of the monomers. This leads to a reduction of remaining polymerisation stress by up to 60% compared to conventional flowable composite resins.47, 48 The volumetric shrinkage is 3.6% but, more importantly, the stress generated during the polymerisation is 1.4 MPa, whereas many other flowable composites are above 4 MPa.49

The fact that SDR exhibits excellent adaptation to the preparation walls due to its flowable nature, reduces the potential for void formation on the cavity margins. Several authors agree that voids can allow the ingress of bacteria, saliva and enzymes which can lead to recurrent decay and post-operative sensitivity.50, 51 When we place composite resin materials that does not easily adapt to the cavity walls, gaps may form in the internal line angles of the preparation. These gaps can be altered and increased by forces of occlusal loading, which in time can lead to the percolation of fluids into the dentinal tubules and eventually lead to fracture of the restoration under recurrent heavy loads.18

Another unique characteristic of the SDR material is the self-leveling feature, which eliminates the need to adapt or sculpt the material before curing. This also creates an ideal surface for the addition of the regular high viscosity composite Ceram.x Universal to complete direct restorations, providing the desired strength, aesthetics and wear resistance for occlusal surfaces.

The case reports outlined in this article described simplified techniques that uses restorative adhesive concepts with the new Ceram.x Universal composite material that incorporate a novel type of filler technology to develop precise anatomical morphology, function and posterior aesthetics.

The experience gained from using this Ceram.x Universal is in line with the results of evaluations conducted by the manufacturer which indicate that placement of Ceram.x Universal is less technique sensitive and more user friendly.25 The material is characterized by (1) simple and controlled application of the composite paste into the cavity; (2) secure adaptation of the composite paste to cavity floor, walls and margins; (3) easy shaping of the uncured composite into the desired anatomical form and (4) fast finishing and polishing procedure to achieve surface luster.

Conclusions
This paper has described innovative materials and techniques that can be used clinically to improve the long-term success of direct posterior composite restorations.

The innovative filler technology SphereTEC and the flowable base material SDR are exciting technological advancements in dentistry. The Palodent V3 sectional matrix system also provides with predictable, anatomically shaped interproximal contacts.

Disclosure
The authors do not have any financial interest in the companies whose materials are included in this article.

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