Posterior indirect adhesive restorations (PIAR): preparation designs and adhesthetics clinical protocol

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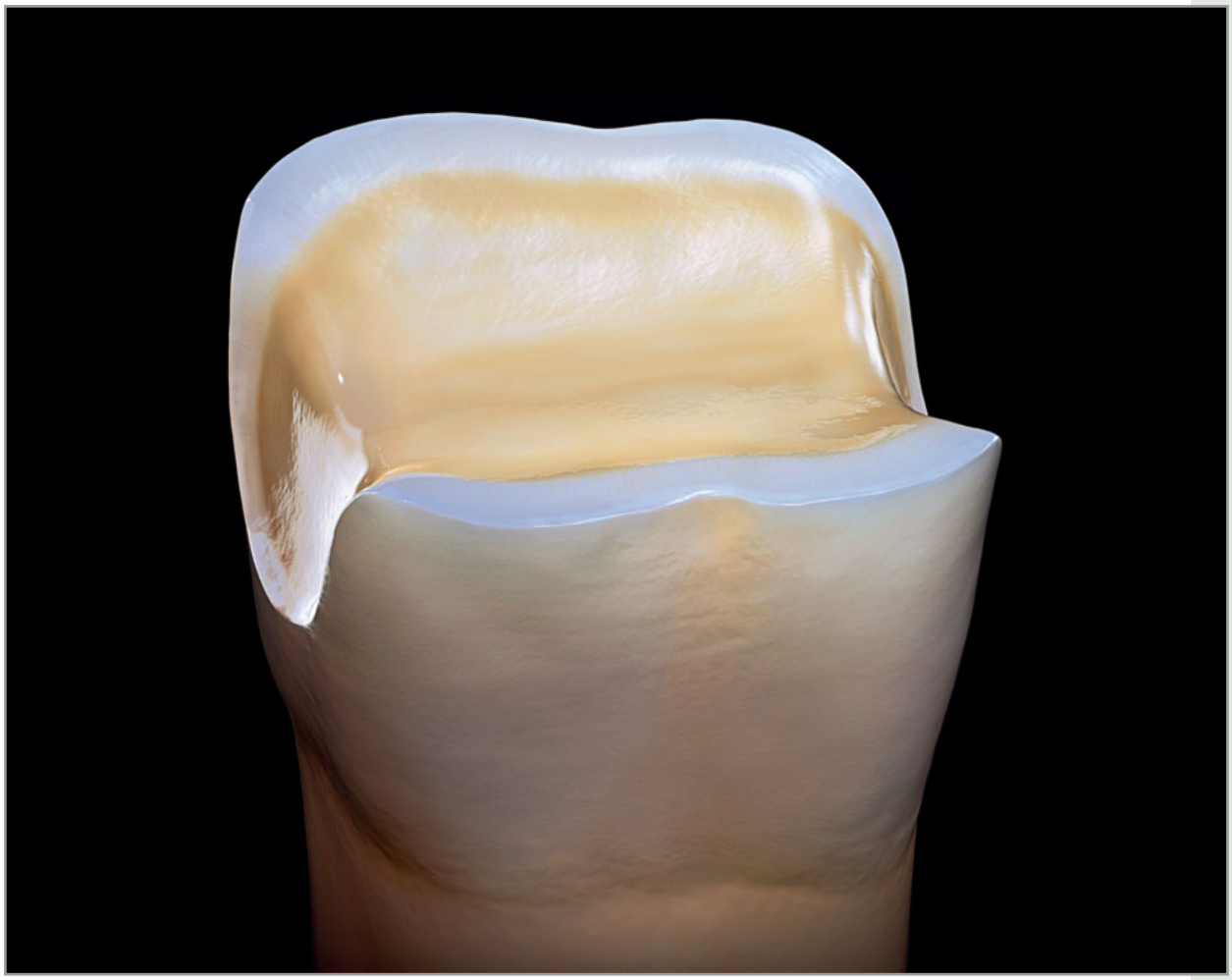

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Abstract

Posterior indirect adhesive restorations (PIAR) are very common nowadays in clinical practice. The indirect approach is often indicated by a need for cuspal coverage (one or more cusps). With the adhesthetics protocol, the first step is to perform a cavity analysis evaluating the resistance of the tooth after restoration. The structures to be evaluated are, in sequence, the interaxial dentin, ridges, roof of the pulp chamber, and cusps. To improve the strength, the cusps should be covered, when required. The build-up for PIAR is performed with an adhesive technique, and, if possible, with low-shrinkage materials. The use of an adhesive post is not required, but not contraindicated if performed with a conservative approach on the root canal. Different preparation designs can be chosen. The butt joint, the most common with an adhesive technique, is used to protect the cusp when it is evaluated to be too fragile. A variant of the butt joint, the bevel, is useful for esthetic purposes or for providing more space or more enamel surface on the peripheral part of the preparation. The shoulder is useful if a cervical grasp is required, but is usually indicated when a previous cusp fracture needs to be restored. The veneerlay combines an overlay design with a buccal veneer when there are specific esthetic needs. In the interproximal areas, the preparation designs can be classified as: slot – the most common; bevel – useful in some cases to restore the ridge with a more conservative approach; ridge up – useful to preserve the ridge (a very important structure to maintain the resistance of the tooth) even when cuspal coverage is required. Ridge up can have two variants: ridge preservation and ridge coverage. More than one preparation design is used in many cases in the same preparation, taking into consideration the specific situation of the tooth and its different areas, in order to balance the prognosis with a conservative approach.

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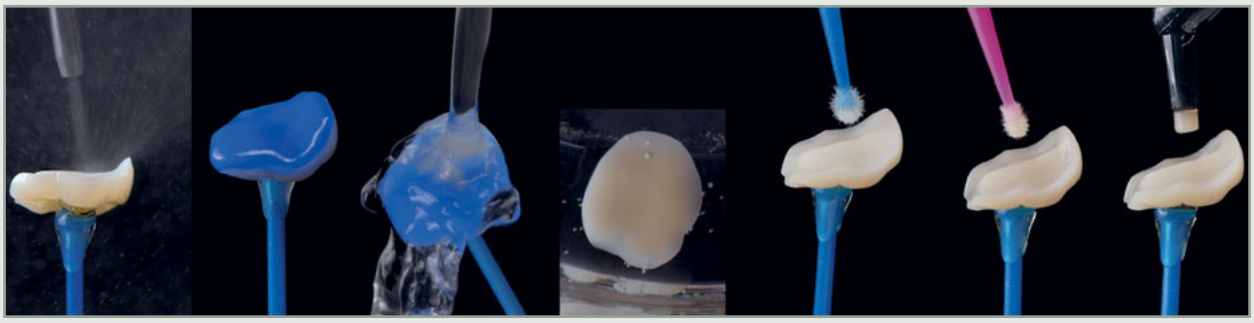

Introduction

The daily clinical use of posterior indirect adhesive restorations (PIAR) (Fig 1) is very frequent in cases of cavities with extended coronal destruction.[1,2]

The preparation for an adhesive partial restoration allows for a greater preservation of healthy tissue than one for a full-crown metal-free preparation.[3-5]

The typologies of cavities that have to be restored in the posterior area may have the following shapes once they are clean and prepared: inlay (a cavity that does not need any cuspal coverage), onlay (a cavity with coverage of one or more cusps), overlay (a specific onlay typology with complete cuspal coverage), and veneerlay (an overlay with the involvement of the buccal wall and a preparation combined with a laminate veneer). In order to complete this type of indirect posterior restoration, it is appropriate to consider the full crown, as this procedure foresees the coverage of the full clinical crown.

Fig 1 Posterior indirect adhesive restorations (PIAR) made with layered resin-based composite material. The buccal parts are for a cuspal coverage only, and the palatal surfaces are for a more extended coverage.

Modern dentistry offers many restorative solutions with various approaches and the use of a range of different materials. The advent of adhesive techniques and their predictability[6] has profoundly changed the clinical scenario, modifying some fundamental principles of classic dentistry. The use of adhesion in restoration has unquestionably led to some advantages, including conservation, sealing, function, and esthetics.[7] In the case of PIAR, these advantages are well represented.

If PIAR follows specific clinical protocols – a careful evaluation of the indications, a design of the preparation suitable to the clinical situation, the right choice of restoration materials, adequate dental impression taking and restoration manufacture, and an adequate cementation protocol – it is possible to make a difference regarding the prognosis[8] and the comfort of the patient, in addition to an excellent esthetic integration. Our experience in daily clinical practice (as well as common sense) suggests that the uncoordinated use of isolated procedures cannot give a predictable result; rather, a consolidated and codified protocol is necessary to achieve this.

The aim of this article is to share some important aspects of clinical protocols related to PIAR on the basis of the adhesthetics approach, which will be presented in a more complete way in the related forthcoming book.[7]

The name adhesthetics is the combination of the terms “adhesion” and “esthetics,” and the presented approach takes into account the most consolidated clinical protocols, giving a concrete solution for some practical aspects of adhesive dentistry that are less frequently

addressed and codified in the scientific literature.

Indications

After performing a correct diagnosis, the first restorative protocol decision to take is the choice of restoration, for which some specific indications should be taken into account. In the posterior region, the clinician can generally choose between direct and indirect restorations, and frequently with indirect restorations there is a distinction between partial or complete cuspal coverage. A cuspal coverage restoration can also be approached using a direct technique, historically with the realization of direct onlays in amalgam, and more recently with composite resin materials and adhesive techniques that can be managed in different ways (eg, the index technique) (Fig 2).[9]

Generally, in the adhesthetics protocol, indirect restorations are not chosen for inlay cavities (which therefore do not have cuspal coverage), especially on a single tooth, fundamentally for a greater conservation of healthy hard tissue.

Given that an indirect restoration must not have undercuts inside the cavity, the inlay can be approached in two different ways: by filling up the undercut area with restorative material (block out) or by eliminating a part of healthy dental structure in order to remove the undercut. The first way is certainly the more conservative. From a practical point of view, to achieve a situation of block out with adhesive techniques, various field isolation and adhesive procedures must be followed. This often represents the great part of the work required to achieve a direct restoration in the mouth, and is the reason that a direct technique is often considered in order to restore an inlay cavity. In any case, comprehensive indirect restorative inlay approaches have been presented, eg, the creation of multiple cavities in the same semi arch.

Fig 2 The transparent silicone keys used in the index technique protocol to build up the occlusal onlay restoration using a direct approach.

Fig 3 Worn dentition with an abundant amount of enamel. This kind of situation is manageable with a conservative tabletop preparation for the overlay.

The main indication during a PIAR is therefore the covering of one or more cusps (onlay restoration), and consequently also the whole occlusal surface (overlay restoration, which is therefore a specific type of onlay). Tabletop restorations are also a typology of overlay,

often used in some types of restorative rehabilitations on abraded and/or eroded teeth (Fig 3). Therefore, it can be concluded that the absence of one or more cusps can be an indication for a partial indirect restoration.

Another possible indication was considered in the past in the clinical situation of a cervical margin in dentin. In this case, one approach favored an indirect inlay in order to better seal the margin. This approach was partially confirmed;[10] however, another study indicated that a direct restoration was a more reliable method.[11] In other studies, no differences were found in the resin–dentin interfaces for indirect inlay and direct resin composite restorations.[12,13] This is therefore a controversial point, and for this reason the cervical margin in dentin does not strongly indicate an indirect restorative approach in the PIAR protocol.

Cracked tooth syndrome is another possible indication for cuspal coverage. Using a composite onlay/overlay has been demonstrated to be an effective approach to eliminate the symptoms of cracked tooth syndrome without root canal treatments in the large majority of cases.[14] However, clinicians should be cautious when using this type of approach indiscriminately because, as a literature review[15] underlined, and as limited clinical studies show, once a tooth is diagnosed with cracked tooth syndrome and reversible pulpitis, it may be treated successfully with a full crown, a complex amalgam, or a bonded composite overlay.

In the adhesthetics protocol, it is believed that the main indications for indirect partial posterior restorations are:

- Medium- to large-sized cavities where one or more cusps are missing.
- Cavities where the coverage of one or more cusps is advisable to improve the prognosis of the complex restored tooth.
- Morphological modification and/or raising of the posterior occlusal vertical dimension (OVD) in cases of oral rehabilitations on elements where a full-crown restoration would be too invasive.
- Cracked tooth syndrome, when the symptomatology needs to be managed with the aim of maintaining the vitality of the tooth.
- Multiple medium- to large-sized cavities in the same quadrant (even if indirect inlay restorations are not the first choice).

What is the ideal way to deal with a potentially fragile residual cusp? Should it be retained or covered? What is the adequate thickness required to support the occlusal load? These questions form part of daily clinical practice for the restorative clinician, and although some authors have investigated them,[16,17] the literature does not provide absolute answers.

Another concern for the restorative clinician is the partial or extended fracture of the dental crown, as the consequences can be very serious, both on vital and (especially) on non-vital teeth. A particular type of restorative approach can prevent such fracture, especially in the presence of an occlusal overload. Even evident hard tissue cracks, especially if contextualized with the other aforementioned factors, may be determined by occlusal or accidental

traumatic overloads. Moreover, teeth become more fragile with the passage of time, and therefore more susceptible to cracks and fractures, especially if previously weakened by restorative procedures[18-22] or endodontic treatments.[20]

Resistance to fractures can be influenced by different factors such as the cavity dimension,[21-23] the physical properties of the restorative material,[18] and, in the case of indirect restorations, the cementation system used.[23-25]

In order to protect the weakened tooth, it is advisable to cover the cusp with partial or total restorations.[26,27] The studies on onlays or partial crowns made with dental amalgam and conventional cementation techniques are not applicable to the clinical situation of adhesive restorations.[28]

The PIAR ceramic partial crowns are cemented in an adhesive way, which not only protects the restorative material, but also reinforces the other hard tooth tissue.[29]

The resin cements used for the cementations are elastic and tend to deform themselves, being able to absorb possible stress.[30] Due to the performance of adhesive cements, the cavity preparations of the pre-adhesive era[31,32] are no longer relevant because adhesion plays a fundamental role in maintaining the cemented restoration.[28] Obviously, the effectiveness of the adhesive bond depends on many factors that have to be analyzed individually, eg, the quality and quantity of the hard tissue, the materials with which the cementation is made, the type of masticatory pattern of the patient, and the morphology of the preparation.

Analysis of cavity factors and indications for restoration: clinical protocol

All the abovementioned considerations may have clinical significance, but to put them into a protocol we have to codify the practical procedures for clinicians to follow. Therefore, given that some factors (such as an occlusal overload and the presence of obvious hard tissue cracks) emphasize the risk of fracture, the adhesthetics protocol needs to be analyzed in terms of the diagnosis of cavity factors and the choice of the type of restoration, with the related preparation approach:

- Anamnesis and objective exam. Useful in order to become aware of the restorative history and previous coronal fractures.
- Complete removal of eventual decayed tissues and previous restorations.
- Analysis of cavity factors.
- Identifying, in order of importance, the presence of interaxial dentin, proximal residual ridges, roof of the pulp chamber, and residual cuspal walls.

In order to preserve the tooth, the hierarchy of importance mentioned above[16,17] is relevant, with the interaxial dentin being the most important aspect to consider, and the residual cuspal walls the least important. The more unfavorable the cavity situation, the more the clinician has to consider cutting and covering the cusps to prevent possible coronal fractures. Generally, if the cuspal thickness of the vital tooth (measured at the thinnest point and in axis with the cuspal apex) is < 2 mm, a cuspal coverage

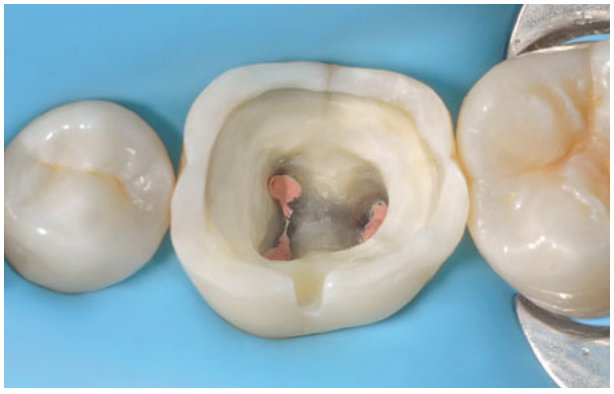

Fig 4 Devitalized molar with a large amount of dentin lost before the build-up. At this point, it is useful to do an analysis of cavity factors.

Fig 5 An analysis of cavity factors makes it evident that the interaxial dentin and the roof of the pulp chamber are missing. Measurement of cusp thicknesses is important to decide a possible coverage to improve the strength of the tooth after the restoration.

is suggested. This is in line with some suggestions in the literature.[33,34] For non-vital posterior teeth, the thickness limit is 3 mm[35] (Figs 4 and 5). The non-functional thin cusps (with a thickness less than the aforementioned values) can be even more fragile, and special attention must be paid to them. When using adhesively bonded restorations, the thin cusps should be completely covered or reduced to avoid enamel cracks and marginal deficiency.[36] The remaining cusp wall thickness of non-functional cusps of adhesively bonded restorations should have a thickness of at least 2.0 mm to avoid cracks and marginal deficiency.[37]

The central isthmus to the cavity must have a minimum thickness in order to meet the cavity design. Dietschi and Spreafico[33] suggest that it should be no less than 2 mm,[33] which is understandable in terms of the restoration's resistance, especially after cementation.

Build-up

There are various advantages to the basic preventive reconstruction (the build-up or block out), which is carried out before proceeding with the definitive preparation:

- The block out of the undercuts, filling the areas in which the indirect restoration would not find a favorable morphology to the substrate. This allows for a conservative preparation, given that some areas that determine the undercut do not need to be physically removed as they are filled with the restorative material of the build-up.
- Immediate hybridization of the dentin,[38] known as immediate dentin sealing (IDS),[39] especially when the exposed dentinal area is wide,[40] and by the consequent coverage with a material that has a variable thickness, which isolates the dentinal substrate from bacterial, environmental, and

thermal situations that can occur, from the impression taking to the adhesive cementation.

- Being able to determine the thickness of the future restoration, an approach that has already been introduced under the names of dentin sealing[41] or dual bonding.[42]

The disadvantages are that the clinician has to perform an additional clinical step with the field isolation, adhesion, and reconstruction. Moreover, shrinkage stress of the build-up can occur if it is not managed properly, which is why resin-based materials with low-shrinkage properties are recommended, in addition to a stratification with controlled volumes.

A controversial question is raised by the presence of an adhesive post (eg, fiberglass) inside non-vital teeth. According to Dietschi et al,[43] the clinical indication for a post is in full-crown restorations where there is little residual hard tissue for the abutment. We assert that the indication for the presence of a post for the purpose of anchorage does not exist in the PIAR protocol, as this type of restoration mainly exploits the adhesive bond resulting from the low-retention design of the preparation. We believe it to be realistic that the risk of fracture of the reconstruction and of the tooth is not increased, as can occur with customized metal posts, because the fiberglass post causes more debonding failures.[44,45] However, some studies in the literature have shown how the presence of a post, including a fiberglass one, as the core of a full-coronal coverage restoration increases the risk of fracture of the tooth–restoration complex, compared to the composite material build-up without a post.[46] On the contrary, it has been demonstrated that the presence of a fiberglass post increases fracture resistance compared with the reconstruction of an abutment with only a resin-based material.[47] It is difficult to say with certainty that the fiberglass post directly affects the possibility of fracture of the restored tooth. Teeth restored with fiberglass posts and composite resin cores showed a homogeneous stress distribution within the root dentin.[48] From a clinical point of view, it is advisable to adapt the post to the canal and not the other way round, so as not to remove healthy dentin and so weaken the residual root.

Fig 6 Build-up made with a resin-based composite material. Low-shrinkage materials are useful for this purpose. The enamel margin should remain free in order to have a favorable adhesive substrate at the cementation step.

In conclusion, a simple build-up without post is often suggested (Fig 6) for the PIAR. However, according to the adhesthetics protocol, adhesive fiber posts are not contraindicated, for instance, in the case of a vast lack of some dental walls, or when it is thought that in future a prosthetic crown could be made on the

Fig 7 Occlusal grooves represent the first step of preparation. They are useful to determine the vertical reduction.

Fig 8 Overlay preparation is done with a palatal butt joint, a buccal bevel (to include some enamel cracks in the preparation), and interproximal slots (the residual enamel was very thin). The central groove is not mandatory; it is done on the build-up to gain a better reference during the positioning phases at cementation, and to give more space in the area of the sulcus.

same element, with the one condition that an over-preparation enlarging the canal space left by endodontic therapy is not created. In the latter case, the post would be considered to be a "mini-filler" or a coarse resin filler, cemented inside the canal with resin-based material and capable of giving a favorable biomechanical distribution in the radicular dentin.

Preparation designs

The morphologies of preparation can be different, depending on the clinical situation, but there are some general rules that apply (Figs 7 to 12).

Absence of undercuts (according to the manufacturer's axis of insertion)

In fact, the presence of undercuts prevents the correct positioning of the restoration in the cavity. There are situations that are exceptions, where undercut areas can be predicted (eg, with a veneerlay in the buccal area if the axis of insertion is buccolingual).

Presence of internal rounded corners and sharp finishing lines

Internal rounded corners can allow for the avoidance of certain situations, eg, friction areas (which can displace the correct position of the restoration), steep surfaces (which can negatively interfere with the extrusion of cement excesses), and difficulty when it comes to reproducing very pronounced corners on the cast.

Another reason for internal rounded corners is resistance to mechanical stress, because molar teeth restored with glass ceramic in lithium disilicate with a retentive preparation design have demonstrated a lower medium resistance to fractures,[49,50] compared with other studies with a simple horizontal preparation design.[51]

Fig 9 Composite resin-based overlay before the cementation.

Fig 10 Field isolation with rubber dam for the adhesive cementation phases.

Fig 11 Overlay at 1 week after cementation.

Fig 12 Four-year follow-up without any major repolishing. Some little-wearing facets are visible on the composite surface, but the maintenance is more than acceptable.

The geometry of retentive restorations is more complex, and presents relatively sharp inner corners. Due to this, some predetermined breaking points may be evident. It can be assumed that the simple geometric designs of the restorations can contribute to raising resistance to mechanical stress. On the other hand, the presence of a finishing preparation margin on a sharp line allows the clinician to accurately indicate the end of the restoration, and to check the proper positioning of the restoration on the cavity.

Fig 13 Butt joint preparation, which is not flat but mainly follows the inclination of the occlusal plane. The more peripheral margins (buccal and lingual) have a more horizontal design.

Presence of substrates favorable to adhesion

Having substrates that respond well to adhesion and maintaining this condition over time are important considerations for a restoration of this type. The first among these substrates is a margin of well-represented enamel. While the adhesion of dentin and composite (the build-up) can be favorable, enamel remains the most reliable and stable. According to the adhesthetics protocol, the two best substrates for adhesive cementation are enamel and composite build-up (or block out), which allow for a wider hybridization and overcoating of the dentin substrate immediately after the cleansing of the cavity. These two substrates can be adequately prepared for adhesive procedures, bearing in mind that the best guarantee of a restoration's resistance is a completely enamel preparation.[51]

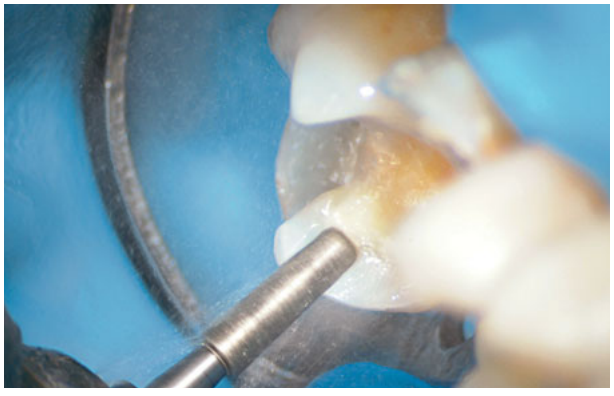

Fig 14 Occlusal reduction for a cuspal coverage when the residual thickness is not considered adequate for a medium- to long-term prognosis. This kind of bur should have depth marks.

Types of preparations

The PIAR can be applied to various needs and different clinical goals. There is no clear classification in the literature for the different types of preparation; therefore, a classification is presented here on the basis of clinical experience.

In the case of posterior onlay/overlay, three types of preparation can be applied to the main forms according to the adhesthetics protocol: butt joint, bevel, and shoulder. A veneerlay preparation may be used in the case of cuspal and buccal coverage. For tabletop on a worn dentition, the recommended preparation is an ultraconservative butt joint with a simple surface finishing.

Fig 15 Bevel preparation. This kind of design is a variant of the butt joint, where it is possible to create a bevel (usually between 1 and 1.5 mm in length) on one or more surfaces. In this case, it is evident on the buccal side.

Fig 16 Shoulder preparation. A rounded shoulder characterizes this preparation design. The depth of the shoulder is usually around 1 mm.

The *butt joint* (Fig 13) requires minimal preparation and is therefore suitable for adhesive techniques. It is represented by an occlusal reduction that follows the evolution of the cusps and the main sulcus, so is generally flat but with an inclined surface. At the level of the finishing line, the butt joint should have an inclined trend toward and follow the occlusal surface, which is then made more horizontal. The occlusal reduction is generally calibrated by burs with the presence of depth marks (ie, 959KRD 314-018 or 6487KRD 314-016, Komet).

Indications for a butt joint preparation:

- Cuspal reduction to protect the teeth from the occlusal load (Fig 14).
- Cuspal fracture in the area of the occlusal third (or middle third, in some cases).
- Presence of strong abrasions/erosions of the occlusal surface (with the possibility of increasing the vertical dimension).

The *bevel* preparation (Fig 15) is similar to the butt joint but with the substantial difference of the presence of an inclined bevel, generally of 45 degrees or more, for an average length of 1 to 1.5 mm,

which can be more extended in exceptional cases. This beveling is generally present on the buccal side, but can also be on the palatal side (eg, in cases where the cracking of the enamel within the preparation should be included [see Figs 8 and 10] or when more thickness and support is required for a restoration on a working cusp). Where there is a bevel on the whole circumference, the variant of a full bevel can be considered.

Indications for a bevel preparation:

- Esthetic need for a more gradual integration of the restoration–tooth transition.
- Wider surface of external enamel, which enhances adhesive cementation procedures.
- To create more space for the restoration in the peripheral zone (see Fig 25).

The *shoulder* (Fig 16) is a preparation characterized precisely by a rounded shoulder, which develops on the peripheral part of the design. The central part is generally represented by the build-up (or block out), usually made of a resin-based material. The thickness of the shoulder is about 1 mm, thus allowing for the largest possible enamel thicknesses that enhance adhesive cementation procedures. The management of the finishing line must be realized with a geometrically determined bur, with a slightly tapered shape and a rounded inner corner. If the bur head diameter is 1 mm (ie, 6487KRD 314-016), it should be sunk to the entire thickness of the substrates to be prepared, but if it is larger (ie, 959KRD 314-018), it should not be completely sunk.

Indications for a shoulder preparation:

- Previous cuspal fracture to the cervical third (or medium third in some cases), and then, by effect, the central build-up automatically defines the peripheral shoulder design (Figs 17 to 20).
- Where a greater structural protection is required for a cusp coverage with a cervical grasp.

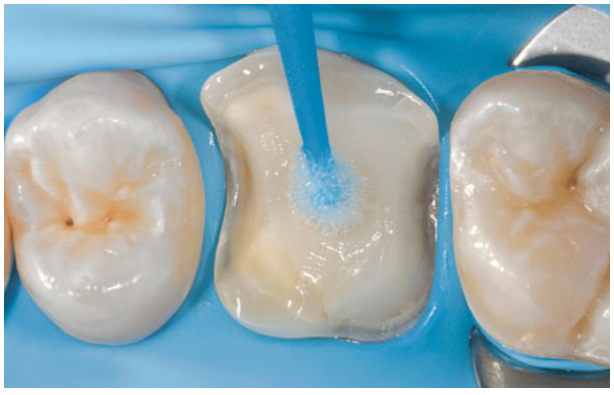

Fig 17 Adhesive phases on a devitalized molar prepared for an overlay. The butt joint design represents the cuspal coverage for three cusps, and the shoulder was performed on the distopalatal cusp where a fracture had occurred.

Fig 18 The overlay made on a mixed preparation (butt joint and shoulder) prior to cementation.

Fig 19 The composite resin-based overlay 1 week after adhesive cementation.

Fig 20 Four-year follow-up after cementation, without any major repolishing.

Proximal preparation designs

There are three types of approaches for the interproximal areas according to the adhesthetics protocol: slot, bevel, and ridge up.

- *Slot:* a frequent interproximal preparation is represented by this design, which has a rounded shoulder (coherent with the shoulder preparation), generally of about 1 mm (Fig 21). One reason for this preparation being so widespread is because this type of shoulder is naturally determined after the excavation of an interproximal carious lesion, allowing for the creation of a central reconstruction to the dental crown.
- *Bevel:* a less invasive preparation compared with the slot for restoring the interproximal area without going

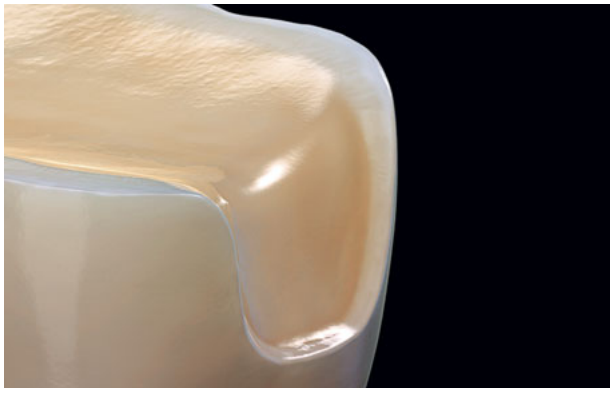

Fig 21 Slot interproximal preparation. This kind of design is very common, especially when a previous carious lesion has affected the area.

Fig 22 Bevel interproximal preparation. This approach is more conservative compared with slot interproximal preparation. It is suitable for when the contact area must be restored without managing a cavity from a previous carious lesion.

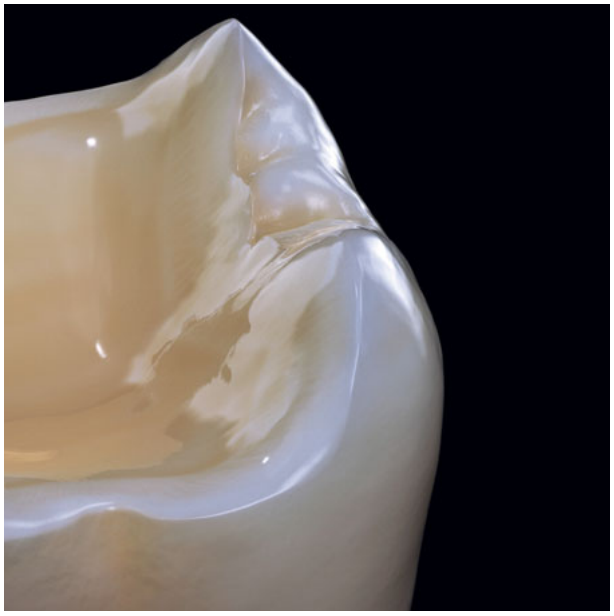

Fig 23 Ridge up interproximal preparation. The most conservative approach for the ridge when a cuspal coverage is performed. In the variant known as ridge preservation, the aim is to maintain the structure intact.

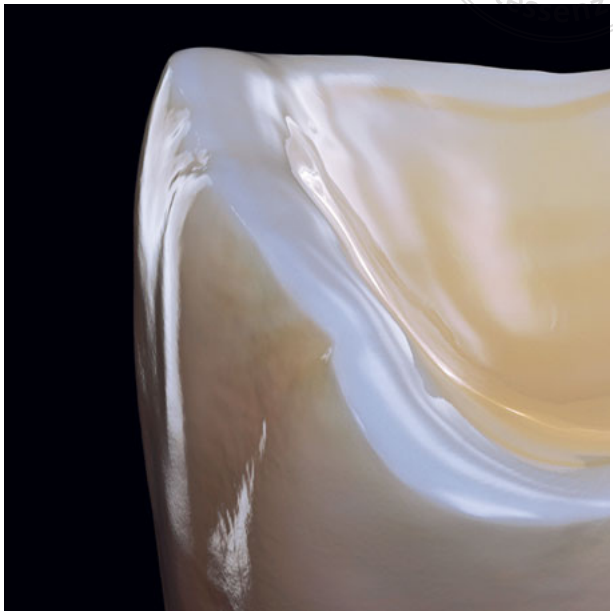

Fig 24 Ridge up interproximal preparation. In the variant known as ridge coverage, the ridge is slightly prepared.

Fig 25 Non-vital overlay preparation. Ridge up (ridge coverage variant) on the mesial surface, slot on the distal surface, and bevel on the buccal surface.

in too deeply at the cervical level. This configuration offers some advantages for a bevel preparation (Fig 22), such as a good surface of enamel, which enhances the adhesive cementation procedure. This preparation is indicated when an extensive restoration needs to be made to the interproximal area without a previous carious lesion, and localized cervically compared to the contact area.

- *Ridge up:* the ridge preservation variant of this approach allows for the maintenance of the integrity of the marginal ridge (Fig 23), whereas the ridge coverage variant allows for minimal surface preparation (Fig 24), preserving the contact area that has not obviously suffered from carious lesions. Given that the ridge is one

Fig 26 Another view of the preparation on the removable abutment, and the finished overlay.

Fig 27 The overlay ready for cementation. In this case, a monolithic restoration is achieved with a hybrid resin-based material reinforced with ceramic particles.

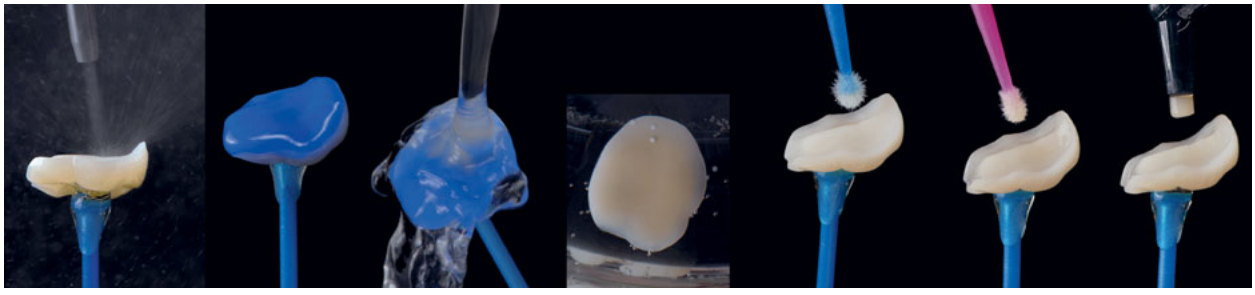

Fig 28 Adhesive steps of the PIAR. On composite material, increasing the roughness with sandblasting is an important step, while hydrofluoric etching is a fundamental step on ceramic materials. Other steps can be optional. The adhesive agent and cement are then very important.

of the most important structural elements with regard to the integrity of the non-vital tooth,[52] in cases of reduced thickness of the adjacent cusps one can opt for a cuspal coverage with the preservation of the ridge. The indication for this type of preparation is a cuspal coverage with the purpose of structural protection, but with a good integrity of the ridge and the absence of cavitated carious lesions (Figs 25 to 29).

Fig 29 Overlay with ridge up on the mesial at 1-year follow-up after cementation.

Preparation and finishing: clinical protocol

First preparation

Analysis and choice of preparation
Cavity diagnosis plays a fundamental role in the choice of a preparation. The preparation should be made with clean cavities, without residual decay or previous restorations.

Occlusal preparation
One of the first steps is the creation of occlusal grooves to determine the height of the preparation (see Fig 7). This can be done using different types of burs such as rounded diamond burs (which are sunk to half their diameter and which produce a groove of a certain thickness) or tapered burs with depth marks (drawn with the laser) that allow for the use of rotary instruments such as a probe (ie, 959KRD 314-018 or 6487KRD 314-016).

The regularization of the occlusal surface can be performed with the same conical tapered diamond burs, either medium grit (107 µm) or coarse grit (151 µm). The thicknesses to maintain vary, depending mainly on the restorative material being used: 2 mm is a secure thickness in the case of layered composite,[33] although it may be slightly lower. A thickness of 1 mm is suitable for monolithic restorations, ceramic materials such as lithium disilicate, and resin-based materials reinforced with ceramic, which in conditions of normal masticatory loads could be used up to a thickness of 0.5 mm.[53] A thickness of between 1.0 and 1.5 mm is considered safer in order to avoid clinical complications, even for a high-resistance glass ceramic such as monolithic lithium disilicate.[54]

Peripheral preparation
This can vary depending on the chosen design (butt joint, bevel or shoulder) and interproximal access, if required, which can be made with a pointed bur (ie, 858-314-010) especially to create the bevel. To create a shoulder slot, a tapered bur with a reduced diameter can be used (ie, 847-314-012).

Finishing of the preparation

Once the first preparation has been done and the shape of the cavity is thus defined, surface finishing coherent with the preparation can be performed. For this purpose, for the adhesthetics protocol a fine grit bur (46 µm) with a reduced number of speeds can be used. This should preferably be assembled on the speed-increasing handpiece (ie, red ring). The shape and dimension should be coherent with the burs used for the first preparation (ie, 8847-314-016).

The last step is the definitive finishing of the edges and, if desired, the flat surfaces. This phase in the adhesthetics protocol can be done with manual instruments such as a chisel, or with diamond instruments. Preferably, extra-fine grit burs (25 µm) should be used, which have been introduced into the kit of adhesthetics burs so as to always have points with a coherent shape and dimension that can give an accurate definition of the finishing line, both in the shoulder and the interproximal slot (ie, EF847 314-016), as well as for the

finishing of the occlusal inclined surface (ie, EF959 314-018). When these types of burs are used, the goal should be to polish off the edges and surfaces using reduced pressure so as not to create undesired microgrooves. If a revision (also minimal) of the preparatory design is necessary, it is advisable to go back one or more steps and use burs with a larger grit size. It is optional to use polishers to polish some of the preparation surfaces.

Other protocol steps

All the procedures described in this article are carried out within a clinical protocol, which ensures that they are all appropriate and coherent, including the impression taking (analog or digital). For this step, all the surfaces and edges of the preparation must be read well and replicated in a precise and faithful way, as the cementation with this type of design (scarcely retentive) must best exploit the conditioning of the surface of the restoration (see Fig 29) and the tooth. If the PIAR is made with resin materials, the most adequate preconditioning is usually sandblasting using various techniques and possible particles, whereas for glass ceramic hydrofluoric acid is best, and, in both cases, including additional adhesive steps.[7] However, these topics are not the subject of this article and are thus not analyzed here.

Also, while this article does not cover the material selection for a PIAR, it is important to mention that positive data exists in the literature for both glass ceramic and resin-based composite onlay materials. For performing an onlay/overlay in endodontically treated molars, composite is better than feldspathic ceramic in terms of mechanical strength.[55,56] However, lithium disilicate monolithic performs well compared with resin-based composite and other ceramic materials (such as leucite and feldspathic), and even though it has been shown to exhibit higher stress concentration, the failure risk of the restoration was lower.[57]

In any event, it is important for the clinician to have a specific protocol that takes into account the natural variables that can be found under different circumstances. This protocol should be followed from the first diagnostic phases to the conclusion of treatment. Dietschi and Spreafico[58] recently published the clinical rationale for the biosubstitutive approach with bonded inlays and onlays, clarifying many aspects of the clinical protocols for this type of restoration.

Conclusions

A cavity diagnosis is very valuable when it comes to indication and the type of PIAR to execute. The protocol suggested in this article should help the clinician to decide whether to maintain, integrate or reduce some cusps for the purpose of final resistance of the complex tooth restoration.

It is strongly recommended to use the build-up or block out in nearly all cases of PIAR to effectively allow for the immediate protection of the dentin, the filling of the undesired undercuts, and the determination of the thickness of the future restoration.

The butt joint is the most advisable adhesive preparation, with its variant

bevel in some cases. The shoulder preparation is almost always used for restorations that have one or more previous cuspal fractures (to the third medium or cervical). The aim is to prepare the PIAR in an increasingly conservative way to balance the prognosis of the restoration.

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