

The Guide to Class IV Restorations with

IPS Empress® Direct



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Anterior restorations require a high level of skill and technical knowledge about the material to be used so that a harmonious integration with the natural smile can be achieved. Reproducing the natural play of light is especially important in Class IV restorations in order to prevent the overall restoration from appearing optically “dead”.

The following pages describe an esthetic and economically efficient approach to create Class IV restorations with IPS Empress® Direct. As in most cases, several roads lead to the same destination. This guide aims to describe the techniques that are easiest to learn and fastest to apply without impairing the esthetic result.

Step-by-step, the guide will take you through the techniques that help you create successful Class IV restorations:

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1 Shade selection

IPS Empress Direct is offered in an extensive selection of shades. However, some of these shades are only needed in exceptional cases. Here is how to put together a basic set that will allow you to handle most cases:

- IPS Empress Direct – Enamel shades: A1, A2, A3, A3.5, A4, B3, B4
- IPS Empress Direct – Dentin shades: A1, A2, A3, A4, IVA5, IVA6
- IPS Empress Direct Effect – highly translucent incisal shades: Trans 30, Trans Opal
- IPS Empress Direct Color: white, brown
- IPS Empress Direct Opaque

The procedure

Switch off the operatory light and the light of your loupes, if using. A bright light source may result in you selecting shades that are too bright. Do not blow the tooth dry with air. Do not isolate with cotton rolls or a rubber dam before you have determined the shade. Enamel dries very easily and once dry, it looks more opaque and brighter than when it is moist. It takes at least 30 minutes for the tooth shade to return to normal through the absorption of water (Russell et al 2000). To determine the shade of the enamel, hold the incisal edge of the enamel shade guide against the incisal edge of the tooth to be restored. To determine the dentin shade, compare the shades on the dentin shade guide with the cervical shade of the canines. If you are undecided between two shades, choose the darker one. Now assess the level of translucency; this quality refers to the same optical properties as transparency and opacity, indicating the level of light that is transmitted through an object, from low light transmission (opaque) to high light transmission (Fig. 1).

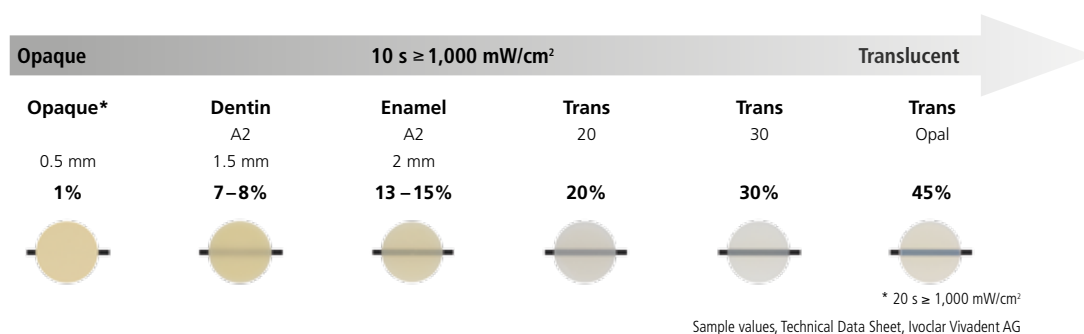


Fig. 1: Various degrees of translucency

For a successful Class IV restoration, the correct reproduction of the translucency is more important than the correct selection of the shade! A change in translucency will always result in a change in brightness; one affects the other. As the oral cavity forms a dark backdrop, a restoration appears darker with increasing translucency (Figs 2 and 3).

Teeth become more translucent with age (Baratieri et al. 2007). Composite restorations, on the other hand, become more opaque over time due to material aging. There is no remedy against this situation – you have to rely on your experience and judgement. If you are in doubt, restore the tooth to be more translucent rather than too opaque. We will return to this point when discussing the layering technique.

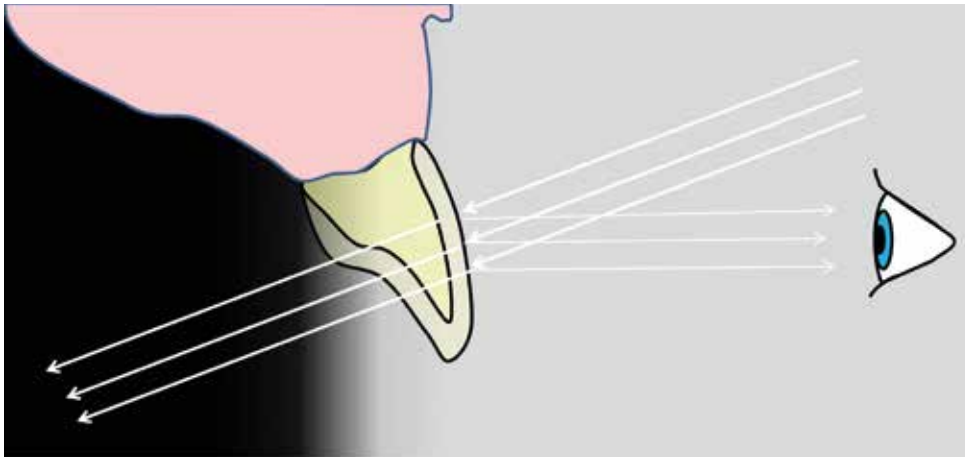


Fig. 2: Translucent tooth or restoration: The light passes through the tooth. Only a small portion of light is reflected on the surface of the restoration or tooth. This makes the tooth appear darker.

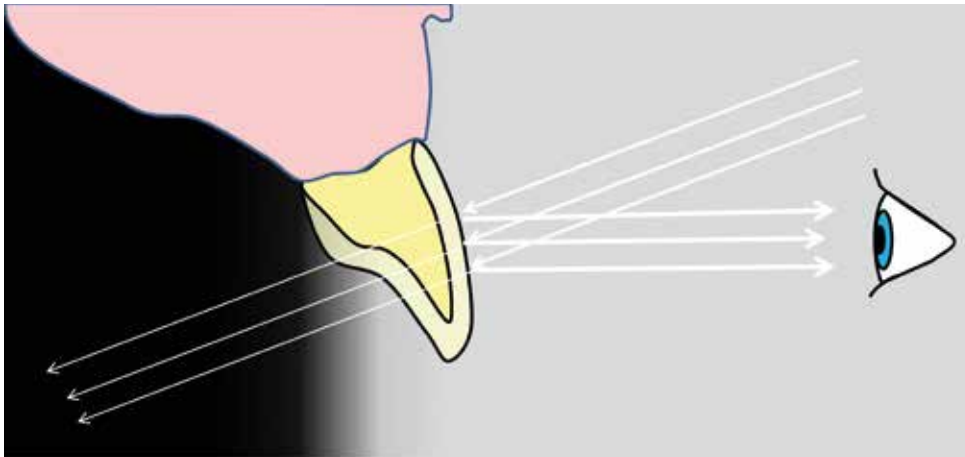


Fig. 3: Opaque tooth or restoration: An increased portion of light is reflected on the surface of the restoration or tooth. A smaller amount of light dissipates in the oral cavity and the tooth appears lighter.

2 Analysis

Identify those characteristic features of the dentition that are important for achieving a harmonious integration of the restoration. Pay special attention to the basic shape of the teeth, the position of the ridge lines, surface texture, mamelons, opalescence and the halo effect (Figs 4 and 5a–c). The expression of the essential characteristics in anterior teeth varies strongly from patient to patient and, in addition, is age-dependent.

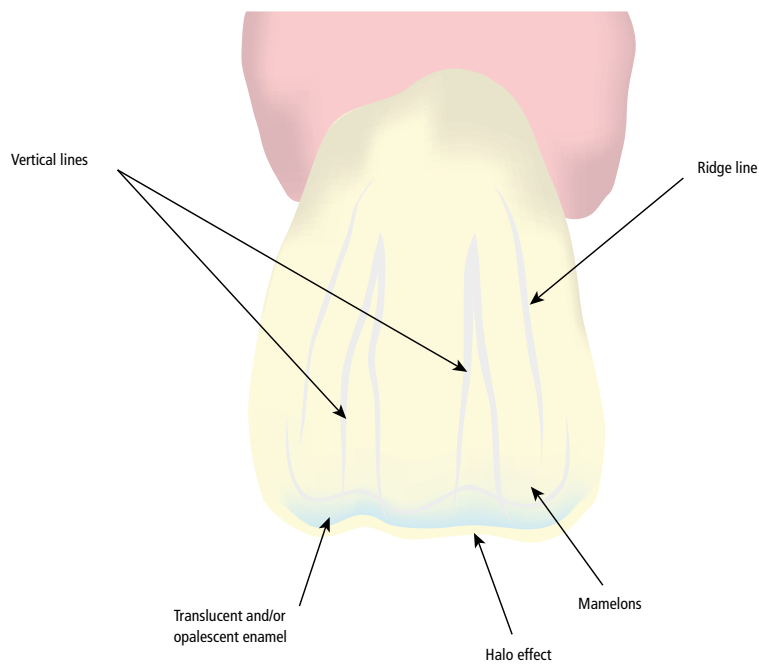


Fig. 4: Essential characteristics of a natural incisor



Figs 5a–c: The morphology of teeth can vary greatly.

Excursus: canine guidance

Before you begin with the restoration, check the protrusive movements and laterotrusion. If you were to build up a Class IV restoration in such a way that contact occurs on the restoration during laterotrusion, the restoration would be predestined to fail. In these cases, canine guidance should first be re-established before proceeding with the restoration. Pictures 6a to 6c illustrate this point by means of an example:

- Picture 6a shows an anterolateral view of the teeth in habitual intercuspation. The patient is 25 years old. Clear signs of advanced wear can be seen already from this view. The cusp tip of the upper canine is flattened. In addition, the distal angle characteristic of the lateral incisor shows a kink - a sign that vertical dimension has been lost here, too.



Fig. 6a

- In laterotrusion to the right, canine guidance is lost. Instead, anterolateral group guidance occurs. If the lateral incisor is altered (build-up of the incisal edge), the guidance in laterotrusion would shift entirely onto the build-up. The canines would be in disclusion. Fracture of the restoration would be the likely outcome.



Fig. 6b

- In laterotrusion, all posterior teeth remain in contact, resulting in a progressive reduction of the vertical relation.



Fig. 6c

- After the wear facets on the upper canines have been restored with composite material, disclusion is re-established (Fig. 6d). Splint therapy is indicated to maintain the stability of the situation.



Fig. 6d

Using composite material to re-establish canine guidance inevitably leads to two questions:

1. Does a composite build-up on a canine not involve a risk of fracture?
2. Will the build-up be worn down over time?

Composite build-ups on canine teeth hardly ever fracture. The bonding surface is considerably larger than the bonding surface of Class IV defects on lateral incisors. It goes without saying that build-ups made of composite are subject to wear over time, like those made of other materials. This means that the guidance should be checked at every recall to see if it is still appropriately in place. It will be necessary to replace the build-up at some point in time, depending on the patient's functional activity. Ceramic restorations are considerably more robust in terms of wear. However, if ceramic is used on the upper canines, it would be necessary to additionally restore the wear defects on the lower canines to forestall excessive wear.

3 Preparation

In most cases, restoration of a Class IV defect requires only a minimal amount of tooth preparation. A few guidelines should nonetheless be borne in mind:

1. Prepare a facial bevel; a width of 1–2 mm will be sufficient. In the cross-section of the tooth, the bevel should be convex shaped (Fig. 7). As a general rule, all sharp edges should be smoothed out.
2. On the oral side, prepare a narrow bevel only.
3. Do not create irregular or wave-shaped bevels. This approach was advocated at a time when translucent enamel shades were not yet in use. With the use of modern anterior composites, this measure has become obsolete.
4. Finish the enamel edges with a fine-grit diamond (Xu et al. 1997).

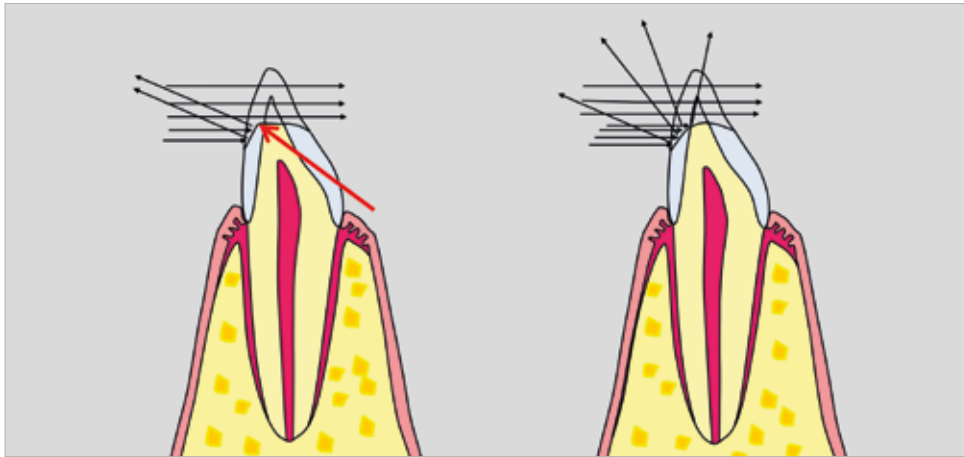


Fig. 7: Light scatters differently in a bevel with sharp edges (left) than in a bevel with a convex shape (right).

If the restoration is translucent, more light passes through the restoration than through the tooth. Less light is reflected. This results in a distinct optical transition between the opaque tooth structure and the translucent composite build-up, see red arrow in Figure 7. If a convex bevel is prepared (Lenhard 2004), as in the tooth on the right, more light is scattered, resulting in a softer optical transition. However useful though this technique is, it can balance out variations in translucency only up to a certain degree.

4 Bonding

Phosphoric acid etching of enamel is still crucial to ensure an optimum marginal seal that stays tight even after exposure to masticatory forces. The marginal seal is critical to the long-term success of a Class IV restoration because microleakage may lead to marginal staining. Compromises are not admissible here. Selective enamel etching should be performed if a universal adhesive is used. This means that initially the enamel is etched for 30 seconds with phosphoric acid. Subsequently, the cavity is rinsed with water for 10 seconds, dried briefly and then a universal adhesive (e.g. Adhese® Universal) is applied according to the manufacturer's instructions for use. Apply the phosphoric acid well beyond the preparation margin (Fig. 8). Minute composite excesses do not cause esthetic problems as long as they firmly adhere to the tooth.

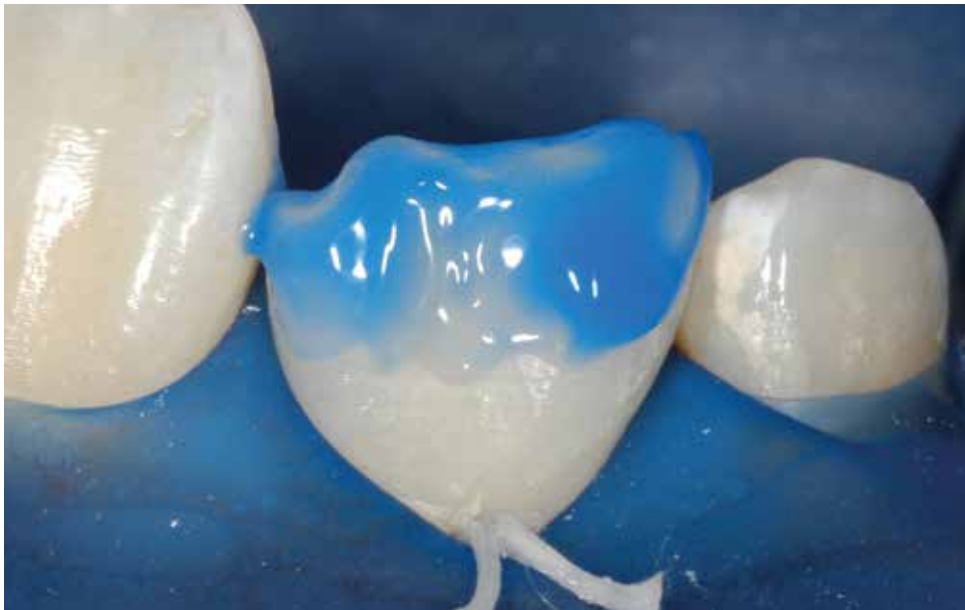


Fig. 8: Apply phosphoric acid well beyond the preparation margin.

5 Layering technique

Basic technique

IPS Empress Direct is best applied in what is known as an anatomical layering technique. This means that enamel is replaced with enamel and dentin is replaced with dentin to restore the defect. Based on this principle, the basic technique to restore a Class IV defect consists of four steps (Figs 9a–e). Approximately 90% of all cases can be restored with this technique alone.

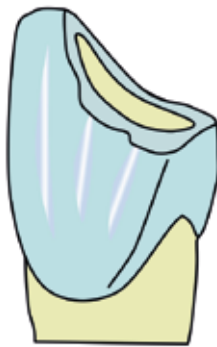


Fig. 9a: Preoperative situation

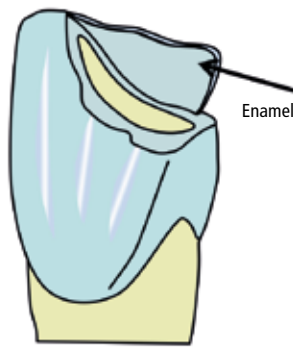


Fig. 9b: Restoring the oral wall with enamel (< 1 mm)

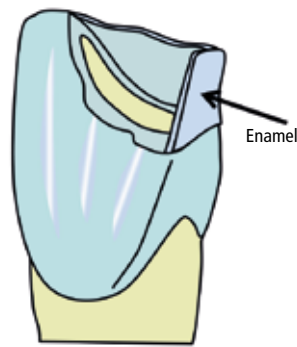


Fig. 9c: Restoring the proximal wall with enamel (< 1mm)

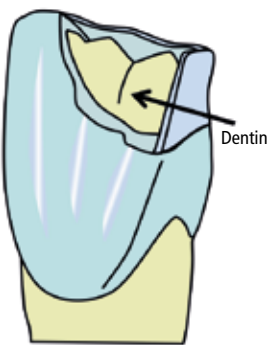


Fig. 9d: Rebuilding the dentin core with dentin

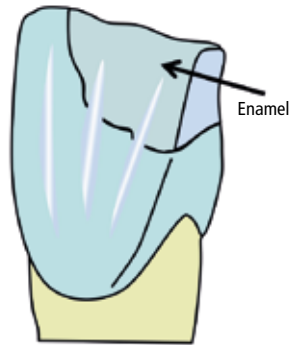


Fig. 9e: Creating the facial aspect with enamel

Extended layering technique

However, additional steps are sometimes required to reach an optimal result. Most modifications of the basic technique are done to increase the translucency and reproduce the opalescent effect of the incisal edge. If opalescent incisal edges are desired, IPS Empress Direct Trans Opal is applied towards the incisal edge between the mamelons after the dentin core has been built up. The Trans Opal material may by all means overlap the dentin. Subsequently, the facial aspect is restored with enamel, in line with the basic technique (Fig. 10a). To increase the opalescent effect in the incisal edge, divide the facial layer into two parts, so that you first apply some enamel material to the defect from the cervical margin upwards and then translucent material (e.g. IPS Empress Direct Trans 30) towards the incisal (Fig. 10b).

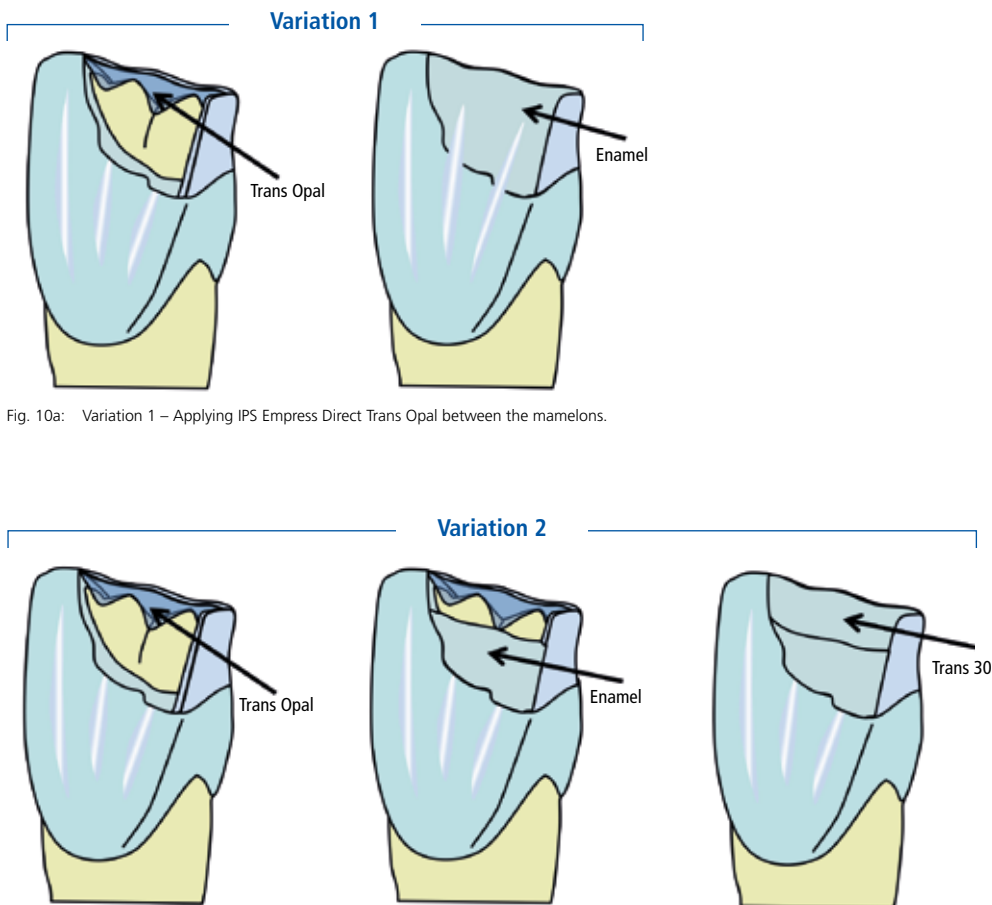


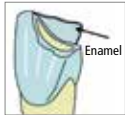
Fig. 10a: Variation 1 – Applying IPS Empress Direct Trans Opal between the mamelons.

Fig. 10b: Variation 2 – Dividing the facial layer into two parts: enamel material is first applied to the cervical part of the defect upwards and then translucent material towards the incisal.

Basically, I recommend the following toolkit for the layering technique:

- Small double-ended spatula with a thin blade,
- Modelling instrument with foam pad attachments (OpraSculpt® Pad),
- Translucent plastic matrices and
- Wooden wedges.

Using IPS Empress® Direct in practice: Example 1 – Basic technique



Step 1: Restoring the oral wall with enamel (<1 mm)

Use your index finger as a palatal or lingual matrix. This is by far the most accurate and quickest technique for restoring Class IV defects if you do not want to use a lab-fabricated silicone key.

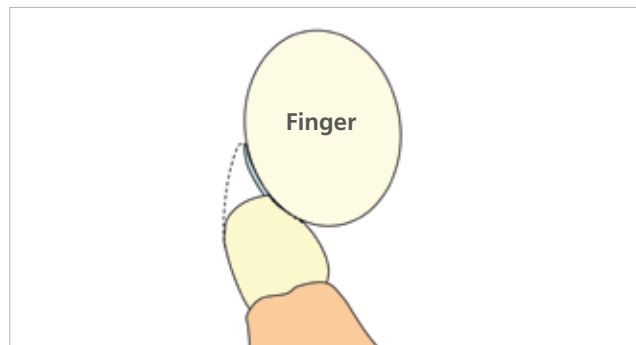


Fig. 11

Place your finger neatly against the surface of the tooth so that there is no gap between your finger and the tooth. This enables you to build up a thin concave enamel wall. Do not exert any pressure as this will otherwise result in the formation of a curved-in shoulder at the restoration margin. Support your finger on both adjacent teeth. This method ensures that the incisal edge of the restoration is positioned correctly on the incisal arch. Ideally, the reconstructed oral wall already reflects the final shape of the incisal edge.



Fig. 12a

Remember: The oral wall should not be thicker than 1 mm!

In the incisal area, the palatal wall should almost touch the adjacent teeth, while in the gingival area some distance should be maintained.

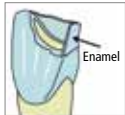


Fig. 12b



Warning

Dental monomers may cause allergic reactions (Wallenhammar et al. 2000, Goon et al. 2006). Most reactions are caused by HEMA (2-hydroxyethyl-methacrylate) (Aalto-Korte et al. 2007, Goon et al. 2006). HEMA is a hydrophilic functional monomer that is found in many dentin adhesives as an ingredient. Protective gloves provide only limited protection because the monomers penetrate the gloves after a certain time (Nakamura et al. 2003, Lonroth et al. 2003). There is therefore a risk that you may be exposed to the monomers after a while if you use your finger as the matrix. To minimize or eliminate this risk, change your glove after you have built up the oral wall to make sure that no monomer can get through.



Step 2:
Restoring the proximal wall with enamel (< 1 mm)

The proximal wall is built up in 3 steps: First, place a matrix around the tooth. Use a wedge that is thick enough so that it cannot extend beyond the proximal area into the oral cavity. Place your finger behind the oral wall and press the matrix firmly against the build-up.



Fig. 13a

In the second step, build up the proximal wall using enamel material. Make sure that you adapt the composite firmly in the transitional zone between oral and proximal wall. It is important that you firmly press the matrix onto the tooth in the palatal area to prevent the composite from being pressed into the proximal space. The matrix band must not be folded around the tooth on the vestibular side so that the contact point to the neighbouring tooth is not lost. Repeat this technique for the construction of the distal wall.

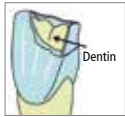


Fig. 13b

Then remove the matrix. If everything has been done correctly, the composite should now be adapted to the oral and proximal margins without excess.



Fig. 13c



**Step 3:
Creating the dentin core**

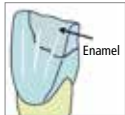
Build up the dentin core with the selected dentin material (Fig. 14). Although this is technically an easy task, building up the dentin core presents the main challenge as regards the final optical results. This is because the thickness of the dentin layer determines the degree of translucency of the restoration. If you make the dentin core too thick, the restoration will be too opaque and therefore too bright - the opaque dentin layer would optically block out the dark backdrop and reflect large amounts of incident light. If you make the dentin core too thin, the restoration will be too translucent, looking grey and dark.



Fig. 14

The IPS Empress Direct dentin materials exhibit a translucency between approx. 7 and 8%. They are therefore quite opaque and go well with the natural dentin of young patients. However, dentin grows more translucent with increasing age (see "Shade selection"). You need to adjust the layer thickness of the dentin core to the age of the patient: The older the patient, the less dentin material! It is impossible to indicate exact quantities because the degree of translucency does not only change with age, but also varies considerably from person to person. Here, your judgement and experience come into play. Generally, you will be on the right track if you try to reproduce the natural dimension of the dentin core in very young patients. By contrast, you would want to use only a small amount of dentin material in most 70-year-old patients and sometimes no dentin material at all is required.

As mentioned above, if you are in doubt, make the restoration rather more translucent than too opaque. The longer the restoration has been in the mouth, the more the translucency will begin to blend in. If the restoration has been too opaque from the outset, the differences in translucency will increase the longer the restoration stays in the mouth.



**Step 4:
Restoring the facial aspect**

As the last layer, apply enamel material to restore the facial surface. It is absolutely essential that air bubbles are avoided here. In my experience, the hand-held Optrasculpt® Pad is well suited for adapting the facial composite layer.

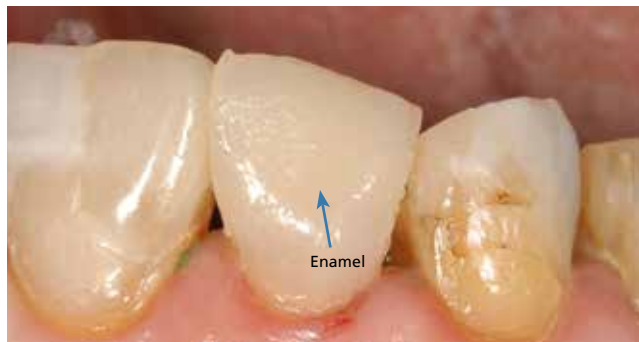


Fig. 15

Postoperative situation after one week

The restored lateral incisor looks especially esthetic due to the halo effect (see page 29) that has been built into the incisal edge (arrow).



Fig. 16

Using IPS Empress® Direct in practice: Example 2 – Extended layering technique (Variation 1)



Step 1: Preoperative situation, preparation and bonding

Preoperative situation: partially fractured incisal edge build-up. Note that the existing composite covers approximately half of the total crown length.



Fig. 17a

Situation after preparation: All sharp edges and transitions have been removed.

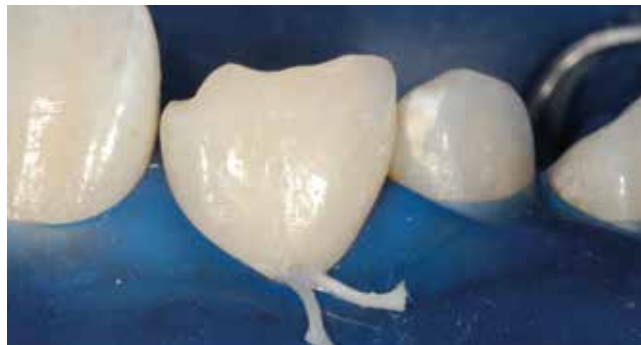


Fig. 17b

Palatal view



Fig. 17c

Apply the phosphoric acid etchant well beyond the preparation margin. Etch the enamel for 30 seconds. Then, rinse the cavity for 10 seconds with water and blow dry briefly.

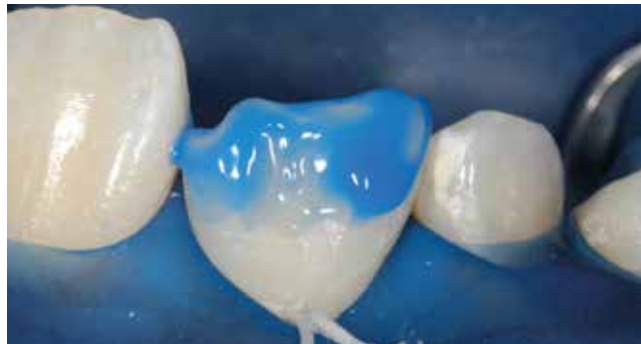
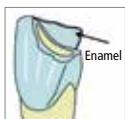


Fig. 18a

Apply a universal adhesive (e.g. Adhese® Universal) according to the manufacturer's instructions.



Fig. 18b



Step 2:
Restoring the oral wall with enamel (<1 mm)

The palatal wall is restored with enamel material. The finger is placed on the palatal surface without applying pressure and supported on the two neighbouring teeth.



Fig. 19a

Completed palatal wall. Near the incisal edge, the wall should almost touch the neighbouring tooth. Below this area, the interdental space should be clear to enable a triangular passage (see point 2. in "Good to know" below).

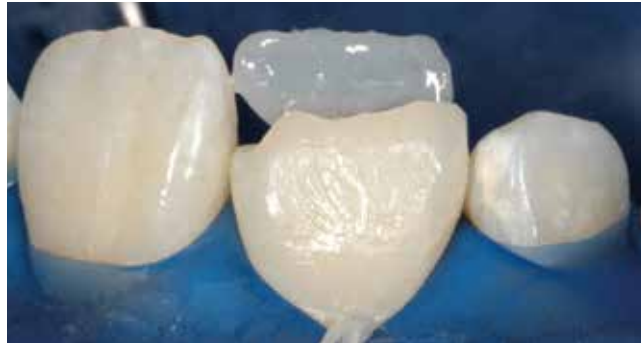
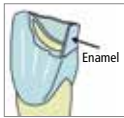


Fig. 19b



Step 3:
Restoring the proximal wall with enamel (< 1 mm)

To restore the proximal wall, place a clear plastic matrix in the proximal space and secure it with wedges. Use your finger to fold the matrix onto the palatal surface and press it against the palatal wall.



Fig. 20a

Then, rebuild the mesial wall with enamel material. Do not fold the matrix around the tooth onto the vestibular side to avoid losing the proximal contact point.



Fig. 20b

Once you have reconstructed the mesial wall, remove the wedge and the matrix.



Fig. 20c

Situation after the proximal walls have been rebuilt

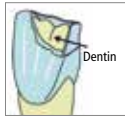


Fig. 20d

Move your patient in an upright position and look them straight in the face. Assess and adjust the length of the reconstructed palatal wall as necessary.



Fig. 20e

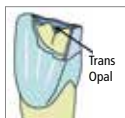


**Step 4:
Creating the dentin core**

Build up the dentin core with the dentin material selected. Contour the mamelons so that they are just short of the height of the incisal edge.



Fig. 21

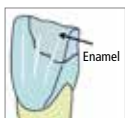


**Step 5:
Applying IPS Empress® Direct Trans Opal**

Apply IPS Empress Direct Trans Opal between the mamelons to create an opalescent incisal edge. The Trans Opal material may slightly overlap the dentin.



Fig. 22



**Step 6:
Building the facial layer**

As the last layer, apply enamel material to restore the facial surface. It is absolutely essential that air bubbles are avoided here.



Fig. 23

Move the patient again into an upright position to adjust the angle characteristics and check the contours of the restoration. Easy to see: The teeth are not symmetrical; the mesial angle characteristic requires adjusting.



Fig. 24

The completed restoration exhibits an opalescent incisal edge with mamelons and halo effect.



Fig. 25



Good to know

1. Relation of the mamelons and dentin core to the incisal edge

When restoring a Class IV defect in the upper jaw, you are normally seated behind the patient in a 12-o'clock position. In other words, you see the teeth upside down. After you have built the palatal and proximal walls, you normally proceed to reconstruct the dentin core. Here, however, you should first establish the exact position of the incisal edge before you continue with applying the dentin materials. This is difficult to do from a 12-o'clock position. Move your patient in an upright position and look them straight in the face. Only now will you be able to correctly assess and adjust the position of the incisal edge. If you perform the restoration under complete isolation (rubber dam), you should isolate the teeth from canine to canine to be able to assess the incisal line.

- In Figure 26a, the palatal wall is too long. If you begin to build up the mamelons at this point and shorten the restored tooth only at the end of the restorative process, you will end up removing the translucent part of the incisal edge that you have previously created.



Fig. 26a

- Move the patient into an upright position and look them straight in the face to assess the incisal edge (Fig. 26b). Then, shorten the edge to the correct length using a grinding disc.



Fig. 26b

You do not need to worry if you remove the oxygen-inhibited layer whilst adjusting the incisal length. Studies have shown that the oxygen-inhibited layer is not required to bond two consecutive composite layers (Shawkat et al. 2009, Dall'Oca et al. 2007, Papacchini et al. 2007). Any resulting grinding dust can simply be rinsed off with water spray. Unlike saliva and blood, water does not cause contamination on composite surfaces. Before the next step, the surface only needs to be dried thoroughly.

2. Restoring the proximal wall with the help of cotton pellets

When restoring the proximal wall, it is essential to avoid excess material in the proximal area in order to keep later finishing efforts as minimal as possible. For this reason, the palatal area below the proximal contact point is initially left clear when building up the palatal wall (Fig. 19b). This way, the transition between the proximal and palatal wall is shifted slightly to the palatal and any excess material will be easier to remove. To reconstruct the proximal wall, insert a matrix band, fold it onto the palatal surface to obtain a neat transition and hold it in place with a finger. A cotton pellet can additionally be inserted from the palatal in the proximal space between the matrix and finger to ensure that the matrix is firmly adapted in the transitional area between the interdental space and palatal aspect (the finger does not fit into this area). Figure 20a shows the cotton pellet behind the matrix band in the interdental area.

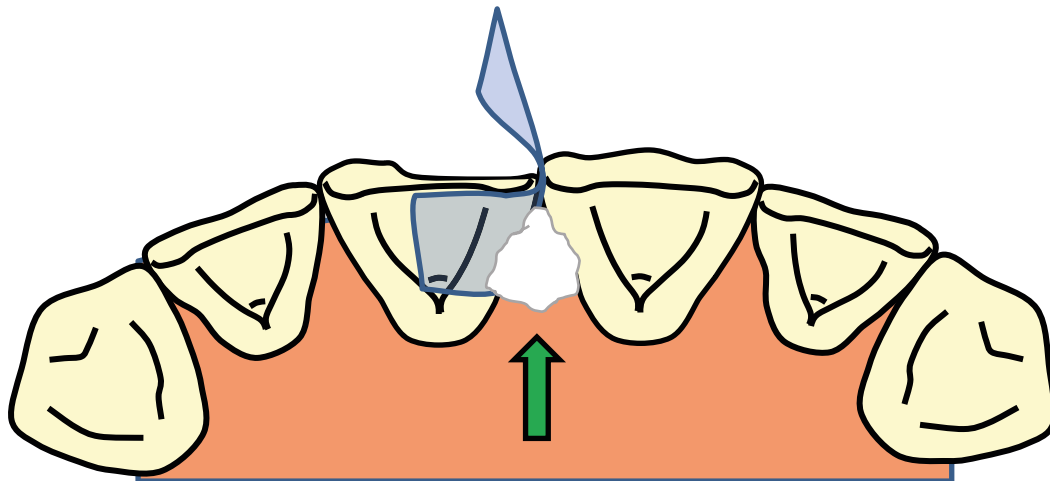


Fig. 27: Restoring the proximal wall with the help of a cotton pellet

3. Deviations from the tooth shade directly after completion of the restoration

Do not expect the shade of the restoration to match the natural tooth structure after polishing. On the contrary: If there is a perfect shade match straight after completion of the restoration, you have a problem. The reason for this is that the natural tooth structure is drier than usual at this point and thus appears much brighter and more opaque than it normally would. Depending on the degree of desiccation, it takes about 30 to 60 minutes until the tooth is rehydrated and the natural tooth shade returns (Figs 28a–b).

- Figure 28a shows the postoperative situation as it should look after completion of the restoration:
The natural enamel is desiccated. This makes the restoration appear too dark and too translucent (see red arrow).



Fig. 28a

- Figure 28b shows the successful integration of the restoration after the natural tooth structure has become rehydrated.



Fig. 28b

6 Finishing and polishing

Generally, this is the stage where the most time is lost due to an inefficient approach. Always follow the same sequence of steps to avoid undue loss of time. First, finalize the tooth shape and then polish.

I recommend the following toolkit:

- Preparation diamonds 90–40 μm ,
- Sof-Lex™ polishing discs (3M Espe), fine abrasive grade, \varnothing 9.5 mm,
- Intensiv ProxoStrips 40 μm / 15 μm (Intensiv),
- Intensiv Proxoshape Flexible (Intensiv),
- OptraPol®.

Step 1:

Adjusting the incisal edge

First, check once more the length of the tooth (Fig. 29a) and adjust as necessary (Fig. 29b). Flexible grinding discs are best suited for this task. It is important that the patient is in an upright position and you are standing in front of them when you perform this step. Only in this position can you assess the length appropriately. Hold the grinding disc in a slight angle to the oral side. This results in a small wear-like grinding facet.

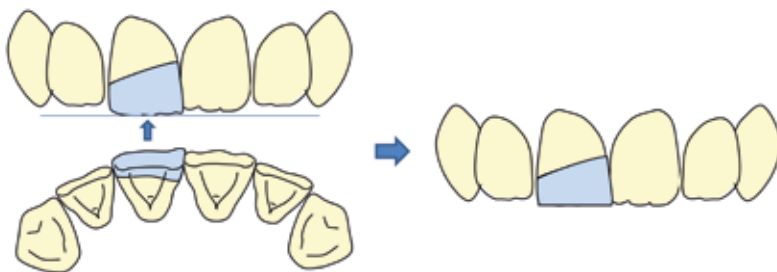


Fig. 29a: Restoration after completion of the layering technique



Fig. 29b: If necessary, adjust the length of the incisal edge once more.

Step 2:

View from the incisal

Once you have adjusted the length, view the restoration from the incisal (Fig. 30). Generally, the layering technique described above results in the restoration to slightly extend beyond the facial plane in the interdental area and overlap the neighbouring tooth a touch.

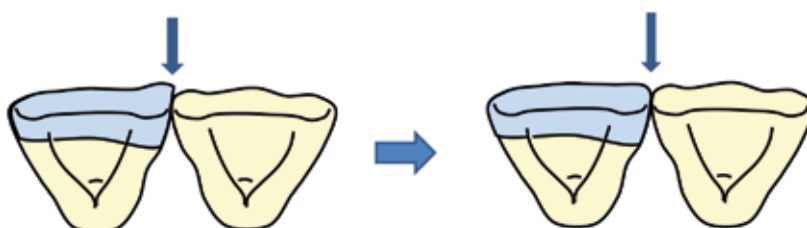


Fig. 30: View of the restoration from the incisal

Step 3:**Adjusting the transitional areas**

In the next step, adjust the transitions from the facial to the proximal surface. Again, you best use a flexible grinding disc for this task (Fig. 31). To facilitate the access to the interdental space, you may slide a small spatula into the proximal space and rotate it slightly to separate the teeth a touch. Do not overdo it – this is quite uncomfortable for the patient.



Fig. 31: Adjusting the transitions

Step 4:**Removing excess material**

To remove proximal excess material or to adjust the shape below the contact areas, use finishing strips or machine driven files (Fig. 32). Gingival and interdental excess material can be removed with an Intensiv Proxoshape® Flexible / EVA® system (Intensiv).



Fig. 32: Removing excess from the interdental and gingival areas

Step 5:**Adjusting the tooth shape**

Now, adjust the angle characteristics (Fig. 33). This step is essential to obtain an optical separation between the teeth. Always compare the shape of the restored tooth with the corresponding tooth on the opposing side.

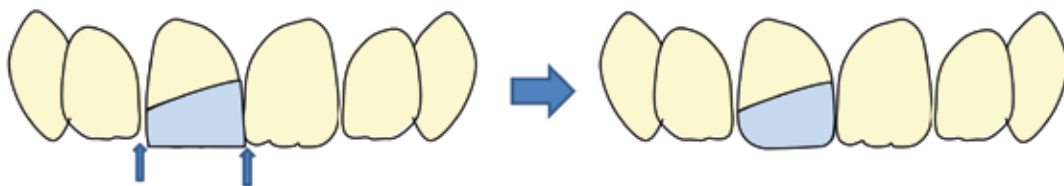


Fig. 33: Adjusting the tooth shape

Step 6:

Adjusting the facial surface

In the last step, adjust the facial surface. Use rough to fine diamonds to reproduce the macromorphology of the surface (Fig. 34). After this step, the tooth should appear perfect when it is moistened with saliva.



Fig. 34: Adapting the facial surface

Step 7:

Final polishing

You may have noticed that no silicone polishers have been advocated so far. Polishers are appropriate for achieving a surface gloss and not for contouring. Use them only once you have perfected the tooth shape. Any other use is simply a waste of time. For polishing, I recommend the use of an OptraPol polisher (cup or large flame). OptraPol allows you to polish the restoration in a single step without having to change the instrument, starting from a surface that you have previously finished with a fine-grit diamond (40 μm) (Fig. 35). Diamond pastes and polishing brushes are usually not required.



Fig. 35: High-gloss polishing is performed quickly and easily with OptraPol.

Do you prefer a different sequence of steps? This is not a problem as long as you always follow the same sequence and you do not jump unnecessarily between steps.

Special effects

Special effects are the icing on the cake in Class IV restorations, but they are almost never really necessary. Ask a patient if they would like to have an artificial brown crack inserted on their anterior restoration. How often will you hear an enthusiastic “yes”? Exactly, never! At times, however, there are situations where it makes sense to imitate mottled enamel, cracks and similar characteristics.

Useful or not?

Figure 36 shows the treatment result in a patient whose anterior teeth show brown infiltrated vertical cracks. The lateral incisor has been restored with a full crown build-up made of composite. Although an artificial enamel crack has been added, it is not critical to the optical integration of the restoration.



Fig. 36: Restoration with enamel crack

Class IV restoration in a dentition affected by mild dental fluorosis with mottled enamel: this is one of the few cases where applying special effects really makes sense because the spots are a characteristic feature of the dentition. A restoration without these spots would not blend in very well. Figure 37a shows the preoperative situation in a young patient with dental fluorosis. Her wish was to have the gap between the lateral incisor and canine closed. The white enamel spots were reproduced when the corner of the lateral incisor was built up (widened) to enhance the optical integration of the restoration (Fig. 37b).



Fig. 37a: Young patient with dental fluorosis



Fig. 37b: Corner build-up of the lateral incisor with enamel spots

Halo effect

One of the most common effects to be reproduced is the halo effect. This is also a simple effect to achieve: The halo effect is produced by the reflection of the shade of the dentin core in the incisal edge. It is only visible in highly translucent incisal edges and appears as fine opaque line in the incisal edge (Fig. 38).



Fig. 38: Halo effect

Often, the halo effect appears by itself once the restoration has been finished and polished without requiring any further intervention. If you cannot see a halo effect in the incisal edge of the completed restoration, check the following points:

- Is the incisal edge too thick? If you have created a thick incisal edge, a halo effect does not appear.
- Is the incisal edge too opaque? Even in the natural tooth, a halo effect is only visible in translucent incisal edges.
- You still cannot see a halo effect even if the incisal edge is translucent and not too thick? Try applying a small grinding facet at an angle of 45° on the palatal side of the incisal edge (Fig. 39b).



Fig. 39a: Initial situation, no halo effect

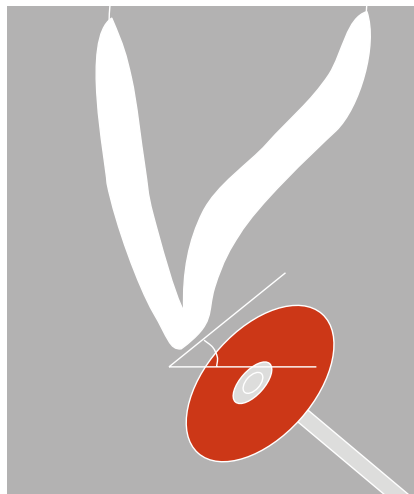


Fig. 39b: Apply a small grinding facet on the palatal side



Fig. 39c: Now visible: halo effect

Fluorosis (white spots, mottled enamel)

If the optical effects of fluorosis are to be reproduced, the first few steps of the basic technique remain the same: building up the oral wall, proximal wall, dentin core (Fig. 40a). After these steps have been implemented, the procedure needs to be adjusted. To achieve lifelike fluorosis spots, they must be placed close to the restoration surface. To ensure that the white Color material is placed everywhere equally close to the later surface layer, any uneven areas of the dentin core must first be levelled out. For this purpose, a layer of enamel material is applied to create an even surface (Fig. 40b). Enough space should remain to allow the application of a thin final enamel layer (~ 0.5 mm).

Once the surface of the dentin core has been levelled out, the stains (IPS Empress Direct Color) are applied to create the desired pattern (spots, stripes) (Fig. 40c). Do not apply the Color materials too thinly; the characterizations should look white and opaque. At the end, coat the Color material with a layer of enamel (Fig. 40d). The Color materials are not wear resistant. Exposed Color material on the surface should therefore be avoided. Once the Color materials have been applied, they should be covered with a thin coating of enamel (Fig. 41).

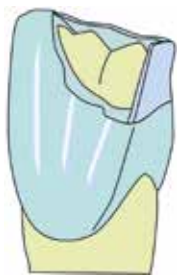


Fig. 40a: Basic technique



Fig. 40b: Applying a thin coating of enamel material



Fig. 40c: Applying Color materials



Fig. 40d: Overcoating with enamel



Fig. 41a: Applying fluorosis spots using IPS Empress® Direct Color white



Fig. 41b: Completed restoration after coating with enamel

Enamel cracks

Very few patients will be interested in having their restorations customized with an artificial enamel crack. Accordingly, you will rarely have the opportunity to try out this technique. However, if a patient requires a Class IV restoration on a tooth that is already sporting an enamel crack, then you will not have much of a choice but to either remove the crack from the natural tooth structure or continue it in the restoration. Allowing a natural crack to stop abruptly at the boundary to the restoration is the least favourable solution from an esthetic point of view. If you want to remove a natural crack, you should reduce the relevant tooth structure down to the outer layer of dentin using a needle-shaped preparation diamond and then restore it with composite. Cutting into the dentin is appropriate here because the discoloured infiltration of the enamel crack usually penetrates completely through the enamel, causing the outer dentin to become stained, too. In most cases, your patients will prefer having the natural crack removed rather than having it extended artificially.

If you decide to apply an artificial enamel crack in a restoration, you should ensure that you do not accidentally remove it again when you finish and polish the restoration. You should design the crack to be three-dimensional like a natural enamel crack. Therefore, the crack should reach through the entire facial enamel layer down to the dentin core. The first steps remain the same as outlined for the basic technique (Fig. 42a). Once the dentin core has been built up, the facial layer is built up in two steps. First, apply the enamel material, starting from the site of the defect up to the natural crack (Fig. 42b). The resulting surface, which is perpendicular to the dentin core, should now represent an ideal extension of the natural crack. It is important that the layer forms a 90° angle to the surface. Now polymerize this layer. Then, select the shade from the IPS Empress Direct Color range that best matches the natural crack and apply a minimal amount to the area perpendicular to the dentin core (Fig. 42c). Apply the material sparingly with the tip of a dental probe. The Color materials have a very intensive effect. If you can easily see the Color material without magnification loupes, you will probably have applied too much of it. Polymerize the Color material and then proceed by applying enamel material onto the remaining area of the defect (Fig. 42d). You will be able to see the crack clearly only after finishing and polishing.



Fig. 42a: Basic technique

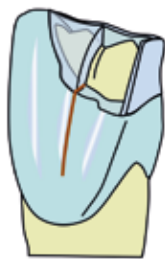


Fig. 42b: Applying enamel material starting from the site of the defect up to the natural crack



Fig. 42c: Applying a minimal amount of IPS Empress® Direct Color perpendicular to the dentin core



Fig. 42d: After the Color material is polymerized, enamel material is applied.

Perikymata

Perikymata are horizontal lines on the surface of dental enamel. They are present on most teeth. Over time, they may disappear due to surface abrasion. The perikymata on the lateral incisor in Figure 43 are artificial, the entire crown in the visible zone is a composite restoration.



Fig. 43: Lateral incisor with perikymata

It is an open question if it makes sense to reproduce perikymata on a composite surface. As a result of the grooves, the composite surface becomes rougher. After wetting with saliva, the lines are hardly recognizable. However, if you think that it is necessary to reproduce the perikymata in one case or another, then proceed as follows: After finishing and polishing, use a preparation diamond with a 90- μm grit. Rework the facial surface of the tooth in a horizontal direction once. Whilst doing so, repeatedly lift the diamond from the surface for short intervals. Do not apply grooves across the entire width from mesial to distal as this would look rather unnatural. After that, take a polishing brush and polish the surface briefly (Fig. 44b). Do not use a silicone polisher after you have applied the perikymata.

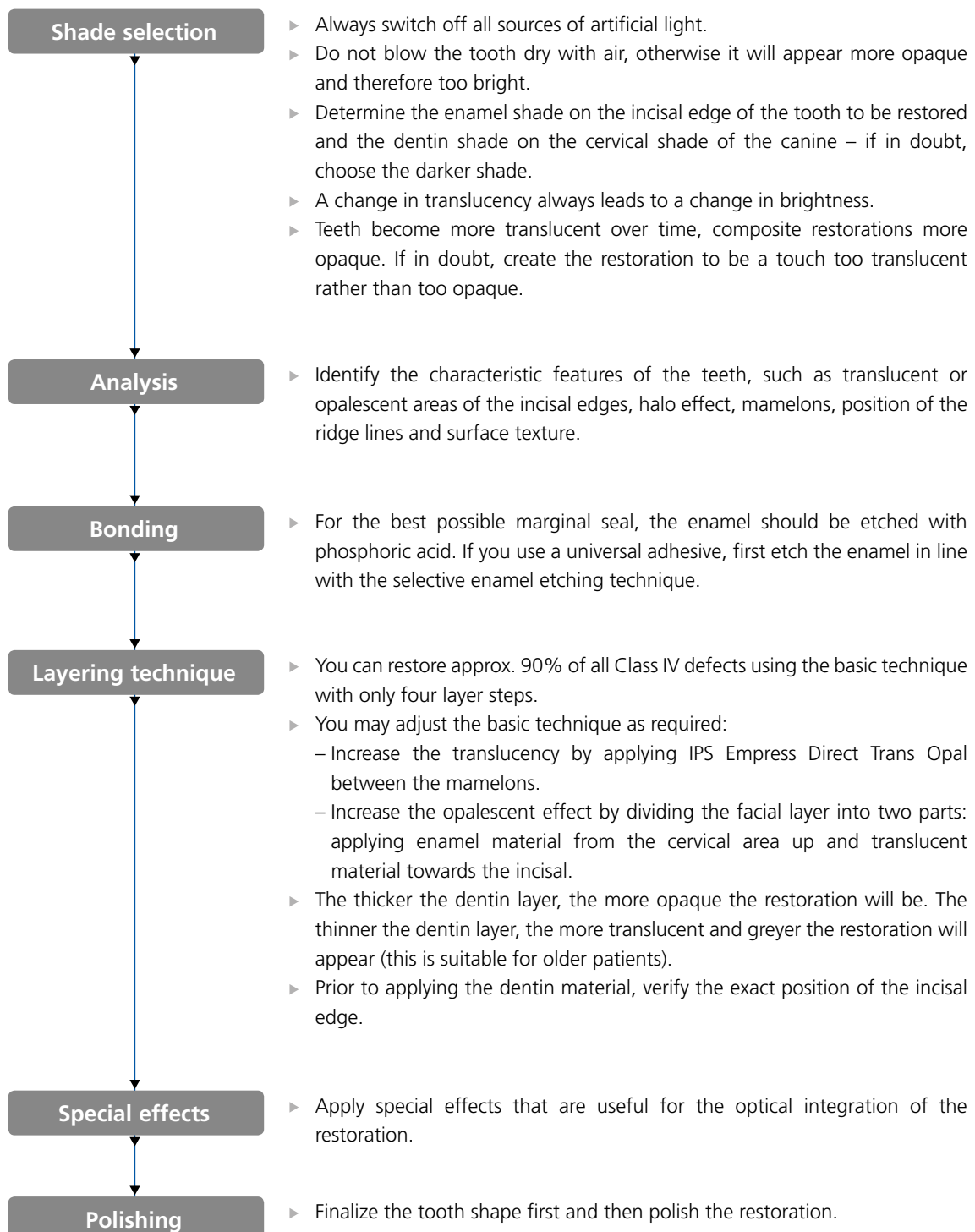


Fig. 44a: A preparation diamond is used to rework the tooth surface in a horizontal direction.



Fig. 44b: After polishing with a polishing brush

Successful Class IV restorations with IPS Empress® Direct – Overview of the steps



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A stylized, handwritten signature in black ink, consisting of a large loop followed by a series of connected strokes.

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