The course of time in dental morphology

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_Multifarious factors contribute to the realization of successful individual aesthetic restoration, either in ceramic or in composite. This is especially true when indirect technique is applied. Technical awareness in the lab together with expertise on dental morphology play a fundamental role in the reproduction of the shape where no details can be ignored.

Perfect knowledge of dental morphology is a legacy to be safeguarded and used beyond the usual time limits of techniques and materials. The growing demand for aesthetic restorations has given a strong impulse to the commercial development of such aesthetic materials as ceramic or composite.

_Morphology

Correct aesthetic reproduction must never be influenced by materials. On the contrary, the choice of the materials must follow an analysis of their real potentials for proper and easy reproduction of the tooth surface, its polishing quality and long lasting stability. As we all know, reproduction of natural tooth color is strictly linked to dental morphology. Proper chromaticity is the result of correct stratification of the different elements within the space available for the requested restoration.

Thus, in order to achieve natural and mimetic results it is fundamental for the technique applied to be carried out either in ceramic or composite. As far as my experience goes, Enamel Plus HFO composite system offers a wide range of colors and shades and makes it possible to reproduce basic features such as opalescence and internal effects (ie, intensives and characterizations). This determines the final aesthetic harmony of the job and favors the balance between color and correct morphological reproduction. The knowledge of basic morphology and the ability to harmonize all tooth parts—lobes (cones) and surface (texture)—are valid criteria to carry out a restoration that will fit perfectly with the surrounding teeth, periodontal tissues, and the face (Figs. 1–3).

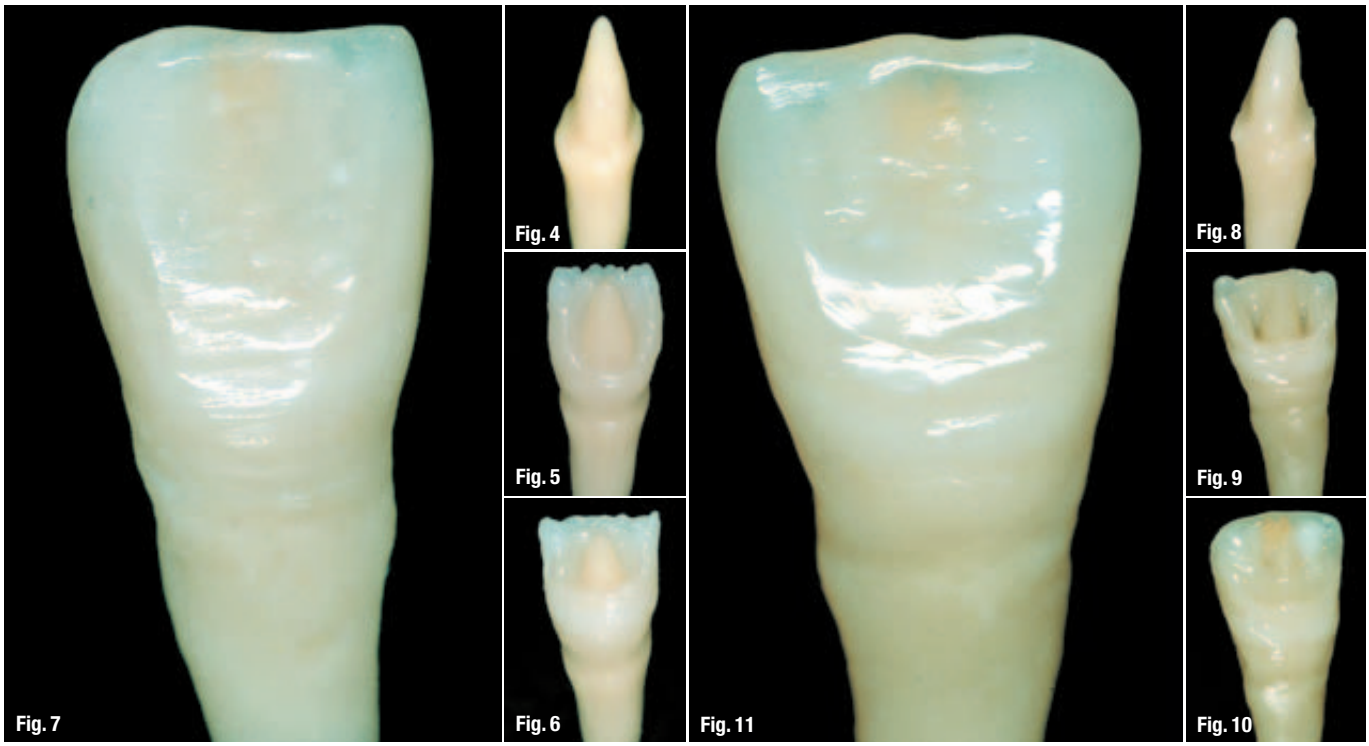
It is fundamental to check the position of the cones, which are considered anatomic subdivisions of the tooth, and are usually separated by vertical primary grooves. This check-up is useful to obtain an exact conjunction between the different elements (margin crests, labial crests, transition areas, incisal edges, horizontal grooves), and consequently achieve the best tooth composition (Figs. 4–7 and 8–11). The development of each cone determines its relationship with the next lobe and consequently its direction,

Figs. 1–3_Pressure die cast ceramic. The restoration must be perfectly integrated both morphologically and chromatically. The perfect reproduction of the lip surface is a determining factor.


Fig. 1


Fig. 2


Fig. 3

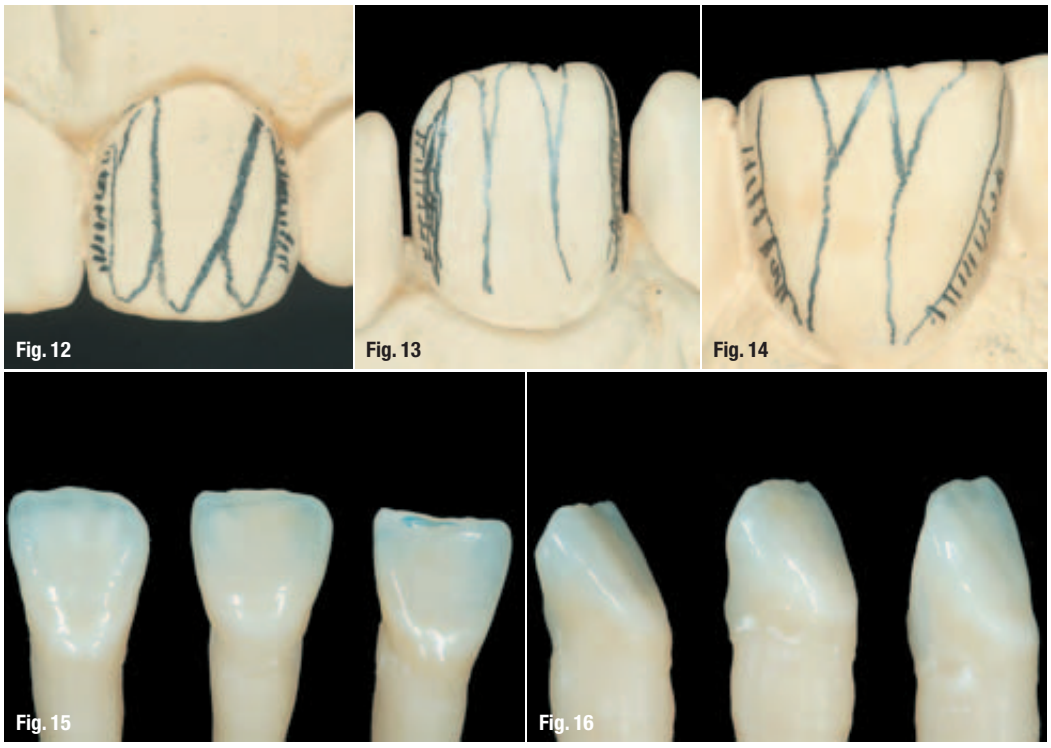


thickness and connection point between lobes. Dental morphology is the result of summing up of the various lobes and their interaction (Figs. 12–14).

_Surface texture

Surface texture plays an important role for the aesthetic result of our restoration, and the expertise and ability to reproduce it, help imitate such processes as the tooth's natural ageing. As nature is actually the only model for our work, the careful observation of natural teeth, together with good practice, are key for the development of the necessary skills to achieve an "invisible" dental restoration either in ceramic or composite.

In an embryological point of view, the natural tooth is a harmonious whole of protrusions whose



Figs. 4–7_The tooth bio-architecture together with control of the primary elements is an additional system both for ceramic and composite materials.
Figs. 8–11_The development of each cone determines the relationship with the following one and its direction, thickness and junction point between lobes. Dental morphology is the result of the aspect of the different lobes and their interaction.
Figs. 12–14_Position and development depend on the primary shape to be reproduced and the junctions will determine an oval, squared or rectangular shape.
Figs. 15–18_Natural teeth remain the best example to observe and imitate, taking into account the course of biological time.

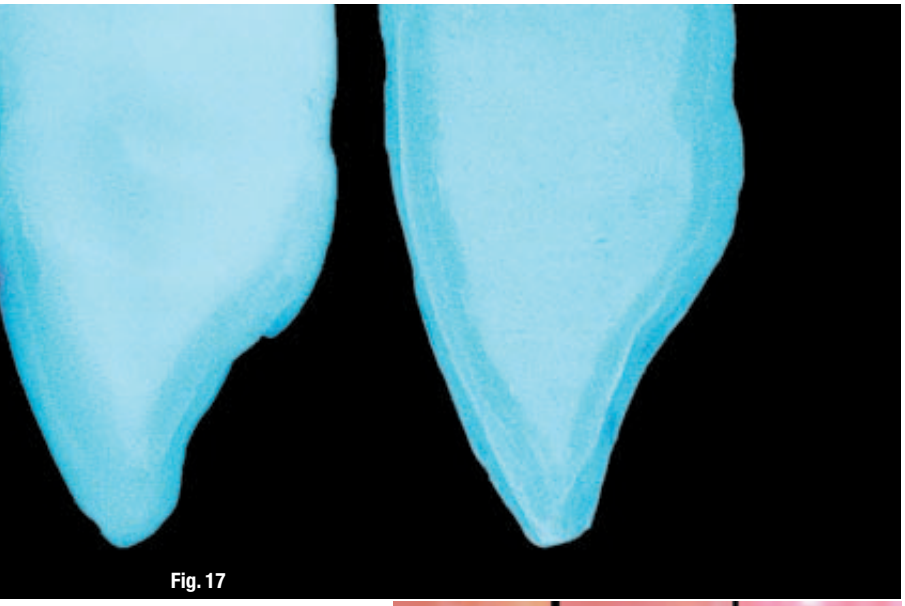


Fig. 17

Figs. 19–21 _Composite replica of the effects of ageing and function on tooth morphology and color.


Fig. 18


Fig. 19


Fig. 20

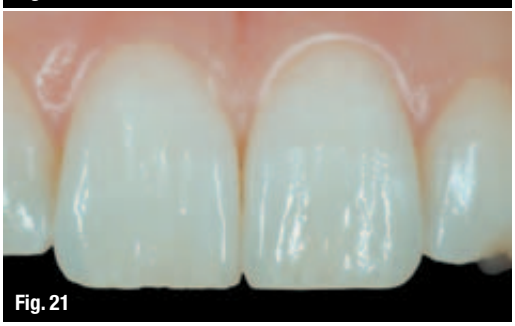


Fig. 21

junction determines the formation of crests and grooves. When modeling a restoration it is vital to concentrate on the position and shape of the crests rather than on the grooves and hollows, which are in fact but a result of the junction between crests. It is thus important to achieve aesthetic goals having shape and color consistent with the patient's age (Figs. 15, 16).

_Age-caused tooth color changes

In the oral environment, however, many external factors—such as the changes in the periodontal support structure and the appearance of a wear and tear facet—interact to modify how the teeth look. Such processes are linked to age and strongly influence the tooth aesthetics. During adolescence, for instance, surface features such as edge and secondary crests, horizontal grooves and lines, are clearly visible; they will all help determine a rather rough surface.

With age the surface texture of the teeth tends to modify because of the continuous labial friction and of the mechanical action of the toothbrush. As a consequence, the typical roughness of a young tooth's surface leaves room for sheen and smoothness to influence the teeth's overall chromaticity.

This is mainly due to a rise in the dentine color reflection through the labial surfaces. Year after year higher calcification increases the labial enamel translucence, thus helping the dentine color gradually come through. This was formerly inhibited by the low translucence of the young tooth's dim enamel.

_Classification of materials

Tooth color is also determined by the age-caused changes dentine undergoes. The older dentine gets the more water it absorbs and the more translucent it gets. As a consequence, the natural color of a tooth changes from light to a darker shade with translucent nuances. The intense white shade of an adolescent's teeth tends to become dimmer and yellowish then finally turns a light brownish tone.

The use of aesthetic materials that allow realistic and easily classified color variations is thus necessary. This classification is available in the HFO universal dentine classification, with chromaticity increasing from UD1 to UD6. Moreover, universal dentines are more fluorescent than enamels as they can perfectly reproduce the natural behavior of dentine-enamel (Fig. 17).

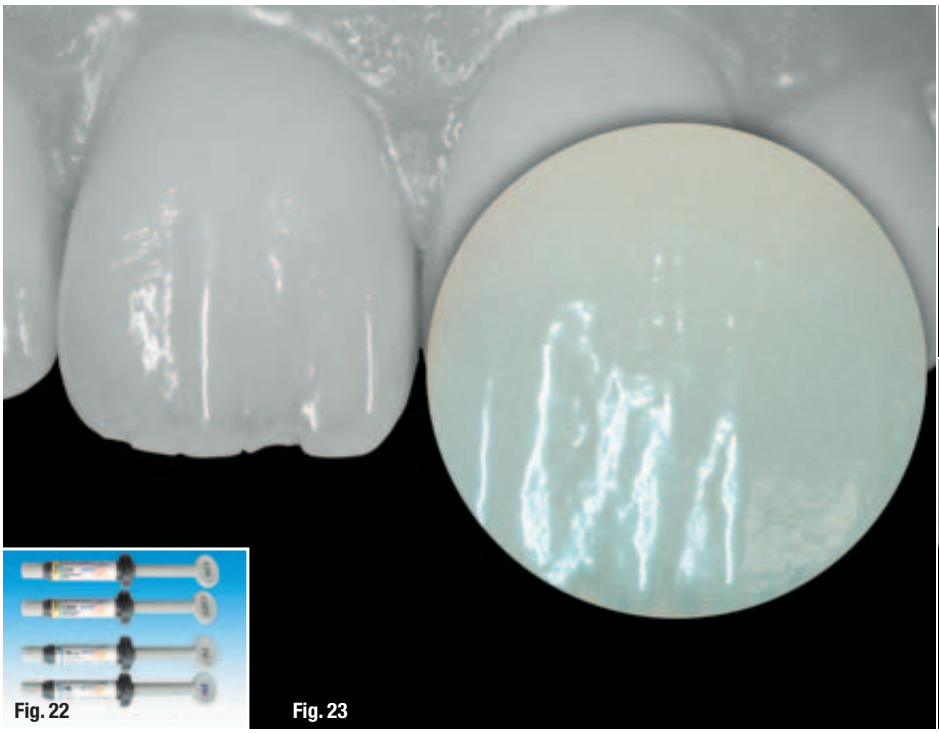


Fig. 22

Fig. 23

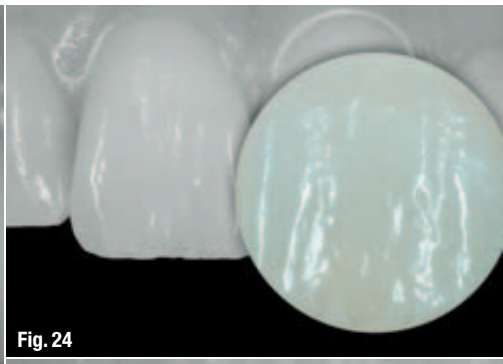


Fig. 24


Fig. 25

For correct aesthetic restoration, morphological and chromatic modifications due to ageing must be properly and realistically reproduced. Among composites, the HFO enamels calibration is remarkable as their different value makes it possible to use them in accordance to the patient's age: GE1 elderly patient; GE2 middle-aged patient; GE3 young patient (Fig. 18). An attempt to recreate the effect of biological ageing only through surface coloring without considering the internal modification of the dentine can affect the final aesthetic result.

_External & internal influences

Mamellons are normally clearly visible in adolescence, but tend to disappear at a relatively young age because of natural friction. The conse-

Fig. 22_Syringes or intensive samples and opalescents.
Figs. 23–25_Natural tooth texture details with enlargement.
Figs. 26–41_Case report.


Fig. 26

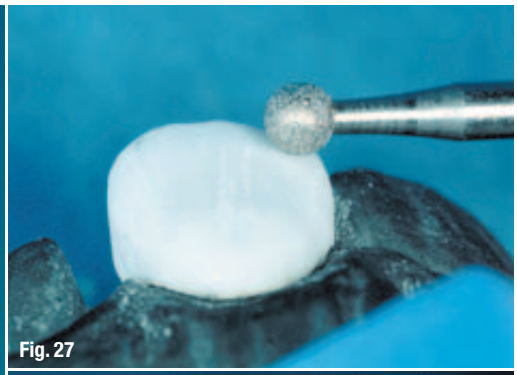


Fig. 27


Fig. 28

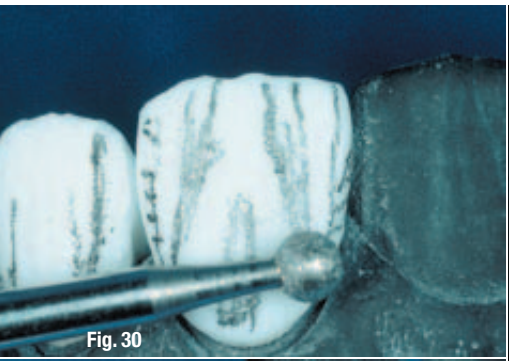


Fig. 30


Fig. 31


Fig. 29

Figs. 26–41_Case report.

quent progressive abrasion causes the incisal edge to shorten and flatten. This presents several wear and tear patterns according to the individual's mouth closing scheme. Because of their bent, the facets' wear and tear pattern is visible upon both the upper and lower front teeth lingual surfaces. As the upper front teeth's worn facets are not visible from the labial side, the only evident change is the gradual shortening of the incisal edges (Figs. 19–21).

Upon worn surfaces, especially on the incisal edge, dentine exposition may occur. As dentine is generally softer than enamel, it is normally more easily worn, thus causing hollows around the incisal edge area. When exposed it is also subject to dischromias that will affect the overall chromaticity of the natural tooth. The types of different tooth features that may affect the tooth age from within, are usually reproduced in ceramic and are

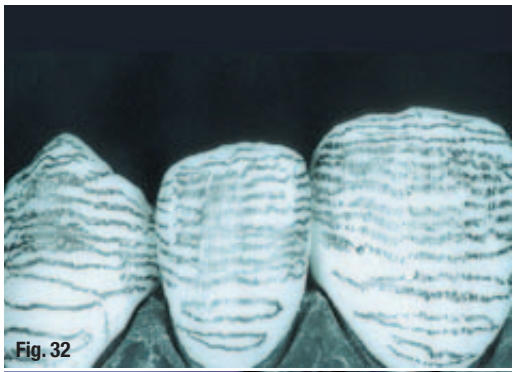


Fig. 32


Fig. 33


Fig. 34

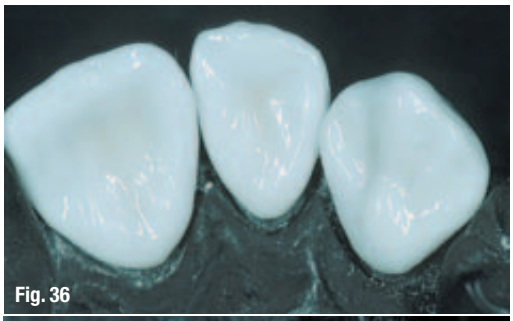


Fig. 36


Fig. 37

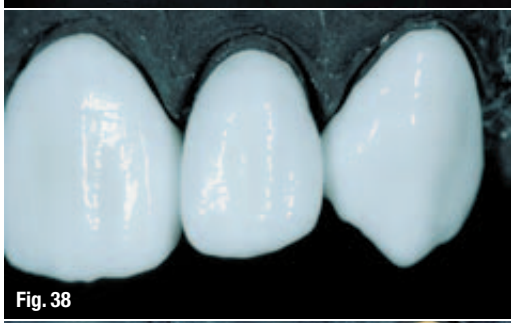


Fig. 38


Fig. 39


Fig. 40


Fig. 41

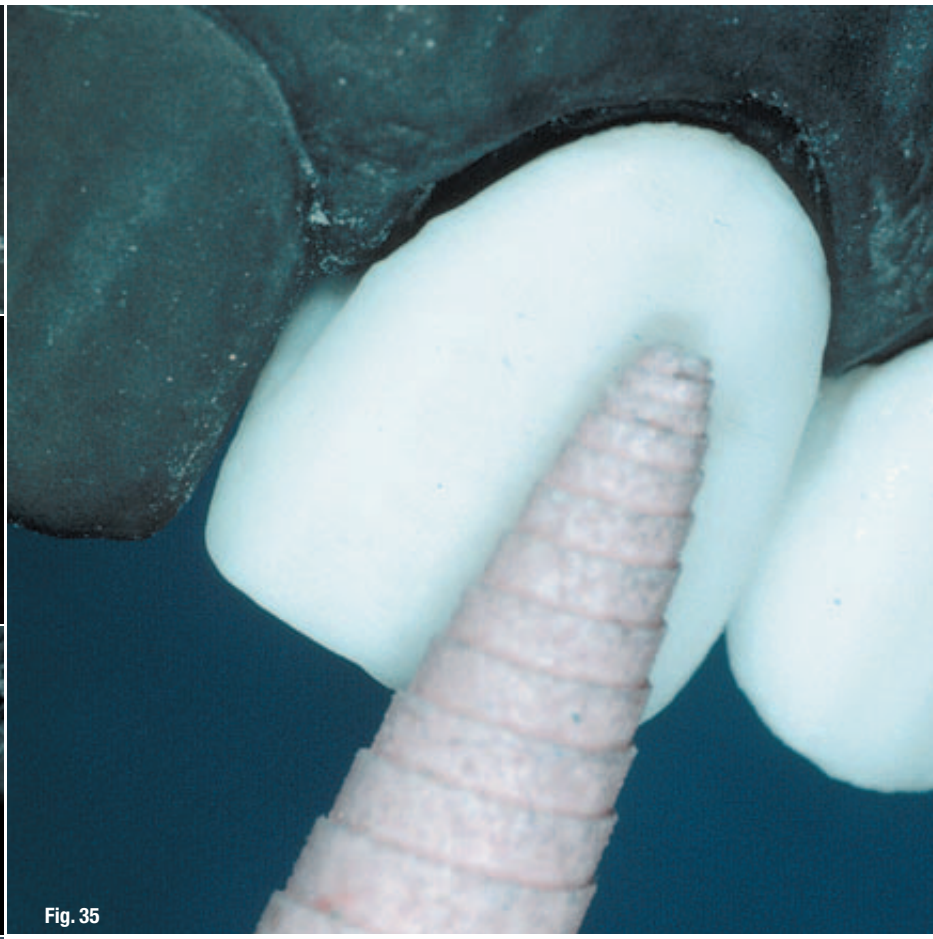


Fig. 35

Figs. 26–41_Case report.

presently basic standards in the HFO aesthetic system where such intensives as I.W, I.M. and opalescent effects—such as O. Amber, O. White, O. Blue Natural, O. Blue, O. Gray—are fundamental elements for the correct stratification of composite restorations. (Fig. 22)

With young teeth the tooth surface features such as marginal crests, labial crests, horizontal grooves and stripes are well developed and surface texture is rough. (Figs. 23–25). With age, natural abrasion makes the tooth smoother and restoration must take into account this "wear and tear" and correctly reproduce any surface variation due to natural ageing.

_Case report

The following exercise with opaque white ceramic is useful in recreating an accurate morphological refinishing scheme. This material allows better analysis of the surface texture and better application of the most proper technique to be applied to any covering material.

_After the whole opaque ceramic mass has been processed and baked and after the crowns have been adapted to the master model, they shall be

Figs. 42–45_Confrontation between two aesthetic covering materials: ceramic and composite. Please note the different behavior under light reflection.


Fig. 42


Fig. 43


Fig. 44


Fig. 45

lined up with the rest of the teeth. This step will be carried out through reduction by extended diamond or silica drills. By operating both horizontally and vertically we shall check the crown perimeter as well (Fig. 26).

_We shall then move on to the external profile (labial crests) by using a diamond sphere longitudinally on the tooth (Fig. 27). The cones' bioconstruction and correct location of the primary lobes will thus be achieved (Figs. 28–30).

_By a thin point tungsten cutter, we shall replicate the secondary vertical details of the crown labial surface (Fig. 31).

_The horizontal grooves are pencil marked, following the proximal transition areas. The grooves within the incisal body the grooves are more numerous and follow the trend and depressions formed by the links to the primary cones. In the cervical body area, on the contrary, the grooves are less numerous and more evident (Fig. 32).

_For this finishing we shall use a small sphere diamond edge point and carefully follow the project formerly drawn on the labial surface (Figs. 33, 34).

_To complete the mechanical finishing of the crown, the diamond points' action shall be reduced by polishing the abrasive paper cones (Fig. 35).

_The paper cones and, later on, the oven obtained self-shimmering, will help to give the final restoration a natural look that takes into account the effect of natural wear and tear.

_The imitation of biological ageing may be intensified by using pumice and diamond pastes which may eventually give the tooth the typical "aged tooth" effect (Figs. 36–38).

_We are now ready to repeat the mechanical finishing scheme also with the stratified crowns: the effect obtained will be extremely natural thanks to the rigorous application of building techniques in combination with morphological finishing (Figs. 39–41).

_When the job is stratified, in order to make a better morphological check-up, "Silver" powder may be useful to eliminate surface reflections. After that, this non polluting powder will be easily washed away before the final polishing (Figs. 42–45).

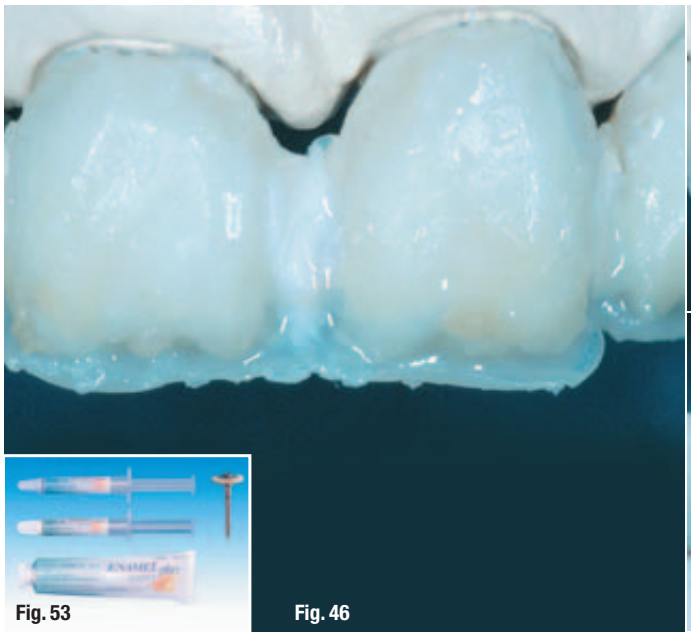


Fig. 53

Fig. 46


Fig. 47


Fig. 48


Fig. 49


Fig. 50


Fig. 51

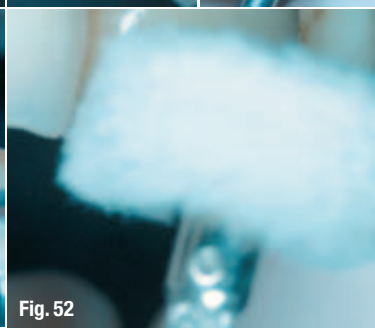


Fig. 52

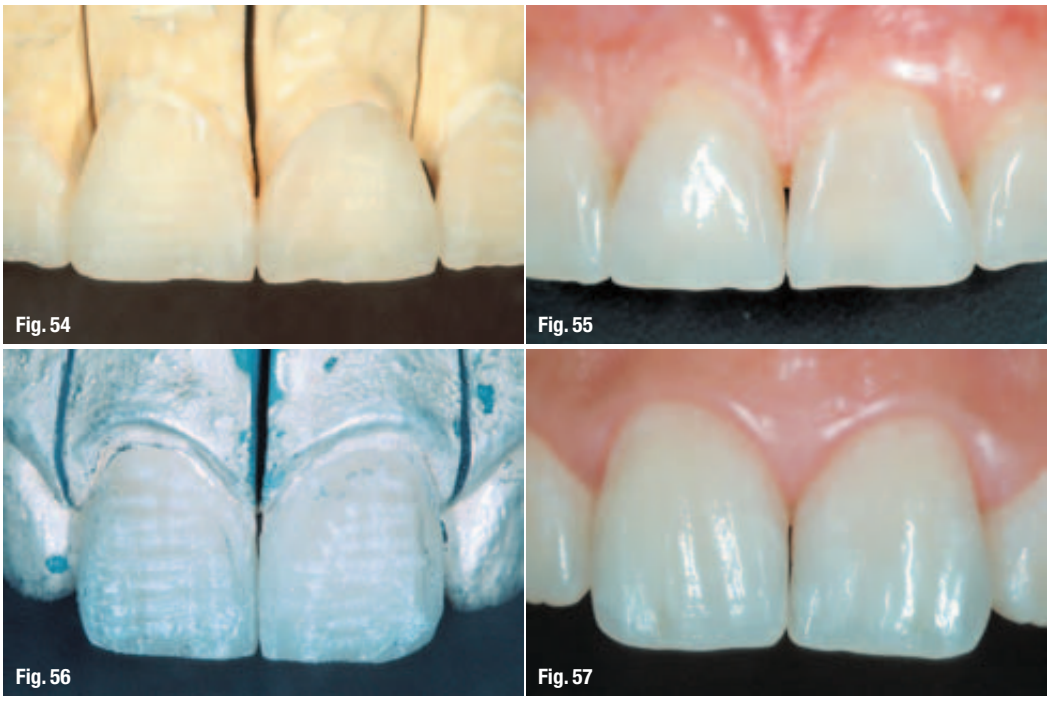
_Conclusion

It is vital for the technician to be able to apply the fundamental working procedures, with the same schemes and methods for any covering material used. (Figs. 46–53) In aesthetic restoration, the development of composite materials has strongly supported the use of these materials also in lab, above all for the chance they offer to obtain mimetic aesthetic solutions and for their long lasting surface stability.

It was possible to apply the same techniques and tools normally used for the mechanical finishing of ceramic materials. The only difference is the use of simple abrasive diamond paste to obtain the final

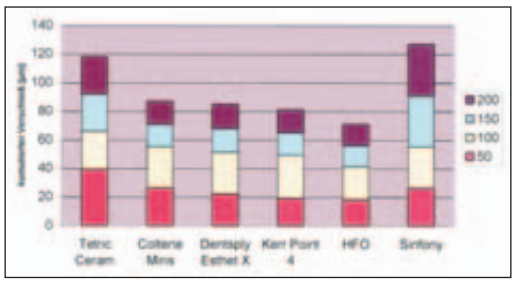
Figs. 46–53_Polishing possibilities of composites.

Figs. 54–57_Composite in direct aesthetic restorations. Four composite facets, two anterior covering inlays.



shimmer without the help of glazing varnishes or oven obtained shimmering. In ceramic restoration mechanical polishing is getting more and more common without glazing materials which may cause the natural tooth to be abrased and alter its aesthetic behavior. For this reason also when using composites it is advisable to use diamond pastes and brushes for tooth polishing (Fig. 53). This is possible especially with micro-hybrid composite materials such as HFO enamel which allow us to obtain a perfectly smooth and bright surface—very close to the natural one—with the help of Shine pastes.

Table 1_Source: "Drei-Medien-Verschleiß von Füllungskompositen"; Rosentritt, Behr, Schulz, Handel; Quintessenz Int. 2003; 6: 9–14



The importance of last generation composites in aesthetic removables has become paramount thanks to the finishing and polishing possibilities they offer (Figs. 55–57):

_application of the connecting mass
_micro-hybrid composite covering
_diamond point mechanical finishing
_abrasive cone smoothing and 3 step: 3, 2, 1, micron diamond paste shimmering.

The composites we refer to are new generation micro-hybrid ones. After clinical usage in direct technique, are presently successfully used also in indirect technique as their surface compactness offers an almost physiological abrasion resistance (Table 1).

All this has given a new impulse to the diffusion of composites for lab techniques especially for posterior aesthetic inlays and anterior restorations when the use of the same material also for cementation is the key to a successful and long lasting result. Moreover these solutions are a new working horizon for technicians in the aesthetic restoration field who can eventually exploit their know-how and expertise with particular care to dental morphology, an inalienable legacy for today's professionals in this field. _

_author info

cosmetic dentistry

Author Daniele Rondoni has worked since 1981 in the dental laboratory Savona. In Italy, he became acquainted with aesthetic restoration with a specialty in blending technique with composites. He aided in the development of Enamel plus HFO Tender blending systems, gives international lectures, and regularly teaches continuing education courses for technicians and dentists at home and abroad.