

## RESEARCH ARTICLE

# EVOLUTION TECHNOLOGIQUE DES RESTAURATIONS ESTHETIQUES FIXEES [TECHNOLOGICAL EVOLUTION OF FIXED AESTHETIC RESTORATIONS]

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### ABSTRACT

In response to the growing demand from our patients, various prosthetic restorations have been proposed in line with technological developments, from the advent of all-metal restorations to metal-ceramic restorations and finally all-ceramic restorations with removal of the metal infrastructure. Through this work we will review the evolution of his aesthetic restorations by clinical cases.

**Key words:** Tissue economy; Aesthetic; All-ceramic Restorations, Inlays-onlays, Facets, Bonded bridges.

### INTRODUCTION

The fixed prosthesis is a unitary or plural prosthesis, intended, depending on the case, to strengthen and restore the morphology of the teeth, or to replace missing teeth. The fixed prosthesis is nowadays the most sought-after prosthetic solution in dentistry, due to its incomparably greater comfort than that provided by removable prostheses. Its average lifespan is about fifteen years. The techniques used to design these prostheses have been used for many years until now. For a long time, most constructions were governed by mechanical specifications that met the requirements of solidity. The advent of new materials has led to the development of new prosthetic designs that meet both mechanical and aesthetic criteria. This article proposes a step backwards to highlight the various advances in fixed aesthetic dentistry to date, and to show the influence of the evolution of techniques and materials on the appearance and development of new concepts for the realization of this type of restoration.

#### Evolution of fixed partial coronary restoration techniques

**Inlays /onlays:** For more than a century, silver amalgam has been the most widely used filling material in dentistry to restore large cavities [Fig.1], despite its colour and lack of adhesion to dental tissue causing significant tissue sacrifices (Koubi, 2006 and Dahan, 2011) But the demand from patients. Who wish to benefit from aesthetic, low mutilating and durable restorations even for posterior teeth has led dentists to reduce its use in favour of aesthetic adhesive techniques (Hajto, 2014). This evolution has been made possible thanks to the arrival of new materials but also thanks to technical advances in the field of bonding (Koubi, 2006 and Dahan, 2012). Inlays-onlays are prosthetic parts assembled by gluing or sealing, intended to restore a loss of dental substance. They are mainly indicated in restorations of posterior teeth with medium to large cavities. These prosthetic elements can be metallic or cosmetic in polymeric or ceramic material. While precious metal (gold-based) inlays/onlays are considered the benchmark in terms of clinical decline [Fig 2], the current context tends to favour aesthetic restorations.



Fig. 1. Silver amalgam occlusal filling



Fig. 2. Occlusal restoration with precious alloy inlay

The first composites used in indirect technique, made with microfilled resins, were not a great success, due to their poor properties. On the other hand, in view of the good results obtained with feldspar ceramics, they were introduced for later inlays-onlays initially (Dahan, 2010 and Hajto, 2013). However, the number of restoration fractures has initiated a return of practitioners to composite in view of the advent of



Fig. 3. Onlay with cuspidian covering and ceramic inlay



Fig. 4. Ceramic facets

new generations of laboratory composite resins combined with advances in adhesive biomaterials. Indeed, the use of post polymerization and the use of an anatomical stratification technique have improved the mechanical and optical properties of these restorations (Jardel, 2010). Due to the unsatisfactory clinical results obtained with the first ceramics, manufacturers have developed leucite-reinforced glass-ceramics for pressing, which can be masked and form the entire prosthetic part or used as a framework for secondary lamination (). At the same time, computer-aided design and manufacturing (CAD/CAM) techniques were proposed for the subtractive machining of prefabricated ceramic blocks. Long-term prospective clinical studies confirm, after 12 years of observation, the clinical success of the IPS Empress (leucite-reinforced pressed glass ceramic) glued to the lateral areas. For CAD/CAM systems, studies place ceramic partial restorations from the CEREC system at the same survival rate as gold inlays [3.20].

**The facets:** The 1980s were decisive in the emergence of different techniques and materials designed to improve or even transform the aesthetics of the smile. The concept of glued veneers began in the 1930s with Doctor Charles PINCUS (1938) (Miara, 2012), who proposed, during a shooting, to improve the smile of some Hollywood actors by temporarily fixing thin resin veneers; then he improved the technique by using, already at the time, ceramics fired under atmosphere on platinum sheets without any tooth preparation. Although these techniques were revolutionary at the time, they were gradually forgotten, as it was not yet possible to permanently attach these fine reconstructions to the enamel of the teeth. This has led some researchers to try to use laboratory composites to make glued veneers. The first tests were carried out in the 1980s with composites such as Dentacolor (Kulzer) (Touati and Pissis, 1984), Isosit N (Ivoclar) (Miara 1988), Visiogem (ESPE)... Unfortunately, these so-called first generation composites, although attractive in terms of implementation and immediate aesthetic appearance, very quickly showed their limits with

partial or total fractures, significant abrasions, colourings, marginal hiatus...( Moussally, 2007). It was not until the so-called second generation composites (Touati et al, 1997), which are very different in structure and composition, that these materials were reused more successfully (Pfundtner, 2012 and Miara, 2012). With the launch of the first pressable ceramics in Europe in the early 1990s, they gained much popularity. Ceramic veneers are a proven therapeutic option for many indications [Fig 4].

It is thanks to three major discoveries that the concept of ceramic veneers will really develop:

- The etching of the enamel by Buonocore in 1955 (Buonocore 1955);
- The birth of Bis Gma resins applied to dentistry in the 1960s by Bowen (Bowen 1965);
- The surface treatments of ceramics proposed by Rochette (Rochette 1973) since 1972 and improved by Horn (Horn 1983), Calamia (1983) and Simonsen (Simonsen 1983) in the 1980s.

Ceramic veneers combine the advantages of ceramics (stability, aesthetics) and composites (adhesion, preservation of healthy tissues) while avoiding the respective disadvantages, since:

- The brittleness of the ceramic part is compensated by adhesion to the dental structure and the adverse effects caused by the contraction polymerization and thermal expansion of the composite are limited by thin film use (the composite only concerns the sealing interface).

The main techniques currently used to produce a ceramic veneer are as follows: ceramic lamination on a refractory die, ceramic pressing, slip assembly and, more recently, CAD/CAM (Hajtó, 2012 and Miara, 2012).





Fig. 5. Cast crowns in non-precious alloy with unsightly appearance

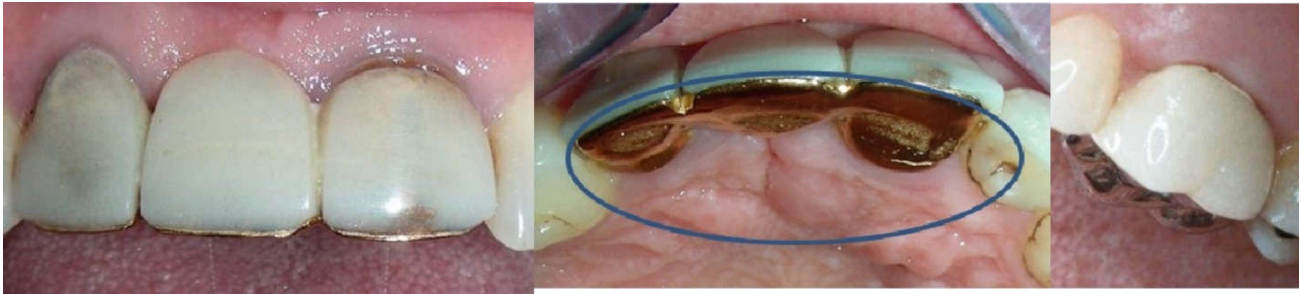


Fig. 6. Restorations with vestibular inlays (resins) and palatal surfaces made of precious and non-precious alloys



Fig.7 a.b. Ceramic-metallic restorations

**Evolution of fixed total coronary restorative techniques:**

The prosthetic crown is defined by the Nomenclature Committee of the Academy of Denture Prosthetics as a fixed restoration of most or the entire dental crown of a natural tooth. A few years ago, so-called ring crowns were made using a model of the quadrant concerned and a perimeter of the preparation for the axial walls. In 1869, Morisson introduced the two-part fitted crown, entirely in gold. In the 1950s, with cast techniques [12], it was replaced by "the crown cast in gold but, due to the decline of precious metals and their replacement by other alloys, this term became "coating metal crown (CMR)", or "cast crown". Entirely metallic, it cannot meet aesthetic requirements, but it ensures the preservation of the dilapidated tooth and its functional integration by respecting the natural envelope and the periodontal environment. Its indications remain limited to posterior teeth, for which it ensures solidity and durability [Fig. 5]. However, aesthetic concern had led to the creation of crowns with a satisfactory aesthetic face, which takes the form of inlaying by fitting a resin or ceramic tooth on a metal coating support on the vestibular face, the shape of which has been designed to receive the aesthetic material (Pierre, 2002).

**The crown with vestibular inlay:** The vestibular inlay crown [Fig. 6] is a delicate prosthesis and despite the precision of the morphological and aesthetic adjustment it cannot satisfy all

cases, it is currently less and less suitable for the benefit of the ceramic-metallic crown, the latter has been used for over a century. Since its development, its principle has been widely applied to become a common technique that nowadays ensures the best compromise between the aesthetics and mechanical strength of a joint prosthesis, whatever its extent (Pierre, 2002).

**Ceramic-metallic crowns:** They are in constant evolution (Pierre, 2002) whether in the design of preparations, instrumentation, but especially the materials used to make them. Thus, after precious alloys, non-precious alloys have been used [Fig 7 a and b], the use of titanium represents an important evolution in CCM technology; it avoids some disadvantages of non-precious alloys. Metal-ceramic systems make it possible to produce highly resistant restorations, whose long-term durability has proven its worth [Fig. 8].

However, these systems have a number of aesthetic and biological deficiencies:

- A sometimes visible metallic edge and an unsightly greyish shadow at the gingival level;
- The need for an intra-sulcular cervical limit in the esthetic zone with risk of periodontal inflammation that can lead to gingival recession;



Fig. 8. Opaque appearance of the 11ceramic-metallic resumed by a more aesthetically pleasing ceramic



Fig. 9. Restoration of the anterior area with more natural all-ceramic restorations



Fig. 10. Conventional ceramic-metallic bridge

- A loss of brightness and low light dispersion;
- The risk of metallic corrosion with diffusion of metallic oxide especially with the use of non-precious metals;

Over the past decade, advances in dental materials have led to the introduction of a large number of all-ceramic systems for the restoration of anterior and posterior teeth (Margossian, 2002).

**All-ceramic crowns:** "Restoring the natural appearance of a smile cannot be achieved without the use of all-ceramic systems" John MacLean 1975. This visionary father of modern ceramics was right more than 30 years ago and that progress has been made since then. The arrival of zirconia (Mahiat, 2006), in prosthetic dentistry has really allowed us to move almost definitively into the era of ceramic ceramics. Ceramic-ceramic restorations provide long-term mechanical strength, biocompatibility and an unmatched natural appearance (Viennot, 2005 and Margossian, 2007). The rise of these constructions is the result of the advent of new bonding techniques and new ceramic materials used [Fig. 9].

**Evolution of fixed replacement techniques for missing teeth**

**Conventional bridges:** Clinical experience has always driven the evolution of our practice.

The need to replace missing teeth was already evident in the Etruscans (8th-4th century BC). Closer to home, these bridges, defined as "fixed prosthetic elements replacing missing teeth by relying on neighbouring abutment teeth", were popularized by the Americans Dwinelle, Bing and Logan and experienced an extraordinary boom at the end of the 19th century. Initially made by blurring, these fixed plural prostheses remained quite fragile mechanically, offering uncertain stability with a major risk of infection of the abutment teeth and the periodontium. Thus, Maulk in 1919 specified the rules to be respected mechanically and biologically. In 1924, in the Treaty of Joint Prosthesis, Béliard deepened the mechanical foundations of the buildings (number, arrangement, resistance of the support points). Currently, in addition to the search for simplicity of clinical and laboratory implementation[, the improvements focus on the treatment of abutment teeth (periodontal treatments, endocanal therapy), on the constant concern for dental substance saving involving the use of implants whenever possible, and on the aesthetic and functional qualities of the materials, which since the advent of bonding, research has turned towards the development of increasingly aesthetic, metal-free prosthetic materials that promote the preservation of dental tissues, with adhesion requiring less mutilation than sealing, which must satisfy the mechanical principles imposed by retention[10]. After an initial period successfully leading to the development of pure ceramic unit



prostheses, the profession is moving towards the production of small "all-ceramic" bridges, whose long-term success depends on the quality of the shape of the preparations and the precision of adaptation of the ceramic core to the preparation which will be the best support for porcelain. The ceramic core is often reinforced at the embrasures, regardless of aesthetic requirements (Koubi, 2008; Mahiat, 2006; Gatard, 2004). [Fig 10,11].



Fig. 11. All-ceramic bridge replacing the 24 and 26

**Bonded Bridges:** The technique of bonded bridges was introduced in 1963 by Rochette. This was the first type of fixed non-invasive prosthesis because the abutment teeth were not prepared in advance. The scope was limited to tooth replacement in the anterior areas. Remained fairly confidential for a decade, this technique made real progress in the early 1980s with the proposals of the Maryland school. These proposals involved minimum preparations based on the concepts of stabilization of partial removable prosthesis anchorage means, and surface treatment of metal infrastructures by electrolytic etching. The indication of bonded bridges extended after the replacement of the posterior teeth (Folch, 2007 and Pfundtner, 2012) [Fig. 12]. The first data in the literature showed a significant rate of detachment (initial survival of 75% anterior and 44% posterior to 7.5 years).



Fig. 12. Bonded bridge replacing the 24 with metal fins

Currently, advances in gluing and improved forms of preparation have resulted in a survival rate of 87,7% at more than 5 years old, the bonded bridge remains today a good alternative to single implant placement, especially in the anterior sector where space management and aesthetic

integration are a source of difficulties or even failure (Magne, 1999), the use of bonded bridges with metal fins at the anterior level is reconsidered, the all-ceramic bonded bridge currently offers an alternative so that no greyish coloration of the metal shows through [Fig.13]. (Pfundtner, 2012 and Cazier, 2010).

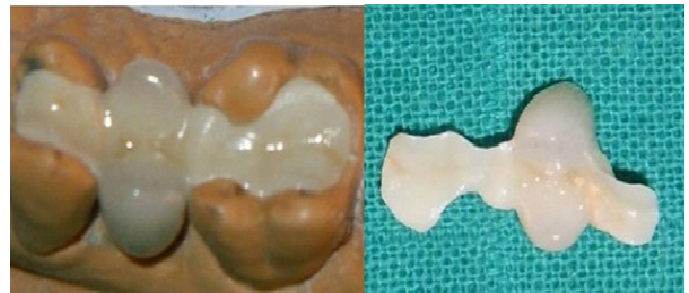


Fig. 13. Ceramic bonded bridge

**The implant-borne crown:** The 20th century will be decisive for implantology. The contribution of radiology provides an anatomical approach appreciated by implant sites. The surgical method is empirical, the result random, the complications frequent. In the 1980s, Brånemark's work on osseointegration gave him a decisive boost, dental implants made it possible to compensate for unitary gaps and were successfully used routinely [Fig. 14].



Fig. 14. Implant-supported restorations

The implant-borne crown is now considered an undeniable alternative to conventional and glued bridges (Richelme, 2007 and Magne, 1999). Today, implantology is the cardinal method for the rehabilitation of edentulous sites. The digital acquisition of modern imaging with its possibilities of measurement, reconstruction, simulation, guide or actor of the surgical procedure, possibly assisted, is the surgeon's partner (Koubi, 2008).

**Conclusion**

The last decade has been marked by technological advances and the performance of aesthetic and adhesive dentistry. Thus we observe:

- the use of materials with properties similar to natural teeth (fluorescence, opalescence), which makes it possible to restore light circulation while demonstrating mechanical properties that meet the requirements of modern and reliable dentistry;
- the progressive disappearance of metal in the infrastructures and superstructures of our restorations;
- the replacement of a mechanistic approach (retention, stabilization) synonymous with tissue mutilation by a more biological approach (tissue economy). Thus, in two fields as different but in fact related as architecture and dentistry, the penetration of light has

been one of the driving forces behind technological upheavals.

## REFERENCES

- Cazier, S.L. Dahan. « Approche clinique des bridges collés » l'information dentaire vol. 23n° 9, 2010.
- Dahan, L. F. Raux, « Pourquoi et quand faire un inlay /onlay » l'information dentaire vol.34, no 6, 2010.
- Dahan, L. F. Raux, « Les inlays-onlays esthétiques Procédures d'assemblage » l'information dentaire vol.1, no 4, 2012.
- Dahan, L. F. Raux, « Comment faire un inlay /onlay esthétique : de la préparation à la temporisation » l'information dentaire vol.7, no 16, 2011.
- Folch, H. S.Abgrall, S.Armand, J.Verge. « Bridges collés ». Editions Scientifiques et Médicales Elsevier 2000
- Gatard. F. « Le scellement des restaurations céramiques à base d'alumine ou de zircone ». Stratégie Prothétique vol .1, no 4, 2004.
- Hajtó, J. U. Gehringer., « Préparations et stratification personnalisées pour facettes céramiques » Cas clinique : quintessence revue internationale de prothèse dentaire vol., 2012.
- Hajto, J. C.MarInes, H.AHlers « Inlays et onlays en céramique : critères de succès ». Réalités Cliniques. vol. 24, n°4 : pp. 99-104, 2013.
- Jardel, V.A. Grignoux., « Réalisation de restaurations céramo-céramique en zircone Prettau à l'aide du système pantographe Zirkonzahn en pratique journalière ».
- Quintessence revue internationale de prothèse dentaire vol.3,2011.
- Koubi, S. G. Aboudharam, J-L., Brouillet, « Inlays/onlays en résine composite: évolution des concepts » Elsevier Masson, 2006.
- Koubi, S. J-L. Brouillet, A.Faucher, G.Koubi, H.Tassery, « Nouveaux concepts en dentisterie esthétique » Elsevier Masson 2008.
- Magne., P. « Optimisation des concepts mécaniques en médecine dentaire esthétique » l'information dentaire vol.6, no 10, 1999.
- Mahiat, Y.« La zircone : cette méconnue ». Stratégie Prothétique vol .1, no 6, 2006.
- Margossian, P. G.Laborde. « Restaurations céramo-céramiques »,Elsevier Masson 2007.
- Miara P.« les facettes collées en composite de laboratoire à matrice époxy » rev odont stomat vol. 31, p : 243-257, 2012.
- Moussally, C. J.B. Cheise « les facettes en céramiques par CFAO directe » l'information dentaire vol.29, no 5, 2007.
- Pfundtner, M. « Bridge sur inlays-onlays collé : Association zircone et céramique pressée ». Quintessence revue internationale de prothèse dentaire vol.1 no 7, 2012.
- Pierre, A. G.Derrien. « Couronnes céramo-métalliques ». Editions Scientifiques et Médicales Elsevier 2002.
- Richelme, J. F.J. Hagege. « Préserver l'esthétique », l'information dentaire vol.32, no 26, 2007.
- Viennot, S. G. Malquarti, Y.Allard, C.Pirel. « Différents types de bridges » Elsevier 2005.

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