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# The Today & Tomorrow of fixed Prosthodontics

**Sonia Nanda[1,*], Tarun Nanda[2], Deepak Grover[3]**

[1]Reader, Dept. of Prosthodontics & Crown & Bridge, [3]Reader, National Dental College, Punjab, [2]Reader, Dept. of Periodontics, Bhojia Dental College, Baddi, Himachal Pradesh

***Corresponding Author:**
Email: drsonia84@gmail.com

## Abstract

The scientific and technological basis of dentistry, are expanding rapidly in a world where alternative changes in the managements and financing of health care and public expectations of better "quality of life" are there. In this paper, many significant changes taking place in fixed prosthodontics are discussed and suggestions regarding the importance and potential influence of the changes are made.

**Keywords:** Impressions, All-ceramic, Provisional restorations, Tooth preparation

## Introduction

Large numbers of crowns and fixed prostheses are accomplished daily. Most general practitioners would agree that this area of dentistry is the largest single income producer in their practices and that increasing numbers of patients need this treatment or demand it for reasons of esthetics. During the last 40 years, there is significant increase in the quantity of fixed prosthodontics. Materials and techniques have improved. Some of these changes are well-proven, while others are in process of being accepted or rejected. More changes are occurring in fixed prosthodontics than in almost any other area of dentistry.

## Electric handpieces versus air-driven handpieces

Electric handpieces have been the most popular tooth-cutting mechanism in numerous countries for years. But in some areas, clinician's use of electric handpieces is just beginning to mature where air-rotars and air-motors long have been the dominant instruments for cutting tooth preparations.(1)

Electric handpieces are quiet during use, they posses high torque, even at low speed and they are concentric if they are maintained well. The disadvantages are equally evident after minimal use. Electric handpieces have larger heads than air-driven handpieces; they heat up if not maintained well; and if soft tissue or intraoral objects such as cotton rolls, in the path of the rotating instrument make contact with the bur, the result is a significant challenge because of the high torque of the handpiece and the inability to stop the rotating bur rapidly.(2) Low-speed electric handpieces are a significant improvement over low-speed air-driven hand-pieces, and they have replaced their air-driven predecessors in dental office. High-speed electric hand pieces offer some distinct advantages over air-rotor hand-pieces, but these advantages are less impressive than those observed with low-speed electric handpieces vs. air-rotor hand-pieces. Thus they do offer the advantages promoted for them, but at significant expense.

**Tooth preparation:** All-ceramic crowns and a fixed prosthesis require deeper tooth preparations to allow for the thickness of zirconia substructures underneath the esthetic veneering ceramic. Manufacturers recommended a 0.3 mm thickness of zirconium oxide on anterior teeth and 0.5 mm thickness on posterior teeth. When one compares tooth preparations for zirconia-based prosthesis with those for conventional PFM prosthesis. The all-ceramic crowns require deeper tooth structure removal on the mesial, distal and lingual aspects of the praparation to achieve optimum thickness of substructure and veneering ceramic. As the popularity of all-ceramic restorations continues to increase, deeper tooth preparations will be used more frequently. This necessity probably will limit the use of all-ceramic crowns for younger patients who have larger pulps.(3)

An axial and occlusal reduction of 0.8–1.0 and 2.0 mm respectively is required. To minimise stress concentration within the ultimate restoration and facilitate digitisation of the preparation, the use of sharp line angles, boxes, grooves and 'butt' type shoulders is contra-indicated and a medium, chamfered, axial reduction is required. For similar reasons it is important to round off all surface transitions and there must be no residual sharp edges to the preparation. To facilitate appropriate tooth preparation a set of customised diamond burs is available.(4) Preparation margins should be placed supragingivally wherever possible. The use of subgingival margins, e.g. for aesthetic reasons, should be restricted to the labial aspect of upper anterior teeth. This will not only simplify impression procedures but it will also help to maintain optimal periodontal health.(5,6)

## Have fixed-prosthodontic impressions become easier?

Excellent fixed-prosthodontic impressions are ensured with the presence of healthy soft tissue, atraumatic tooth and soft-tissue preparation, use of packing cords when indicated, routine use of astringents and taking enough time to accomplish the preimpression procedures thoroughly. Currently advertised products that supposedly eliminate the difficulty of fixed-prosthodontic impressions and the need for cords have decreased some of the frustrations of impression making, but the challenge remains. Excellent impressions require accurate and stable impression materials, time, conscientious and thorough techniques, attention to every detail, good support staff and a working knowledge of all aspects of the concepts involved.[7]

Inadequate fixed-prosthodontic impressions are one of the most frequently occurring challenges faced when making crowns or fixed prostheses. However, by incorporating the following points into routine practice, practitioners can improve their impressions.

- Make sure gingival tissues are healthy before beginning restorations, by accomplishing whatever periodontal therapy is needed and allowing an adequate healing period before making tooth preparations.
- Use 0.12 percent chlorhexidine mouthrinse two times daily for two weeks before preparing the teeth.
- Make precise tooth preparations that ensure identification of the preparation margins on the impression, so that the technician can see where to end the crown.
- Do not cut or otherwise injure the gingival tissues during tooth preparations. If tooth preparation margins are deeply subgingival, use instruments to hold the soft tissue away from the bur to avoid cutting it while preparing the tooth.
- Use adequate, stable (preferably custom) trays for clinical situations with three or more prepared teeth.
- Take enough time to ensure excellent soft-tissue retraction and bleeding control. When impressions are inadequate, the cost of remaking them is significant in terms of both money and time. Dentists tend to accept impressions lacking complete tooth preparation detail on some portion of the tooth preparations, thinking that the laboratory technician can "fake" the margins. The result is almost certainly a poor fit.
- Use the two-cord tissue retraction technique when the preparations are deeply subgingival or when soft tissue tends to rest close to tooth preparation margins. Put one cord in before finishing preparations, finish the preparations, put the second cord in for a few seconds, remove only the second cord and then make the impression while the first cord remains in place.
- Use small packing instruments and great care when using tissue-packing cords, to avoid injuring soft tissue and causing bleeding.
- When slight bleeding occurs while impression material is being injected, use an astringent chemical on the gingival tissues, followed by a slight airstream. Repeat this procedure two or three times to control bleeding during the impression-making procedure.

Vinyl polysiloxane and poly-ether impression materials are at the center of almost all of the impression techniques. However, on the horizon is an entirely new clinical concept in which a scanner is used to make multiple pictures of the tooth preparations and surrounding teeth, the opposing arch and interocclusal relationship. The digital information is transferred to a cooperating laboratory. CAD/CAM devices produce models of the prepared teeth, the surrounding teeth and the opposing arch mounted in the correct interocclusal relationship. The restorations are fabricated on this model.[1]

The possibility of scanning instead of making intraoral impressions with elastomers has a high possibility of making a major impact on the profession. However, a few years will be necessary for this to occur, because of the cost of the new concept and relative success of current impression related techniques.

## Post concepts are changing

Fixed prosthodontic procedures continue to be accomplished in significant quantities, and it does not appear that this trend will decline. Many of the teeth being crowned require endodontic therapy as a part of the tooth preparation, and some require endodontic therapy after crowns or fixed prostheses have been placed. Post-and-core build-ups are necessary in some of these teeth. During the last few years, there has been a major shift away from metal custom-cast posts and cores toward prefabricated metal posts and resin-based composite cores, and recently there is a clearly observable movement toward use of fiber-reinforced resin-based composite posts used with bonded resin-based composite build-ups.

Use of post-and-core restorations has changed markedly in the past several decades. Current use and research supports techniques using tooth-colored, fiber-reinforced resin-based composite posts or titanium alloy posts cemented with resin cement, followed by resin-based composite build-ups. Although fiber-reinforced resin-based composite posts appear to be very promising, long-term clinical observation is needed.[2]

## Provisional restorations for fixed prosthodontics

Resin-containing compounds make the best temporary crowns and dental prosthetics and are least likely to lead to complications such as poorly fitting final restorations. Various less preferable temporary materials include aluminum shell crowns, nickel-chrome, and polyethyl methacrylate. For single-tooth repairs a wax impression of the tooth is made, the resin compound is placed in the cooled wax, the resulting structure is adjusted to the bite, and seated onto the tooth. Temporary repairs involving several teeth are more complicated. Such repairs involve making a cast of the teeth, placing the resin compound in the cast, making a template of the area to be repaired, and adjusting both the template and temporary restoration. Finally, the restoration is cemented onto the tooth.[8]

## Changes in correlations between cervical crown edge and marginal gingiva

Subgingivally located crown margin, crowns, rugged cervical surfaces may retain plaque, cause gingival inflammation, increased pocket depth. It has been shown that fixed constructions are compatible with periodontal health even in cases of severely reduced periodontal tissue support, provided crown edges have supragingival location. For esthetic reasons it may be necessary to place crown margins at the gingival margin or with a tolerable limit subgingivally 0,5mm. Reconstructions with crowns and bridges could be able to assure interproximal hygiene with interdental brushes. Regular oral health maintenance programs for patients receiving fixed prosthodontics may reduce gingival inflammation, recessions and overgrowth.

Thus, Along with the functional and aesthetic results, prosthodontic constructions must correspond to biological needs as well. They don't have to irritate the periodontal tissues, alveolar bone and gingiva. If patients follow a strict maintenance program, a good prognosis can be anticipated. The main factors to realize periodontal prophylactic role of fixed prostodontics and to preserve periodontal health are exact adaptation of crowns and retainers toward gingival preparation limits, maximum release of the interdental spaces, correct contour of the crowns, good polishing, motivation and instruction for mouth hygiene of the patient.

## Shade matching in fixed prosthodontics using instrumental color measurements and computers

Instrumental color measurement could be preferred over visual color determination in fixed prosthodontics because instrumental readings are objective and more rapid. A measuring device permits precise shade selection without subjective impressions from the surroundings. Newer methods of shade selection include computerized shade matching systems that have appeared in the market.

- An understanding of the science of color, color perception and their modification is important if success must be attained in the ever-expanding field of esthetic restorative dentistry.
- Colorimeters have been shown to be capable of providing reliable and reproducible tooth color measurements, removing potential variables found when the visual method is used.
- Electronic shade matching ensures accuracy, complete shade matching and the elimination of variables that tend to confuse and clutter the shade taking process. In effect, computerized shade matching puts the lab technician chairside.
- Although the human eye will be the final arbitrator, success in color construction and communication can best be achieved by combining traditional artistic techniques with the science of colorimetry.

## Replacing a Single Missing Tooth

When a single tooth is missing, the most common treatment options are the traditional tooth supported bridge and an implant supported crown. When a traditional bridge is used to replace a missing tooth, the adjacent teeth are cut down into peg shapes in order to fit the cemented bridge in place. This method of tooth replacement can be very esthetic and functional for a period of time. However, a tooth supported bridge does not replace the bone that previously surrounded the root. Since there is no longer a root to hold the bone in place, the bone deteriorates or melts away.

There are many advantages to replacing a single missing tooth with an implant supported crown:

- It looks, feels and functions like a natural tooth.
- It is much more esthetic long term.
- It does not decay.
- There is no need to grind down the adjacent natural teeth.
- The bone is preserved, preventing a visible bony defect
- It is more hygienic than a tooth supported bridge.

## Choosing an all-ceramic restorative material

**Porcelain-fused-to-metal or zirconia-based? Procera all-ceramic crowns: a new approach to an old problem?**

Use of zirconia-based all-ceramic crowns and fixed prostheses is rapidly growing. Zirconia-based crowns and fixed prostheses have undergone few years of basic science research and laboratory and clinical observation.

Observations regarding zirconia-based all-ceramic restorations when compared with PFM restorations:

- They are better esthetically than typical PFM restorations.
- The long-term color stability probably will be the same as that observed with PFM restorations.

- The margins of the restorations have a more acceptable appearance than those of PFM restorations when gingiva recedes.
- Research shows that the strength and service record of PFM restorations and zirconia-based restorations in three-unit prostheses is similar, but longer clinical observation is necessary for final judgment.
- Prostheses requiring precision attachments or stress breakers are best made with PFM restorations.
- The long-term wear characteristics on opposing teeth for either material probably will be similar, because the external ceramic materials are similar.
- Gingival sensitivity to metal will be reduced or eliminated with use of zirconia-based restorations.
- The cost of zirconia-based restorations is higher than that of PFM restorations, but it probably will decrease as further developments take place.

Overall, the potential for zirconia-based all-ceramic restorations appears to be very good.

## Computer-assisted generation of all-ceramic crowns and fixed partial dentures

The successful application of the concept of computer-assisted manufacturing in restorative dentistry requires that computer-assisted design (CAD) and computer-assisted machining (CAM) not only meet but actually exceed currently accepted standards for the material and clinical quality of dental restorations. In addition, the continued development of systems for polyvalent processing of disparate materials and objects must be assured. With these critical requirements in mind, the Precident system is a clinically proven and competitive system. The resolving power of the CCD chip is much improved compared to conventional cameras or charge-coupled devices. The scanner is able to scan entire casts in a fully automated process. In principle, this facilitates the production of frameworks for fixed prosthetic devices (FPD) of any size. It is also possible to create at least partial frameworks for removable prosthetic devices (RPD). A factor of great clinical and economic importance is the polyvalence of the process in materials processing: the numeric control (NC) machine can be programmed for metal alloys and ceramic materials as well as fiber-reinforced resins. The Precident System is routinely used for producing all single crowns and FPDs with up to four units. CAD/CAM all-ceramic crowns and FPDs currently cost about the same as metallo-ceramic or conventional all-ceramic restorations.

## CAD-CAM Technologies

Advances in dental ceramic materials and processing techniques; specifically; computer aided design(CAD)/computer aided manufacturing(CAM) and milling technology, have facilitated the development and application of superior dental ceramics. CAD/CAM allows the use of materials that cannot be used by conventional dental processing techniques. Tightly controlled industrial ceramic processing can produce increased microstructural uniformity, higher density, lower porosity and decreased residual stresses. Such improvements have the potential to improve clinical predictability.

Recently, two strategies using different CAD/CAM processes to generate high strength all-ceramic frameworks have been developed. One strategy uses materials that completely eliminate the glassy phase by directly sintering the crystals together without any intervening matrix. This strategy is referred to as solid sintered ceramics. There are several different processing techniques that allow the fabrication of either solid sintered aluminous oxide or zirconia oxide frameworks.

The second strategy allows the reinforcing component to form a continuous skeleton like meshwork of either alumina or spinell or an alumina/zirconia mixture that is subsequenty infiltrated with a low-viscosity lanthanum glass. This class of materials is referred to as interpenetrating phase network compounds. This strategy was used in the development of Inceram for the CEREC inLab system. In-Ceram differs from the glass ceramics in which reinforcing particles are completely surrounded by their glassy matrices.

## Porcelain Veneers

Porcelain veneers are thin shells of porcelain that bond to the front surfaces of teeth. Custom-made for each individual patient, the color of each veneer is closely matched to the patient's teeth. With a semi-translucent, enamel-like quality, porcelain veneers allow light to be absorbed and reflected off the dentin beneath, resulting in bright, luminescent teeth that look completely natural. Placing porcelain veneers is usually a three-step process that begins with a light buffing of the teeth to eliminate about one half millimeter of enamel. A mold of the patient's mouth will then be made and used to create veneers that fit perfectly to their teeth. During the final phase of treatment, the veneers will be fitted and bonded to the teeth, resulting in a dramatic improvement in the appearance of the patient's smile. They can help our teeth to appear Whiter, Straighter and Shaped Beautifully.

**Lumineers** are porcelain veneers that offer the simplest way to a permanently whiter and perfectly aligned smile. With Lumineers, we can apply these contact lens-thin "smile shapers" to teeth with minimal grinding or shaving, transforming teeth into a naturally beautiful smile. LUMINEERS are contact lens-thin and are placed over existing teeth without having to remove tooth structure (unlike traditional veneers.) LUMINEERS are a painless, permanent cosmetic solution for stained, chipped, discolored or misaligned

teeth. In just 2-3 visits, we can have a custom-made smile that is clinically proven to last over 20 years.[2]

**CEREC Single Day Veneers** are beautiful ceramic veneers that can be started and completed in a Single Visit, without the need for temporaries. The veneers are completed the day we start treatment. The esthetic results are outstanding, and they are the only way to achieve the perfect smile in a single day.

**CEREC Single-Visit Crowns**

With CEREC technology, patients can be in and out of the office in a single day with beautifully made, custom porcelain crowns. In comparison to traditional crowns, CEREC single-visit crowns require patients to undergo fewer injections and to take less time out of their busy schedules.

CEREC single visit crowns can be manufactured quickly. Using this system, patients can actually view their teeth on a screen while the restorations are being created. An infrared camera captures images of the patient's mouth and delivers them to a computer, where 3D images enable us to see all aspects of the patient's teeth. With on-site equipment, we can then create the patient's all-porcelain crown in about ten minutes.

Dental crowns made with CEREC technology contain no metals, avoiding possible allergic reactions. They are also more visually attractive. CEREC crowns are made out of tooth-colored materials – either ceramic or composite resin. They can be used to make onlays (partials crowns), as well as full crowns and porcelain veneers. When used for partial crowns instead of amalgam (metal combined with mercury), we can avoid concerns regarding the health risks associated with mercury, and these restorations feel and look like part of the patient's natural tooth structure. Moreover, CEREC restorations chemically bond to teeth and thus can expand and contract with changes in temperature, which prevents cracking and breakage from occurring.[7]

## Conclusion

Fixed prosthodontic procedures compose a major part of dental practice. Numerous changes in techniques, materials and devices have made crowns and fixed prosthesis more predictable in service, faster and easier to fabricate, and more esthetically pleasing. Need and demand for crowns and fixed prosthesis will increase with time.

## References

1. Christensen, GJ. Improving the quality of fixed prosthodontic services. *JADA*. 2000;131:1631–1632.
2. Christensen, GJ. Day-to-day fixed prosthodontics: a fast, easy, predictable approach. *JADA*.1992;123:91–92.
3. Kishimoto M, Shillingburg HT Jr, Duncanson MG Jr. Influence of preparation features on retention and resistance. Part II: Three-quarter crowns. J Prosthet Dent 1983;49:188-92.
4. Standlee JP, Caputo AA. Load transfer by fixed partial dentures with three abutments. Quintessence Int 1988; 19:403-10.
5. Alan BC, David TB. Preparation of abutment teeth. McCracken's Removable Partial Prosthodontics. 11th ed. St. Louis: Mosby; 2011: 205-16.
6. Shillingburg HT, Hobo S, Whitsett LD, Jacobi R, Brackett SE. Preparations for extensively damaged teeth. In Fundamentals of Fixed Prosthodontics. 3rd ed. Chicago: Quintessence; 1997. p. 181-210.
7. Tsumita M, Kokubo Y, Ohkubo C, Sakurai S, Shunji F. Clinical evaluation of posterior all-ceramic FPDs (Cercon): A prospective clinical pilot study DCNA 2010;54:2,102-105.
8. Cronin J, David R. An Update on Fixed Prosthodontics *JADA*. 1997;128:4:425–436.