This article provides information regarding the many ways that removable partial dentures (RPDs) may be used to solve restorative problems in the esthetic zone without displaying metal components or conspicuous acrylic resin flanges. The esthetic zone is defined and described, as are methods for recording it. Six dental categories are presented that assist the dentist in choosing a variety of RPD design concepts that may be used to avoid metal display while still satisfying basic principles of RPDs. New materials that may be utilized for optimal esthetics are presented and techniques for contouring acrylic resin bases and tinting denture bases are described.

Esthetic dentistry is associated most often with anterior restorative dental care. Esthetic dentistry describes the efforts made to restore teeth or prostheses without drawing attention to those changes. Esthetic dentistry may enhance one’s appearance by improving contours of teeth and gingival architecture or by providing a brighter and more noticeable look. Removable partial dentures (RPDs) are one aspect of esthetic restorative dental care that often is neglected. Due to the emphasis placed on esthetic dentistry in the media and the advances made in this area during the past 15 years, patients have come to demand prostheses that not only are comfortable but also are less noticeable or more natural in appearance. Many of the materials, techniques, and designs that enhance esthetics often are not taught to undergraduate dental students. Most dental schools are reducing the curriculum hours devoted to the clinical teaching of removable prosthodontics at a time when the need for RPDs is increasing.

Implant dentistry may be used to replace RPDs for some patients; however, financial, anatomic, psychological, or medical considerations still require dentists to understand how to create a treatment plan, design, and treat patients for removable prostheses. Fabricating inconspicuous implant restorations in the esthetic zone is challenging and often can be performed more satisfactorily by utilizing RPDs. RPDs also offer a less complicated, less expensive, and time-saving alternative to implant treatment.

This article describes the esthetic zone, how it should be evaluated, and how it relates to the six partially edentulous dental categories that determine RPD treatment options.

**The esthetic zone**

The term *esthetic zone* is used here to describe the teeth and gingiva as they are observed when a patient emits a hearty laugh; this laugh should be described, drawn in the treatment plan, or displayed in a photograph. This practice will allow dentists to avoid including unwarranted displays of clasps and other metal components in the treatment plan (Fig. 1). According to Preston, the esthetic zone is wherever the patient thinks it is. Even though the patient may not display metal while laughing, he or she still may believe that it can be observed. Dentists should always communicate to patients when metal is to be used on the facial surfaces of teeth, even when the metal will not be visible in the esthetic zone. Patients should have the opportunity to select alternative designs.

In 1984, Tjan et al demonstrated that 87% of all patients had what was referred to as the *average smile*, in which the cervical to incisal length of all maxillary anterior teeth was displayed to either the first or second premolar. In light of this finding, dentists must be vigilant to eliminate clasps, metal proximal plates, spaces, or any obstruction in the esthetic zone for the majority of individuals in their practice. In that same study, 4.0% of the patients displayed all of their maxillary anterior and posterior teeth and their attached gingiva. These patients are the most difficult to satisfy since all framework components and acrylic resin flanges will be visible (Fig. 2). Dentists must pay attention to flange design (that is, contours) in such cases; custom color characterization also may be necessary for optimal esthetics. Finally, the study noted that 6.0% of all patients displayed only the maxillary anterior teeth from canine to canine when smiling and may display only part of those teeth and no attached gingiva (Fig. 3). Dentists can offer these patients a wide array of RPD design concepts that do not compromise the esthetic zone.

Mandibular anterior teeth must be observed and described in the treatment plan. Most patients display only 50% of the mandibular anterior teeth and 50% or less of the buccal surfaces of the premolars in the esthetic zone, while all occlusal surfaces of the premolars usually are visualized. Dentists can conceal distracting RPD components in these patients but planning is more complicated for the
many patients who don’t fall into this category. Patients display more mandibular teeth and gingiva as they age.

**Categories of partial edentulism**

This article is divided into six categories of partial edentulism that are used to determine RPD treatment options.

**Esthetic zone is not a concern and no need exists for abutment retainers**

Most prosthodontists agree that a less-complicated approach to RPD treatment is best. Any conventional clasping arrangement can be used, provided abutment teeth are not restored and the esthetic zone does not display an RPD’s components. The patient must be informed that clasps will be placed on the facial surfaces of teeth. These clasps will not be visible when the patient smiles or emits a hearty laugh; however, they may be visible if the lips are displaced forcibly. The patient should consent to this prior to treatment rather than after a framework has been constructed.

Infrabulge clasps are the most esthetic of the conventional retentive clasps, offering dentists the best opportunity for placing metal in less-conspicuous locations. The foot of the infrabulge clasp often can be reduced for optimal placement. Ideally, these clasps should be placed in the gingival third of a tooth and the approach arm should not traverse soft tissue undercuts.

Wrought wire and cast circumferential clasps are alternative designs for surveyed casts and appropriately contoured abutment teeth. The approach arm of these clasps should emanate from the middle third of an abutment tooth and the retentive tip of the clasp should be in the gingival third of the abutment tooth. The proximal section of circumferential clasps should not emanate from the occlusal third of the tooth.

When tooth-supported RPDs are possible, a posterior anterior rotational path RPD also should be considered. This RPD will allow conservation of tooth structure on posterior abutments while avoiding facial and lingual clasps that can irritate the tongue and facial attached gingival tissues (Fig. 4). The rotational path RPD design will be described in detail later in this article.

**Esthetic zone is a concern and no need exists for abutment retainers**

When the facial surfaces of abutment teeth are visible in the esthetic zone, dentists should consider other locations for retentive and/or bracing clasps. It is important to distinguish between bracing and reciprocating clasps as part of a clasp assembly. Reciprocating a force from a retentive clasp cannot be attained practically without milling a cast restoration. Bracing is a term used to describe what has been known conventionally as a reciprocating clasp. The bracing clasp is used to prevent horizontal movement after the clasping assembly is seated completely. Together with the retentive clasp and rest of a clamping assembly, the bracing clasp satisfies a basic principle of clasp design by encircling the abutment tooth by more than 180 degrees.

Using lingual retention to hide a retentive clasp often is an excellent option. If the abutment tooth has the appropriate contour, a lingual undercut can be utilized for the retentive clasp that is not visible. To satisfy the basic principle of encirclement, bracing can be utilized on the distofacial aspect of the abutment teeth—together with rests, minor connectors, and tooth contacts (Fig. 5 and 6)—without the unsightly display of a buccal clasp arm.

The lingual retention option can be utilized for tooth-supported and tooth-and-tissue-supported restorations.

When abutment tooth contours are favorable, the posterior anterior rotational path RPD can be designed for lingual retention of the conventional clasp assembly (Fig. 7).

A Saddle-Lock RPD (Boos Dental Laboratories, Minneapolis, MN; 800.333.2667) avoids visible clasps by utilizing a distal facial undercut and a mesial rest.
This design is particularly suited for tooth-supported situations. One should be cautious when using it for tooth-and-tissue-supported partial dentures, as this design makes it difficult to establish guiding planes on abutment teeth and it may compromise retention and stability of the prosthesis (Fig. 8 and 9).

The Rotational Path of Insertion concept is one of the most appropriate designs for this category.\textsuperscript{14,15} By rotating an RPD into position, dentists can avoid using the standard number of clasps that normally are required. It must be remembered that this design concept is used primarily for tooth-supported RPDs, although there are a variety of ways to utilize this concept: posterior anterior (PA), anterior posterior (AP), and lateral paths of placement. The first letter indicates the initial path of placement (utilizing a rigid proximal component); the second letter indicates the segment of the prosthesis after rotation has occurred. This segment has a conventional clasping system.

The AP design used in Kennedy Class IV situations (that is, partially edentulous spaces that cross the midline) is the most popular rotational path design. This design eliminates clasps on the facial surfaces of anterior teeth. Conventional clasp design can be utilized on both maxillary and mandibular posterior teeth that are out of the esthetic zone (Fig. 10 and 11). The author has used this concept to replace first premolars and all maxillary anterior teeth successfully.

When a limited space (for example, two central incisors) must be replaced, dentists should use a dental surveyor to ensure that rests and rigid proximal plates are not prevented from seating on natural teeth during the initial path of placement. Additional modification spaces also may be replaced using this concept but the design is more complex and proper blockout procedures must be performed to avoid interferences when rotation occurs around abutment teeth (Fig. 12).

Although it is not always considered, a Kennedy Class III with a modification space on the other side of the arch (bilateral tooth-supported partially edentulous spaces) is another method for utilizing the AP rotational path RPD, precluding the need for a visible clasp on a first or second premolar. A distal undercut on premolars is used for the initial path of placement and the RPD is rotated with a conventional clasping system on the molars (Fig. 13 and 14).

Conceptually, the lateral path of RPD insertion is not different from the AP, except that a Kennedy Class III partially edentulous space (that is, one that does not cross the midline) is replaced with a rotational path RPD that is rotated in a more diagonal direction. When conventional clasp design is utilized, the initial path is located more anteriorly and the contralateral side is rotated and positioned more posteriorly (Fig. 15 and 16).

Flexite (Dentsply International, York, PA, 800.877.0020) is a translucent material that can be used to avoid metal display; it also can be attached to metal frameworks, resulting in cross-arch stabilization and clasp encirclement. In recent years, the author has experienced excellent clinical success using this material with cast frameworks (Fig. 17–19). Due to Flexite’s lack of tensile strength, it must be designed with greater vertical height and thickness than metal, which results in broader coverage of the abutment tooth. The author designs Flexite clasps from the height of contour of the abutment tooth; most are 3.0–4.0 mm high and 1.5 mm

---

Fig. 10. An AP rotational path RPD designed to replace teeth No. 7–10.

Fig. 11. A patient wearing the AP rotational path RPD seen in Figure 10.

Fig. 12. An AP rotational RPD path with modification spaces.

Fig. 13. Initial path of insertion on distal of first premolar, left side.

Fig. 14. Initial path of insertion on distal of first premolar, right side.

Fig. 15. Lateral path of insertion framework with diagonal rotation.

Fig. 16. Lateral path of insertion RPD replacing teeth No. 6 and 7.
thick. Flexite is a relatively new material and there is concern regarding its clasp strength and stability in the mouth over time; as a result, this design would be the last choice for achieving an optimal esthetic result in this category.

**Esthetic zone is a concern and the need exists for abutment retainers**

All of the above concepts can be utilized when metal ceramic crowns are needed to restore abutment teeth in tooth-supported situations. This section focuses on tooth-and-tissue-supported RPDs. Precision attachments are needed for this situation to avoid clasps in the esthetic zone. While there are numerous precision attachments on the market, it would be desirable for a dental practice to limit the available attachments to two or three. Limiting the available choices will reduce the number of necessary components and result in greater efficiency and reduced cost.

As stated previously, most prosthetists agree that a less-complicated approach to RPD treatment is best. However, dentists must be prepared to place precision attachments on unrestored abutment teeth when the esthetic demand is high. In these situations, the author prefers to use extracoronal attachments, which are easier to fabricate and more amenable to repair than intracoronal attachments. Extracoronal attachments also minimize tooth reduction and satisfy stress-releasing or stress-direction principles that are required for tooth-and-tissue-supported RPDs (Fig. 20).16

Based on experience, the author prefers the ASC-52 anterior protect system (Medesco Attachment/Implant Company, Laguna Hills, CA; 800.633.3726) and the ERA-RV attachment (Sterngold Attachments, Attleboro, MA; 800.243.8942).17 The ASC-52 attachment is a universal joint resilient extracoronal attachment, containing an iridium platinum receptacle that is cast with the abutment crown (Fig. 21). The receptacle is resistant to wear and avoids food retention due to its open design. The ASC-52 is a spring-loaded dowel that can be replaced easily. As a universal joint, this attachment is unique because it does not require parallelism to function, it does not torque the abutment teeth, and it can be used with a single abutment support when good cross-arch stability is achieved.18

One major advantage the ASC-52 system offers is the accuracy between the attachment and the metal ceramic crown that is maintained during the processing of the acrylic resin. A brass processing dowel is used during the investing process (in place of the attachment ferrule) to secure the relationship between the attachment and the crown. This brass dowel prevents damage during divesting by allowing the laboratory technician to remove the metal ceramic crowns from the master cast prior to investing; it also maintains the exact relationship of the RPD framework and the crown (Fig. 22). Delivery of the RPD is accomplished without difficulty and the need to correct an ill-fitting attachment with an auto-cured resin pick-up at delivery is reduced.

The ERA attachment has a plastic receptacle that is connected to the wax-up for the metal ceramic crown. For the ERA attachment to fit accurately into the receptacle, an excellent casting process is required. Because the receptacle is made from the same metal as the crown, a metal of sufficient hardness must be used to limit wear. The manufacturer recommends a Vickers hardness of 200 and a minimum of 85,000 psi ultimate tensile strength. Dentists must be aware of this metal requirement and communicate this to the technician, although metal receptacles will wear as a result of the plastic attachment regardless of the metal that is used.

Sterngold provides ERA attachments in a variety of sizes. The increased circumference provides more retention in the receptacle attached to the abutment.
tooth, which compensates for metal wear. The increased circumference of these attachments is color-coded for ease of selection. Sterngold also recommends picking up this attachment in the mouth with an auto-cured acrylic resin during the delivery of the RPD by making a window through the lingual flange of the acrylic resin base (Fig. 23).

An alternative technique involves placing an analog in the impression by using a black processing male (Fig. 24). This technique makes it possible for the laboratory to connect the attachment during the processing of the acrylic resin base rather than forcing the dentist to do so at chairside. It is critical that this analog is positioned properly into the impression; positioning the analog inaccurately, coupled with the resiliency of the impression material, could result in an unsuccessful seating of the prosthesis at delivery. If seating is unsuccessful, the misplaced attachment must be removed and picked up in the mouth as described previously. Despite these concerns, this attachment is relatively easy to fabricate, repair, and maintain when used properly.

Height concerns and impression procedures are general considerations common to both attachments. Accurate diagnostic mountings are essential when precision attachments are used. The space between the proximal gingiva and the opposing tooth is critical for the use of these attachments; this distance can be measured using diagnostic casts (Fig. 25). The ASC-52 requires a minimum vertical height of 5.5–6.0 mm, while the ERA requires 4.50 mm (slightly more if a 0.3 mm metal housing is used).

The author has found the Turbyfill technique to be useful for making impressions utilizing the ASC-52 and the ERA. This technique involves picking up the abutment crowns from the mouth and making them an integral part of the master cast. The RPD framework is made from this cast to attain a high degree of accuracy when relating the RPD framework to these crowns. The author prefers making a one-piece border molded impression of the teeth and the edentulous areas, utilizing a custom tray with a polyvinyl siloxane or polyether impression material. In the mandible, border molding the alveololingual sulcus is particularly important to ensure more accurate placement of the inferior section of a lingual bar or plate. Border molding is not necessary for areas where a metal component or acrylic resin flange will not be present. To avoid locking the tray in the mouth, it is important to block out the gingival embrasures of any natural teeth prior to making the impression. Impressions made in this manner preclude the use of an altered cast procedure and are equally accurate. Esthetic zone is not a concern and loss of a critical abutment tooth exists

The upper lip becomes longer with age, making it possible to use more of the tooth surface without displaying clasps. Another esthetically satisfactory method can be utilized when one cannot observe the gingival 20% of the existing teeth and the patient is missing a canine or another tooth critical for adequate stability or retention. This method involves the Swing-Lock RPD (Swing-Lock, Dallas, TX; 214.361.8263), which is not often thought of as an esthetic RPD design. The Swing-Lock makes it possible to locate retentive terminals on abutment teeth that are more cervical than can be accomplished ordinarily using conventional clasp mechanisms. Generally, 6.0–8.0 mm of attached gingival space is necessary for placing a labial bar. High labial frenum attachments could interfere with the labial bar placement and are a concern when using this design concept; a frenectomy or free gingival graft sometimes is required to place the frenum in a more apical position. Based on the author’s experience, the free gingival graft produces a more predictable and stable result than the frenectomy.

The Swing-Lock prosthesis does not need retention for every existing tooth; two or three vertical clasp tips or lugs is sufficient for retention. If one or two teeth display the entire facial surface from cervical to incisal, a clasp can be eliminated here and another tooth that allows for more inconspicuous placement may be utilized. It also is possible to place clasp tips at the line angles of teeth rather than in the center of a tooth (Fig. 26 and 27). In
the author’s opinion, the Swing-Lock partial denture is one of the most underutilized and beneficial designs for RPDs.

**Esthetic zone is a concern and loss of a critical abutment tooth exists**
This category does not allow the use of conventional RPD designs. Extracoronal precision attachments can be used on maxillary Kennedy Class IV situations using premolars as abutments (Fig. 28 and 29). Caution is necessary when precision attachments are used on anterior teeth to avoid overcontouring abutment crowns and interfering with the opposing occlusion. In these situations, the author has had success using Flexite clasps and Flexite major connectors with full palatal coverage (Fig. 30 and 31). Making palatal plate major connectors with Flexite material seems to provide adequate stiffness.

Another way to treat patients in this category involves using implants for selective replacement of these lost, critical-needed abutment teeth. Implants can be used as abutments to assist in retaining a prosthesis. A variety of stud attachments are available as abutments for implants capable of retaining one or more sections of the RPD. The author has had excellent clinical success using the Locator Implant Attachment System (Zest Anchors, Inc., Escondido, CA; 800.262.2310). While conventional clasping would not be placed in the esthetic zone, it may be utilized in other areas of the arch (Fig. 32 and 33).

Utilizing RPDs for esthetic purposes becomes very difficult when patients have four or fewer teeth remaining in an arch. It is difficult to develop acrylic resin flanges adjacent to natural teeth without creating unattractive spaces and shadows. Metal proximal plates often are visible in the esthetic zone. The retention and stability of an RPD prosthesis also may be compromised. When this situation occurs, overdenture prostheses should be considered for areas where the dentist has total control of the placement of teeth and denture base flanges. For the mandible, it would be beneficial to consider stud or bar attachments to enhance retention and stability for the overdenture prosthesis.

**Esthetic zone is a concern and flange design is important**
When treatment planning for a patient who falls into the small (4%) category of patients who display all of their anterior teeth and attached gingiva, it is necessary to pay attention to the denture flanges of RPD prostheses. It must be understood that acrylic resin flanges of RPDs are used to replace missing bone. The flanges of many RPDs are overcontoured in relation to the adjacent teeth and alveolar support. In the esthetic zone, natural teeth often require replacement with tooth-supported prostheses.

Alveolar defects vary from person to person. When adjacent natural teeth are present, the supporting alveolar structure should be used as a guide for blending acrylic resin to develop the edentulous soft tissue. Inaccurate placement of tooth gingival junctions of the artificial teeth relative to the natural teeth leads to thick, bulky denture flanges that replace hard and soft tissue apically and proximally, resulting in readily visible esthetic compromises. Occasionally, it is possible to replace the artificial tooth with little or no...
denture flange (Fig. 34 and 35). The proximal and apical flanges of acrylic resin on tooth-supported RPDs should be knife-edged rather than rounded. This edging will prevent shadows and allow the color of the soft tissue to blend and even show through in these critical areas. It also is important to control the proximal contours of teeth in these circumstances, since bell-shaped teeth with proximal gingival undercuts will create a dark space between the adjacent artificial tooth and the flange of the prosthesis. Proper use of a dental surveyor is important for overcoming these esthetic concerns.

Tinting or characterization techniques are critically important for patients whose attached gingival tissues have melanin pigmentation or coloration that does not match the available colors of acrylic resin. However meticulous the design and fabrication, all could be lost if critical abutment teeth mean that dentists no longer have to invade the esthetic zone with unsightly RPD components.

**Summary**

The esthetic zone should be evaluated as part of the clinical findings. The dentist should photograph, diagram, or describe the esthetic zone in writing for reference. Thorough esthetic evaluation will serve the dentist through all fabrication procedures and help to avoid costly mistakes. RPD designs, new materials, adjunctive techniques to help characterize denture bases, and implants that can replace missing critical abutment teeth mean that dentists no longer have to invade the esthetic zone with unsightly RPD components.

**Disclaimer**

The opinions expressed in this article represent the sole views of the author. The author has no commercial interest in any of the manufacturers listed in this article.

**Author information**

Dr. Ancowitz is the program director, prosthodontic residency program, West Los Angeles Veterans Administration Medical Center, and an assistant clinical professor, Department of Prosthodontics, UCLA School of Dentistry. He also is a continuing education faculty member for postgraduate programs in Esthetic Dentistry at the State University of New York at Buffalo, the University of Minnesota in St. Paul, the University of California at San Francisco, and the University of Florida at Gainesville.

**References**