

# When to Choose Which Retention Element to Use for Removable Dental Prostheses

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The aim of this article is to introduce criteria for planning treatment with a removable dental prosthesis (RDP) in a partially dentate arch, including the indications for placement of dental implants. The retention of RDPs is achieved through clasps, adhesive attachments, crowns, and fixed partial dentures with intra- or extracoronal attachments, telescopes, root caps, and/or prefabricated interradicular retainers. RDP designs vary from a removable partial denture to an overdenture prosthesis. Potential abutment teeth are selected for RDP retention according to their prognosis, their position in the arch, and the planned prosthesis design. Retainer selection mainly depends on the remaining tooth substance, the intra- and intermaxillary relationships, esthetics, and financial aspects. With dental implants as additional retainers, the supportive area for the RDP is increased, the soft tissue load is minimized, and the extension of the base of the prosthesis can be reduced to enhance a patient's comfort. For RDP planning, strategic considerations are needed to determine the appropriate prosthesis design, to select the abutment teeth, and to choose the appropriate retention element for each particular abutment. *Int J Prosthodont* 2009;22:161–167

Despite a growing trend to use fixed dental prostheses to maintain more teeth in older age groups and an increasing use of dental implants, removable dental prostheses (RDPs) are still prevalent.<sup>1</sup> The RDP in the partially dentate arch is designed either as a removable partial denture (RPD), with the residual dentition visible, or as an overdenture prosthesis, covering and resting on the abutment teeth.<sup>2</sup> When combining

both types of restorations within one RDP, eg, one composed of clasps and telescope retentions or differing extensions of the base of the prosthesis, it is also called a hybrid prosthesis. Decisive factors for using an RDP in the partially dentate arch are: (1) the need to compensate for severe alveolar ridge defects when no augmentation procedure is feasible or desired; (2) correction of tooth malposition or misalignment, including the inter- and intramaxillary relationships, when no orthodontic or surgical intervention is feasible or desired; and (3) few retention elements present, requiring additional support from mucosal tissues. The prevalence of RPDs in the adult population varies in European countries, with 5% to 9% in Sweden, 11% in Switzerland, 14% in England, 15% in Denmark, and 27% in Finland.<sup>1</sup>

When an RDP is selected for a particular situation, treatment planning comprises strategic considerations for selecting the abutment teeth, as well as the selection of the appropriate retention element for each particular abutment. It is the aim of this article to introduce criteria for planning prosthodontic treatment with an RPD, including the indications for placement of dental implants in the partially dentate arch.

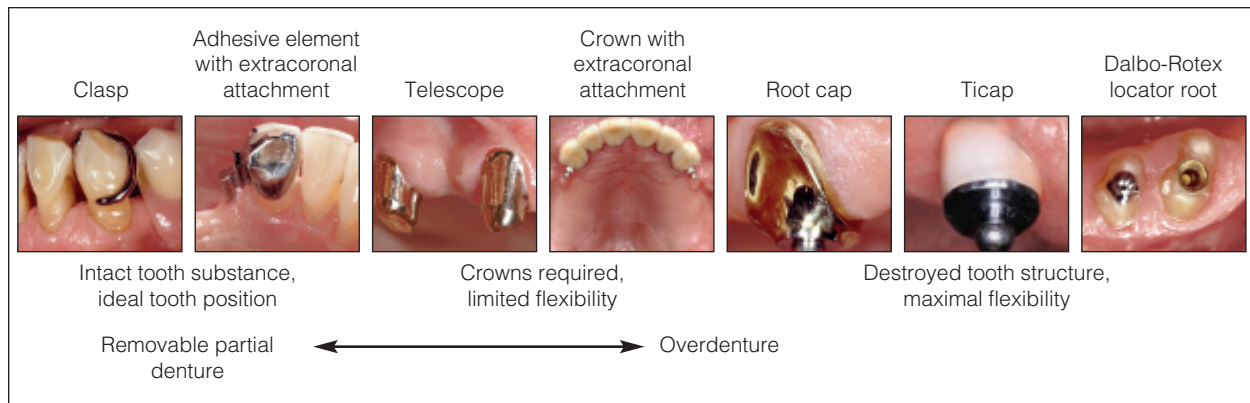
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**Fig 1** Indication and use of different retention elements for RDPs.

### Treatment Concept for an RDP

In general, the retention of RDPs is achieved through clasps, adhesive attachments, crowns and fixed partial dentures with intra- or extracoronal attachments, telescopes, and/or root caps (Fig 1). Instead of root caps cast on gold alloy posts with prefabricated retentive elements, intraradicular retainers (eg, Dalbo-Rotex, Cendres and Métaux; Ticap, Unor; Locator Root, Zest Anchors) can be used in teeth with a questionable prognosis at a lower cost.<sup>3</sup> Since combining different types of retentive elements in an RDP is feasible, the appropriate element is selected for each individual abutment and depends on the remaining tooth substance (ie, intact clinical crown, decayed and/or filled and in need of a crown restoration, or root canal-treated and only root maintainable). Additional factors are the intra- and intermaxillary relationships, the esthetic requirements, and the financial aspects of the patient. Double crown systems, such as telescopes and individual root caps, are the most costly retainers both technically and for treatment.

Planning an RDP in the partially dentate arch is best approached systematically. To begin with, the practitioner must diagnose the existing dentition and soft tissue situation,<sup>4</sup> define the intended support (mainly tooth- or tissue-supported) and desired extension of the base of the prosthesis, analyze the anticipated stability of the prosthesis and possible retention according to the number and position of the existing dentition, and consider additional stabilization and retention from dental implants. As a general rule, the extension of the prosthesis and the number of selected abutment teeth should be large enough to provide sufficient stability and retention, but as small as possible for optimal comfort and favorable biologic conditions.

### Patient Examination

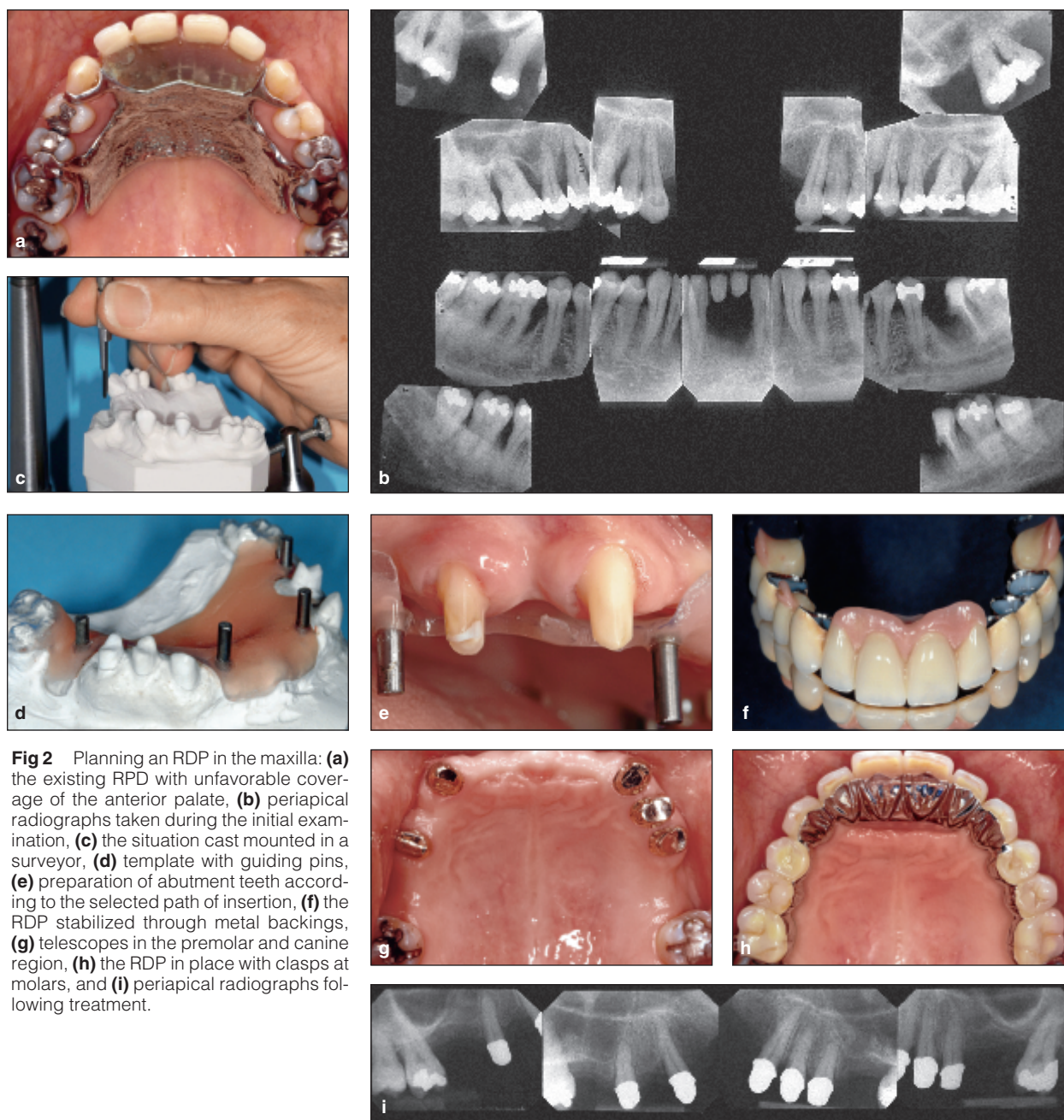
Adequate treatment planning for an RDP requires the anamnesis and examination to comprise the following aspects:

- Patient's aspects and requests: patient agrees on a removable appliance with a major connector (possibly with palatal coverage), financial budget.
- Dental and periodontal examination: decayed, filled, and missing teeth; vital and nonvital teeth; probing pocket depth; and bleeding on probing.
- Periapical radiographs: evaluation of apical pathologies and existing root canal fillings.
- Prosthodontics (evaluation of the situation with and without the existing appliance): relationship between the ideal position of the occlusal plane and gingival margin of the residual dentition, relationship between the maxilla and mandible (intermaxillary relationship) and among the teeth on each (intramaxillary relationship), extension of alveolar ridge defects. A diagnostic setup may be required to evaluate the ideal tooth position.<sup>5</sup>

Evaluation of these aspects indicates whether changes in tooth position are required, additional root canal treatment is needed (due to extensive preparation), alveolar ridge defects require compensation with the base of the prosthesis, and buccal and/or lingual flange extension is needed.

Based on these findings from the examination, diagnosis and prognosis is attained for the entire situation, as well as for each individual tooth:

- Whether the tooth is useful as a retainer abutment, questionable (requires pretreatment and has to be reevaluated following initial therapy), or hopeless with poor prognosis (extraction indicated).



**Fig 2** Planning an RDP in the maxilla: **(a)** the existing RPD with unfavorable coverage of the anterior palate, **(b)** periapical radiographs taken during the initial examination, **(c)** the situation cast mounted in a surveyor, **(d)** template with guiding pins, **(e)** preparation of abutment teeth according to the selected path of insertion, **(f)** the RPD stabilized through metal backings, **(g)** telescopes in the premolar and canine region, **(h)** the RPD in place with clasps at molars, and **(i)** periapical radiographs following treatment.

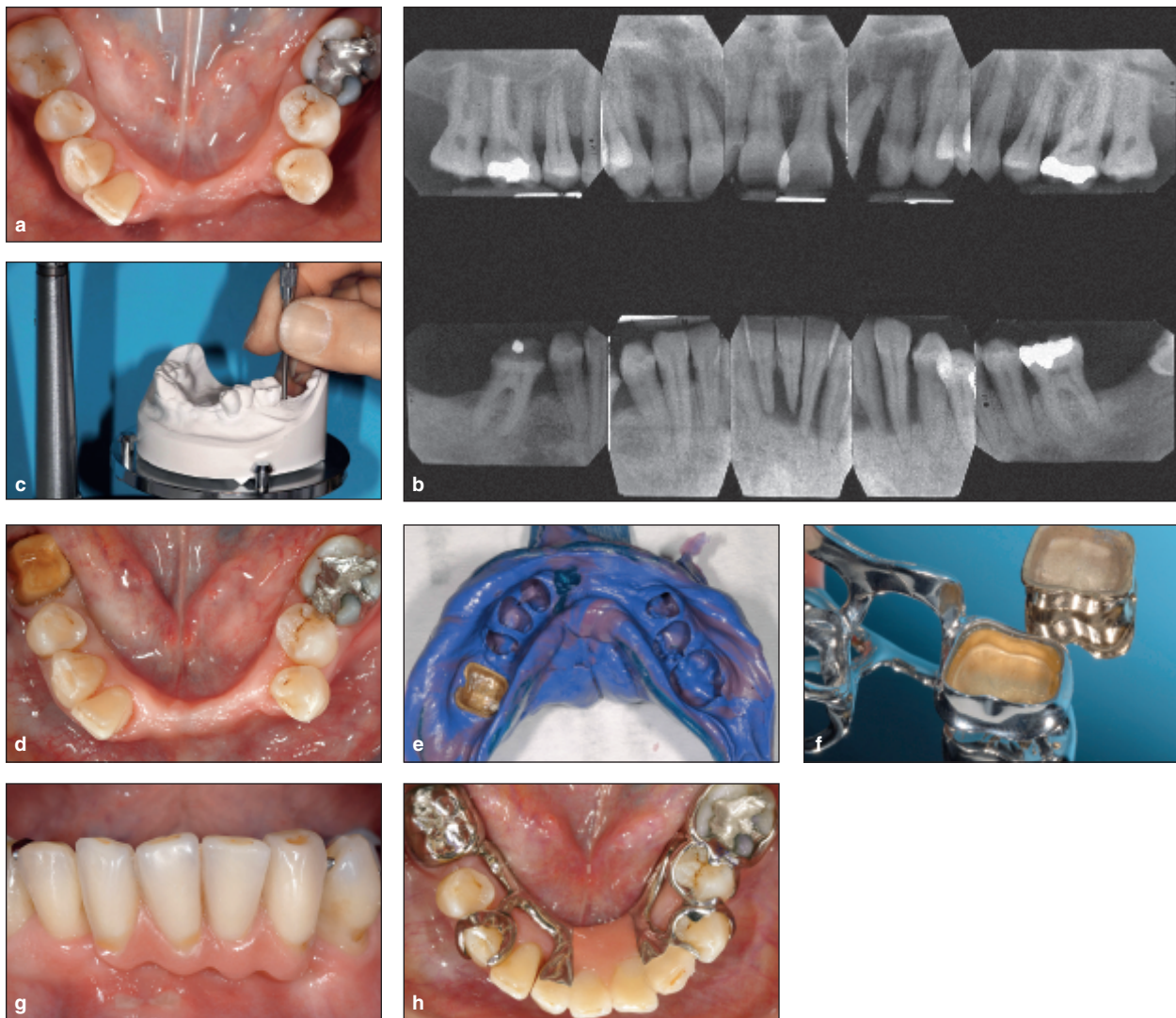
- Initial therapy: periodontal treatment, treatment of caries lesions, root canal treatment, extraction of hopeless teeth, and provisional restoration or adjustment of existing RDPs.
- Reevaluation: periodontal exam, sensitivity testing, radiographs, extension of fillings, and presence of root canal treatment.

Following initial therapy and reevaluation of the dentition, the abutment teeth used for retention of an RPD or overdenture prosthesis are finally selected.

### ***Selection of Abutments***

The selection of the abutment teeth depends on the following considerations:

- Whether the tooth has a good periodontal and endodontic prognosis, particularly if it is intended as part of a fixed partial denture section or located in a decisive position for adequate prosthesis retention.



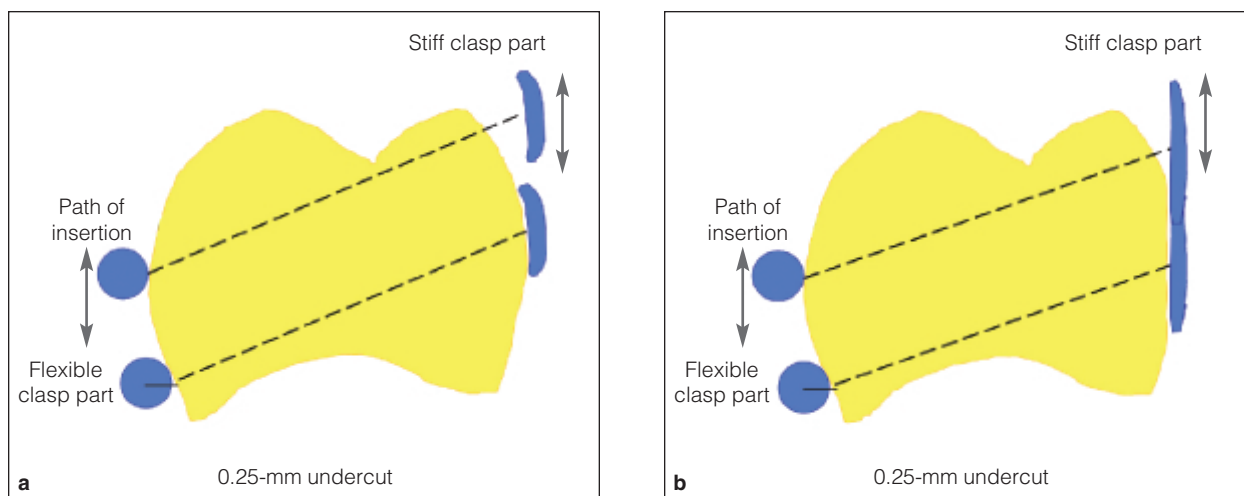
**Fig 3** Planning an RDP in the mandible: **(a)** the initial situation with an extended composite filling in the right first molar, **(b)** periapical radiographs taken during the initial examination, **(c)** evaluation of the path of insertion and undercuts with the situation cast mounted in a surveyor, **(d)** the intraoral situation with prepared abutment teeth for a telescope in the right first molar and occlusal rests for clasps, **(e)** a second impression following the telescope try-in, **(f)** galvano secondary element luted into the chromium-cobalt superstructure, **(g)** the anterior prosthesis base modified according to the extension of the ridge defect, and **(h)** the RDP in place.

- Ideally, four retentive elements are selected, which are evenly distributed in the anterior and posterior region of the arch (eg, left and right canine and second molar region).
- Retention at more than four elements is practical if their inclusion is efficient for obvious reasons (eg, an adjacent molar tooth is easily provided with a clasp) (Fig 2) or the prognosis of an abutment is questionable.
- If prosthesis stabilization and retention is not sufficiently provided from the existing tooth abutments, additional use of dental implants can be considered.

### ***Selection of Retentive Elements***

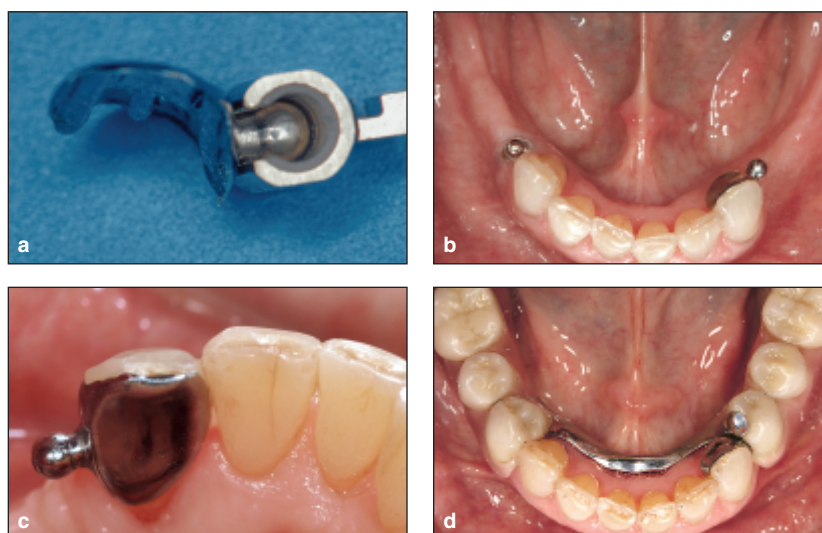
Since combining different types of elements for retaining an RDP is feasible, the indication criteria for selecting the appropriate retention elements are applied to each abutment tooth considered (Figs 1 and 3). The decisive criteria are as follows.

An intact, caries-free tooth intended as a retentive abutment is best provided with a clasp or an adhesive attachment. When using clasps, the following requirements must be fulfilled: vertical support by an occlusal rest (ideally located on a sound tooth structure),



**Fig 4** Reciprocal effect of clasps. **(a)** Insufficient lingual guiding surface, **(b)** Ideal lingual guiding surface.

**Fig 5** Bilateral free-end situation with an RDP retained at an adhesive attachment in the left mandibular canine and an implant provided with a ball abutment in the right mandibular first premolar. **(a)** An adhesive element with extracoronal attachment and matrix, **(b)** the intraoral situation, **(c)** an adhesive element inserted with composite cement, and **(d)** the RDP in place.



retention provided by the elastic arm, stabilization against shearing forces provided by the stiff part of the clasp encompassing more than 180 degrees, reciprocal effect, and passivity. In the final position of the prosthesis, no active forces affect the abutment teeth. As soon as any tension acts on the RDP during mastication or prosthesis removal, the clasp tip engaging the retentive undercut bends and the resulting lateral forces affecting the tooth have to be neutralized by the opposing stiff reciprocal parts of the clasp (Fig 4). This stiff part on the opposite side is designed so that tooth contact is maintained as long as the deflecting elastic arm applies forces on the abutment tooth. Using clasps for retention requires very limited preparation for an occlusal rest, but there should be sufficient guide planes for the stiff part to counteract the elastic arm and, eventually, an adequate undercut of the elastic arm

must be prepared. In any case, a diagnostic evaluation of the best possible path of insertion for all abutment teeth is required in advance. Therefore, a situation cast is mounted in a surveyor to determine the prosthetic equator and the position and extension of undercuts intended for the retentive elastic clasp part. For cobalt-chromium alloys, which are more fatigue-resistant than titanium or gold alloys,<sup>6</sup> the undercut depth ideally measures 0.25 mm in the horizontal dimension.<sup>7</sup>

While clasps potentially interfere with esthetic demands in the anterior region, adhesive elements with an extracoronal attachment are almost invisible in the lingual region. An intact enamel substance is a prerequisite for the long-term retention of adhesive elements, and cementation with adhesive composite cement is needed. A diminutive preparation is required that eliminates undercuts to provide sufficient parallel

surfaces on the lingual aspect. In addition, occlusal rests and guiding grooves are ideally prepared within the enamel substance.<sup>8</sup> Using an intraoral surveyor (Parallel-a-Prep, Dentatus) facilitates the parallelism of these grooves, which are prepared in the direction of insertion of this particular adhesive element. Depending on the available vertical space, a frictional cylinder or ball anchor is selected as extracoronal retention and positioned in the selected path of insertion of the RDP. The adhesive elements are cemented with an opaque composite cement (eg, Panavia F Opaque, Kurary) in order to avoid any gray shining through in the incisal area (Fig 5).

Decayed teeth and those with extended fillings are better restored with telescopes or crowns, provided that no root canal treatment is required. With several telescopic abutments distributed in the arch, the use of a template with guiding pins placed according to the pre-selected path of insertion is helpful to avoid severe overcontouring of the telescopes (see Fig 2).

For the nonvital tooth with a destroyed clinical crown, root canal treatment is required and the root cap provided with a post is the most appropriate solution. On the plateau of the root cap, the retentive element (cylinder or ball) is luted or laser-welded in a position that coincides with the selected path of insertion of the overdenture prosthesis.

### **Prosthesis Design**

Depending on the elements chosen, varying amounts of the tooth structure and the alveolar ridges are covered by the prosthesis in order to provide sufficient retention, stabilization, and support (see Fig 1). For RPDs using only clasps and/or adhesive elements, the extension of the base of the prosthesis is mainly restricted to the area of replaced teeth and deficient alveolar ridge areas. In extended free-end situations, retromolar pads and tuberosities are also covered to provide mucosal support for the prosthesis's base. For this type of RPD prosthesis, the position of the residual dentition has to be appropriate with regard to the inter- and intramaxillary relationships and a major connector in the lingual or palatal region has to be accepted by the patient.

If telescopes are used as retentive elements, the periodontal tissues of the abutment teeth are ideally uncovered (perio-overdenture design) and stabilization of the RDP is provided by either using a major connector or from the lingual/palatal metal backing (see Fig 2). Maintaining the anterior dentition with crowns or fixed partial dentures equipped with distal extracoronal attachments for retention of the RDP is preferable to telescopes, particularly in the maxilla, for esthetic and psychologic reasons. These combined

fixed removable restorations are, however, associated with frequent failures due to loss of retention of the cemented part at one or more abutment, resulting from framework or tooth fracture or decay. In a retrospective study, almost 40% of RDPs needed to be remade or undergo major repair after an observation period of 8 years.<sup>9</sup>

The overdenture prosthesis retained at individual root caps or prefabricated intraradicular retainers offers the greatest flexibility with regard to the extension of the base of the prosthesis and the coverage of the alveolar ridge in the area of missing teeth. Periodontal tissues of the abutment teeth are either left uncovered, which facilitates better comfort and interproximal oral hygiene (perio-overdenture design<sup>10</sup>), or these regions are covered with the buccal or lingual prosthesis flanges. The latter is indicated in case of discrepancies between the abutment tooth and ideal clinical crown position, eg, with malpositioned or misaligned teeth, gingival recessions, or a high lip line. This latitude to vary the extension of the prosthesis flange of the overdenture makes individual adaptation feasible to fulfill esthetic demands and facilitate proper phonation.

### **Indication for Dental Implants**

If there are few potential abutment teeth maintained and they are located close to one another rather than evenly distributed in the arch, adequate prosthesis stability will be lacking and prosthesis retention will possibly be insufficient. The use of implants as retainers in partially edentulous patients has rarely been discussed in the literature,<sup>11-14</sup> but it can be a helpful adjunct to serve the purposes listed below and to achieve the subsequent goals.<sup>15</sup>

Implants are indicated in addition to natural teeth as follows:

- To improve retention, stability, and support of the RDP
- To enable a simpler prosthesis design
- To enhance a patient's comfort.

Implants can also be inserted as an alternative to natural teeth as follows:

- To facilitate RDP retention detached from the residual dentition;
- To replace a potential tooth abutment when its prognosis is questionable.

When dental implants are used as additional retainer elements, the supportive area for the RDP is increased, the soft tissue load is minimized, and the extension of the base of the prosthesis can be reduced

in order to enhance a patient's comfort. In cases with an anterior residual dentition (bilateral free end), which is either caries-free or sufficiently restored, clasps are generally indicated but might not be accepted by the patient for esthetic reasons. With implants placed distally to the posterior teeth on each side, sufficient retention can be achieved to eliminate the need for clasps and the residual dentition becomes detached from the restoration (Fig 5).

Implants are also indicated when the abutment prognosis is questionable or poor and the risk of failure needs to be minimized. In this situation, one must decide what would be the ideal implant position. This determines whether tooth extraction and immediate implant placement is required or whether an adjacent edentulous region is more suitable for implant insertion.

Single implants placed as additional support for an RDP are easily provided with prefabricated stud attachments, such as ball abutments or locators (Fig 5). These attachments are in line with the implant axis and the matrices only allow limited divergence. Hence, the orientation of implant placement must coincide with the predetermined prosthesis' path of removal and insertion. Otherwise, individual abutments, such as telescopes, must be fabricated by a laboratory technician using a more complex procedure. Compensation for a diverging implant axis is also feasible to some extent with conventional bars soldered or laser-welded to gold cylinders. Sufficient retention from bar matrices requires matrices to be at least 1 cm in length and, therefore, implants must be placed at suitable distances from one another.<sup>16</sup> These aspects must be considered during treatment planning and necessitate a thorough diagnosis in the first place to avoid mechanical complications and loss of prosthesis retention due to component wear.

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