Clinical Effectiveness of Implant-Supported Removable Partial Dentures—A Review of the Literature and Retrospective Case Evaluation

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Purpose: To review the published data on the treatment outcomes of restoring the partially edentulous patient with implant-supported removable partial dentures (ISRPDs) and describe the concept of ISRPDs and the clinical guidelines for placing implants for ISRPDs, and evaluate case series results.

Materials and Methods: For the review, a literature search was performed using the PubMed and Ovid databases. Reports in English from 1969 to 2008 were considered. Also, 35 patients have had their dentition restored with ISRPDs supported by 67 implants. These patients were evaluated in terms of implant and teeth survival.

Results: The data from the published reports and the presented case series suggest that the incorporation of dental implants into removable partial dentures could be an optional treatment plan for the partially edentulous patient to improve function and patient satisfaction.

Conclusions: ISRPDs provide patients with stable, long-term predictable prostheses. This treatment alternative should be considered whenever fixed restorations are not a valid option. Strict maintenance and a follow-up protocol are recommended to obtain satisfactory results. Longitudinal clinical studies are required for evaluation of ISRPDs.

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Removable partial dentures (RPDs) are still extensively used for restoration of partially edentulous patients. However, these prostheses have been associated with poor patient acceptance, compromised function and esthetics, and an increased risk of caries and periodontal disease.1,4 Therefore, it is the mutual objective of the clinician and patient to restore the partially missing dentition with a fixed restoration that exhibits better longevity.5 Implant-supported restorations have become a predictable treatment modality to obtain this desirable treatment outcome.6-8 Nevertheless, for various reasons, fixed implant-supported restorations might not be prescribed.

The treatment goals of restoring the partially edentulous patient with an RPD are to improve the masticatory function and esthetics and to restore the posterior occlusal support and vertical dimension of occlusion, all without compromising the patient’s oral health. However, studies have shown that the long-term use of RPDs results in an increased risk of caries, residual ridge resorption, and periodontitis, especially in patients with poor oral hygiene.1,2,9,11 No evidence has shown that the prosthesis per se causes the damage.5 Moreover, it has been reported that RPD wearers are more dissatisfied with their oral conditions than patients without a partial denture12 and that RPDs are more inconvenient.12,13 In addition, elderly patients were more satisfied with their RPD only when it added a significant number of
occlusal units to their dentition. Clinicians should also be aware that a significant proportion of RPDs prescribed for these patients are not used, especially in Kennedy Class II patients.

The combination of dental implants to support the RPD might alleviate some of these problems associated with conventional RPDs. The present report describes the concept of implant-supported RPDs (ISRPDs), the indications for their use, and the clinical parameters that dictate implant location.

Materials and Methods

For the review, a data search was performed using the PubMed and Ovid databases. Reports in English from 1969 to 2008 were considered. Also, the data from 35 patients who had had their dentition restored with ISRPDs supported by 67 implants at 2 medical centers were reviewed. Those patients were evaluated in terms of implant and teeth survival.

Results

Overall, from 1969 to 2008, the data search revealed 10 reports on ISRPDs. Most of the publications were single case reports. Two publications were in vitro studies assessing the ISRPD design, and 3 were retrospective clinical studies.

In a retrospective study, 10 patients were treated with unilateral and bilateral mandibular distal-extension RPDs supported by 16 posterior implants. The implants were used alone as vertical stops to enhance RPD support or with resilient retentive elements. The investigators showed consistently increased satisfaction in all patients, minimal component wear, no radiographic evidence of excessive bone loss, and stable peri-implant soft tissues after at least 1 year of clinical follow-up. In another study, 15 partially edentulous patients with an unfavorable number and distribution of abutments were treated with ISRPDs. The partially edentulous arch configuration was modified by placing 33 implants into strategic sites. The implant survival rate was 100%, with only minor prosthetic complications and significantly improved patient satisfaction. In a retrospective study of implants used to restore the dentition of partially edentulous patients with ISRPD, an overall implant survival rate of 95.5% was reported during a mean follow-up period of 31 months.

CASE EVALUATION

The study sample included 35 consecutively treated patients (26 men and 9 women; mean age at implant placement 55.3 years, range 35 to 67) at 2 medical centers (Tel Aviv University School of Dental Medicine, Tel Aviv, Israel, and the Department of Prosthodontics, Sheba Medical Center, Tel Hashomer, Israel). The study subjects were partially edentulous, had lost more than 5 teeth in either arch, and had no previous denture wearing experience. A smoking habit was reported by 12 patients (34.3%). Only medically healthy patients who had been treated with an ISRPD were included in the present study. No other exclusion criteria were applied. All patients signed an informed consent statement.

All patients were examined clinically and radiographically before implant placement. Patients were treated with a 2-stage surgical procedure with implants from 3 different manufacturers (Zimmer Dental, Carlsbad, CA; 3i Implant Innovations, Palm Beach Gardens, FL; and MIS Implants Technologies, Shlomi, Israel). In addition to the implants, teeth were selected as abutments to provide support for the ISRPDs according to their pulpal and periodontal condition, the presence and type of coronal restoration, the need for indirect retention, and the distribution and number of abutments and implants in the arch. Guiding planes and rest seats preparations were performed after treatment planning and cast survey. All prostheses had a rigid chromium-cobalt alloy (Dentorium, New York, NY) major connector. The implants provided support only using healing caps or retention with different resilient attachments, such as the Locator attachment (Locater, Zest, Escondido, CA), the O-ring attachment (Zimmer Dental), or a bar and clip. Patients were assessed 1 week postoperatively after each surgical stage and at regular follow-up appointments after prosthesis insertion. An implant was considered a failure if it was removed because of clinical mobility; if it showed evidence of peri-implant radiolucency and/or persistent pain, discomfort, or infection that was attributable to the implant; or if it was unrestorable.

A total of 67 implants were placed in 35 partially edentulous patients who received ISRPDs from 1996 to 2007. Overall, 35 ISRPDs were placed. Maxillary prostheses were provided to 14 patients and mandibular prostheses to 21 patients. The postimplant placement follow-up period was 9 to 120 months (mean 35.4).

Before implant placement, the most prevalent arch configuration was Kennedy Class II in the mandible (10 patients) followed by Kennedy Class I in the mandible (8 patients) and Kennedy Class I in the maxilla (7 patients). The arch configuration was modified by implant placement in 18 patients (51.4%) (Table 1). Of the 67 implants, 39 were placed in the mandible (18 in the anterior area, 5 in the premolar area, and 16 in the posterior area), and 28 implants were placed in the maxilla (9 in the anterior area, 13 in the premolar area, and 6 in the posterior area).
Overall, 2 (2.9%) of the 67 inserted implants failed, resulting in a crude rate for implant survival of 97.1% for the present study. Both failures occurred in the same patient. This patient was a heavy smoker with pre-existing periodontal disease. During follow-up, only 1 abutment tooth was lost. All other abutments remained functional without need for retreatment at the last follow-up visit.

Discussion

Implants are used to improve the RPD support, enhance retention and stability, preserve the residual ridge underneath the denture base, reduce the stress applied on the abutment teeth, eliminate the need for unesthetic clasp assemblies, and modify unfavorable arch configurations. Most of the available data on implant-tissue supported RPD or ISRPD is from clinical reports describing the use of posterior implants for distal-extension RPDs.14-18

From our review of the published data, the key factors to be considered when designing an ISRPD are listed in Table 2 and discussed in the following sections.

KENNEDY CLASS I TISSUE ISRPD

The Kennedy Class I partially edentulous arch has bilateral distal extensions. The functional load is transmitted to the teeth and the soft tissue. Implant location depends primarily on the dimensions of the residual ridge and the biomechanical considerations of the RPD design. Two distally positioned implants in the area of the second molars would effectively transform the Kennedy Class I configuration to a more favorable Kennedy Class III. Theoretically, the implants should be located as distally as possible to provide maximal support and stability (Fig 1). This is of special importance in the mandible because of the significant displacement of the denture base that is not supported by the major connector. The implants might be used for support only using healing caps or for retention with resilient attachments connected to the implants. A low-profile attachment is preferred to decrease the off-load forces to the implants. Endodontically treated abutments would be specifically beneficial when used for support only without direct retainers applying unfavorable lateral displacing forces.25

However, an inadequate posterior ridge dimension could restrict implant placement to a more anterior location, distally to the existing abutments. In addition, the clinician should be aware that implant therapy is versatile and that, in the future, the patient might select to restore the edentulous ridges with fixed implant-supported restorations. In this case also,

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<th>Table 1. ARCH CONFIGURATIONS ACCORDING TO KENNEDY CLASSIFICATION BEFORE AND AFTER IMPLANT PLACEMENT</th>
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<td>Arch Configuration Before</td>
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<th>Table 2. CLINICAL GUIDELINES FOR ISRPD</th>
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<td>1. Place implants in area of second molars in distal extension patients</td>
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<td>2. Place implants adjacent to distal abutment in case future fixed restoration is an option, distal abutments are poor, or patient is concerned about clasp showing</td>
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<td>3. Place implants medially in Kennedy Class IV arch</td>
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<td>4. Use short or narrow-body implants if necessary</td>
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<td>5. Use resilient attachments on the implants</td>
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<td>6. Design a simple RPD; use rest seats and guiding plates similar to conventional RPD</td>
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<td>7. Use rigid major connector design for maxillary arch</td>
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<td>8. Minimize mandibular lingual flange if difficult for patient to adjust</td>
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<td>9. Incorporate retentive elements to denture base under functional load</td>
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<td>10. Schedule patient for checkups and maintenance appointments</td>
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the implants should be located more medially, adjacent to the existing abutments, to allow future prosthodontic use (Fig 2). Moreover, when implants are placed adjacent to the distal abutments, the esthetic retentive clasp on the distal abutments could be spared.

KENNEDY CLASS II TISSUE ISRPD

The Kennedy Class II partially edentulous arch has a unilateral distal extension. An ISRPD should be used when the tooth loss is extensive (Fig 3). Otherwise, just as when only the molars are missing, the patient might not use the prosthesis. When the patient has no functional problem, a shortened dental arch concept, with no prosthesis, should be considered.26,27

Placing a single implant in the posterior region would modify the Kennedy Class II configuration to a Kennedy Class III and increase the stability and retention of the prosthesis. The same considerations discussed for the Kennedy Class I tissue ISRPD also apply.

KENNEDY CLASS III ISRPD

The Kennedy Class III partially edentulous arch has edentulous space bounded by teeth. Therefore, implants should be used when the edentulous space is long, the abutments are compromised, and when the patient objects to the appearance of the clasps (Fig 4). The implants should be placed adjacent to the abutments.

KENNEDY CLASS IV ISRPD

The Kennedy Class IV partially edentulous arch has a single, anterior edentulous space that crosses the midline and is bounded by the remaining teeth. The implants should be placed as medially as possible to the abutments to provide optimal support (Fig 5). The labial flange of the prosthesis might serve to restore the lip support in these ISRPDs. The use of implants in Kennedy Class IV partially edentulous patients renders the use of retentive clasps and elaborated dual-path RPD designs unnecessary.
The ISRPD serves as a cost-effective, prosthetic solution for partially edentulous patients who are not immediate candidates for extensive, fixed implant-supported restorations. Incorporation of dental implants to improve the RPD support and retention and to enhance patient acceptance should be considered when treatment planning for RPD.

As mentioned, a high incidence of periodontal disease and dental caries has been reported in conventional RPD wearers, attributed mainly to a lack of motivation and compliance with adequate oral hygiene. Therefore, patients should be advised of their role in the maintenance of the ISRPD, and a definite follow-up protocol is mandatory to obtain satisfactory long-term results.

Additional research is warranted to evaluate the long-term survivability of the implants, the long-term influence on the abutment prognosis, and the effects of the implants and the decreased loading on the health of the supporting soft tissue and alveolar bone.

**References**

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CLINICAL EFFECTIVENESS OF IMPLANT-SUPPORTED REMOVABLE DENTURES