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Marcela Anaid De Leon Flores
Master of Sciences student,
Universidad Autonoma de Nuevo
Leon, Facultad de Odontologia,
Monterrey, Nuevo Leon, 64460 ZIP,
Mexico.

**Maria Argelia Akemi Nakagoshi
Cepeda**
Professor, Universidad Autonoma de
Nuevo Leon, Facultad de
Odontologia, Monterrey, Nuevo Leon,
CP 64460, Mexico.

Maria Eugenia Vazquez Sanchez
Professor, Universidad de
Guadalajara, Departamento de
Ciencias Clínicas Odontológicas
Integrales, Guadalajara, Jalisco,
44680 ZIP.

Rosa Elia Arias Gomez
Professor, Universidad de
Guadalajara, Clinicas Odontologicas
Integrales, Guadalajara, Jalisco,
44290 ZIP, Mexico.

Fatima Del Muro Casas
Professor, Universidad Autonoma de
Zacatecas, Unidad Academica de
Odontologia, Zacatecas, Zacatecas,
98000 ZIP, Mexico.

Nelly Alejandra Rodriguez Guajardo
Professor, Universidad Autonoma de
Zacatecas, Unidad Academica de
Odontologia, Zacatecas, Zacatecas,
98000 ZIP, Mexico.

Gloria Martha Alvarez Morales
Professor, Universidad Autonoma de
Zacatecas, Unidad Academica de
Odontologia, Zacatecas, Zacatecas,
98000 ZIP, Mexico.

Danya Mayte Muñoz Cazares
Dentistry student, Universidad
Autonoma de Nuevo Leon, Facultad
de Odontologia, Monterrey, Nuevo
Leon, 64460 ZIP, Mexico.

Juan Manuel Solis Soto
Professor, Universidad Autonoma de
Nuevo Leon, Facultad de
Odontologia, Monterrey, Nuevo Leon,
64460 ZIP, Mexico.

Corresponding Author:
Marcela Anaid De Leon Flores
Master of Sciences student,
Universidad Autonoma de Nuevo
Leon, Facultad de Odontologia,
Monterrey, Nuevo Leon, 64460 ZIP,
Mexico.

Implant-assisted removable partial dentures as treatment for Kennedy Class I and II Arches: A literature review

Marcela Anaid De Leon Flores, Maria Argelia Akemi Nakagoshi Cepeda, Maria Eugenia Vazquez Sanchez, Rosa Elia Arias Gomez, Fatima Del Muro Casas, Nelly Alejandra Rodriguez Guajardo, Gloria Martha Alvarez Morales, Danya Mayte Muñoz Cazares and Juan Manuel Solis Soto

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Abstract

Introduction: The use of implant-supported removable partial dentures (ISRPDs) has recently attracted interest; however, available information on treatment outcomes is poor.

Objective: To analyze the existing literature on the clinical performance of ISRPDs in terms of implant survival rates, marginal bone loss, technical-prosthetic complications and patient satisfaction.

Methodology: An electronic search was performed through PubMed, Google Scholar and Scopus, using the terms: "Implant-supported removable partial dentures", "Patient's satisfaction", "Quality of life", "Removable partial".

Results: Overall, implant survival rates reported by the included studies ranged from 91% to 100%. Mean marginal bone loss around implants ranged from 0.64 to 2.11 mm, with stable periodontal conditions around implants. Some prosthetic complications and need for repair are reported with regard to relining, replacement of the elastic component of the attachment and damage to the prosthetic structure. All selected studies reported significant improvement in quality of life and patient satisfaction with the use of ISRPDs compared to distal extension removable partial denture (DERPDs).

Conclusions: The use of ISRPD should be considered a favorable rehabilitation treatment for partially edentulous patients because they provide high implant survival rates with low marginal bone loss values, as well as improvements in quality of life and patient satisfaction.

Keywords: Removable partial denture, dental prosthesis, implant-supported dental prosthesis, dental implant, quality of life, chewing, patient satisfaction, Kennedy class I, Kennedy class II

1. Introduction

Tooth loss can compromise physiological and stomatognathic functions, thus affecting the patient's quality of life ^[1]. Distal extension removable partial dentures (DERPD) are a treatment option that continue to be widely used for the rehabilitation of partially edentulous Kennedy-Applegate class I or II patients. However, this type of prosthesis is associated with increased alveolar bone resorption, caries lesions in the teeth, and psychologically less acceptable treatment ^[2]. In addition, DERPDs present many biomechanical problems (unsatisfactory retention and stability), which can compromise masticatory efficiency ^[3]. For these reasons, some patients rehabilitated with DERPDs do not wear their prostheses regularly, and, therefore, there is a need for clinicians to consider other treatment alternatives such as dental implants.

According to the literature, dental implants are a highly successful treatment option for the replacement of missing teeth. Their long-term survival rate has been evaluated in many systematic reviews concluding survival rates higher than 92.8% (95% confidence interval [CI]: 90-94.8) at 10 years of follow-up ^[4]. However, the presence of bone defects at the implantation site sometimes limits the availability of bone tissue to place an adequate number of implants.

Fortunately, other therapeutic solutions exist, such as the use of small dental implants^[1] or bone regeneration of the edentulous jaw, a process that may use a combination of bone substitutes with autologous mesenchymal stem cells or autologous bone grafting^[6, 7]. In addition, bone substitutes of animal, human or synthetic origin can be used to reconstruct small defects. However, these alternative treatments are often associated with increased cost, treatment time and postoperative morbidity.

Implant-supported removable partial dentures (ISRPDs) can be an effective alternative to conventional removable partial dentures and implant-supported fixed partial dentures when implant insertion is limited by bone height and thickness. In this situation, a smaller number of shorter implants can be placed to stabilize the prosthesis in the vertical direction, provide comfort and increase the patient's masticatory efficiency^[8]. This treatment option not only increases prosthesis retention and thus limits lateral and vertical displacement of the removable partial denture, but also distributes masticatory forces more effectively^[9, 10]. It also increases patient satisfaction and improves chewing ability, phonetics and esthetics, as the removable can sometimes be designed without metal clasps.

However, more systematic reviews and meta-analyses are needed to provide clear scientific evidence of the long-term therapeutic efficacy of implant-supported removable partial dentures compared with conventional removable dentures.

This work reviews the existing literature on the clinical performance of ISRPDs in terms of implant survival rates, marginal bone loss, technical-prosthetic complications, and patient satisfaction.

2. Materials and methods

An electronic search was carried out through PubMed, Google Scholar and Scopus, using the terms: "implant-supported removable partial dentures", "patient's satisfaction", "Quality of life", "Removable partial", using Boolean operators "AND" and "OR". The quality of the articles was evaluated using the PRISMA guidelines tool. As inclusion criteria, only articles from high impact journals were collected, including systematic reviews, literature reviews or clinical studies that treated edentulous Kennedy class I or II patients with ISRPD and that evaluated the associated mechanical and biological complications. Likewise, the search was delimited in terms of publication date, taking only recent articles, published within the last 5 years. The selection of articles was made according to the relevance of the title and/or abstract to the topic to be analyzed. After the selection of relevant studies, their bibliographies were searched for possible additional relevant studies that met the inclusion criteria.

3. Results and Discussions

3.1 Implant Survival Rate

Overall, the implant survival rates reported by the included studies ranged from 91% to 100%^[11]. Jensen *et al.* reported an implant survival rate of 100% after 3 months of evaluation^[12]. Mijiritsky *et al.* incorporated the longest evaluation period (15 years), which yielded a 100% survival rate^[13]. The lowest survival rate (91.6%) was reported by in a study with 28.6 months of evaluation^[14]. The implant survival rates of the included studies according to the Kennedy classification were as follows: class I, 91.7-100%; class II, 100%; and classes I and II, 91.6-100%. Other authors^[15,16] reported similar results; reporting a survival rate of 100% after the follow-up

period ranging from 2 to 180 months, while for others^[17-19] a survival rate of 91.6% to 97%. Most of the implants placed in the patients included in these studies were of conventional type. However, from a comparative study between the survival of using conventional implants (3.3-6 mm in diameter) and mini-implants (2-3 mm in diameter), with a difference of 5-14 mm in length, it was shown that conventional implants had implant survival rates similar to those of mini-implants^[20]. Therefore, the use of short implants to retain DERPDS can be considered a viable treatment option for patients with distal edentulism and contraindications to more complex implant rehabilitation^[17, 21]. Similarly, Threeburuth *et al.* compared mini-implants and conventional implants^[5]. The authors reported similar results for both groups, with 2 failed implants in each group. However, this study reported less bone loss around mini-implants than around conventional implants. Lemos *et al.* conclude that the similarity of the results may be due to the fact that the forces exerted on removable implant-supported prostheses tend to be lower than those applied to fixed prostheses. On the other hand, it is argued that implant position (Premolar or molar) does not affect implant survival rates^[18, 22]. As well as some authors reported that implant placement in the mandibular arch may contribute to higher implant survival because bone density and compact bone thickness are greater in the mandible, leading to a higher probability of survival than in the maxillary arch^[23].

Some of the included studies showed implant survival rates of 100%. One of these studies had at least 15 years of follow-up, implying that this treatment option shows promising results even after a long follow-up period.

3.2 Marginal bone loss

Biologic complications such as marginal bone loss around implants and pocket depth have been reported in studies that evaluated these parameters. Mean marginal bone loss around implants ranged from 0.64 to 2.11 mm and mean deep pockets ranged from 2 to 4 mm. Some authors reported implant bleeding on probing, mobility or probing depth, abutment loosening, or replacement of ball fixtures^[19]. Gonçalves *et al.* found stable periodontal conditions around implants, with no intrusion or tooth mobility, and no radiographic changes in bone level after 2 months of follow-up^[15]. However, implants placed in posterior sites showed significantly more complications than anterior implants (peri-implant mucositis)^[9]. In another study, the authors concluded that the use of short implants to retain DERPDS can be considered a viable treatment option for patients with distal edentulism and when there are contraindications for more complex implant rehabilitation^[17]. In a specific analysis, no differences in bone loss were observed for implants with a different position (premolar versus molar)^[18, 22]. Yi *et al.*, indicated that implants placed adjacent to the natural tooth had higher success rates than those far away from the natural teeth^[24]. In contrast, other authors have reported better results when implants are placed posteriorly than anteriorly^[25, 26]. Also, significant differences were observed in favor of mini-implants compared to conventional implants^[5]. In addition, the LOCATOR attachment exhibited less bone loss than the ball attachment^[27]. This may be related to the higher resilience of the LOCATOR attachment system with better stress distribution and, therefore, recommended for implant-supported removable prostheses^[1].

No significant differences in marginal bone loss according to implant position are reported. However, the included studies

report a greater preference for implants placed in the molar than in the premolar, possibly to improve force distribution and decrease lever movements.

3.3 Prosthetic/technical complications

Some studies reported the results of prosthetic/technical complications for DIARPs. Jensen *et al.* reported that 15 of 23 prostheses using ball attachments had no complications [18]. Three studies reported attachment loosening [28-30]. Ortiz-Puigpelat *et al.* found no attachment loosening; however, all plastic retaining components had to be replaced after 12 months [14]. De Freitas *et al.* showed one case of frame fracture requiring refabrication [8] while Mijiritsky *et al.* reported one case of breakage of the rest [13]. In addition, Payne *et al.* observed that 58.3% of patients rehabilitated with implant-associated RPD had additional prosthetic repair needs, such as matrix activation or deactivation, clasp adjustment and one case of prosthesis base fracture, a negative aspect for structural repair [19]. Metal-on-acrylic prosthetic frameworks are recommended [31]. Other technical complications included: clasp setting, denture tooth fracture, need for denture base relining, reprocessing of RPD, and attachment replacement [28, 32]. On the other hand, it is reported that the morphology of the implant attachment affects the movement of the prosthesis and the distribution of stress strain on the cortical bone near the implant neck. Ohyama *et al.*, concluded that prosthesis movement is more limited when high attachments (greater than 2 mm) are used than when mucosal attachments are used [26].

The most common prosthetic complications include the need for repair with regard to relining, replacement of the elastic component of the attachment, framework damage, loosening of screws, and damage to the acrylic denture base.

3.4 Patient satisfaction

Placing implants in strategic positions under a removable partial denture significantly improves patient-reported outcomes and masticatory efficiency [12, 33, 34].

Some studies evaluated patients' quality of life and satisfaction after receiving rehabilitation treatment with DERP and ISRP. The quality of life and satisfaction of these patients were assessed using the oral health-related quality of life questionnaire (OHRQoL), the oral health impact profile (OHIP-49), the short-format health survey (SF-36), a visual analog scale (VAS), and a patient satisfaction questionnaire. All selected studies reported a significant improvement with the use of ISRP compared to DERP [9, 33-36]. Bandiaky *et al.* concluded that, between the two prosthetic therapy modalities, data from analyzed studies show a statistically significant difference in mean quality of life score between DERP (65.5±16.3) and ISRP (30.9±18.1) ($p < 0.05$) [9]. In addition, better patient satisfaction is reported when using magnetic attachments and ball attachments over healing attachments [36, 37]. Despite the observable superiority of ISRP over conventional DERP, when ISRP were compared with implant-supported fixed prostheses, ISRP result in lower chewing efficiency and, consequently, lower quality of life [38]. This justifies the statement that the use of dental implants with fixed prostheses should continue to be considered the standard for rehabilitation of partially edentulous patients [1]. One of the reasons for this preference is the difference in support between the two types of rehabilitation. Despite being associated with dental implants, ISRP still rely on the support and strength provided by the underlying mucosa.

Converting the already well-accepted and patient-integrated DERP to an ISRP provides more comfort during use by limiting dislocation of the prosthesis from its supporting surfaces, particularly during mastication; obtaining a more stable and retentive prosthesis; Limiting food accumulation under the distal extension bases of the removable partial denture; and decreasing pressure on the resilient mucosa [9, 39-43]. However, maintenance of the hygiene of the natural teeth and implant attachment systems is required.

Therefore, ISRP should be considered as a favorable treatment option, as they provide better prosthetic stability and retention, which increases the patient's chewing efficiency and, therefore, improves quality of life or patient satisfaction.

4. Conclusions

Following tooth loss, as well as prolonged use of DERP, the amount of available bone is limited, especially in the posterior region due to its proximity to anatomical structures, making rehabilitation more challenging. In addition, a larger number of implants would result in higher treatment cost, which can be a limiting factor for many patients. The use of ISRP should be considered a favorable rehabilitation treatment for partially edentulous patients because they provide high implant survival rates with low marginal bone loss values, as well as improvements in quality of life and patient satisfaction.

5. Conflict of Interest

Not available

6. Financial Support

Not available

7. References

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