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# Rehabilitation of Edentulous Ridge Patients with Implant-Supported Removable Dentures (ISRD): A Systematic Review

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**Abstract**

Implant-Supported Removable Dentures (ISRD) represent an innovative prosthodontic solution for rehabilitating patients with partial or complete edentulism, combining the superior stability of dental implants with the flexibility and accessibility of removable prostheses. This systematic review evaluates the clinical efficacy, biomechanical performance, and patient-centered outcomes associated with ISRD compared to conventional removable partial dentures (RPD). The key findings demonstrate that ISRD provides significantly enhanced masticatory comfort, function, and overall performance through more balanced distribution of occlusal forces, which effectively reduces pressure on soft tissues and alveolar bone while minimizing progressive bone resorption. Strategic implant placement, particularly in posterior regions, combined with modern attachment systems such as Locator® and ball attachments, substantially improves biomechanical efficiency, prosthetic stability, and aesthetic outcomes. However, clinical challenges persist, including biological complications such as peri-implant inflammation and marginal bone loss, as well as prosthetic complications including attachment wear and framework damage. The significance of these findings lies in establishing that optimal long-term success requires comprehensive integration of evidence-based prosthetic design principles, selection of high-quality biocompatible materials, rigorous oral hygiene protocols, and systematic maintenance programs. Beyond functional restoration, ISRD provides substantial aesthetic benefits by supporting facial soft tissues and restoring natural facial contours, thereby significantly enhancing patient self-confidence and psychosocial well-being. To ensure sustained positive clinical outcomes, continued development of standardized installation protocols, evidence-based maintenance guidelines, and structured patient education programs is essential to minimize complication risks and maximize quality-of-life improvements for edentulous patients.

**Keywords:** Edentulous ridge; Implant supported; ISRD; Prosthetic; Removable Dentures.

## INTRODUCTION

Implant-Supported Removable Dentures (ISRD) are an innovation increasingly used in the rehabilitation of patients with partial edentulousness or a fully edentulous ridge (Bandiaky et al., 2022; Lemos et al., 2023). The main advantage of ISRD lies in combining the stability provided by implants with the flexibility of removable prostheses, which offer better comfort and masticatory function compared to conventional removable prostheses (Almutairi, 2024). Untreated tooth loss can cause changes in jaw structure, such as alveolar bone resorption, which affects tooth stability and the patient's facial aesthetics. While conventional removable prostheses often fail to

distribute loads evenly, ISRD provide a superior biomechanical solution (Kuroshima et al., 2023; Gonçalves et al., 2023).

Implant-Supported Removable Dentures (ISRD) offer superior function, including better mastication, improved load distribution, and reduced bone resorption (Kuroshima et al., 2023; Lemos et al., 2023; Murakami et al., 2021). Root- or implant-supported dentures are a modality requiring frequent maintenance. Implant-supported dentures in the lower jaw or mandibula have been documented with good clinical outcomes and are recommended as a maintenance standard (El-Qaryati et al., 2023; Dhamodaran et al., 2022). In the past, before implants became a standard prosthetic therapy, remaining roots were maintained to prevent vulnerable bone resorption and discomfort associated with conventional complete dentures. Various types of root-supported or dental implant dentures have been described, including short copings with or without precision attachments installed directly or individually cast gold copings. Unlike studies on dental implants, studies on root-supported teeth are less common (Bandiaky et al., 2023; Yi et al., 2023).

However, although ISRD offer many advantages, challenges remain. Biological complications such as peri-implant inflammation and marginal bone loss often occur, requiring attention from practitioners (Molinero et al., 2022). Technical complications, such as attachment failure and damage to the prosthesis framework, have also been reported, necessitating optimization of design and materials. Previous studies have shown that ISRD can improve patients' quality of life in terms of comfort and masticatory function. Strategic placement of implants in the posterior jaw can reduce pressure on the supporting bone and prolong prosthesis life (Frantz et al., 2024; Miler et al., 2017). Further research is still needed to overcome these challenges and develop more effective clinical protocols to ensure the long-term success of ISRD. This includes developing new materials, refining insertion protocols, and educating patients on maintaining oral hygiene to prevent peri-implant complications. With continued development, ISRD can become a reliable and sustainable solution for patients with partial edentulousness (Bandiaky et al., 2022; Chen et al., 2023).

The novelty of this systematic review lies in its comprehensive and integrated analysis, distinguishing it from previous syntheses. It simultaneously examines biomechanical principles, clinical outcomes, patient satisfaction, and complication profiles associated with Implant-Supported Removable Dentures (ISRD), offering a holistic perspective absent in narrower reviews. Specifically, it addresses the critical role of strategic implant positioning and modern attachment system selection in optimizing long-term success, synthesizes emerging evidence on their interaction, and identifies gaps in current clinical protocols to propose standardized procedures. Furthermore, by examining both successful outcomes and complications, it provides balanced, clinically relevant guidance and extends the theoretical foundation for ISRD by integrating contemporary understanding of peri-implant biology, biomechanics, and patient- centered assessment.

Based on this, the primary objectives are to critically evaluate the clinical efficacy of ISRD and systematically analyze its underlying biomechanical principles, including load distribution and the influence of implant position and attachments. It also aims to comprehensively assess patient-centered outcomes, identify and characterize associated biological and prosthetic complications, and examine the comparative effectiveness of different attachment systems. Ultimately, this review seeks to develop evidence-based clinical recommendations for optimal treatment planning and maintenance, identify critical knowledge gaps, and propose future research directions. The goal is to provide

comprehensive guidance for dental practitioners and researchers, thereby improving clinical decision-making and enhancing the quality of patient care in the rehabilitation of edentulous patients.

## RESEARCH METHOD

This study used a qualitative descriptive approach to evaluate Implant- Supported Removable Dentures (ISRD). This approach allows for an in-depth understanding of the experience, satisfaction, and clinical outcomes of ISRD use in patients with partial edentulous. Data were collected through in-depth interviews with patients using ISRD, as well as questionnaires measuring patient satisfaction regarding comfort, stability, and masticatory function. The study will also involve clinical observations to evaluate the success of chewing load distribution and the impact on periodontal tissues and alveolar bone. This study is supported by relevant literature sources, including previous studies that have highlighted biomechanical, biological, and patient satisfaction aspects related to ISRD (Kuroshima et al., 2023; Gonçalves et al., 2023; Bandiaky et al., 2023; Yi et al., 2023). Data analysis was performed using qualitative techniques such as content and descriptive analysis to identify emerging patterns and themes related to patient acceptance and outcomes of ISRD use. Further research into more effective management methods is needed to improve patient quality of life and long-term care efficiency (Kuroshima et al., 2023; Gonçalves et al., 2023).

## RESULTS AND DISCUSSION

Study shows that Implant-Supported Removable Dentures (ISRD) are an effective solution in rehabilitating patients with partial tooth loss. ISRD users experience significant improvements in prosthetic stability, comfort, and masticatory ability compared to conventional removable partial dentures (RPD). Survey instruments such as OHIP-49 show that ISRD not only improves patients quality of life but also increases their self-confidence due to superior prosthetic stability. Clinical observations show that ISRD is able to distribute the chewing load more evenly, thereby reducing pressure on soft tissues and alveolar bone, a problem that often occurs in the use of conventional RPD (Frantz et al, 2024 ; Dhamodaran et al, 2022 ; Sahin et al 2024).

Following This is image visually comparing Implant-Supported Removable Dentures (ISRD) and conventional Removable Partial Dentures (RPD). This image illustrates the advantages of ISRD, including improved stability, comfort, and masticatory function, as well as strategic placement of implants, especially in the posterior area. This image also highlights benefits such as balanced distribution of masticatory forces, reduced pressure on soft tissues and bone, and prevention of bone resorption, along with the use of the Locator® attachment system for additional stability (Miler et al, 2017 ; Prasad et al, 2024). In addition, this diagram emphasizes the aesthetic improvements that ISRD provides to the facial soft tissues. From a biomechanical perspective, strategic placement of implants, especially in the posterior area, has been shown to support masticatory loads well. This strategy helps protect the peri-implant bone and reduces the risk of marginal bone resorption. However, the greater masticatory forces on implants in the posterior area can sometimes cause mild peri-implant inflammation (Sahin et al, 2024 ; Dede et al, 2020).

Complications can be minimized by maintaining good oral hygiene and regular check-up. In addition, the use of modern attachments such as the Locator® provides additional stability while reducing pressure on the peri- implant bone. This system also

helps prevent biomechanical damage that often occurs with conventional attachment types (Miler et al, 2017 ; Prasad et al, 2024). However, several challenges remain, especially related to biological and prosthetic complications. Marginal bone loss around the implant, although rare, remains a major concern, especially in posterior implants that receive greater chewing loads. In addition, prosthetic problems such as attachment wear and metal framework cracking have also been found, albeit on a small scale. These problems are often related to suboptimal chewing load distribution, emphasizing the importance of proper prosthetic design and selection of high-quality materials. Patient satisfaction with ISRD not only from improved masticatory function but also from significant aesthetic benefits (Almutairi, 2024 ; Dhamodaran et al, 2022).

Implant-Supported Removable Dentures (ISRD) offer more than just functional benefits in terms of stability and chewing ability, but also provide essential support for the facial soft tissues, which is much needed for patients who experience changes in facial shape due to tooth loss. Tooth loss, especially in the back, can cause changes in facial contour, such as decreased volume in the cheeks or the formation of hollows around the mouth (Molinero et al, 2022 ; Prasad et al, 2024). ISRD can help solve these problems by providing support for the facial soft tissues, maintaining a natural facial shape. In addition, the aesthetics of ISRD are more realistic and more in line with the patient's dental structure, playing a major role in increasing their self-confidence, which has a direct impact on their quality of life, both in social interactions and daily activities. Compared with conventional RPD that often look more conspicuous, ISRD provide a better aesthetic solution, allowing patients to feel more comfortable and confident with their appearance (Sahin et al, 2024 ; Dhamodaran et al, 2022).

Overall, this study confirms that ISRD is a highly effective method of dental rehabilitation, both functionally and aesthetically. However, to ensure optimal long-term results, several points need to be considered. Further development of the attachment protocol and prosthetic design is essential to overcome challenges such as biological and prosthetic complications (El-Qaryati et al 2023 ; Frantz et al, 2024) More efficient protocols and better maintenance procedures will support long-term patient stability and comfort. In addition, the selection of quality materials and the use of the latest technology in attachment design can prolong the life and improve the performance of ISRP. Patient education also plays an important role in preventing complications in implants. Providing clear information on the importance of maintaining oral hygiene and how to properly care for and maintain the prosthesis can reduce the risk of infection and prolong the life of ISRD. With this comprehensive approach, ISRD not only offers functional and aesthetic benefits but also contributes to improving the overall quality of life of patients (Kuroshima et al., 2023; Gonçalves et al., 2023).

**Implant-Supported Removable Dentures (ISRD)**

Implant-Supported Removable Dentures (ISRD) are an innovative prosthodontic solution that combines removable dentures with dental implants to improve stability and chewing function. ISRDs are defined as dentures that rely on dental implant support, as opposed to conventional removable partial dentures (RPD) that rely solely on soft tissue. This structure allows for a more balanced distribution of chewing forces through the implants, thereby reducing excessive pressure on the soft tissues and preventing alveolar bone resorption that often occurs due to instability of conventional dentures (Kuroshima et al., 2023; Gonçalves et al., 2023). ISRD has significantly improved the patient's quality of life through better prosthetic stability and speech comfort. The main advantage of ISRD over conventional RPD is the ability to distribute the chewing load more evenly, which can prevent soft tissue trauma and further bone resorption. This added stability

also allows the prosthesis to remain in the ideal position during speech or eating, addressing the discomfort often experienced by users of traditional RPD (Bandiaky et al., 2023; Yi et al., 2023). Advances in attachment technology, such as the Locator and ball systems, have also improved the performance of ISRD by providing greater flexibility and stability. By utilizing modern biomechanical designs, ISRD not only improve oral function but also provide significant aesthetic benefits, making them one of the most effective options for comprehensive oral rehabilitation (Chen et al., 2023 ; Prasad et al, 2024).

**Position Implant**

Position implant own role important in determining success implant supported removable dentures (ISRD), especially for ensure distribution burden optimal chewing at once minimize risk complications mechanical and biological. Placement properly implant placement, such as in the molar area, indicates more capabilities good in distributing pressure chew compared to with position others. This is reducing pressure mechanics on the alveolar bone, which helps protect network Supporter as well as support stability of ISRD in long term. However, research show existence difference biomechanical between placement implants in the anterior and posterior areas, where implants in the posterior area tend to experience pressure bigger, so at risk cause complications like resorption marginal bone and peri-implantitis (Gonçalves et al., 2023; Yi et al., 2023). In addition, the progress technology now allows use implant short as solution alternatives, especially for patients with limitations alveolar bone. Implant short become practical choice for avoid procedure augmentation complicated and invasive bone, as well as still give adequate stability for support function prosthetics (Sahin et al, 2024 ; Almutairi, 2024). Although, success in using implant short depends a lot on factors like orientation implant, quality bones and distribution burden chew. Study further also emphasizes importance attachment design and placement strategic implants for reducing risk complications, well mechanical and biological, so that increase results clinical in a way overall (Kuroshima et al., 2023; Bandiaky et al., 2023 ; Chen et al., 2023).

**Indication For Implant Strategic**

Indication placement implant strategic can summarized in connection with distribution tooth remainder as following : (1) remainder unilateral teeth, (2) exclusive anterior teeth and one or second missing canine teeth, (3) free unilateral or bilateral situation end with remaining canine teeth, (4) only a number of anterior teeth and molars remaining in the jaw above, or (5) implants savior for overcome lost roots in group repair. In (Figure 1) shows scheme theoretical from each indication (Kauffman et al, 2009). Because of the diversity amount remainder root, crown or tooth buffer as well as mechanism different retention, dentures own different designs. If support aspect four is enough given, design poultice horse or horseshoe type more liked for upper jaw dentures. If not, the dentures designed with transpalatal major connector or full palatal plate. Arch opposite shows tooth experience full or prosthesis fixed supported by teeth and implants (27 %) or there is dentures part detachment (65.5%). Complete dentures (8%) found in upper jaw dentures. Acrylic resin dentures are installed on all prosthesis. If there is removable partial dentures or complete dentures over arch opposing teeth, scheme occlusal lingualization used (Kauffman et al, 2009 ; Bandiaky et al., 2023; Yi et al., 2023 ; Chen et al., 2023).

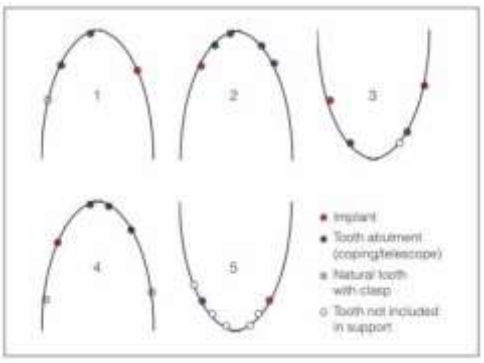
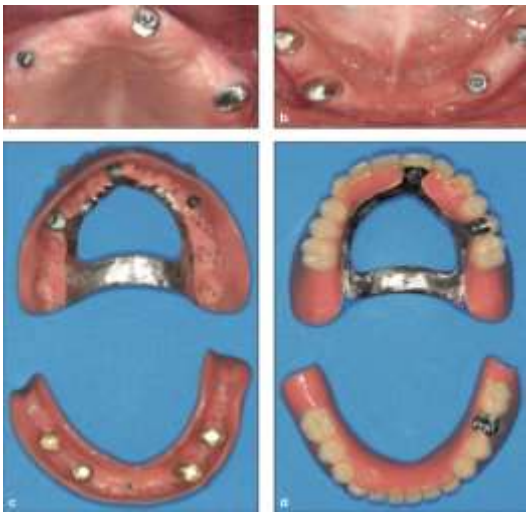



**Figure 1: Example Indication for Implant Strategic (Kauffman et al, 2009).**

**Maintenance Implant-Supported Removable Dentures**

All patients involved in a routine maintenance program with controls returned twice a year. This protocol included inspections of oral cleanliness, caries, and periodontal/peri-implant tissues. A dental hygienist (*expert health tooth*) performed all related cleaning procedures, while a prosthodontist was responsible for all required prosthodontic services. Crestal bone changes at the mesial and distal implant locations were measured on single orthograde radiographs taken with a film holder. The first radiograph, used as the baseline measurement, was taken at the moment the dentures were installed; the second was taken after an observation period of 1 to 8 years. All biological and technical complications were noted in the patient charts throughout the observation period. Technical problems were classified into three categories, adapted from previous clinical studies (21, 24, 25). These categories related to complications, failures, and repairs of the dentures (Kauffman et al., 2009).

Patient cases with dentures in the maxilla and *mandibula* included: (a) maxilla: two root copings and one implant with a ball anchor; (b) *mandibula*: two teeth and two implants with telescopic crowns; (c and d) inside and outside surfaces of dentures with metal frameworks, female retainers, overdenture designs, and open palates in the maxillary denture (Kauffman et al., 2009).



**Figures 2 (a-b-c-d): clinical patient with removable /overdenture and support implants on maxilla and mandibula (Kauffman et al, 2009).**

**Attachment System**

The attachment system in implant-supported removable dentures (ISRD) plays an

important role in providing stability, comfort, and prosthetic efficiency. Several types of attachments such as Locator®, ball, and bar have specific advantages that can be tailored to individual patient needs. The Locator® system, for example, is a popular choice due to its ability to reduce pressure on the periimplant bone compared to ball attachment systems (El-Qaryati et al, 2023 ; Miler et al, 2017). This is made possible by the elasticity of the Locator® material, which supports small movements without compromising the stability of the prosthesis. With these characteristics, Locator® can help reduce mechanical stress on the implant, thereby reducing the possibility of biomechanical complications (Kuroshima et al., 2023; Bandiaky et al., 2023 ; Dede et al., 2020).

In addition to mechanical stability, a well-designed attachment system also affects the distribution of chewing pressure. Proper attachment placement can distribute pressure more evenly, reduce the risk of damage to the alveolar bone, and prolong the service life of the prosthesis. With a more optimal pressure distribution, the need for follow-up treatment can be minimized, supporting the long-term efficiency of ISRD treatment. In addition, the bar attachment system, although requiring more complicated treatment, has shown the ability to provide higher stability, especially in cases with significant retention needs, such as in patients with limited alveolar bone (Gonçalves et al., 2023; Yi et al., 2023 ; Dede et al, 2020). In choosing an attachment system, aspects such as biomechanics, patient preference, aesthetics, and cost need to be considered. Therefore, dentists must perform a comprehensive evaluation to determine the attachment option that best suits the patient's needs. By combining technological advances in attachment design and a personalized treatment approach, the use of ISRD can provide optimal results in various clinical conditions (Kuroshima et al., 2023; Bandiaky et al., 2023).

**Complications in Installation Implant**

1. Biological Complications and prosthetic complications are often obstacles in the use of implant-supported removable dentures (ISRD). The main biological complications include marginal bone loss around the implant, which can be caused by excessive mechanical loading or chronic inflammation such as peri-implantitis. Implants in the posterior area tend to be more susceptible to peri-implantitis compared to the anterior area, due to the higher distribution of chewing loads, which can increase the pressure on the peri-implant bone and trigger inflammatory reactions (Gonçalves et al., 2023; Yi et al., 2023). In addition, prosthetic problems often occur such as attachment wear, cracks in the metal framework, and deformation of other prosthetic components. Loss of attachment retention can reduce prosthetic comfort and function, requiring periodic repair or replacement of the attachment (Kuroshima et al., 2023; Bandiaky et al., 2023).
2. Damage to the frame metals are often associated with uneven distribution of chewing load or excessive masticatory forces. Therefore, it is important to design the prosthesis properly, choose the right material, and undergo regular check-ups by the dentist to reduce the risk of prosthetic complications (Gonçalves et al., 2023; Yi et al., 2023). An integrated management approach between biomechanical and biological aspects is key to minimizing complications and increasing the overall success of ISRD. Further research on more effective management methods is needed to improve patients quality of life and long-term treatment efficiency (Chen et al., 2023 ; Sahin et, 2024).

3. Complications related root of teeth, crown telescopic, components implants, and devices retainer (Miler et al, 2017; Prasad et al, 2024):
    a. Coping / telescope gold cast off or is lost in accordance need from recementation
    b. Loosening ball anchor or telesope coverage
    c. Female atttachment damaged or loose
    d. Tightening of the female attachment
4. Failure mechanical and structural dentures (Sahin et al, 2024 ; Molinero et al 2022):
    a. Denture base fracture
    b. Fracture of the artificial teeth denture
    c. Fracture of the skeleton cast
    d. The need for change design prosthetics followed with making new dentures
5. Adjustment related prosthesis (Frantz et al, 2024 ; Dhamodaran et al, 2022):
    a. Relief of spot painful
    b. Coating repeat denture
    c. Occlusal adjustment
    d. Change arrangement teeth because reason aesthetics
    e. Wear and tear excessive teeth

**Patient Satisfaction**

Patient satisfaction with implant-supported removable dentures (ISRD) is an important factor in improving quality of life. Studies show that patients using ISRD report significant improvements in satisfaction, especially regarding masticatory ability and esthetics. Questionnaire-based surveys such as the OHIP- 49 indicate increased overall satisfaction scores after ISRD placement compared to conventional removable partial dentures (RPD). Patients experience greater comfort and confidence with ISRD, which enhance prosthetic stability and provide a more natural appearance relative to traditional alternatives. In addition, ISRD distribute chewing loads more effectively, reducing pressure on implants while improving patient comfort (Bandiaky et al., 2023; Yi et al., 2023). Further studies demonstrate that ISRD offer long-term benefits in esthetics and functionality, contributing to overall quality-of-life improvements. These higher satisfaction scores reflect that ISRD not only enhance functional aspects such as mastication but also provide superior aesthetic benefits, boosting patients' confidence in daily life (Bandiaky et al., 2023; Gonçalves et al., 2023).

## CONCLUSION

Implant-Supported Removable Dentures (ISRD) provide an effective rehabilitation option for patients with partial edentulousness, offering superior prosthetic stability, comfort, masticatory ability, and balanced chewing load distribution compared to conventional removable partial dentures (RPD), with strategic posterior implant placement and modern attachment systems like Locator® enhancing biomechanical efficiency and aesthetics (Miler et al., 2017; Dhamodaran et al., 2022). These dentures also deliver aesthetic benefits by supporting facial soft tissues, boosting patient confidence and quality of life, though challenges such as peri-implant inflammation, marginal bone loss, attachment wear, and framework damage necessitate optimal

prosthetic design, material selection, oral hygiene, fitting protocols, and patient education to ensure long-term success (Kuroshima et al., 2023; Gonçalves et al., 2023; Frantz et al., 2024; Molinero et al., 2022; Bandiaky et al., 2023; Chen et al., 2023). Future research should prioritize randomized controlled trials comparing long-term outcomes of various attachment systems and materials in diverse patient populations to refine evidence-based protocols and minimize complications.

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