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Prosthetic rehabilitation options for dental implants

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Abstract

Introduction: Dental implant restorations have shown high 5-year survival rates ranging from 97.1% for fixed dental prostheses to 95%-100% for implant-retained overdentures.

Objective: To analyze the literature on prosthetic rehabilitation options for dental implants. Single-unit implant restorations, 3-unit restorations, overdentures, and implant-supported removable prostheses will be analyzed.

Methodology: An electronic search was conducted through PubMed, Google Scholar, and SCOPUS, using the terms: “single implant,” “3-unit restorations”, “overdentures”, “dental implant,” and “implant locators.”

Results: For prosthetic rehabilitation options, the following should be considered: for single implants, prior planning should be carried out, and monolithic restorations show better survival. Three-unit restorations show greater marginal bone loss than single implants. Overdentures: prosthetic restoration spaces must be considered when planning an overdenture. Implant-supported removable prostheses: the use of locator-type attachments is recommended because they provide patient comfort, good retention, and high survival rates.

Conclusions: Implant restorations require prior planning, survival rates are favorable, and monolithic restorations show better survival. Three-unit implant-supported restorations have high survival rates; however, greater marginal bone loss is observed than in single implants. Prosthetic restoration spaces must be considered when planning an overdenture, as well as the material with which the restoration will be made. For removable implant-supported prostheses, the use of locator-type attachments is recommended.

Keywords: Single implants, implant prosthesis, implant overdenture, dental implant, implant locators

1. Introduction

Restorations on dental implants have shown excellent survival rates for fixed dental prostheses in implant-retained overdentures ^[1].

Over the fifty years since osseointegration was first discovered ^[2], dental implantology has matured from an experimental innovation into a predictable and highly successful treatment for tooth loss ^[3]. The use of dental implants has risen dramatically, from 0.7% of the population during 1999-2000 to 5.7% in 2015-2016. The most significant surge was observed among adults aged 65 to 74, with a 12.9% absolute increase, while those aged 55 to 64 experienced the largest relative growth at nearly 1,000% ^[4].

Edentulism can cause significant functional impairment, as well as unfavorable aesthetic and psychological changes in patients. Reported drawbacks include dietary restrictions and limited ability to eat certain foods, impaired speech, and loss of support for facial muscles ^[5].

Edentulism is a problem that affects the global population. Dental implant treatment provides an alternative for patients who have lost one or more teeth. It is important to be aware of the prosthetic rehabilitation options available, depending on the number of implants to be rehabilitated.

The significant rise in dental implant prevalence, especially among older adults, underscores their critical role in modern dentistry. Edentulism severely impacts patients' masticatory function, aesthetics, and overall quality of life. With a wide array of available prosthetic options—from single crowns to complex overdentures—a clear synthesis of the literature is urgently needed. Therefore, analyzing and comparing these rehabilitation modalities is essential to guide clinical decision-making and optimize patient outcomes. The aim of this work was to analyze and compare the prosthetic rehabilitation options for dental implants, including single-implant restorations, fixed partial dentures, and implant-supported overdentures, based on the current scientific literature.

2. Methodology

A systematic search of PubMed, Scopus, and Google Scholar was conducted for literature published within the last five years. The selected articles were evaluated for quality using established guidelines for identification, review, selection, and inclusion, while systematic reviews were assessed with a specific appraisal tool. The search strategy utilized the Boolean operators AND, OR, and NOT with the keywords "implant prosthesis," "implant overdenture," "dental implant," "single implants", 3-unit restorations", "implant-supported removable prosthesis" and "implant locators," which were used both in isolation and in relation to one another.

3. Results

3.1 Single implants

Single-implant screw-retained crowns should be considered in many clinical situations for the following reasons: predictable retention and recoverability, absence of possible biological consequences associated with residual cements, as occurs with cemented restorations, choice between metal-ceramic or all-ceramic, and only one margin at the implant/abutment interface [6].

3.1.1 Planning

The protocol for predictable immediate implant placement in the aesthetic zone involves eight essential steps, which must be executed in a specific sequence with careful planning. These steps are: the pre-surgical phase and temporary restoration, performing an atraumatic extraction, preparing the initial osteotomy for the implant, grafting the bone, placing the implant using a surgical guide, inserting a customized abutment, relining the temporary crown, and finally, grafting connective tissue harvested from the tuberosity [7]. A thorough diagnosis and planning phase is critical to prevent implant failure caused by technical complications. This process must establish the final prosthetic objective, using tools like a wax-up to determine the ideal 3D implant position. Furthermore, selecting the appropriate type of prosthesis, its components, and materials is essential for ensuring long-term success [8].

3.1.2 Survival

All-ceramic reconstructions supported by dental implants showed excellent durability in medium-term studies, with monolithic designs emerging as a reliable treatment alternative for use with ceramic implants [9].

Crowns made entirely of ceramic on two-piece dental implants had a lower long-term success rate. Furthermore, those attached with dental cement caused more biological and other complications than those secured with screws [10]. Single-unit implant prostheses restored with titanium-based abutments showed favorable short-term survival rates [11].

3.1.3 Monolithic or layered restoration

Implant-supported layered and monolithic ceramic single restorations showed favorable short-term survival and complication rates. However, significantly higher rates of ceramic chipping were reported for layered crowns compared to monolithic ceramics [12].

3.1.4 Early or delayed restoration

Evidence demonstrates the clinical efficacy of the early implant placement protocol. Current studies show it achieves similar success rates to both immediate and delayed placement, with the added advantage of superior preservation of the surrounding bone compared to immediate implantation [13].

Single-implant crowns are a highly viable and predictable treatment option. Screw-retained designs are often preferable due to their recoverability and avoidance of cement-related complications. For optimal outcomes, meticulous planning and a precise surgical protocol are paramount. Furthermore, the choice of materials significantly impacts longevity, with monolithic ceramic restorations demonstrating lower fracture rates than layered ceramics.

3.2 3-unit restorations

Research indicates that for a three-unit prosthesis supported by implants, a greater number of implants bearing axial loads enhances its mechanical performance during chewing [14]. The overall success rates for tooth-supported and implant-supported fixed bridges are comparable. However, a patient's history of periodontal disease is a critical factor, as it leads to significantly lower prosthetic success rates for bridges on both natural teeth and implants when compared to patients without such a history [15]. Implant-supported fixed dental prostheses with screw access holes showed lower maximum fracture load values, regardless of the type of structure. The mechanical cycle affected the maximum fracture load of zirconia-based screw-retained implant-supported fixed dental prostheses [16].

3.2.1 Marginal bone loss

The findings indicate a direct relationship between abutment angle and stress, with higher angles increasing the mechanical load on the peri-implant bone and the implant-abutment interface. Furthermore, the crown material's composition was identified as a factor that modifies stress distribution within the prosthetic system, though it does not influence the stresses exerted on the bone [17]. Clinically, mean marginal bone loss one year post-loading was more pronounced in implants supporting 3-unit fixed bridges compared to single crowns, and the intra-oral location was a significant factor. Notably, the incidence of biological and technical complications was low [18].

3.2.2 Type of restorative material

There are no significant differences between the groups of three-unit cast-on-metal porcelain implant-supported dentures and implant-supported denture reconstruction in terms of total implant and denture failure and complication rate [19]. Monolithic zirconia showed promising results in mechanical fatigue analysis for three-unit fixed prostheses, with superior results for 3Y-TZP/5Y-TZP compared to 4Y-TZP/5Y-TZP and porcelain-coated bilayers in terms of fatigue. Failure load, cycles to failure, survival probabilities, and mechanical reliability (Weibull modulus); 4Y-TZP/5Y-TZP showed higher fatigue failure load and cycles to failure compared to the bilayer group [20].

Success of a 3-unit implant-supported prosthesis is influenced by biomechanical factors and material selection. Using a greater number of implants and ensuring axial loads can improve the mechanical response. Monolithic zirconia demonstrates superior fatigue resistance and mechanical reliability compared to porcelain-fused-to-metal or layered zirconia designs. Furthermore, careful case selection is crucial, as patients with a history of periodontal disease exhibit lower prosthetic success rates.

3.3 Overdentures

The restoration spaces for each type of prosthesis are specific to the restoration and must be considered during treatment planning to facilitate appropriate case selection and improve patient satisfaction [22]. Multiple factors must be considered when determining whether a fixed complete prosthesis with implants or an overdenture on implants is most appropriate for patients with completely edentulous jaws [23].

In general, the most common trend is to place at least four implants to ensure a higher implant survival rate. However, the relationship between overdenture survival, patient quality of life, and the number of implants needed to support a maxillary overdenture has not yet been clarified [24].

3.3.1 Mini implants

Using four mini dental implants can improve the retention and reduce the wear of an overdenture attachment. However, no significant difference was found between using two or three implants for these factors [25]. Furthermore, a long-term follow-up of five to eight years demonstrated that two-implant mandibular overdentures, which are loaded immediately, provide successful clinical outcomes, are cost-effective, and result in high patient satisfaction [26]. Maxillary mini implants for overdentures are an accessible and acceptable treatment option. Although between one-fifth and one-quarter of mini implants were lost after 5 years, prosthetic success remains at 80.0% [27].

3.3.2 Complications

The frequency of prosthetic complications varied depending on the prosthetic design. Full arch prostheses had the highest probability of complications, while single prostheses had the lowest [28]. While prosthetic complications are an expected occurrence with implant-supported overdentures, adhering to a rigorous follow-up protocol can help mitigate unforeseen issues. To build a more comprehensive understanding, further clinical research is required. This will enable a constructive meta-analysis that considers key variables such as the opposing arch, the prosthesis's functional design, attachment method, and overall quality [29].

3.3.3 Type of attachment

Bar attachment offered the highest degree of retention, the telescopic system was not only rated most favorably by patients but also resulted in the least amount of change to the surrounding gum tissue. For cases with limited arch space or requiring parallel implant placement, the ball attachment is a suitable alternative [30].

Implant-supported overdentures are a viable rehabilitation strategy, with their success heavily dependent on appropriate case selection and design. The choice of attachment system is critical; bar attachments offer superior retention, while telescopic systems provide high patient satisfaction and favorable tissue response. Furthermore, while mini-implants present a cost-effective option with good patient outcomes,

they may exhibit higher failure rates in the maxilla. Ultimately, a meticulous follow-up protocol is essential to manage the inevitable prosthetic complications associated with these restorations.

3.4 Implant-supported removable prosthesis

3.4.1 Locator-type attachment

The locator attachment system shows fewer complications, including loss of retention and fewer maintenance appointments, fewer soft tissue complications, and fewer periodontal complications than the ball attachment system. In other related results, no significant differences were observed between ball and locator attachments [31]. Research recommends using angled locator attachments for maxillary implant overdentures, as they are linked to superior patient satisfaction and oral health-related quality of life compared to angled ball attachments. It is important to note, however, that this increased satisfaction comes with a trade-off: locator attachments are associated with a greater need for prosthetic maintenance following insertion [32].

Of the common overdenture attachment types, ball and locator attachments are generally superior. While locators require slightly more maintenance, magnetic attachments are prone to causing bone loss and can dislodge during use. Studies confirm that patient satisfaction and compliance are significantly higher with ball and locator systems, as well as bar attachments, compared to magnets. Overall, ball and locator attachments demonstrate excellent performance, offering high survival rates, healthy tissue response, and greater patient satisfaction [33]. Ball attachments and locators produce stable implant results at 5 years and a better quality of life related to oral health. Locators proved to be problematic, as they necessitated greater maintenance efforts and contributed to lower user retention rates [34].

Locator attachments require more attention in terms of wear, although attachments are less likely to cause significant complications. In addition, the bar attachment group has less marginal bone loss and requires less maintenance than the non-splinted screw attachment group. This may be due to the splint effect between implants, not the type of locator attachment fixation. Based on these previous studies, it is currently not possible to conclude whether the splint of the attachment system affects the implants [35].

Studies involving wear simulation indicate that locator attachments provide excellent retention and stability for maxillary overdentures, with minimal loss of retention over time. Consequently, they are recommended over bar attachments for this application [36]. When tested to mimic six months of wear, a specific type of denture attachment (the Locator medium) kept the denture more securely in place—preventing it from lifting vertically or tipping sideways—compared to other similar attachment options [37].

3.4.2 Number of implants

For any implant-supported restoration of an edentulous upper jaw—whether fixed or removable—a minimum of four implants is essential. A fixed, one-piece, full-arch bridge can be supported by either: a) two straight implants in the front and two angled implants in the back, or b) six to eight straight implants placed symmetrically from front to back. For an overdenture, the recommended number is four to six implants. The use of mini implants is not advised for the upper jaw [38]. Immediate implant placement and planned overdenture loading improve patient expectations and satisfaction. The distribution of the implants allows for better stability of the

overdenture with the elimination of anterior-posterior rocking during function. The use of an overdenture also provides a lower overall cost of treatment and easier oral hygiene maintenance for the patient than a fixed approach [39].

Locator attachments are a highly recommended system for implant-supported overdentures, demonstrating high retention, stability, and patient satisfaction. However, they are consistently associated with a greater need for post-insertion maintenance and repairs compared to other systems like ball attachments. For optimal support, a minimum of four to six implants is recommended for a maxillary overdenture to ensure stability and eliminate functional rocking. This combination of a sufficient number of implants and a well-selected attachment system provides a predictable and successful rehabilitation outcome.

4. Conclusion

Success of any implant-supported prosthesis—from single crowns to full-arch overdentures—hinges on a meticulous, patient-specific treatment plan. Key universal principles include selecting the appropriate prosthetic design and materials to manage biomechanical stress, such as using screw-retained single crowns or monolithic zirconia for multi-unit bridges. For removable prostheses, the choice of attachment system directly impacts retention, maintenance needs, and patient satisfaction. Ultimately, regardless of the chosen modality, careful planning and a commitment to long-term maintenance are fundamental to achieving predictable, functional, and durable clinical outcomes.

Conflict of Interest

Not available

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