



Major considerations and clinical outcomes of maintaining or rehabilitating red aesthetics in dental implants: a systematic review

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Abstract

Introduction: In implant dentistry, maintaining the red aesthetics of the gingiva is very important for smile quality and patient comfort. In this context, immediate loading or function requires primary implant stability, necessitating the maintenance of gingival architecture and alveolar bone tissue. **Objective:** It was to analyze the main considerations and clinical outcomes of maintaining or rehabilitating red aesthetics in dental implants. **Methods:** The PRISMA Platform systematic review rules were followed. The search was carried out from February to April 2026 in the Scopus, PubMed, Science Direct, SciELO, and Google Scholar databases. The quality of the studies was based on the GRADE instrument, and the risk of bias was analyzed according to the Cochrane instrument. **Results and Conclusion:** 133 articles were found, 38 articles were evaluated in full, and 29 were included and developed in the present systematic review study. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 16 studies with a high risk of bias and 24 studies that did not meet GRADE and AMSTAR-2 standards. Most studies did not show homogeneity in their results, with $X^2=77.2\%>50\%$. It was concluded that the aesthetic effect of using porcelain veneers to repair developmental anterior interdental spaces is ideal, and that filling the papillae between the teeth meets patients' expectations. Digitalization plays an important role in anterior aesthetic restorations. The use of digital technology to manage the entire process of anterior aesthetic restorations can improve results, reduce the number of follow-up appointments, shorten consultation time, and increase patient satisfaction. Collaborative

decision-making is crucial to optimizing aesthetic results.

Keywords: Red Aesthetics. Dental implants. Implant dentistry. Rehabilitation. Alveolar bone tissue.

Introduction

In implant dentistry, maintaining the red aesthetics of the gingiva is very important for smile quality and patient comfort. In this context, immediate loading or function requires primary implant stability, necessitating the maintenance of gingival architecture and alveolar bone tissue [1,2].

The gingival contour is associated with individual anatomical characteristics, as gingival tissues can be exposed during facial expressions. In inflamed areas, modifications resulting from inflammation of the affected areas appear, causing changes in gingival color and contour. The health, color, and texture of gingival tissues are crucial for long-term success and the aesthetic value of the treatment [3-5].

In this sense, surgical planning is necessary for aesthetic improvement, focusing on gingival anatomy, both soft and hard tissue, and the use of gingival ceramics, which are important for correcting certain clinical situations [6-9]. This can ensure aesthetic gain and satisfactory functions, thus correcting certain situations, such as black spaces due to the loss of interdental papillae, and improving areas with significant bone resorption [10].

Changes in anatomical structures make the use of rehabilitation implants as an alternative to this

inclination challenging in order to obtain the best results. Thus, the use of an intermediate curvature to enable prosthetic rehabilitation is necessary [10]. Prosthetic rehabilitation must establish a harmonious gingival contour of the tooth or implant adjacent to the complete interproximal papilla, regular concave arch, and satisfactory thickness and color of the soft tissue, especially in relation to the upper anterior teeth [10,11].

The challenge is to obtain the relationship between the prosthetic crown and the surrounding tissues, knowing that a well-applied ceramic restoration can mimic any dental unit. However, to achieve optimal results in terms of aesthetics and natural gingival contour around prosthetic implants, many studies are still needed. The red components of aesthetics encompass not only the color, thickness, and harmonious contour of the gingival tissue, but also the presence of interdental papillae [1,2,12].

Thus, factors such as alveolar bone height, periodontal biotype, dental restoration shape, contact point, and implant position in the arch play a significant role in the location and quality of the interproximal papilla. The papilla plays a unique role in periodontal protection, including the alveolar bone crest, with protective action against microorganisms and food [13-15].

Therefore, the present study aimed to analyze the main considerations and clinical outcomes of maintaining or rehabilitating red aesthetics in dental implants.

Methods

Study Design

The present study followed the international systematic review model, following the rules of PRISMA (preferred reporting items for systematic reviews and meta-analysis). Available at: <http://www.prisma-statement.org/?AspxAutoDetectCookieSupport=1>. Accessed on: 04/18/2026. The methodological quality standards of AMSTAR-2 (Assessing the methodological quality of systematic reviews) were also followed. Available at: <https://amstar.ca/>. Accessed on: 04/18/2026.

Data Sources and Research Strategy

The literary search process was carried out from February to April 2026 and was developed based on Scopus, PubMed, Web of Science, Lilacs, Ebsco, Scielo, and Google Scholar, covering scientific articles from various to the present. The health science descriptors (DeCS/MeSH Terms) were used: "*Red Aesthetics. Dental implants. Implant dentistry. Rehabilitation. Alveolar bone tissue*" and using the Boolean "and" between the MeSH terms and "or" between historical

discoveries.

Study Quality and Risk of Bias

Quality was classified as high, moderate, low, or very low in terms of risk of bias, clarity of comparisons, precision, and consistency of analyses. The most evident emphasis was on systematic review articles or meta-analyses of randomized clinical trials, followed by randomized clinical trials. The low quality of evidence was attributed to case reports, editorials, and brief communications, according to the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument by analyzing the Funnel Plot graph (Sample size versus Effect size), using the Cohen test (d).

Results and Discussion

Summary of Findings

A total of 133 articles were found that were subjected to eligibility analysis, with 29 final studies being selected to compose the results of this systematic review. The studies listed were of medium to high quality (Figure 1), considering the level of scientific evidence of studies such as meta-analysis, consensus, randomized clinical, prospective, and observational. The biases did not compromise the scientific basis of the studies. According to the GRADE instrument, most studies showed homogeneity in their results, with $X^2=77.2\%>50\%$. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 16 studies with a high risk of bias and 24 studies that did not meet GRADE and AMSTAR-2.

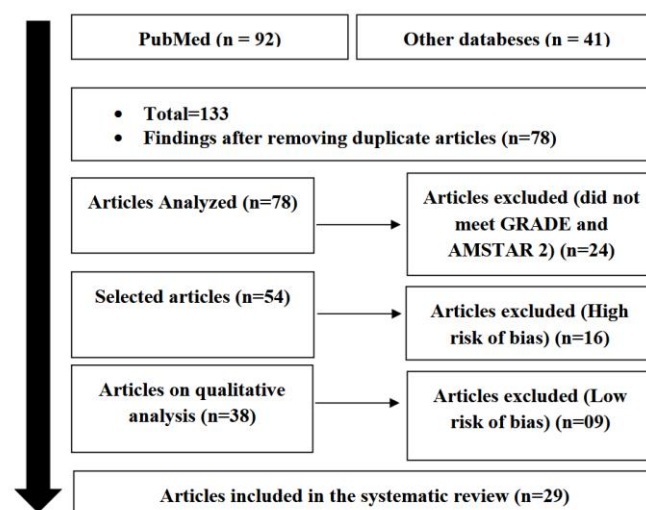


Figure 1. The article selection process by the level of methodological and publication quality. Source: Own authorship.

Figure 2 presents the results of the risk of bias of the studies using the Funnel Plot, showing the calculation of the Effect Size (Magnitude of the difference) using the Cohen Test (d). Precision (sample

size) was determined indirectly by the inverse of the standard error (1/Standard Error). This graph had a symmetrical behavior, not suggesting a significant risk of bias, both between studies with a small sample size (lower precision) that are shown at the bottom of the graph and in studies with a large sample size that are presented at the top.

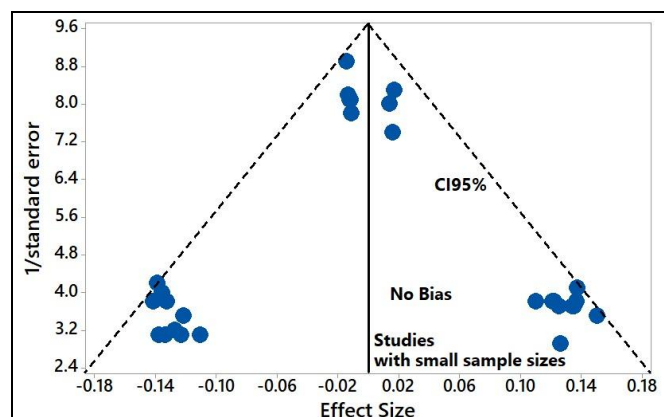


Figure 2. The symmetric funnel plot suggests no risk of bias among the small sample size studies that are shown at the bottom of the graph. High confidence and high recommendation studies are shown above the graph (n=29 studies). Source: Own authorship.

Major Results and Development

A study evaluated the aesthetic effect of red and white porcelain veneers in the restoration of congenital anterior interdental spaces. A total of 152 anterior teeth from 64 patients with congenital anterior interdental spaces were restored with porcelain veneers. The aesthetic effects before and after restoration were evaluated using the Pink Aesthetic Index (PAI) and the White Aesthetic Index (WAI). The aesthetic effect of filling and reconstructing the gingival papilla was evaluated using the Interdental Gingival Papilla Index (IPI). The Visual Analogue Scale (VAS) was used to compare patient satisfaction before and after restoration. The overall mean PAI scores before and after restoration of the 152 congenital anterior teeth with interdental spaces were 9.63 ± 2.23 and 13.64 ± 0.88 , respectively. The mean WES scores before and after restoration were 6.85 ± 1.87 and 9.81 ± 0.58 , respectively. There were significant differences in PAI and WAI scores before and after restoration ($P < 0.01$). The interdental gingival papilla was completely filled, presenting an ideal shape, with statistically significant differences between the two periods ($p < 0.01$). Patients were more satisfied with the smile curve and morphology of the restored anterior teeth than with other parameters [16].

Liu et al. (2024) [17] compared the clinical results of traditional and digital crown extension guides in the aesthetic restoration of anterior teeth. A total of 62

patients who needed aesthetic restoration of their anterior teeth were selected for this study. The patients had a total of 230 anterior teeth and were randomly divided into three groups: a control group of 22 cases that received diagnostic wax-up with pressure film, an experimental group 1 of 20 cases that received 3D-printed digital models with pressure film, and an experimental group 2 of 20 patients who received dual-position digital guides. The control group had a total of 84 anterior teeth, experimental group 1 had 72 anterior teeth, and experimental group 2 had 74 anterior teeth. The surgical time for the experimental group was significantly shorter than that of the control group. During the postoperative period, between the 1st and 3rd month, the PES indices for the marginal gingival level and the proximal and distal mesiodistal gingival papillae of the experimental group showed a trend towards superiority compared to the control group. At the 6th month, the marginal gingival level showed a significant difference between the experimental and control groups. The experimental group demonstrated superior results compared to the control group in terms of tooth shape, contour, and volume, restoration color, surface texture, and transparency, as well as tooth characteristics, during the 1st and 3rd postoperative months. At the 6th month, comparative results indicated that the experimental group continued to show superior results compared to the control group in terms of restoration shape, color, surface texture, and transparency, as well as tooth characteristics. Furthermore, the experimental group presented significantly less gingival alteration than the control group at the 1st, 3rd, and 6th postoperative months, a difference that was statistically significant. In addition, the combination of 3D printing technology with restorative techniques resulted in consistent patient satisfaction.

Kooijmans et al. (2026) [18] evaluated the aesthetic results of four treatment options for missing upper lateral incisors: canine replacement, canine replacement with reconstruction, adhesive fixed prostheses, and dental implants. 144 digital intraoral photographs from specialized clinical archives were analyzed, including those from the control group. The recurrent dental aesthetic proportion (RED) was more favorable in the two groups that underwent canine replacement than in the group with adhesive fixed prostheses. The vertical position favored adhesive fixed prostheses compared to canine replacement with reconstruction. Black triangles were less frequent in both the canine replacement group and the control group, compared to the group with adhesive fixed prostheses. The gingival zenith was less favorable in both canine replacement groups compared to the

control group and to removable partial fixed prostheses. The control group showed the best color results, outperforming all treatment groups except the dental implant group. The distance between the central and lateral incisors (ACD) was better in the canine replacement with reconstruction and control groups than in the canine replacement without reconstruction group. The distance between the lateral incisors and canines (ACD) was higher in the canine replacement and control groups compared to removable partial fixed prostheses and dental implants.

In this context, a study carried out by the authors Baghiana et al. (2022) [3] evaluated the RED ratio and the golden ratio among 106 participants (50 men and 56 women), aged 18 to 25 years. The RED ratio was noted to be inconsistent as it progressed distally. It was observed that the Golden Ratio was at 6-29% of the existing population of individuals. Thus, the emergence of indices that assess the outcome of treatment, including the red aesthetics scale, and aesthetics of the measurement index of implant crowns and adjacent soft tissues, collaborate as important tools for assessing the degree of red aesthetic [7]. Thus, a new stage in implant dentistry was initiated through the development of the white and red aesthetic index Buser, Martin, and Belser, 2004), which measures the objective results in different stages of treatment, from planning to the measurement of the outcome of treatment [19].

In this sense, five questions are evaluated in red aesthetics (1) mesial papilla (2) distal papilla, (3) the curvature of buccal mucosa, (4) Level of facial mucosa, and (5) curvature of the root/color and texture of soft tissue in facial appearance of the implantation site, assigning a score of 2, 1 or 0 for all five parameters to red aesthetic [8,9]. All teeth were compared to their counterpart. A score of 2, 1, or 0 was assigned to each variable; thus, a score of 10 denoted a crown on the implant, and an excellent score of 6 was the acceptance limit for clinical treatment. Furthermore, when the related red and white aesthetic index score was 20, determined perfectly; an excellent overall aesthetic result if the total score obtained is 17; satisfactory aesthetic overall result if the sum is 15, and 12 as the threshold of clinical acceptance [9].

In this system, current studies are directed to explore the thickness of the mucosa, which would have similar implications around dental implants [9]. The absence of keratinized gingiva was also associated with increased buildup of plaque, bleeding on probing, gingival inflammation, and recession. These findings suggest that the thickness of keratinized mucosa can determine the future dynamics of the soft tissues surrounding dental implants [2,10].

Thus, it has been reported that the presence or

reconstruction of keratinized tissue around implants can facilitate restorative procedures, to promote the aesthetic and still allow the maintenance of the oral hygiene routine without irritation or discomfort to the patient [11,12]. Moreover, according to a recent consensus of the International Oral Implantology Congress, the success of the implants must meet both functional and aesthetic criteria. Based on these findings, gingival augmentation procedures are indicated in clinical practice with plaque control, patient comfort, and better aesthetic results, especially when in association with prosthetic treatment [13].

The width of the central incisor is multiplied by the desired red ratio to determine the point of view frontal width of the lateral incisor. The values of red ratios used are between 60% and 80% [8-13]. The resulting lateral incisor width is multiplied by the same red ratio to obtain the desired front view of the canine. Thus, a certain mathematical formula to calculate the upper central incisor width for any red ratio is determined by measuring the front view width between the distal aspect of the upper canine teeth, which is (a front view of the previous six teeth) / 2 (1 RED2 + RED +) = central incisor width [14].

The use of ceramic gum has been an alternative for the correction of defects or replacement of the protective periodontium, often lost by extensive bone resorption present in certain areas. Thus, you can replace the need for surgery, possibly, since this may be impractical for the patient much discomfort due to the increase in the cost [14,15]. Thus, using the rehabilitation gingival ceramic has the advantage of reducing the cost, labor time, and discomfort for the patient and the possibility of air sealing, by promoting improvement in the patient's phonation above [19]. It also promotes improvement in aesthetics, and it eliminates the black spaces present in patients with loss of papillae interproximal [20]. Even in this context, the acquisition of aesthetic excellence in the rehabilitation of the anterior maxilla is a factor of extreme difficulty, as in the work of Belser [20], in which none of the 45 cases evaluated obtained a maximum score of 20, and the highest value was 18. Buser et al. [19] found a value of 16.75.

The emergence of various indices to measure the aesthetic result provided objective data to evaluate the diagnosis, planning, execution, and final evaluation of rehabilitation. Belser, Buser, and Higginbottom reported that the use of implants in the esthetic zone was well documented in the literature, but no well-defined aesthetic criteria [19,20]. According to Belser et al. [20], it can be seen that it is possible to perform a treatment associated with the white and red aesthetics without breaking the tissue integrity and return to the

patient the structure lost without causing losses of the functional and aesthetic point of view of obtaining good results over time. Dental implants have brought current Dentistry unparalleled advances in aesthetic and functional rehabilitation of patients, complete or partially edentulous [21-23].

Some other studies have reported that the implants can survive without a range of appropriate keratinized gingiva, but the goal of the current implant is to ensure that the implants, and osseointegrated, maintain their state of full health, function, and aesthetics, especially to gingival esthetics [1-3]. Taking into account differences between the interface of the soft tissues around dental implants compared to natural teeth, one can question whether the peri-implant keratinized mucosa is necessary or at least beneficial to the peri-implant health, as well as if the minimum 2.0 mm keratinized mucosa recommended for natural teeth is also applicable to dental implants [3-5].

Thus, several factors may influence the need for an appropriate range of keratinized mucosa [20-22]. Regarding sanitation, the lack of this can create a less capable mouthwash condition and make individuals more susceptible to irritation and discomfort during routine procedures, as well as the clinical features of gingival inflammation and bleeding on probing [23-25]. On the other hand, sufficient keratinized tissue areas can offer more resistance to the forces of mastication and the friction occurring during oral hygiene procedures [26-29]. Another important factor related to keratinized mucosa is the gingival recession in the peri-implant region. Studies have shown that the width and thickness of the peri-implant mucosa had a significant negative correlation with the gingival recession, demonstrating that a range of less than 2.0 mm of keratinized tissue increased the risk of recession and exposure of the threads of the implants [28,29].

The presence of keratinized tissue around the implants also offers the advantage of ease of molding during rehabilitation, the lower probability of tissue collapses above the head of the implant, and facilitating the aesthetic [29], as shown similar to tissue surrounding teeth; Thus, the stability of the soft tissue around the implant tails is an important factor to achieve optimal esthetic result. In case of a lack of soft tissue and areas of recession, grafting techniques can be displayed, and despite the discomfort provided by surgical techniques, these positive results show significant gains and tissues, providing comfort and aesthetics appropriate to the patient [26-29].

There are several techniques available to increase the gingival thickness, such as the flap positioned apically, the flap positioned laterally, the free gingival graft, the flap of partial thickness positioned apically, or

the connective tissue graft [24]. It is important to note that the keratinized mucosa is not decisive in isolating the front implants from bacteria in the oral cavity [2,3]. It is noteworthy that the vast majority of patients seeking rehabilitation treatment with dental implants lost their natural teeth because of periodontal disease induced by the plate [3,4] bacteria. Thus, patients rehabilitated by implant prostheses must be within a plaque control program and constant professional guidance regarding hygiene techniques and oral therapy, which will contribute to the clinical success of rehabilitation treatment [4,5].

Conclusion

It was concluded that the aesthetic effect of using porcelain veneers to repair developmental anterior interdental spaces is ideal, and that filling the papillae between the teeth meets patients' expectations. Digitalization plays an important role in anterior aesthetic restorations. The use of digital technology to manage the entire process of anterior aesthetic restorations can improve results, reduce the number of follow-up appointments, shorten consultation time, and increase patient satisfaction. Collaborative decision-making is crucial to optimizing aesthetic results.

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Informed Consent

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Conflict of Interest

The authors declare no conflict of interest.

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It was applied by Ithenticate@.

Application of Artificial Intelligence (AI)

Not applicable.

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It was performed.

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