

Achieving Predictable Aesthetic Outcomes in Implant Therapy: A Comprehensive Review

Nissy Chacko¹, Kala Sukumaran², Harsha Kumar Karunakaran³, Smitha Ravindran⁴

Department of Prosthodontics and Crown & Bridge Government Dental College, Trivandrum

Abstract

Aesthetic outcomes are now a critical measure of success in oral implantology, especially in the anterior maxilla and other visible areas. Modern implant therapy requires both functional rehabilitation and a natural, harmonious appearance. Predictable aesthetic results depend on thorough diagnostic evaluation, careful planning, and integration of surgical and prosthetic principles. Key factors affecting peri-implant aesthetics include lip line, gingival biotype, alveolar bone volume, and the position of the gingival margin and papillae. Precise implant placement, reconstruction and optimization of supporting alveolar bone and peri-implant soft tissue contours, and the use of customized abutments and provisional restorations are essential for achieving a natural emergence profile and stable gingival architecture. Standardized assessment indices, such as the Pink Esthetic Score and White Esthetic Score, are widely used to objectively evaluate the aesthetics of restorations supported by implants. Advances in digital smile design, immediate provisionalization, and biomaterial innovations further improve predictability. A patient-centred, interdisciplinary, and evidence-based approach is essential for achieving long-term aesthetic success in implant dentistry.

Keywords: Aesthetics, Dental, Maxilla, Dental Implants, Dental Implantation, Treatment outcome, Tissue management.

Introduction

Aesthetics has become a clinical necessity in modern dentistry rather than a luxury. Dental implants, which were once primarily evaluated based on osseointegration and durability, are now expected to achieve a natural appearance, particularly when placed in the aesthetic zone. Attaining this balance between biological function and visual appeal requires a meticulous, interdisciplinary approach. The accidental discovery of osseointegration by Branemark and colleagues marked a pivotal advancement in oral rehabilitation, fundamentally transforming tooth replacement strategies. Dental implants have since become integral to restorative dentistry, providing a solution edentulism. Initially, the focus of implantology centered on achieving osseointegration, survival of implants, and peri-implant tissue health. However, as implants are increasingly placed in the maxillary anterior region and other aesthetically complex areas, there has been a paradigm shift toward prioritizing the aesthetic outcomes of implant-supported restorations. Patients now expect restorations that are both functional and visually indistinguishable from natural dentition. In current dental practice, esthetic outcomes are recognized as essential to treatment success, consistent with the World Health Organization's definition of health, which includes "physical, psychological, and social well-being rather than merely the absence of disease".[1] Implants placement in the aesthetic region is technique-sensitive and it requires thorough planning and accurate execution. Even minor deviations in implant positioning or inadequate management of hard tissues like alveolar bone and soft tissues (ST) like gingiva can compromise the final aesthetic result and lead to patient dissatisfaction.[2,3] Therefore, achieving optimal aesthetic outcomes necessitates a thorough understanding of anatomical, prosthetic, and surgical factors.

In the context of dentistry, aesthetics refers to "the theory and philosophy that deal with beauty and the beautiful, especially with respect to the appearance of a dental restoration, as achieved through its form and/or colour; those subjective and objective elements and principles underlying the beauty and attractiveness of an object, design, or principle".[3] Aesthetic success in implant dentistry encompasses more than osseointegration; it requires harmony among surgical precision, prosthetic design, and soft-tissue stability. Predictable aesthetic outcomes depend on preserving buccal bone thickness, maintaining gingival margins, and positioning implants to support papillary architecture.[4] Restoration-driven placement aligns implant position with the final prosthesis, which ensures a natural emergence profile (EP) and stable peri-implant tissues. Achieving aesthetic predictability relies on accurate diagnosis, effective soft-tissue management, and prosthetically guided planning. The use of provisional restorations, customized abutments, and papilla-preserving flap designs is essential for shaping gingival contours and maintaining long-term tissue health. Objective indices, such as the Pink and White aesthetic Scores, standardize evaluation and facilitate refinement of clinical protocols. The addition of digital tools, including Cone Beam Computed Tomography (CBCT), Computer-Aided Design (CAD)/ Computer-Aided Manufacturing (CAM), guided surgery, and digital smile design, enhances procedural precision and reduces aesthetic complications.

Recent advancements in materials and implant design have significantly improved aesthetic implant therapy. Materials such as Titanium Abutment Union (TAU), carbon, titanium sponge, direct laser metal formed (DLMF) titanium and polyether ether ketone (PEEK) offer enhanced biocompatibility, color matching, and favorable soft-tissue responses.

Design innovations, including reverse conical necks and micro threaded collars, contribute to crestal bone preservation and gingival stability, thereby increasing the predictability and longevity of clinical outcomes. Future developments in aesthetic implant dentistry are expected to be driven by digital and biomaterial innovations. Technologies such as 3D printing, AI-assisted planning, and customized regenerative approaches will further enhance procedural precision, personalization, and minimally invasive treatment. The emphasis is shifting from mere implant survival to patient-centered aesthetic excellence, characterized by natural appearance, biological stability, and long-term satisfaction.

A. Principles of Aesthetics

Aesthetics comprises of seven factors as shown in Figure 1.[5,6]

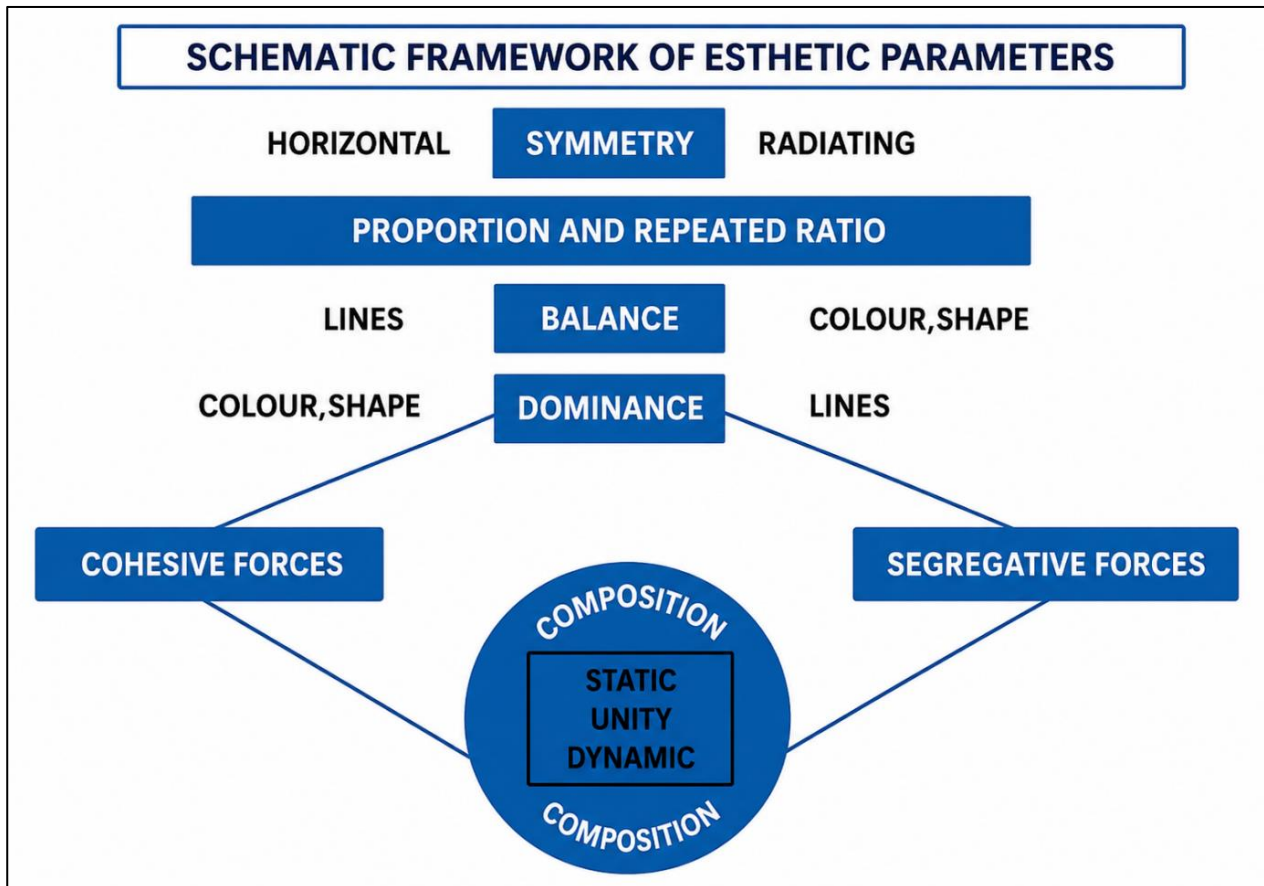


Figure 1. Schematic framework of esthetic parameters.

B. Aesthetic Analysis of Smile

Aesthetic analysis of the smile encompasses four primary components: facial analysis, dentofacial analysis, dental analysis, and phonetic analysis. Facial analysis involves evaluating various facial proportions and reference lines in the horizontal dimensions and vertical dimensions, conducted in the frontal and sagittal planes. Dentofacial analysis examines both static and dynamic aspects of the smile, including tooth exposure, symmetry, lip line, smile line, and negative space.[6] Dental analysis assesses the interincisal line, tooth morphology, tooth proportions, contact areas, ST components, tooth color, and tooth inclination. Phonetic analysis is performed using the sounds "s," "f," "v," "m," and "th."

C. Aesthetic Zone

The esthetic outcome of a smile depends on the harmonious relationship among the three elements of the esthetic zone: teeth, gingiva, and lips. The lip line's position is crucial in determining the visibility of the teeth and gingival tissues. Based on this display, smiles are classified as high, medium, or low lip line.[7] (Figure 2).



Figure 2. Classification of smile line based on teeth, gingiva and lips.

Lip Line Type	Description	Clinical Implication
High Lip Line	- The complete cervico-incisal dimension of the maxillary anterior teeth (MAT), along with a continuous zone of gingival tissue, is visible. - During smiling, the entire prosthetic restoration, surrounding gingival architecture, implant-restoration junction, and soft tissues apical to the upper lip are exposed.	Most critical to restore High aesthetic demand Challenging if tissue is lost
Medium Lip Line	- Approximately 75–100% of MAT, together with the interdental gingiva, are visible. - The teeth, interdental papillae, and portions of the marginal gingiva are exposed during smiling.	Moderately esthetic demand Papillary and marginal tissue visibility is important
Low Lip Line	- Less than 75% of MAT are visible. - The junction between the implant-supported restoration and the implant remains concealed beneath the lip line.	Least aesthetic concern Interface not visible Restoration more forgiving in appearance

Table 1: Lip Line Classification (Tjan et al., 1984).[8]

The primary objective of implant supported restoration is to achieve harmony with the smile, and facial structure. Effective treatment planning should focus on both hard tissue (alveolar bone) and ST (gingiva) deficiencies and integrate precise implant placement (IP). This comprehensive approach enables implant restorations (IR) to become indistinguishable from adjacent natural teeth.

D. Aesthetic Predictability

To assess aesthetic predictability, Rosenquist et al.[9] identified four critical factors influencing the gingival tissue aesthetics surrounding an implant:

1. The width and position of the attached gingiva: Sufficient attached gingiva ensures stability, resists recession, and contributes to a natural peri-implant mucosal appearance.
2. The buccal volume of the alveolar process: Adequate buccal bone and ST volume maintain contour and prevent collapse of the facial profile.
3. The level and configuration of the gingival margin: An appropriately positioned and scalloped gingival margin promotes harmony with adjacent teeth and improves symmetry.
4. The size and shape of the papilla: Well-formed interdental papillae occupy the embrasures and prevent the formation of unesthetic ‘black triangles’.

E. Diagnostic Keys for Predicting Peri-Implant Aesthetics by John Kois.[10]

Single-tooth peri-implant aesthetics depend on five key diagnostic factors. First, evaluation of tooth position ensures that the replacement tooth aligns with adjacent teeth. Second, assessment of the bone level of neighbouring teeth is essential, as it supports the gingival tissue and determines the final contour. Third, adequate bone level at the site where the implant is to be placed is necessary to provide secure anchorage and stability. Fourth, the shape and health of the peri-implant gingival tissue contribute to a natural appearance and successful implant integration. Finally, identification of the tissue phenotype, whether thick or thin, informs prognosis and guides treatment planning to achieve optimal aesthetic outcomes.

F. Aesthetic Assessment

1. Pink Aesthetic Score (PES)[11]

PES is a comprehensive framework for evaluating the peri-implant ST aesthetic outcomes. It identifies seven key ST parameters. The first parameter is the presence or absence of mesial papillae, referring to the interdental papillae between the implant and the adjacent tooth on the side closer to the midline. The presence of mesial papillae contributes to a natural-appearing gum line. The second parameter is the presence or absence of distal papillae, which indicates whether gingiva is present between the implant and the neighboring tooth on the side farther from the midline. This papilla maintains the esthetic continuity of the gingiva. The third parameter evaluates the level at which the IR emerges from the facial aspect of the mucosa, ensuring proper alignment with the surrounding teeth and gum tissue. The fourth parameter evaluates the emergence line curvature of the IR as it exits the facial aspect of the mucosa.

A natural curvature is essential for esthetics and for blending with the natural contour of the gingiva. The fifth parameter is the convexity of the ST in the facial region, as adequate convexity supports the overlying gingiva and achieves a lifelike appearance around the implant. The sixth parameter assesses the peri-implant mucosal color, which should closely match the surrounding natural gum tissue to ensure a harmonious esthetic result. The seventh parameter examines the texture of the facial marginal peri-implant mucosa, as a natural texture is important for both the appearance and health of the tissue surrounding the implant.[11]

2. Three Aesthetic Indices – PICI, ICAI, PES/WES[12]

PICI – “Peri Implant and Crown Index”

ICAI – “Implant Crown Aesthetic Index”

PES/WES – “Pink Aesthetic Score/White Aesthetic Score Index”

These indexes are used to calculate relative esthetics using criteria like peri-implant mucosa, white aesthetics and many other factors.

G. Diagnostic Factors for Aesthetic Risk Assessment[13,14]

Aesthetic risk assessment comprises several diagnostic factors that collectively determine potential challenges in achieving optimal esthetic outcomes. 1. The lip line height during smiling is a critical consideration, as a high lip line exposes a greater portion of the gingiva and teeth, thereby increasing the visibility of imperfections. 2. The gingival biotype in the treatment area, significantly influences both healing and the final esthetic appearance. 3. The morphology of the missing tooth and adjacent teeth affects the ability of restorations to blend seamlessly. 4. The condition of the adjacent tooth to the edentulous space is significant as previously restored teeth may affect the integration of new restorations. 5. Edentulous space characteristics, including its contours and tissue quality, can either complicate or facilitate treatment. 6&7. Furthermore, dimensions of the alveolar bone and ST in the edentulous space are essential, as they determine the available support for implants or prostheses and directly influence the overall esthetic outcome.

H. Management of Peri-Implant Aesthetics

Peri-implant aesthetics has following components: Pre-treatment considerations, Surgical considerations and Prosthetic considerations.

H.1. Pre-Treatment Considerations

Pre-treatment considerations comprise following factors: 1. Patient Selection and evaluation, 2. Implant site assessment, 3. Treatment planning and 4. Pre-placement procedures.

H.1.1 Patient Selection

General risk assessment should be done. It includes medical history, risk factors for periodontal diseases, and habits like smoking. High aesthetic risk category should be identified, which includes heavy smokers, bone or immunologic diseases, thin gingival biotype, high lip line, history of radiotherapy, triangular shaped tooth and alveolar ridge defects.

H.1.2. Implant Site Evaluation

According to the criteria established by Kopp and Belser, “the evaluation of a tooth-bounded edentulous site should include the following: periodontal examination and probing to assess interproximal bone level, ridge mapping to determine buccolingual ST width, bone sounding to measure the height of alveolar bone at the cervical area, and gingival biotype assessment to classify tissue as thick or thin”.[15] Tissue volume can be assessed using classifications like Siebert classification[16], Allen classification[17] and Pallaci-Ericsson classification.[18]

H.1.3. Treatment Planning

Top-down approach of treatment planning is needed utilizing clinical photographs, mounted study casts, digital smile design (DSD) or aesthetic wax-up for final restorative outcome, CBCT and intraoral scan for 3D evaluation, surgical guide and radiographic surgical template.

High Smile Line Cases

In patient who have high smile line and are undergoing full mouth reconstruction, it's better to avoid observable transition lines between the prosthetic work and remaining ST by treatment considerations like utilization of gingival masks, gingival contouring, osteoplasty, avoid immediate IP, zirconia/hybrid abutments, crown-high translucency monolithic zirconia or layered lithium disilicate and screw-retained preferred over cement retained prosthesis.

Timing of Implant Placement

When the implant is placed immediately after extraction is Type 1. In Type 2, the implant is placed after early ST healing which is about 4 to 8 weeks after the extraction. In type 3, the implant is paced in partially healed extraction socket which is approximately 12 to 16 weeks after extraction. When the implant is placed after 4 to 6 months in a completely healed socket is type 4.[19]

H.1.4. Pre-placement Procedures

Several pre-placement procedures are available to achieve optimal esthetics.[20] These include: (a) Ridge (socket) preservation, which involves atraumatic tooth removal at the appropriate time followed by placement of graft material; (b) Forced orthodontic eruption, which promotes a favorable osseous crest position in the facial bone margin; (c) Gingival augmentation techniques, such as connective tissue grafting, papilla reconstruction, and free connective tissue grafts; (d) Controlled tissue expansion, which utilizes the elasticity of the gingival epithelium for tissue expansion through the use of a silicone balloon expander; and (e) Hard tissue augmentation, including autogenous bone grafts, ridge splitting, and guided bone regeneration.

H.2. Surgical Considerations

Careful planning and precise execution are essential for a successful surgical approach.

H.2.1. Tischer Guidelines

Tischer has proposed comprehensive rules for the placement of implant and esthetic zone, emphasizing that the surgeon must employ a minimally invasive flap design, carefully evaluate the existing hard and ST, IP timing correctly, imagine the three-dimensional view of the placement of the implant, place the implant in the right location, consider the achievement of an ideal EP, and selection of a proper abutment and final prosthetic design.[19]

H.2.2. Implant Positioning

Ideal aesthetic IR requires precise three-dimensional positioning of implantses. Four key parameters—bucco-lingual, mesiodistal, apico-coronal positioning, and implant inclination—must be evaluated during placement to achieve successful outcomes. The implant should be centred to facilitate a EP that looks natural, ideally positioned near the center of the replacement tooth with at least 1 mm of buccal alveolar bone preserved. In cases of thin gingival biotypes, slightly palatal placement may be necessary to prevent recession. Sufficient mesio-distal spacing is critical for maintaining papillary height and interproximal bone, with 1.5–2 mm between the implant and the teeth next to the implant and 3–4 mm between two adjacent implants. For apico-coronal positioning, the shoulder of the implants should be 1–2 mm apical to the adjacent tooth's cemento-enamel junction in one-stage procedures and 2–3 mm in two-stage procedures to establish an appropriate biologic width and EP. Over-sinking should be avoided at all cost, as it may result in the loss of bone and tissue recession. Finally, implant angulation should replicate that of adjacent teeth to ensure an esthetic and functional prosthesis. Improper angulation can compromise prosthetic screw access and oral hygiene. The use of surgical guides and custom abutments assists in achieving optimal orientation.

H.2.3. Implant Placement

The optimal restoration design should determine the placement of the implant surgically. This approach, termed “restoration-driven IP”, contrasts with the previously accepted “bone-driven IP” concept. Placement of implant in aesthetic zones must correspond to the final prosthetic design. If proper positioning cannot be achieved through prosthetic modifications, alveolar bone and gingival augmentation procedures are required to establish an acceptable site.

Table 3: Garber Classification for the placement of Implants in edentulousesthetic sites[21]

Class I	Class II	Class III	Class IV	Class V
Favourable Horizontal and Vertical levels	Slight Horizontal deficiency	More Horizontal bone loss	Significant Horizontal loss	Extensive Apico-coronal loss
Ideal Implant Positioning	Expansion with serial Osteotomes. No drilling.	Attempted if primary stability achieved. GBR necessary.	Staged approach -Ridge widening with GBR -Delayed Implant Placement	No longterm clinical evidence

H.2.4. Flap Management

Successful implant aesthetics depend not only on the implant position, it also depends on the preservation of soft-tissue architecture during surgery. The flap design should maximize visibility and access while maintaining blood supply and minimizing trauma. Papilla-sparing or parapapillary incisions are preferred to preserve interdental papilla and prevent post-surgical recession. When adequate amount of alveolar bone and attached gingiva are present, flapless IP can minimize soft-tissue trauma and preserve vascularity. Techniques such as titanium papillary inserts and papilla regeneration flaps can enhance soft-tissue aesthetics.

H.2.5. Post Placement Soft Tissue Management

Management of vertical and horizontal defects can be addressed by gingival and alveolar bone augmentation techniques. The PDP Management triad includes increasing ST thickness, “implant position (P), implant design(D), and prosthetic design (P)”. [22] To reduce bone loss around implants, procedures like the platform switching, adding microthreads at the coronal part of the implant, surface modifications, changing the dimensions of the implant, and using a mono-implant are done.

H.3. Prosthetic Considerations

A proper EP ensures a easy transition from submerged implant platform to coronal crown and supports papilla before final impression. Provisional restorations shape peri-implant ST, maintain papillary height, and allow tissue maturation, with space, volume, and time as key considerations for stability. [23] Tissue can be prepared with full-contour (FP) or sub-contoured (SP) provisionalization, determined by aesthetic, bounded, and crestal zone relationships. Custom healing abutments and progressive contouring guide ST, and approach selection depends on clinical scenario for optimal results. Healing abutments, conventional or customized, remodel gingiva and aid EP; abutments must also support aesthetics. Restorative/prosthetic reshaping can encourage interdental tissue growth, with papilla height relying on adjacent bone height ($\leq 5\text{mm}$). [24,25]

Conclusion

Aesthetic implant dentistry has evolved from a solely functional focus to an emphasis on patient-specific aesthetic outcomes. Success in the aesthetic zone depends on comprehensive assessment, meticulous planning, and expert execution. Mastery of tissue dynamics and the application of advanced techniques, such as custom abutments, provisional restorations, and digital technologies, facilitate natural-looking and durable results. An individualized, interdisciplinary, and evidence-based methodology is critical for achieving optimal aesthetic outcomes. The integration of innovations, including AI-driven smile design, digital twin technology in implant planning, and patient-reported outcome measures, is recommended to enhance aesthetic implant therapy.

References

1. World Health Organization. Oral health [Internet]. Geneva: World Health Organization; 2021 [cited 2025 Sep 20]. Available from: <https://www.who.int/about/governance/constitution>.
2. Buser D, Martin W, Belser UC. Optimizing esthetics for implant restorations in the anterior maxilla: anatomic and surgical considerations. *Int J Oral Maxillofac Implants* 2004;19:S43-61.
3. The Glossary of Prosthodontic Terms 2023: Tenth Edition. *J Prosthet Dent* 2023;130:e1–3
4. Forna N, Agop-Forna D. Esthetic aspects in implant-prosthetic rehabilitation. *Med Pharm Rep* 2019;92:S6-13.
5. Lombardi RE. The principles of visual perception and their clinical application to denture esthetics. *J Prosthet Dent* 1973;29:358–82
6. Morley J, Eubank J. Macroesthetic elements of smile design. *J Am Dent Assoc* 2001;132:39-45.
7. Melo M, Ata-Ali J, Ata-Ali F, Bulsei M, Grella P, Cobo T, et al. Evaluation of the maxillary midline, curve of the upper lip, smile line and tooth shape: a prospective study of 140 Caucasian patients. *BMC Oral Health* 2020;20:42.
8. Tjan AH, Miller GD, The JG. Some esthetic factors in a smile. *J Prosthet Dent* 1984;51:24-28.
9. Rosenquist B. A Comparison of Various Methods of Soft Tissue Management Following the Immediate Placement of Implants into Extraction Sockets. *Int J Oral Maxillofac Implants* 1997;12:43–51.
10. Kois JC. Predictable single-tooth peri-implant esthetics: five diagnostic keys. *Compend Contin Educ Dent* 2004;25:895-907.
11. Fürhauser R, Florescu D, Benesch T, Haas R, Mailath G, Watzek G. Evaluation of soft tissue around single-tooth implant crowns: the pink esthetic score. *Clin Oral Implants Res* 2005;1:639–44.
12. Tettamanti SG, Millen C, Gavric J, Buser D, Belser UC, Brägger U, Wittneben JG. Esthetic evaluation of implant crowns and peri-implant soft tissue in the anterior maxilla: comparison and reproducibility of three different indices. *Clin Implant Dent Relat Res* 2016;18:517–26.

13. Belser UC, Grütter L, Vailati F, Bornstein MM, Weber HP, Buser D. Outcome evaluation of early placed maxillary anterior single-tooth implants using objective esthetic criteria: a cross-sectional, retrospective study in 45 patients with a 2- to 4-year follow-up using pink and white esthetic scores. *J Periodontol* 2009;80:140–51.
14. Tarnow DP, Chu SJ, Salama MA, Stappert CF, Salama H, Garber DA. Flapless postextraction socket implant placement in the esthetic zone: Part 1. The effect of bone and soft tissue thickness on facial marginal tissue recession. *Int J Periodontics Restorative Dent* 2014;34:323–9.
15. Kopp FR, Belser UC. Esthetic checklist for the fixed prosthesis. In: P Sharer, LA Rinn, FR Kopp, editors. *Esthetic guidelines for restorative dentistry*. Chicago (IL): Quintessence Publishing Co.; 1982. p. 187–92.
16. Seibert JS. Reconstruction of deformed, partially edentulous ridges, using full thickness onlay grafts. Part II. Prosthetic/periodontal interrelationships. *Compend Contin Educ Dent* 1983;4:549–62.
17. Allen EP, Gainza CS, Farthing GG, Newbold DA. Improved technique for localized ridge augmentation. A report of 21 cases. *J Periodontol* 1985;56:195–9.
18. Palacci P, Ericsson I. *Esthetic implant dentistry soft and hard tissue management*. 2nd ed. Quintessence Publishing Co Inc., U.S. 2001.
19. Marković A, Mišić T. Implant therapy in the esthetic zone-surgical considerations. *Balk J Dent Med* 2016;20:83–8.
20. Balasubramaniam AS, Raja SV, Thomas LJ. Peri-implant esthetics assessment and management. *Dent Res J* 2013;10:7–14.
21. Garber DA, Rosenberg ES. The edentulous ridge in fixed prosthodontics. *Compend Contin Educ Dent (Lawrenceville)* 1981;2:212-23.
22. Fu J, Lee A, Wang H. Influence of Tissue Biotype on Implant Esthetics. *Int J Oral Maxillofac Implants*. 2011;26:499–508.
23. Esquivel J, Gomez Meda R, Villarroel M. Timing implant provisionalization: Decision making and systematic workflow. *J Esthet Restor Dent* 2024;36:858–67.
24. Blatz MB, Hürzeler MB, Strub JR. Reconstruction of the lost interproximal papilla--presentation of surgical and nonsurgical approaches. *Int J Periodontics Restorative Dent* 1999;19:395–406.
25. Kokich VG. Esthetics: the orthodontic-periodontic restorative connection. *Semin Orthod* 1996;2:21–30.