

Implants in Esthetic Zone

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Abstract:- Oral rehabilitation has undergone a revolutionary change thanks to the development of osseointegration by Branemark and colleagues, as well as the use of dental implants to replace missing teeth. In edentulous or partially edentulous individuals, implant-supported restorations are fairly predictable, according to numerous studies. Early on in the development of contemporary implantology, tissue health and implant survival were the main priorities. In the past ten years, there has been a growing understanding of how important esthetics along with health contributes to the success of the final restoration. It does, after all, stand for a particular facet of health. As well as being functional, esthetic restorations are becoming more and more in demand from patients. Contrary to implants in the early stages of osseointegration, numerous implants are currently being placed in the maxillary region and other esthetically delicate places. The placement of implants to replace one or more teeth in the esthetic zone can be quite challenging for a dentist, especially in regions where there are several missing teeth as well as soft tissue or bone insufficiency. Preserving or creating the soft tissue scaffold necessary to mimic a natural tooth can be quite difficult. The placement of dental implants in the esthetic region is a sensitive technique with limited margin for an error. A small error in the implant's location or incorrect soft- or hard-tissue care could lead to esthetic failure and patient dissatisfaction.

Keywords:- Esthetic Zone, Implants

I. INTRODUCTION

The dentoalveolar segment, which includes the teeth, gingiva, and lips, is an essential esthetic zone. Together, these factors influence the patient's smile and facial beauty. Therefore, esthetic implant therapy not only aids in the patient's quest for the perfect smile but also tackles the need for impairment and handicap brought on by the esthetic deficiency¹. Through continual research and development, the evolution of implant dentistry has proceeded with notable improvements in biomaterials and clinical methods².

In the current situation, esthetic implant therapy attempts to produce an exceptional likeness and functional treatment outcome inside the given edentulous area. In an

esthetically challenging condition, it's important to remember that the prosthetic tooth's shape, size, placement, and colour must completely match the opposing tooth. It's also important to build healthy peri-implant soft tissue. The soft tissue profile is a common esthetic concern in today's implant dentistry. For many years following the introduction of the Branemark system, the esthetic criteria was ignored. Palacci was the first medical professional to take into account the peri-implant zone's esthetic issues⁵.

➤ *From a Surgical Perspective, the Primary Esthetic Goals of Implant Therapy are:*

- *Creating a Harmonious Gingival Border without Significantly Altering the Tissue's Height*
- *Preserving the Papillae's Integrity*
- *Achieving a Convex Alveolar Crest form⁶.*

The cornerstone of implant treatment in the esthetic zone is proper interdisciplinary treatment planning. It necessitates careful consideration of the technical, surgical, and prosthetic components of the care to be given. The Systematic and Interdisciplinary Approach is the first of several elements to be taken into account during the treatment planning process. The patient's medical, dental, and psychological assessments are included in this. Restorative factors for implants in the esthetic zone are then discussed. Functional, biological, and esthetic issues are the three main considerations in restorative care⁷. It is essential to have adequate bone and soft tissue in the apico-coronal, mesio-distal, and buccolingual dimensions, as well as the correct implant angulations, to achieve overall aesthetic and functional success surrounding implants.

The aim of surgical therapy is to set implants in such a way that the anterior maxilla's dental implant restorations can effectively blend in with the surrounding natural dentition⁸.

Surgical placement of dental implants in locations that will lead to the best possible implant restoration is advised as part of a restorative-driven strategy. In order to do this, dental implants must be inserted in locations where there is sufficient bone volume and soft tissue contouring. Typically, this entails the use of bone grafts and soft tissue

augmentation to correct the shortage in bone and soft tissue and produce the best locations for implant insertion.

The accomplishment of four goals—placing dental implants in ideal positions with adequate bone and soft tissue support, correction of any discrepancies in soft tissue contour and form, and ensuring adequate tissue support for facial aspect and embrasure areas—is crucial to the success of restorative-driven implant placement in the anterior maxilla. The placement of a permanent implant restoration that blends in with the surrounding soft tissue and neighbouring teeth without significantly changing colour or contour are the final two elements. Other components include the use of temporary restorations to shape soft tissue around implants before a permanent implant restoration⁸.

II. ESTHETIC ELEMENTS FOR HARD AND SOFT TISSUE

➤ *Optimal Soft Tissue Esthetics*

The degree of a person's concern with soft tissue esthetics will likely depend on how much gingival display that person has. However, regardless of gingival presentation, individual personal preference and esthetic requirements may range from frank indifference to an obsessive attention to detail and a need for perfection, even when soft tissues are not apparent in their regular smile⁹.

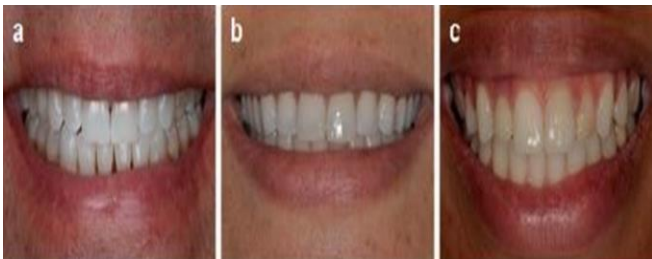


Fig 1 (a) - (a) patient with low smile line. There is limited or no gingival display while smiling. (b) patient with average smile line. There is partial gingival display while smiling. (c) patient with high smile line. There is significant gingival display upon smiling⁹



Fig 2 In a normal dentition without restorations or missing teeth, ideal periodontal esthetics exist. The shapes of soft tissues are bilaterally symmetrical. Up to the point of contact, papilla fill the interproximal voids. Each tooth's axial inclination affects the gingival border, which follows the cemento-enamel junction and has its zenith coincident with or just distal from the midline, as shown by the dotted line through the tooth's long axis⁹.

➤ *Soft and Hard Tissue Esthetics Determinants*

Periodontal soft tissue esthetics are influenced by many variables including

- Tooth size, position, and proximity to neighbouring teeth.
- Periodontal biotype.
- Supporting bone.
- Periodontal health.

All of these factors will also influence peri-implant soft tissue esthetics⁹

III. ANALYSIS CRITERIA FOR ANTERIOR ESTHETICIAN

After acquiring information such as a thorough medical and dental history, clinical findings, pictures, mounted diagnostic casts, and radiographs, the restorative dentist will design and oversee the plan. It will be necessary to consult with additional specialists (such as an endodontist, an orthodontist, a periodontist, and an oral surgeon) in order to address any occlusal, skeletal, and space issues as well as periodontal and endodontic health concerns. A correct diagnosis and knowledge of the long-term prognosis are necessary to develop an integrated treatment plan.

The team's treating specialists must work together to analyse their findings, which may include the following tests:

➤ *Periodontal Examination*

If periodontal disease is present, determining the attachment level (probing depths and gingival recession) as well as any contributory elements, such as mucogingival problems (lack of keratinized connected tissue) and furcation involvement, will have an impact on the prognosis of the remaining teeth. A bone sounding is the most reliable clinical sign for identifying the attachment level. The interproximal attachment level on the teeth close to a possible implant site will determine the future gingival architecture.

➤ *Occlusal Analysis*

It is important to identify patients who have occlusal wear or abfraction type problems as a result of clenching or bruxism. A thorough evaluation covers the occlusal arrangement and recommendations for lateral and protrusive motions. Mounted diagnostic casts are used to assess occlusion. It is crucial to consider the degree of accessible restorative space, as well as the amount of vertical and horizontal overlap.

➤ *Endodontic*

It is necessary to determine the vitality and endodontic integrity of the remaining dentition. It is necessary to assess any pathological alterations, such as periapical lesions and incomplete root canals already present. Any tooth with a poor endodontic prognosis should undergo a thorough risk

evaluation in order to prevent compromising future implant sites.

➤ *Restorative*

Predicting the future gingival contours of the teeth next to the implant site is crucial in the esthetic zone. A bad or hopeless prognosis will be given for teeth that are fractured, broken down beyond expected restoration, or have compromised support. Prior to removal, each tooth's strategic value must be assessed. Even teeth with a poor prognosis can frequently be saved in complex instances in the initial stages to support a fixed interim prosthesis while implant healing develops. The complicated case will be managed with this stepwise strategy of progressive extraction, sometimes over extended stretches of time (two years), as the implant sites mature and heal.

➤ *Orthodontic Analysis*

It is important to pay close attention to the roots' position and angulation within the alveolar bone. The tipping and drifting of the remaining teeth can occasionally result in space problems, especially mesially-distally. When opening or closing spaces in relation to root placements, the orthodontist must have clear instructions. Radiographs will

be used during treatment to offer information. It is important to pay close attention to the root's position and angulation within the alveolar bone. The tipping and drifting of the remaining teeth can occasionally result in space problems, especially mesially-distally. Clear directions must be given to the orthodontist when opening or closing spaces with relation to root positions.

• *Radiographic Examination*

In the pre- and postoperative examination of implants in the esthetic zone, radiography is a crucial diagnostic tool. Information on the morphology, volume, and orientation of the alveolar ridge must be gathered before the doctor moves further with implant placement. The vicinity of important structures, the presence of anatomical variations, and the absence of pathology must all be considered while evaluating the area. The clinician can choose from a variety of imaging modalities to achieve this. These alternatives include cross-sectional imaging modalities like computed tomography (CT) and cone-beam computed tomography (CBCT), as well as conventional plain-film radiography like periapical and panoramic radiographs¹⁰.



Fig 3 Using a medium field of view, cone-beam computed tomography images were acquired in the multiplanar view (MPR). Axial image of the mandibular arch in (a). Sagittal view of the central incisors in (b). (c) A coronal image showing the molar tee¹¹

Imaging modality	Advantages	Disadvantages
Periapical radiography	High resolution, accessible, low radiation exposure, inexpensive	Limited anatomic coverage, 2D, susceptibility to distortion
Panoramic radiography	Broad anatomic coverage, low radiation exposure, inexpensive	2D representation of anatomy, unequal and unpredictable magnification, low resolution
Cone-beam computed tomography	Accurate 3D representation of anatomy, reliable linear measurements, good resolution	Less accessible, expensive, higher radiation dose than 2D

Fig 4 Radiographic imaging of implants: A comparison of methods¹¹

IV. SURGICAL CONSIDERATIONS

The surgical strategy needs to be carefully planned and carried out. For implant insertion and rehabilitation in the esthetic zone, Tischler has established guidelines¹². The surgeon should, in accordance with these recommendations:

- *Employ a conservative flap design,*
- *Evaluate the preexisting bone and soft tissue,*
- *Precisely time the placement,*
- *Visualise the implant's three-dimensional position,*
- *Take into account the healing period before implant loading,*
- *Take into consideration about the factors that influence the emergence profile*
- *Select the right abutment and final restoration design.*

The effectiveness of the restoration depends on four positional factors, all of which must be carefully taken into account during implant placement¹³. These include the angulation of the implant as well as the **buccolingual, mesiodistal, and apicocoronal** placements in relation to the implant platform. Design considerations for prosthetics, such as whether they are screw- or cement-retained, are crucial as well.

➤ *Buccolingual Position*

An implant that is positioned too far buccally frequently causes buccal cortical plate dehiscence and high risk of gingival recession. The healing of the implant is also made significantly more difficult by this placement¹⁴. A suitable emergence profile is produced, the restorative process is simplified, and oral hygiene is made easier with an implant that is properly buccolingually positioned¹⁵.

The desired crown placement, as well as the features of the implant and abutment, influence the optimal buccal-lingual position. The crown should naturally arise from the soft tissue scaffold during implant placement in order to mimic a natural tooth¹⁶. To achieve this, the implant's centre line must frequently be situated at or close to the centre of the tooth it replaces¹⁷.



Fig 5- Implant positioned buccolingually. An imagined line that reaches the incisal borders of the surrounding teeth is touched by the buccal portion of the implant platform¹⁷.

➤ *Mesiodistal Position*

The available mesiodistal space must be precisely measured in order to choose the right implant and arrange for the right implant spacing in order to prevent an unpleasant esthetic result. A minimum gap of 1.5 to 2 mm should be kept between implants and neighbouring teeth when there are multiple implants, with a spacing of 3 to 4 mm between each implant at the implant abutment level¹⁹. The horizontal distance of the implant fixture from the tooth or implant is highly inversely linked with crestal bone loss at neighbouring teeth or between implants. It could be better to position the implant slightly distally in order to match the natural symmetry of the maxillary central incisor.

➤ *Apicocoronal Position or Countersink*

To hide the metal of the implant and abutment, the implant must be positioned apically. The osteotomy site may need to be countersunk to achieve this placement. This will be done to varying degrees, and how it is done will be determined in part by the implant head's design. The implant diameter²⁰ has some bearing on the amount of countersinking necessary. The emerging profile is often better when implant is placed more apically²¹. The repair is more esthetically pleasing (and the surrounding tissue is less healthy) the more apical the implant placement.

Excessive implant countersinking can result in saucerization, which is an unfavourable loss of crestal bone around the implant's perimeter, and subsequent gingival recession following loading. On the other hand, shallow implant placement might result in a damaged restoration without a progressive, appealing emerging profile, obvious metal edge, or optical reflection²². In the absence of gingival recession, it is frequently appropriate to locate the cemento-enamel junction (CEJ) of nearby teeth as a point of reference to determine the apicocoronal position of the implant platform. The sink depth of the implant shoulder, whether it is a one-stage implant or a two-stage implant, should be between 1 and 2 millimetres (mm) apically to the imaginary line connecting the mid-buccal of the neighbouring teeth's CEJs without the implant.

The CEJs of the nearby teeth must be taken into account. For instance, the CEJ of the canine and central incisor next to it are typically situated 1 mm further coronally than the CEJ of the maxillary lateral incisor. In the presence of gingival regression, the mid-buccal gingival margin can be used as a reference rather than the CEJ²³.

V. SOFT TISSUE AUGMENTATION FOR IMPLANT DENTISTRY²⁴

Surgical techniques to increase the width of inadequate mucosa are typically used before implant implantation or when submerged implants are accidentally exposed.

- *Apically positioned flaps (APFs).*
- *APF/Vestibuloplasty (APF/V) combined with autogenous tissue (subepithelial connective tissue graft [SCTG]/free gingival graft [FGG]).*

- FGG
- The epithelialized palatal graft method
- SCGT technique or Acellular dermal matrix graft (ADMG)/ collagen matrix (CM)

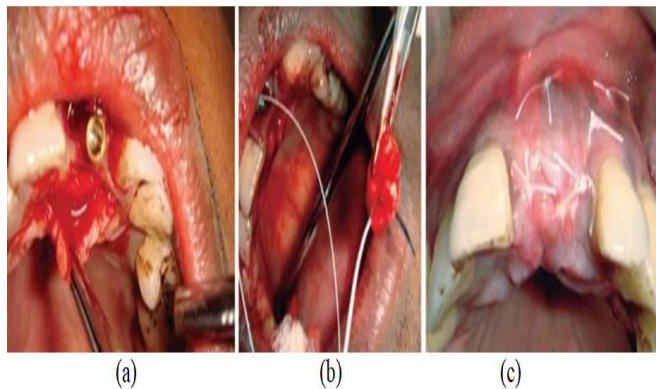


Fig 6 -connective tissue graft for augmentation of buccal keratinized tissue (purse string technique): (a) connective tissue graft donor site (palatal) in relation to 21 (b) CTG graft threaded on the eptfe suture (c) CTG graft sutured ²⁴



Fig 6 (c)- 2 months postoperative after buccal tissue augmentation with prosthetic abutment placed

➤ Pink Esthetic Score /White Esthetic Score

Achieving clinical esthetic success depends critically on the soft tissue esthetic outcome. The pink aesthetic score /white aesthetic score (PES/WES) can be used to assess the esthetic outcome of peri implant soft tissue²⁵. In order to achieve continuous improvement in PES score, connective tissue grafts may be required in around one-third of patients after immediate implant placement after tooth extraction²⁶. When followed for at least three years following crown installation, CTG augmentation during Stage 2 implant surgery or after final restoration indicated spontaneous improvements of PES score in the short-term follow-up²⁷.

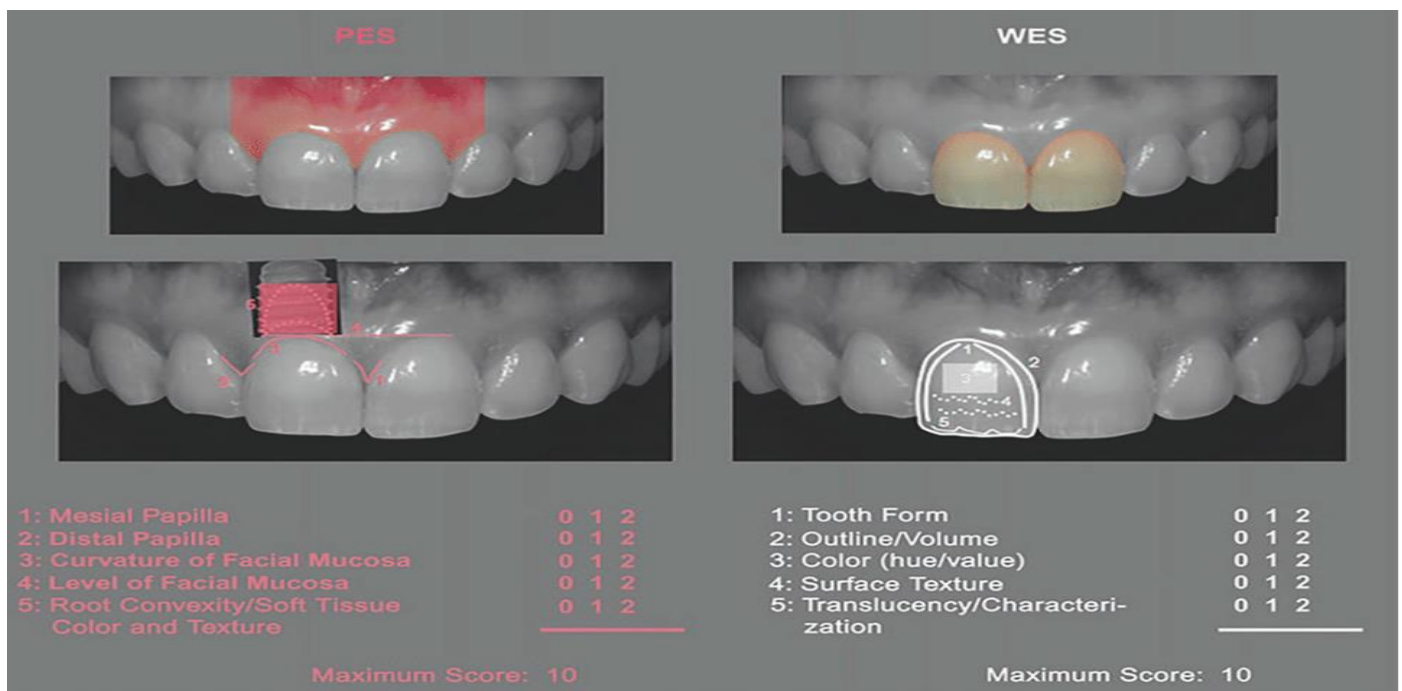


Fig 7- PES and WES ²⁵

➤ Allografts

FGGs and CTGs are associated with considerable patient morbidity because of the wound at the palatal donor site and the likelihood of insufficient donor tissue. To make up for these shortcomings, soft tissue replacements have been used. Acellular dermal matrix graft²⁸ and human fibroblast-derived dermal replacement are two types of dermal allografts that have been used for palatal donor tissue. Allograft materials led to an increase in keratinized tissue width²⁹.

➤ Xenografts

Allografts come from human cadavers, which raises potential ethical issues as well as the danger of disease transmission. Collagen membrane (CM) of porcine origin, which has been employed with oral wound-healing/around natural teeth, has been tried to overcome the aforementioned drawbacks³⁰. In comparison to autogenous CTGs, Mucograft, a collagen matrix of porcine origin, successfully enhanced the width of keratinized gingiva while also improving the esthetic results³¹.

VI. HARD TISSUE AUGMENTATION (ESTHETIC ZONE)

➤ Anterior Jaw Regions

A surgery to increase the sagittal and/or vertical bone dimensions will be necessary if there is less vertical bone volume. Studies using autografts, allografts, xenografts, and alloplasts for vertical and sagittal bone augmentation at single tooth implants have all demonstrated similarly successful and comparable outcomes. No augmentation method appears to be better than another³².

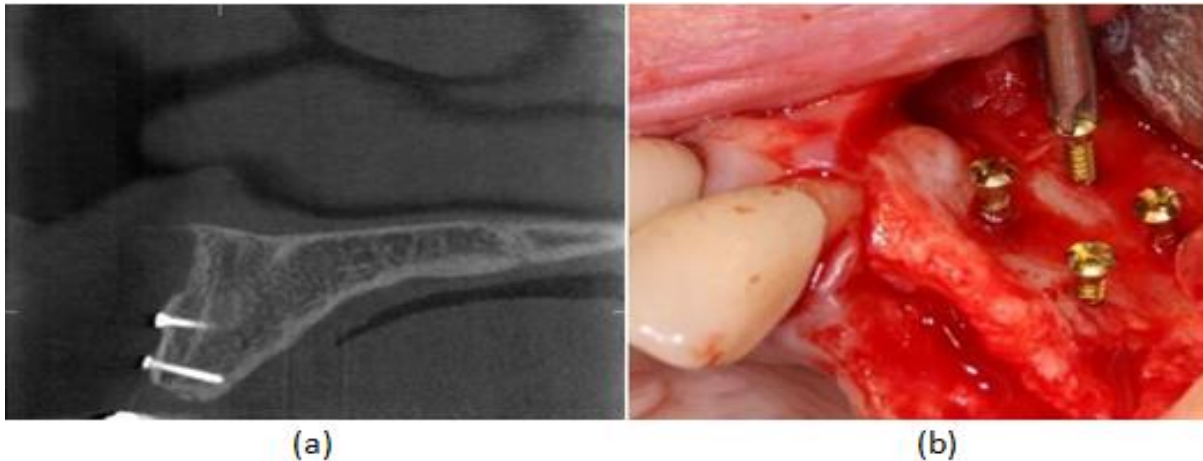


Fig 8 (a)- Radiograph of buccal onlay block bone fixed with two mini-screws(b)Mini screws used as tent-poles to keep bone particles in position³²

➤ Timing of Implant Placement

Following tooth extraction, implant can be placed

- *Immediately (Type 1)*
- *Early after soft tissue healing (Type 2)*
- *Partial bone healing (Type 3)*
- *After complete socket healing (Type 4)*³³.

4 to 8 weeks after tooth extraction, Type 2 placement is the recommended technique for the esthetic zone. At that point, the buccal wall has somewhat flattened due to a bundle of bone resorption, and the soft tissue has healed. The fundamental goal of this protocol is to repair the soft tissue in a way that gives it enough volume and creates a large zone of keratinized mucosa that enables tension-free primary closure after guided bone regeneration surgery. The possibility of esthetic issues is reduced in this approach.

It is required to deviate from this technique when there are significant apical bone abnormalities that affect the stability of the initial implant. In such a situation, early implant placement with partial bone healing following 12 to 16 weeks (**Type 3**) is indicated.³³



Fig 9 Type 2 placement.(a) Following GBR, the soft tissue recovered entirely and allowed for the initial tension-free closure.³² (b) Bundle bone resorption has caused a little flattening of the buccal wall³⁴.

Classification	Advantages	Disadvantages
Type 1	<ul style="list-style-type: none"> • Extraction and implant placement are combined in the same surgical procedure • Reduced overall treatment time compared to types 2, 3, and 4 an implant in an ideal position • Peri-implant defects often present as two- or three-walled defects, which are favorable for simultaneous bone augmentation procedures 	<ul style="list-style-type: none"> • Morphology of the site may increase the difficulty of placing • Morphology of the site may compromise initial implant stability • Lack of soft tissue volume makes attainment of tension-free primary closure more difficult • Increased risk of marginal mucosal recession • Inability to predict bone modeling may compromise outcomes
Type 2	<ul style="list-style-type: none"> • Reduced treatment time • Additional soft tissue volume allows for easier attainment of tension-free closure • Additional soft tissue volume may enhance soft tissue esthetic outcomes • Flattening of facial bone contours facilitates grafting of the facial surface of the bone • Peri-implant defects often present as two- or three-walled defects, which are favorable for simultaneous bone augmentation procedures 	<ul style="list-style-type: none"> • Two surgical procedures are required • Morphology of the site may compromise initial implant stability
Type 3	<ul style="list-style-type: none"> • Allows for resolution of pathology associated with the extracted tooth • Partial bone healing usually allows implant stability to be more readily attained • Additional soft tissue volume allows for easier attainment of tension-free closure • Additional soft tissue volume may enhance soft tissue-esthetic outcomes • Peri-implant defects often present as two- or three-walled defects, which are favorable for simultaneous bone augmentation procedures • Flattening of facial bone contours facilitates grafting of the facial surface of the bone • Allows for resolution of pathology associated with the extracted tooth 	<ul style="list-style-type: none"> • Two surgical procedures are required • Extended treatment time as compared to type 1 and type 2 placement • Socket walls exhibit varying amounts of resorption • Increased horizontal bone resorption may limit the volume of bone for implant placement
Type 4	<ul style="list-style-type: none"> • Bone healing usually allows implant stability to be readily attained • Additional soft tissue volume allows for easier attainment of tension-free closure • Additional soft tissue volume may enhance soft tissue esthetic outcomes and type 3 placement • Allows for resolution of pathology associated with the extracted tooth 	<ul style="list-style-type: none"> • Two surgical procedures are required • Extended treatment time compared to type 1, type 2, • Socket walls exhibit greatest amounts of resorption • Greatest chance of increased bone resorption limiting the volume of bone for implant placement

Fig 10- Advantages and Disadvantages of Type1, Type2, Type3, Type 4³³

In the esthetic zone, immediate implant insertion is extremely difficult. Only a small percentage of patients who are low risk for esthetic issues, have healthy bone walls, thick facial bone walls (at least 1 mm), no infections at the extraction site, and enough bone volume to support the primary implant are candidates for this approach³³. Even if the treatment period is shorter and there is ideal bone volume for implant insertion, rapid procedure is linked to a higher risk of gingival recession. Immediate implant insertion protocol under unfavourable gingival biotype conditions, a patient's absence of bone or soft tissue, or a high smile line can all result in esthetic failure, which is crucial in the esthetic region^{33,34}

➤ *Implant Placement in Edentulous Sites*



Fig 11- Immediate implant placement. Implant positioned in the fresh extraction socket³⁵

When an edentulous site in the esthetic zone is planned for implant placement, the site must be thoroughly evaluated. Garber has proposed a classification for such sites³⁶. This classification depends on the type of reconstruction needed to get good positioning of the implant.

➤ *Garber Class I*

When both the horizontal and vertical levels of soft tissue and bone are favourable, selecting the optimum placement for an implant is an easy task. It is ideal to perform a soft tissue augmentation at the same time as implant placement in order to lower the risk of soft tissue recession and buccal bone resorption in patients with a thin gingival biotype.

➤ *Garber Class II*

According to the method proposed by Summers³⁷, sites with no vertical bone loss and a small horizontal bone shortage measuring 1 to 2 mm narrower than usual can be extended by employing successive osteotomes rather than drilling. By compressing the maxillary cancellous bone while slightly expanding the bony ridge horizontally, this procedure will enhance the bone's quality³⁸

➤ *Garber Class III*

If an initial stability is attained, implant placement can be tried in sites with no vertical bone loss and horizontal bone loss greater than Class II. Bone regeneration that is guided is required.

➤ *Garber Class IV*

In areas with negligible vertical bone loss but considerable horizontal loss, it is crucial to use a staged strategy in which the ridge is extended with directed bone regeneration. After a few months of required healing time³⁸, implants are then placed using block bone grafts or GBR methods.

➤ *Garber Class V*

Sites with considerable apicocoronal bone loss pose a surgical challenge. As was already said, there are no reliable surgical techniques that can consistently increase bone ridge height. According to some case reports, GBR utilising a non-resorbable membrane and delayed implant implantation are surgical approaches³⁹.

VII. ADVANCES IN IMPLANT DENTISTRY

➤ *Custom Implant using Three-Dimensional Printing*

The use of CAD/CAM as a supportive tool to enhance the outcomes of implant therapy has increased with the development of implant dentistry. For challenging circumstances where standard abutments might not offer an acceptable choice for a future prosthesis, customised implant abutments have been successfully manufactured utilising CAD/CAM. In order to give a more correct impression in such circumstances, customised coping was also produced in addition to customised abutments⁴⁰.

Clinicians have proposed ideas for applying 3DP and CAD/CAM at the planning stage of implantation, in addition to their use in the production of prosthesis-related components. Cone beam computed tomography (CBCT) along with CAD/CAM have been recommended in order to provide a surgical guide for implant placement⁴¹.



Fig 12 The surgical guide for implant placement. CBCT and CAD/CAM are used to produce a surgical Guide for implant placement⁴²

VIII. CONCLUSION

- Due to the need to produce the best possible aesthetic outcome, implantological rehabilitation of the esthetic zone is one of the most demanding and complicated treatments. The following conclusions can be reached from the extensive clinic experience and relevant literature:
- Immediate placement is less traumatic for the patient as there are fewer surgical procedures involved, and patients tend to prefer this clinical approach regarding quality of life. Immediate placement can be a successful procedure in terms of esthetics, but it is technique sensitive and requires an experienced team. The diagnostic step is crucial for treating bone and soft-tissue injuries as well.
- Infected sites can be loaded immediately post-extraction.
- The fixture should be positioned according to generally accepted standards, however the vestibular/palatal position of the implant depends on the abutment morphology.
- When a shoulderless abutment is used, the long axis of the implant, aimed at the incisal edge of the future restorations, is the most suitable implant position since it permits a restorative crown morphology with a cervical contour similar to a natural tooth.

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