

Single tooth implants

Since the predictability of osseointegration is well established, successful placement of implant-supported restoration in edentulous and partially edentulous patients has been well documented. Currently, treatment success is measured not only by osseointegration, proper function and longevity but also by the aesthetics of the restoration. The aesthetic restoration must possess a form that complements the surrounding tissues and facilitates proper plaque control and occlusal function.

Anterior single tooth replacement is the ultimate challenge facing the restorative dentist. Treatment modalities for a missing single tooth include:

- 1- Conventional fixed bridge.
- 2- Removable partial denture.
- 3- Resin-bonded bridge.
- 4- Implant-supported prostheses.

Many aspects should be considered when replacing a missing single tooth:

- 1) Predictability of the aesthetic result before treatment.
- 2) Preservation of tooth structure.
- 3) Preservation of periodontal tissue and alveolar bone.
- 4) Optimal functional goals (e.g., mastication, phonetics).
- 5) Potential treatment problems for patient, dentist and dental technician.
- 6) Biocompatibility of materials used.
- 7) Restoration time.
- 8) Financial aspects.
- 9) Long-term results.
- 10) Future service needs.

The fixed bridge can be fabricated in shorter time, is more predictable and satisfies the criteria of normal contour, comfort, function, aesthetics, speech and health.

However, a single crown has a clinical longevity of 50% for 13 years. Also, the risk for future endodontic treatment is higher with the crown. Daily care on the natural abutments for a fixed restoration is more difficult and the risk of caries is greater than for an unrestored tooth.

On the other hand, removable partial denture is rarely accepted by the patient as a substitute for a single tooth. The usual obligation for using this option is economics.

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The third modality is the use of a resin-bonded prosthesis that is more commonly used as a temporary solution during implant healing process. The usual cause of failure for such prosthesis, is debonding which often occurs during function, this in turn may cause the patient embarrassment and insecurity.

In conclusion, when adjacent teeth are healthy, with acceptable aesthetics and contour or in the presence of diastemas that the patient wishes to maintain, or when the patient refuses the preparation of adjacent teeth for the fabrication of a traditional three-unit fixed partial restoration, a single tooth implant is the natural solution.

This modality offers other advantages including its retrievability compared with other options, and the ability to clean the proximal surfaces of the adjacent teeth and root surface.

Indications for single tooth replacement by implants:

Single tooth implant is indicated when: -

- 1- Adjacent teeth are healthy and have acceptable or perfectly formed crowns.
- 2- Natural diastema exists within the arch and the patient wishes to keep it.
- 3- The patient wishes to keep adjacent teeth intact. Their point of view is that a one-tooth replacement is superior to a three-tooth replacement. But unfortunately, tooth loss usually results in inadequate width of bone for ideal implant insertion. Therefore, the implant dentist must consider bone augmentation procedures.
- 4- Anterior single tooth implant is also indicated in case of congenitally missing tooth. The most common congenitally missing anterior tooth is the maxillary lateral incisor that can be successfully restored with implant. However, the roots of adjacent teeth often impinge on the edentulous zone and sometimes, the mesiodistal length is insufficient so orthodontic therapy before implant placement should be considered.

Contraindications for single tooth replacement:

Single tooth replacement by implant is contraindicated when:

- 1- Inadequate bone volume as a result of irreversible loss of alveolar bone, which suggests the use of bone grafting procedures. Without a bone graft, the decreased width mandates a more palatal and apical placement of the implant. The final crown appears longer than the adjacent teeth, and the prosthetic solution often compromises long-term daily maintenance of the facial sulcular region. Therefore, the majority of maxillary anterior single tooth implants require bone grafting for ideal esthetics and hygiene in the cervical region. The bone available to place the implant must be evaluated in both facial palatal width and mesiodistal length.
- 2- Adjacent roots are in close proximity to implant site. As a result, smaller diameter implants may need to be selected that satisfy the mesiodistal and height requirements but often compromise the facial crown contour, requiring the creation of an overcontoured facial emergence profile, which has long-term maintenance limitations. The potential damage to adjacent roots caused by angulation and proximity is an obvious limitation of the procedure and should be carefully

considered and reviewed with the patient.

3- Mobility of 2 to 4 adjacent teeth which may be caused by past periodontal disease. As a consequence, the adjacent teeth move out of occlusion during excursions and the load of several teeth may be exerted solely upon the implant. So presence of anterior mobile teeth contraindicates the use of implant, unless the occlusion is relieved to distribute forces to the natural teeth. If the mobility of the surrounding teeth is too great for proper occlusal adjustment, the single tooth implant should not be considered.

4- Arch relationship is unfavorable. Patients with Angle's class II division II skeletal patterns or diminished vertical space should not receive implants without the prior corrections of the occlusal plane and inadequate maxillomandibular relationships.

Anterior maxillary single tooth implant limitations:

1- Time of the treatment: The time required for a rigidly fixated implant to heal and be restored is approximately 5 to 7 months. Whereas, a traditional three-unit, fixed prosthesis could be completed in less than three weeks.

2- The transitional appliance required: the transitional restoration for a single tooth implant is often a removable prosthesis that lack stability and retention. The soft tissue-borne transitional may cause bone loss around the implant during stage I healing, and may depress the interdental papillae of the adjacent teeth. While the transitional restoration for a three-unit bridge is an acrylic fixed prosthesis, fabricated in the same day of the procedure.

3- Challenging esthetics: the esthetics of a maxillary anterior single crown on natural tooth is one of the most difficult challenges in restorative dentistry. The challenge on an implant abutment is even greater. As the implant is round in cross-section, the cervical esthetics of a single implant crown must accommodate this round diameter and balance hygiene and esthetic parameters. Also, additional prosthetic steps and components are required to render the illusion of a crown on a natural abutment.

4- Increased risks of failure: the consequences of failure are greater for a single tooth implant, compared with a three-unit fixed bridge. As the implant failure may result in bone loss that requires bone grafting. The doctor must put in mind that the patient believes the early implant failure, at least in part, the doctor's responsibility.

5- The training for a single tooth implant is acquired in continuing education programs after graduation or through several trial and error experiences. While the training to perform a three-unit fixed prosthesis is acquired in dental school.

6- The equipment to prepare and deliver fixed partial denture is present in any general dentist office. Whereas, the electric motor, handpiece, and inventory to place a single tooth implant are additional expenses which all in turn affect the cost of the procedure.

Cement versus screw-retained prostheses:

The ideal implant position is directly under the incisal edge of the crown, so that a straight abutment for cement retention emerges directly below the incisal edge. So, a greater range of corrective options exists with a cement-retained crown for implants not ideally placed. Also, the location of the cervical margin of a cemented crown can be anywhere on the abutment post provided it is 1mm or more above the bone. The fixation screw for a screw-retained prosthesis must fit within the cingulum of the tooth for ideal esthetics, therefore, the screw-retained crown requires a more exact surgical placement. Since the long axis of the implant for a screw-retained crown must emerge in the cingulum position, this often requires a buccal correction facing away from the implant body. This modified ridge lap crown has become the common solution to improve the esthetics of the restoration. However, plaque control in the facial of the implant is almost impossible. Disadvantages of this situation include off-axis mechanical loads, increased forces and moment loads on all components. As a conclusion, incorrectly angled implants should be considered for removal as early as identified, rather than attempting inventive prosthetic strategies.

Treatment considerations:

The restoration of a single missing tooth with an implant-supported prosthesis in the aesthetic zone requires not only osseointegration, but also the maintenance of an aesthetic hard and soft tissue complex.

The aesthetic zone has been defined as the area incorporated by the lip perimeter. The relationship of the three components involved in the smile (teeth, lips, gingiva) determines whether or not a particular smile is deemed attractive. Many steps should be considered in order to achieve optimal aesthetic in an implant-supported anterior single tooth restoration.

Presurgical planning:

The presurgical planning represents the decision-making step in the treatment protocol in order to achieve the best aesthetic result. Many factors should be evaluated prior to performing the surgery including bone, soft tissue, lip line, tissue biotypes, etc.

1- Bone quantity and quality: The volume and contour of available bone may require augmentation to ensure the stabilization of the implant at stage I surgery and to serve as a scaffold for an aesthetically acceptable soft tissue profile. The use of different radiographic views is mandatory in order to assess the remaining alveolar bone and to decide whether grafting procedures are needed or not. The volume of the osseous structure must allow for implant placement in an ideal situation for the restoration. Also, bone volume is the prime factor that ensures

proper aesthetic outcome, as it is the hardware that supports the software on top. After proper evaluation, the decision should be made to augment the area for the redevelopment of the lost hard tissue topography. Also, the clinician should decide either to augment the area before or at the time of implant placement.

2- Soft tissue quantity and quality: The evaluation of the soft tissue should determine the presence or absence of gingiva and its dimensions in height and width. The evaluation of the gingiva should assess the quality, the quantity, the color, the type, the level and the stability. The thickness of the soft tissue will dictate the length of the submarginal component of the restoration. If the soft tissue is greater than 3.5mm, reduced access for oral hygiene will be the result. A wide band of keratinized mucosa is preferable for the stability of the tissues surrounding the implant components. Presence of enough keratinized tissues allow for predictable manipulation of the soft tissue forming the outer frame around the implant-supported prosthesis. Preservation of the papillae is critical to the aesthetic result. The level of the papilla is determined by several factors:

- . 2 Peak of the interproximal bone.
- . 3 Type of periodontium.
- . 4 Distance from interproximal contact to the alveolar crest.
- . 5 Interproximal distance of the adjacent teeth.
- . 6 Absence or presence of a diastema.

On a healthy periodontium, the peak of the interproximal bone is:

- 2 1.2mm to 1.5mm from cemento-enamel junction (CEJ).
- 3 5mm from contact point.
- 4 Pyramidal on anterior teeth.
- 5 Flat on posterior teeth.

In this stage, the decision to proceed with any soft tissue grafting should take place before or after implant placement depending on the presence of a stable keratinized band and whether it is required to attain optimal results.

3- Tissue biotype: Two types of periodontium exist in the oral cavity:

- 2 Thin, translucent and scalloped.
- 3 Thick, opaque and flat.

Each of these two types has its own shape of dentobiologic characteristics and distinctive surrounding structures. Therefore, distinguishing between these two types is mandatory for the proper selection of the implant type and size in order to reach a stable biological balance.

The thin, scalloped type of periodontium is characterized by the following;

- . 2 Distinct disparity between location of the gingival margin on the direct facial and that found interproximally.
- . 3 Delicate and friable soft tissue curtain.

- 4 Underlying osseous form that is scalloped and often has dehiscence and fenestration.
- 5 Small amount of attached masticatory mucosa, both quantitatively and qualitatively.

The thin, scalloped periodontium reacts to insult by recession, both facially and interproximally. The tooth form that is most often present in this type of periodontium possess the following criteria:

- 6 Subtle, diminutive convexities in the cervical third of the facial surfaces.
- 7 Contact areas of adjacent teeth located toward the incisal or occlusal third.
- 8 Triangular anatomic crowns.
- 9 Contact areas of adjacent teeth that are small faciolingually and incisogingivally.

The thick, flat type of periodontium is characterized by the following:

- 10 Less disparity between the location of the gingival margin on the direct facial and that found interproximally.
- 11 Dense, fibrotic soft tissue curtain.
- 12 Flat, thick underlying osseous form.
- 13 Large amount of attached masticatory mucosa, both quantitatively and qualitatively.

This type of periodontium often reacts to insult by pocket formation. The tooth form that is most often present with this type possess the following criteria:

- 14 Bulbous convexities in the cervical third.
- 15 Contact areas of adjacent teeth located toward the apical areas.
- 16 Square anatomic crowns.
- 17 Contact areas of adjacent teeth that are large faciolingually and incisogingivally.

The thin, scalloped periodontium is known to be more demanding and tends to recede following implant placement, while the thick, flat periodontium tends to be more forgiving.

3- Emergence profile: Natural teeth exhibit a flat emergence profile, therefore the future implant should possess the same flat emergence profile. Achieving such a goal provides optimal esthetic result, simulating the adjacent natural teeth. The faciolingual consideration in placing the implant is critical to the development of a proper emergence profile. The biologic width composed of the connective tissue attachment and the epithelial attachment, and the sulcus that extends coronally above the osseous level, should measure a minimum of 3mm. The use of an accurately fabricated surgical template ensures proper implant positioning, thus allowing the

production of an accurate emergence profile.

5- Lip line and smile line: The high lip line shows the maxillary dentition and a large area of the gingiva. The medium lip line shows only the maxillary dentition and gingival embrasures, while the low lip line shows only part of the maxillary dentition.

The high lip line is the most critical for implant restoration because during smiling, the patient exposes the entire restoration, the restorative gingival frame, the implant prosthetic interface and the expanse of soft tissue below the inferior border of the upper lip. The medium lip line appears to satisfy the current needs of the cosmetic public. The teeth are visible in their entirety, along with the interdental papillae and often a couple millimeters of the free gingival margin. Therefore, the medium lip line is often critical. With the low lip line, the interface between the implant and the restoration is hidden behind the drape of the lip. On view of the above, any mishandling of either bone or soft tissue will show every time the patient smiles, in case of high lip line situation. In order to establish a harmony and symmetry in the smile, the following points should be considered;

· 2 The line joining the crests of the free gingival margins should be parallel to the form of the upper lip.

· 3 The incisal edges of the maxillary teeth should parallel the form of the lower lip.

· 4 The teeth should extend bilaterally to the corner of the smile.

If all these points are not considered, the outcome may be an exquisitely aesthetic implant-supported restoration with an unattractive smile.

3- Lip thickness: Presence of a thick lip is also an important factor to be considered.

Such a lip usually masks the gingival artifacts, thus obscuring defective margins of the restoration if present. So small defects could be accepted in case of thick lip. In some patients, the resorption pattern occurs horizontally leading to the loss of lip support with subsequent reduction in the muscle tone. This dilemma can be solved by bone grafting procedures.

4- Treatment options: The alternative treatment options for the restoration of a single missing tooth include a fixed bridge, a removable partial denture, an acid-etched resin-retained prosthesis, or an implant-supported prosthesis. All these options should be thoroughly discussed in order to reach the best treatment for the patient. Many factors should be in mind to attain the right judgment including condition of the remaining dentition, occlusion, the patient financial situation and the patient aesthetic demands. The clinician must negotiate many factors with the patient in case of single tooth implant-supported restoration such as treatment duration, treatment cost, extra corrective surgeries needed, possible complications and ways of provisionalization. Full understanding of the treatment plan and patient cooperation are very important factors for the success of the whole procedure.

5- Types of intervention: Different surgical approaches have suggested for implant placement including immediate implant placement, delayed implant placement and delayed immediate implant placement. Immediate implant placement has proved to

be highly successful, however this approach needs some prerequisites such as the absence of infection at the extraction site, adequate apical bone to ensure primary stabilization, precise implant placement and adequate implant soft tissue coverage. Immediate placement of the implant in the aesthetic zone present some possible complications such as compromised aesthetic result due to traumatic manipulation of the soft tissue and the decrease in the amount of attached gingiva in order to achieve tension-free closure. This situation could be solved by the use of a palatal rotated pedicle flap to seal the socket, thus keeping the labial soft tissue intact as suggested by some authors. Also, in case of immediate placement, bone grafting procedures should be considered in order to fill the gap between the implant and the socket walls.

The delayed implant placement allow for complete healing of the socket as a waiting period of about six months is left prior to surgical intervention. This approach shows some drawbacks such as bone resorption at the extraction site and possibility of original tooth space loss.

In case of delayed immediate implant placement, surgical intervention is performed after a waiting period of six weeks. This period allows for the development of a soft tissue seal, thus reducing the soft tissue complications and minimizing the rate of bone resorption. However, bone grafting is mandatory when using such an approach.

6- Periodontic considerations: Periodontal health of the patient should be carefully assessed before initiating implant therapy. Cross-infection could occur from sites affected with periodontitis to the implant site leading to peri-implantitis with subsequent loss of the implant later on. This condition is possible as the periodontopathic organisms can be easily transmitted in the same mouth. Therefore, any periodontal problems should be eliminated prior to surgery.

7- Orthodontic considerations: A number of orthodontic procedures could be performed during implant therapy in order to facilitate implant placement. One of these procedures is the orthodontic extrusive remodeling that enhance both soft and hard tissue profiles. This extrusive movement can be valuable to the improvement of the papillary height as well as to allow for more bone deposition beneath the remaining root. Hence the need for bone grafting could be minimized. Another type of orthodontic interference is space creation or development used in cases of diminished space from mesial drifting of the neighboring dentition. This predictable method develop the required space that would accommodate the tooth to be replaced.

8- Number of missing dentition: Restoration of multiple teeth differs from the restoration of a single tooth as different methods should be considered in order to obtain the best aesthetic result. Reducing the number of implants in case of multiple missing teeth will enhance the peri-implant soft tissue architecture at the pontic area. By reducing the number of implants, the clinician could develop the inter-implant papilla by different techniques. On the other hand, using an equal number of implants to replace the same number of missing teeth will make creation of papillary illusions considerably difficult.

9- Implant size selection: The implant size is directly related to the available bone volume. The selection of the implant width and length is based on the diameter of the missing tooth and the proximity of the adjacent roots. As the diameter of the implant decreases, it should be positioned further apically to allow for the transition from the circular crosscut of the implant interface into that of the natural tooth that is to be replaced. In the aesthetic zone, the implant could be

countersunk below the crestal bone, so it may reside up to 4mm below the facial cemento-enamel junction in order to develop the proper crown emergence profile with as flat a contour as possible in order to maintain health, prevent recession and support the adjacent tissue of the adjacent natural teeth. Therefore, the use of all the available bone length in the aesthetic zone may benefit the function but the esthetics would be compromised.

10- Provisional solutions: Many provisional options are available to be used during the healing period of the implant. The decision of which type of provisional restorations to be used must be taken before starting the implant therapy. These options include a removable partial denture, a resin-bonded bridge and temporary implants. The resin-bonded bridge is usually preferred by the patient as it is more secure and comfortable, also it does not exert any pressure on the implant. Also, temporary implants are good solution but it offers additional cost. When using a removable partial denture, the fitting surface must be relieved over the implant head in order to avoid any possible pressure. All these options must be carefully discussed with the patient during the treatment planning.

Implant positioning:

Appropriate implant position enhances the natural aesthetics by providing a better facial profile for the restoration. Fabrication of a proper surgical template is the key to achieve such a goal. Achieving the correct location and orientation of the single implant is primarily dependent on the adjacent teeth, their position in the arch, the occlusal dental relationships and the topography of the alveolar bone. The angulation of the implant should allow the occlusal forces to be directed along the long axis of the implant and the right distribution of the occlusal load. Implant positioning involves three planes: mesio-distal, api-co-coronal and labio-palatal planes.

1- Mesio-distal position:

The mesio-distal position of the implant depends on the width of the coronal edentation, the adjacent root proximity and the presence or absence of diastema. The middle orientation in a mesio-distal direction is mandatory to avoid placing the implant in the interdental papilla position or subsequent approximation of the neighboring roots. The implant should approximate the position from which the natural tooth originally emerged from the gingival sulcus. The mesio-distal implant axis should pass by the center of the future crown or the bisecting line angle of the adjacent roots. When restoring multiple missing teeth, the clinician should pay attention to the mesio-distal space between the implants in order to keep a natural gingival embrasure size. The mesio-distal position determines the selection of the implant and the existence of the interdental papillae.

2- Api-co-coronal position:

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Ideally, the body of the implant must be placed 2mm to 3mm above an imaginary line that connects the cemento-enamel junction of the adjacent teeth. This position will allow the transition from the narrow circular cut of the implant head to that of the natural tooth size at the cervical margin. Also, this distance is necessary to foresee the emergence profile, to accommodate an abutment and to place the porcelain of the restoration subgingivally. Less than 2mm will lead to an aesthetically unacceptable short crown (which is impossible to correct), and more than 3mm will result in an increased pocket depth around the transmucosal insert or the abutment, hindering proper hygienic maintenance. In the maxillary dentition, missing narrow teeth requires less apical implant placement and missing wide teeth requires further apical implant placement.

3- Labio-palatal position:

In order to obtain proper emergence profile, 1mm of bone should be kept labial to the implant. Orientation at 45 degrees to the occlusal plane provides the best facial contour and lip support and requires the fewest compromises in terms of oral hygiene and maintenance. Placing the implant too far palatally will result in a ditched-in restoration with a modified ridge-lap design for the final restoration, which is unfavorable from hygienic and esthetic points of view. Also, it may create increased strain on the implant when loaded. On the other hand, placing the implant too far labially will totally jeopardize the esthetics by having a bulky overcontoured crown that is impossible to correct with angulated abutment. In case of placing the implant in a more palatal direction due to anatomical or clinical obligations, the implant should be placed 1mm apically for every mm that is placed palatally. In screw-retained abutments, the implant is generally placed slightly palatal to the long axis of the crown to access the connecting screw palatally. Whereas, in case of cemented abutment the implant is located exactly in the center of the long axis of the crown. The labio-palatal position should be in the most labial position compatible with the labial bone to avoid jeopardizing the implant fixation, to satisfy the restoration aesthetic result and to prevent iatrogenic gingival recession if the biotype is thin.

Soft tissue management:

For the aim of achieving a natural soft tissue aesthetic result, the contour, height and width of the gingiva at the implant site must correspond to the soft tissue aspects surrounding the natural adjacent teeth. Delicate handling of the soft tissue is considered to be the main factor for achieving optimal aesthetic result. The soft tissue management could be classified according to the timing of clinical intervention into: soft tissue management before implant placement, during implant placement, at the time of abutment connection and after abutment connection. Many techniques were described for soft tissue management including connective tissue grafts, free gingival grafts, modified roll technique, gingival recontouring technique and the use of provisional crowns. Careful understanding of these clinical procedures will lead to proper soft tissue framing replicating the natural teeth appearance.

Soft tissue management before implant placement: -

When there is insufficient soft tissue available to create the desired form of the prosthetic recipient site, it may be necessary to gain more keratinized tissue, this will help minimizing soft tissue complications later on. For example, presence of a remaining root that would be extracted and replaced by implant suggests its reduction in height using a bur below the bone level without traumatizing the gingival margin. This procedure allows the soft tissue to grow by secondary epithelization after a period of time (three to four weeks), closing the alveolar socket over the reduced remaining root. This method will help minimizing surgical trauma usually induced in immediate implant placement by developing new keratinized tissues. Also, this procedure stabilizes the mucogingival junction at its biological level, preserves the anatomical structure and prevents post extraction bone resorption.

Soft tissue management during implant placement:

Management of the mucoperiosteal flap during surgery is considered one of the main factors that influence the soft tissue profile. The horizontal incision should be made along a line connecting the palatal line angles of the adjacent teeth, and the vertical incision should be made at the adjacent teeth. The incision should allow complete mobilization of the mucoperiosteal flap. A preservative interdental papillae incision should be performed as it offers many advantages including:

- . 2 It prevents soft tissue shrinkage after the procedure.
- . 3 It minimizes recession around adjacent roots.
- . 4 It keeps the papilla and interdental bone intact.
- . 5 It is less traumatic.

Another important factor that should be considered is the flap closure. Achieving a tension-free closure of the mucoperiosteal flap is mandatory in order to avoid soft tissue complications. Sometimes it is very difficult to achieve primary closure, especially in case of bone grafting procedures where the height and width of the remaining alveolar bone are increased. The following steps could be undertaken when manipulating the mucoperiosteal flap to achieve tension-free closure over the grafted sites with guided tissue regenerative procedures:

- . 6 Extending the vertical incisions.
- . 7 Undermining the flap.
- . 8 Performing deep basal periosteal slitting.

Soft tissue management at the time of abutment connection:

At the second stage surgery, the gingival margin around the implant can be corrected or improved to a great extent. Many soft tissue procedures could be included in the second stage surgery as the management of the mucoperiosteal flap, the use of connective tissue graft, palatal flap advancement, modified roll palatal flap and the soft tissue punching. Bulking the keratinized tissue labially is one technique used to enhance the aesthetic outcome by increasing the keratinized tissue band. Another technique is scalloping the keratinized tissue in order to accommodate the circular shape of the healing abutment. Also, it is advisable to limit the incision to the keratinized tissue (not extending the incision to the vestibular tissue) to

avoid scarring. Maintenance and creation of the interdental papilla is mandatory as it is considered the most important factor for creating a natural-looking implant-supported restoration. Papillae can be created by means of continuous mild pressure from an existing partial denture or a provisional ovate pontic. Also, papillary illusion by allowing a substantial excess of keratinized tissue to be stabilized at the implant site, can be created. The use of connective tissue grafts during the second stage surgery improves the soft tissue topography. The connective tissue can be harvested from the palate or the tuberosity area. The success rate of these grafts is higher as they receive their blood supply from two surfaces.

The palatal flap advancement and the modified roll flap can help increase the soft tissue height labially. The modified roll flap starts with a palatal incision with partial thickness palatal flap dissection. Then, the labial flap is reflected with the palatal connective tissue extension. The palatal connective tissue extension is then rolled inward and underneath the labial flap. This procedure can be used to improve the minor ridge defects without any bone grafting procedures. A coronally repositioned flap can be also performed, by making a C-shaped incision at the implant site with the convexity toward the labial surface. The circumference of the incision should be deeper than that of the abutment. Thus, when the flap is repositioned coronally, excess tissue will be present between the abutment and the adjacent teeth. This excess tissue will create a papillary illusion. The only disadvantage of this technique is the reduction of the labial attached gingiva.

Soft tissue punching has very limited clinical use in cases having a wide and fibrotic keratinized band of tissues.

Soft tissue management post-abutment connection:

After final abutment connection, the gingival area surrounding the abutment is reshaped to match the natural tooth appearance. This is the refining and profiling stage. Soft tissue manipulation in the second stage surgery might reveal a loss of keratinized band or the presence of some scars. Small tissue dimples or labiocrestal concavities can be corrected by subepithelial connective tissue grafting to bulk up the tissue labially if needed. Gingival electrosurgery is used to cut the desired gingival contour. Also, gingivoplasty using a high-speed diamond burs to correct flat or ledged margins have been suggested.

Tissues require time to heal and remodel before proceeding with corrective procedures.

The corrective procedures involve the following:

- 1- The use of onlay grafts to improve soft tissue quality by either increasing the band of keratinized tissue or eliminating soft tissue scarring which improve the condition of the keratinized tissue. This procedure may present a drawback as the donated soft tissue may not match the color or texture of the recipient tissue.
- 2- The use of inlay connective tissue grafts that will improve the soft tissue height and contour. For example, the split-thickness recipient pouch technique is performed to improve moderate ridge defects. It is performed by placing two partial thickness vertical incisions mesial and distal to the defect and then conducting a subepithelial dissection. A piece of connective tissue is then placed in the created pouch. This procedure can substitute further bone grafting procedures.
- 3- Pedicle grafts can also be used as they provide sufficient soft tissue thickness. These grafts are highly predictable as they receive good blood supply from their origin. The palate is an excellent donor site because of its rich blood supply that favors wound healing and minimizes potential sloughing.
- 4- Also, the use of provisional restorations is an important factor for the reshaping of the gingival area.

5- Gingival recontouring techniques have been suggested for the reshaping of the gingival profile, provided that a sufficient volume of soft tissue is present. This technique can be used when minimal corrections are required. Wide, temporary healing abutments are used to allow gingival maturation around a wide cap.

Esthetic bone grafting:

For the aim of achieving natural aesthetic result, it is necessary to determine whether adequate bone is available for the planned prosthesis. The term esthetic bone grafting is defined as the regeneration of the osseous foundation in all directions to serve esthetic purposes. Some preventive measures could be taken in order to favor the bone configuration. For example, non-traumatic extraction should be performed to prevent post-extraction resorption. Another conservative technique to increase the amount of bone is with the use of osteotomes. Drilling does not improve the local anatomic characteristics or bone quality, whereas osteotome technique is a predictable procedure to augment soft maxillary bone.

Advantages of osteotomes:

- 2 Preservation of bone.
- 3 Bone expansion and densification.
- 4 Increase of bone for the insertion of a longer and wider implant in soft bone.

The orthodontic extrusion has been developed as a non-surgical technique to increase the amount of bone for the insertion of a longer implant. This technique is indicated when a hopeless tooth with no active pathology needs to be extracted. When applying this technique, the socket component moves coronally and provides the potential for bone to regenerate in the previous defect. Also, improvement in soft tissue topography will be concomitant with the change in osseous configuration.

Available knowledge and technical advances allow clinicians to regenerate osseous support in highly predictable amounts. Autografts, allografts, guided tissue regenerative procedures and titanium mesh are different methods available for bone regeneration. Autografts could be donated from the iliac crest, rib, cranium and chin. However, intraoral sites, such as tuberosity and exostosis are preferred specially when the grafting is not extensive. The chin is usually selected as a donor site as it offers many advantages:

- 5 Easy accessibility of the oral cavity.
- 6 Low morbidity.
- 7 No hospitalization required.
- 8 No cutaneous scarring.
- 9 Osteogenesis and availability.

On the other hand, autografting presents some disadvantages including:

- 10 Creation of a second surgical site.
- 11 Occasionally prolonged postoperative recovery.

It is advisable when using allografts to cover the area with a membrane in order to obtain a larger volume of regenerated bone. The titanium mesh has proven also to be a very predictable method for bone regeneration. Choice between these methods depends on size of the bone defect, the type of bone at the recipient site, the patient's medical condition and the pattern of bone resorption. Accurate reestablishment of the osseous architecture is mandatory in order to obtain the best esthetic outcome.

Provisionalization:

Provisionalization is a major clinical step in the achievement of a proper aesthetic result. Proper and adequate stimulation of the gingival tissue must take place because exaggerated pressure could lead to sloughing and necrosis. Dimension and contour of the crown and stability of the gingival margin are the primary concerns in assuring durable esthetics in implant dentistry. There are three different clinical applications involved: ovate pontic development, provisional acrylic resin restoration and the cervical contouring technique. The use of an ovate pontic has been widely used in order to enhance the soft tissue's appearance. The ovate pontic helps to produce an emergence profile that replicates the natural tooth appearance. The use of a removable partial denture with an ovate pontic was also applicable in order to stimulate the soft tissue area on top of the implant head. Thus, when the implant is uncovered, the peri-implant papilla is already contoured to the required shape with the desired emergence profile. So this ovate pontic helps to enhance the papilla formation between adjacent implants.

Provisional resin restoration helps to overcome minor mistakes in implant placement and helps profile soft tissue by adding some acrylic resin to the cervix of the provisional restoration. The final soft tissue profile should be replicated on the model, so the provisional restoration should be fabricated according to the desired gingival contour. To increase the tissue dimension by expansion, the subgingival portion of the restoration can be built out to the dimensions of the natural missing tooth similar to the manner in which an ovate pontic forms the gingival tissue in a ridge area. Moreover, provisional restoration can help improving function and durability of the implant, that is gradual loading can be implicated through the provisional restoration in areas that have poor bone quality.

The cervical contouring concept is one of the factors responsible for the proper configuration of the peri-implant soft tissues. It can also corrects the discrepancies between the diameter of the implant body and that of the natural teeth. First of all, we have to transfer the intraoral condition into a model with impression posts and implant analogs. Then, the subgingival area is envisioned to an optimal configuration and redesigned during the laboratory phase. This area is reshaped by a scalpel or a diamond bur on the model. An acrylic resin crown can then be fabricated to fill the carved space around the abutment. This new design is transferred to the vital oral tissue in order to press against the peri-implant soft tissue to form the required emergence profile.

A sound provisional plan is an important factor that enhances the long-term serviceability as well as the natural-looking restoration of the dental implant and the final restoration.

Prosthetic management:

Numerous restorative materials and prosthetic components have been advocated in implant dentistry. Proper prosthetic management will definitely affect the treatment's outcome. Many factors are involved in this phase including:

1- Healing abutments: wide, temporary healing abutments are used to transfer the narrow cross-section of the implant head into the wider cross-section of the teeth. However, the author has found that the short and narrow healing abutment helps to preserve soft tissue integrity and allows it to creep on top of the short abutment. Thus, minimizing recession and reducing the possibility of intruding on vital structures. The smooth collar of the wide abutment allows for the slippage of soft tissue around the abutment because of pressure.

2- Final abutments: Different final abutments are available in market including cement-retained, screw-retained, custom-made, tooth-colored and anatomic abutments. The cement-retained abutments are superior in occlusion, esthetics, passivity and loading characteristics when compared with screw-retained abutments. Custom-made abutments have the advantages of contours and finish lines that can be altered to match the tissue dimensions. The tooth-colored abutments can be used where soft tissues are thin in order to prevent the metal collar from showing underneath the gingiva, thus obtaining better esthetics.

Because of the discrepancy in the diameter between the implant head and the natural tooth diameter at the CEJ level, anatomically correct abutments have been manufactured in order to improve and maximize the esthetic outcome. These anatomic abutments improve the emergence profile, reduce stress on the connecting screw, improve mechanical properties and increase prosthetic stability.