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Single Implant Restorations: Prosthetically Induced Soft Tissue Topography

Nitzan Bichacho, DMD
Cobi J. Landsberg, DMD

An aesthetic transition from the smaller diameter of the implant to the prosthetic restoration that resembles the size of the natural tooth has presented an ongoing challenge to the implant restorative dentists. The appearance of the surrounding soft tissue is of major importance, and various techniques have been developed to guide and optimize its topography. The learning objective of this article is to present a cervical contouring concept, whereby the soft tissue topography is optimally determined already in the laboratory phase. Using a custom abutment and provisional crown as components of the transmucosal prosthetic unit (TPU), the topography is transferred to the vital intraoral tissues, which predictably adapt to the enhanced aesthetic configuration. Clinical cases are presented to demonstrate the sequence of the technique in treating the anterior region of the maxilla.

The achievement of an aesthetic implant-supported restoration is a constant challenge to the restorative dentist. Due to the circular shape of the implant and its smaller diameter, when compared to the root of a natural tooth, a dilemma inevitably occurs of how to construct an artificial crown and abutment system which will imitate the natural tooth crown form when emerging from the gingiva with narrow margins to fit the implant head. In natural teeth, the emergence profile angle is relatively straight.[1-3] Any attempt to reproduce this angle in an implant-supported crown will result in a restoration that appears unnatural and artificial, unless it is a lateral maxillary incisor with root dimensions matching the standard dental implants.

Nitzan Bichacho, DMD, is Vice President of the European Academy of Esthetic Dentistry. He is a general dentist maintaining a private practice limited to Prosthodontics, Tel Aviv, Israel.

Cobi J. Landsberg, DMD, is a diplomate of the American Board of Periodontology. He maintains a private practice limited to Periodontics and Implant Surgery, Tel Aviv, Israel.

Address correspondence to:

Nitzan Bichacho, DMD
16 Miriam Hahashmonait St.
Tel Aviv, Israel 62665
Tel: 011-972-3-60-54-370
Fax: 011-972-3-54-60-415

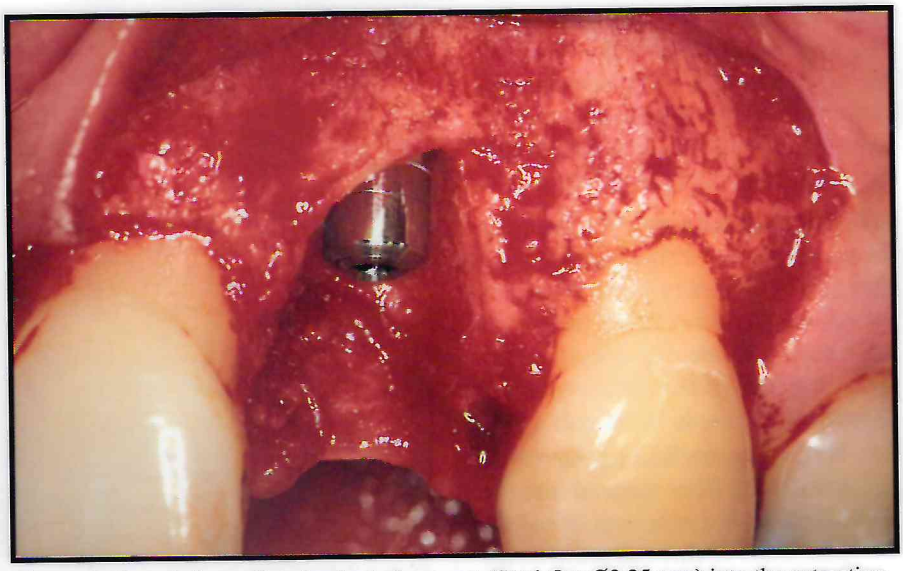

Figure 1. Case 1. Immediate implant placement (Steri-Oss Ø3.25 mm) into the extraction socket of the left lateral incisor. Note the extensive buccal plate resorption.

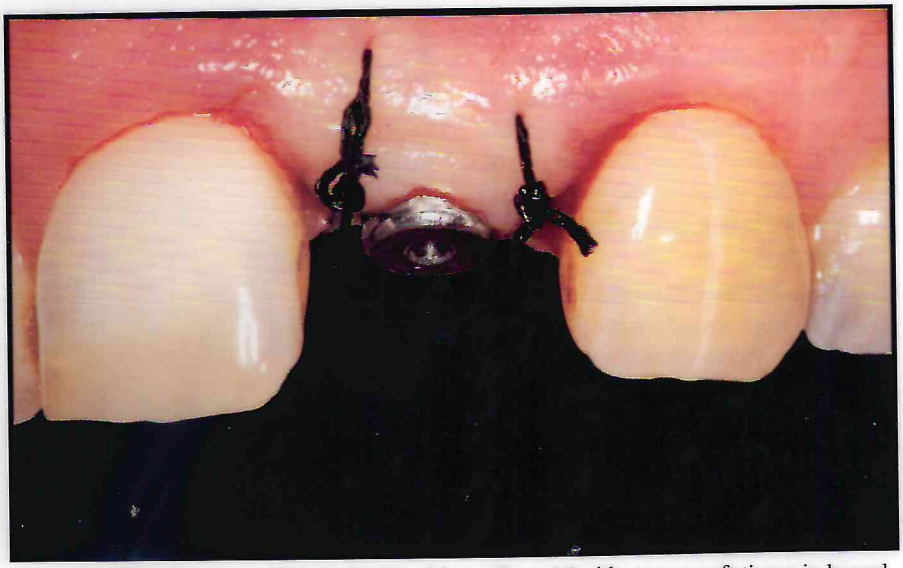

Figure 2. Stage II surgery. Flap is displaced buccally to provide excess soft tissue in buccal and coronal directions. Note no vertical incisions to minimize gingival recession.

CLINICAL PROCEDURE

Case 1

A 35-year-old female patient presented requiring implant-supported restoration of a maxillary lateral incisor. Despite the difficult initial condition at the presentation (Figure 1), utilizing the current augmentation techniques (Figure 2),[4] an aesthetically acceptable result was achieved (Figures 3 and 4). These techniques are of primary importance in preparing the hard and soft tissue site suitable for implant placement, since the objective of the surgical steps is to enable a precise implant placement in an optimal site in accordance with prosthetic and aesthetic demands. However, not all teeth to be replaced are lateral incisors, with the cervical diameter of the tooth matching the diameter of the standard implant. Therefore, the challenge remains of how to connect a large noncircular crown base to a narrow cylindrical implant, while attempting to achieve a natural-appearing restoration.

Gingival Recontouring Techniques

To compensate for the discrepancies between the implant head and the natural root diameter, several clinical techniques have been proposed for reshaping the gingival profile, provided that a sufficient volume of soft tissue is present:

1. Wide temporary healing abutments[5] are used to allow gingival maturation around a wider cap. Since the diameters of these abutments are standardized and available only in limited sizes, it is not possible to achieve an optimal gingival contour in every clinical circumstance.
2. Gingival electrosurgery is used to cut the desired gingival contour.[6] The results are not always predictable, since shrinkage of the free gingiva and gingival recession may result.[7-9]
3. Gingivoplasty has been suggested with high-speed diamond burs at the appointment of the final crown delivery.[10] This rotational curettage might cause unfavorable recession, especially when thin facial tissue is recontoured.[11]
4. A two-section porcelain-fused-to-metal (PFM) crown might be fabricated in which a ceramometal

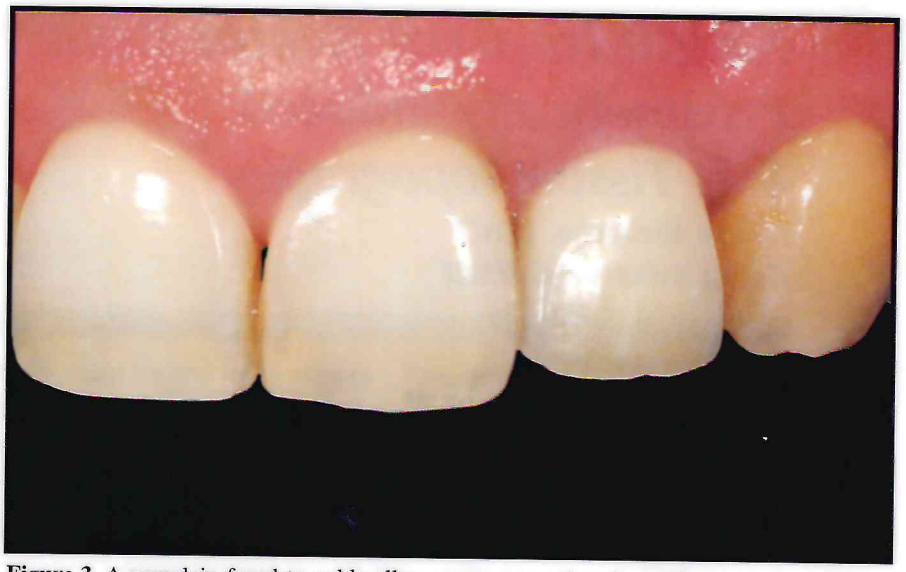

Figure 3. A porcelain-fused-to-noble-alloy crown restoration, 6 months postcementation.

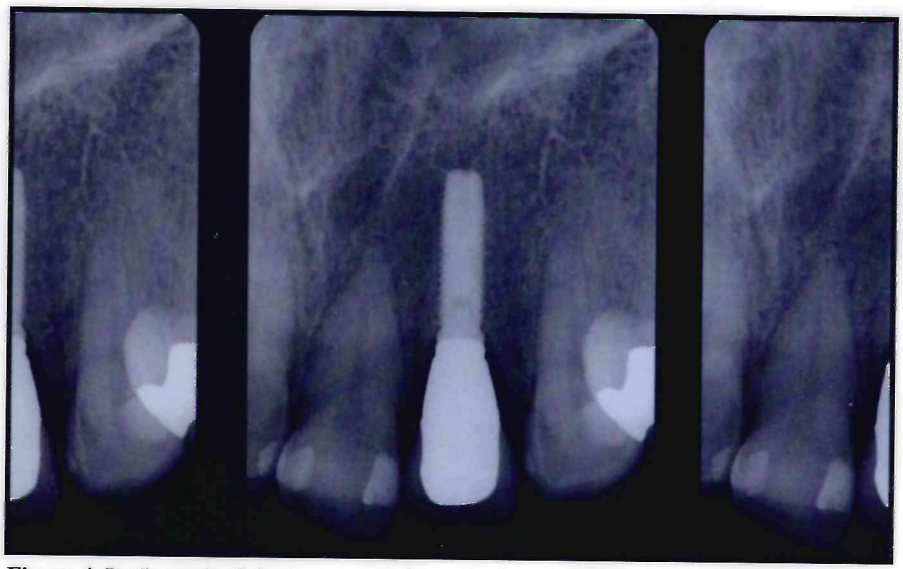

Figure 4. Radiograph of the transmucosal prosthetic unit (TPU) exhibits the precise fit of all components (implant/abutment/crown).

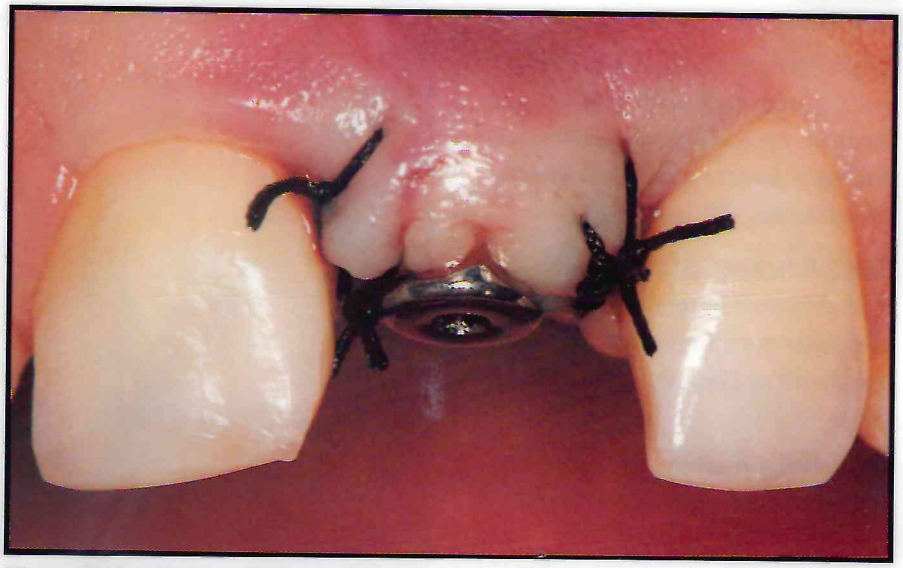

Figure 5. Case 2. Stage II surgery. Excessive keratinized tissue displaced buccally and coronally, surrounding the healing cap (Steri-Oss Ø3.25 mm).

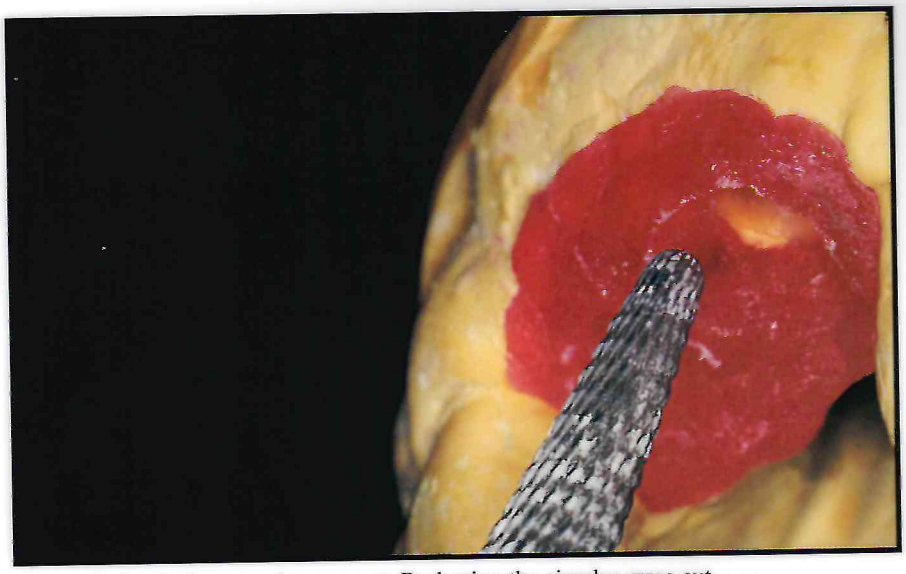

Figure 6. Cervical contouring concept. Reshaping the circular cross-cut.

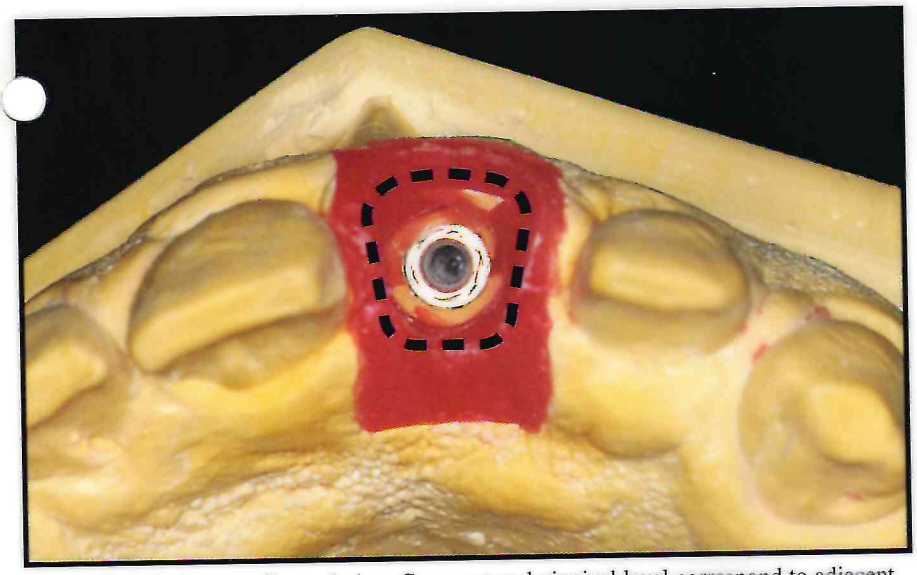

Figure 7. Soft tissue replica redesign. Cross-cut and gingival level correspond to adjacent central incisor.

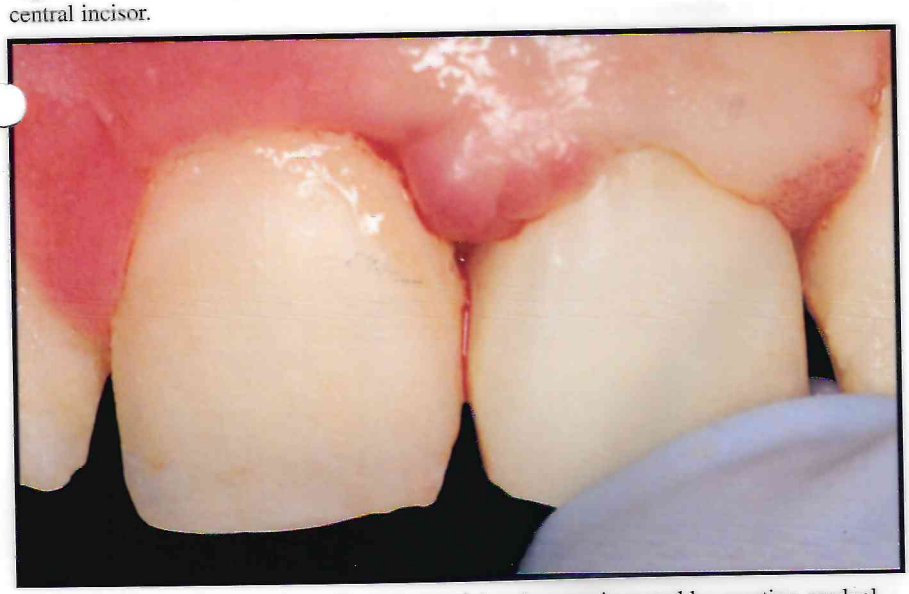

Figure 8. The prefabricated acrylic resin provisional crown is seated by exerting gradual pressure on the soft tissue. Note the transient blanching of the soft tissue.

intracrevicular substructure is connected directly to the implant.[12] Its profile guides maturation of the periabutment gingiva during the healing period.

5. Prosthetically induced gingival alteration is the most commonly used solution; it has been developed by various prosthodontists in different ways. Since all cemented implant-supported crowns require transmucosal abutments, this prosthetic component has gained attention in implant prosthodontics in recent years. Where implant location and planned crown size permit, utilization of a prefabricated anatomic abutment is the simplest and most readily achieved solution. These abutments can be slightly modified, if required, and can even be cut intraorally when already attached.[13] Modification of a prefabricated titanium abutment has been suggested to allow a proper abutment design.[14,15]

The use of a prefabricated titanium abutment, to be modified with gold overcasting to an individual shape, has also been suggested.[16] Another alternative is the use of a custom-made abutment with PFM subcervical region.[17] Advanced prefabricated anatomical abutments (DIA Anatomic Abutment System, Steri-Oss, Yorba Linda, CA) have been introduced,[18,19] followed by the Bio-Esthetic abutment system.[20] The introduction of a tooth-colored ceramic abutment[21-23] is not only configuration-oriented, but it also augments the abutment by its fourth dimension — color. The most common procedure for obtaining the desired abutment configuration is the use of modified plastic cylinders in the lost wax technique to produce customized gold cylinders.[24] Prefabricated plastic cylinders are also utilized for the fabrication of provisional restorations.[25]

Cervical Contouring Concept

The prosthetic components, apical to the free gingival margins, form the Transmucosal Prosthetic Unit (TPU). The TPU can be composed of several combinations:

1. Implant alone – the implant head is located supragingivally.

2. Implant head + abutment – the abutment shoulder is supragingival.
3. Implant head + crown – the crown is screwed directly to the implant (UCLA type) without an intermediate abutment.
4. Implant head + abutment + crown – the apical part of the crown is subgingival and sits on the abutment that is screwed to the implant. This is the most commonly found combination.

According to the components selected, any TPU is a combination of some of the following materials: Titanium (implants and some abutments); gold alloys (some abutments and some crowns); nonprecious alloys (some abutments and some crowns); ceramics (some abutments and some crowns); composite resins (some crowns); acrylic resins (some crowns).

This ideal design is transferred to the vital oral tissue through the provisional restoration which is fabricated accordingly ...

The cervical contouring concept further addresses the achievement of predictable results.[26] It is logical to conclude that the most important factor responsible for a natural appearance of the restoration is the desired configuration and dimension of its surrounding soft tissue. Therefore, regardless of the type of TPU selected, this concept places emphasis on the design of the soft tissue. The periprosthetic region is envisioned to an optimal configuration and redesigned previously in the laboratory phase. This ideal design is transferred to the vital oral tissue through the abutment and provisional restoration which are fabricated accordingly, guiding the surrounding soft tissue to imitate the model replica. The periimplant gingival tissue is duplicated by a rigid acrylic resin (Dura-Lay, Reliance, Worth, IL) to allow improved control of the remodeling process. Carving the periabutment gingiva in the working model allows fabrication of the prosthetic

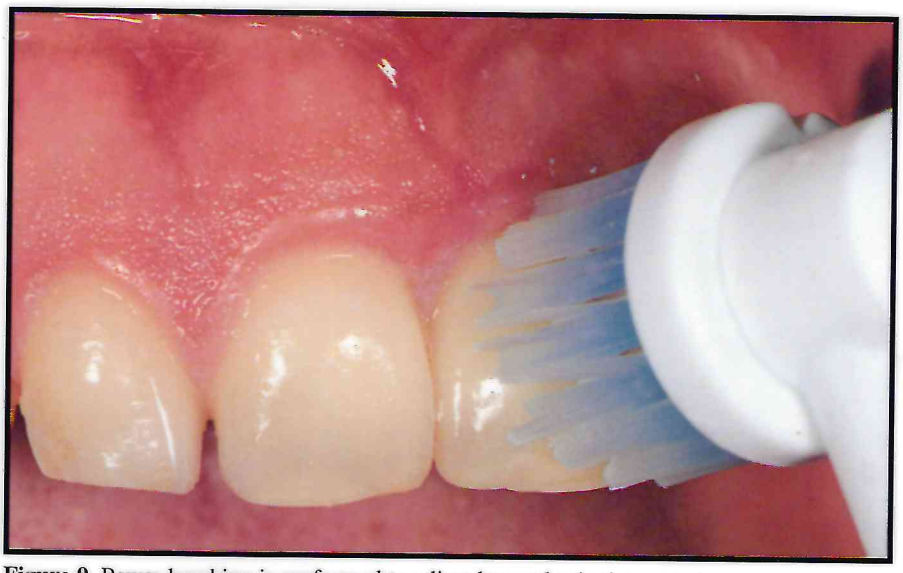

Figure 9. Power brushing is performed to adjust hyperplastic tissue contour.

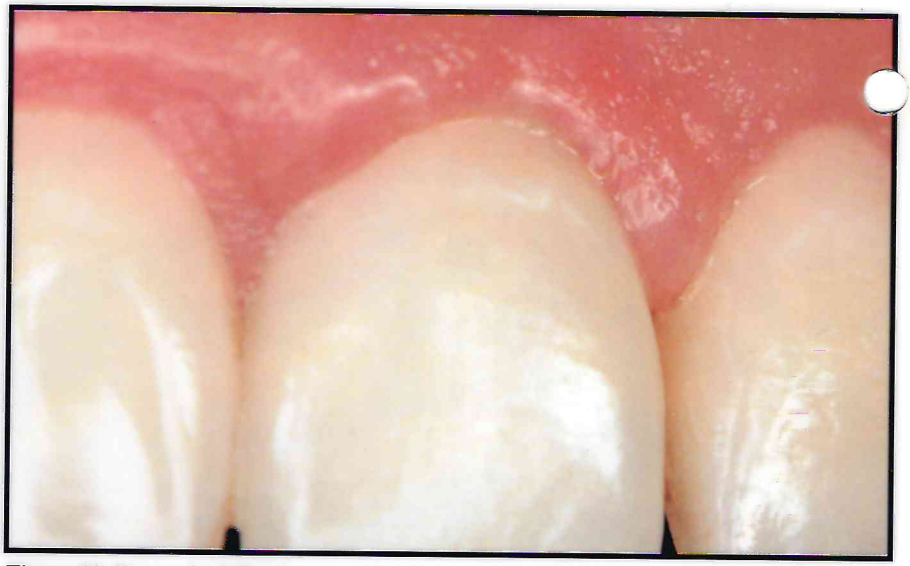

Figure 10. Six weeks following provisional crown cementation, using electric toothbrushing technique. Note adjustment process of the soft tissue.

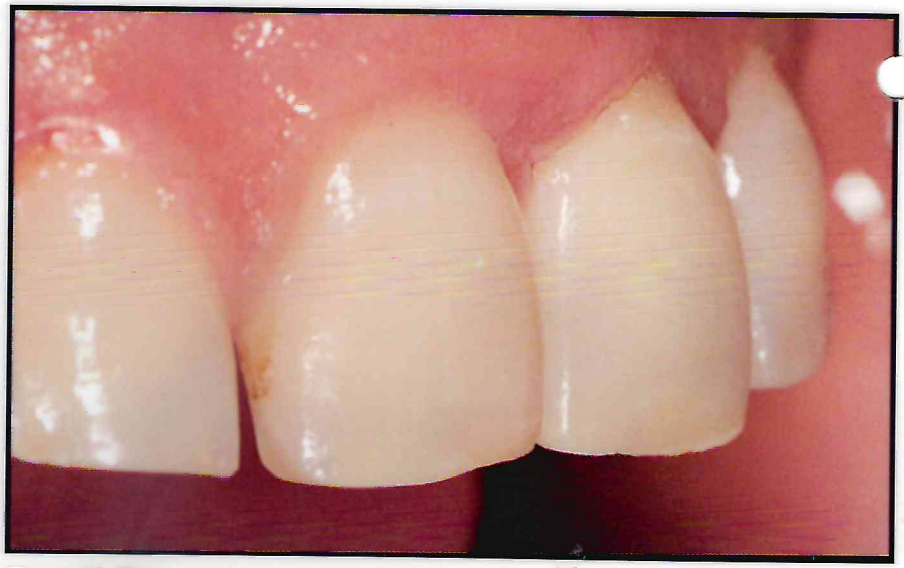

Figure 11. Three-month postcementation view of the porcelain crown. Note natural emergence from soft tissue.

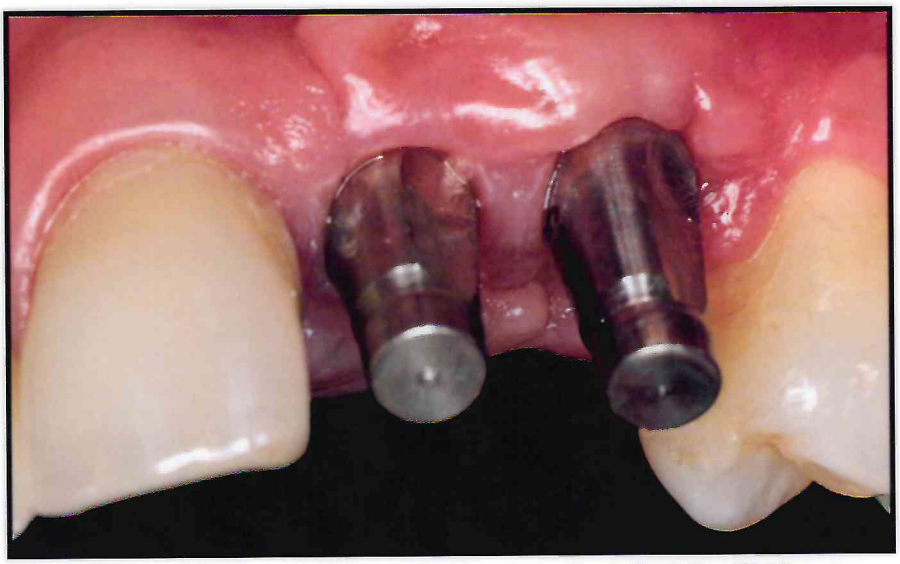

Figure 12. Case 3. Impression copings screwed to the implants (Steri-Oss Ø3.25 mm). Note favorable implant position and orientation.

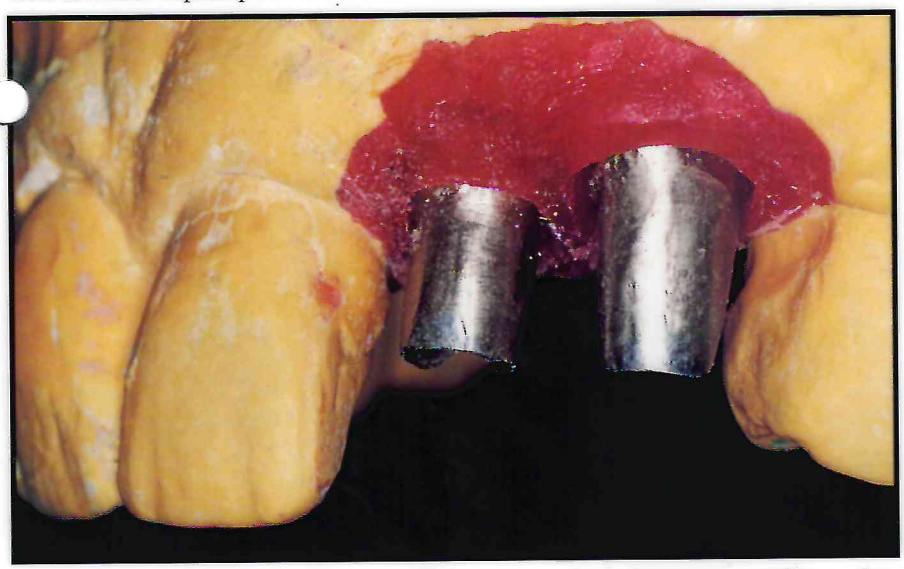

Figure 13. Type IV gold alloy is used to fabricate customized abutments according to the cervical contouring concept.

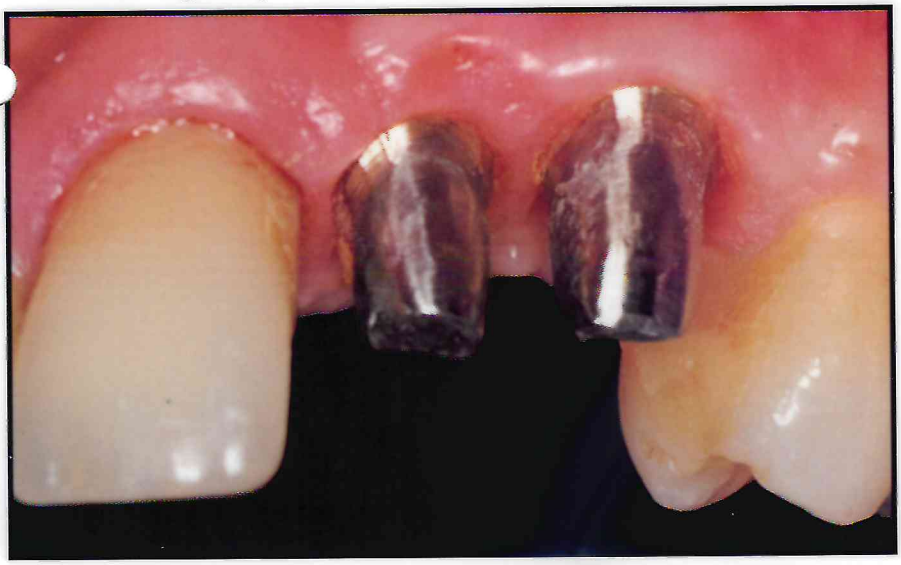

Figure 14. The transmucosal abutments connected intraorally.

components in the desired dimensions, which are placed intraorally, where the periabutment tissue adjusts itself to the TPU components (abutments, provisional restorations, and final restorations).

The cervical contouring concept focuses on shaping the abutment and the cervical crown region following the prior design of the surrounding tissues and facilitates predictable, proper fabrication of an implant-supported crown, despite the difficulties created by the shape of the implant fixture (Table).

Case 2

A 22-year-old male patient presented with a missing left central incisor. During second-stage surgery, the flap was transferred buccally to provide sufficient soft tissue to be reshaped at a later stage (Figure 5). The excess of gingival tissue was intentional, due to anticipated

The cervical contouring concept focuses on shaping the abutment and the cervical crown region ...

recession of the buccal soft tissue following the connection of the prosthetic components. In this case, the margins of the tissue covering the healing abutment were placed approximately 3 mm incisally from their designated final location.

Following impression-taking and pouring the model according to the cervical contouring concept, reshaping of the circular periabutment tissue was performed in the laboratory (Figure 6) to provide suitable periabutment dimensions for this central incisor. The buccal margins were carved away apically (approximately 3 mm) to the level of the free gingival margin of the contralateral tooth. A triangular shape was created in cross-cut, which is typical of a natural central incisor of this level (Figure 7). A provisional acrylic resin crown was fabricated on a transmucosal individual gold abutment. Its volume filled the space between the abutment and the periabutment remodeled replica.

Once the abutment was connected intraorally, the prefabricated provisional crown was seated, and digital pressure was exerted to compress the gingiva (Figure 8). The pressure created a transient blanching of the soft tissue, resulting in transformation of its dimensions to the crown configuration. Following 6 weeks and a meticulous oral hygiene regimen with an electric plaque remover (Braun Oral-B Electric Plaque Remover, Redwood City, CA) (Figure 9), the tissue adjusted to a more favorable location and contour (Figure 10). In most similar cases, approximately 6 months are required for the soft tissue to reach a completely natural appearance within its long-term maturation period (Figure 11).

Case 3

A 47-year-old female patient accepted a treatment plan requiring restoration of the anterior maxilla, involving 3 natural teeth and 2 implant-supported restorations. Following optimal placement of the 2 implants to replace the left lateral incisor and canine, conventional surgical augmentation techniques were used, and an impression of the implant heads was taken (Figure 12). Following the desired modification of the soft tissue replica, two individual type IV gold abutments (BIO-H; APM-Sterngold, Attleboro, MA) were fabricated according to the cervical contouring concept (Figure 13) and connected to the implants intraorally (Figure 14). The natural teeth abutments, adjacent to the customized implant transmucosal abutments, were prepared according to conventional crown-and-bridge techniques, and final preparation of the implant abutments was performed intraorally (Figure 15). Provisional acrylic resin single crowns were adapted chairside and cemented temporarily for an evaluation period of 2 months (Figure 16).

The periprosthetic region is envisioned to an optimal configuration and redesigned previously in the laboratory phase.

Table

Cervical Contouring Concept Sequence of Treatment

1. Impression is taken of implant head.
2. Resin is poured in the periabutment zone.
3. Combined working model is fabricated: Hard stone, periimplant zone, and implant analog.
4. Periabutment resin is recontoured to ideal dimensions in accordance with adjacent and contralateral teeth and their free gingival margins.
5. Transmucosal abutment is selected (prefabricated or custom fabricated) according to the new optimal soft tissue configuration.
6. Provisional acrylic resin crown is fabricated according to the abutment and Dura-Lay dimensions and shape.
7. The abutment is transferred and connected to the implant, intraorally.
8. The provisional crown is positioned on the abutment with gradual digital pressure.
9. The crown is removed and cemented with temporary noneugenol cement.
10. Oral hygiene regimen includes powerbrushing with electric plaque remover.
11. An observation and evaluation period lasts at least 8 weeks.
12. Routine conventional crown-and-bridge techniques follow.

Intraoral Procedures Laboratory Phase

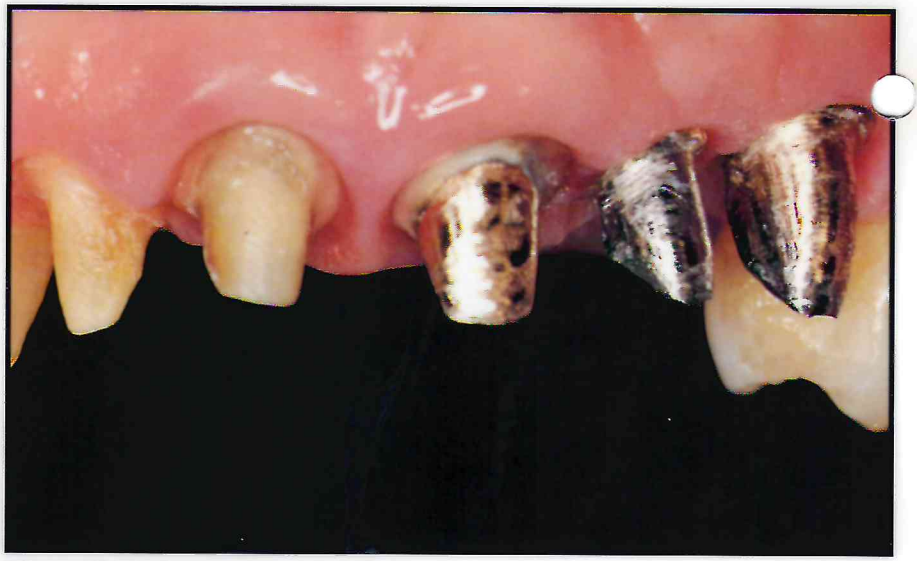

Figure 15. Final preparation of the implant abutments and the natural teeth.

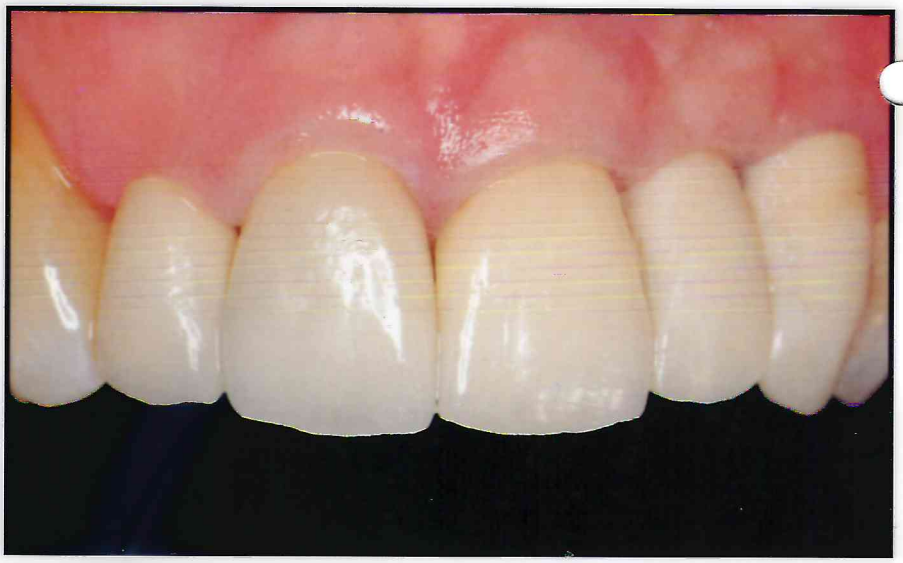

Figure 16. Two months postcementation of provisional acrylic resin crowns.

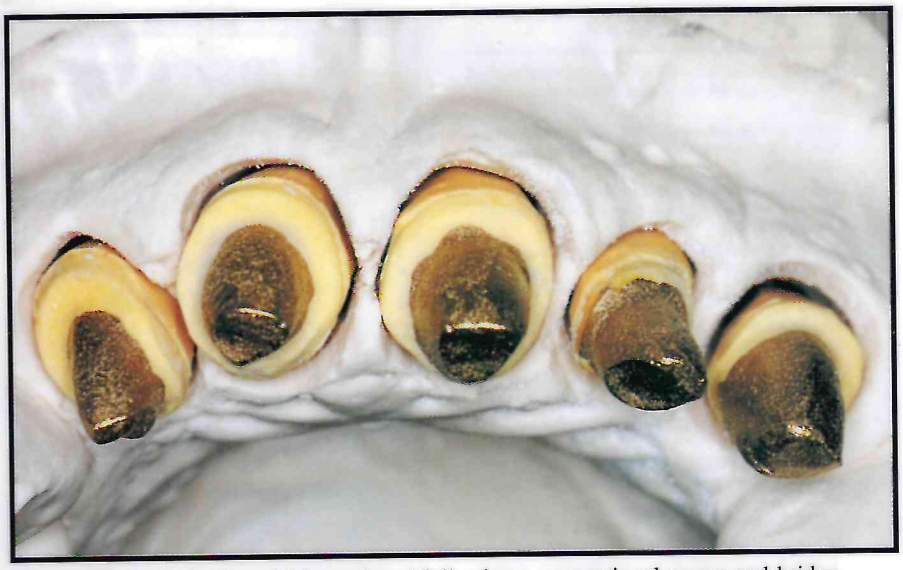

Figure 17. A "Geller" model is produced following a conventional crown-and-bridge impression technique.

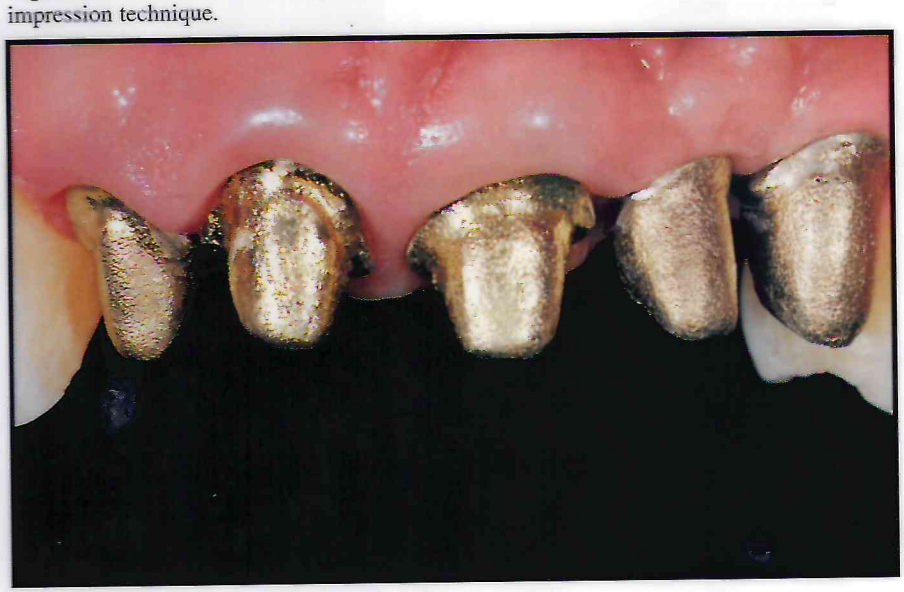

Figure 18. Intraoral fit verification of single unit copings.

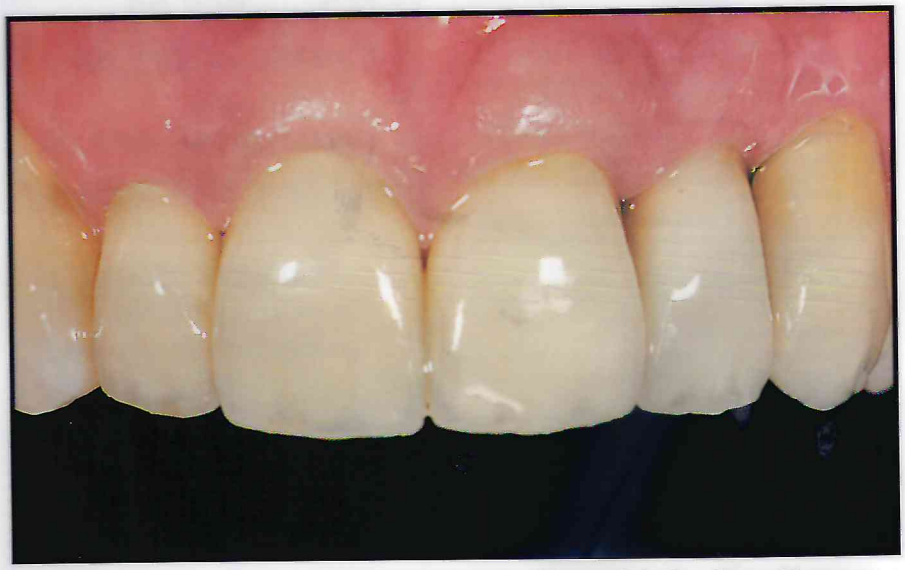

Figure 19. Final cementation of the 3 natural teeth with porcelain-fused-to-gold crowns and 2 polyglass-fused-to-gold implant-supported crowns.

The impressions were taken using the conventional cord-retraction technique, and a "Geller" model was produced, whereby the soft tissue impression was cast-replicated in hard plaster stone (Figure 17). A small amount of the stone in the buccal and interdental sulci was removed, creating a gap between the abutments and the inner aspect of the free gingiva. This prosthetic adjustment was performed to restore the anatomic curvature in the sulci and allow intracrevicular convexity of the crown restorations.[27] Noble composite alloy copings (Captek, Longwood, FL) were fabricated in the laboratory to elicit a favorable response from the adjoining vital tissues and enhance a natural background for the veneering materials (Figure 18).[28,29] Porcelain (Creation, Jensen, North Haven, CT) was baked onto the copings of the natural teeth due to its natural opalescent and fluorescent effect in creating intensified optical depth and brilliance of the porcelain restorations.

The use of single implants has become a legitimate treatment option in fulfilling specific rehabilitation requirements ...

The implant copings were covered with polyglass resin (Artglass, Heraeus Kulzer, Irvine, CA) to provide a more flexible material, since these implant-supported crowns shared in the anterior guidance and lateral movements in the occlusal pattern of the patient. Although asymmetrical, this combination created a harmonized and aesthetic anterior dentition (Figure 19).

CONCLUSION

Great steps forward are being taken in implant dentistry. The use of single implants has become a legitimate treatment option in fulfilling specific rehabilitation requirements, and the utilization of this treatmant option is not limited to the anterior region.[30,31] The

aesthetic demands of this treatment modality, limited by the characteristics of the implant systems available, dictate certain modifications of the traditional recommended treatment options for conventional prosthetic implant dentistry. However, the various prosthetic solutions represent uncertain long-term results: The current TPU components and techniques have been developed to compensate for the differences between the implant configuration and the respective crowns. This dictates placement of the implant head deep under the free gingival margin, especially in the anterior region of the maxilla, so that the TPU has a sufficient distance to be transferred from a circular and narrow region (connected to the implant) to a crown-form region (supporting the crown).

The present implant restorative systems potentiate the development of deep pockets, particularly in the interproximal areas from the peak of the papillae to the implant head. This may lead to abscess formation, periimplantitis, and eventual implant failure. Even in a noninflammatory state, the periprosthetic soft tissues remain insufficiently supported; this compromised biophysical condition predisposes to recession and loss of interdental papillary height within time. No other perioprosthetic treatment modalities of such nature would be considered adequate and predictably successful on a long-term basis. A reasonable solution for enhancing the periimplant restoration environment is probably by conversion of the traditional circular cross-cut of the implant head to that of a natural root. When this modification is then performed at the level of the implant head instead of the abutment, it will be possible to place the implant head considerably closer to the soft tissue margins surrounding the crown, thereby creating not only an aesthetic and functional restoration but also fulfilling the biologic criteria for a long-term service.

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