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Papilla regeneration in cases of multiple-implant restorations in the aesthetic zone: case report

Regeneracja brodawek w przypadku odbudowy wieloimplantowej w strefie estetycznej: opis przypadku

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Summary

Establishing good aesthetics and harmony between the implant-supported crown and the adjacent natural teeth is a critical challenge during the reconstruction of an edentulous space in the anterior maxilla. This article has presented, step by step, a technique of obtaining a harmonious scalloped gingival display. A meticulous approach was taken to ensure the proper positioning of the implants, maintaining adequate inter-implant distance and supporting the surrounding soft tissues. A pseudo-natural gingival profile was obtained through the use of a multiple implant-retained provisional restoration in the anterior region in order to reconstruct the inter-implant papilla. The provisional restoration was initiated in the second stage of the surgery, enabling optimal soft tissue healing and adaptation. Primitive regenerated papillae were obtained after six weeks, demonstrating the effectiveness of this technique in enhancing aesthetic outcomes. Successful papilla reconstruction depends on specific conditions related to implant positioning and the characteristics of the provisional restoration, which significantly enhance the probability of achieving optimal aesthetic outcomes.

Streszczenie

Zapewnienie dobrej estetyki i harmonii pomiędzy koroną wspartą na wszczepie a sąsiednimi zębami naturalnymi jest kluczowym wyzwaniem podczas rekonstrukcji bezzębnej przestrzeni przedniej szczęki. W artykule przedstawiono krok po kroku technikę uzyskania harmonijnego wyglądu dziąsła. Dołożono wszelkich starań, aby zapewnić prawidłowe umiejscowienie implantów, utrzymanie odpowiedniej odległości między implantami i wsparcie otaczających tkanek miękkich. Pseudonaturalny profil dziąsła uzyskano poprzez zastosowanie wielokrotnej odbudowy tymczasowej na implantach w odcinku przednim w celu rekonstrukcji brodawki międzyimplantowej. Odbudowa prowizoryczna została wprowadzona w drugim etapie operacji, umożliwiając optymalne gojenie i adaptację tkanek miękkich. Pierwotnie zregenerowane brodawki uzyskano po 6 tygodniach, co wykazało skuteczność tej techniki w poprawie wyników estetycznych. Skuteczna rekonstrukcja brodawek zależy od specyficznych warunków związanych z umiejscowieniem implantu oraz charakterystyką uzupełnienia tymczasowego, które znacząco zwiększają prawdopodobieństwo osiągnięcia optymalnych efektów estetycznych.

Introduction

Despite a decrease in the occurrence of tooth loss, up to one-quarter of individuals in Western countries have lost no less than one anterior tooth.[1] After the tooth is removed, the papilla begins to recede mainly due to the lack of vascular and osseous support.[2] Indeed, the alveolar bone will quickly resorb and the causes include the thinness of the bone septum, the reduced vascular supply to the inter-radicular bone (following extraction), the direct exposure of the inter-radicular bone to oral bacteria and the absence of Sharpey fibers which stimulate bone remodelling and maintain it at a higher level.[3]

The papilla protects the surrounding periodontium, particularly the alveolar bone crest, by acting as a biological barrier against external aggressors and preventing food impaction. Furthermore, its absence may bring about aesthetic imperfections and phonetic issues.[4] As a matter of fact, restoring the vanishing papilla should be a pivotal objective during any prosthetic rehabilitation, even implant supported prostheses.

In fact, an implant-supported prosthesis is often regarded as the most effective method for replacing missing teeth. Such treatment has to provide aesthetic outcomes to satisfy the patient's expectations.[1]

Previously, implants were placed according to the "bone-driven implant placement concept". The new concept actually utilizes the "restoration-driven implant placement". The final restoration guides the implant placement. This concept leads to functional and aesthetic restoration as well as healthy peri-implant soft tissue.[2]

Although multiple authors suggested the immediate loading of dental implants in order to preserve or reconstruct the papillae, in 1999 Jemt came up with an approach for reconstructing the interdental papillae during the second stage of the surgery. In fact, temporary crowns were implemented to guide soft tissue healing within the inter-implant space.[5]

This paper describes, through a clinical case, a technique of inter-implant papilla regeneration in the anterior maxillary region using provisional implant-supported restoration. This technique was applied during the second stage of the surgery.

Case presentation

A 28-year-old female patient presented at the department of prosthodontics with missing maxillary incisors (Fig. 1A). The patient had a history of a trauma resulting in the loss of her upper incisors four years prior to the consultation. She received a removable partial denture (RPD) to restore her smile, with which she was not satisfied; she disapproved of the metallic clasps. Nevertheless, the patient had a high aesthetic expectation and explicitly sought a fixed prosthesis. Except for a penicillin allergy, she had neither a noteworthy medical history nor a history of smoking.

Clinical examination revealed a good oral hygiene. The anterior residual alveolar ridge was thin and regular. The fibro-mucosa was relatively thin and adherent to the underlying bone. The adjacent teeth had an ovoid crown shape. The patient's gingival biotype was thin and highly scalloped. The examination of the occlusion revealed disturbed occlusal plane due to over eruption of the anterior mandibular teeth. Three-dimensional radiographic scans were taken using cone beam computed tomography (CBCT). The aim was to evaluate bone volume and architecture to determine the optimal implant characteristics and the eventuality of a bone augmentation surgery.

The assessment revealed a flat morphology with thickness of the anterior alveolar ridge of less than 3 mm, which imposed the bone augmentation surgery.

After thorough examination, several treatment options were presented and discussed with the patient. She chose fixed implant-supported crowns to replace the anterior maxillary incisors preceded by a provisional phase during the second surgical stage in order to reconstruct the lost papillae. Postponing the provisional phase was necessary due to potential risks associated with immediate loading on the grafted bone regeneration process. A written consent form was duly obtained from the patient, outlining and acknowledging her agreement to proceed with the chosen option.

Four implants 3.3 × 11.5 mm were chosen according to the available bone volume. Drilling for implants placement targeted the palatal ridge wall to ensure primary stability and achieve an optimal three-dimensional implants orientation. Implants were strategically positioned, maintaining a minimum inter-implant distance of 3 mm and ensuring a 2 mm separation from adjacent natural teeth. Once the implants were placed, a guided bone regeneration procedure was executed to increase the bone volume and consequently provide the necessary support for the surrounding soft tissues.

After four months, the periapical radiograph showed a well-placed osseointegrated implants (Fig. 1B). Considering the patient's aesthetic requirements, a four implants-fixed provisional restoration was opted for during the second stage of surgery. This therapeutic option enabled the reconstruction of the inter-implant papilla and the optimisation of aesthetics during the definitive restoration.

The treatment began with enhancing the patient's motivation for oral hygiene, followed by a session of supra- and sub-gingival scaling with a prescription of a chlorhexidine mouthwash.

The mandibular incisors were ground to re-establish the occlusal plane and increase the available prosthetic space. An alginate impression was taken. The prosthetic project

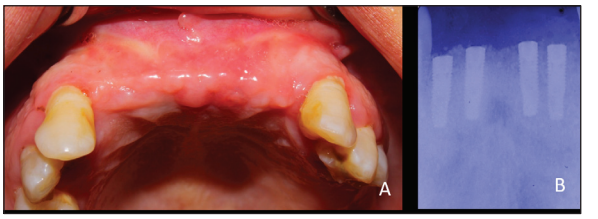

Fig. 1. Post-operative situation; A – clinical situation after implant placement, B – periapical radiograph showing osseointegrated implants.

was simulated in wax with a harmonious gingival contour (Fig. 2A) and its aesthetic aspect was approved by the patient.

The wax model of the provisional prosthesis had two distal extensions on the cingulum of the neighbouring teeth. These extensions, in form of wings, enabled an accurate placement of the prosthesis during the operating phase, therefore avoiding its collapse due to the lack of gingival cushioning (support), since in this second stage of surgery the flap was reclined. A silicone putty index was made on this simulated prosthetic project to enable the preparation of a heat-polymerized provisional shell (Fig. 2 B, C, D).

This provisional shell was extended approximately 2.0 mm beyond the free gingival margins. Gingival embrasures were created between implants. Holes were drilled in the palatal side regarding each implant to receive the titanium provisional abutment.

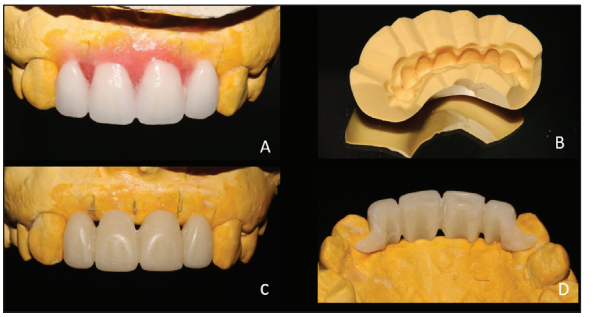

Fig. 2. Provisional Shell preparation; A – simulation of the prosthetic Project in wax, B – a putty silicone index, C – provisional shell seated on the model with wide gingival embrasure, D – palatal view of the provisional's shell.

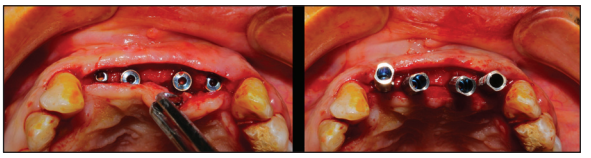

Fig. 3. A – subcrestal incision uncovering the implants, B – the titanium provisional abutment attached to the implants.

Under local anaesthesia, a subcrestal incision was made to uncover the implants and to remove the covering screws (Fig. 3A). Titanium provisional abutments were attached to the implants (Fig. 3B) and their seating was confirmed radiographically.

Basing on adjacent teeth and using a sterile pen, incisal and palatal marks were made in these provisional abutments. Indeed, limits were set 1.5 to 2.0 mm apically and lingually to the anticipated crowns' contours (Fig. 4A). Provisional abutments were removed and then associated with their analog to facilitate their manipulation. Under water irrigation, abutments were sectioned with metal cutting disk according to these marks (Fig. 4B). The abutments were replaced and the shell's fit was tried on. A space of 0.5 to 1.0 mm between the shell and the abutments was provided (Fig. 4C).

In order to conceal all external metal areas, a thin layer of a low-viscosity opaquing resin was applied. The screw access channels were filled with cotton pellets and block-out Cavit type material in order to prevent the provisional material from flowing into these channels. A flowable composite was added to the coronal area of the abutments and the shell. The shell was placed into its correct position having the distal wings as a reference and the composite was polymerised. Additional palatal composite was added to ensure satisfactory connection between the shell and the abutments. Filling in all parts of the shell and emerging areas is not required at this point. Once the composite was set, the screw access channels (dark shadowing at the cingulum) were located. The covering

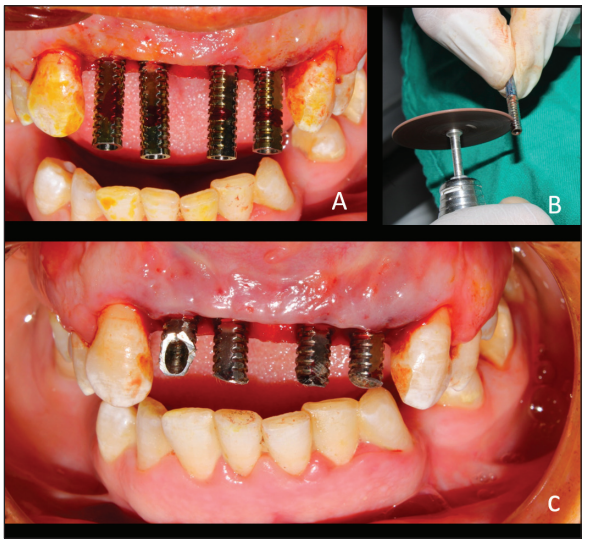

Fig. 4. A – marking of the provisional abutments level with a pen, B – trimming of the provisional abutment using a metal-cutting disk, C – provisional abutments at their definitive height.

thin layer of resin, the Cavit and the cotton were removed to access the screws. The combined abutments/shell as one piece was recovered from the implant (Fig. 5A). With an acrylic

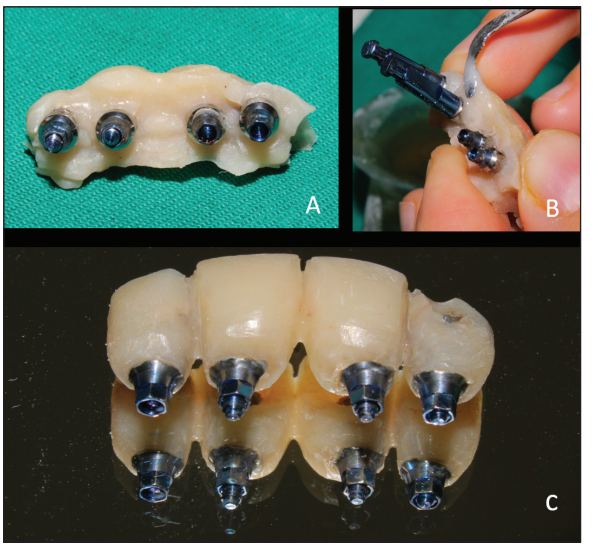

Fig. 5. Adjustment of the provisional prosthesis; A – the combined abutments/shell as one piece removed from the implants, B – using a small spatula to add resin in order to complete the space between the cervical position of the provisional shell fixed by aesthetic requirements and the implants analog margin, C – final form of the provisional after finishing and polishing.

bur, the general shape of the restoration was adjusted. The screw-retained temporary bridge was re-screwed to an implant analog to protect the implant interface area during shaping and polishing of the emergence area. Chemically activated composite resin was added with a small spatula to complete the space between the cervical position of the provisional shell fixed by aesthetic requirements and the implant analog margin (Fig. 5B). With light-activated composite resin, the subgingival contours were reshaped to meld the cervical emergence profile harmoniously from the abutment's metal collar to the coronal contours generated by the shell. The embrasures were released with a diamond disk to give them a pyramidal shape that will receive the anticipated papilla (Fig. 5C).

The provisional bridge was seated onto the implants intra-orally. Some points were evaluated, first, the soft tissue, all signs of blanching or pressure were eliminated. Then, the gingival embrasures with space opening anticipating the prospective coronal migration of the papilla. Lastly, the occlusion and interproximal contacts, natural closeness of the interproximal contacts was exhibited, but there were to be slight contacts in maximum intercuspation position (MIP) and none throughout the excursive movements. It was critical not to make adjustments in a fresh surgical site.

All surfaces were polished with water slurry of fine flour of pumice followed by acrylic resin polishing compound on a rag wheel in a dental lathe. A particular attention should be paid to the titanium at the base of the provisional, and the composite in the emergence area. The provisional prosthesis was disinfected in chlorhexidine gluconate 0.12% oral rinse. It was then replaced on the implant (Fig. 6A) and the retaining screws were tightened to the manufacturer's recommended force (10 N cm). The internal sides of the abutments were cleaned with chlorhexidine. Presterilized polytetrafluoroethylene tape (Teflon tape)

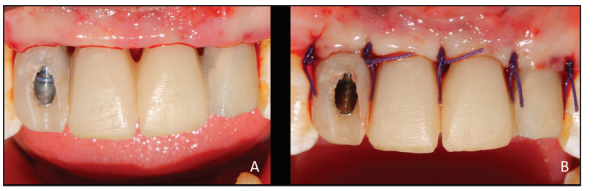

Fig. 6. A – seating of the provisional bridge into the implants, B – suturing of the flap orders using "O" points passing through the gingival embrasure.

was condensed over the abutments screws and the screw access channels were filled with a composite resin or Cavit. The flap was sutured using "O" points passing through the gingival embrasure (Fig. 6B). Postoperative instructions were provided; especially to avoid masticatory loading of the interim restoration and to reinforce oral care.

After two weeks, the patient had returned for suture removal and control. Incision sites healed uneventfully, and suture removal was performed. Future recall appointment was scheduled after a minimum of six to eight weeks to allow gingival tissue maturation. After the healing period, the temporary bridge was unscrewed and a great increase in the height of the gingival collar and dental papillae was observed (Fig. 7A, B).

Once the sought gingival profile was attained, the stage of the definitive restoration using customized transfer copings was launched.

The patient was scheduled for several follow-up appointments after one week, two weeks, six months and one year. She was satisfied with her new smile

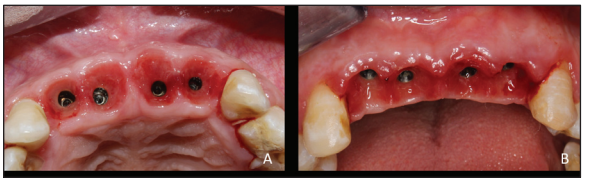

Fig. 7. A – occlusal view of the emergence profile after six weeks revealing a sufficient thickness of the keratinized tissue and a symmetry between central incisors and lateral incisors, B – vestibular view of a gorgeously scalloped gingival margin with regenerated inter-implant papilla.

Discussion

The gingival papilla fulfils fundamental physiological roles given that it gets involved in mastication, phonetic processes, and aesthetic integration of the prosthesis. The issue is most noticeable in cases of total or partial papillae loss. The re-establishment of the gingival papilla's integrity is subsequently to be considered.[6] *Lemongello*[7] recommended a screw-retained provisional restoration to guide the soft tissues healing and therefore to reconstruct the papillae. A screw-retained provisional was favoured over a cement-retained one. This choice was made due to the easy retrievability and the provision of a cement-free subgingival area (elimination of any possibility of a residual cement in the peri-implant region avoiding soft tissue irritation). Furthermore, screw-retained provisional restorations enable easy access and, if necessary, customization of the emergence profile.

Two types of provisional restorations need to be distinguished: those created in a dental laboratory (whether using computer-aided technologies or traditionally crafted applying stone and conventional laboratory components) and those individually adjusted by the clinician at the chairside. While laboratory-fabricated provisionals are a viable treatment option, chairside custom-fabrication of provisional restorations provides greater flexibility in tissue manipulation concurrently mitigating supplementary laboratory costs. Although properly planned, prefabricated laboratory provisional may not satisfy the tissue modelling requirements provided chairside.[8]

Regarding the provisional's morphology, square-shaped crowns with broad and flat proximal surfaces as well as contact points positioned as apically as possible are favoured since it would increase the probability of a complete papilla fill, and consequently achieve more predictable soft tissue aesthetics.[6] Accordingly, *Tarnow* et al. recommended positioning the dental contact between 2 mm and 4 mm from the bone crest (average 3.4 mm) in order to obtain a fully matured papilla in rehabilitations for neighbouring implants.[6]

The emergence profile of the abutment might be either overcontoured or undercontoured. Overcontouring exerts pressure on the soft tissue, pushing it apically. Undercontouring will allow space for the soft tissue to migrate coronally. Actually, the facial surface should be considerably undercountoured during immediate implant placement and provisionalization to allow for swelling, blood supply, and apical migration of the peri-implant tissues. This will generally provide for an excess of tissue, which is advantageous around implants.[8]

Special attention should be given to the shape and apparent width of the tooth at the cervical area. The mesio-distal width of the abutment at this position should mirror that of the contralateral tooth or teeth. Within the peri-implant zone, the most delicate and challenging aspect is the management of the papilla. This small, pyramid-shaped soft tissue acquires its height and blood supply from its connections to nearby natural tooth roots and underlying bone. Adjacent to an implant, at least half of this support no longer exists.

The soft tissue positions are examined after the gingiva has matured. This should be conducted 6-8 weeks after the placement of the provisional restoration. If the papilla has not been able to completely fill the gingival embrasure, the amount of space left can be filled (if desired) by the definitive prosthesis along with a little composite restoration on the adjacent teeth. At this stage, the gingival margin and zenith position are assessed. If modification is desired, the provisional is removed and composite resin is applied to the sites in which gingiva apical movement is sought.

After the provisional restoration is modified and replaced, it should remain in place,

undisturbed for six weeks. This allows sufficient time for the peri-implant soft tissue "o-ring" to develop and mature.

This phenomenon persists even beyond the six-week period, although the majority of the transformation has taken place by this point. At the six-week re-evaluation stage, conclusive photographs and impressions are taken. Employing a custom impression coping is imperative to guarantee that the laboratory technician possesses an accurate duplicate of the patient's oral soft tissue.

The frequency of provisional restoration removal and adjustments should be kept to a minimum. Multiple removals of components at the implant level have been demonstrated to lead to further bone and soft tissue loss, contrary to the desired outcome.[8]

Patient perspective

The use of a provisional restoration, in conjunction with a meticulous adjustment of the emergence profile, facilitates on-site evaluation of the patient's biological response, adaptation and expectations. Once consensus is reached among all involved parties regarding the provisional restoration's outcomes, the final restoration can be executed.

Actually with the advance of the digital technology, the prevision of the aesthetic result can facilitate the communication with the patient and the treatment plan execution.

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