



Maintenance of Interdental Papillae in the Esthetic Zone Using Multiple Immediate Adjacent Implants to Restore Failing Teeth – a Report of Ten Cases at 2 to 7 Years Follow-up.

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Abstract

Restoration of failing multiple adjacent anterior teeth with dental implants has presented an esthetic challenge. It is commonly accepted that placement of adjacent implants into edentulous sites in the esthetic zone leads to compromised soft tissue esthetics, especially when related to the creation of the inter-implant papillae. On the basis of this it is generally accepted that multiple adjacent implant placement should be avoided in the esthetic zone. However, in this regard, there may be a significant advantage to one-stage immediate implant placement in adjacent sites with respect to maintenance of the interdental (inter-implant) gingival architecture. This is illustrated by a report of ten cases with a 2 to 7 year follow-up. The results presented in this paper highlight the importance of case selection and the need for im-

proved understanding of the biologic response to the placement of implants and their components in different situations. Clearly there are some differences in the remodeling response to implants placed in healed ridges compared with implants placed into extraction sockets. The tissue biotype and labial tissue thickness are also factors that may play a significant role, especially with regard to maintaining the labial tissue contours and esthetics, which further accentuates the need for careful case selection. The diverse nature of the cases illustrated in this paper, all treated by the author in his private practice, would seem to suggest that this approach is a valuable alternative for restoration of failing teeth in the anterior maxilla.

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Implant dentistry is now a mainstream protocol in esthetic and restorative dentistry. When restoring missing and failing teeth in the esthetic zone the implant option is more often than not considered as the first possible modality. However, soft tissue esthetics represent a considerable challenge, especially with regard to the stability of labial contours and the inter-implant papillae.

Indeed we understand today that bone and soft tissue remodeling occur around all dental implant restorations (irrespective of the system used) and this remodeling has been attributed to a number of factors. The most commonly accepted one seems to be the concept of the establishment of a 'biologic seal' commonly referred to as a 'biologic width' from the implant-abutment interface.¹⁻³ From a clinical perspective, the concept of biologic width around implants should be considered as a three-dimensional zone representing the body's attempt to create a seal around the implant restoration – the remodeling of the bone three-dimensionally to form adequate room for a connective tissue compartment between the bone and the epithelium. The extent of this remodeling has been suggested to be potentially influenced by: 1) the position of the implant abutment interface relative to the bone crest both in a vertical and horizontal direction; 2) the design of the implant abutment connection; 3) the repeated removal and replacement of prosthetic components; 4) the material of the transmucosal components (i.e., titanium, ceramic, zirconium, acrylic, gold, or porcelain); 5) the shape and contours of the transmucosal components; and 6) the thickness of the soft tissues.^{1,3-13} In contemporary practice, clinicians attempt to predict the consequences of this remodeling on the end result and, therefore, plan and execute treatments to accommodate or more specific-

ly compensate for anticipated soft tissue and bone changes.

The goal in any implant therapy in the esthetic zone is to produce a lasting restoration of the teeth that blends inconspicuously into the patient's smile. Factors such as a high lip-line and thin gingival biotype can present significant hurdles in achieving a lasting esthetic outcome, particularly when it comes to labial soft tissue stability over time. It is commonly accepted that in most cases where there is a single missing or single failing tooth, this goal is more easily achieved than in the restoration of multiple adjacent missing or failing teeth.^{14,15} Thus, the popular view is that placement of adjacent implants for the restoration of adjacent teeth in the esthetic zone should be avoided.

In recent years, immediate and flapless implant placement techniques have gained popularity as they offer a minimally invasive and often virtually atraumatic surgery. Whilst this has obvious benefits for the patient in terms of the surgical experience and perhaps treatment acceptance, it may not be so advantageous from a longer-term clinical outcome standpoint, especially when it comes to the stability of the labial bone and gingival tissues. Both recession and labial volume loss are accepted risks when using the technique,¹⁶⁻²⁰ prompting many clinicians to advocate a number of additional surgical steps such as grafting of biomaterials and tissue grafting in an attempt to increase the predictability of the soft tissue outcomes.^{6,19-29} These additional steps require a higher degree of surgical skill and are by no means always easy when working in a small site such as an extraction socket.

Clinical experience has shown that bone remodeling around implants placed



Fig 1 Case 1 was referred by the general dental practitioner after repeated de-cementation of crowns and root fractures evident on the maxillary central incisors. The veneers on the lateral incisors were also inadequate and the gingival line was too coronal on central incisors, making them appear too short and square.

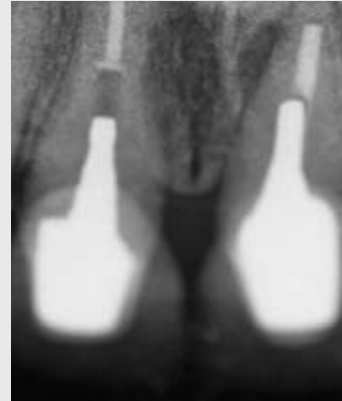


Fig 2 Case 1 pretreatment radiograph of failing teeth demonstrating the endodontic failure and external resorption.



Fig 3 Case 1 at the 5-year follow-up. Note excellent maintenance of the gingival architecture and papillae along with improvement in the proportions of the teeth and overall esthetics. All-ceramic crowns on implants replaced the maxillary central incisors and new veneers were fitted to lateral incisors. It should also be noted that in all cases anorganic bone mineral was packed into the labial void between the implants and the labial socket wall at the time of implant placement.



Fig 4 Case 1 radiograph at the 5-year follow-up showing stability of the very pronounced inter-implant bone peak.



Fig 5 Case 2 at presentation. Failing maxillary central incisors were part of a full-mouth rehabilitation carried out on this patient.

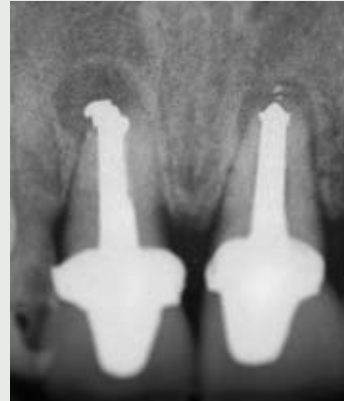


Fig 6 Case 2 radiograph of failing incisors with chronic apical lesions.



Fig 7 Case 2 at the 7-year follow-up demonstrates excellent stability of the papilla between the implants. Although there has been labial recession due to the fact that this case represents our early experience with the technique and, as can be seen in later more recent cases, this can be prevented by use of appropriate transmucosal under-countours and additional soft tissue grafting.



Fig 8 Case 2 radiograph at the 7-year follow-up shows excellent maintenance of the inter-implant bone peak at the same level as the bone levels on the mesial of the lateral incisors.

in immediate extraction sockets using a flapless technique not only seems to have a reduced horizontal and vertical component, but may also have the potential to create improved maintenance of interproximal bone peaks in adjacent sites.^{19,20} On a sobering note though it should be remembered that the labial bone may not be

maintained and there remains a risk of labial tissue thinning and, therefore, subsequent recession (Fig 7). However, this may not be as critical from an esthetic standpoint when dealing with adjacent teeth as opposed to a single tooth. This is particularly the case if the teeth in question are contra-lateral across the midline, because



Fig 9 Case 3 with periodontal disease and existing recession, extrusion, and splaying of the incisors.



Fig 10 Case 3 pretreatment radiograph. The patient did not want to maintain the teeth.



Fig 11 Although not an ideal esthetic result, case 3 at the 5-year follow-up demonstrates improved esthetics and maintenance of the papilla height between four implants.

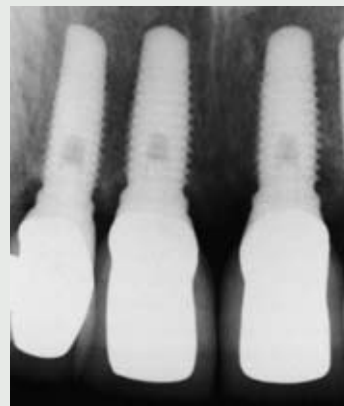


Fig 12 Case 3 radiograph at 5-year follow-up, bone peaks are maintained between the four implants.

the recession is likely to be symmetrical and over a broader area and, therefore, less noticeable. Nevertheless it is recommended that steps be taken to attempt to reduce the potential labial volume loss as detailed below.

The scope and application of the immediate one-stage flapless implant placement

approach for restoration of multiple adjacent failing teeth is illustrated by the report of ten cases at between 2 to 7 years follow-up treated by the author in his private practice. The diverse nature of the cases is representative of cases seen and treated in private practice.



Method and materials

All cases involved the replacement and restoration of two or four adjacent failing anterior maxillary incisor teeth with immediate implants placed in a one-stage flapless approach and ultimately restored with cement-retained single all-ceramic crowns based on high strength alumina copings (Procera Alumina, Nobel Biocare, Gothenburg, Sweden). A variety of implant systems and components were used including the Replace Select, Nobel Replace Tapered Groovy, and Nobel Perfect (Nobel Biocare, Gothenburg, Sweden) and Ankylos (Dentsply Friadent, Mannheim, Germany) implant systems. The implant systems were combined with either titanium, custom porcelain-fused-to-metal, or zirconia abutments screwed down to manufacturer's recommended torque, and restored with all-ceramic crowns cemented with a glass ionomer cement (Fuji 1, GC, Tokyo, Japan). The abutment screw-access holes were sealed with cotton pellets and glass-ionomer cement prior to cementation of the crowns. In all cases, the final crowns were cemented onto the abutments without the use of provisionals on the abutments (only the initial provisionals were used) and tissue maturation was allowed to occur on the definitive crowns.

All treatment was carried out using 4.8x magnification loupes. In all cases, the teeth were extracted carefully to ensure minimal trauma to the surrounding soft tissues and bone, sockets were carefully debrided under magnification, and evaluation of the bone was carried out to ensure the presence of an intact labial plate. Patients were given prophylactic antibiotics, either penicillin V 250 mg q.i.d., cephalexin 500 mg b.i.d. or clindamycin 150 mg q.i.d.

for 5 days with the initial dose just prior to surgery. Implants were placed using commonly accepted protocols with the pilot hole being made in the palatal wall of the socket in the apical third of the socket and osteotomies carried out so that implants were oriented to the incisal edge whilst keeping up against the palatal socket wall. Any apical granulomas or defects were thoroughly curetted and debrided through the sockets. The implants were placed largely palatal to any apical defects, which were either left to heal spontaneously or packed through the socket with anorganic bone mineral (Bio-Oss, Geistlich AG, Wolhusen, Switzerland) prior to implant placement depending on the size of the defect (the larger ones were grafted). A space of approximately 2 mm was left labial to the implants in the sockets and anorganic bone mineral was packed firmly into the voids to the level of the implant head. The implant head was placed 2 to 3 mm apical to the desired final gingival margin of the final restorations in most cases with the exception of case 7 where the scalloped implant was used and the head of the implant was placed more shallowly: 1 to 1.5 mm apical to the final desired gingival margin at the labial. In cases 2, 3, 6, 7, 8, 9, and 10, healing abutments were placed and a provisional fixed partial denture was fitted with hollow pontics that were relined to the healing abutments. Provisional fixed partial dentures were either Rochette fixed partial dentures cemented to the adjacent teeth (cases 6 and 7) with a resin-modified glass-ionomer cement (Fuji II LC, GC), or conventional fixed provisional partial dentures retained on adjacent prepared teeth (cases 2, 3, 8, 9, and 10) cemented with provisional cement (Tempocem, Minerva Den-



tal Ltd, Cardiff, UK). Care was taken to ensure that the proximal contours provided support for the interdental papillae and that a small amount of provisional cement was used to seal the gap between the pontic and the healing abutments, being especially careful to ensure that all cement excess was removed. In cases 1, 4, and 5 the implants were immediately fitted with provisional crowns directly to the implants at the time of implant placement.

The diverse mixture of cases treated are reflective of real private practice – from thick flat tissue biotypes to thin scalloped tissues, two or four adjacent implants, and in some cases the anterior implants were part of a larger restoration of the patient's mouth. Labial gingival stability was good to excellent in all cases, although a little recession (1 to 1.5 mm) was seen in some cases, as is commonly occurs with the immediate protocol. In some of the older cases, this may have been primarily due to the more convex transmucosal contours used at that time. In some cases recession was deliberately caused (cases 1 and 5), but later cases show better stability as narrower, under-contoured transmucosal contours were used. In fact, in a number of cases coronal gain of tissue was achieved through under-contour and connective tissue grafting (cases 6, 7, and 8). Labial thinning was most pronounced in case 5 where some shine-through of the metallic components led to shadowing of the gingiva, leading to the conclusion that when using the scalloped or supracrestal implant placement a thick biotype is more appropriate. Alternatively, in order to minimize shine-through labial tissue augmentation should be considered by means of connective tissue grafting at the time of implant placement at the labial aspect in the

gap between the implant healing or temporary abutment and labial gingiva.^{19,20,26}

Clinical experience indicates the importance of thickening the labial gingival tissue by this means to create better labial stability of the gingival tissues. In case 6, labial connective tissue grafts were performed at the time of implant placement by sandwiching the grafts between the healing abutments and labial gingiva. This was also performed in case 8 for the lateral incisors. In case 10, a connective tissue graft was performed only on the maxillary right central incisor where, at the time of surgery, the tissue quality was considered particularly poor. It is interesting to note that in case 10 the tissue quality and esthetics where the connective tissue graft was performed actually appears better than on the other three implants where a little thinning is seen. This highlights the importance of tissue thickness in the quality of the labial gingival esthetics. All ten cases have been followed up for at least 2 years.

Results and discussion

Stability of the papillae was evaluated by comparison of the pretreatment inter-implant papilla or papillae using the papillae mesial to the maxillary canines (between the lateral incisors and canines) as the reference to gauge the relative levels and stability.

In all cases, with the exception of case 5, the papillae and gingival architecture were well maintained and, most interestingly, the interproximal peaks of bone were also maintained as apparent in the radiographs. This is particularly marked in some cases, as the peaks in these are quite narrow and steep. Nevertheless the interesting point to



Fig 13 Case 4 at presentation. Maxillary central incisors were failing and needed removal. Patient did not want orthodontic treatment.



Fig 14 Case 4 pretreatment radiograph.



Fig 15 Case 4 at the 6-year follow-up. All-ceramic crowns on implants were used to restore the central incisors and the lateral incisors were veneered in order to improve the tooth proportions. Although the result is by no means ideal, there is a considerable improvement in the esthetics. The important point, from the perspective of the present study, is that the inter-implant papilla has been maintained at the same level when compared with the papillae mesial to the canines.



Fig 16 Case 4 radiograph at the 6-year follow-up shows maintenance of the unusual bone peak.



Fig 17 Case 5 at presentation with failing maxillary central incisors. The existing gingival levels are disharmonious and crown lengthening of the central incisors was desired.

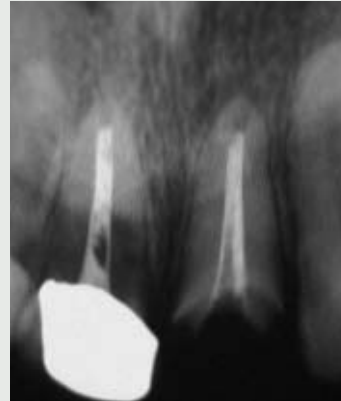


Fig 18 Case 5 pretreatment radiograph shows failed teeth and internal resorption of the root.



Fig 19 Case 5 at the 2-year follow-up. Some darkening of the gingiva is seen probably due to shine-through of the components. Slight recession of the papilla between the implants is seen in this case. The results reflect early experience with the scalloped implant design and the implants were placed too deep. Nevertheless, the overall esthetic result is a significant improvement over the pretreatment situation.



Fig 20 Case 5 radiograph at the 2-year follow-up demonstrates a less-than-ideal maintenance of the bone peak between the implants again, probably due to the placement of the implants being too deep.



Fig 21 Case 6 pretreatment. This was a very difficult case as there was discolored gingiva, failing incisors, and the central incisors were already too big. The need was to bring the labial tissue more coronal, which presented a significant clinical challenge.



Fig 22 Case 6 pretreatment radiograph.



Fig 23 Case 6 at the 2-year follow-up. All-ceramic crowns were placed on implants to restore the central incisors, and were combined with direct resin composite bonding on the mesial side of the lateral incisors to improve the tooth proportions. Connective tissue grafts at the time of implant placement were sandwiched between the healing abutments and labial gingiva. Undercontouring of the transmucosal components created additional space for increased soft tissue thickness. An excellent result was obtained with considerable coronal gain of tissue, resulting in shorter looking papilla.



Fig 24 Case 6 radiograph at the 2-year follow-up demonstrates excellent bone maintenance.



Fig 25 Case 7 pretreatment view of failing central incisors. Note uneven gingival line. The patient requested that the labial gingiva be brought more coronally.



Fig 26 Case 7 radiograph before treatment. The general dental practitioner referred the patient after repeated de-cementation of the crowns and subsequent root fracture.



Fig 27 Case 7 at the 4-year follow-up. Note labial gingival levels were successfully moved coronally by shallow placement of the implants along with under-contouring of the transmucosal form. This gives the illusion of a shorter papilla, but this is not the case when compared with the mesial side of the canines.



Fig 28 Case 7 follow-up radiograph at 4 years shows maintenance of bone peak between implants at the same level as those on the adjacent teeth.



Fig 29 Case 8 was a complex full-mouth rehabilitation with compromised gingival esthetics owing to disease and tooth migration. The patient requested single-tooth restorations and an immediate flapless approach was taken.

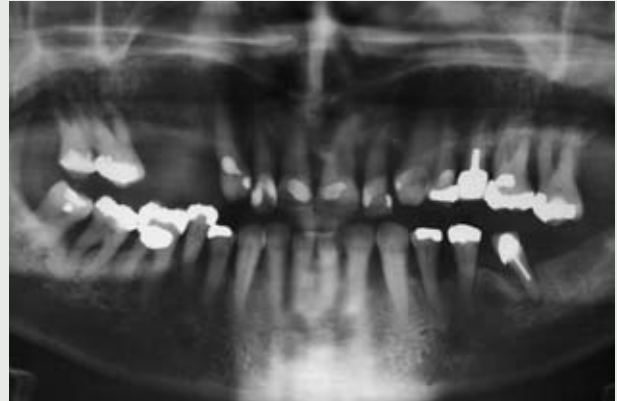


Fig 30 Case 8 pretreatment orthopantomograph.



Fig 31 Case 8 at the 2-year follow-up. Note the improved gingival esthetics. Although not a perfect result, there is no reduction in the papillae and an improvement in gingival esthetics in an already very compromised case. Connective tissue grafts were used on both lateral incisors at the time of implant placement using the sandwich technique described.



Fig 32 Case 8 orthopantomograph at the 2-year follow-up.



note in these cases is that the normal flattening of the interdental bone peaks seen after tooth extraction is not experienced with this protocol. The one exception, as previously mentioned, is case 5 (Figs 17 to 20) where there has been some flattening of the inter-implant bone peak and a small subsequent recession of the papilla. However, this case represents early experience with the scalloped implant design. The placement of the implants in this case were clearly too deep and this is likely to have influenced the results. In all other cases the papillae and bone levels have been well maintained.

In case 1 (Figs 1 to 4), the implants were deliberately placed deep relative to the initial gingival margins in order to anticipate the increased clinical crown length, and as a rule implants were placed 2 to 3 mm apical from the desired final labial gingival margin. It is interesting that the very tall interproximal bone peak was maintained even at the 5-year follow-up nonetheless. In case 2 (Figs 5 to 8), the interdental papilla was already somewhat flattened prior to treatment, but nevertheless had been maintained and somewhat improved with complete maintenance of the inter-implant bone peaks at the 7-year follow-up (Figs 7 and 8). Labial recession is more marked in this case, although there has been some deliberate lengthening of the teeth to compensate for incisal wear as part of the full-mouth rehabilitation.

In case 7 (Figs 25 to 28), it should be noted that the papilla between the two implants remained stable, but appears less steep and shorter because of the coronal shift in labial gingival margins, hence shortening the clinical crown length. This was produced by intentional undercutting of the transmucosal aspects of the restorations, as the patient wanted



Fig 33 Periapical radiograph of case 8 at the 2-year follow-up.

slightly shorter teeth when compared with the pretreatment crowns. Some loss of labial volume of tissue is seen in some of the cases, but as this is spread over a wider area than would be seen with a single tooth, there is less negative impact from an esthetic viewpoint. The application of anorganic bone mineral may also have played a significant role in diminishing the amount of labial volume loss.^{19-25,28,29}

Perhaps the most striking case is case 9 where there was considerable periodontal disease and loss of attachment with the teeth. The implants in this case were placed accepting that there would be some inevitable recession, but as with many periodontal cases there had been some extrusion and proclination of the incisors allowing the incisal edges of the restored teeth to be placed more apically and palatally and, therefore, still maintaining good esthetics. The implants were placed so that the head of the implants were placed 1 to 2 mm supracrestal to labial bone levels at the time of tooth ex-



Fig 34 Case 9 had a number of failing teeth due to periodontal disease, and the anterior teeth were extruded and proclined.



Fig 35 Case 9 pretreatment orthopantomograph.



Fig 36 Case 9 at the 3-year follow-up with single implant crowns for the maxillary incisors. Note that the gingival scalloping and the height of the inter-implant papillae were maintained when compared with the mesial side of the canines.

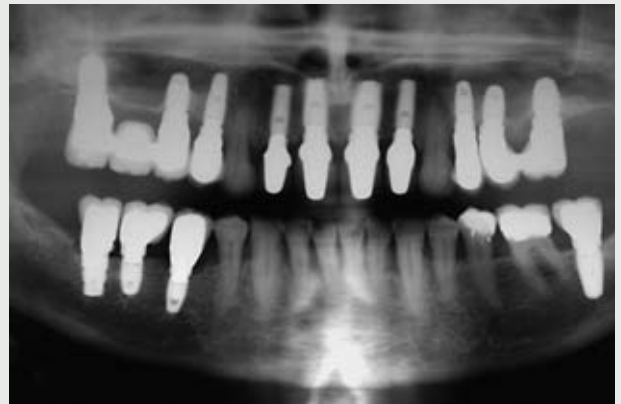


Fig 37 Case 9 orthopantomograph at the 3-year follow-up.



Fig 38 Case 9 at the 3-year follow-up showing a close-up of the maxillary anterior teeth restored with four adjacent implants.



traction, thus perhaps reducing the impact of the components, disconnection and re-connection on labial bone levels as the connection was, in effect, supracrestal. Support was provided to the interdental papillae by means of healing abutments and provisional bridgework, and the 3-year follow-up slides and radiographs demonstrate excellent results.

It is difficult to explain the mechanism of these results although it is likely that there is not only a reciprocal relationship between the tissue and bone and that the vertical alveolo-gingival fibers perhaps play a role in 'holding up the bone' in the interproximal areas when the tissue is supported and the papillae not allowed to collapse. It is also apparent from clinical experience that the remodeling seen in extraction sites seems to have smaller vertical and particularly horizontal components, with a steeper angle of bone remodeling when compared to implants placed into healed ridges. Perhaps the application of anorganic bone mineral also plays a part in reducing the apparent remodeling. However, it should be emphasized that these conclusions can only be drawn with respect to the proximal bone levels seen radiographically. There is insufficient data concerning what happens on the labial aspect with respect to implants placed using a flapless technique into extraction sites with the simultaneous application of bone mineral.

The interesting aspect of the present results is that the immediate one-stage flapless implant placement approach may have considerable benefits in regard to maintaining the scalloped nature of the gingival architecture and the interdental papillae. These results, particularly in respect to four adjacent implants, indicate that this approach has the potential to

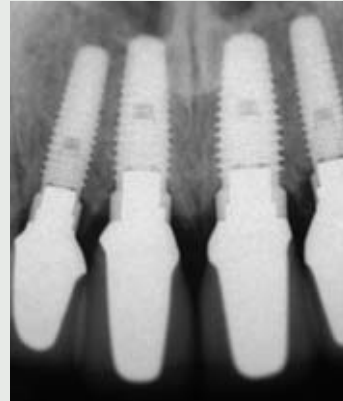


Fig 39 Case 9 periapical radiograph at 3-year follow-up demonstrates maintenance of the bone peaks between the implants.

create superior gingival esthetics to the placement of two implants and two pontics for the replacement of four teeth – the traditional approach most commonly advocated today.³⁰ However, it should be stressed again that equivalent results are not obtained when conventional implant placement is carried out in a healed ridge and an immediate flapless one-stage approach is not used. Although not the focus of this paper, the labial gingival levels were better maintained by creating additional tissue thickness by means of transmucosal under-contouring of the components, connective tissue grafting, or a combination of both. It should also be noted that anorganic bone mineral was packed into the labial void between the implants and the labial socket wall at the time of implant placement in all cases, and this may contribute to the successful results with regards to the labial tissue esthetics.

Clearly, these results are interesting and suggest the need for further study and perhaps a revision of some of the currently held beliefs regarding implant restoration of multiple failing teeth in the esthetic zone.



Fig 40 Case 10 at presentation. The four maxillary incisors were failing.

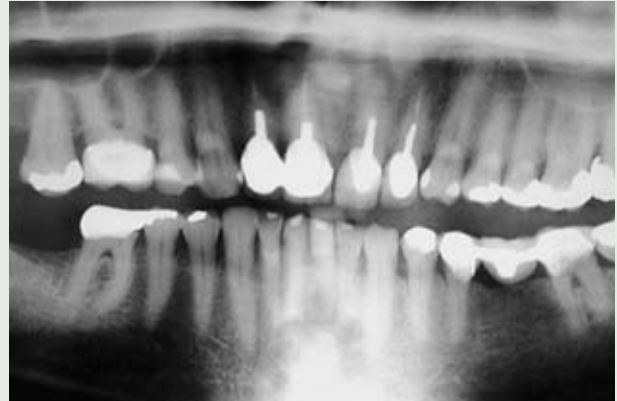


Fig 41 Case 10 pretreatment orthopantomograph.



Fig 42 Case 10 at the 5-year follow-up with excellent maintenance of soft tissue architecture considering the compromised pretreatment state. Note that a connective tissue graft at the time of implant placement was sandwiched between the labial gingiva and the healing abutment, and was only used on the right central incisor. Interestingly, the labial gingival tissue on this site has the best quality and esthetics.

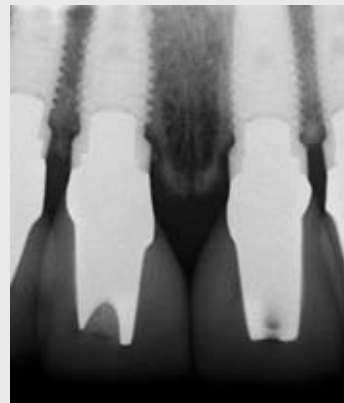


Fig 43 Case 10 radiograph at 5 years shows maintenance of inter-implant bone.



Conclusions

The diverse nature of the cases illustrated, in terms of components used and gingival biotypes, demonstrates the effective maintenance of the interproximal/inter-implant gingival architecture when using a flapless one-stage immediate implant approach. A variety of systems were utilized, but the most striking results were obtained with the 'flat-top' implant designs.

The key steps are:

1. Correct three-dimensional positioning of the implant (i.e., in the palatal aspect of the socket lined up with the incisal edge.) The implant head should be 2 to 3 mm vertically from the desired final gingival margin for a "flat-top" implant. The labial edge of the implant should be 2 mm from the labial plate.
2. Anorganic bone mineral or non-resorbable bone substitute should be packed into the labial void to best maintain the soft tissue contours.
3. The best labial soft tissue quality and stability was achieved with a connective tissue graft sandwiched into the labial aspect of the socket between the abutment and gingiva.
4. The labial aspect of the abutment and restoration should be under-contoured or flat in the transmucosal area.

Immediate one-stage implant placement in a flapless approach offers a viable esthetic alternative for the replacement of failing maxillary anterior teeth in the esthetic zone.



Fig 44 Case 10 close-up view of maxillary anterior implants and teeth at the 5-year follow-up.

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