

Bridge design, part four: aesthetic enhancement for anterior fixed bridge restorations

By Paul Tipton, BDS, MSc, DGDGP (UK)

Following on from his previous articles on fixed-movable and fixed-fixed bridgework, Paul Tipton now examines aesthetic issues regarding anterior fixed bridge restorations

The premature loss of anterior teeth can lead to several aesthetic problems. If the tooth has been removed some time previously without any ridge preservation techniques, then in all probability there will have been horizontal and vertical bone loss, often with complete loss of the buccal cortical plate of bone. This makes the aesthetic replacement of the missing tooth, be it with a fixed bridge or dental implant, a very difficult task.

The final restoration needs also to conform to certain aesthetic requirements. The general direction of the incisal plane of the maxillary teeth and the gingival margin outline must be parallel to the interpupillary line. This harmony must be further reinforced by the incisal plane following the lower lip line during smiling (Chiche, 1994). The dental midline perpendicular to this interpupillary line serves to anchor the smile on the face (Golub, 1988). The maxillary centre line should therefore coincide with the midline of the face.

Lombardi (1973) pointed to the importance of the proportion between width and length in the dimensions of individual teeth. This proportion has been called the Divine or Golden Proportion (Levin, 1981) and classically has a proportion of 1.618:1. That is, the width of the central incisor to the lateral incisor should be in that proportion when viewed from the front (this is not to be confused with the actual width but the width as seen by the viewer). The width of the lateral incisor to that of the canine should be in the same proportion and so on.

Pleasing proportions of the central incisors are also expressed in a width to length ratio of approximately 75% to 80%.

Pleasing central incisors of pleasing proportions are an essential aspect of a successful aesthetic rehabilitation.

Because the pontic gingival interface is important for proper aesthetics in visible anterior regions alveolar ridge deformities present special challenges during fixed bridge reconstruction. Seibert (1983) originally presented a system for classifying various edentulous ridge deformities:

- Class I - Bucco-lingual loss of ridge contour
- Class II - Apico-coronal loss of ridge contour
- Class III - Combined bucco-lingual and apico-coronal loss of ridge contour.

The previous paper in this series concentrated on the technical aspects of fixed-fixed bridgework. This paper will reflect on the aesthetic principles involved in fixed bridgework.

RIDGE PRESERVATION

Recently much work has been done in an effort to save the precious buccal cortical plate of bone by a series of ridge preservation techniques. The first of these is the atraumatic extraction of the tooth by the use of periostomes, whereby the socket is not expanded during the extraction procedure. Socket space can then ideally be filled with an immediate replacement implant such as 'Replace' from Steri-Oss which is tapered and a similar shape to the tooth that has been extracted. Alternatively, should the patient wish to delay or forgo implant treatment, the socket can be filled with a bone substitute, provided primary closure is established. Primary closure itself can be difficult in these circumstances, and often a membrane can be placed over the socket or a connective tissue graft taken from the palate for primary closure. The alternative is to bury the root by cutting off the crown and preparing the root face subgingivally and allowing the soft tissue to proliferate and heal over the top. The root can then be removed at a later date via a small palatal incision and the use as previously mentioned of the periostome. Primary closure can then proceed as normal.

OVATE PONTIC

The ovate pontic is the ideal pontic form with a rounded base and is indicated where aesthetics are of paramount impor-

Paul Tipton BDS, MSc, DGDGP (UK), is a specialist in prosthodontics and runs a private referral restorative and implant practice at the St Ann's Dental Clinic in Manchester. The clinic takes referrals for both the surgical and prosthetic aspects of implantology. He also runs one-year practical restorative and implantology courses from St Ann's Dental Education Centre, Manchester

tance. It also fulfils ideally the requirements of function and oral physiology but can only be utilised if the recipient site is initially prepared to receive it by some form of surgical procedure, or if the pontics are inserted into the extraction socket at the same time as tooth removal. The rounded base of the pontic must be accurately formed to fit the prepared concave recipient site precisely. The intimate relationship allows floss to pass over the convex base, simultaneously cleaning the pontic and the concavity of the soft tissue.

RIDGE AUGMENTATION PROCEDURES

Garber (1981) described several distinct types of surgical procedures that were available for treating the resorbed residual edentulous ridge prior to creation of the ovate pontic. These included the de-epithelialised connective tissue pedicle graft often used during second stage implant surgery, the autogenous combined epithelial connective tissue free graft and the sub-epithelial connective tissue graft. This article describes a case presentation of a sub-epithelial connective tissue graft.

CASE PRESENTATION

This 55-year-old female was referred to St. Ann's Dental Clinic by her periodontist in Manchester for replacement of her anterior bridge. On examination it could be seen that there was a vertical and horizontal defect in the ridge and there had been tissue recession around the retainers with black triangles forming in-between the anterior teeth (Figure 1) necessitating ridge augmentation procedures.



Figure 1: Pre-op condition showing loss of interdental papilla between central incisors and inadequate ridge shape

TOOTH PREPARATION

A provisional bridge was fabricated by the laboratory from an initial diagnostic wax up and placed after initial tooth preparation (Figure 2). All tooth preparations were etched and bonded with dentine adhesive in order to reduce sensitivity after crown preparation and before cementation (Felton, 1991). Desensitisers obturate exposed dentine and tubules with a resinous material, blocking tubule fluid flow and reducing the



Figure 2: Provisional four unit bridge prepared and placed

sensation of pain (Brannstrom, 1984). After crown preparation as many as one to two million dentinal tubules may be exposed (Richardson, 1991) increasing the potential for post-operative sensitivity. After tooth preparation dentine can still become sensitive as a result of microleakage of the provisional restoration and the resultant formation of bacterial by-products (Pashley, 1984). However, with the use of a thin layers of resin based dentine adhesive such as 'One Step' (Optident) the effect of external agents on dentine sensitivity can be greatly reduced.

CONNECTIVE TISSUE GRAFT

The donor site for the connective tissue graft was the lateral aspect of the palate in the tuberosity region and the tissue for the graft is removed as part of a wedge procedure. A split thickness flap was raised on the buccal aspects of the deformed ridge leaving the periosteum and a portion of the connective tissue overlying the alveolar ridge. Vertical incisions extended in an oblique fashion either side of the deformed ridge and into the labial flap as high as necessary to reposition the muco-gingival junction. The connective tissue from the donor site was placed and sutured in position with resorbable sutures (Figure 3). The overlying flap, together with the underlying connective tissue base should provide an adequate

Figure 3: Connective tissue graft sutured in situ

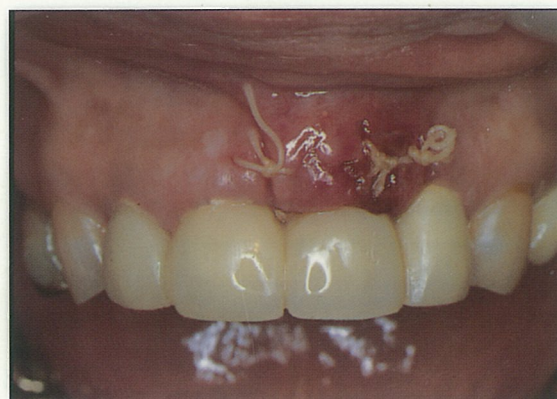




Figure 4: Provisional bridge modified to shape of new edentulous ridge

source of nutrients for the connective tissue graft. Sutures were removed at ten days and the correct pontic concave recipient site is created in the augmented ridge with the provisional acrylic restoration (Figure 4).



Figure 5: Definitive bridge abutment preparations

BLACK TRIANGLE DISEASE

After six months (during which time the graft will have matured) definitive tooth preparations proceed (Figure 5).

In order to re-establish interdental papillae, measurements are taken from the soft tissue pontic area adjacent to each abutment tooth to the underlying interdental bone. This can be done by measuring from radiographs or bone sounding using a periodontal probe. Tarnow (1992) confirmed that to ensure an interdental papillae is always present between the teeth after restoration then the distance from the most coronal aspect of the contact area of adjacent teeth to the underlying crest of bone needs to be a minimum of 5mm or less. In such cases a papillae is present 100% of the time. When this distance, however, increases to 6mm a papillae is only present 56% of the time and when it is 7mm or more the papillae is present only 27% of the time. These measurements are transferred to the dental technician so as to place the coronal aspects of the contact areas in the correct position, and avoid black triangle disease.

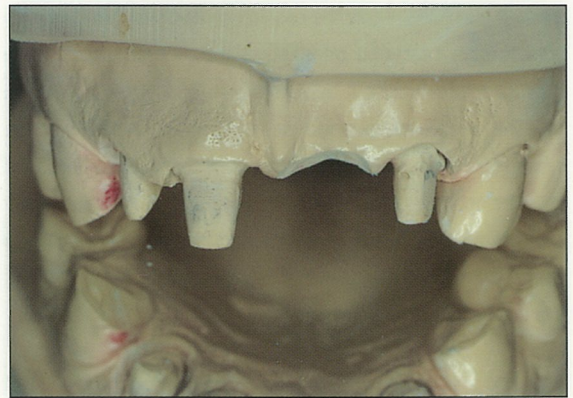


Figure 6: Geller model with ovate pontic site developed in laboratory (front view)

GUIDED SOFT TISSUE HEALING

Because of the underlying periodontal disease and mobility present and to establish ideal aesthetics, the three remaining teeth were used as abutments for this four unit fixed bridge. To further enhance the aesthetic outcome, cast scoring of the final stone cast was performed by the technician (Stein 1966) (Figure 6). A Geller model (Willie Geller) was fabricated by the technician to reshape the interdental papillae by trimming width, but not height off the cast, having removable stone or silver dyes in an acrylic based model. An acrylic-based model reproduces all the soft tissue and can be trimmed in order to guide soft tissue healing (Figure 7). The fixed four unit anterior bridge shows long contact areas where the technician has brought this down to within 5mm of the interproximal bone (Figure 8) ovate pontic and the width of the teeth are in the golden proportion (Levin 1981). A certain amount of soft tissue blanching of the surgically enhanced residual ridge occurs upon seating of the definitive bridge (Figure 9).

CONCLUSIONS

The final restoration shows excellent form and function, with no black triangles, pontic form and height the same as the adjacent abutment tooth. The contact area falls within 5mm of the underlying bony contour and the shape of the teeth fall into the gold-

Figure 7: Occlusal view showing ridge contouring

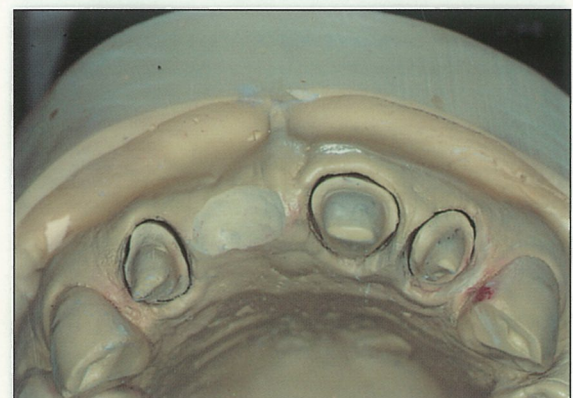




Figure 8: Four unit bridge constructed by technician



Figure 9: Bridge cemented in situ showing alignment of gingival margins of centrals and no black triangles



Figure 10: Patient's smile showing completed bridge



Figure 11: Close up of bridge

en proportion as described by Levin (1981) (Figures 10 & 11). With soft tissue surgery fixed bridgework can be aesthetically predictable if all aesthetic principles described here are applied. The next article in the series will deal with the selection of abutments for retainers in bridgework. ■

ACKNOWLEDGEMENTS

I would like to thank dental technician Martin Fletcher for his help in this case.

REFERENCES

- Brannstrom M (1984). Communication between the oral cavity and the dental pulp associated with restorative treatment. *Oper Dent* **9**: 57-68
- Chiche G (1994). Ed in *Aesthetics of Anterior Fixed Prosthodontics*. Quintessence, Chicago
- Felton D (1991). Evaluation of the desensitising effect of gluma dentin bond on teeth prepared for complete coverage restorations. *Int J Prosthodont* **4**: 292-298
- Garber D (1981). The edentulous ridge in fixed prosthodontics. *Compend Cont Ed Dent* **11**(4): 212-223
- Levin E (1981). Dental aesthetics and the golden preparation. *JPD* **40**(3): 244-252
- Lombardi R (1973). The principles of visual perception and their clinical application to dentine aesthetics. *J Prosth Dent* **29**: 358-
- Pashley D (1984). Smear layer: physiological considerations. *Oper Dent Suppl* **3**: 13-29
- Richardson D (1991). Dentin permeability: effects of crown preparation. *Int J Prosthodont* **4**: 219-225
- Seibert J (1983). Reconstruction of deformed, partially edentulous ridges, using full thickness onlay grafts. Part I: technique and wound healing. *Compend Contin Ed Dent* **4**: 437-
- Stein R (1966). Pontic residual ridge relationship – a research report. *JPD* **16**(2): 251-285
- Tarnow D (1992). The effect of the distance from the contact point to the crest of bone on the presence or absence of the interproximal dental papilla

Bridge design, part four: aesthetic enhancement for anterior fixed bridge restorations

By Paul Tipton, BDS, MSc, DGDGP (UK)

Following on from his previous articles on fixed-movable and fixed-fixed bridgework, Paul Tipton now examines aesthetic issues regarding anterior fixed bridge restorations

The premature loss of anterior teeth can lead to several aesthetic problems. If the tooth has been removed some time previously without any ridge preservation techniques, then in all probability there will have been horizontal and vertical bone loss, often with complete loss of the buccal cortical plate of bone. This makes the aesthetic replacement of the missing tooth, be it with a fixed bridge or dental implant, a very difficult task.

The final restoration needs also to conform to certain aesthetic requirements. The general direction of the incisal plane of the maxillary teeth and the gingival margin outline must be parallel to the interpupillary line. This harmony must be further reinforced by the incisal plane following the lower lip line during smiling (Chiche, 1994). The dental midline perpendicular to this interpupillary line serves to anchor the smile on the face (Golub, 1988). The maxillary centre line should therefore coincide with the midline of the face.

Lombardi (1973) pointed to the importance of the proportion between width and length in the dimensions of individual teeth. This proportion has been called the Divine or Golden Proportion (Levin, 1981) and classically has a proportion of 1.618:1. That is, the width of the central incisor to the lateral incisor should be in that proportion when viewed from the front (this is not to be confused with the actual width but the width as seen by the viewer). The width of the lateral incisor to that of the canine should be in the same proportion and so on.

Pleasing proportions of the central incisors are also expressed in a width to length ratio of approximately 75% to 80%.

Pleasing central incisors of pleasing proportions are an essential aspect of a successful aesthetic rehabilitation.

Because the pontic gingival interface is important for proper aesthetics in visible anterior regions alveolar ridge deformities present special challenges during fixed bridge reconstruction. Seibert (1983) originally presented a system for classifying various edentulous ridge deformities:

- Class I - Bucco-lingual loss of ridge contour
- Class II - Apico-coronal loss of ridge contour
- Class III - Combined bucco-lingual and apico-coronal loss of ridge contour.

The previous paper in this series concentrated on the technical aspects of fixed-fixed bridgework. This paper will reflect on the aesthetic principles involved in fixed bridgework.

RIDGE PRESERVATION

Recently much work has been done in an effort to save the precious buccal cortical plate of bone by a series of ridge preservation techniques. The first of these is the atraumatic extraction of the tooth by the use of periostomes, whereby the socket is not expanded during the extraction procedure. Socket space can then ideally be filled with an immediate replacement implant such as 'Replace' from Steri-Oss which is tapered and a similar shape to the tooth that has been extracted. Alternatively, should the patient wish to delay or forgo implant treatment, the socket can be filled with a bone substitute, provided primary closure is established. Primary closure itself can be difficult in these circumstances, and often a membrane can be placed over the socket or a connective tissue graft taken from the palate for primary closure. The alternative is to bury the root by cutting off the crown and preparing the root face subgingivally and allowing the soft tissue to proliferate and heal over the top. The root can then be removed at a later date via a small palatal incision and the use as previously mentioned of the periostome. Primary closure can then proceed as normal.

OVATE PONTIC

The ovate pontic is the ideal pontic form with a rounded base and is indicated where aesthetics are of paramount impor-

Paul Tipton BDS, MSc, DGDGP (UK), is a specialist in prosthodontics and runs a private referral restorative and implant practice at the St Ann's Dental Clinic in Manchester. The clinic takes referrals for both the surgical and prosthetic aspects of implantology. He also runs one-year practical restorative and implantology courses from St Ann's Dental Education Centre, Manchester

tance. It also fulfils ideally the requirements of function and oral physiology but can only be utilised if the recipient site is initially prepared to receive it by some form of surgical procedure, or if the pontics are inserted into the extraction socket at the same time as tooth removal. The rounded base of the pontic must be accurately formed to fit the prepared concave recipient site precisely. The intimate relationship allows floss to pass over the convex base, simultaneously cleaning the pontic and the concavity of the soft tissue.

RIDGE AUGMENTATION PROCEDURES

Garber (1981) described several distinct types of surgical procedures that were available for treating the resorbed residual edentulous ridge prior to creation of the ovate pontic. These included the de-epithelialised connective tissue pedicle graft often used during second stage implant surgery, the autogenous combined epithelial connective tissue free graft and the sub-epithelial connective tissue graft. This article describes a case presentation of a sub-epithelial connective tissue graft.

CASE PRESENTATION

This 55-year-old female was referred to St. Ann's Dental Clinic by her periodontist in Manchester for replacement of her anterior bridge. On examination it could be seen that there was a vertical and horizontal defect in the ridge and there had been tissue recession around the retainers with black triangles forming in-between the anterior teeth (Figure 1) necessitating ridge augmentation procedures.



Figure 1: Pre-op condition showing loss of interdental papilla between central incisors and inadequate ridge shape

TOOTH PREPARATION

A provisional bridge was fabricated by the laboratory from an initial diagnostic wax up and placed after initial tooth preparation (Figure 2). All tooth preparations were etched and bonded with dentine adhesive in order to reduce sensitivity after crown preparation and before cementation (Felton, 1991). Desensitisers obturate exposed dentine and tubules with a resinous material, blocking tubule fluid flow and reducing the



Figure 2: Provisional four unit bridge prepared and placed

sensation of pain (Brannstrom, 1984). After crown preparation as many as one to two million dentinal tubules may be exposed (Richardson, 1991) increasing the potential for post-operative sensitivity. After tooth preparation dentine can still become sensitive as a result of microleakage of the provisional restoration and the resultant formation of bacterial by-products (Pashley, 1984). However, with the use of a thin layers of resin based dentine adhesive such as 'One Step' (Optident) the effect of external agents on dentine sensitivity can be greatly reduced.

CONNECTIVE TISSUE GRAFT

The donor site for the connective tissue graft was the lateral aspect of the palate in the tuberosity region and the tissue for the graft is removed as part of a wedge procedure. A split thickness flap was raised on the buccal aspects of the deformed ridge leaving the periosteum and a portion of the connective tissue overlying the alveolar ridge. Vertical incisions extended in an oblique fashion either side of the deformed ridge and into the labial flap as high as necessary to reposition the muco-gingival junction. The connective tissue from the donor site was placed and sutured in position with resorbable sutures (Figure 3). The overlying flap, together with the underlying connective tissue base should provide an adequate

Figure 3: Connective tissue graft sutured in situ





Figure 4: Provisional bridge modified to shape of new edentulous ridge

source of nutrients for the connective tissue graft. Sutures were removed at ten days and the correct pontic concave recipient site is created in the augmented ridge with the provisional acrylic restoration (Figure 4).

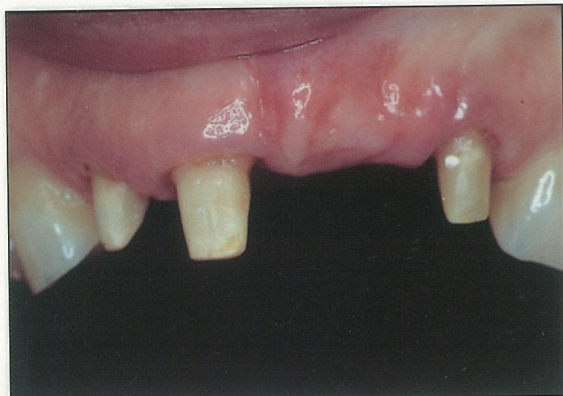


Figure 5: Definitive bridge abutment preparations

BLACK TRIANGLE DISEASE

After six months (during which time the graft will have matured) definitive tooth preparations proceed (Figure 5).

In order to re-establish interdental papillae, measurements are taken from the soft tissue pontic area adjacent to each abutment tooth to the underlying interdental bone. This can be done by measuring from radiographs or bone sounding using a periodontal probe. Tarnow (1992) confirmed that to ensure an interdental papillae is always present between the teeth after restoration then the distance from the most coronal aspect of the contact area of adjacent teeth to the underlying crest of bone needs to be a minimum of 5mm or less. In such cases a papillae is present 100% of the time. When this distance, however, increases to 6mm a papillae is only present 56% of the time and when it is 7mm or more the papillae is present only 27% of the time. These measurements are transferred to the dental technician so as to place the coronal aspects of the contact areas in the correct position, and avoid black triangle disease.



Figure 6: Geller model with ovate pontic site developed in laboratory (front view)

GUIDED SOFT TISSUE HEALING

Because of the underlying periodontal disease and mobility present and to establish ideal aesthetics, the three remaining teeth were used as abutments for this four unit fixed bridge. To further enhance the aesthetic outcome, cast scoring of the final stone cast was performed by the technician (Stein 1966) (Figure 6). A Geller model (Willie Geller) was fabricated by the technician to reshape the interdental papillae by trimming width, but not height off the cast, having removable stone or silver dyes in an acrylic based model. An acrylic-based model reproduces all the soft tissue and can be trimmed in order to guide soft tissue healing (Figure 7). The fixed four unit anterior bridge shows long contact areas where the technician has brought this down to within 5mm of the interproximal bone (Figure 8) ovate pontic and the width of the teeth are in the golden proportion (Levin 1981). A certain amount of soft tissue blanching of the surgically enhanced residual ridge occurs upon seating of the definitive bridge (Figure 9).

CONCLUSIONS

The final restoration shows excellent form and function, with no black triangles, pontic form and height the same as the adjacent abutment tooth. The contact area falls within 5mm of the underlying bony contour and the shape of the teeth fall into the gold-

Figure 7: Occlusal view showing ridge contouring

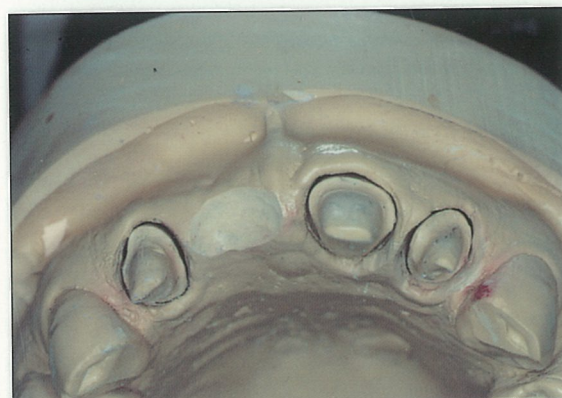




Figure 8: Four unit bridge constructed by technician



Figure 9: Bridge cemented in situ showing alignment of gingival margins of centrals and no black triangles



Figure 10: Patient's smile showing completed bridge



Figure 11: Close up of bridge

en proportion as described by Levin (1981) (Figures 10 & 11). With soft tissue surgery fixed bridgework can be aesthetically predictable if all aesthetic principles described here are applied. The next article in the series will deal with the selection of abutments for retainers in bridgework. ■

ACKNOWLEDGEMENTS

I would like to thank dental technician Martin Fletcher for his help in this case.

REFERENCES

- Brannstrom M (1984). Communication between the oral cavity and the dental pulp associated with restorative treatment. *Oper Dent* **9**: 57-68
- Chiche G (1994). Ed in *Aesthetics of Anterior Fixed Prosthodontics*. Quintessence, Chicago
- Felton D (1991). Evaluation of the desensitising effect of gluma dentin bond on teeth prepared for complete coverage restorations. *Int J Prosthodont* **4**: 292-298
- Garber D (1981). The edentulous ridge in fixed prosthodontics. *Com*

of Can Ed **11(4)**: 212-223

Levin E (1981). Dental aesthetics and the golden preparation. *JPD* **40(3)**: 244-252

Lombardi R (1973). The principles of visual perception and their clinical application to dentine aesthetics. *J Prosth Dent* **29**: 358-

Pashley D (1984). Smear layer: physiological considerations. *Oper Dent Suppl* **3**: 13-29

Richardson D (1991). Dentin permeability: effects of crown preparation. *Int J Prosthodont* **4**: 219-225

Seibert J (1983). Reconstruction of deformed, partially edentulous ridges, using full thickness onlay grafts. Part I: technique and wound healing. *Compend Contin Ed Dent* **4**: 437-

Stein R (1966). Pontic residual ridge relationship – a research report. *JPD* **16(2)**: 251-285

Tarnow D (1992). The effect of the distance from the contact point to the crest of bone on the presence or absence of the interproximal dental papilla

Implant aesthetics – managing the hard and soft tissues, part one

By Ashok Sethi BDS, DGD, MGDS RCS, DUI(Lille)

In the first of a two-part series, Ashok Sethi discusses patient assessment and conventional implant placement in adequate bone

The primary focus of attention in implant dentistry used to be the achievement of osseointegration. The close adaptation of living bone to the implant surface can now be predictably achieved. Furthermore it has been demonstrated that a stable level of attachment of the bone to the implant can be to be achieved and maintained. The success rate of implants now supercedes the 85-95% that was published by Adell et al (1981). With refinements such as internal irrigation and the use of larger implants (Bahat, 1992), presently much higher success rates (up to 98.8%) have been described (Gomez-Roman et al, 1997). It is, therefore, possible to get an implant to integrate with the body with a very high degree of certainty.

Our attention has now changed and focuses on producing aesthetic restorations supported by the implants. The excellent brochures that are published by the implant manufacturers have raised the expectations of our patients. Invariably a perfectly matched incisor can be seen emerging from the perfectly contoured soft tissues. It is natural, therefore, that the patient will expect a perfect result, which they have been led to believe is routinely achievable. The clinician has been set goals that are often very demanding to achieve.

There are several aspects to creating restorations that look natural.

The fabrication of a tooth constructed of a material which has the same reflective and refractive properties of natural tooth structure in varying conditions and wavelengths of light remains as exacting as it always has been.

'Pink Aesthetics', relating to the health and contours of the gingival tissues is also the responsibility of the



Figure 1: The upper left central incisor is an implant-supported restoration emerging out of naturally contoured soft tissues. Note the gingival margin and the interdental papillae

clinician. Therefore the implant dentist also takes on the task of ensuring that there is adequate hard tissue which will provide the optimal biomechanics for the planned restoration. In addition to this, the clinician has to ensure that bone is situated in the ideal position to receive an implant for a restoration with an aesthetic form. This in turn will ensure that the positioning of the abutment is such as to produce an emergence profile, which reflects the soft tissue contours of the adjacent teeth, addressing the cervical margin as well as the inter-dental papilla (Figure 1).

The task is very demanding and excellent communications need to be established between the various members of the team that will undertake the responsibility for such a restoration.

In addition to the clinician or clinicians undertaking the surgical and restorative aspect of the treatment, the dental technician, who will fabricate the tooth, is a vital member of the team, as is the dental hygienist, who will help to monitor and maintain the patient.

DECISION-MAKING

The clinician has to make a decision whether sufficient bone and soft tissue are present or not. Therefore a decision whether augmentation will be required has to be made and the most appropriate technique has to be decided upon. The techniques available are conventional implant placement, maxillary ridge expansion or autogenous bone grafts. The requirements for each of these are as follows.

Ashok Sethi has a referral practice dedicated to implant and reconstructive dentistry. He is a visiting lecturer at the University of Lille, France. Together with Peter Sochor, he runs a teaching programme – now in its ninth year – on implant dentistry from his practice in Harley Street