An alternative multiple pontic design for a fixed implant-supported prosthesis

Rafael Del Castillo, DDS,[a] Carlo Ercoli, DDS,[b] Juan Carlos Delgado, CDT,[c] and Jaime Alcaraz, MD, DDS[d]
University of Rochester, Eastman Institute for Oral Health, Rochester, NY; Oral Design Institute, Madrid, Spain

In situations of moderate residual ridge resorption where multiple tooth replacement is needed, and where the patient desires a fixed implant-supported restoration, it is challenging to design a pontic-tissue interface. The semiconvex multiple pontic design described in this article, with its mucosal contact exerted with moderate pressure, is proposed to circumvent the problems encountered with the plaque accumulation, maintenance conditions, phonetics, and compromised esthetics frequently encountered in these patients. The use of a screw-retained, implant-supported restoration is also emphasized to allow for sufficient tissue contact during placement of the prosthesis and for prosthesis retrievability for maintenance or technical reasons. (J Prosthet Dent 2011;105:•••-••)

Residual ridge resorption and soft tissue changes after tooth loss represent a challenge for the restorative team. Residual ridge defects are classified as primarily horizontal defects with normal ridge height, primarily vertical defects with normal ridge width, or as a combination of vertical and horizontal defects[1] with the combination defects being the most frequent.[2]

In patients where only vertical ridge resorption is present, the pontic design does not present a challenge for the clinician. However, in situations of extensive horizontal resorption, a flange is usually required to provide adequate lip support. For the latter situations, the presence of an extensive flange hinders the ability of the patient to perform adequate plaque removal, and therefore, the choice of a removable prosthesis is warranted.[3] This type of residual ridge resorption could be at least partially resolved with bone and soft tissue augmentation procedures. However, when moderate ridge resorption is present and patients prefer a fixed restoration, more conservative treatment options than bone and soft tissue grafting should be considered.[4]

Pontics for fixed and implant prostheses must fulfill esthetic, mechanical, functional, and hygienic demands.[5] Four pontic designs have been proposed: hygienic, ridge lap, modified ridge lap, and ovate pontic. The hygienic and modified ridge lap designs were introduced to minimize or avoid contact between the pontic and the mucosa.[6] While prostheses with these designs are cleansable, their lack of adequate tissue contact contraindicates their use in esthetic areas. However, although the ridge lap design can provide adequate esthetics, its large concave tissue surface hinders proper oral hygiene.[7]

More recently, the ovate pontic has been recommended to fulfill functional and especially, esthetic demands. Its convex design allows for adequate cleansability,[5] while its placement within the soft tissue volume allows for improved esthetics, simulating the natural tooth emergence profile. To achieve adequate esthetics with this pontic design, however, a sufficient buccolingual width and apicocoronal tissue thickness of the edentulous ridge must be present.[8] A moderately resorbed or thin knife-edge residual ridge is generally a contraindication for its use.

A modified ovate pontic design has been proposed by Liu[8] to overcome the problems with ovate pontic design. This design involves moving the height of contour at the tissue surface of the pontic to a more labial position. The author states that because of the altered position of the height of contour, this pontic design does not require as much faciolingual soft-tissue thickness to create an adequate emergence profile. The author also suggests that this design is easier to clean than the ovate pontic because of its less convex design.[8]

Several authors[9-11] have reported

[a]Private practice. Alicante, Spain.
[b]Associate Professor, Chairman, and Program Director, Division of Prosthodontics, University of Rochester, Eastman Institute for Oral Health.
[c]Oral Design Institute, Madrid, Spain.
[d]Private practice, Alicante, Spain.

[Q1]

prosthetic complications associated with conventional fixed implant-supported prostheses in edentulous maxillas. One of the most frequent complications is poor phonetics, generally because of air escape. In these situations, the prosthetic replacement of lost hard and soft tissue with gingival porcelain is an alternative for patients who are not candidates for, or are unwilling to undergo, an additional reconstructive surgery but prefer a fixed implant restoration. Proper phonetics can be achieved by adding gingival porcelain to fill the interproximal spaces between implants. However, this could compromise oral hygiene around implants and pontic areas.

Screw-retained, implant-supported restorations represent one of the available options for treating partially or completely edentulous patients. The primary reason for using screw-retained, implant-supported restorations is the possibility of prosthesis retrieval for hygiene or technical reasons.[12,13]

It has been recognized that plaque removal from the pontic areas of a fixed dental prosthesis (FDP) is important for tissue health and the long term prognosis of the restoration.[14] The biologic response to the pontic of an FDP depends on daily flossing and the effectiveness of the oral hygiene procedures. In a study by Tripodakis and Constantinides,[15] it was suggested that if those 2 conditions were met mild hyperpressure in combination with a convex pontic design, if permitted by the resilience of the tissue, could be biologically acceptable.

This clinical report describes the semiconvex multiple pontic design, which was developed to circumvent the problems encountered with the plaque accumulation and compromised esthetics frequently encountered in patients with moderate ridge deficiencies, and who desire a fixed implant-supported restoration. In these situations, this pontic design can best achieve proper tissue contact when incorporated into the design of a screw-retained prosthesis. Indeed, a screw-retained prosthesis allows for the possibility of prosthesis retrieval for hygiene or technical reasons, as well as a progressive tightening of the prosthesis. Controlled placement of the prosthesis can, therefore, be performed in such a manner that mild hyperpressure can be exerted on the pontic areas.

Intimate contact between the multiple pontic areas of the implant-supported prosthesis and the tissue, leading to moderate pressure exerted by the prosthesis, may complicate oral hygiene procedures. The use of screw-retained, implant-supported restorations may overcome this situation because of prosthesis removal, on a regular basis, for hygiene purposes. The use of a screw-retained, implant-supported restoration is also emphasized to allow for a "staged" tightening of the prosthesis while placing the prosthesis intraorally, thus, controlling soft tissue accommodation. The advantages of this technique include reduced plaque accumulation gingival to the prosthesis after several months of function, improved esthetics at the tissue-prosthesis connection line, and reduced air escape beneath the prosthesis. The disadvantages of this technique include the technique sensitive protocol needed during the fabrication of the prosthesis in the laboratory, and the increase in clinical chair time while placing and performing the necessary adjustments to the prosthesis before insertion.

TECHNIQUE

1. After an adequate implant osseointegration period, make a complete maxillary arch impression with polyether impression material (Permadyne Penta; 3M ESPE, St Paul, Minn) at the implant and/or abutment level (Astra Tech AB, Mölndal, Sweden) using the open tray technique (Fig. 1). Before pouring the impression, inject an elastomeric material for gingival reproduction (Gi-Mask Automix; Coltène/Whaledent AG, Alstätten, Switzerland), around the impression copings, abutment and/or implant analogs, and edentulous areas of the impression. [F1]

2. Pour the impression with type IV dental stone (GC FujiRock; GC Europe, Leuven, Belgium).

3. Make a face bow transfer and interocclusal records to mount the maxillary and mandibular definitive casts on the articulator (Dentatus AB, Stockholm, Sweden).

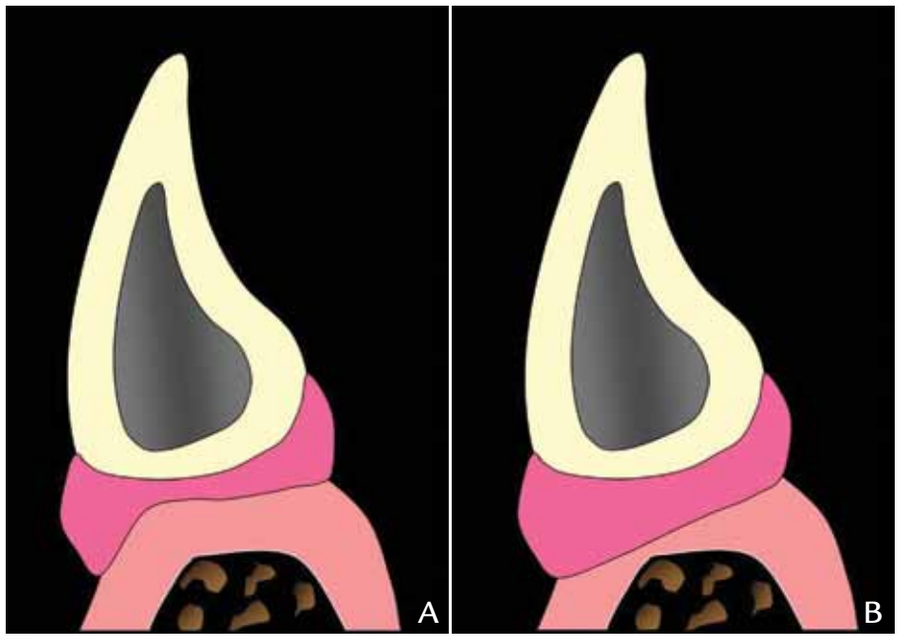
4. Fabricate an acrylic resin (Pro-Base Cold, Ivoclar Vivadent AG, Schaan, Liechtenstein) provisional implant-supported, screw-retained prosthesis or diagnostic waxing to evaluate occlusal vertical dimension, esthetics, phonetics, and function and obtain patient consent before the fabrication of the definitive metal ceramic screw-retained prosthesis.

5. Fabricate a wax framework pattern for a screw-retained prosthesis using, as references, silicone indexes

1 Intraoral view of maxillary impression copings in place before making final impression.

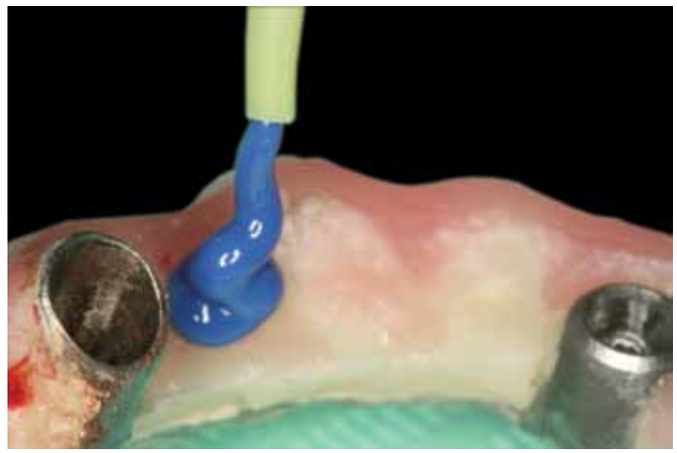
(Labosil; Protechno, Girona, Spain) obtained from the acrylic resin provisional implant-supported prosthesis or diagnostic waxing secured on the maxillary definitive cast. Cast the framework in a noble alloy (Cerapall 6; Cendres & Métaux SA, Biel-Bienne, Switzerland).

6. After clinical and radiographic metal framework fit verification, return the metal substructure to the ceramist for veneering porcelain (VITA VMK Master, VITA Zahnfabric, Bad Säckingen, Germany) application. During the application of the veneering material, first define the dental anatomy and, later, the gingival anatomy to avoid mixing porcelain masses of different colors. Design the pontic tissue surface of the definitive prosthesis with a semiconvex design, fabricated in such a way that the contour height of the pontic areas produces moderate pressure on the tissues during prosthesis seating. (Fig. 2). [F2]



2 A, Traditional modified ridge lap pontic design. Design and type of mucosal contact complicates hygiene procedures and plaque removal. B, Shape of mucosal contact in semi-convex multiple pontic is designed to exert mild pressure on tissues.

7. Immediately after the bisque trial insertion, and to ensure an accurate replica of the intraoral gingival tissues before final adjustments are made on the definitive prosthesis, inject a light-bodied polyether impression material (Permadyne Garant 2:1, 3M ESPE) onto the basal surface of the pontic areas (Fig. 3). [F3] Place the prosthesis intraorally, secure it with 3 screws (1 anterior and 2 posterior), and allow the impression material to polymerize following the manufacturer's recommendations (Fig. 4). [F4]



3 Light body polyether impression material injected onto basal surface of prosthesis before prosthesis is replaced intraorally.

8. Remove the initial soft tissue mask from the definitive cast and reposition and secure the prosthesis with the light-bodied polyether impression material on the definitive cast. Inject new elastomeric gingival material onto the definitive cast beneath the prosthesis to reproduce the tissues as they were captured by the light-bodied impression material.

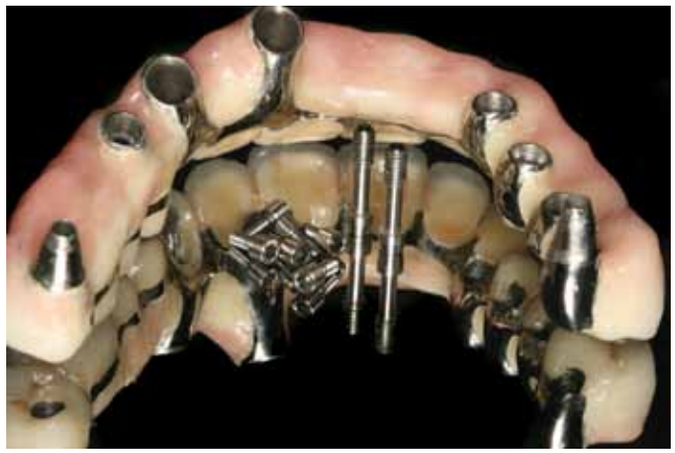
9. Remove the light-bodied polyether impression material from the intaglio surface of the prosthesis and return the prosthesis and the definitive cast to the ceramist for final adjustments to the gingival porcelain.

10. Paint the surface of the new elastomeric gingival material with separating varnish (VITA Modisol insulation pen; VITA Zahnfabric). Add additional gingival porcelain on the intaglio surface of the prosthesis and screw the prosthesis on the definitive cast, so that a "porcelain reline" is performed over the new elastomeric gingival material.

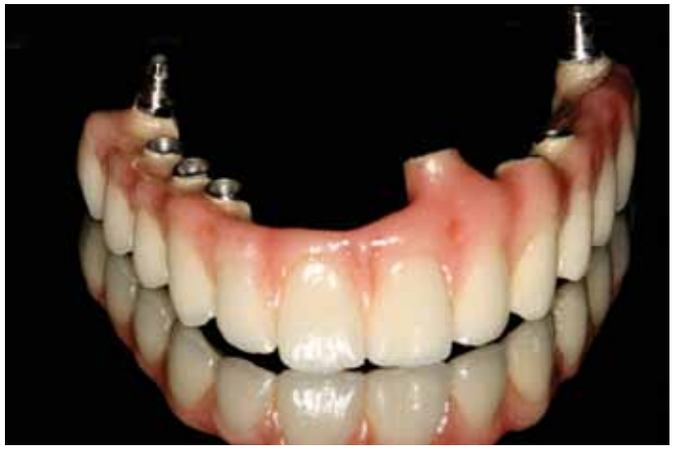
11. Once the "porcelain reline" is completely dry, unscrew and remove the prosthesis from the definitive cast and fire it in the porcelain furnace (Austromat; DEKEMA Dental-Keramiköfen GmbH, Freilassing, Germany) following the manufacturer's recommendations.

12. Remove the prosthesis from the porcelain furnace. After an adequate cooling period and without reseating the prosthesis on the definitive cast, add more gingival porcelain (1 mm to 1.5 mm thick) to the intaglio surface of the pontics to define the final anatomy in such a way that the height of the contour of the pontic areas produces moderate pressure on the tissues during prosthesis seating (Fig. 5). Place the definitive prosthe- [F5]

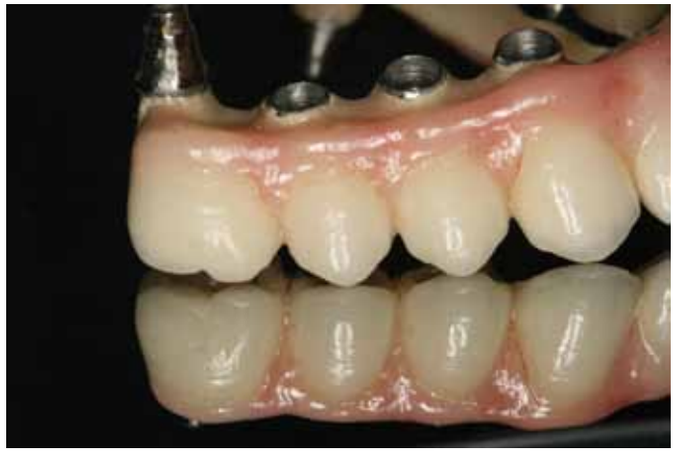
4 Intaglio surface of prosthesis after reline with light-bodied polyether impression material. Areas where gingival porcelain is not shown need additional porcelain to obtain desired pressure.



5 Gingival porcelain anatomy before intraoral adjustments.



6 Frontal view of final prosthesis before PIP is applied for intraoral adjustments. Sagittal perspective of posterior segments allows identification of semiconvex multiple pontic design areas.



7 Close-up view of right buccal side of prosthesis. Note that height of contour of gingival porcelain is located towards labial aspect of gingival porcelain.

sis with this new addition of gingival porcelain in the porcelain furnace and fire it according to manufacturer's recommendations.

[F6]
[F7]

13. Remove the prosthesis again from the furnace and let it cool. With finger pressure over the prosthesis, check the pressure of the prosthesis over the elastomeric gingival material on the definitive cast. The resilience of the elastomeric gingival material will make the prosthesis rebound, depending on the thickness of the latest addition of gingival porcelain. The magnitude of the rebound effect of the prosthesis on the definitive cast is a preliminary indication of how prosthesis pressure will interact with intraoral gingival tissues. Ensure that this pressure is the maximum allowed by the resilience of the tissues, so that a proper fit of the castings on the implants or abutments is not hindered (Figs. 6, 7).

[F8]

14. Place pressure indicating paste (PIP), (Keystone Industries, Cherry Hill, NJ) to evaluate tissue pressure, patient compliance, and tissue accommodation and displacement while seating the prosthesis intraorally (Fig. 8). Use a "staged" tightening protocol of the prosthetic screws of the screw-retained, implant-supported restorations to secure the prosthesis. Tighten all the screws one half turn at a time, allowing 3 to 4 minutes between turns to provide for soft tissue accommodation.

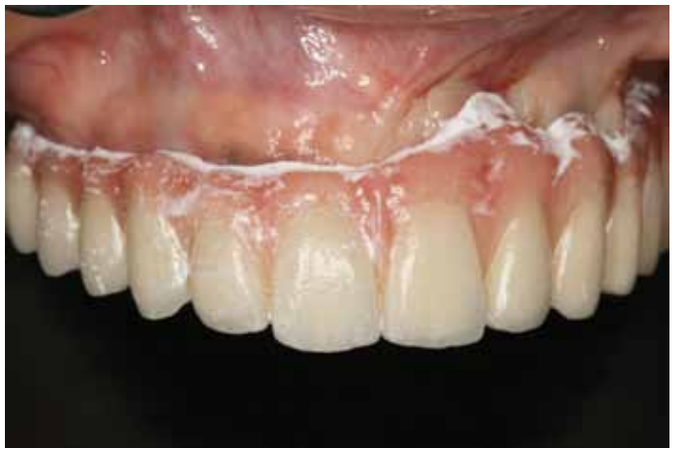
15. Remove the prosthesis from the mouth if tissue ischemia remains evident beneath the prosthesis and does not disappear in 3 to 5 minutes after the screws have been completely secured.

16. Perform controlled adjustments with diamond rotary cutting instruments (Dentacare SA, Bioggio-Lugano, Switzerland) mounted on a high speed handpiece in areas of excessive pressure (areas where PIP has been completely removed) on the gingival porcelain (Figs. 9, 10).

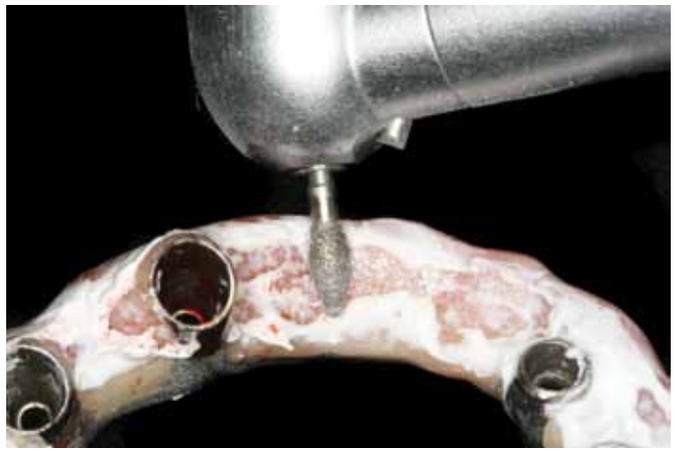
[F9]

17. Reseat the prosthesis intraorally and reevaluate for excessive tissue pressure and ischemia with pressure indicating paste. If ischemia on the tissues does not disappear in 3 to

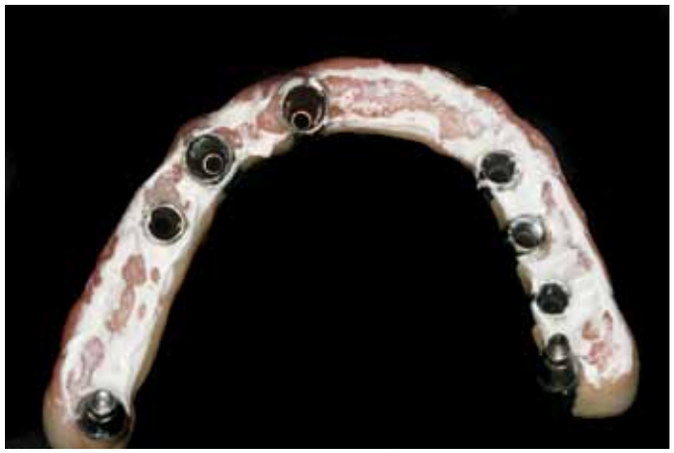
[F10]



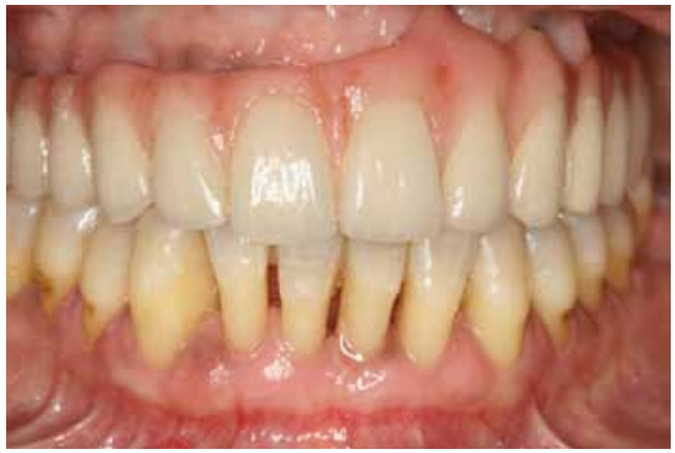
8 Pressure indicating paste is used to identify areas of excessive pressure during seating of prosthesis.



9 Diamond rotary cutting instruments used to adjust areas of excessive pressure on gingival porcelain.



10 Clinical aspect of pontic tissue-surface of prosthesis after adjustments. Note pressure indicating paste is not completely removed in areas of pressure.



11 Intraoral view of final prosthesis after all necessary adjustments have been completed.

5 minutes, repeat steps 14 through 16 as necessary.

18. After the completion of all necessary adjustments, remove the pressure indicating paste from the prosthesis with 96% alcohol. Polish the porcelain with rubber wheels (Bredent Medical GmbH & Co KG, Senden, Germany) to remove porcelain irregularities before final prosthesis insertion.

19. Insert the prosthesis intraorally and secure it on the implants or abutments with the corresponding screws again by using the staged tightening protocol (Fig. 11). Use polytetrafluoroethylene tape (Loctite, Henkel AG & Co KGaA, Barcelona, Spain) and a light polymerizing resin-based restorative material (Tetric EvoCeram; Ivoclar Vivadent AG) to close the screw access channels and adjust occlusion.

[F11]

SUMMARY

This article describes an alternative multiple pontic design for a fixed implant-supported prosthesis. The semiconvex pontic design with its mucosal contact under moderate pressure is proposed to circumvent the problems encountered with the plaque accumulation, maintenance of oral hygiene, phonetics, and esthetics frequently found in patients with moderate ridge resorption who seek treatment with a fixed restoration.

REFERENCES

1. Seibert JS. Reconstruction of deformed, partially edentulous ridges, using full thickness onlay grafts. Part II. Prosthetic/periodontal interrelationships. Compend Contin Educ Dent 1983;4:549-62.
2. Abrams H, Kopczyk RA, Kaplan AL. Incidence of anterior ridge deformities in partially edentulous patients. J Prosthet Dent 1987;57:191-4.
3. Zitzmann UN, Marinello CP. Treatment plan for restoring the edentulous maxilla with implant-supported restorations: removable overdenture versus fixed partial denture design. J Prosthet Dent 1999;82:188-96.
4. García LT, Verret RG. Metal-ceramic restorations--custom characterization with pink porcelain. Compend Contin Educ Dent 2004;25:242, 244, 246.
5. Garber DA, Rosenberg ES. The edentulous ridge in fixed prosthodontics. Compend Contin Educ Dent 1981;2:212-23.
6. Stein RS. Pontic-residual ridge relationship: a research report. J Prosthet Dent 1966;16:251-85.
7. Council on Dental Materials and Devices, American Dental Association. Pontics in fixed prostheses--status report. J Am Dent Assoc 1975;91:613-17.
8. Liu CL. Use of a modified ovate pontic in areas of ridge defects: a report of two cases. J Esthet Restor Dent 2004;16:273-81.

9. Jemt T. Fixed implant-supported prostheses in the edentulous maxilla. A five-year follow-up report. Clin Oral Implants Res 1994;5:142-7.
10. Lundqvist S, Lohmander-Agerskov A, Haraldson T. Speech before and after treatment with bridges on osseointegrated implants in the edentulous upper jaw. Clin Oral Implants Res 1992;3:57-62.
11. Worthington P, Bolender CL, Taylor TD. The Swedish system of osseointegrated implants: problems and complications encountered during a 4-year trial period. Int J Oral Maxillofac Implants 1987;2:77-84.
12. Del Castillo R, Delgado JC. Complexity's solution: Protocol for the rehabilitation of the atrophic maxilla with full-arch, implant-supported, screw-retained, metal-ceramic restorations. J Dent Technol 2008; 25:50-6.
13. Hebel KS, Gajjar RC. Cement-retained versus screw-retained implant restorations: achieving optimal occlusion and esthetics in implant dentistry. J Prosthet Dent 1997;77:28-35.
14. Stein RS. Pontic-residual ridge relationship: a research report. J Prosthet Dent 1966;16:251-285.
15. Tripodakis AP, Constantinides A. Tissue response under hyper pressure from convex pontics. Int J Perio Rest Dent 1990;10:409-14.

Corresponding author:
Dr Rafael Del Castillo
C/ Alfonso el Sabio 34
2° A. Alicante 03004
SPAIN
Fax: +965-214104
E-mail: casher@infomed.es

662 663 664 665 666 667 668 669 670 671 672 673
674 675 676 677 678 679 680 681 682 683 684 685
686 687 688 689 690 691 692 693 694 695 696 697

Queries:

Q1- If this is Private Practice, it should be designated as such. (line 108)