

# CLINICAL UPDATE

## *Contemporary Periodontics & Implantology*



CONTEMPORARY PERIODONTICS  
& IMPLANTOLOGY

Volume 1, Issue 9

February–March 2001

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### Dr. Petrungaro February-April 2001 Lectures

- Amara Institute, Stillwater, MN
- University of Minnesota School of Dentistry, Department of Dentistry Continuing Education
- State University of New York Continuing Education; Buffalo, NY
- New York University, Dept of Continuing Education; New York, NY
- Harvest Technologies, Clinicians Meeting; San Juan, Puerto Rico

## The Use of Platelet Rich Plasma With Growth Factors (Autologous Platelet Gel) to Enhance Hard and Soft Tissue Healing and Maturation in the Reconstruction of the Maxillary Pneumatized Sinus

As stated in previous clinical updates, the implant team is continually challenged with the dilemma of the lack of sufficient volume and quantity of bone in sites selected for implant placement. From the surgical standpoint, new techniques and materials are continuously being developed to aid in solving the dilemma of insufficient alveolar bone. One of the most recent developments to reach the dental spectrum has been the use of Autologous Platelet Gel to enhance the soft and hard tissue healing and maturation after surgical procedures. In addition, the delivery of growth factors directly to the grafted region significantly enhances the replacement and restoration of the grafted tissues.

### Pneumatized Maxillary Sinus

One of the most common dilemma's facing the implant team preceding the placement of dental implants in the posterior maxillae is the lack of quantity and quality of bone. This problem may result in the aggressive pneumatization (enlargement) of the maxillary sinus due to premature tooth loss, or from aggressive periodontal destruction. All too often, many patients are forced to compromise on their mode of treatment, or be left with a removable appliance due to the lack of bone in this area. With proper sinus elevation procedures being accomplished, the foundation can be laid to allow for dental implants to be placed and provide a fixed restoration that can be successful long term.

### Why Perform Sinus Elevations?

The Sinus Elevation or Sinus Lift procedure has the following benefits:

- Allows for better quality and quantity of bone to be present in the atrophic posterior maxillae.
- Decreases the volumetric space of an enlarged pneumatized sinus cavity.
- Allows for improved drainage of the pneumatized maxillary sinus.
- Provides the basis for implant replacement for prematurely lost posterior teeth.
- Allows for the early recognition and treatment of sinus pathology.

### What are the Results of the Procedure?

The sinus elevation has been performed for over 25 years. Moderate to severe posterior maxillary alveolar resorption, with decreased interocclusal space and an increased pneumatized sinus, can be reconstructed with a sinus lift graft operation and implants. The sinus grafting operation is the ideal procedure to treat posterior maxillary atrophy because it solves the problem of lack of sufficient volume and quantity of bone, and allows for the proper environment to be established to receive dental implants.

The surgery involves few risks, the morbidity is low, and few vital anatomic structures invade the surgical site. It can be done under local anesthesia and complications are rare. With the inception of Autologous Platelet Gel and Platelet Rich Plasma, the healing rate and osseous maturation of the graft complex has been shown to occur in a more rapid time frame than had been previously observed. In addition, with the cohesive properties of the Platelet Rich Plasma, complications regarding tears and/or pathology of the sinus can be



rapidly solved, and protection of the graft complex within the lateral wall of the maxilla can be accomplished by separating the graft from the overlying connective tissue without the use of a regenerative barrier, as the Platelet Poor Plasma acts as a membrane and also stimulates the maturation of the graft complex by local delivery of growth factors.

**Review of Autologous Platelet Gel**

Autologous Platelet Gel (APG) was developed in the early 1990's as a byproduct of Platelet Rich Plasma (PRP) sequestration in cardiac surgery. When PRP is combined with thrombin and calcium, a viscous coagulum (gel) is rapidly formed. This gel was used primarily as a hemostatic agent and for its tissue sealing properties.

APG is produced from PRP, which has three to five times the native concentration of platelets. The addition of thrombin and calcium to PRP results in activation of the clotting cascade with conversion of fibrinogen to fibrin, and also the activation and subsequent degranulation of the platelets. The platelets become trapped in the fibrin mesh, secreting their contents and stabilizing the clot via receptors for fibrin, collagen and adhesive glycoproteins. The fibrin matrix that results is that of a native fibrin clot, allowing normal cellular infiltration of monocytes, fibroblasts and other cells critical to wound healing.

**Substances Released by the Degranulated Platelets**

A number of substances released by degranulated platelets contribute to their role in primary hemostasis. They include:

serotonin	fibrinogen	factor V	calcium
catecholamines	fibronectin	Von Willebrand factor 8	
ADP	ATP	Thromboxane A2	

Of equal and perhaps greater importance is the release by platelets of a number of platelet derived growth factors that enhance wound healing by autocrine and paracrine mechanisms. They include:

Platelet-Derived Growth Factor (PDGF)	Platelet-Derived Angiogenesis Factor (PDAF)
Transforming Growth Factor-beta (TGF-B)	Insulin-like Growth Factor (IGF)
Platelet-Derived Endothelial Cell Growth Factor (PD-ECGF)	

**Formation of Platelet Rich Plasma Using an Automated Dual Spin Centrifuge**

A 60cc syringe is prefilled with 5cc of a citrate based anticoagulant (ACD-A). For each Processing disposable, approximately 45-55cc of the patient's blood is withdrawn from a venous puncture in the upper arm into the 60cc syringe. The anticoagulated blood is dispensed into the blood chamber of the processing disposable. The blood must be drawn prior to the commencement of surgery, because surgery itself leads to platelet activation of the coagulation system.

The processing disposable is loaded into the centrifuge rotor cup of the SmartPreP™ Platelet Concentrate System. A counter balance is placed in the opposing rotor cup unless a second processing disposable is required.

During the processing, the blood is initially centrifuged at 3,650 rpm to separate the red blood cells from the plasma. The centrifuge slows to approximately 60rpm, allowing the plasma to automatically decant into the plasma chamber. The centrifuge then accelerates to 3,000 rpm to form a pellet of pure platelet concentrate in the bottom of the plasma chamber. The entire process to separate the whole blood into 1) red blood cells, 2) platelet poor plasma, 3) platelet concentrate is completely automatic and completed in approximately 12 minutes.

The blood chamber of the process disposable contains the red blood cells. The second chamber contains the platelet concentrate (a button-like precipitate) and Platelet Rich Plasma (supernatant). Approximately two-thirds of the Platelet Poor Plasma (PPP) is removed and can be saved for hemostatic applications. The platelet concentrate is then re-suspended in the remaining Platelet Poor Plasma; thereby creating a very concentrated Platelet Rich Plasma (PRP) solution.

The activator for the Platelet Rich Plasma and Platelet Poor Plasma is a mixture of 5,000 units of topical bovine thrombin and 5cc of 10% calcium chloride. The activator is drawn into two-1cc syringe and 10cc of PRP (and for the other syringe PPP) is drawn into the other 10cc syringe. The two syringes are attached to a 20G dual cannula applicator tip where the contents are mixed as they are applied into the bone graft, wound, or incisions.

## Formation of the PRP/Graft Complex

Using the top surface of a sterile specimen cup, the chosen graft material is placed in its granular form. Following a repeated criss/cross technique, the Platelet Rich Plasma is incorporated into the bone graft material. Rotation of the receptacle while following the above application technique will lead to the formation of a cohesive autologous gel in which the graft is incorporated. This is routinely observed after only 3-4 seconds at which time the PRP/graft complex can be moulded into the desired shape for delivery to the surgical area.

**Clinical Use: The following case reports depict the use of PRP/APG in the sinus grafting procedure.**

### Case 1

A 55 year-old healthy, non-smoking male presented for implant reconstruction of the maxillary arch (figure 1). After a comprehensive diagnosis and treatment planning phase, the decision was made to initially proceed with removal of teeth #3 and 14, with simultaneous bone grafting, and one month post extraction (figure 2) proceed with the placement of ten implants, bilateral sinus elevations, and the use of Platelet Rich Plasma to aid in the healing and maturation of the hard and soft tissues. It was decided to maintain the canines which required endodontic therapy, to assist in the temporization phase for the initial four months after surgery. Figure 3 shows the left lateral aspect of the maxillae after a palatal incision and full thickness flap elevation.



Figure 1

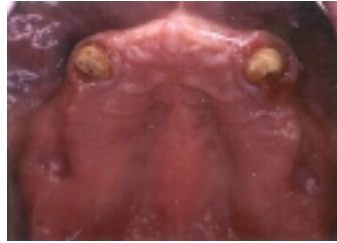


Figure 2

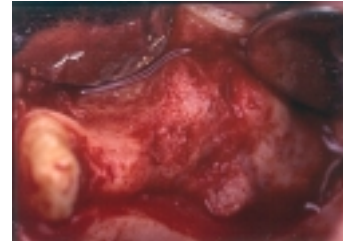


Figure 3

### Formation of the PRP/Graft Complex, Case 1

The graft complex (figure 4) consisted of demineralized freeze-dried bone, Osteograf N-700 and Pepgen P-15™ (CeraMed Dental, Lakewood, CO). Once these materials were added to the top surface of a sterile specimen cup, the introduction of the Platelet Rich Plasma is accomplished in a criss/cross technique (figure 5) until saturation of the graft complex is achieved.



Figure 4



Figure 5

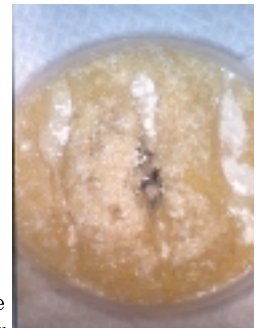


Figure 6

Once the cohesive autologous gel has formed within the graft complex, separation into "strips" can be accomplished for either easy placement into the sinus cavity, or layering of the PRP/graft complex over an osseous defect (figure 6). Prior to coring of the implant sites, the lateral wall osteotomy technique for sinus elevation procedures is initiated (figure 7). After completion of this procedure bilaterally, the predetermined sites for the placement of the implants are prepared with protection of the sinus membrane from the implant drills to prevent damage to the membrane (figure 8). Prior to the placement of the PRP/graft complex into the medial aspect of the sinus, a small amount of the Platelet Poor Plasma is introduced into the sinus. Its cohesive properties allow for the superior position of the rotated lateral wall of the osteotomy, and sinus membrane, to be passively maintained (figure 9). Other applications of the Platelet Poor Plasma at this point would be to repair any tears in the schneiderian membrane that may have occurred in either the creation of the osteotomy, elevation of the sinus membrane, coring of the implants, or pathology around natural teeth or the sinus itself. The Platelet Poor Plasma is superior when compared to previous methods available to repair the damaged sinus membrane.



Figure 7



Figure 8

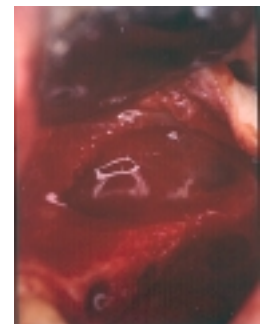


Figure 9

Placement of the PRP/graft complex is then accomplished into the medial aspect of the sinus, followed by insertion of the predetermined implants. The PRP/graft complex is then placed over the buccal surface of the implants and compacted into the sinus (figure 10). The Platelet Poor Plasma is once again applied over the lateral wall of the osteotomy and graft complex (figure 11). The cohesive properties of the Platelet Poor Plasma allow for the formation of the autologous gel which acts as a regenerative barrier impregnated with growth factors. This stimulates mineralization of the buccal aspect of the graft complex whereas previous materials (resorbable or non-resorbable barriers) acted solely to prevent migration of the connective tissues into the graft complex.

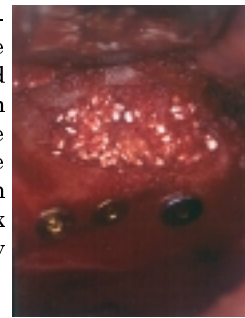


Figure 10



Figure 11

The procedure described above was completed in the right maxillary sinus as well, in addition to the placement of four implants into the area between the canines. Closure was then accomplished by a combination of horizontal and vertical mattress continuous sling suturing techniques with 5.0 Monocryl suture. Platelet Poor Plasma is then applied over the wound site to act as a surgical dressing, and stimulate soft tissue healing and maturation (figure 12). Figure 13 shows the immediate post-operative panorex of the above surgical procedure. Figure 14 depicts the level of soft tissue maturation at ten days post-surgery, while figure 15 shows a 3 month post-surgical view. At 4 months, Stage II was accomplished over the implants at position #5, 7, 8, 9, 10 and 12 to aid in the support of the preexisting fixed maxillary canine supported temporary.

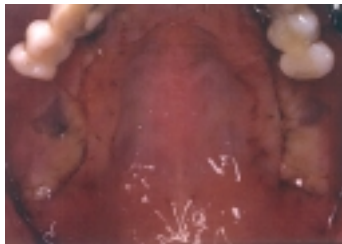


Figure 12



Figure 13



Figure 14



Figure 15

A four month post-operative panorex after abutment connection on the anterior implants can be seen in figure 16. Please note the appearance of the sinus regions which depict a radiographically sound PRP/graft/implant complex. At six months post-surgery, stage II will be accomplished on the remaining four fixtures present, followed by restorative procedures to provide a fixed maxillary prosthesis, and new transitional prostheses in the mandibular arch to level the plane of occlusion until implants can be placed there as well. It has been normal procedure to wait eight to nine months after either sinus elevation or a combined sinus elevation/implant placement technique prior to placement of the implants into the grafted bone, or loading of the implants, respectively. With the PRP procedure, I am routinely placing implants in the sinus, or loading implants in the simultaneously placed PRP/graft/implant reconstructed sinus at five to six months post-surgery and achieving excellent results of which supporting histological analysis will be published in clinical journals in the near future.



Figure 16

## Case 2

A 47 year old healthy, non-smoking male presented for full mouth rehabilitation which included implant reconstruction of the mandibular posterior sextants, and the maxillary left posterior sextant (figures 17 & 18). After a thorough treatment planning and diagnostic waxing process, it was decided that tooth #12 would also be removed. The initial surgical procedure for the maxillary left sextant involved elevation of the left maxillary sinus, (which did not present with enough cortical bone to warrant a combined sinus elevation/implant placement procedure) and placement of two implants at #11 and 12, following removal of tooth #12 at the surgical visit. Immediate temporization and loading of the implants placed at the #11 and 12 sites was also planned.



Figure 17



Figure 18

The pre-operative view of the maxillary left quadrant after bridge removal can be seen in figure 19. After a palatal incision posterior to tooth #12, and a crestal incision anterior to tooth #12, a full thickness mucoperiosteal flap elevation was accomplished (figure 20). Please note the residual ridge defect present in the #10 location that will require ridge augmentation in conjunction with implant placement.



Figure 19

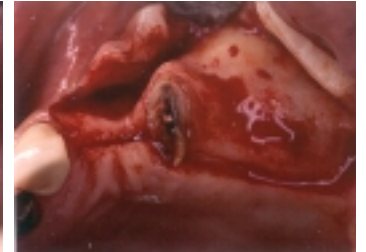


Figure 20

Figure #21 shows the lateral wall of the maxillae inferior to the zygomatic arch prior to initiation of the osteotomy for sinus elevation. After careful atraumatic removal of tooth #12, the initiation of the osteotomy is completed (figure 22). Following the lateral wall osteotomy technique, infracture of the wall of the maxillae is accomplished and rotated medially and superiorly, with simultaneous elevation of the schneiderian membrane (figure 23).

Preparation of the PRP/graft complex follows the previously outlined method. Figure 24 shows the mixture of demineralized freeze dried bone with Osteograft N-700 and Peppen P-15™ (CeraMed Dental, Lakewood, CO) in its granular forms. Intro-



Figure 21

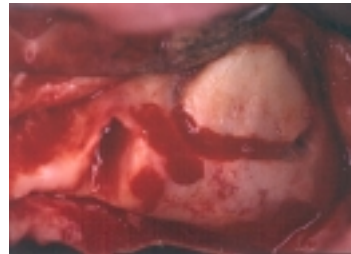


Figure 22

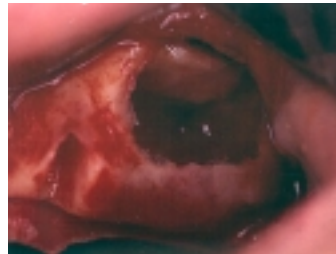


Figure 23

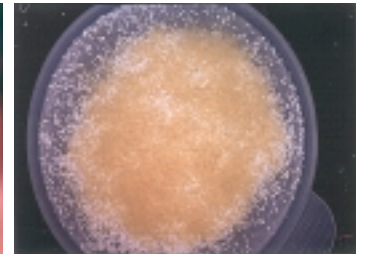


Figure 24

duction of Platelet Rich Plasma in the criss/cross technique follows in figures 25 and 26. At this point, due to the amount of the PRP/graft complex needed, a layering technique is employed to increase the volume of the complex. Additional graft material is added (figure 27), followed by additional application of PRP (figure 28). Placement of two BioHorizons implants, a D3, 4mm x 12mm in the #10 position followed by a D4, 5mm x 12mm in the #11 position was then accomplished (figure 29). Please note how the lateral wall of the sinus has remained in the rotated position throughout the implant placement procedures as a result of the Platelet Poor Plasma introduction previously. After separation of the PRP/graft complex (figure 30), the sinus is then filled with the autologous gel-graft material (figure 31). Please note that two stock BioHorizons abutments have been prepared, and Platelet Poor Plasma is once again applied over the lateral wall of the maxillae to provide local delivery of growth factors to the grafted sinus region, in addition to acting as a barrier for containment of the PRP/graft complex

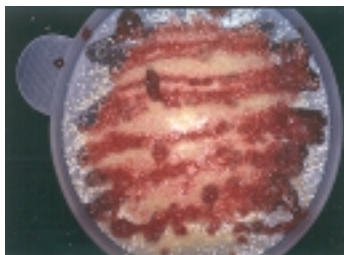


Figure 25

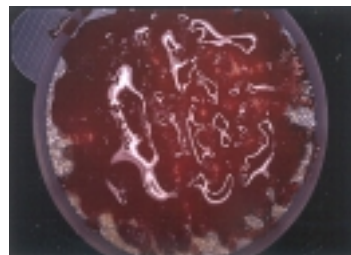


Figure 26



Figure 27



Figure 28



Figure 29

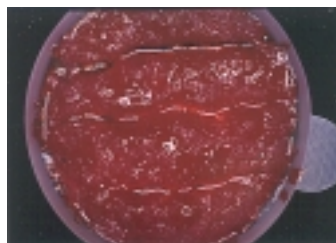


Figure 30



Figure 31

and preventer of connective tissue migration. Once temporary fabrication has been completed, and the temporaries cemented (figure 32), Platelet Rich Plasma is placed over the implant surfaces and adjacent alveolar bone (figure 33). The application of the PRP at this point accomplishes two things: delivery of growth factors to the exposed implant surface and adjacent bone, and it provides adhesion for the stabilization of the graft complex. After placement and shaping of the PRP/graft complex, additional Platelet Rich Plasma is applied followed by application of Platelet Poor Plasma (figure 34). Closure is once again accomplished by continuous sling horizontal and vertical mattress suturing techniques with 5.0 Monocryl sutures (figure 35), and the occlusion checked for no lateral, protrusive, or centric function at this point. Additional application of the platelet poor plasma over the surgical site to act a wound dressing and promote soft tissue maturation is then completed. An immediate postoperative panorex is seen in figure 36. Please note the density in the grafted sinus region. Figure 37 shows a 10-day postoperative view, note the level of soft tissue maturity at this point.



Figure 32



Figure 33



Figure 34



Figure 35



Figure 36



Figure 37

## Conclusion

As these cases have demonstrated, the use of both Platelet Rich and Platelet Poor Plasma in sinus grafting procedures is an efficient way to stimulate the hard tissue mineralization rate of the grafted sinus by the local delivery of growth factors to all regions of the graft within the sinus cavity. In addition, the benefits of tissue regeneration obtained by the Platelet Poor Plasma, and its growth factor delivery, allow for an increased rate of maturation of the soft (connective and gingival) tissues. Also, the ease of handling of the graft complex is a great benefit in the application of the surgical technique. As applications of the PRP procedure continue to expand, the great benefit that the localized delivery of growth factors provides will become ever more valuable to the periodontal, oral surgical or implant surgeon.

## Questions Often Asked Regarding the Use of Platelet Rich Plasma (PRP) in Sinus Augmentation Procedures

1. *How much healing time is saved by using PRP to stimulate the substrate (graft)?*

Normally the required healing time for sinus lift procedures with immediate implant placement is 8 months, whereas a sinus elevation/delayed implant procedure can take up to 16 months for the graft/implant complex to be ready for loading. With PRP, the healing time is reduced to 5-6 months for a combined sinus/implant procedure or 10-12 months for a grafting/delayed implant placement procedure.

2. *What is the optimal graft mixture to be reconstituted with the PRP for sinus elevation procedures?*

The optimal graft mixture would be as follows:

two-thirds = Peppen P-15™ (with Ostoegraf N-700 being added for volume)

one-third = demineralized freeze-dried bone allograft, or autogenous bone particles

Peppen P-15™ is the first and only bone replacement graft material to mimic both the inorganic and organic components of autogenous bone. The organic component confirms P-15, a synthetic 15 amino acid peptide that mimics the cell-binding domain of Type-1 collagen which modulates cell binding, migration, proliferation and differentiation. The inorganic component, ABM (anorganic-bovine-derived mineral) is composed of calcium phosphate and mimics the natural anatomic structure of autogenous bone necessary for cellular invasion.

When Peppen-15™ acts as the substrate and is mixed with PRP, an unparalleled graft is obtained in regards to a bone replacement device.

## In the Next Issue of Contemporary Periodontics and Implantology's Clinical Update Series: Treatment of Failing Implants: Using Platelet Rich Plasma to Reestablish Bone Contours Around Diseased Implant Sites



Pre-operative clinical view, failing implant



Clinical view of diseased implant surface



Clinical view of implant surface after detoxification



PRP/Graft complex placed within the osseous defect



Platelet Poor Plasma applied over the graft complex



Closure, with Platelet Poor Plasma acting as a hemostatic gel and protective matrix

## Upcoming Publications for Dr. Petrungaro throughout 2001

- Multiple Tooth Replacement in the Aesthetic Zone Using the Transgingival Implant Placement Approach  
CERP, January 2001 Issue
- The Management of Compromised Vertical Dimension Using Transitional Implants Throughout the Healing Phase of Implant Reconstruction  
AGD Implant Review, January 2001
- Immediate Provisionalization in Anterior Implant Reconstruction: Providing the Foundation for Optimal Function and Aesthetics in the Replacement of the Natural Tooth System  
Journal of Cosmetic Dentistry, Winter 2001 Issue
- The Use of The Master Diagnostic Model® Technique for Optimal Management in Cosmetic Restorative and Surgical Dentistry  
CERP, April 2001 Issue
- Using Platelet Rich Plasma to Accelerate Soft Tissue Maturation for Immediate Provisionalization of Aesthetic Single Tooth Implants  
Journal of Cosmetic Dentistry, Summer 2001 Issue
- Immediate Placement and Provisionalization in the Aesthetic Zone Using Platelet Rich Plasma to Accelerate the Healing and Maturation Phase  
CERP, October 2001 Issue
- Utilization of Platelet Rich Plasma to Accelerate Hard and Soft Tissue Maturation in the Immediate Placement and Loading of Implants  
Journal of Implantology, Fall 2001 Issue, to be submitted



## The Marketing of Platelet Rich Plasma ( Autologous Platelet Gel) to Your Patients

The marketing of PRP to your patients is best accomplished by the following two scenarios: first, the rate of healing that is observed in regards to the maturation rate of both the soft and hard tissues. This is very appealing and desirable to patients as their post-operative course is usually more friendly and their healing phase is shorter. They in turn can realize the finished prosthetic result in a more rapid time frame. Secondly, is the fact that in today's society, with the concerns of various disease transmissions, the patient is able to use their own blood products to replace lost or missing alveolar structures. When patients are informed that we will be drawing their own blood and placing their whole blood through the centrifuge process to obtain growth factors and deliver them back to the surgical site to stimulate osseous and soft tissue maturation, their commitment to the procedure, and their willingness to undergo more extensive procedures, has been observed in my practice, and others using the procedure, to increase. Along with this willingness and commitment to the procedure, their value assessment to the financial aspect of the entire surgical and prosthetic treatment plan has been observed to be enhanced.

Educating the entire staff on the PRP technique is recommended so that they have a thorough understanding of the procedure, and the benefits it provides your patients. They can reiterate your prescribed treatment plans, and truly come to understand the enhanced surgical results that will be obtained, along with the significant contribution that their practice has made to the quality of their patients lives.

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*Dr. Petrunaro graduated from Loyola University Dental School in 1986, where he completed an independent study of Periodontics at the Welsh National Dental School in Wales, U.K. He completed his residency in Periodontics & has a specialty certificate in addition to a Master of Science degree in Periodontics from Northwestern University Dental School. He is the former Coordinator of Implantology, Graduate Department of Periodontics, NWU Dental School. Dr. Petrunaro has been in the private practice of Periodontics and Implantology since 1988, and holds a license in both Illinois and Minnesota. He has given numerous seminars and lectures on advanced periodontal, prosthetic and implant interrelationships, bone regeneration and aesthetic tissue formation, the use of transitional implants and the use of platelet rich plasma in bone grafting throughout the U.S., Europe, Canada, Australia and South America. In addition, he has authored numerous articles on all of the above, along with the topics of cosmetic bone grafting and implant procedures. He is also a fellow of the International & American College of Dentists, and a Diplomate of the International Congress of Oral Implantologists.*