OPTIMAL ROOT CLEANING AND MICROINVASIVE PERIODONTAL POCKET SURGERY WITH MICROSCOPE-CONTROLLED GLASS BEAD BLASTING

Peter Kotschy, MD, DDS[1]

The use of a microscope with a magnification power of 15× to 20× combined with kinetic glass bead blasting offers clinicians a microinvasive approach to the treatment of inflammatory periodontal conditions. This treatment places minimal demands on the patient and provides excellent results. Using a one-stage approach that combines conservative initial and nonsurgical treatment, optimal root cleaning and pocket debridement can be achieved.
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[1]Private practice, Vienna, Austria.

Correspondence to:
Prof Dr Peter Kotschy
Lindengasse 41/15
1070 Vienna, Austria
Fax: 43 1 524 17 98
Email: peterkotschy@parodontologie.cc

In the classical treatment of chronic periodontitis, biofilm, supra- and subgingival calculus and root surface contaminates are removed by scaling and root planing (SRP). After the initial treatment and a healing phase of 6 to 8 weeks, reevaluation is carried out. If pocket depths greater than 5 mm with bleeding on probing are identified, periodontal surgery may be required.[1]

In periodontal surgery, an access flap is made to allow for thorough root cleaning and removal of inflamed pocket tissue. Traditionally, scalpels, scalers, and ultrasonic and rotary instruments are used. Opening the flap exposes healthy bone, which has been shown to result in loss of 0.5 to 1 mm of bone. After the periodontal defect and roots are cleaned, the flap is replaced and sutured. The sutures are usually removed after 7 to 10 days. Adverse postoperative effects can include bleeding, swelling, and pain. These effects can make postoperative care difficult.

Even when performed to the highest standard, traditional SRP is unlikely to remove all of the biofilm and deposits on the root surface. This becomes evident when inspecting the pocket using a microscope. Further, an area treated with traditional SRP will often have extensive abrasion and gouging of the root surface (Figs 1 and 2). The optimal technique for root cleaning without damaging the root surface involves the use of the operating microscope at a magnification of 20× to direct glass bead blasting (Fig 3).

This method allows for the conservative initial and microinvasive treatment steps to be performed in one phase (Fig 4). This is achieved by kinetic abrasion with microglass beads using a high-pressure jet unit. Because periodontal inflammation does not affect each tooth in the same way, glass bead blasting can be tailored to the severity of involvement for each individual tooth. This allows healthy tissue to be spared.

In 1945, Black[2] suggested that 90-µm glass beads could be used for supragingival prophylaxis. It was the current author's aim to find a minimally invasive procedure using the microscope with direct visual control to accomplish

Fig 1 Use of curettes to modify root surface will leave deposits in the crevices (magnification ×20).

Fig 2 Ultrasonic instruments are less aggressive but leave crevices contaminated. The water-cooling system also blurs the dentist's view through the microscope (magnification ×20).

Fig 3 Glass bead blasting completely cleans root surfaces without disturbing the clinician's view and without causing any visible damage (magnification ×20).

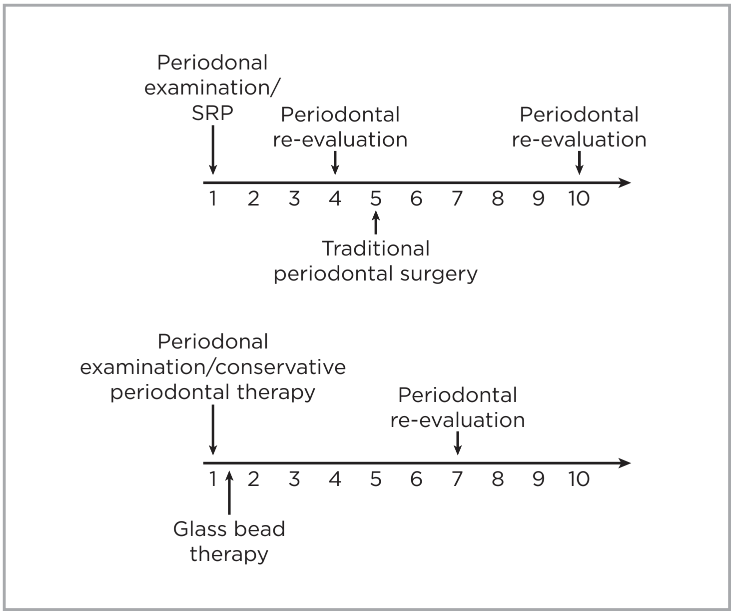

Fig 4 *(right)* Comparison of the treatment schedules of traditional periodontal surgery versus glass bead blasting.

subgingival debridement. This technique would achieve the removal of biofilm and calculus and the complete cleaning of all root surfaces without damaging the cementum.

In 1999, Schiele and Ryssel[3] reported using glass bead blasting with either the naked eye or loupe magnification. However, loupe magnification is not powerful enough to allow visual inspection of the root surface during treatment. If the subgingival root surface is not adequately cleaned, then there may be limited healing with residual inflammation. In these inflamed bleeding pockets, there are always residual deposits. Only under the microscope can these deposits as well as any irregularities on the root surface be seen in detail.

The use of the microscope and glass bead blasting allows cleaning of the root surfaces without damaging them and also allows for the controlled removal of diseased soft tissue. This provides the conditions for optimal healing with tissue repair or regeneration.

MATERIALS AND METHODS

Following an initial comprehensive examination of the patient, including appropriate radiographs and medical history review, the findings, diagnosis, and treatment options are discussed. Additionally, the dentist explains the nature of the disease, which may include a discussion of the anatomy and pathology of periodontal structures. At this point, a preliminary prognosis may also be given.

Figs 5 and 6 Preliminary removal of major calculus with an ultrasonic tip at low magnification (×6; *left*) and high magnification (×20; *right*).

Fig 7 At high magnification, deposits that cannot be removed with ultrasonics are clearly visible (magnification ×20).

Fig 8 Glass bead blasting is able to remove deposits previously unreachable with traditional treatment (magnification ×20).

In the next treatment phase, the dental hygienist does detailed periodontal charting[4,5] supra- and subgingival and carries out oral hygiene instruction and ultrasonic debridement of calculus and plaque using loupes with a 3.5× magnification. The hygienist also uses a powder jet to clean and polish all supragingival tooth surfaces. The dental hygienist does not perform SRP (Figs 5 and 6).

After the completion of treatment by the dental hygienist, the dentist's treatment phase begins. This should occur on the same day or on the next day to avoid healing and shrinkage of the gingiva, which could impair visual access to the pockets. This differs from the traditional procedure, in which a healing period is allowed after initial periodontal treatment. This healing period may lead to the development of a tight gingival cuff, which can interfere with visual access, especially in pockets with depths of 8 mm or greater.

Using a microscope with a magnification of 15× to 20× (OPMI Pro Magis, Zeiss), areas of biofilm, calculus, and discoloration are clearly visible (Figs 7 and 8). The glass bead blasting is done using the PrepStart unit (Danville Engineering). It is fitted with a regulating screw for use with sterilized glass beads. The handpiece can be fitted with a selection of nozzles with working angles of 45, 80, 90, and 120 degrees and with a diameter of 0.66 mm. The slender attachments and various angled nozzles make every site in the mouth accessible under either direct or indirect vision.

The nozzle of the high-pressure unit is directed into the periodontal pocket at an angle ranging from approximately 5 to 20 degrees under microscopic visual control. The air jet (~ 0.5 to 5 bar) opens the pocket, removes the upper part of the inflamed pocket tissue, and cleans the root surface (Fig 8). The glass bead jet first removes the biofilm and then all contaminants,

Fig 9 After inflamed tissue is removed, no bleeding will block the clinician's view (magnification ×20).

Fig 10 At the end of the procedure, healthy tissue has been preserved (magnification ×20).

Fig 11 The pocket is opened with a spatula to show the perfectly cleaned root and undamaged Sharpey's fibers (magnification ×20).

Fig 12 Distal surface of a mandibular right second premolar. Glass beads were blasted into a 6-mm-deep pocket. The root surface is completely cleaned, and all tissues and Sharpey's fibers are healthy. The inflamed tissue has been removed. There is no bleeding, and the pocket is free of glass beads. The next step will be to place amelogenin or wait for the stabilizing blood to coagulate.

discoloration, and calculus present on the root surface. Within the cementum, crevices and niches are cleared away without gouging or otherwise damaging the root surface. As the root surfaces are cleaned, there is concurrent debridement of inflamed epithelial and granulation tissue within the pockets (Fig 9). The removal of this tissue significantly reduces bleeding and thus allows for an even better view into the depth of the pockets. Following debridement, the Sharpey's fibers clearly stand out as white structures attached to the root surfaces (Figs 10 and 11), indicating that healthy periodontal tissue has been preserved.

Amelogenin (Emdogain, Straumann) may be applied to the root surfaces to promote periodontal regeneration (Fig 12).[6,7] The soft tissue is then compressed against the root surface. If needed, porous bovine bone mineral (BioOss, Geistlich) can be used to fill exposed infrabony pockets.[8,9]

Cleaning can be performed down to the pocket base, which is clearly visible through the microscope. Treatment around a tooth can be tailored to the variable pocket depths, allowing for the minimum level of invasiveness to be used. Granulation tissue in a pocket can be removed down to the bone, and the root surface can be thoroughly cleaned even at difficult-to-access sites such as distal furcation entrances and crevices. This can be accomplished under full vision.

In many cases, the use of local anesthesia can be omitted for this procedure. If porous bovine mineral is placed, the patient will feel only light pressure. Patients with very deep pockets usually do require the use of local anesthesia. Because of the complete root cleaning and the removal of inflamed tissue, the wounds heal impressively and show a significant potential for regeneration. The lack of pain associated with the procedure is a matter for further research.

Fig 13 A two-part plastic compression splint is digitally pressed on the mucosa to avoid air emphysema during the procedure.

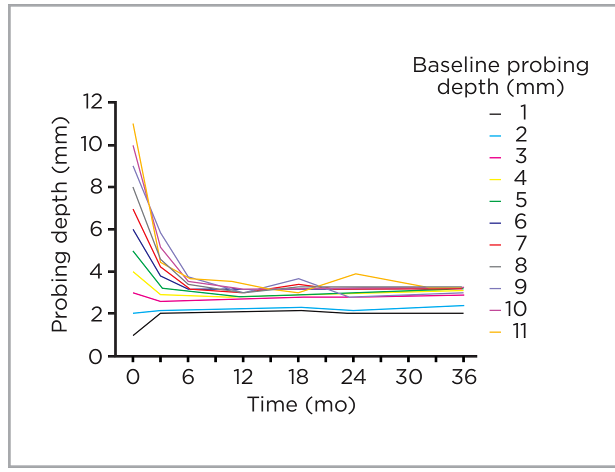

Fig 14 Probing depths over the 36-month course of the trial.

Glass beads that escape the oral cavity are captured by an external suction (Big Power). The air from this machine is subsequently disinfected and led through a HEPA-filter, which meets ISO standards.

This procedure combines conservative periodontal treatment with minimally invasive periodontal surgery, albeit without a scalpel. Depending on the patient's periodontal status, pocket depths of up to approximately 10 or 11 mm can be treated using this method. A single tooth, groups of teeth, or the entire mouth can be treated in one or two visits.

One potential danger presented by this procedure is the development of air emphysema, in which air is pressed through the pockets into the surrounding gingival tissue. The areas most at risk are the buccal regions of both the maxillary and mandibular molars. Air emphysema does not occur on the lingual or palatal aspect of the molars, and it is rare in the anterior region because of the tight gingiva propria in these regions. Air emphysema can be avoided by using a two-part compression splint (Fig 13). One part is made from plastic material, and the other, from a flexible rubber material. Pressure is gently compressed digitally or using forceps by either the dentist or assistant. Cotton rolls can be used distal to the molars where access is difficult. The rolls are pressed against the tissue at the site with forceps.

The procedure is well accepted by patients because there is very little pain or discomfort. For the dental team, however, the procedure is quite demanding. Because of the complexities of the microscope, the assistant must be well trained.[10–13] If direct vision through the microscope is not possible, mirrors that are 6 to 15 mm in diameter can provide indirect vision. Manipulations at the distal furcations of the maxillary molar regions are possible with continuous visual control. This is difficult with other methods because the water jet from ultrasonic instruments and the bleeding during traditional treatment would obscure the view. This new technique leaves the site virtually bloodless once the inflamed tissue is removed. Following the completion of treatment, the patient is left with hard and soft tissue surfaces in excellent condition.

Posttreatment care is minimal. It includes a liquid diet for 1 week, no oral hygiene at the treated sites for 1 week, and rinsing with 3% hydrogen peroxide diluted with water at a ratio of 50:50, followed by rinsing the entire mouth with 0.2% chlorhexidine for 1 or 2 weeks (Curasept, Curaden). If there is bleeding on probing at reevaluation, it is usually attributable to a residual deposit in a furcation area of very limited access. In such cases, the area will probably require a microsurgical mini-flap to tunnel the area or to clean it using glass bead blasting.

RESULTS

This procedure has been used on more than 300 patients. All of the patients provided informed consent pursuant to the guidelines of the World Health Organization, the Declaration of Helsinki, and Austrian Dental Law. In this prospective clinical study, data covering 3 years and 24 patients were collected and analyzed. The data relating to the periodontal status of the 24 patients included periodontal probing depths (PDs), clinical attachment levels (CALs), bleeding on probing (BOP), and the O'Leary Plaque Index (PI).

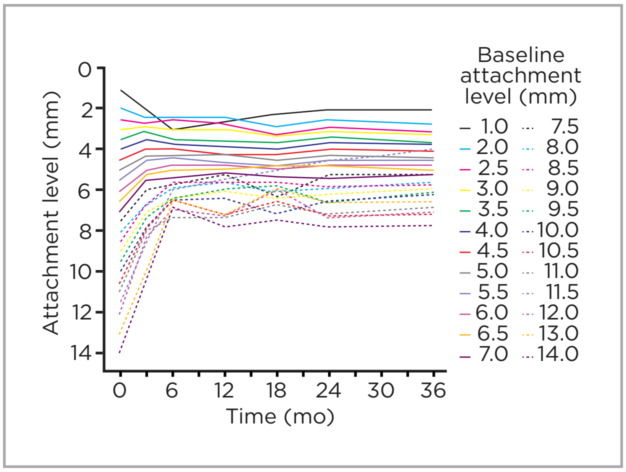

Fig 15 Clinical attachment levels over the 36-month course of the trial.

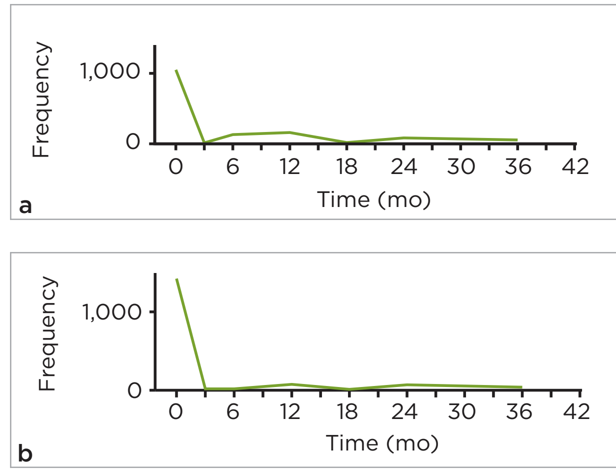

Fig 16 Plaque Index *(a)* and bleeding on probing *(b)* over the 36-month course of the trial.

Each patient had between 1 and 32 teeth treated. One patient failed to show up for the second follow-up visit and was eliminated. All patients were treated with the glass bead technique. Examinations were performed at baseline and at 3, 6, 12, 18, 24, and 36 months. Not all patients were examined at each time point, so the sample sizes at the time points may vary. The data were analyzed using SPSS version 14.0 by the Section of Medical Statistics of the Core Unit for Medical Statistics and Informatics at the Medical University of Vienna.

The results are shown in Figs 14 to 16. To determine how PD, CAL, and PI changed independent of the patient or individual sites, the means of all observations at each time point were calculated. The sites that initially had the highest probing depths generally had the fastest rate of change. After 12 months, all sites leveled off at PDs of 2 to 3 mm (Fig 14). A similar pattern of change was observed for CAL (Fig 15).

Changes over time were similar for all tooth sites, with no significant differences noted between anterior, premolar, and molar teeth. The data regarding PD, CAL, and BOP demonstrate that this method of periodontal treatment is superior to traditional scaling and root planing.

The precise and demanding nature of this procedure results in long working times. Although, the final cost to patients is expected to be one-third less expensive than traditional procedures including surgery. However, once the benefits are explained, patients will be willing to choose this less invasive procedure. It is rewarding to see that patients are free from pain by the first evening and fully relaxed one day after the procedure.

DISCUSSION

This new approach to periodontal treatment benefits both the patient and dental team. In a small number of cases, minimally invasive tunnel flap surgery may be needed in the molar region because of furcation anatomy.

Manual scalers and curettes are no longer the most effective means for nonsurgical subgingival root debridement. The harm they cause to the root surface can be extensive, and they do a less than thorough job of root debridement. Ultrasonic scalers do less harm to the root surface, but they also glide over small crevices. Optimal cleaning is virtually impossible, healing is incomplete, and tissue regeneration is unlikely. Electron microscope analysis by Virnik showed that no destructive changes are caused to the cementum when the glass bead technique is used as described. However, if pressures greater than 5 bar are used, slight impressions from the glass beads onto the cementum surface may occur.

Because there are flying glass beads that can escape the oral cavity, the patient must be protected. These protective measures include the intraoral use of dry tips (Mölnlycke Health Care) on the left and right cheek to protect the parotid gland saliva ducts. Lips are retracted and protected using Optragate (Ivoclar Vivadent). The patient also wears a face mask to cover the nose and eyes. Under this mask the patient can wear TV glasses to watch the procedure via a three-chip video camera mounted on the microscope (Figs 17 and 18). The assistant should leave a small pool of fluid at the base of the tongue and back of the mouth. This helps to protect the patient from inhaling and ingesting the glass beads.

Fig 17 Mouth, nose, and eye protection for the patient.

Fig 18 TV glasses show the dentist's view through the microscope to the patient.

However, if some of the sterile glass beads are ingested, they are nontoxic and will be passed naturally by the body. At a pressure of 5 bar, no destruction occurs to the glass beads. Even if tested in vitro on an animal under 20× magnification at a pressure of 9 bar, no splitting of the glass beads occurred. During the procedure, all beads are removed by intraoral and external suction.

By working with a microscope at 15× to 20× magnification, a quantum leap can be made in detecting the causes underlying inflammatory periodontal conditions. This is a one-stage approach that combines initial conservative and microinvasive surgical treatment to manage inflamed periodontal pockets. The use of microscope-guided direct vision makes it possible to clean the root surfaces optimally. Once clinicians experience this level of precision, it is difficult to return to traditional periodontal therapy.

CONCLUSION

The use of a microscope at 15× to 20× magnification to direct glass bead blasting offers clinicians a microinvasive approach for the treatment of inflammatory periodontal conditions. All of the patient's pockets are cleaned over a 1- or 2-day period to prevent reinfection from untreated sites. The glass bead blasting removes all deposits including biofilm and subgingival calculus with precision. The root surfaces are cleaned without injury, and the inflamed pocket epithelium and granulation tissue is removed without destroying the collagen fibers.

This minimally invasive one-stage approach has many benefits compared to conventional therapeutic approaches. Eliminating the need to raise surgical flaps helps to preserve periodontal alveolar bone, and the glass beads preserve root morphology while thoroughly cleaning the pocket. Treatment can usually be done without the use of local anesthesia and can be tailored to individual pocket anatomy. Since there are no incisions and no flaps, there is very little swelling, bleeding, or pain. No dressings are needed, and posttreatment wounds are minor.

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REFERENCES

1. Cortellini P, Pini Prato G, Tonetti MS. The modified papilla preservation technique. A new surgical approach for interproximal regenerative procedures. J Periodontol 1995;66:261–266.
2. Black RB. Technique for nonmechanical preparation of cavities and prophylaxis. J Am Dent Assoc 1945;32:955–965.
3. Schiele KH, Ryssel SM. Ein Meilenstein in der Vereinfachung der Behandlung parodontaler Erkrankungen. Die Zahnarzt Woche 1999;14:18–20.
4. Kotschy P. Die Systematik der funktionsorientierten zahnärztlichen Diagnostik und ihre karteimäßige Erfassung. Öster Stomatol 1976;12:445–449.
5. Kotschy P. Die Dokumentation der Anamnese, Befunderhebung, Diagnostik und Therapie in der Zahn-, Mund- und Kieferheilkunde. Öster Stomatol 1979;6:214–220.
6. Velasquez-Plata D, Scheyer ET, Mellonig JT. Clinical comparison of an enamel matrix derivative use alone or in combination with a bovine-derived xenograft for the treatment of periodontal osseous defects in humans. J Periodontol 2002;73:433–440.
7. Zetterström O, Anderson C, Eriksson A, et al. Clinical safety of enamel matrix derivative (Emdogain) in the treatment of periodontal defects. J Clin Periodontol 1997;24:697–704.
8. Camargo PM, Lekovic V, Weinlaender M, Vasilic N, Kenney EB, Madzarevic M. The effectiveness of enamel matrix proteins used in combination with bovine porous bone mineral in the treatment of intrabony defects in humans. J Clin Periodontol 2001;28:1016–1022.
9. Lekovic V, Camargo PM, Weinlaender M, Nedic M, Aleksic Z, Kenney EB. A comparison between enamel matrix proteins used alone or in combination with bovine porous bone mineral in the treatment of infrabony periodontal defects in humans. J Periodontol 2000;71:1110–1116.
10. Kotschy P. Team work with supine patients (I) [in German]. Quintessenz J 1981;11:341–345.
11. Kotschy P. Team work with supine patients (II) [in German]. Quintessenz J 1981;11:447–455.
12. Kotschy P. Team work with supine patients (III) [in German]. Quintessenz J 1981;11:533–540.
13. Kotschy P. Team work with supine patients (IV) [in German]. Quintessenz J 1981;11:615–624.