Use of the Dental Microscope in Plastic Periodontal Therapy – Evolution or Revolution?

Rino Burkhardt, DMD

Since the 1980s, root coverage, increase of keratinized tissue around implants, augmentation of alveolar defects, and delocalization of the gingival line are among the surgical methods that have been introduced and modified within the field of mucogingival surgery (Figs. 1-3). Utilizing these procedures, the majority of periodontal concerns can be resolved successfully and predictably. However, the key to aesthetic and functional success as well as predictability is the selection of a minimally traumatic approach which not only depends on the surgeon's dexterity, but also on the perception of the human eye. Therefore, the use of magnification systems is essential to appropriately performing microsurgical techniques. It is the aim of this article to describe the technical components and benefits of the microsurgical technique applied in periodontal surgery.

Fig. 1: Removal of a Gore-Tex membrane, combined with a double-split flap to increase the width of the masticatory mucosa

Fig. 2: Abutments placed, connective tissue flap sutured in place

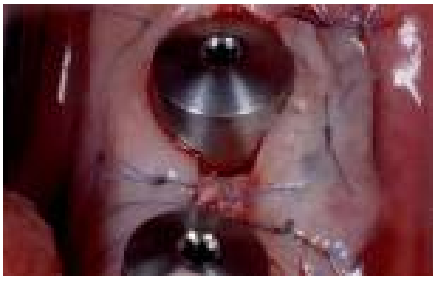

Fig. 3: Completed clinical procedure without denuded bone surfaces

Microsurgery in general is not an independent discipline, but merely a technique which can be applied in different surgical specialties. It is based on the fact that the human hand, when trained appropriately, is capable of performing more precise movements than the naked eye is able to control.

The advantages of the microsurgical technique have long been recognized in other surgical specialties and revolutionized the results in, for example, casualty and replantation surgery, as well as neuro and eye surgery. The entirely positive results of microsurgically modified interventions have led to today's clinical applications in dental treatment, seen first in endodontics.

The treatment results have been analyzed statistically since the introduction of microendodontic techniques and published in prospective studies. Within one year of apical surgery performed with a microscope, 96.8% of the cases were considered healed. A re-evaluation, 5 to 7 years after the first postoperative year, still yielded a success rate of 91.5%, measured by clinical and radiographic parameters.[5] The corresponding percentage of healed cases, treated without a surgical microscope, yielded a success rate of only 44.1%.[4]

The first publications in periodontal surgery were limited to case reports, based on subjective statements made by patients or the observations of the attending dental surgeons. Today, however, the benefits of microsurgical techniques are confirmed by scientific studies with a high level of evidence.

Technical aspect: Vision

Optimal vision is a strict necessity in periodontal surgery. Visualization of intricate detail is enhanced by increasing the image size of the object. Image size can be increased in two ways: first, by moving closer to the objects, and second, by visual magnification. Utilizing the former, the ability of the eyes' lenses to accommodate becomes important and has a relevant influence on the visual capacity.

As one ages, the ability to focus at closer distances is compromised because the lens of the eye looses its flexibility. Presbyopia affects all middle-aged people and becomes especially noticeable when the nearest point at which the eye can focus accurately exceeds the ideal working distance. This is why an older individual reading without glasses must hold the reading matter farther from the eyes to see the print. Increasing the distance enables the person to see the words but, on the other hand, the longer working distance means the written text appears smaller.

Fig. 4: Ergonomic posture for surgeon and assistant

Fig. 5: The MORA Interface for OPMI® pico allows the operator to remain in an upright viewing position regardless of the angle of the microscope

The use of a dental microscope in the periodontal practice overcomes all these effects, provides the surgeon with a freely selectable magnification level, and additionally guarantees the ideal lighting conditions important for optimal visual acuity. While working with a microscope, in contrast to loupes, the light beams strike the retinas of the observer parallel so that no eye convergence is necessary thus placing only minimal demands on the lateral rectus muscles. Additionally, the dentist's head is placed in the center of its balance point over the spine and stabilized against gravity. All these factors greatly improve postural ergonomics and avoid the multitude of back, neck, shoulder and eye problems that dentists frequently suffer (Fig. 4).

The microscope – consisting of numerous optical components, a lighting unit and a mounting system – is either attached to the wall, the ceiling or a floor stand.

During a surgical intervention, the surgeon uses both hands to perform the treatment procedure. For that reason a stepless, motor-driven magnification changer, operated by a foot pedal, seems to be more ergonomic.

Conversely, if the magnification needs frequent changes, it can be accomplished faster with the manual changer. In order to visualize lingual or palatal sites that are difficult to access, the microscope must have sufficient maneuverability. Recent technical developments have further enabled direct viewing of oral operation aspects (Fig. 5).

Instruments

Proper instrumentation is fundamental for a microsurgical intervention. Various manufacturers have complete sets of microsurgical instruments that are generally conceived for vascular and nerve surgery and are, therefore, inappropriate for use in plastic periodontal surgery. An ideal basic set of instruments for plastic periodontal surgery consists of a micro-needle holder, micro-scissors, micro-forceps, small elevators and a variety of surgical blades. The precision with which the instruments are manufactured varies greatly. For example, the configuration of the needle holder jaw has a considerable influence on how firmly it grips the needle. Serrated inserts are the best at preventing the needle from twisting or rotating between the needle holder jaws. This benefit must be weighed against the potential harm the serrations may cause to the suture material. Smooth jaws cause no demonstrable damage to 6-0 monofilament nylon sutures, whereas serrated needle holder jaws markedly reduce the suture breaking strength. Additionally, the sharp outer edges of the needle holder jaws must be rounded to avoid breakage of delicate suture materials. When the needle holder jaws are closed, no light must pass through their tips. Locks aid in rotating the instrument handles in a controlled manner and without exerting pressure.

In order to prevent damage, microinstruments should be stored in a sterile container or tray. The tips of the instruments must not touch each other during sterilization procedures or transportation. The practice staff should be thoroughly instructed about the cleaning and maintenance of such instruments, as cleaning microinstruments in a thermodisinfector without fixing them in place may cause irreparable damage to their tips.

Suture material

The suture material and its application technique are essential considerations in microsurgery. Wound closure is a key prerequisite for healing following surgical interventions and most important for avoiding complications. However, penetrating the soft tissue with a needle causes additional trauma and the presence of foreign materials in a wound may significantly increase the susceptibility to infection. Hence, it's obvious that needle and thread characteristics also influence the wound healing and surgical outcome.

Fig. 6: Primary wound closure after papilla base incision

Fig. 7: Primary closure achieved with a microsurgically modified papilla suture

Fig. 8: Macrosurgically treated recession, 7 days after intervention

Histological examinations confirmed the inflammatory tissue reactions with a distinct infiltrate. If a resorbable suture is left in situ for more than two weeks after wound closure, an acute inflammatory reaction will result. This is an indication that the sutures must be removed at the earliest biologically acceptable moment in time and that adverse quality, resorbable suture materials must be avoided in the bacteria-loaded oral cavity. Additionally, it was shown that bacterial migration into the tissues along the thread increases with higher diameter suture materials which, in turn, means that the selection of smaller diameter thread reduces the trauma and improves tissue healing. Polyfilament threads exhibit higher capillarity than monofilament threads and, in addition, facilitate bacterial migration. Bacteria can penetrate into the inner compartment of the thread which impairs the immunological response of the host. This is one more reason for favoring thin, monofilament, non-resorbable suture threads in periodontal surgery.

Clinical indications

At present, the degree to which the level of magnification influences the result of the operation can only be speculated. In the available literature, the magnification recommended for surgical interventions ranges from 2.5x to 20x.[1,6] In periodontal surgery, a magnification range of 6x to 8x seems appropriate for clinical examinations or surgical interventions where an entire quadrant must be in the field of vision. As the depth of field decreases with increasing magnification, the maximum magnification for a surgical intervention is limited to about 12x to 15x when dealing with a localized problem such as covering a single soft tissue recession or interdental wound closure after guided tissue regeneration of an infrabony defect (Figs. 6, 7).

Opponents of periodontal microsurgery often mention the adverse effect of the prolonged duration of the intervention while working with microscopes. It has been shown in studies from the 1980s that the incidence and severity of complications and pain following periodontal surgery correlate well with the duration of the surgical procedure. It may be speculated that an extended operation time may compensate for the beneficial treatment effect of minimally invasive techniques. However, recent surgical studies did not support such a hypothesis. Quite the contrary, in a recently published cohort study comparing loupe users, microscope users and dentists working without magnification, the microscope users fulfilled the specified tasks with the highest level of precision and incurred the least complaints about ergonomic posture problems.

Most periodontal surgical interventions require primary wound closure using a previously raised flap. This can be accomplished by choosing an appropriate suture material and technique. A recent experiment aimed to evaluate the influence of suture strengths and needle characteristics on the tearing behavior of mucosal tissue samples. The tearing-tension diagrams were plotted for 3-0, 5-0, 6-0 and 7-0 monofilament threads. The results demonstrated clearly that dynamic tearing to breakage could occur either at the tissue level or within the threads. While the 3-0 sutures almost exclusively led to tissue breakage, within the 7-0 group the threads broke before tissues were torn. This in turn means that the clinician can influence the amount of trauma by selecting thinner suture material which, on the other hand, requires magnification.
In many instances, appropriate previous training facilitates cooperation with the assistant and automates instrument handling during surgery so that the operating team can fully concentrate on the surgical procedure.

From a subjective point of view as well as on the basis of the available literature data, there is no contraindication for the use of magnification in periodontal surgery.

Scientific data

Most of the periodontal studies from the 1990s, which evaluate the beneficial effects of the application of the microsurgical technique, are case reports. However, since the beginning of this century, more and more scientific data support the improved results with a high level of evidence when applying minimally invasive techniques.

One prospective cohort study clearly demonstrated the improved treatment outcomes with the use of microsurgical techniques when compared with macrosurgically performed flap surgery.[3] The use of a dental microscope was associated with a very high ability to obtain and maintain primary wound closure

Fig. 9: Microsurgically treated recession, 7 days after intervention

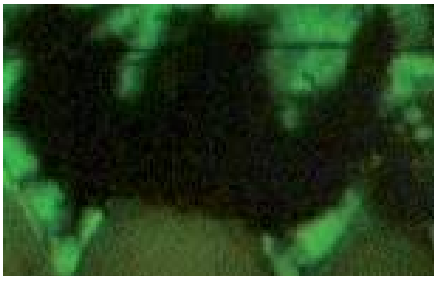

Fig. 10: Angiographic evaluation of a macrosurgical site, 7 days after the intervention

Fig. 11: Angiographic evaluation of a microsurgical site, 7 days after the intervention

of the interdental tissues over barrier membranes in regeneration procedures. This could be accomplished by optimal visualization of the intricate details, resulting in enhanced clinical handling of the soft tissues.

Another study compared the short and long-term results after recession coverage procedures in a prospective, randomized clinical trial.[2] In a split-mouth design, buccal root recessions on upper canines were either covered microsurgically or macrosurgically. The angiographic evaluation performed immediately after the surgical interventions, and again after three, and finally, after seven days documented the statistically significant improved vascularization of the microsurgically treated sites compared with the conventional approach (Figs. 8-11). The clinical follow-up during the first postoperative year confirmed the beneficial effect of the microsurgical approach which contributed with a 10% improvement in mean recession coverage.

These results are corroborated by recent studies comparing microsurgical and macrosurgical approaches in periodontal therapy.

Conclusions

In periodontal practice, we often have to deal with problems where the naturally given visual capacity reaches its limits. Therefore, the tasks can only be partially fulfilled or at a lower level of precision and the use of magnification becomes mandatory to improve the quality of work. A substantial number of periodontists have already adopted the use of magnification provided by loupes and dental microscopes in their practices and recognize its value.
However, despite the entirely positive results in prospective studies, the dental microscope continues to experience slow acceptance in periodontal surgery. An anticipated extended learning curve and the financial investment may keep many practitioners from a trial session or attending a microsurgical course.

Although the microsurgical approach in periodontal plastic surgery is documented as being superior to conventional methods, evolution continues to take time!

Image courtesy: Figs. 1-4 and Figs. 6-11: Dr. Rino Burkhardt, Zurich, Switzerland

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Dr. Rino Burkhardt earned his DMD from the University of Zurich, Switzerland, and he holds a Master of Advanced Studies degree in Periodontology. He maintains his private practice limited to periodontology and implantology in Zurich where he has been using a dental microscope since 1992. Dr. Burkhardt attended the Microsurgery Training Institute in Santa Barbara, California, USA. He acts as a clinical instructor in the Department of Periodontology, at the University of Berne, Switzerland. His publications, lectures and courses cover selected topics on his specialty. These include hard and soft tissue management within the scope of implant restorations, aesthetic aspects from the point of view of the periodontist and the relationship between the prosthetic restoration and periodontal tissues. Dr. Burkhardt won the 2006 research prize from the European Federation of Periodontology. He is an active member of the European Academy of Esthetic Dentistry (EAED), the European Association of Osseointegration (EAO), the Swiss Society for Periodontology (SSP) and the Swiss Society of Implantology (SGI).
Dr. Burkhardt can be reached at Rino.Burkhardt@bluewin.ch