

Review Article

Periodontal Microsurgery- Magnifying Facts, Maximizing Results

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ABSTRACT:

The field of dentistry has evolved with advancement in equipments making the surgical procedure more precise, less painful and strenuous both for the patient and the practitioner. Over the past several years, a therapeutic revolution has taken place in surgical field requiring the surgeons to update themselves with advanced surgical methodology and equipments. Periodontal microsurgery shares the attributes with medical microsurgery that will positively influence its professional acceptance. The field of medicine has shown that magnification and microsurgery can significantly improve clinical outcomes. These include improved cosmetic results, increased predictability, less pain and higher patient acceptance. The application of magnification to periodontics promises to change clinical concepts of periodontal surgical care. This review article provides a general insight of use of microsurgery in medicine and dentistry. To our knowledge, this article covers all the detailed aspects of microsurgery which are not yet covered in a single review article.

Keywords: Microsurgery, Periodontal disease, Tissues.

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Introduction:

Microsurgery has been broadly defined by Daniel RK. (1979)¹ as surgery performed under the magnification provided by operating microscope. Microsurgery was described by Serafin (1980)² as a methodology which assures modification and refinement of existing surgical techniques using magnification to improve visualization, with applications to all specialties. Microsurgery has been an indispensable asset in medicine for many years and the recent application of its principle to various fields of dentistry like periodontal surgery has been extremely valuable. Periodontal microsurgery is an

extension of surgical principles and techniques by which exceedingly accurate and delicate preparation and atraumatic handling of soft and hard tissue enhances primary wound closure through optical or video magnification. The continuous development of operating microscopes and refinement of surgical instruments and techniques has played a decisive role for the worldwide establishment of the microsurgical technique in many specialties including dentistry.³

Historical perspectives:

In 1694, Amsterdam merchant Anton van Leeuwenhook constructed the first compound lens microscope. In 1921, Carl

Nylen, who is considered the father of microsurgery, first used a binocular microscope for ear surgery.⁴ From 1921-1960 microsurgery was utilized in different specialties and achieved better results than macrosurgery. The micro vessel surgery revolutionized plastic and transplantation surgery was mainly developed by neurosurgeons Jacobsen & Suarez¹⁹⁶⁰.⁵ Apotheker and Jako first introduced the microscope to dentistry in 1978.⁶ During 1992, Carr published an article outlining the use of the surgical microscope during endodontic procedures.⁷ In the Oral Surgery field, Leblanc JP and Van Boven RW, laid the foundations and used nerve microsuturing nerve repair techniques to treat traumatic injuries to the lower dental nerve.⁸ In 1993, Shanelec & Tibbetts presented a continuing-education course on periodontal microsurgery at the annual meeting of the American Academy of Periodontology which led to the development of centers devoted to teaching periodontal microsurgery.⁹ Belcher wrote an article in 2001 summarizing the benefits and potential usages of the surgical microscope in periodontal therapy.¹⁰

Principles of microsurgery:

As a treatment philosophy, microsurgery incorporates three important principles:

1. Improvement of motor skills, thereby enhancing surgical ability
2. An emphasis on passive wound closure with exact primary apposition of the wound edge
3. The application of microsurgical instrumentation and suturing to reduce tissue trauma.

Treatment rendered with visual enhancement supplied by the microscope is termed microscopic. Improved outcomes obtained from the use of microscopic surgical procedures have resulted in a shift toward precision microsurgery which offers

a more rapid and comfortable healing phase for the patient.¹¹

Microsurgical triad:

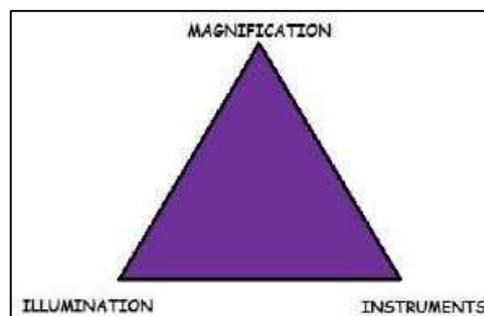


Figure 1: Microsurgical triad

The three elements, i.e. magnification, illumination, and refined surgical skills by instruments are called the microsurgical triad (Belcher et al. 2001), the improvement of which is a prerequisite for improved accuracy in surgical interventions. Without any one of these, microsurgery is not possible.¹⁰ (Figure 1)

Magnification systems

There is a wide range of simple and complex magnifying systems that are available, including three types of magnification loupes and the operating microscope.

Loupes

Loupes, the most common magnification system used in dentistry today, were introduced to medicine in 1876 by Saemisch. Loupes are two monocular microscopes with side by-side lenses that are angled to focus on an object to form a magnified image which has stereoscopic properties. They are of three types.

Simple Loupes: Simple loupes are primitive magnifiers containing a pair of single meniscus lens limited to only two refracting surfaces. Their magnification can be increased by increasing lens diameter and thickness. Size and weight constraints

make simple loupes impractical for magnification beyond 1.5X. They are greatly affected by spherical and chromatic aberration which distorts the shape and color of objects being viewed.

Compound loupes: Compound loupes use converging multiple lenses with intervening air spaces to gain refracting power, magnification and adequate working distance. Such lenses can be adjusted to clinical needs without excessive increase in size or weight. The specific density of each piece counteracts the chromatic aberration of the adjacent piece, making such lenses a desired feature by dentists. Compound loupes are commonly mounted in or on eyeglasses.

Prism Loupes: Prism loupes, the most optically advanced type of loupe, contain Schmidt or rooftop prisms that lengthen the light path through a series of mirror reflections within the loupes which fold the light so that the barrel of the loupe is shortened. Prism loupes produce better magnification, wider depths of field, longer working distances, and larger fields of view than other types of loupes. At magnifications of 3.0 diameters or greater the increased weight often results in headband-mounted loupes being more comfortable and stable than those mounted on glasses.

Loupe Magnification:

Loupes available with magnifications ranging from 1.5 to 10 can be purchased. For most periodontal procedures, loupes of 4 to 5 provide increased visual acuity with an effective combination of magnification, field size, and depth of field.¹²

Operating microscope:

The surgical microscope consists of a complicated system of lenses that allows stereoscopic vision at a magnification of approximately 4–40×. The optical unit of

the microscope includes the following components:

1. Magnification changer
2. Objective lenses
3. Binocular tubes
4. Eyepieces
5. Lightning unit
- 6 Additional attachments

Operating microscopes are designed on Galilean principles. When using the microscope, there must be an adequate working distance between the microscope and the object being viewed for instruments to be used. The addition of inclinable binocular eyepieces gives a microscope great improvement in maneuverability.¹³

Loupes versus operating microscope:

Advantages of loupes:

- Ergonomic benefits of an increased working distance from the viewing object as well as increased visual acuity.
- Loupes are less expensive and initially easier to use.
- They are also less cumbersome in the operating field and less likely to breach a clean operating field.

Advantages of Operating Microscope:

- It offers versatility due to an extended range of variable magnification from 2.5 to 20 and to excellent coaxial fiber-optic, shadow-free illumination.
- Availability of numerous accessories for digital still and video image case documentation.
- Increased operator eye comfort due to the parallel viewing optics provided by the Galilean system.

Disadvantages of Loupes:

- Include fixed magnification or a lack of magnification variability.
- Potential need for additional light for magnification levels of 4.0 or greater.
- Eyes must converge to view an image, which can result in eyestrain, fatigue,

and even vision changes with prolonged use of poorly fitted loupes.

- As the length of the loupe increases to provide for more magnification, the weight of the lens also increases which becomes more uncomfortable.

Disadvantages of Operating Microscope:

- Can be more cumbersome to use.
- More expensive
- Difficult to master the technique to use.

Both the loupes and the operating microscope allow clinicians to perform tasks with improved visual acuity; however, loupes cannot compare to the comfort, versatility, illumination, and visual acuity offered by the microscope.¹⁴

Illumination:

Before considering the selection for an appropriate accessory light source, total weight, quality and the brightness of the light, ease of focusing and ease of transport between surgeries should be kept in mind. When using loupes, each surface refraction that occurs through the lens results in a 4% loss of transmitted light and 50% reduction in brightness unless antireflective coatings are used. Surgical microscopes use coaxial fiber-optic illumination which produces an adjustable, bright, uniformly illuminated, shadow-free, circular spot of light that is parallel to the optical viewing axis. Several sources of fiber optic light can be attached to handpieces, instruments, or loupes. Fiber optic illumination is beneficial in removing deposits in moderate to deep periodontal pockets. Recently, use of halogen lamps has also gained importance.¹⁵

Refined surgical skills:

Over the past two decades, periodontics has seen increasing refinement of surgical procedures, which requires the development of more intricate surgical and motor skills. Microsurgery involves surgical principles in which gentle handling of soft and hard

tissues and extremely accurate wound closure are achieved through magnification which allows for well-planned and precisely executed surgical procedure.

Clinical philosophy:

Repeated application of the philosophy and technique is necessary for the operator to attain the experience and competence needed for various periodontal surgical procedures. Effective periodontal microsurgery allows the operator to consistently achieve clinical results that were once thought to be unlikely. Microsurgery enhances the motor skills and surgical skills. The methods of precise, delicate tissue handling, wound closure, and suturing require concentration, practice and new thought patterns regarding surgical esthetics.¹¹

Hand control

Physiologic Tremor: Physiologic tremor is the uncontrolled movement arising from both the intended and unintended actions of our bodies. There are several factors that can influence a surgeon's physiologic tremor, including anxiety, recent exercise, alcohol, smoking, caffeine, heavy meals, hypoglycemia, and medication usage. To minimize tremors, a microsurgeon must have a relaxed state of mind, good body comfort and posture, a well-supported hand, and a stable instrument-holding position. The surgeon must be seated upright with the legs extending forward and with both feet flat on the floor so that the calf of each leg forms a right angle to the thigh. The surgeon's head should be held in a comfortable upright position. All movements should be efficient and should be made with an effort towards purposeful, deliberate motions.

Hand Grips: The most commonly used precision grip in microsurgery is the pen grip or internal precision grip in which the thumb and index and middle fingers are

used as a tripod. The forearm should be slightly supine, positioning the knuckles away so that the ulnar border of hand, wrist, and the elbow are all well supported, allowing the weight of the hand to be on the ulnar border. The middle finger should rest firmly and directly on either the working surface supporting the hand or indirectly on the ring finger and middle finger holds the instrument. Using the pen grip, the flexor and extensor muscles of the hand are relaxed, resisting fatigue, while the intrinsic muscles that rotate the hand are well postured, resulting in accurate movements. The microsurgeon's position relative to the patient is an important consideration. The most precise rotary suturing movement for a right-handed person is from the 2 o'clock to the 7 o'clock position, while the most precise movement for left-handed people is from the 10 o'clock to the 4 o'clock position. Persistent practice of alternative positions around the entire 360-degree axis ultimately results in mastery of surgical skills necessary to render successful microsurgical treatment in all areas of the mouth.¹⁶

Instruments:

An important characteristic of microsurgical instruments is their ability to create clean incisions and closure that prepare wounds for healing by primary intention.

A basic set of periodontal microsurgery instrument kit comprises of

- Knives and scalpel blades
- Micro scissors
- Anatomic and surgical microforceps
- Micro needle holder
- Micro scalpel holder

Knives and scalpel blades: The knives most commonly used in periodontal microsurgery are those used in ophthalmic surgery or plastic surgery:

1. Blade Breaker Knife
2. Crescent Knife

3. Mini crescent Knife
4. Spoon Knife
5. Lamellar Knife
6. Scleral Knife.

The crescent knife can be used for intrasulcular procedures. The spoon knife is often used to undermine into the lateral sulcular region in preparation for placement of connective tissue grafts using a sulcular, nonrelief technique. Scalpel blades include mini crescent microsurgical blade. Microsurgical incisions are established at a 90-degree angle to the surface using ophthalmic microsurgical scalpels.

Microscissors: These are used for the dissection of tissues, blood vessels, and nerves. The most commonly used microscissors are 14 cm and 18 cm long. To manage the delicate part of the tissues, 9-cm microscissors are preferable. Straight scissors cut sutures and trim the adventitia of vessels or nerve endings. Curved scissors dissect vessels and nerves.

Microforceps: They are used to handle minute tissues without damaging them and to hold fine sutures while tying knots. Jeweler forceps are strong and can even be used to separate minute vessels and nerves.

Micro Needle Holder: It is used to grasp the needle, pull it through the tissues, and tie knots. The needle should be held between its middle and lower thirds at its distal tip. If the needle is held too close to the top, the anastomosis between the two ends of the vessel cannot be completed with a single stitch. If it is held too close to the bottom, maintaining steady control is difficult, and the direction of the tip can be changed easily. A titanium needle holder is the best choice.

Needles: In order to minimize tissue trauma in microsurgery, the sharpest needles, reverse cutting needles with precision tips or spatula needle with micro tips are

preferred. For periodontal microsurgery, the 3/8" circular needle generally ensures optimum results.¹⁵

Suture Material: Although 4-0 or 5-0 sutures are typically used in Periodontics, in periodontal microsurgery 6-0 and 7- 0 sutures are appropriate (Table 1).

The geometry of microsurgical suturing consists of the following points:

1. Needle angle of entry and exit of slightly less than 90 degrees
2. Suture bite size of approximately 1.5 times the tissue thickness
3. Equal bite sizes (symmetry) on both sides of the wound
4. Needle passage perpendicular to the wound

Knot tying using the microscope is done using instrument ties, with a microsurgical needle holder in the dominant hand and a microsurgical tissue pick-up in the nondominant hand.¹⁷

Wound healing in periodontal microsurgery:

Microsurgery encourages repair through primary healing, which is rapid and requires less formation of granulation or scar tissue. Wound healing studies show anastomosis of microsurgical wounds within 48 hours. Secondary wound healing is slower because new tissue formation is required to fill voids at the edge of the partially closed wound. Because surgical trauma is minimized during microsurgery, less cell damage and necrosis occurs, resulting in less inflammation and reduced pain.¹⁸

Applications in Medical Field:

Microsurgery, with its refined optics and high magnification, expands the visual horizon of the surgeon so that reconstructive procedures which were impossible with conventional surgery even with the aid of magnifying loupes can now be completed successfully. Microsurgery have been used in various branches of

medical science like gynaecology for treating several pathological conditions of the female genital tract which can result in infertility, urology for reconstruction of the male urogenital tract, plastic surgery to treat extensive burns, trauma, cancer excision and irradiation necrosis, neurosurgery for the prevention and treatment of cerebral ischaemia, ophthalmology for retinal surgery etc.¹⁹

Application in Dentistry:

The introduction of the microscope into precision dental practice is one of the greatest advances seen in modern dentistry. This will help in improvement of the abilities and skills of dentists to provide offer better dentistry care, as well as cutting down on the efforts and stress involved in dental practice.

Endodontics: Indications for using a microscope in Endodontics are removing broken instruments from the canals, preparing the retrograde obturation cavity, obturating of the back cavity, increasing permeability of calcified channels and locating the pulpal chamber canals, for performing retrograde cavity obturation, treating periapical radiolucencies. Endo perio lesions, which sometimes becomes very difficult to treat due to inaccessibility and complications can also be treated successfully with microsurgical approach.²⁰

Oral Surgery: Precisely indicated in the surgical treatment of injuries and lesions involving the nerves. Microsurgical repair provides an improvement in neurosensory function in patients that present with an inferior alveolar nerve injury.²¹

Prosthodontics: For finishing and polishing the final edges of the prosthesis, checking the tooth/material obturation interface and, checking the adjustments of metallic structures and porcelain edges, high resolution magnification using a microscope is extremely useful.²²

Table 1:
Needle Thread Combination for Microsurgery¹⁵

Indications	Suture material	Needle characteristics	Thread Material	Product name
Buccal releasing incision	7-0 7-0 9-0	3/8 curvature, cutting needle with precision tip, needle length 7.6 mm asymptotic curved needle, cutting needle tip, round body, needle length 8.9 mm 3/8 curvature needle, spatula needle, needle length 5.2 mm	Polypropylene Polypropylene Polyamide	Prolene Prolene Ethilon
Interdental sutures, front area	6-0 7-0	3/8 curvature, cutting needle with precision tip, needle length 11.2 mm 3/8 curvature, cutting needle with precision tip, needle length 11.2 mm	Polypropylene Polyamide	Prolene Ethilon
Interdental sutures, premolar area	6-0 6-0	3/8 curvature, cutting needle with precision tip, needle length 12.9 mm 3/8 curvature, cutting needle with precision tip, needle length 12.9 mm	Polyamide Polypropylene	Ethilon Prolene
Interdental suture, molar area	6-0	3/8 curvature, cutting needle, needle length 16.2 mm	Polyamide	Ethilon
Crestal incisions	7-0 6-0	3/8 curvature, cutting needle with precision tip, needle length 11.2 mm 3/8 curvature, cutting needle with precision tip, needle length 12.9 mm	Polyamide Polypropylene	Ethilon Prolene
Papilla basis incisions	7-0 9-0	asymptotic curved needle, cutting needle tip, round body, needle length 8.9 mm 1/2 curvature, cutting needle with micro tip, needle length 8.0 mm	Polypropylene Polyamide	Prolene Ethilon

Orthodontics: Although traditional orthodontic therapy is the gold standard for treating many adult dental malpositions, it can be problematic when applied to patients with a thin periodontal biotype, who may experience root dehiscence and/or recession. These goals may be achieved with a piezosurgical technique that permits microsurgical corticotomy around each root and the immediate application of biomechanical force. This technique avoids involvement of the periodontal tissue fibers, which is necessary in traditional orthodontic movement, thereby preventing periodontal and bone resorption.²³

Microsurgery in Periodontics:

The use of surgical prism loupes or the surgical microscopes has introduced the reality of considerably less invasive surgical incisions and flap reflection in periodontics.

Benefits of Microscopes in Periodontics:

The surgical operating microscope, like all magnification, enhances visual acuity. This leads to:

1. Increased precision in delivery of surgical skills, which results in more accurate incisions via smaller instrumentation, less trauma, and quicker postoperative healing.
2. Precise repositioning of tissues with smaller needles and sutures
3. Improved view of root surfaces, which permits more definitive removal of calculus and improved smoothness of the root.¹⁰

Microscopes in Scaling and Root Planing:

It is observed that to treat periodontal disease effective plaque and calculus removal from the root surface is a determining factor for the success of the treatment and the control of the disease. Furthermore, research demonstrates that root preparation is enhanced when it is

performed under illumination.²⁴ Fleischer et al 1989²⁵ reported that regardless of the experience level of the operator, calculus-free roots were obtained more often with surgical access. Watchtel et al 2003²⁶ concluded that the amount of residual calculus on root surfaces treated by scaling and root preparation showed less residual calculus on those treated with surgical access. Peter Kotschy 2010²⁷ used microscope with a magnification power of 15× to 20× combined with kinetic glass bead blasting for the treatment of inflammatory periodontal conditions which gave excellent results. Currently, no studies indicate whether magnification can enhance the effectiveness of periodontal calculus removal.

Microscope in Periodontal Plastic Surgery:

Periodontal plastic surgery, with its emphasis on esthetics, is an important aspect of periodontal practice. There are two basic periodontal procedures in which periodontal plastic microsurgery may be applied: those relative to the level of the dentogingival junction and those relative to the edentulous ridge.

Correcting Gingival Recession:

Periodontal plastic microsurgical reconstruction of gingival tissue over denuded roots can be routine and predictable using subepithelial connective tissue grafting. Francetti et al(2005)²⁸ conducted a controlled clinical study for microsurgical treatment of gingival recession and concluded that the application of magnification in mucogingival surgery accomplished better results compared to conventional techniques. Patrícia F. Andrade et al 2010²⁹ compared the macro- and microsurgery techniques for root coverage using a coronally positioned flap associated with enamel matrix derivative and observed a statistically significant increase of width and thickness of

keratinized tissue in test group. Dhir V³⁰ discussed a case report of Microsurgical treatment of gingival recession by subepithelial connective tissue graft and concluded that the advent of subepithelial connective tissue graft for root coverage has demonstrated high degree of success.

Establishing an Esthetic Smile Line: An abnormal smile line may result from a number of causes, including gingival recession, abnormal eruptive patterns, incisal wear, and excessive tissue growth of various etiologies. The creation of an ideal esthetic smile with harmonious gingival contours involves symmetry, lip position, and relative gingival levels of adjacent teeth. W. Peter Nordland(2002)³¹ discussed the Role of Periodontal Plastic Microsurgery in Oral Facial Esthetics and concluded that Periodontal plastic microsurgery may play a significant role in oral facial esthetics.

Restoring the Edentulous Ridge: Ridge augmentation can involve a variety of techniques using microsurgical approach, including guided bone regeneration, block and particulate grafts, soft tissue grafts. In addition to establishing adequate vertical height, sufficient soft tissue thickness must be created to provide an emergence profile for pontics or a dental implant prosthesis.

Microscopes & implants

All phases of implant treatment may be performed using a microscope. Increased visual acuity, improved ergonomics, and body posture are closely related to these improvements. No studies establish that microsurgery reduces postoperative pain following extraction or implant placement, there is strong theoretical rationale to suggest that less surgical trauma results in less pain and faster healing, and that microsurgery leads to those ends. Shanelec DA³² discussed a case series of 100 consecutive patients in private practice requiring extraction of maxillary central

incisors, lateral incisors, or cuspids and showed that microsurgery can be utilized for implant placement in extraction sockets with a high degree of clinical success.

Advantages and disadvantages of microsurgery

Advantages

1. Less tissue trauma
2. Less patient anxiety
3. Atraumatic tissue management
4. Accurate primary wound closure.
5. Increased diagnostic skills.
6. Minimally invasive
7. Improved cosmetic results
8. Increased surgical quality
9. Increased effectiveness of root debridement results in greater predictability of: a) Regeneration procedures, b) Cosmetic procedures.
10. Improved documentation e.g. video, slide, digital.

Disadvantages

1. Educational requirements
 - A) Surgical technique
 - B) Understanding of optics
2. Long adjustment period for clinical proficiency
3. Initial increased surgical time
4. High patient cost
5. Limited surgical access.^{3, 33, 10}

Future Perspectives: Robotic Microsurgery

Robotic microsurgery is taking over minimally invasive techniques in surgery. The delicate steps of operation are performed with the system that control instruments from 10 feet away inserted through small incisions. The surgeon manipulates the tele robot and watches the operation through a three dimensional video and is able to witness the precision that it delivers. It can also complete each step of the complex operation which was previously impossible. Future research in

this field is required to incorporate this technique in dentistry.³⁴

Conclusion:

Magnification systems have opened up a whole new world for the surgeon in many specialties. The cardinal essentials of gentle tissue handling, accurate approximation, meticulous hemostasis, and minimal tissue destruction are the hallmarks of the microsurgical approach. The use of magnification has increased in many areas of dentistry. Understanding the optical principles that govern magnification is also important for its successful application to dental procedures. The “magnification escalation” in dentistry is likely to continue. With advanced magnification, there are previously unthinkable possibilities as new techniques and instruments are currently being developed to meet the needs of this growing segment of practicing dentists.

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