

REVIEW ARTICLE

Microsurgery in Periodontics: A Review

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ABSTRACT:

Microsurgery is broadly defined as the surgery performed under an operating microscope. Now, the microsurgery has laid its hands in the field of periodontics as it involves precise surgical procedures. This review deals applications of periodontal microsurgery for the procedures ranging from mucogingival surgeries to the regenerative procedures and implant dentistry

Key words: Magnification loupes, microsurgery, mucogingival surgery, periodontal plastic surgery, surgical microscope

Received: 8 May, 2019

Revised: 27 May 2019

Accepted: 29 May 2019

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This article may be cited as: Avhad R, Laddha R, Sewane S, Agrawal S, Sharma D, Upadhye K. Microsurgery in Periodontics: A Review. J Adv Med Dent Scie Res 2019;7(6): 41-47.

INTRODUCTION:

Microsurgery as an interesting concept is developing nowadays in dentistry. Most of the dental professions are unable to perform microsurgical procedures due to lack of understanding of what exactly microsurgery means. The purpose of this article is to briefly review about periodontal microsurgery which includes magnification, microsurgical instruments, clinicians posture, hand control and grips, applications in periodontal surgery, its drawbacks, its effect on root coverage. Periodontal microsurgery is the refinement of basic surgical techniques made possible by the improvement in visual acuity gained with the use of the surgical microscope.(1)

In 1979, Daniel defined microsurgery in broad terms as surgery performed under magnification by the

microscope.(2) Historically most of the dental treatment was done with the unaided eye, i.e without the use of visual magnification. Such treatment is termed as Macroscopic, while treatment done under magnification is termed as Microscopic. Carl Nylen, is the Father of Microsurgery, who first used a binocular microscope for ear surgery in 1921.(3) In 1978, Apotheker and Jako first introduced the microscope to dentistry.(4) In 1992, Carr published an article which included a use of the surgical microscope for endodontic procedures.(5) In 1993, Shanelec and Tibbetts presented a continuing education course on periodontal microsurgery at the annual meeting of the American Academy of Periodontology.

Principles of Microsurgery(6):

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.

The Microsurgical triad includes the illumination, magnification and microsurgical instruments.

Magnification enables dentists to use smaller instrumentation with more precision.

The goal of the periodontist is to handle tissues gently and cause as less damage as possible to tissues. Adaptation of flap should be such that the healing will occur by primary intention rather than secondary intention because the latter one heals more slowly and with more inflammation as granulation tissue fills the wound.

Magnification methods:

1. Loupes
2. Operating Microscope

In dentistry, the most common method used for magnification is Loupes. Basically, loupes are two monocular microscopes with side by- side lenses which are angled to focus on an object. Due to the convergent lens system, a magnified image is formed has stereoscopic properties.

Loupes are of three types: Simple, Compound and Prism loupes. But today in dentistry, only compound and prism loupes are used today. Because simple loupes have a magnification range of just 1.5 diameters.

Compound loupes (Figure 1) :

Properties :-

- Use of multiple converging lenses with intervening air spaces.
- Gains refracting power, magnification, working distance, and depth of field, as these loupes use converging multiple lenses.
- Without excessive increase in size or weight, the lenses can be adjusted to clinical needs.
- Loupes are mounted in or on eye glasses.
- Compound lenses can be achromatic, i.e.all rays of light, blue and red focus at same point.
- Lenses consist of two glass pieces bonded together with clear resin.

Prism loupes (Figure 2) :

Properties :-

- Presently these loupes are the most optically advanced type of magnification.
- Produce better magnification, wider depth of field, longer working distance, and larger fields of view when compared to other loupes.

- Contain Schmidt or rooftop prisms which lengthens the light path through a series of mirror reflections within the loupes, eventually folding the light and hence the barrel of the loupe can be shortened.
- Since the barrels of prism are short, it can be mounted on eyeglasses or a headband.
- The headband mounted loupes are more comfortable and stable than mounted on glasses, when loupes are used at magnifications of 3.0 diameter or greater, as it increases the weight of the loupe.

Loupe Magnification :

- Loupes with magnification are available from 1.5x to 10x.
- For periodontal microsurgical procedures and for microdentistry, loupes of 4x to 5x provide good visual acuity, magnification field size and depth of field.(1)
- Loupes should be properly adjusted in a position to view the field rather than the clinician.
- The distance between the field and the clinician should be correct, at least 14 inches, because if the distance is closer to the field, the clinician eyes will try to adjust and focus on surgical field by converging and dilating the eyes, which will cause fatigue to the muscles of eye. (Figure 3) (7)

Operating Microscope (1) (Figure 4)

Properties :

- Operating microscopes are designed on Galilean principles.
- These microscopes incorporate fully coated optics and achromatic lenses with high-resolution and high-contrast stereoscopic vision. Steroscopic vision means human ability to view with both eyes in similar, but slightly different ways. Depth in an image for binocular vision.
- These surgical microscopes use coaxial fiber-optic illumination, which means the type of light produced is an adjustable, bright, uniformly illuminated, shadow-free.
- It has a combination of magnification of loupes with a magnification changer and a binocular viewing system.
- The binoculars are parallel which will protect against eyestrain and fatigue.
- Operating microscope is much more superior than magnifying loupes with the greatest flexibility and comfort in optical magnification.
- Initially it is more difficult to use but with the proper instructions and practice, it can be simple to use.
- Highly expensive.

Loupes Versus Operating Microscopes (1, 8)

Loupes	Operating Microscopes
1.5x to 5x magnification	2.5x to 20x magnification
Need additional illumination for magnifications of 4x or greater	Use excellent coaxial Fiber-optic illumination, hence does not need additional light source
Operator eye comfort is less as the eyes must converge to view the image	High comfort as it has parallel binoculars
Initially easy to use	Basic training required to use surgical microscope
Less expensive	Highly expensive
Cannot provide variable magnification	Has the advantage of providing variable magnifications
No accessories facility with the loupes.	Accessories such as video cameras are present for case documentation.
Vision is not restricted.	Restricted area of vision and loss of depth.

Microsurgical instruments (1,8,9,10)

- The microsurgical instruments are of 15cms length to provide adequate hand control. The working tips of these instruments are much smaller than regular conventional instruments, approximately ten times smaller.
- These instruments are circular in cross section which allows for smooth rotation movements.
- The instruments are specially manufactured under magnification.
- Instruments with rectangular cross-section and smaller instruments do not allow precise manipulation and therefore, they are not ideal for microsurgery.
- Several types of ophthalmic knives such as the crescent, lamellar, blade breaker, sclera and spoon knife can be used in the field of Periodontics for microsurgical procedures.
- Micro mirrors with sapphire surfaces are used in microsurgery (Figure 5)

Hand control

- Physiologic tremor is the uncontrolled movement arising from both intended and unintended actions of our body or body part. Awareness of its effect is magnified by visual enhancement.
- During microsurgery, physiologic tremor manifests as a naturally occurring unwanted hand and finger movement.
- To minimize tremors, the clinician's chair position relative to the patient is an important consideration.
- A clinician's chair should have proper arm and hand support. Support of the ulnar surface of the forearm and wrist is necessary to control or reduce tremor.
- The clinician 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 clinician's head should be held in a comfortable upright position.
- In microsurgery, the hand should either directly or indirectly rest on an immovable surface or unwanted movements will occur so that only the fingertips move.
- A clinician must have a relaxed state of mind, good body posture with comfort, a well-supported hand support, and a stable instrument-holding position.

Hand grips (Figure 6)

- The most commonly used precision grip in microsurgery is the pen grip or internal precision grip, which gives greater stability than any other hand grip.
- The thumb and index and middle fingers are used as a tripod.
- When an instrument is held with the internal precision grip, the instrument can be opened and closed with very fine control.
- Any tremor resulting from the thumb or index finger is minimized by the steady middle finger.
- Accurate, exact hand movements with instruments of the correct length and design along with precision hand grips are important for good microsurgical results.

Microsurgical needles and sutures (1,8)

- An appropriate combination of properly selected needles and closure materials allows the surgeon to precisely position the suture and to approximate the tissue with as little trauma as possible while eliminating dead space and preventing movement of the wound.
- The availability of smaller needles demands the need of different types of finer sutures
- An accepted surgical practice in existing condition is selection of smallest sutures that adequately mend the tissues.

- Although 4-0 or 5-0 sutures are typically used in Periodontics, in periodontal microsurgery 6-0 and 7-0 sutures are appropriate.
- One of the three basic premises of microsurgery is attention to passive wound closure. The desired result is exact primary apposition of the wound edge.
- Ideally, the incisions should be almost invisible and closed with precisely placed, small sutures with minimal tissue damage and no bleeding.
- An ideal suture material is sterile, easy to handle, minimally reactive in tissue, resistant to shrinkage in tissues, and capable of holding securely when knotted without fraying or cutting.
- Ideally, the needle and the suture material should be the same size.
- Microsurgery uses needles of a fine-gauge material that are small to very small.
- Surgical needles are designed for maximum needle holder stability.
- Needle holder performance has a significant impact on the entire suturing procedure.
- The surgeon must have the utmost control of the needle sitting in the holder without the needle wobbling as it is passed through the tissue.
- Therefore, the needle holder must be appropriately sized for the needle and suture selected.

Suture Geometry (11,12)

- Suturing techniques are completely different in macrosurgery and microsurgery.
- 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.
- Only the working tips of the instruments are visible in the microscopic field.
- Microsurgery is therefore done by visual reference only, as the breaking force of micro sutures is often less than the human threshold of touch.
- Well-tied microsurgical suture knots are stable and resist loosening, even under functional loads.
- The art of microscopically tying a good surgeon's knot can only be mastered with repeated laboratory practice under the microscope.



Figure 1- Compound loupes mounted on eye-glasses



Figure 2- Prism loupes

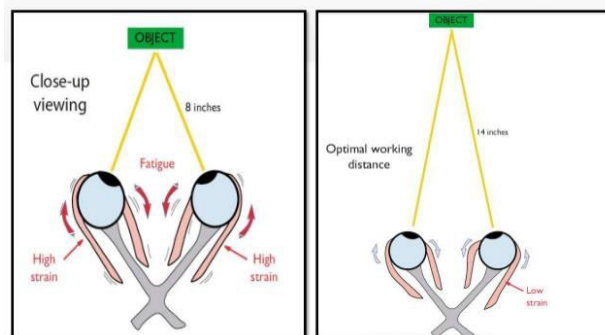


Figure 3 - Distance between the working field and the clinician



Figure 4- Surgical microscope



Figure 5- Micro mirrors with sapphire surfaces



Figure 6 - Pen grip or internal precision hand grip

Indications in Periodontal Surgery (13)

- Periodontal plastic surgery,
- Guided tissue regeneration (GTR),
- Cosmetic restorative
- Crown lengthening,
- Gingival augmentation procedures,
- Soft and hard tissue ridge augmentation,
- Osseous resection,
- Dental implant placement
- Guided bone regeneration (GBR) and other procedures where increasing the amount of bone needs special preparation forms of the soft tissue.
- Accurate split thickness flaps.
- Double papilla flaps.
- Apical or coronal repositioned flaps.
- Connective tissue grafts.
- Pedicle or sliding flaps.
- Microsurgical techniques are especially beneficial to mucogingival procedures.

Drawbacks of Microsurgery

- As we upgrade our surgical maneuvers with the aid of microsurgical concepts there are a few shortcomings of this modus operandi which need to be considered prior to its application.
- It is much more demanding and technique sensitive, the cost incurred to establish a microsurgical set-up is also high.

- Magnification systems used also pose some difficulties including restricted area of vision, loss of depth of field as magnification increases and loss of visual reference points.
- An experienced team approach mandates microsurgery and is time consuming to develop.
- Physiologic tremor control for finer movements intra-operatively and a steep learning curve are required for clinical proficiency.

Advantages over Conventional Surgery

- Cleaner incisions,
- Closer wound apposition,
- Reduced hemorrhage,
- Reduced trauma at the surgical site.
- Patient acceptance is more

Based on the microsurgical principles MIS (Minimally Invasive Surgery) was introduced. Further, MIST (Minimally Invasive Surgical Technique) followed by M-MIST (Modified Minimally Invasive Surgical Technique) were introduced. (14)

- Root preparation is an important modality in periodontal therapy.
- Lindhe & Nyman (1984) have suggested the success of periodontal therapy is due to the thoroughness of debridement of the root surface. (15)
- Furthermore, research demonstrates that root preparation is enhanced when performed under illumination (Reinhardt et al. 1985).
- The surgical microscope provides fiber optic lighting and magnification for calculus removal.

Studies

One of the study concluded that performing root coverage techniques microsurgically versus macrosurgically substantially improved the vascularization of connective tissue grafts and the percentage of additional root coverage (Burdhardt & Lang 2005). (16)

Sandro Bittencourt et al 2012, concluded that microsurgical and conventional surgical procedures were capable of producing root coverage, but use of surgical microscope was associated with additional clinical benefits in the treatment of teeth with gingival recession. (17)

Nizam et al 2015, evaluated the clinical results of micro and microsurgical approaches in the coverage of gingival recession using connective tissue graft and concluded that microsurgical approach is likely to preserve clinical outcomes longer than microsurgical approach for 2 years post operatively. The also found that healing was faster using microsurgery procedure, but aesthetic outcomes were similar in both approaches. (18)

Perumal et al 2015, compared the clinical outcomes of microsurgery with conventional open flap debridement in

patients with chronic periodontitis. The results of the study concluded that in open flap debridement procedure, a microsurgery can substantially improve the early healing index and induce less post operative pain compared to conventional microsurgery.(19)

A systemic review and meta analysis on Microsurgery for root coverage, by Kian Jian et al in 2015 compared the treatment approaches for root coverage with microsurgery and conventional surgery. This meta analysis concluded that using microsurgical technique may be effective in achieving complete root coverage for subepithelial connective tissue graft.(20)

Thankkappan et al 2012, compared 2 different types of root coverage procedures using periodontal microsurgical approach. It showed that use of microsurgical instruments helped to deliver precise incision , better visual acuity and improved illumination which facilitates to gain a better final outcome.(21)

Sweta singh et al. 2017, compared the root coverage of localized gingival recession using modified coronally advanced flap and root conditioning with 24% EDTA ethylenediaminetetraacetic acid when done under magnification and without magnification. They came to a conclusion that VAS visual analog scale scores were significantly lower in group where magnification was used for surgery at 3rd and 7th day post operatively, which says that microsurgery offers less pain and enhanced outcomes when compared to microsurgery or conventional surgical procedures.(22)

Onar Ucak et al 2017, evaluated the laterally moved coronally advanced flap technique (LMCAF-M) with magnified vision and using microsurgical instruments and compared it with conventional LMCAF-C in miller class III recession defects. The mean root coverage in LMCAF-M group was 97.64% while in LMCAF-C group was 90.48%. so the study indicates that performing LMCAF with microsurgical instrument offers definite advantages in terms of complete root coverage and mean root coverage decreased post operative morbidity and increased acceptance by patients.(23)

Microsurgery in implant therapy

- One of the novel applications of microsurgery is in the sinus lift procedure. The surgical microscope can aid in visualization of the sinus membrane.
- Magnification achieved by the surgical microscope is instrumental in implant site development and placement.
- All phases of implant treatment may be performed using a microscope.
- With a microscope, very small surgical openings are used
- Large incisions, stitches, and pulling back flaps of tissue is avoided
- Reduced trauma minimizes pain, swelling and bleeding

- More precise implant positioning is accomplished
- Microsurgery is a safe and proven approach using local anesthesia

Dennis A Shanelec in 2011, based on case presentations, Used a newly developed microsurgical approach, the SMILE (Simplified Microsurgical Implant Lifelike Esthetics) Technique, with successful outcome of 298 of 300 cases. The success is attributed to microsurgical precision associated with this technique. The goal of this technique report is to establish some of the benefits and versatility of dental implant microsurgery and the SMILE Technique for these esthetically challenging situations. He concluded that with the SMILE technique, a clinician has an orderly treatment sequence for providing immediate implant placement and provisionalization. It results in excellent esthetics , as well as predictable success of dental implant osseointegration. (24)

CONCLUSION

- Microsurgery offers possibilities to improve therapeutic results of various procedures. A number of periodontal and implant reconstructive procedures can be performed using minimally invasive approaches.
- Microsurgical periodontics is technique-sensitive and more demanding than periodontal macrosurgery, but it results in more rapid healing because it is less invasive and less traumatic.
- The improved visual acuity and ergonomics provide significant advantages to those who take the time to become proficient in microsurgical principles and procedures.
- The operating microscope allows the surgeon to practice enhanced, precise, delicate surgical procedures that have important healing processes and outcomes for patients.
- Periodontal microsurgery and periodontal plastic microscopic surgery provide a natural evolution in the progression of periodontics.
- It is a skill that requires practice to achieve proficiency.
- The small scale of microsurgery presents special challenges in dexterity and perception.
- Its execution is technique sensitive and more demanding than are conventional periodontal procedures.
- Microsurgery offers new possibilities to improve periodontal care in a variety of ways.

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