Review Article

Applications of Microsurgery in Periodontics

S. Harini, T. Siji Jacob, Rajasekar Sundaram

Department of Periodontics, Rajah Muthiah Dental College and Hospital, Annamalai University, Chidambaram, Tamil Nadu, India

ABSTRACT

Periodontal microsurgery is an advance in the field of periodontal surgical procedures. It has been described as the methodology where there is modification and refinement of the existing surgical procedure with the use of magnification to improve visualization and has implications and applicability to all specialties. The criteria for the success of the treatments performed to improve esthetics may be different compared to the surgical procedures where the main goal is to improve periodontal health and restore the function. Therefore, the use of the surgical microscope in periodontal surgery is less documented with only few studies addressing the advantages of the application of magnification to periodontal surgery. The resource for the article was obtained through search in the web with the inclusion of case reports and comparative studies. This article presents an overview of magnifying tools available and their applications in periodontics.

KEYWORDS: *Loupes, magnification, microsurgery, minimally invasive surgery, periodontal microsurgery, surgical microscope*

Received: 10-12-2021.
Decision: 13-12-2021.
Accepted: 15-12-2021.
Published: 08-02-2022.

DEFINITION

Periodontal microsurgery is defined as the refinement of basic surgical techniques by the improved visual acuity with the use of surgical microscope. Daniel,[1] in 1979 defined microsurgery as surgery performed under magnification by the microscope. The word microscope comes from Greek word MICROS means small; SKOPEIN means to view.

HISTORY

Apotheker and Jako introduced surgical operating microscope (SOM) to dentistry in 1978.[2] In an article by Carr *et al*. in 1992, the advantages of using surgical microscope during endodontic procedures were described. It was postulated by Shanelec and Tibbetts in 1992 that the microscope could provide more precision in periodontal surgery and patients had less pain postoperatively when using microsurgical techniques.

RATIONALE

- Microsurgical instruments allow, to reduce the size of the operating field
- Microscope allows to avoid certain incisions altogether, contributing to a better blood perfusion of the tissue
- The blade edges are sharper, and the surface texture is smoother, resulting in perfect incision
- Inflammation, oedema, post-operative pain, healing time, as well as the risk of scarring are reduced
- Reduced bleeding, better vision, comfortable posture, better results, contribute to the improved surgical environment.[3]

PRINCIPLES

- Improved motor skills and enhanced surgical ability
- Passive wound closure with exact primary apposition of the wound edge
- Reduced tissue trauma.[4]

Microsurgery is based on three important elements which form the microsurgical triad that includes magnification, illumination, and instruments [Figure 1].

Access this article online

Quick Response Code:

Website: www.ijofb.org

DOI: 10.4103/ijofb.ijofb_2_21

Address for correspondence:
Dr S. Harini,
Department of Peridontics, Rajah Muthiah Dental College and Hospital, Annamalai University, Annamalai Nagar, Chidambaram, India.
E-mail: harinisharma96@gmail.com

How to cite this article: Harini S, Jacob TS, Sundaram R. Applications of microsurgery in periodontics. Int J Orofac Biol 2019;3:1-7.

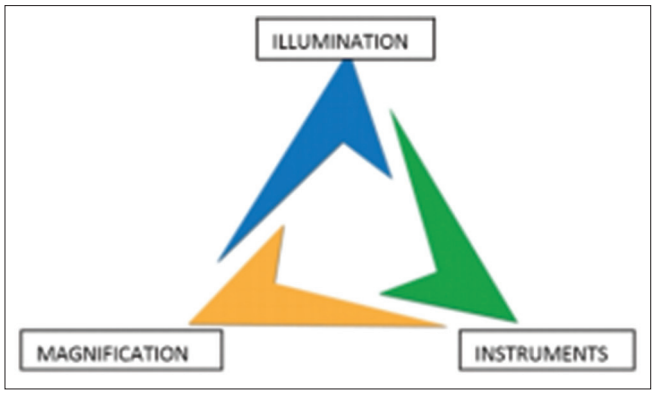

Figure 1: Microsurgical triad

Magnification

Magnification involves defining the following terms:

The power of magnification

The ability of the lens to increase the visual size of the object. The power of magnification is measured in terms of x. If a magnification is ×4, it means that the object appears four times larger.

Working distance of the focal length

The distance measured from the eye lens location to the object in vision. The less the amount of space between the object and the magnifier the shorter is the working distance and higher is the power of the microscope.

Field of view

The area of the object that can be seen through the microscope. It represents the width and height of the area seen. Higher the magnification, smaller the width of field.

Depth of field

It is the distance that a magnifier can be moved and still have the object in focus. The higher the power, the shorter the depth of field.[4]

Types of magnification

a. Magnification loupes
b. SOM.[5]

Magnifying loupes

Surgical loupes enable to experience the ergonomic benefits of an increased working distance and improve visual acuity. Keplerian optical system uses a pattern of convergent lens. It is of three types which are commonly used in periodontics [Figure 2 and Table 1]:

i. Simple loupes
ii. Compound loupes and
iii. Prism loupes.[2]

Simple loupes

Simple loupes are primitive magnifiers with limited capabilities. It consist of a pair of side-by-side positive meniscus lenses[6] limited to only two refracting surfaces. When there is increase in lens diameter and thickness, the magnification is increased. Simple loupes are not used for magnification beyond ×1.5 because of its size and weight. They are affected by spherical and chromatic aberration which distorts the shape and color of objects being viewed.[4]

Compound loupes

Compound loupes use converging multiple lenses with intervening air spaces to gain additional refracting power, magnification, working distance, and depth of field. These loupes can be adjusted to clinical needs without excessive increase in size or weight. They can be achromatic, in addition to offering substantially improved optical design, making such lenses a desired feature by dentist. Compound loupes are commonly mounted in or on eyeglasses.[6]

Prism loupes

Prism loupes are the most optically advanced type of loupe magnification presently available. They contain Schmidt or roof-top prisms which lengthen the path of light through minor reflections within the loupes, resulting in the light folding thereby, the barrel of the loupe can be shortened. Better magnification, wider depths of field, longer working distances, and larger fields of view are produced by these loupes than other types. Eyeglass or headband-mounted prism loupes can be used but at magnifications >3.0 diameters, headband-mounted loupes are more comfortable and stable. Only the surgical microscope can provide better magnification and optical characteristics than prism loupes.[6]

Surgical Operating Microscope

The surgical microscope consists of a system of lenses that allows stereoscopic vision at a magnification of approximately ×4–40 [Figure 3]. Operating microscopes are designed on Galilean principles. During the use, 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.[4] A basic surgical microscope should have the following configuration: Kim *et al*. 2001:

- ×12.5 eyepieces with reticule
- 200- or 250- mm objective lens
- 180° inclinable binocular
- Five-step manual magnification changer or power zoom magnification changer
- Fiber-optic illumination system
- Audiovisual accessories.[6]

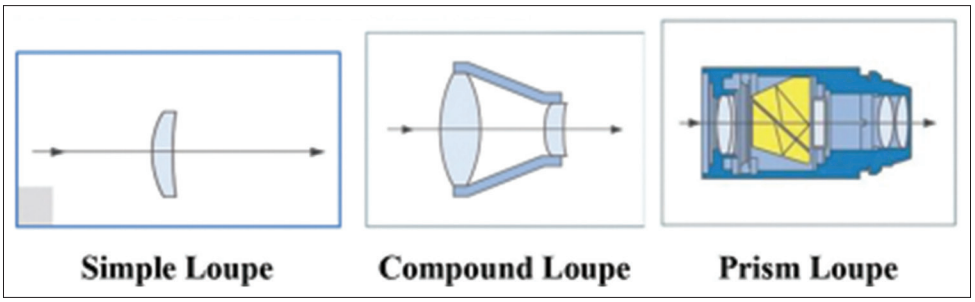

Figure 2: Types of loupes[2]

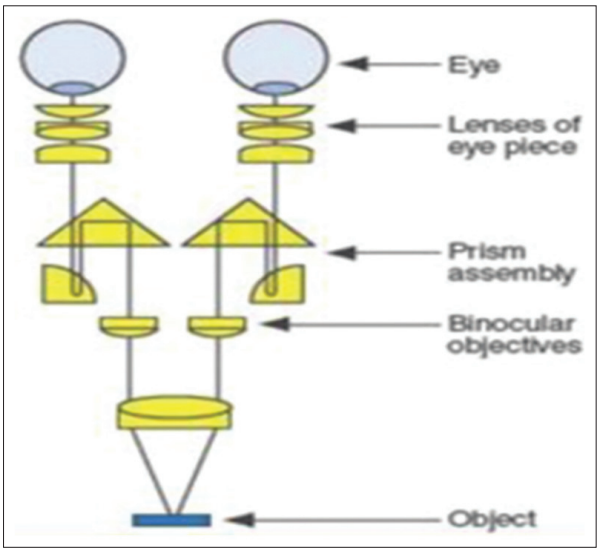

Figure 3: Surgical microscope[2]

Figure 4: Microsurgical knives[2]

Illumination

When loupes are used, each surface refraction occurring through the lens results in 4% loss of transmitted light and 50% reduction in brightness unless antireflective coatings are used. In microsurgery, coaxial fiber-optic illumination is used, which is bright, uniform, shadow free, and can be adjusted and has a circular spot of light. These light sources can be attached to handpieces, instruments, or loupes. Removing deposits in moderate to deep periodontal pockets can be efficiently done with fiber-optic illumination. Recently, the use of halogen lamps has also gained importance.[4]

Instruments

An important characteristic of microsurgical instruments is their ability to create clean incisions and closure that causes wound healing by primary intention. A periodontal microsurgery instrument kit consists of:

- Knives and scalpel blades
- Micro scissors
- Anatomic and surgical micro forceps
- Micro needle holder
- Micro scalpel holder.[4]

Knives

The characteristics of these knives are extreme sharpness and small size which enables precise incisions and maneuvers in small areas [Figure 4].[1]

- Blade breaker knife
- Crescent knife
- Mini crescent knife
- Spoon knife
- Lamellar knife
- Scleral knife.

Suture needle anatomy

Microsurgery needle is a fine-gauge material that is small to very small. Needle holder performance has a significant impact on the suturing procedure. One should have the control of the needle as it is passed through the tissue to prevent wobbling. Therefore, the needle holder must be appropriately sized for the needle and suture selected.[7]

Suture geometry

- Needle angle of entry and exit of slightly <90°
- Suture bite size approximately 1.5 times the tissue thickness
- Equal bite sizes on both sides of the wound
- Needle passage perpendicular to the wound.[7]

Table 1: Comparison between loupes[2]

Simple loupes	Compound loupes	Prism telescopic loupes
Pair of single meniscus lenses	Multiple lenses with intervening air spaces to gain additional refracting surfaces	Schmidt or "rooftop" prisms to lengthen the light path through a series of switch back mirrors between the lenses
Magnification can only increase by increasing lens diameter and thickness	Magnification can be increased by lengthening the distance between lenses, without excessive increase in size or weight	
Greatly affected by spherical and chromatic aberration	Can be achromatic.	Achromatic
Impractical for magnification beyond 1.5x	Inefficient at magnifications above 3x	Better magnification, wider depth of field, longer working distances, and larger fields of view.\

Knot tying

Knot tying with 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.[7]

Microsurgery in Periodontics

The SOM enhances visual acuity which leads to:

- Increased precision in delivery of surgical skills, which results in more accurate incisions which leads to less trauma, and quicker postoperative healing
- Precise repositioning of tissues
- Improved view of root surfaces, which permits definitive removal of calculus and improved smoothness of the root.[4]

Microscopes in Scaling and Root Planing

Effective removal of plaque and calculus determines the success of periodontal treatment and the control of the disease. Furthermore, research demonstrates that root preparation is enhanced when it is performed with magnification.

Watchtel *et al*. in 2003 concluded that the amount of residual calculus on root surfaces treated by scaling and root preparation was less on those treated with surgical access. Peter Kotschy in 2010 used microscope with a magnification of 15× to 20× combined with kinetic glass bead blasting for the treatment of periodontal conditions and reported with excellent results.[4]

Microscope in Periodontal Plastic Surgery

Periodontal plastic surgery is an important aspect of periodontal practice. The two basic periodontal procedures in which periodontal microsurgery can be applied is related to the level of the dento-gingival junction and to the edentulous ridge.[4]

Correcting Gingival Recession

Periodontal plastic microsurgical reconstruction of gingival tissue over denuded roots can be routine and predictable using sub-epithelial connective tissue grafting.[4] Francetti *et al*. 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. Compared the macro and microsurgery techniques for root coverage using a coronally positioned flap with enamel matrix derivative (EMD) and observed a statistically significant increase of width and thickness of keratinized tissue in test group.[4]

Establishing an Esthetic Smile Line

An abnormal smile line results from a number of causes, including gingival recession, abnormal eruptive patterns, incisal wear, and excessive tissue growth of various etiologies. An ideal esthetic smile can be created with its harmonious gingival contours, symmetry, lip position, and gingival levels of adjacent teeth. W. Peter Nordland (2002) discussed the role of periodontal plastic microsurgery in oral facial esthetics and concluded that periodontal plastic microsurgery plays a significant role in oral facial esthetics.[4]

Restoring the Edentulous Ridge

Ridge augmentation involves a variety of techniques using microsurgery, 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 a dental implant prosthesis.[4]

Heiland *et al*.,[8] assessed the effect of navigated implantation after bone transfer using microsurgery with cone beam computed tomography (CBCT) data. In case 1, a 78-year-old patient underwent maxillary augmentation using a microvascular re-anastomosed

fibula flap. After 7 months, six implants were inserted in the fibula, and four in the edentulous mandible. The implants were exposed and dentures were fixed on the implants with Steco magnetic abutments after 6 months. In case 2, a 41-year-old patient required radiotherapy and multiple reconstructive procedures. The results showed that, in both patients, successful implant placement was achieved leading to rehabilitation. The authors concluded that, CBCT data are sufficient for the planning of implant positioning.

In Interdental Papilla Reconstruction

Microsurgical techniques were developed to replace the lost interdental papilla which can create phonetic problems, saliva bubbles, and cosmetic deficiencies. A papillary deficiency can be caused through iatrogenic surgical removal, as part of tissue collapse, with periodontal pocket elimination, periodontal bone loss, and orthodontic separation of overlapped teeth. Success in the treatment of black triangle with microsurgery is a significant leap in the field of perioesthetics, making it a realistic possibility.[9]

Velvart *et al*.,[10] conducted a study to compare long-term loss of papilla height when using either the papilla base incision (PBI) or the standard papilla mobilization incision in full thickness flap procedures in the absence of marginal periodontitis. The surgical procedure was accompanied with microsurgical sutures. The results showed that, after 1 month of flap surgery with complete elevation of papilla, papilla recession took place and after 3 months, there was small increase in loss of papilla height. After 1 year the loss of height was diminished. It was concluded that, the opening of the interproximal space can be prevented by using PBIs and microsurgical sutures.

In Periodontal Flap Surgery

Flap reflection in periodontics is done to gain exposure of the underlying tissues. The flap margins can be elevated uniformly with microsurgery which results in precise adaptation of the tissue by eliminating the gaps and dead spaces providing new tissue formation and enhancing periodontal regeneration.[9]

Fickl *et al*.[11] conducted a study to evaluate the effect of microsurgery for the treatment of intra-bony defects with and without an EMD. Seventy intra-bony defects were assigned randomly to a microsurgical access flap with application of EMD (test group) and on the contralateral side to a microsurgical access flap alone (control group). The results showed that, the test group yielded statistically significantly more clinical attachment level (CAL) gain, probing pocket depth (PPD) reduction, and radiographic bone fill than the control group. The authors concluded that, the combination of a microsurgical access flap with EMD seems to be superior to open flap debridement.

Crown Lengthening Using Microsurgery

Periodontal microsurgery is the transition from conventional surgical principles in which the microscope is used to permit the most accurate, atraumatic handling of tissue to enhance wound healing.[12]

McNeely[13] presented case report on coronally repositioning the cemento-enamel junction to address gingival margin discrepancies. These discrepancies in the esthetic zone can be treated with surgical clinical crown lengthening and orthodontic tooth. Three cases were presented, where the surgical technique used was the same for all cases. It involved obtaining connective tissue from the palate and placed in a surgically created pouch by using microsurgical techniques so that the exposed root surface was covered with connective tissue, resulting in a coronal movement of the gingival margin. The authors concluded that, this technique is predictable, less complicated, and less time-consuming to carry out when compared with other options.

In Root Visualization and Preparation

Success of periodontal therapy depends on visual access to the root surface, treating the pathologically altered root surface, and achieving a clean and smooth root surface.[9] Lindhe *et al.* suggested that the critical determinant for the success of periodontal therapy is the thoroughness of debridement rather than the choice of grafting modality. Because stereomicroscopy is used to evaluate residual calculus, it seems logical that a SOM can enhance the operator's ability to see and remove calculus *in vivo* and enhances periodontal regeneration.[1]

Microsurgery in Minimally Invasive Surgery Technique

Harrel in 1999[1] introduced MIS. This approach was described by Hunter and Sackier in 1993 described as "the ability to miniaturize our eyes and extend our hands to perform microscopic and macroscopic operations in places that could previously be reached only by large incisions." The major difference between the minimally invasive approach and conventional approaches is the use of smaller incisions to gain surgical access and debride the periodontal defect before placing the bone graft and membrane.[14]

Cairo *et al*. combined preservation of the still-attached gingival fibers and maintenance of the body of the interdental papilla using microsurgical flap access for the treatment of shallow to moderate bony defects in the esthetic zone. The results showed that the use of the microsurgical approach helped to minimize marginal tissue recession and improve esthetics.[12]

Microsurgery in Implant Therapy

Microscopes can be used for all phases of implant treatment.[4] This was discussed in 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.[4]

One of the novel applications of microsurgery is the sinus lift procedure. The surgical microscope can aid in visualizing the sinus membrane. Magnification achieved by the surgical microscope is instrumental in implant site development and placement.[1]

Advantages of Microsurgery

- Rapid and comfortable healing phase
- Improved visual acuity and ergonomics
- Cleaner incisions obtained
- Reduced hemorrhage
- Reduced trauma
- Closer wound apposition
- Healing occurs by primary intention
- Endpoint appearance of the tissues is superior[1]
- Less patient anxiety
- Minimally invasive
- Increased effectiveness of root debridement results in greater predictability of regeneration procedures and cosmetic procedures
- Improved documentation.[4]

Disadvantages of Microsurgery

- Surgical technique and understanding of optics
- Long adjustment period
- Initial increased surgical time
- Expensive
- Limited surgical access.[4]

Wound Healing in Microsurgery

Microsurgery encourages repair through primary intention, which is rapid and requires less formation of granulation tissue. Wound healing studies has shown anastomosis of microsurgical wounds within 48 hours. Secondary wound healing is slower than primary wound healing because of the formation of new tissue to fill voids at the edge of the partially closed wound. Because there is less surgical trauma, less cell damage and necrosis occurs, resulting in less inflammation and reduced pain.[4]

Future Perspectives of Microsurgery

Robotic microsurgery is taking over minimally invasive techniques. The delicate steps are performed with the system that control instruments from 10 feet away inserted through small incisions. The surgeon manipulates the tele robot by watching the operation through a three-dimensional video and is able to witness the precision delivered. It can complete each step of the complex operation which was previously impossible. Future research is required to incorporate this technique in dentistry.[15]

Conclusion

The magnification systems have been very useful for the surgeon in many specialties.[16] The advantages afforded to the patient by minimally invasive techniques results in minimizing trauma while still achieving therapeutic aims.[17] The microscope provides a detailed and precise amounts of information for the diagnosis and treatment with skill and accuracy.[18] Magnification is slowly becoming the standard of care in dentistry in the near future.[19] In long term, microsurgery leads to improved esthetics, rapid healing, reduced morbidity, and enhanced patient acceptance.[20,21] Its execution is technique sensitive and is thereby more demanding than conventional periodontal procedures.[22] This method improves existing surgical practice and initiates the possibility for better patient care to the field of periodontology.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Wagh PP, Jayashree A. Periodontal microsurgery: Evolution in progression of Periodontics. Glob J Res Anal 2017;6:70-4.
2. Deepa D, Mehta D, Munjal V. Periodontal microsurgery – A must for perio-aesthetics. Indian J Oral Sci 2014;5:103.
3. Sitbon Y, Attathom T. Minimal intervention dentistry II: Part 6. Microscope and microsurgical techniques in periodontics. Br Dent J 2014;216:503-9.
4. Jain R, Kudva P, Kumar R. Periodontal microsurgery – Magnifying facts, maximizing results. J Adv Med Dent Sci Res 2014;2:24-34.
5. Serafin D. Microsurgery: Past, present, and future. Plast Reconstr Surg 1980;66:781-5.
6. Ramesh A, Upadhyay A. Microsurgery – Periodontics magnified! J Soc Periodontists Implant Kerala 2013;7:36-40.

7. Tibbetts LS, Shanelec DA. A review of the principles and practice of periodontal microsurgery. Tex Dent J 2007;124:188-204.
8. Heiland M, Pohlenz P, Blessmann M, Werle H, Fraederich M, Schmelzle R, *et al.* Navigated implantation after microsurgical bone transfer using intraoperatively acquired cone-beam computed tomography data sets. Int J Oral Maxillofac Surg 2008;37:70-5.
9. Sachdeva S, Goyal J, Jaiswal VR, Gill S, Chaudhry S, Kochar D. Periodontal microsurgery: A leap in surgical intervention. Saint's Int Dent J 2015;1:78.
10. Velvart P, Ebner-Zimmermann U, Pierre Ebner J. Papilla healing following sulcular full thickness flap in endodontic surgery. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2004;98:365-9.
11. Fickl S, Thalmair T, Kebschull M, Böhm S, Wachtel H. Microsurgical access flap in conjunction with enamel matrix derivative for the treatment of intra-bony defects: A controlled clinical trial. J Clin Periodontol 2009;36:784-90.
12. Hegde R, Padhye A, Sumanth S, Jain AS, Thukral N. Comparison of surgical stripping; erbium-doped: Yttrium, aluminum, and garnet laser; and carbon dioxide laser techniques for gingival depigmentation: A clinical and histologic study. J Periodontol 2013;84:738-48.
13. McNeely TE. Coronally repositioning the cemento-enamel junction to address gingival margin discrepancies. J Periodontol 2005;76:138-42.
14. Prabu RC, Madhumala R, Saranyan N, Sayeeganesh. Periodontal microsurgery : A review. Indian J Appl Res 2017;12:149-51.
15. Dadwal A, Kaur R, Jindal V, Jain A, Mahajan A, Goel A. Comparative evaluation of manual scaling and root planing with or without magnification loupes using scanning electron microscope: A pilot study. J Indian Soc Periodontol 2018;22:317-21.
16. Daniel RK. Microsurgery: Through the looking glass. N Engl J Med 1979;300:1251-7.
17. Tibbetts LS, Shanelec D. Current status of periodontal microsurgery. Curr Opin Periodontol 1996;3:118-25.
18. Beckler AD, Blackwell KE. "Principles of Microvascular Surgery," Oral, Head Neck Oncol. and Reconstr. Surg. 2018.
19. Lee DC. Acland's practice manual for microvascular surgery. Arch Plast Surg 2012;39:575.
20. Durrani AF, Preminger GM. Three-dimensional video imaging for endoscopic surgery. Comput Biol Med 1995;25:237-47.
21. Medot M, Nelissen X, Heymans O, Adant JP, Fissette J. Video-microsurgery: A new tool in microsurgery. Br J Plast Surg 1999;52:92-6.
22. Franken RJ, Gupta SC, Banis JC Jr., Thomas SV, Derr JW, Klein SA, *et al.* Microsurgery without a microscope: Laboratory evaluation of a three-dimensional on-screen microsurgery system. Microsurgery 1995;16:746-51.