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Periodontal Microsurgery: A Boon for Precision

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ABSTRACT

The surgical operating microscope increases illumination and visual acuity for the periodontist to perform clinical procedures with improved precision over conventional surgeries. Presently, using a surgical microscope gives an impression of being the best option which helps in better diagnostic ability and treatment quality. This review highlights the basics of periodontal plastic surgery, including the role of magnification and microsurgical instruments, knot tying, clinical applications, and microsurgical effects on aesthetics. This mini-literature review infers that improved visual acuity of microsurgery provides significant advantages of less patient discomfort, rapid healing, improved esthetics, and patient compliance. Periodontal microsurgery combined with minimally invasive surgical techniques benefits the ability of a clinician's precision in manipulating the tissues, thereby offering the simplest and the best probable outcome.

Keywords: Microsurgery, Magnification, Surgical Microscope, Illumination, Periodontal Surgery.

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The participation of each author corresponds to the criteria of authorship and contributorship emphasized in the Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly work in Medical Journals of the International Committee of Medical Journal Editors. Indeed, all the authors have actively participated in the redaction, the revision of the manuscript, and provided approval for this final revised version.

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INTRODUCTION

The development in technology has improved our understanding of the etiopathogenesis, diagnosis, and treatment modality to perform a simple, minimally invasive surgical procedure to obtain better outcomes. Hence, the concept of microsurgery came into practice in 1993 in periodontics. Magnification achieved with loupes or surgical microscopes is widespread in medical and dental practice; however, its usage in periodontics needs to be broadened. This dilemmatic condition for its use in their daily practice may be because of a lack of didactic studies showing benefits or owing to a lack of familiarity with the surgical operating microscope [1]. The potential for treating periodontal tissues increases with the use of an operating microscope and microsurgical instruments by elevating the ability of a clinician to handle it. The success of surgical and non-surgical periodontal therapies, especially periodontal plastic surgeries and implant therapy, has been revolutionized by the use of magnification [2].

Microsurgery basically uses tools called the operating microscope or high-powered loupes, which aids in the precision technique outcome. At this juncture, the "criterion standard" of performing microsurgery is under the microscope, which is used diligently. Leknius and Geissberger have shown a direct relationship between magnification and significantly enhanced performance of technique-sensitive dental procedures. However, some published articles embrace the benefits of magnification. Hence, the present mini-review discussed the efficacy of surgical microscopes and microsurgical instruments for their clinical usage in managing periodontal diseases [2].

History of Evolution

The evolution of magnification from a simple meniscus lens to the presently known operating microscope has been a long journey. Modern periodontology is linked to periodontal plastic surgery and esthetic dentistry. The timeline of evolution is shown in Table 1 [3,4].

Definition and Terminology

A surgical procedure performed under a microscope is called microsurgery. Broadly, it can be defined as "the surgery performed under the magnification provided by the operating microscope," given by Daniel RK in 1979. As defined by Serafin in 1980, microsurgery is

Table 1: The timeline of evolution

SL. NO	YEAR	PROPOSED BY	FIELD
1.	2800	Egyptians	Simple glass meniscus
2.	19TH century		Field of medicine
3.	1921	Carl Nylen	Microscope for operating ear surgery
4.	1950	Barraquer	Corneal surgry
5.	1960	Jacobsen Suarez	Microvascular anastomosis
6.	1964	Antonvan Leuwenhook	Compound microscope
7.	1978	Apothekar Jako	Dentistry
8.	1992	Carr	Endodontics
9.	1993	Shanelec Tibbets	Periodontics

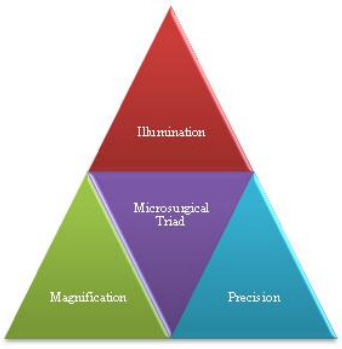

Figure 1: Pictorial depiction of Microsurgical Triad.

a methodology that assures modification and refinement of existing surgical techniques using magnification to improve visualization, with applications to all specialties [3,4].
The working principle of the microscope used in dentistry is based on co-axial illumination [3,5]. Working of a surgical operating microscope is listed under the following headings- magnification, illumination, documentation, accessories [5,6].

MAGNIFICATION

Magnification is determined by the power of the eyepiece, focal length of binoculars, magnification change factor, and focal length of the objective lens.

Magnification changer

The magnification changer is located in the head of the microscope. It is available in two forms, such as three or five steps manual changers or power zoom changers. (Figure 2 a) Magnification in the range of 2.5x to 30x is usually recommended [2,5]. The lower magnification (2.5x to 8x) is used for orientation to the surgical field and allows a wide field of view. Midrange magnification (10x to 16x) is used for operating. High range magnifications (20x to 30x) are used for observing fine detail. [6].
The equation for calculating total magnification [5]

$$MT = fT \times Me \times Mc$$

Where MT= total magnification, fT= focal length of the binocular tube, fO= focal length of the objective lens, Me= magnification of the eyepiece, Mc= magnification factor

Objective lens

It forms an image of the object processed by the magnification changer while projecting illumination from the light source onto the field of view (Figure 2 b). Ideally, an objective lens with a focal length of 200 to 250 mm should be used [2,5]. However, in periodontal surgery, a focal length of 200 to 300 mm can be used [6].

Binocular tube

The conventional binocular tube contains two inverting prisms that rectify the inverted image produced by the objective lens and collected by the lenses in the end region of the tube [2] (Figure 2 c) wherein, straight and inclined binocular tubes are available which are positioned either parallel or inclined at 45- degree angle to the axis of the microscope [5,6].

Eyepieces

The role of eyepieces or ocular lenses is to magnify the intermediate image generated in the binocular tube [2]. Eyepieces with magnification factors of l0x to 20x are available for operating microscopes (Figure 2 d). They can achieve 3x to 40x total magnification, but in dentistry, magnification ranging from 4x to 24x is generally used [5,7].

ILLUMINATION

Illumination shows the path that light takes as it travels through the microscope (100W halogen bulb). A rheostat controls the light intensity, and a fan cools the lamp. The pathway of the reflected light follows through a condensing lens to a series of prisms and then to the surgical field through the objective lens. The important things to contemplate are- eye-to-object distance, light sources, coaxial illumination, parfocality, and beam splitter [5,6,7].

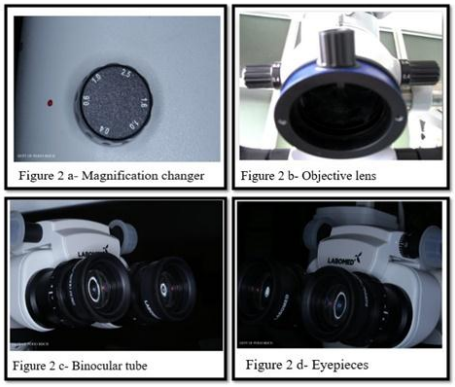

Figure 2: Diagrammatic representation of parts of Microscope.

DOCUMENTATION

The purpose of documentation is to communicate with the referring dentist, educate patients and students and maintain the record of each case. It requires a video adapter, video camera, and video printer. The advancements in the documentation include a three-dimensional view of the surgical field on a video monitor and an HDTV single camera. [3] The charged coupled device sensors in the camera require less light than 35mm film for capturing digital images. Therefore, photos of the surgical field can be taken even without illumination with the flashlight. [5] This prevents the shadowing and vignetting of digital images. It also has the added advantage of assessing the images immediately and, if necessary, deleting the image and retaking the photograph. [6]

Using a video adapter by attaching video cameras to the beam splitter, direct photos and video can be documented. These adapters provide the necessary focal length, thereby providing the same magnification and field of view on the monitor as seen by the surgeon. [7] The most important thing to consider is the resolution of the video camera which should match the recording capability of the video cassette recorder and the resolution of the video monitor. [5] By documenting every case through the microscope, real-time surgeries of all kinds of procedures and techniques can be accessed by the students and practitioners. In the field of teaching and learning, the use of a microscope and documentation has become the single most important development. [4]

Digital documentation capabilities enhance the clinician's ability to efficiently capture surgical procedures of the patient with greater rates of acceptance, thereby increasing the patient's level of reliance and time required. [6]

Principles of Microsurgery

It embraces three key points-

- Enhancement of motor skills for increased precision.
- Reduces surgical field and decreases tissue trauma.
- Superior wound healing [4].

Microsurgery is steadily gaining acceptance among periodontists, the reason being not reduced morbidity. Rather the end-point therapeutic appearance of microsurgery is simply superior compared to that of conventional surgery. The difference is clearly shown in cleaner précised incisions, better closer wound apposition, reduced hemorrhage and tissue trauma at the surgical site [4,8,12].

Microsurgical Instruments

Specific instruments and sutures are used to carry out the microsurgical techniques [10]. Titanium made is superior to stainless steel instruments. However, stainless steel is more

popular as it provides a greater degree of hardness and flexibility [5]. The specifications of these are shown (Table 2).

Table 2: Specifications of microsurgical instruments [6].

Sl. No.	Specifications	Features	Advantages
1.	Design	Top-heavy	précised work and fine motor control
2.	Cross-section	Circular	allows secure rotation between digits
3.	Length	18cm	held securely
4.	Weight	15-20g	avoid fatigue of hand and arm muscles
5.	Color coating	Coated	avoid reflection from light of microscope
6.	Material	Titanium/ steel	stronger, lighter, and non-magnetized

Ophthalmic knives

Offer the dual advantages of being small and extremely sharp to produce a more precise wound edge and better treatment outcomes than standard no. 15 blade. [11,13,14] (Figure 3 a) [3] [15]. The various types of microsurgical knives used are as follows [13,14,15] (Table 3).

Table 3: Types of microsurgical knives used.

Sl. No.	Types	Specifications
1.	Blade-breaker knife	used in place of a no. 15 blade
2.	Crescent knife	intrasulcular incisions, connective tissue graft procedures
3.	Spoon knife	undermine the flap

Needle holders

They are available in various sizes and are designed to grasp very fine needles. They have smooth jaws to give a simple and controlled knot. The most commonly used needle holder is 14 cm and 18 cm [11] (Figure 3 b). The tip of the needle holder should be 1-mm for 5-0 and 6-0 sutures, whereas 0.3 mm for suturing 8-0 and 10-0 sutures [5,6,16].

Microsurgical needles and sutures

Needles have high flexural and ductile strength to prevent breakage. Curved needles are easier to enter into tight spaces. So, needles with 3/8 or ½ curve circular and arc length of 8-15 mm are preferred to use in periodontal surgery [5,10]. Needles with a range of 6-0 to 9-0 are frequently used. According to length, 13–15-mm, 10–12-mm, 5–8 mm long needles are considered for posterior areas, anterior region, and for vertical incisions, respectively [5]. The commonly used suture sizes are 5-0, 6-0, and 7-0, either absorbable or non-absorbable type [9].

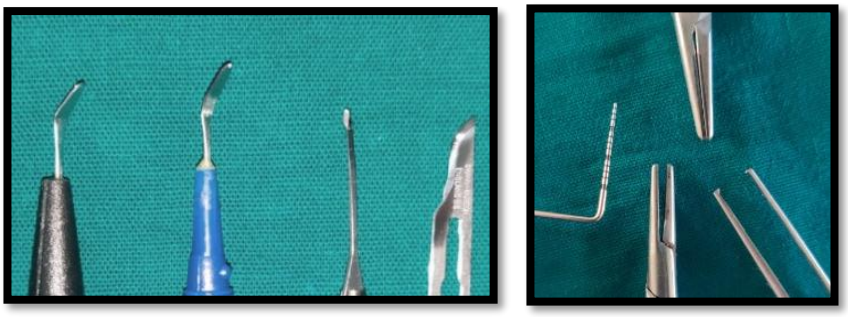

Figure 3: Microsurgical instruments.

Microsurgical knot tying

Knot tying using the microscope is done using instrument ties, with a microsurgical needle holder in the dominant hand and microsurgical tissue pick-up in the non-dominant hand. Three common techniques are used- non-dominant, dominant, and a combination of two; however, non-dominant and combination are the most commonly used. A surgeon's knot followed by a square knot is the preferred knot combination.

Applications of Microsurgery in Periodontics

Periodontal microsurgery is the descendant of conventional periodontal therapy to reduce surgical trauma and open the horizons for better patient care [9,17]. Table 4 outlines the various studies done under a microscope in chronological order.

Table 4: Studies showing the clinical applications of microsurgery.

Clinical application	Aim of the study	Conclusion
Diagnostic procedures 2009	The study was done with the use of high-powered magnification or microscopes in general dentistry [30].	It elaborates on specific general dental applications for high-powered magnification in different fields of dentistry.
Non-surgical periodontal therapy 2005	The study was done on the exposed root surfaces for enhanced periodontal debridement using micro ultrasonics and periodontal endoscopy [39,46].	Endoscopic technology enhances visualization and debridement of the roots in a minimally invasive way.
Management of periodontal flaps 2009	The study assessed the regeneration of lost periodontal tissues using microscope [12].	It concluded the use of a surgical microscope offers definite advantages in terms of increased acceptance, improved visual acuity; superior approximation of wounds, rapid wound healing, and decreased postoperative morbidity.
Regenerative therapy 2021	A study was done to treat intrabony defect using periodontal minimally invasive surgery (MIST) with and without the use of regenerative materials [48].	It is concluded that MIST is an effective treatment for intrabony defects with the use of regenerative materials**.**
Mucogingival surgery 2004	Treatment of gingival recession using microsurgery by free rotated papilla autograft technique combined with the coronally advanced flap [40].	Statistically significant root coverage without additional second surgical site and reducing patient morbidity. Microscopes permitted less traumatic and minimally invasive procedures. Both groups showed convincing improvement in clinical parameters.
2018	Comparative evaluation of treatment of localized gingival recessions with coronally advanced flap using microsurgical vs conventional techniques [49].	Microscopes permitted less traumatic and minimally invasive procedures. Both groups showed convincing improvement in clinical parameters.
Implant therapy 2021	A study was done to treat peri-implant osseous defects using papilla preservation and minimally invasive surgery, a 5-year retrospective study [50].	All implants survived up to 5 years with significant clinical and radiographic outcomes.
Sinus elevation procedure 2021	Treatment of preliminary results of a minimally invasive microsurgical approach to sinus floor elevation and bone reconstruction using a palatal septum window [51].	Bone augmentation was evaluated six months after preservation by computed tomography and histology, and it demonstrated positive preliminary results in bone reconstruction with reduced morbidity.

Advantages of Microscope

The surgical microscope offers advantages to the practicing personnel and gaining its popularity [18,21]. Table 5 highlights it. However, it also has certain disadvantages like high cost of equipment, a restricted working field of about 11-55 mm only, and also the perception and orientation takes time [19,20].

Table 5: Advantages of microscope

Postural	**Procedural**	**Psychological**	**Educational**
Perfect posture avoids discomfort to back and neck muscles	Manual operating abilities are magnified.	Decreases occupational, physical and postural stress	Due to inbuilt camera, documentation of images and videos for further referral.
Working distance is maintained, eyes to the surgical field is constant	Appropriate lighting without overshadowing	Increased personal and professional satisfaction.	Recording of diagnostic sequences and treatment in video format
Inbuilt corrective mechanisms are present in microscopic binoculars to compensate for different eye powers.	Collateral vision decreases:unnecessary visual information avoided	Reduced post-operative discomfort with improved clinical results	

DISCUSSION

The current surgical trend in periodontal therapy entails changing the perception from the use of traditional methods to minimally invasive microsurgery. The practitioner first adapts visually to the microscope before acquiring the new microsurgical skills such as instrument grip and posture through structured training programs [22]. The hands and instruments while operating the microscope are moved by kinaesthetic movement. Wherein there is visual movement without reference to background clues [3,23,24]. The beginners in the microsurgical practice should undergo training to familiarize themselves with the operating microscope, handling of micro-instruments, and technique of knot tying on surgical simulations like surgical gauze, flesh models, and animals to produce high-quality treatment [25,26]. Once completely trained, the practitioner and assistant could steadily introduce it into their practice.

Periodontal microscopy allows high-level motor skills and accuracy when performed at 10x to 20x magnification [3]. With normal vision, the highest possible visual resolution is only 0.2 mm. This can be improved at 20x, wherein hand movement accuracy approaches ten µ with a visual resolution of 1 µ. This means that the surgical site can be accurately focussed [3,24,27,28].

High magnification in surgical microscope gives advantages to treat regenerative [35,42,43,46] and periodontal plastic surgery [23,33,34,49,50] and implant therapy [43,51] successfully over conventional surgery. Clinicians can perform precise work using microsurgical instruments, probably due to fine and sharp blades that extend hard-to-reach areas [31, 36, 38,47].

Also, flaps can be elevated atraumatically as the margins of the flap are sharp. This benefits the fine suturing and accelerated healing outcomes [39, 41, 42]. Hence, the use of microsurgical procedures makes it possible for the clinician to perform completely different from those of conventional procedures [3].

The utilization of a surgical microscope proved to be a boon in various periodontal surgical procedures. Published literature definitely showed a comparison of microscopic periodontal surgery to conventional surgery [29, 32, 35, 49]. Results are superior to a traditional approach. Added advantages were noted, such as less traumatic, enhanced revascularization, higher incidence of primary wound closure, and minimally invasive procedure [41, 42]

Any challenge to visual reality is a fundamental challenge and is not readily believable. Keeping the above advantages in mind, it is necessary that change be accepted with the use of a microscope rather than challenged.

CONCLUSION

Microsurgery offers new knowledge and technology for periodontics that can dramatically improve the therapeutic outcomes of many periodontal plastics and esthetic treatment modalities. This technique will shift the focus of periodontal procedures from a macro to a micro field, thus achieving precise results. As health care professionals become familiar with the benefits of microsurgery, applications of this philosophy in periodontics will likely become a treatment standard. Microsurgical periodontics requires a different practitioner mindset. Periodontal microsurgery and esthetic and plastic periodontal microscopic surgeries afford a natural evolution in the advancement in the field of periodontics. The "magnification escalation" is likely to continue, and tomorrow's dentistry will see increasing use of magnification.

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