

## PERIODONTAL MICROSURGERY AND MICROSURGICAL INSTRUMENTATION: A REVIEW

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### ABSTRACT

Increasing surgical refinement of procedures to meet both biologic and esthetic demands of patients is seen in today's periodontal practice. For these new technologies, instruments, and surgical techniques are necessary. Technical skills of the clinician are challenged by the limit of range of visual acuity. Periodontal microsurgery improves the outcome of basic periodontal surgical procedures by enhancing normal vision through magnification along with favorable lighting system. It gives enhanced outcomes not possible with traditional macrosurgery in terms of passive wound closure and reduced tissue trauma. The purpose of this review is to provide brief knowledge of periodontal microsurgery: the role of magnification, microsurgical instrumentation and applications of microsurgery.

**Keywords:** Magnification, Microsurgery, Microsurgical Instruments

### INTRODUCTION

Microsurgery refers to a surgical procedure performed under a microscope. In 1980, microsurgery was described by Serafin as a methodology, a modification and refinement of existing surgical techniques using magnification to improve visualization, with applications to all specialities.<sup>1</sup>

### HISTORY

Dentistry has borrowed microsurgery from medical science. Carl Nylen (1921), father of microsurgery, used surgical operating microscope for the treatment of otosclerotic deafness.<sup>2</sup> Apotheker and Jako are given the credit to first introduce the microscope to dentistry in 1978. In periodontics, it was introduced by Shanelec and Tibbetts who presented a

continuing education course on periodontal microsurgery at the annual meeting of the American Academy of Periodontology in 1993.<sup>3</sup>

### PRINCIPLES OF MICROSURGERY

Major principles of microsurgery include improvement of motor skills, an emphasis on passive wound closure with exact primary apposition of the wound edge and, the application of microsurgical instrumentation and suturing to reduce tissue trauma.<sup>4</sup>

To improve motor skills a microsurgeon should have minimal tremors, 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

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forward and with both feet flat on the floor. If the patient's head is assumed in the 12 o'clock position in front of and perpendicular to microsurgeon's chest, the most precise rotary suturing movement for a right-handed person is from the 2 o'clock to the 7 o'clock position, while for left-handed people it is from the 10 o'clock to the 4 o'clock position.

The wrist should be stabilized by resting on a flat surface, angled in a dorsiflexion position at approximately 20 degrees. By doing so more accurate, finely controlled finger movements can be accomplished as the muscle tremor is reduced.

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.<sup>5</sup> In the three-digit grip, an instrument is held exactly as a pen is held when writing. The thumb and index and middle fingers are used as a tripod. The forearm should be slightly supine, positioning the knuckles away from clinician, so that the ulnar border of his/her hand, wrist, and the elbow are all well supported, allowing the weight of the hand to be on the ulnar border.

The thumb and index finger are arranged on the instrument into contact with the underlying steady middle finger. When an instrument is held with the internal precision grip, the instrument can be opened and closed with very fine control and fatigue is resisted.

**MICROSURGICAL TRIAD**

The concept of microsurgery is based on three important elements which form the microsurgical triad that includes magnification, illumination and instruments.<sup>6</sup> Without any one of these, microsurgery is not possible.

**1) MAGNIFICATION**

Visual acuity is the ability to perceive two closely lying objects separately. Visualization of fine details can also be enhanced by increasing the image size of the object.

**Magnification systems:**

A variety of simple and complex magnifications are available to dentists, ranging from simple loupes to prism telescopic loupes and surgical microscopes. Each magnification system has its own specific advantages and limitations.

Dental loupes are the most common system of optical magnification. They are fundamentally dual monocular telescopes with side-by-side lenses convergent to focus on the operative field.<sup>7</sup> The magnified image formed has stereoscopic properties by virtue of their convergence. A convergent lens optical system is called a Keplerian optical system. Although being less expensive and cumbersome, dental loupes are widely used but they have disadvantages compared with the microscope. The clinician's eyes must converge to view the operative field which can result in eyestrain, fatigue, and even pathologic vision changes; especially after prolonged use.<sup>6</sup> Three types of Keplerian loupes are typically used in periodontics: simple or single-element loupes, compound loupes, and prism telescopic loupes.(Table 1)

Table 1: Comparison of dental loupes

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 depths of field, longer working distances, and larger fields of view

## SURGICAL MICROSCOPE

It is a complicating system of lenses that allows binocular viewing at magnification of approximately 4X to 40X.<sup>7</sup>

### Basic Principles of the Surgical Microscope

In the binocular concept, the length of the telescope becomes condensed by the use of prisms. The components of microscope are the basic stereo microscope, the binocular head, and the objective lens. This microscope, however, contains two additional elements: a magnification changer and an illuminator which beams the light in through the objective lens. Operating microscopes combine the magnification of loupes with a magnification changer and a binocular viewing system. This type of illumination is desirable because the line of illumination is very close to the viewer's line of vision. Therefore, the surgical field will be illuminated and free of shadows.

### Advantages and Disadvantages of the Surgical Microscope<sup>8</sup>

#### Advantages

##### 1. *Postural*

- Less discomfort to the back and neck of the clinician.
- Less tiredness of eyes, as constant adjustments are avoided.

##### 2. *Procedural*

- Atraumatic tissue management.
- Accurate primary wound closure.
- Increased diagnostic skills.
- Minimally invasive.
- Improved cosmetic results.
- Increased surgical quality.
- Increased effectiveness of root debridement results in greater predictability of

- a) Regeneration procedures, b) Cosmetic procedures.
- Improved documentation e.g. video, slide, digital.

##### 3. *Psychological*

- Less patient anxiety.
- Increased personal, professional satisfaction when improved quality of surgical treatments is seen.

#### Disadvantages

1. Educational requirements.
    - Surgical technique
    - Understanding of optics
  2. Long adjustment period for clinical proficiency.
  3. Initial increased surgical time.
  4. High patient cost.
  5. Limited surgical access.
- 2) **ILLUMINATION:** Most of the manufacturers offer collateral lighting systems which are helpful, particularly for higher magnification in the range of 4X and more.

Considerations to be made in the selection of an accessory lighting source.<sup>2</sup>

1. Total weight, quality, and brightness of the light.
2. Ease of focusing and directing the light within the field of view.
3. Ease of transport between surgeries.

##### 3) **MICROSURGICAL INSTRUMENTS (Table 2)**

Using conventional instruments in microsurgery is not really an option as their size implies a larger surgical access, which goes against the whole concept of microsurgery. So microsurgical instruments are the third element of microsurgical triad.

#### *Rationale in favour of microsurgical instruments*

- As the inflammation, oedema, post-operative pain, and the healing time are increased with larger spread of the soft and hard tissues

included in the manipulation, limiting the extent of the surgical site reduces morbidity.

- Tissues suffer more from crushing than incisions or puncture. The edginess of ophthalmic surgical blades is obtained by electrolytic process and not machined. So, the blade edges are sharper, and the surface texture of the blade is smoother, resulting in a perfect incision leading to least possible trauma. Blunt instruments crush the fragile tissues, potentially inducing necrosis, while the forceps with microscopic teeth allows the operator to delicately reposition the soft tissues.
- Risk of necrotic zones and its related aesthetics and functional consequences are more if the blood supply to the tissues handled is compromised. Certain incisions are altogether avoided using a microscope contributing to a better blood perfusion of the tissues.

For example, while harvesting a connective tissue graft from the palate, magnification makes it technically easier to proceed with a unique incision line, running parallel to the cervix of the teeth, thus avoiding releasing incisions that would deny the flap from one source of its blood supply. Likewise, immediate implant placement, combined with a thickening of soft tissue with a connective tissue graft, can be done with no releasing incision if visibility is adequate using magnification. Also, the risk of scars is eliminated and revascularization of the grafts is faster.

Properties of microsurgical instruments-

- light to prevent hand fatigue;
- rigid enough to maintain proper stability;
- long enough to rest on the saddle formed by the thumb and the index finger;
- round handles to allow rotational movements;
- circular in cross section to allow for a smooth rotation movement;
- working tips of much smaller than those of regular instruments;
- non-reflective to avoid blinding the operator (especially with the high-intensity light of the microscope);
- non-magnetic;
- machined to a very high level of precision to allow a good grip on very small needle or very delicate tissue without damaging them, and still allow an easy opening-closing action.

### MICROSURGERY IN PERIODONTICS

Clinical expertise beyond the range of visual acuity is needed in periodontal plastic surgery, guided tissue regeneration, crown lengthening, ridge augmentation, implant placement etc. So microsurgery is very important in periodontics.

**Esthetic Surgical Procedures-** Periodontal plastic surgery is “technique-sensitive” and more demanding than other periodontal procedures. Microsurgery has wide implications including the rotational, free gingival, double papilla, and the sub-epithelial connective tissue grafts for the coverage since it causes minimal trauma and enhances the wound healing process.<sup>12</sup> The combination of small microsurgical instruments and delicate surgical techniques allow for extremely fine, crisp and accurate incisions, gentle tissue handling, and precise suturing.

**Root coverage-** Accurate diagnosis with microsurgical techniques makes complete root coverage extremely predictable in Class I and Class II marginal tissue recessions. Partial root coverage results achieved in Class III & Class IV marginal recession with conventional surgery can also be greatly enhanced through the use of microsurgery. According to studies, the use of microsurgical technique depicted a greater increase in width of keratinized tissue and thickness of keratinized tissue as compared to the macro-surgical techniques performed.<sup>13-17</sup>

**Table 2: Different microsurgical instruments**  
 A basic set of periodontal surgical instruments includes<sup>9,10,11</sup>

NAME	TYPE	SUBTYPES	ADVANTAGES
Knives	a.Blade breaker knife b.Crescent knife c.Minicrescent knives d.Spoon knife e.Lamellar knife		<ul style="list-style-type: none"> <li>Extremely sharp</li> <li>Small size</li> <li>Etched rather than ground- produce more precise wound edge</li> </ul>
Microsurgical periodontal knives	a.Orban periodontal knife(KO1/2MBH) b.Kramer-Nevins gingivectomy knife(KKN7MBH)		<ul style="list-style-type: none"> <li>Very sharp</li> </ul>
Microsurgical blades	a.Ophthalmic blade b.Blade no 15 c.Blade no 12 d.Blade no 390 e.Blade no 390 c	No.15c No.12d	<ul style="list-style-type: none"> <li>Curved in a 'J' shape</li> <li>Can be run under the papilla to separate it from the underlying bone support, progressing in the narrow space of the dental embrasure</li> <li>Fine incision</li> </ul>
Microsurgical periosteal elevator	a.Pariosteal Schlee PPSCHLEE Handle 6 b.Prichard periosteal (PPRMBH) c.Hourigan periosteal (PH2MBHKD)		<ul style="list-style-type: none"> <li>Precise undermining and release of flap</li> </ul>
Microsurgical periodontal retractors	KP Retractors	a.KP 1 Retractor b. KP 2 Retractor c. KP 3 Retactor	Wider and thinner serrated working ends provide <ul style="list-style-type: none"> <li>better anchorage on bone and</li> <li>prevent accidental slipping</li> </ul>
Microsurgical tissue forceps	a.Microsurgical anatomic tissue pliers TPASTMBH b.Microtissue forceps 180		<ul style="list-style-type: none"> <li>Handle minute tissues without damaging them</li> </ul>
Microsurgical periodontal chisels	a.Rhodes chisel b.Wedelstaedt chisel c.Fedi chisel		<ul style="list-style-type: none"> <li>Precise bone cutting</li> </ul>
Microsurgical periodontal curettes	Langer curettes	a. SL1/2RMBH b. SL3/4RMBH c. SL5/6RMBH	
Microsurgical periodontal needle holder	Microneedle holder Schlee(NHSLSCHLEE)		<ul style="list-style-type: none"> <li>Lock to firmly secure the needle</li> <li>Can be guided through coarse gingival tissue with controlled grip pressure</li> <li>Slender shape allows them to reach far into interproximal areas</li> </ul>
Microsurgical suturing forceps			<ul style="list-style-type: none"> <li>Can easily grab microsutures which can be torn with usual surgical suturing forceps</li> </ul>
Microscissors	a.Micro-vannas tissue scissors b.Goldman-Fox scissors c.Ligature scissors FD252R		<ul style="list-style-type: none"> <li>Smooth cutting of fine and coarse tissues</li> <li>Reduced tissue trauma</li> </ul>
Microsutures	6-0 to 10-0	Vicryl polyglactin (7-0 to 10-0) Ethilon polyamide(7-0,9-0)) Prolene polypropylene(8-0,10-0))	<ul style="list-style-type: none"> <li>Better wound closure</li> <li>Minimizing gaps or voids at the wound, rapid healing with less post-operative inflammation, pain and risk of scar formation.</li> </ul>
Microsurgical needles	a.Reverse cutting needles with precision tips b.Spatula needles with microtips		Shallow needle track and precise needle point allows extremely accurate apposition and closure of flap

**Papilla reconstruction-** Apart from the various root coverage procedures performed other mucogingival surgeries like papilla reconstructions and ridge augmentation around natural teeth and implants can also be carried out.

**Implant surgery-** Microsurgery has proved its potential in implant surgeries. It has established itself in implant site development and implant placement using both the flap and flapless techniques.

**Sinus lift procedures -** Sinus lift procedures using the microsurgical approach are also gaining recognition. The periodontal endoscope allows for subgingival visualization of the root surface at magnifications of 24x to 48x. This is accomplished through a 0.99 mm fiber optic bundle that is a combination of a 10,000-pixel capture bundle surrounded by multiple illumination fibers. This fiber is delivered to the gingival margin coupled into an instrument called an “explorer.” A single use sterile sheath isolates the fiber so it can be used repeatedly. The captured image is relayed to a screen so that the user can see “real time” video of the highly magnified environment (approximately 3 mm on screen at a time)

**Root Surface Conditioning-** Since root surface preparation addresses how the soft tissue attaches to the root of the tooth in root coverage surgery, it is of the utmost importance. In an attempt to get new periodontal ligament attachment of a graft to the tooth with new cementum and Sharpey's fibers, several methods of root preparation have been suggested including mechanical root preparation, chemical root preparation, and biologic root preparation. The outcomes of some methods are based on histologic evidence and others on empirical observation, but all are important for successful root coverage.

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