

# Minimally Invasive Surgery - A Zenith Forte In Periodontal Therapy

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**Abstract :** *Performing minimally invasive surgical procedure is enhanced by using microsurgical techniques. Periodontal microsurgery is the refinement of basic surgical techniques made possible by the improvement in visual acuity gained with the use of surgical microscope. In the last decade, a special emphasis has been focused on the design and performance of surgical procedures for periodontal regeneration.. Minimally invasive periodontal surgery can diminish the negative outcomes while increasing the efficacy of therapy. Minimally invasive periodontal surgery technique allows for minimization of soft tissue trauma and the removal of granulation tissue from periodontal defects using a much smaller surgical incision than that used in conventional surgical techniques. Further in order to improve surgical effectiveness, the use of operating microscopes and microsurgical instruments has been suggested. Future devices for performing minimally invasive periodontal surgical procedures need to be easier to use.*

## INTRODUCTION

The aim of periodontal surgery has always been to alleviate or eliminate the degeneration associated with progressive periodontal disease. In order to accomplish this goal, the access to the periodontal defect for debridement has been integral part of surgical therapy. Traditional surgical techniques used extensive flap procedures to access diseased areas and treat the underlying bone damage<sup>1</sup>. With the advent of more predictable regenerative therapy, the focus of periodontal surgery shifted from the removal of pocket walls to the re growth and regeneration of lost tissue<sup>2</sup>. The ideal surgical

approach for periodontal regeneration would be one that allow access to the site to be regenerated without extending the surgical incision into adjacent healthy areas<sup>1</sup>. In 1990, **Wickham** and **Fitzpatrick** described the technique of using smaller incisions as minimally invasive surgery<sup>3</sup>. The concept of minimally invasive surgery further refined by **Hunter** and **Sackier** as the ability to miniature the operator eyes and extend his hands to perform microscopic and macroscopic surgery<sup>4</sup>. The application of minimally invasive surgery for the treatment of periodontal attachment and bone loss was first described by **Harrel** and **Ress** in 1995. Minimally invasive approach was later modified to Modified Minimally invasive surgical technique (MMIST) in 2009 by **Cortenelli** and **Tonetti**<sup>9</sup>. Main objective of the minimal invasive treatment is minimizing trauma to the tissues and still achieve a satisfactory therapeutic result. Microsurgery incorporates three different principles, That include improvement of motor skills to enhance the surgical ability of operator, to obtain passive wound closure with opposition of wound edges and reduce the tissue trauma by using microsurgical instruments and suturing<sup>5</sup>. The application of magnification to periodontics promises to change clinical concepts of periodontal surgical care. For these reasons minimally invasive surgical procedures are advantageous than conventional surgical procedures.<sup>5</sup>

## REVIEW

The concept of minimally invasive surgery in the field of dentistry was introduced by **Hareel** and **Ress**. Minimally invasive surgery (MIS) has been defined as the ability to perform a procedure

through a substantially smaller surgical wound than had previously been necessary to accomplish the same surgical goals. Minimal invasive surgical procedure is possible through the use of magnifying instruments such as surgical microscope, surgical telescope, microsurgical instruments and materials<sup>6</sup>. There are three elements in microsurgery. These three elements collectively called as microsurgical triad. It consists of:

Magnification,  
Illumination and  
Microsurgical instruments<sup>7</sup>.

**Magnification: The first element of microsurgical triad**

An optimal vision is a stringent necessity in periodontal practice. Vision is a complex process that involves the cooperation of multiple links between the eye, the retina, the optic nerve and the brain. Another important factor influencing visual acuity is the lighting. The relation between visual acuity and light density is well established: a low light density decreases visual acuity. The best

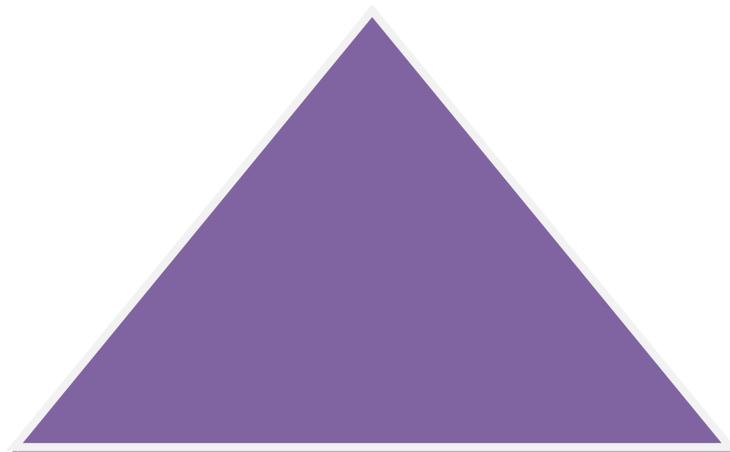
eyesight can be achieved at a light density of 1000 cd/m. At higher densities, visual acuity decreases. This, in turn, means that claims for optimal lighting conditions have to be implemented. Visualization of fine details is enhanced by increasing the image size of the object. Image size can be increased in two ways

1. By getting closer to the objects
2. By magnification. To see small objects in operative field magnifying loupes can be used. Periodontal microsurgery is commonly performed at 10x to 20x magnification. In dentistry two basic types of magnification systems are commonly used:  
1.Loupes  
2.Surgical microscope

**Loupes**

The most common magnification system used in dentistry is magnification loupes. Loupes are fundamentally two monocular microscopes, with side-by-side lenses, angled to focus on an object. The magnified image that is formed, has stereoscopic properties that are created by the use of convergent lens systems. A convergent lens optical system is called as kaplerian optical system.

**MAGNIFICATION**



**ILLUMINATION**

**INSTRUMENTS**

**MICROSURGICAL TRAIID**

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**Working distance**

The working distance is the distance measured from the eye lense location to the object in vision.

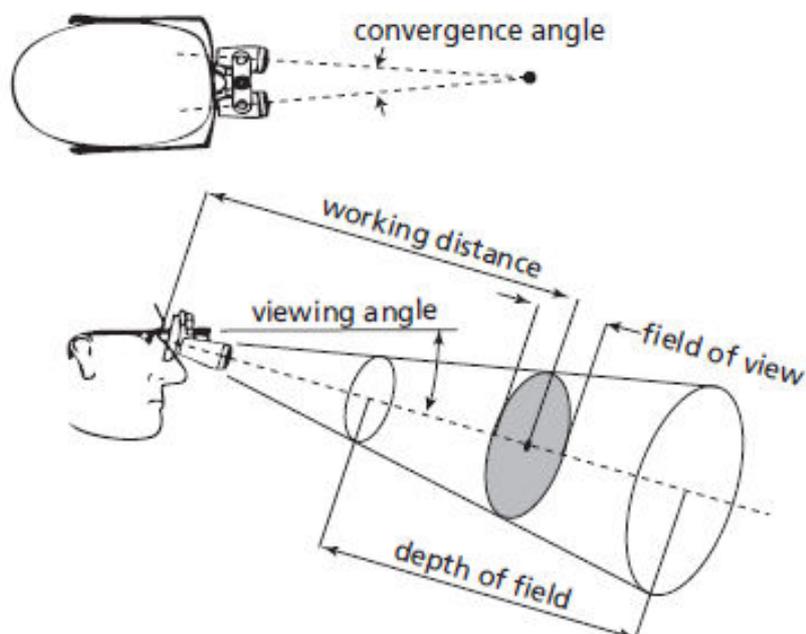
**Working range**

The working range (depth of field) is the range within which the object remains in focus.

**Convergence angle**

The convergence angle is the pivotal angle aligning the two oculars, such that they are pointing at the

identical distance and angle.



## Principal optical features of loupes

### Field of view

The field of view is the linear size or angular extent of an object when viewed through the telescopic system.

### Interpupillary distance

The interpupillary distance depends on the position of the eyes of each individual and is a key adjustment that allows long-term, routine use of loupes.

### Viewing angle

The viewing angle is the angular position of the optics allowing for comfortable working.

Three types of loupes are commonly used:

1. Simple loupes.
2. Compound loupes.
3. Prism telescopic loupes.

**Simple loupes** - Simple loupes consist of a pair of single, positive, side-by-side meniscus lenses. Each lens has two refracting surfaces, with one occurring as light enters the lens and the other when it leaves. Their magnification can only increase by increasing lens diameter and thickness. Its main advantage is that it is cost effective and light weight.<sup>5</sup>

### Compound loupes

Compound loupes use multiple converging lenses with intervening air

spaces to gain additional refractory surfaces. This allows increased magnification with more favourable working distance and depth of field. Magnification of compound loupes can be increased by lengthen the distance between lenses there by avoiding excessive size and weight. These loupes are based on Galilean optical system and allow a magnification of about 2.5x.

### Prism telescopic loupes

Prism loupes are the most optically advanced type of loupe magnification presently available. These loupes actually contain Schmidt or roof-top prisms that lengthen the light path through a series of mirror reflections within the loupe. They are superior to other loupes in terms of better magnification, wider depths of field, longer working distances and larger fields of view<sup>5</sup>.

### Loupe Magnification

Wide ranges of magnifications are available in loupes, ranging from 1.5x to 10x. Loupes with less than 2x magnifications are usually inadequate for the visual acuity necessary for microsurgery. For most periodontal procedures in which magnification is needed, loupes of 4X to 5X provide an effective combination of magnification, field size, and depth of focus<sup>5</sup>.

### Choice of Loupes

Before choosing a magnification system, different loupes and appropriate time for a proper adjustment have to be considered. Improperly adjusted loupes

and the quality of the optics will influence the performance. For the use in periodontal surgery, an adjustable, sealed prism loupe with high quality coated lenses offering a magnification between 4x and 4.5x, either head band or front frame mounted, with a suitable working distance and a large field of view, seems to be instrument of choice<sup>5</sup>.

#### **Risks of the long-term use of magnification**

Loupes are widely used for magnification their major disadvantage is that the eyes must converge to view an image. Individuals suffering from convergence insufficiency, however, are potentially at risk when wearing loupes. Convergence insufficiency occurs when the extrinsic eye muscles responsible for turning the eyes medially (convergence) appear to be weak in relation to the muscles responsible for divergence ('lazy eye'). In spite of this imbalance, the individual's eyes remain straight in all fields of gaze (compensation), resulting in 'strained eyes'. This can manifest itself as headaches, eyestrain (pain), blurred vision, or fatigue when engaged in extended periods of close work. The condition most commonly occurs in teenagers and young adults, although it can occur up to middle age.

#### **Surgical microscope**

The surgical microscope is a complicated system of lenses that allows stereoscopic vision at a magnification of approximately 4–40x with an excellent illumination of the working area. In contrast to loupes, the light beams fall parallel onto the retinas of the observer so that no eye convergence is necessary and the demand on the lateral rectus muscles is minimal. The microscope consists of the optical components, the lighting unit, and a mounting system. To avoid an unfavorable vibration of the microscope during use, the latter should be firmly attached to the wall, the ceiling or a floor stand. Mounted on the floor, the position of the microscope in the room must provide easy and quick access.

#### **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 attach

#### **Loupes Versus Operating Microscopes**

Loupes and optical microscope have some common features which include :

- 1) Both loupes and the operating microscope improve visual acuity and are beneficial in enhancing periodontist's ergonomic comfort and efficiency by increasing the optical working distance.

- 2) A multitude of eye, neck, shoulder and back problems that are common to dentists assuming a shorter working distance to increase visual acuity without magnification, may be eliminated by using the surgical microscope.

- 3) Increasing the normal working distance by 6 to 8 inches has been shown to improve vastly the postural ergonomics and eye strain of industrial workers

#### **Benefits of Microscopes In Periodontics**

Operating microscopes offer three distinct advantages to the clinician: Illumination, magnification and increased precision in the delivery of surgical skills. Collectively, these advantages are referred to as the microsurgical triad. The surgical operating microscope under magnification of 20x enhances visual acuity<sup>12</sup>. This leads to Increased precision in delivery of surgical skills, which results in more accurate incisions via smaller instrumentation, less trauma, and quicker post operative healing. Gentle handling of soft and hard tissues with the same universally accepted surgical principles. Extreme and accurate wound closure. Little damage as possible to the tissues and Ergonomic advantage.

#### **Illumination: The second element of the microsurgical triad**

Since the beginning of the practice of dentistry, dentists have recognized the importance of light in viewing their work. Most of the manufacturers offer collateral lighting systems or suitable fixing options. These systems may be helpful, particularly for higher magnification in the range of 4X and more loupes with larger field of view will have better illumination and brighter image than those with narrower fields of view.

Fiber optic technology has improved the methods of focusing light on specific areas. Several sources of fiber optic light can be attached to hand piece, instruments or loupes. Johnson et al demonstrated that fiber optic illumination /transillumination is beneficial in removing deposits in moderate to deep periodontal pockets. Fiber optic lighting is a standard feature of surgical operating microscopes.

#### **INSTRUMENTS : THE THIRD ELEMENT OF MICROSURGERY**

Proper instrumentation is fundamental for microsurgical intervention. Microsurgical instruments are much smaller, often by tenfold. This creates a smaller surgical field with less injury and bleeding. Microsurgical instrumentation can be made with titanium or surgical stainless steel. Titanium instruments tend to be lighter, but are more prone to deformation and are usually more expensive. Appropriate sets of steel or titanium

instruments for periodontal microsurgery are available from different manufacturers.

### Internal Precision Grip

It is also called pen grip, which is ideal for microsurgical instrumentation. With this grip, the external muscles of the hand, its flexors and extensors, are relaxed to resist fatigue. As the instruments are primarily manipulated by the thumb, index and middle finger, their handles should be round, yet provide traction so that finely controlled rotating movements can be executed. The instruments should be approximately 18 cm long and lie on the saddle between the operator's thumb and the index finger; they should be slightly top heavy to facilitate accurate handling. In order to avoid an unfavorable metallic glare under the light of the microscope, the instruments often have a colored coating surface. The weight of each instrument should not exceed 15–20 g (0.15–0.20 N) in order to avoid hand and arm muscle fatigue. The needle holder should be equipped with a precise working lock that should not exceed a locking force of 50 g (0.5–N). High locking forces generate tremor, and low locking forces reduce the feeling for movement.

A basic set of periodontal microsurgery comprises

- 1) Knives,
- 2) Micro scissors,
- 3) Anatomic and surgical forceps,
- 4) Needle holder,
- 5) Micro scalpel holder and
- 6) Set of various elevator.

### Knives

These knives have their characteristic ability to create clean incisions to prepare the sharp flap margins for healing by primary intention. Using Castroviejo microsurgical scalpel, incisions are made at 90 degrees angles to the surface. Magnification permits easy identification of ragged wound edges for trimming and freshening. Various types of knives such as

1. Blade Breaker Knife
2. Crescent Knife
3. Mini crescent Knife
4. Spoon Knife
5. Lamellar Knife
6. Scleral Knife.

### Scissors

The micro-vannas tissue scissors are used for removal of small fragments of tissue.

### Needle Holders

In order to avoid sliding of the thread when tying the knot, the tips of the forceps have flat surfaces or can be finely coated with a diamond grain that improves the security by which the needle holder holds a surgical needle. The configuration of the needle holder jaw has considerable influence on

needle holding security. The presence of teeth in the tungsten carbide inserts provides the greatest deterrent to either twisting or rotating of the needle between the needle holder jaws.

### Suture materials

Suture material and technique are essential factors to consider in microsurgery. The most popular technique for wound closure is the use of sutures that stabilize the wound margins sufficiently and ensure proper closure over a defined period of time. However, the penetration of a needle through the soft tissue in itself causes a trauma and the presence of foreign materials in a wound may significantly enhance the susceptibility to infection. Hence, it is obvious that needle and thread characteristics influence wound healing and surgical outcome.

### Characteristics of the needle

The needle consists of a swage, body and tip and differs concerning material, length, size, tip configuration, body diameter, and the nature of connection between needle and thread. In atraumatic sutures, the thread is firmly connected to the needle through a press-fit swage or stuck in a laser-drilled hole. The body of the needle should be flattened to prevent twisting or rotating in the needle holder. In order to minimize tissue trauma in periodontal microsurgery, the sharpest needles, reverse cutting needles with precision tips or spatula needle with micro tips are preferred. The shape of the needle can be straight or bent to various degrees. For periodontal microsurgery, the 3/8" circular needle generally ensures optimum results.

There is a wide range of lengths, as measured along the needle curvature from the tip to the proximal end of the needle lock. For papillary sutures in the posterior area, needle lengths of 13–15 mm are appropriate. The same task in the front aspect requires needle lengths of 10–12 mm, and for closing a buccal releasing incision, needle lengths of 5–8 mm are adequate. To guarantee a perpendicular penetration through the soft tissues without tearing, an asymptotic curved needle is advantageous in areas where narrow penetrations are required (e.g. margins of gingiva, bases of papillae). To fulfill these prerequisites for ideal wound closure, at least two different sutures are used in most surgical interventions

### Characteristics of the suture material

The suture material may be either resorbable or nonresorbable material. Within these two categories, the materials can be further divided into monofilament and polyfilament threads. The bacterial load of the oral cavity demands attention in the choice of the suture material. Generally, in the oral cavity the wound healing process is uneventful, hereby reducing the risk of infection

caused by contamination of the thread. As polyfilament threads are characterized by a high capillarity, monofilament materials are to be preferred. Pseudomonofilaments are coated polyfilament threads with the aim of reducing mechanical tissue trauma. During suturing the coating will break and the properties of the pseudomonofilament thread then corresponds to that of the polyfilament threads. Additionally, fragments of the coating may invade the surrounding tissues and elicit a foreign body reaction.

#### Resorbable sutures

Resorbable threads may be categorized as natural or synthetic. Natural threads (i.e. surgical gut) are produced from intestinal mucosa of sheep or cattle. The twisted and polished thread loses its stability within 6–14 days by enzymatic breakdown. Histologic examinations confirmed the inflammatory tissue reactions with a distinct infiltrate. For that reason, natural resorbable threads are generally obsolete. Synthetic materials are advantageous due to their constant physical and biologic properties. The materials used belong to the polyamides, the polyolefines or the polyesters and disintegrate by hydration into alcohol and acid. Polyester threads are mechanically stable and, based on their different hydrolytic properties, lose their firmness in different, but constant times. A 50% reduction of breaking resistance can be expected after 2–3 weeks for polyglycolic acid and polyglactin threads, 4 weeks for polyglyconate, and 5 weeks for polydioxanone threads. The threads are available in twisted, polyfilament forms, and monofilament forms for finer suture materials. The capillary effect is limited and hardly exists for polyglactin sutures.

#### CONCLUSION

Better devices to assist in visualizing small surgical fields, better devices to prepare surgical sites, and better instruments to aid in the placement of regenerative materials are all needed. Such advanced technologies, now ubiquitous across medical-surgical disciplines. This is in contrast to periodontal practice where currently available minimally invasive surgical instruments are suboptimal modifications of instruments designed for large-field surgeries. Therefore, it seems to us that for invasive periodontal surgical techniques to advance in parallel to advances in medicine, our specialty needs to embrace the possibility of new technology. Otherwise, periodontics as a specialty faces the ever-increasing risk of becoming superfluous.

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