

The microsurgical triad – magnifying the success in periodontal plastic procedures

Vikram Deep Singh¹, Ranjana Mohan², Deepali Jain^{3*}

^{1,3}Senior Lecturer, ²Professor, Dept. of Periodontology, ^{1,3}Teerthanker Mahaveer Dental College and Research Centre, Moradabad, Uttar Pradesh, ²RVS Dental College and Hospital, Coimbatore, Tamil Nadu, India

***Corresponding Author: Deepali Jain**

Email: drdeepali1026@gmail.com

Abstract

Magnification is simply increasing the size using lenses and enhanced illumination of the site with most precise instruments considered “the microsurgical Triad”. To ensure the best results and satisfaction of the patient’s beliefs both biological and esthetical are expected from today’s periodontal practice. Microsurgical equipments aid normal vision through magnification with enhanced illumination the execution of precise periodontal procedures are facilitated. This review is to present the basic microsurgical triad and its benefits in periodontics in this era of patient-driven dentistry.

Keywords: Magnification loupes, Microsurgery, Mucogingival surgery, Periodontal plastic surgery, Surgical microscope.

Introduction

In recent years preservation of function to maximum amount and increased patient comfort are major challenges of a surgical intervention which leads to the greatest advances seen in modern dentistry, the introduction of Microscope into precision dental practice under minimally invasive surgical approach.^{1,2} In advanced periodontal practice as today, microsurgery is at the similar spot it employed in medicine in the recent past. Regenerative surgical procedures, periodontal plastic surgery & dental implants all demand high success rate that is made possible with the minimally invasive surgical approach. With microsurgical approach dental practitioner devise amplified visual acuity, better ergonomics, accurate repositioning of tissues and improved precision of surgical skills. These parameters are described under three elements magnification, illumination & instruments collectively known as the microsurgical triad.^{3,4}

Historical Timeline

In 1694, Amsterdam merchant Anton van Leeuwenhook constructed the first compound lens microscope.

1. Magnification for microsurgical procedure was introduced to medicine during the late nineteenth century.⁵
2. Saemisch, a German ophthalmologist, introduced simple binocular loupes to ophthalmic surgery in 1876.
3. In 1921, Carl Nysten, who is considered the father of microsurgery, first used a binocular microscope for ear surgery.⁶
4. During 1950s, Barraquer began using the microscope for corneal surgery.⁷
5. Apotheker and Jako first introduced the microscope to dentistry in 1978.⁸
6. During 1992, Carr published an article outlining the use of the surgical microscope during endodontic procedures.⁹
7. In 1993, Shanelec and Tibbetts presented a continuing education course on periodontal microsurgery at the annual meeting of the American Academy of Periodontology.

Classification of Microsurgical Instruments

Magnifying Instruments

1. Loupes:
 - a. Simple loupes
 - b. Compound loupes
 - c. Prism loupes
2. Operating microscope

Micro surgical instruments:

- a. Microneedle holder
- b. Microforcep
- c. Microscissors
- d. Periodontal instruments

Knives

- a. Blade breaker
- b. Crescent
- c. Minicrescent
- d. Spoon
- e. Lamella
- f. Sclera
- g. Retractors and elevator
- h. Tying forceps :
- i. Platform
- j. Non-platform
- k. Micro needle and micro sutures

The First Element: Magnification

Visual acuity is subjective to the electrophysiologic process of the image and the density of cells packed on the retina, the physiologic and the anatomic elements of visual acuity. Intensity of light is another important factor. Preeminent eyesight is achieved at 1000 candela per square metre. Any positive or negative variation in density decreases visual acuity. Therefore, optimal lighting conditions have to be implemented.¹⁰ Image size is directly proportional visualization of fine details which can be achieved by reducing distance to the objects or by Magnification.

Periodontal practices manipulate very fine tissues resulting in natural visual capacity to reach its limits, stating that magnification is a better choice in such conditions. Under magnification of 10x to 20x periodontal microsurgery is

performed with the precision of hand movement approaches approx. 10 μm comparing with highest normal visual resolution i.e. 0.2mm providing greatest accuracy of hand movement is 1 mm in order to improve the accuracy of clinical skills a varied variety of simple & complex magnifying system are available.¹¹ Surgical Loupes & Surgical Microscope are the two basic magnification systems used in dental practice.

Surgical Loupes

Saemisch, a German physician familiarized surgical loupes to medicine in 1876, two monocular microscopes, with side-by-side lenses, angled to focus on an object. The most commonly used magnification system in dentistry.¹²

To view an image eyes must converge which can result in eye strain, fatigue & prolonged use of poorly fitted loupes even results in vision changes which accounts for their major disadvantage even though loupes are widely used. Loupes are of three type- simple, compound and prism loupes.¹³

Simple Loupes (Fig. 1)

Simple loupes consist of a pair of single, positive, side-by-side meniscus lenses.¹

Advantages

1. Low-cost.¹⁴

2. Light weight.⁷

Disadvantages

1. Distorted image as a result of high subjection to spherical & chromatic aberration⁷.
2. Beyond 1.5x magnification range, they have no practical dental application.¹⁵
3. A set working distance, results in back and neck strain¹⁶

Compound Loupes (Fig. 2)

Compound loupes consist of multiple converging lenses plus prevailing air spaces for added refractory power, extra magnification, increased working distance and enhanced depth of field.

Advantages:¹⁴

1. Achromatic.
2. Superior Optical performance.
3. Enhanced field depth & working distance.

Disadvantages:

1. Above 2.5x magnification it is optically unproductive.¹⁵

Prism or Telescopic Loupes (Fig. 3)

Telescopic loupes or Prism loupes, offer improved ergonomic & noteworthy advancement in optical performance. Improved magnification range to 4x.



Fig. 1 a): Simple loupes; b): Compound loupes; c): Prism loupes



Fig. 2: Fixed compound loupe, adjustable only in the inter-pupillary distance (Galilean Principle)

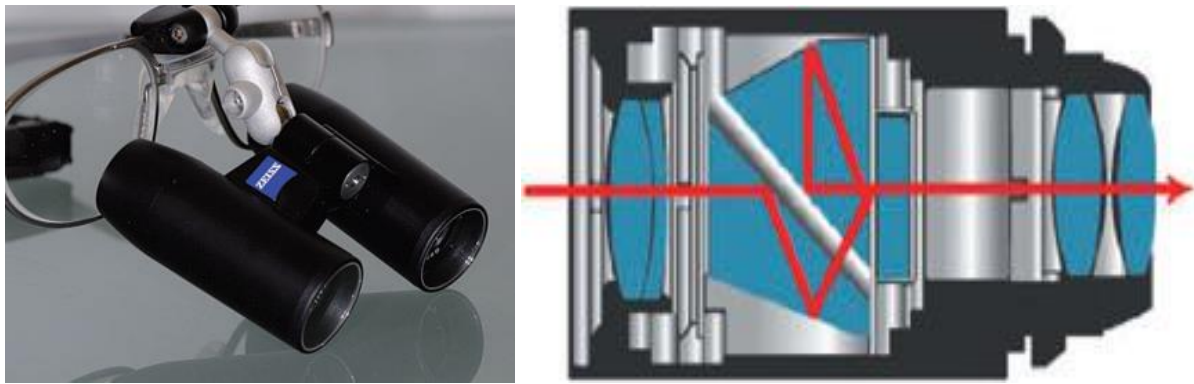


Fig. 3: Prism loupe, front frame mounted and fully adjusted (Prism Principle) & Light path through prism loupes

Surgical Microscope

Stereoscopic vision with magnification of approximately 4–40x and excellent illumination of the working area achieved by a complicated system of lenses. There is no need of eye convergence in surgical microscope as light beams fall parallel onto the retinas of the observer (Fig. 4 a, b & c). Optical components, lighting unit, and a mounting system are the three basic components of all the surgical microscopes available.¹²

Loupes versus Operating Microscope (Fig. 5)

In periodontal surgery, loupe spectacles 4x–5x & surgical microscopes offers 10x–20x magnifications which appears to be ideal as per the treatment.¹

As the depth of field decreases with increasing magnification, the maximum magnification for a surgical intervention is limited to about 12–15X, when dealing with a localized problem such as the coverage of a single soft tissue

recession or interdental wound closure after guided tissue regeneration of an infrabony defect. A magnification range of 6–8 X seems appropriate for clinical inspections or surgical interventions when the entire quadrant is under operation.⁴

Loupes have often inadequate illumination of the operating area and have limited magnifications upto 4.5x but the certain plus over the microscope is less technique sensitivity resulting in short learning phase and very affordable comparing a surgical microscope on other hand with surgical microscope better ergonomic, optimal lighting and high magnification levels can be achieved easily. These advantages are defied by high cost equipment and long learning phase. In order to visualize lingual or palatal sites that are difficult to access, the microscope must have sufficient manoeuvrability. Recent developments have enabled direct viewing of oral operation aspects. By means of these optical devices, it will be possible to perform all periodontal interventions with the surgical microscope.¹

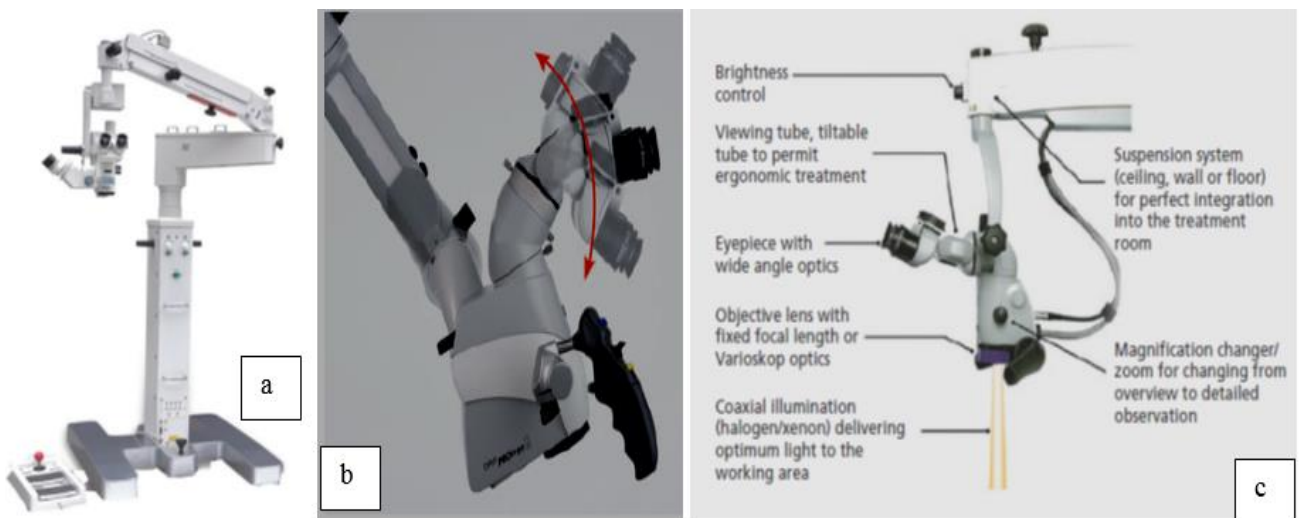


Fig. 4: a): Surgical microscope; b): System components of surgical microscope; c): Tilt able viewing tube which provides an ergonomic posture during clinical work

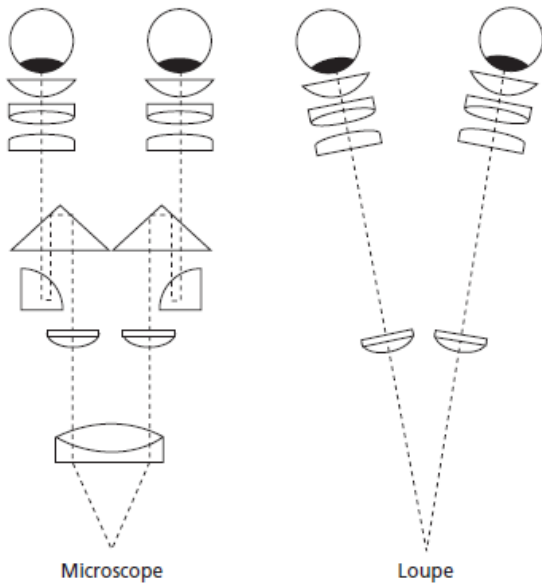


Fig. 5: Diagram illustrating the comparison of vision enhancement with surgical microscope and loupes

The Second Element: Illumination (Fig. 6)

The importance of light in viewing work have recognized by dentist since the establishment of dental practice. Most dental systems offer collateral lighting systems or suitable fixing options which are helpful, particularly for higher magnification.¹³

In telescopic loupes 4% loss in transmitted light due to reflection could amount to 50% reduction in brightness. To counteract this effect anti-reflective coatings have been used, allowing lenses to transmit light more efficiently.¹

Fiber optic technology has improved the methods of focusing light on specific areas, they can be attached to hand piece, instruments or loupes. In recent years, the use of halogen lamps have become popular for illumination.¹

The Third Element: Instruments

Creating a smaller surgical field with less injury & bleeding is fundamental for microsurgical intervention¹. Microsurgical instrumentation are much smaller made with titanium or surgical stainless steel. Use of titanium produces lighter, but more prone to deformation and expensive instruments. Stainless-steel instruments are prone to magnetization, but there is a greater number and wider variety of them.¹⁷

Internal Precision Grip

It is also called pen grip, which is ideal for microsurgical instrumentation. Features of the Internal Precision Grip are as follows:¹⁷ (Fig. 7)

1. It is a chuck grip with thumb, index & middle finger.
2. The instrument rests at the apex of the first web space & on the pads of the fingers.
3. Straight thumb.
4. The metacarpal - phalange joint is flexed approximately 90°.
5. The interphalangeal joints are straight.



Loupes with coaxial fiber optic lighting



Global G-6 SOM with an enhanced metal halide illumination system.

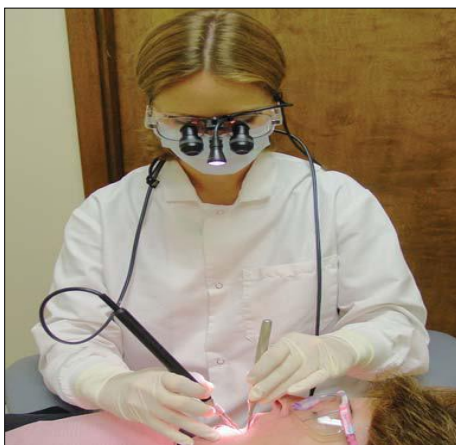


Fig. 6: Vision enhancement with loupes and surgical microscope

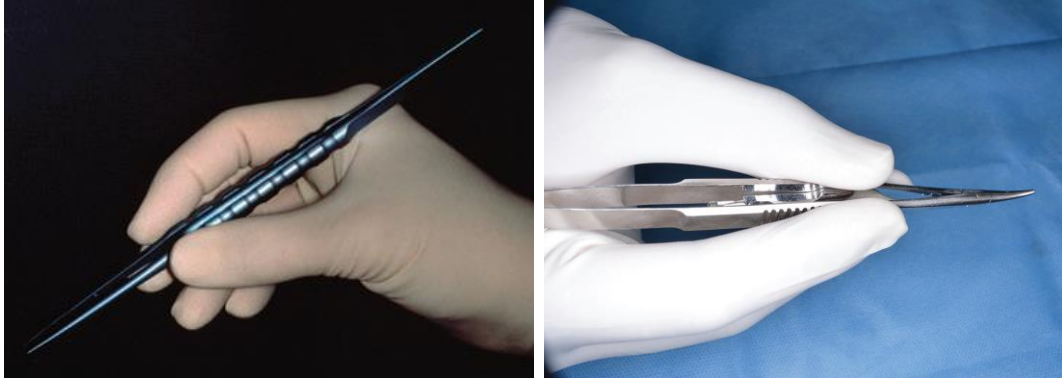


Fig. 7: Hand position for utilization of microsurgical instruments

To resist fatigue the external muscles of the hand, its flexors & extensors, are relaxed. Finely controlled rotating movements can be executed as the instruments are primarily manipulated by the thumb, index and middle finger. The instruments often have a colored coating surface in order to avoid an unfavorable metallic glare. In order to avoid hand and arm muscle fatigue the weight of each instrument should not exceed 15–20 g (0.15–0.20 N). The needle holder should be equipped with a precise working lock that should not exceed a locking force of 50 g (0.5–N).

Knives, Micro scissors, Anatomic and surgical forceps, Needle holder, Micro scalpel holder & Set of various elevators comprises basic set of periodontal microsurgery.

Needles (Fig. 8, 9a&b)

In order to minimize tissue trauma in periodontal microsurgery, the sharpest needles, reverse cutting needles with precision tips or spatula needle with micro tips (Fig.12), are preferred.¹⁸

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. They are used according to the area of surgery:

1. Papillary sutures in posterior areas : 13-15 mm
2. Papillary sutures in anterior area : 10-12 mm
3. Closure of buccal releasing incisions : 5-8 mm

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 papilla).¹⁹

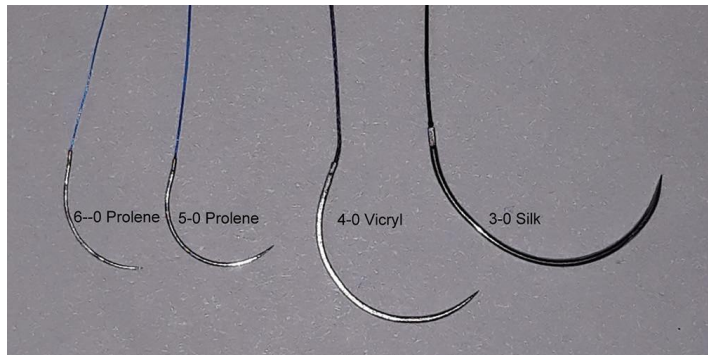


Fig. 8: Spatula needle

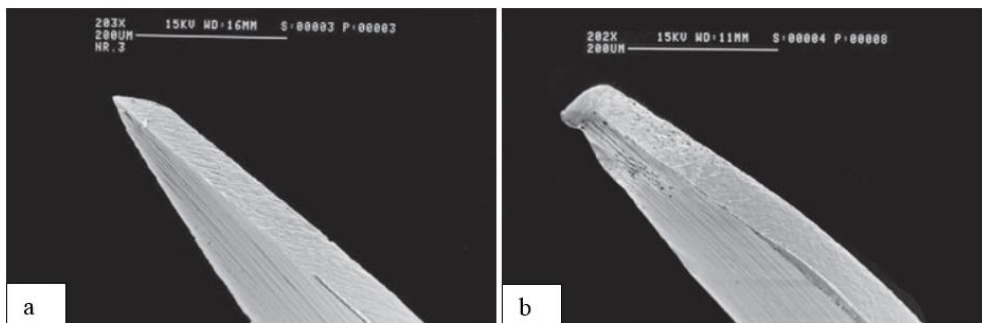


Fig. 9 a): Intact sharp spatula needle; **b):** Damaged needle tip after sticking into enamel surface



Fig. 10: Periodontal microsurgical knives

Suture Material

Suture material and technique are essential factors to consider in microsurgery.²⁰ Wound closure is a key prerequisite for healing following surgical interventions and most important to avoid complications. 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.²¹ Hence, it is obvious that needle and thread characteristics influence wound healing and surgical outcome. The suture material may be either Resorbable material or Non-resorbable material. Within these two categories, the materials can be further divided into Monofilament threads & Poly-filament threads. As poly-filament threads are characterized by a high capillarity, monofilament materials are to be preferred.²²

Summary

For surgeons who perform periodontal plastic surgery to continue to live up to their reputation of being experts in deftly handling soft & hard tissues, proficiency in periodontal microsurgery is a necessity.¹³ Patient's acceptance of minimal invasive periodontal microsurgery is a foregone conclusion. The acceptance of microsurgery by periodontists, however, is likely to hinge in a number of factors. One will undoubtedly be the marketing advantage that individual periodontists perceive in being the first to offer this service to their dental community. Another will be the increased patient acceptance of periodontal microsurgery as compared with conventional periodontal surgery.²³

It can be summarized from the available data that the surgical microscope makes the operator's view sharper & provides:

1. The ability to perform the surgery with greater precision, making much more precise incisions & the ability to use smaller instruments may cause lesser trauma and faster post-operative healing.
2. Precise tissue restructuring with smaller needles & stitches.
3. A better view of the radicular root surface, leading to easier radicular root instrumentation, in turn leading to more effective removal of calculus and radicular root isolation planning.²

Dentistry would definitely see in nearly future the use of the surgical microscope not only in clinical practice but also in extraction, implant placement and restorative procedures.⁴

Conclusion

Microsurgery has the potential to advance dentistry from an era of traumatic tooth loss to one of exact and seamless replacement of a failing anterior tooth with an esthetic implant-supported crown.⁴ Periodontal microsurgery is in its early stages stage, but in the near future it will play a crucial role. It is a skill that requires practice to achieve expertise. Its execution is technique sensitive and more demanding than are conventional periodontal procedures. As the benefits of the microscope are realized, it will be applied more universally. It appears to be a natural evolution for the specialty of periodontics. Microsurgery offers new possibilities to improve periodontal care in a variety of ways. Its benefits include improved cosmetics, rapid healing, minimal discomfort, and enhanced patient acceptance.

The specialty is not faced with a conceptual revolution in periodontal therapy but merely improving the accuracy and gentleness of what is already being done in everyday practice.

Conflict of Interest: None.

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