Review Article

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Periodontal Microsurgery: A Much-Needed Treatment Aspect in Periodontics

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ABSTRACT

Background: The field of periodontology is under the refinement of many surgical procedures. The surgical operating microscope has clearly benefited medicine. Microsurgical concepts have recently been introduced into the field of periodontics. The idea of microsurgery enhanced outcomes in terms of passive wound closure and reduced tissue trauma which is not possible with traditional macrosurgery. The surgical microscope offers the periodontist increased illumination and visual acuity to perform procedures with greater precision than with other methods of magnification. This article is an attempt to introduce and familiarize the periodontist with the surgical operating microscope, its microsurgical principles and also offers suggestions for integrating the microscope into periodontal practice.

Keywords: Magnification, illumination, microsurgery, periodontal microsurgery.

INTRODUCTION

Microsurgery is not an independent discipline but is a technique that can be applied to different surgical discipline.[1] It is based on the fact that the human hands, by appropriate training, are capable of performing finer movements than the naked eye is able to control. [2] Periodontology has grown exponentially incorporating various advances in technology available today, microsurgery being one of them. Microsurgery is not a separate field as such but only a modus operandi applicable to any surgical field in health sciences. [3]

Microsurgery is a treatment philosophy whose clinical horizon will continue to improve with operator experience and willingness to employ previously unused basic optical magnification, ergonomic technique. [4]

Periodontist, especially during the past decade, have attempted to treat surgical sites gently and a traumatically to achieve primary wound closure. The limits of normal visual acuity, however often define the extent to which this goal is possible. [5] Periodontal microsurgery is a natural transition and extension of surgical principles and techniques by which exceedingly accurate and delicate preparation, atraumatic handling of soft and hard tissue enhances primary wound closure through optical or video magnification. [5] In periodontics today, microsurgery is at the same position it occupied in medicine in the recent past. Periodontal microsurgery shares attribute with medical microsurgery that will positively influence its professional acceptance. These include improved cosmetic results increased predictability, less pain and higher patient acceptance. [6]

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Periodontal microsurgery is being accepted by a growing number of practitioners as a means to enhance precision to improve the surgeon's ergonomic comfort and efficacy. Optical magnifications have therefore broadened the horizon of dentistry in general and periodontics in particular. Improvement in visual acuity, made possible through optical magnification has become an integral part of modern dental practices through the quiet trend towards micro dentistry. The use of magnification, microsurgical principles and technology borrowed from medicine, to improve visual acuity and the precision of existing surgical techniques to broaden the scope of periodontics and make it more acceptable to the public. [7]

Historical background of microsurgery:

1590: Hans Lippershey, Zacharias Janssen, and Hans Janssen create a first compound microscope. [8]

1694: Anton van Leeuwenhoek constructed the first compound lens microscope. [9]

1921: Carl Nylen who is considered Father of microsurgery. First used the monocular microscope in clinical otology. [10]

1960: Jacobson and Saurez obtained 100% patency in suturing 1mm diameter blood vessel for anastomoses, by using a surgical microscope hence microsurgery gained wide acceptance in medicine.

1964: Harry Buncke considered as Father of Microsurgery. [11]

1978: Apotheker postulated that the microscope might be advantageous to endodontics.

The early 1990s: Dr Dennis Shanelec is considered as the founder of periodontal microsurgery and Dr Julius Gako as the father of laser microsurgery.

Concepts in Microsurgery:

The Microsurgical Triad:

The continuous development of operating microscopes, refinement of surgical instruments, production of improved suture materials and suitable training laboratories have played a decisive role for the worldwide establishment of microsurgical technique in many specialties. The three elements i.e. *magnification, illumination and instruments,* are called the microsurgical triad. (Fig.1)

Periodontal microsurgery is acquired skills, requiring magnification, microsurgical instruments & frequent practice to achieve & maintain excellence. [8]

LOUPES:

This is the most common magnification system used in dentistry. [5] Loupes are optical aids for the magnified projection of an object on the retina. 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 a convergent lens system. Three types of loupes are commonly used, all employ convergent optics include simple, compound and prism loupes. [5]

SIMPLE LOUPES:

It consists of a pair of single, positive, side by side meniscus lenses which tends to be primitive magnifiers with limited capabilities. Each lens has two refractory surfaces, one through which light enters the lens and from other it leaves. Simple loupes produce the described dioptre magnification that simply adjusts the working distance to a set length as dioptre increases, the working distance decreases. (Fig.2)

COMPOUND LOUPES:

Compound loupes use multiple converging lenses with intervening air spaces to gain additional refractory power, magnification, working distance and depth of field. Such loupes can be adjusted to clinical needs without excessive increase in the size or weight. [12]

These loupes are based on Galilean optical system and allow a magnification of about 2.5X. These are generally considered as a good entry point to those users who are unfamiliar with magnification. They are commonly mounted in or on eyeglasses. (Fig.3)

PRISMS LOUPES:

These are the most optically advanced type of loupe presently available for magnification. They are low

power telescopes and are based on Keplerian astronomical telescopes. These loupes employ

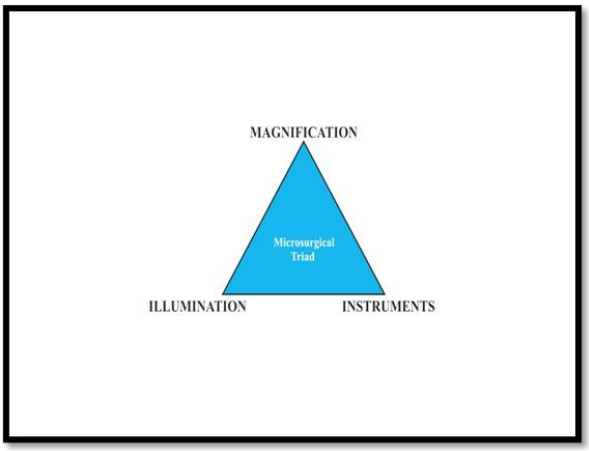

Fig 1: Microsurgical Triad.

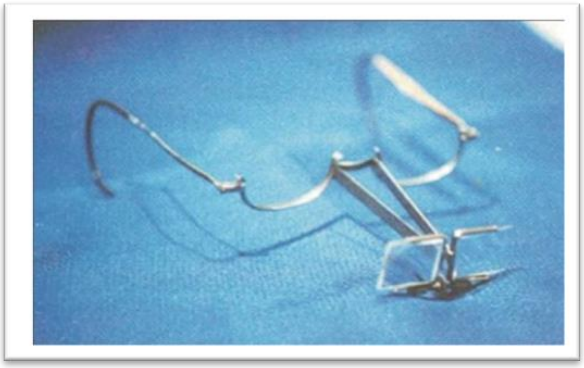

Fig 2: Simple Loupe.

Fig 3: Compound Loupe.

around five lenses and two prisms to give higher magnification up to 6X, which provides superior optical clarity and a favourable view from edge to edge. [13] The barrels of the prism are short enough to be mounted on eyeglass or a headband. At a magnification of 3.0 diameter or greater, the increased weight causes headband mounted loupes to be more comfortable and stable than the once mounted on glasses. Recent innovations have coaxial fibre optic lighting with incorporated lens elements which improve illumination.[5] (Fig.4)

Fig 4: Prism Loupe

Fig 5: Operating Microscope.

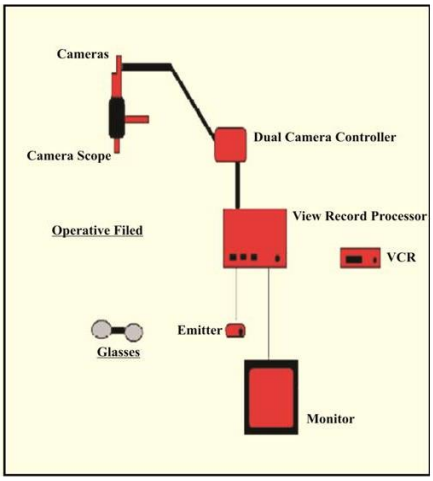

Figure 6: Three Dimensional On Screen Microsurgical System (TOMS)

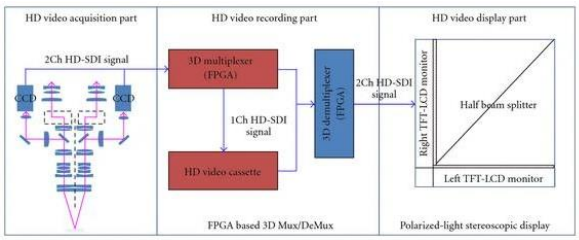

Fig 7: Diagram of the stereoscopic microscope imaging system.

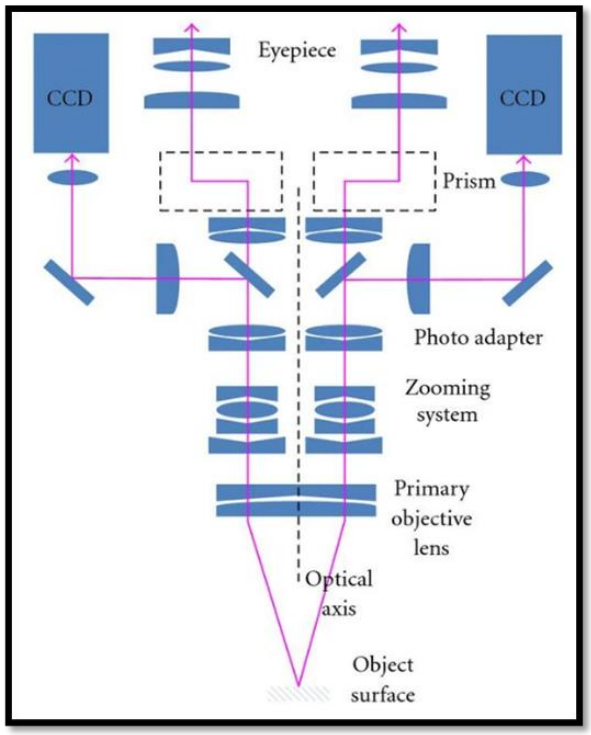

Fig 8: Schematic diagram for stereoscopic image acquisition of the stereomicroscope.

Fig 9: Periodontal microsurgical knifes.

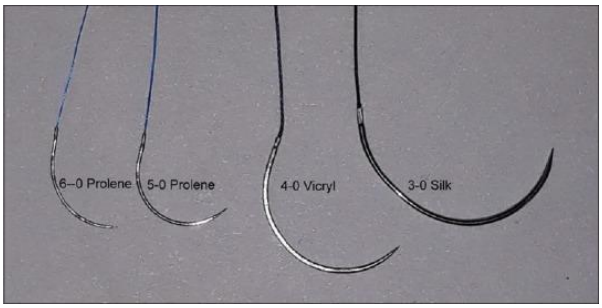

Fig 10: Microneedles and sutures

Operating/ Surgical Microscope:

The surgical microscope is a complicated system of lenses that allow binocular viewing at a magnification of approximately 4X to 40 X. In contrast to loupes, both light beams fall parallel onto the retina of the observer so that no eye convergence is necessary, and the demand on the eye muscles is minimal. [14] The surgical microscope consists of the magnification charger, objective lenses, lighting unit, binocular tubes & eyepieces. It can be fixed to the floor or mounted on the wall or ceiling. (Fig.5)

Advantages:

A. Greater operator eye comfort due to parallel viewing optics of the Galilean system.
B. Range of variable magnification systems.
C. Excellent co-axial fibre optic illumination.
D. Countless accessories such as still and video cameras for case documentation.

ADVANTAGES OF USING A MICROSCOPE IN DENTISTRY:

Postural: Posture should be perfect, so as not to cause discomfort to the back and neck, protecting the spinal column from future problems. The microscope forces us to work at the same distance from the object at all times, avoiding tiring the eyes, as there is no need to make constant adjustments. It considerably improves manual abilities as the operating field is magnified. [14]

Psychological: It decreases occupational, physical and postural stresses and increases personal and professional satisfaction when the improved quality of our surgical treatments is seen. It also improves clinical results, with less post-operative discomfort to the patient. [15]

Educational: This makes it easy to gather clinical images and photographs, as a camera can be incorporated. It is easier to create reports, whether these are reports made for referring to dentists, legal assessment reports or damage valuation reports for insurance companies. it also Makes very much more comfortable to record diagnostic sequences and treatment in video format. [16]

Microsurgical Instruments:

Proper instrumentation is fundamental for microsurgical intervention. In microsurgery, virtually all surgical movements have been reduced to a pinch mechanism between thumb and index fingers ,guiding movement by direct vision rather than feel.[8] As the instruments are primarily manipulated by the thumb, index and middle finger, their handles should be rounded, so that finely controlled rotating movements can be executed.[9] The weight of the instrument should not exceed 15 - 20 gm. A basic set comprises of a needle holder, micro scissors, micro scalpel holder, anatomic and surgical forceps and a set of various elevators. [17]

Surgical Knives: (Fig.9)

Several types of ophthalmic knives, such as the crescent, lamellar, blade breaker, sclera, and spoon knife, can be used in the field of periodontics also. Compared with the standard 15 blades commonly used in periodontics, the smaller size of the ophthalmic knives facilitates surgical work. [6] The crescent knife can be used for intra sulcular procedures. This knife is designed with a single bevel and measures 2.4 mm - 3.7 mm. It can be used in connective tissue graft procedures to a tunnel, to prepare the recipient site. spoon knife is often used to undermine the lateral sulcular region in preparation for placement of connective tissue grafts using a sulcular, non relief technique.

Using smaller instruments under magnification allows surgeons to refine their movements with the end result of enhanced surgical skills. [6]

Needles and Suture Materials: (Fig.10)

Needles vary in size, shape and curvature, but most needles used in dentistry are of 3/8 curvature. Periodontist frequently uses a reverse cutting needle a significant size (16 to 19mm). Although larger needles are sometimes indicated for periodontists, several needles allow more precise approximation of tissue edges. One such needle is a spatula needle, which is 6.6mm in length and has a curvature of 140 degrees. [6]

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, needles of length 13-15 mm are appropriate. The same task in the front aspect requires needles of length 10-12mm and for closing a buccal releasing incision, needles of length 5-8 mm are adequate. [8]

The availability of smaller needles can affect the choice of sutures. Accepted surgical practice is to select the smallest suture that will adequately hold the mending tissue. This practice minimizes the opening made by the needle and minimizes the tissue trauma. Although 4-0 or 5-0 sutures are typically used in periodontics, in periodontal microsurgery 6-0 and 7-0 are used. Surgical gut (plain and chromic), polyglactin 910, poliglecaprone 25and polydioxanone are four absorbable sutures indicated for use in periodontal surgery. [18]

Microsurgery in Periodontics:

The use of surgical prism loupes or the surgical microscopes has introduced the reality of considerable less invasive surgical incisions and flap reflection in periodontics, but the flap reflection must be adequate to the clinical situation. In periodontics, it is common to use dual or buccal and lingual flaps, which are often returned to postsurgical position different from the preoperative position.

Benefits of Microscopes in Periodontics:

The surgical operating microscope, like all magnification, enhances visual acuity.

This leads to:

1. Increased precision in the delivery of surgical skills, which results in more accurate incisions via smaller instrumentation, less trauma, and quicker postoperative healing.

2. Precise repositioning of tissues with smaller needles and sutures.

3. Improved view of root surfaces, which permits more definitive removal of calculus and improved smoothness of the root. [6]

Periodontal applications of microsurgery:

1. Allows the surgeon to minimize the size of the surgical site, reducing patient discomfort and healing time.

2. Improves accuracy of microsurgical incisions and suturing with 6-0 through 8-0 sutures, permitting precise tissue/tissue and tissue/tooth approximation for primary would healing.

3. Improves visualization of the root surface and adjacent intra-bony defects for definitive removal of calculus. [19]

4. Helps inspection of the quality of restorations and peripheral tissues.

5. Permits micro-level osseous surgery facilitating bone removal without nicking the root surface and allows for better periodontal ligament preservation during ostectomy.

6. Permits accurate subepithelial placement and suturing of membranes and subepithelial connective tissue grafts.

7. Permits precise control of laser surgery on adjacent teeth without injury to root or implant surfaces.

8. Permits accurate and more accessible root amputations and hemisection. Also helps with periapical surgeries when required during periodontal surgery.

9. Permits excellent dissection of the mandibular and mental nerves for lateral displacement during the mandibular implant procedure.

10. Permits location of the periodontal ligament for the atraumatic elevation of roots and root tips during extraction with concurrent ridge preservation/augmentation.

11. Improves detection and evaluation of root fractures and abnormalities.

12. Provides upright working conditions, alleviating occupational neck, back and shoulder problems.

13. Provides high-resolution video and 35mm photography for patient education, enhanced training, and insurance/legal documentation. [20]

Ergonomic Advantages of Operative Microscope in Periodontal Microsurgery:

Because of more static design, the microscope determines the operator or the patient from constant positions shift, thus forces the dentist into better management of ergonomics are improved by two fundamental aspects:

1. When working under a microscope the dentist looks in front of him/her, and not at the operating field, and can thus keep an upright position, getting rid of all non- physiological curves of his/her spine. Certain high-end microscope even proposes focal length, allowing the operator to assume an ideal posture for the entire duration of the procedure without having to worry about keeping the operative field at a specific distance from the lens.[21]

2. The optic of a microscope is parallel, aligned with the axis of vision at infinity. The eyes of the operator do not need to converge or to accommodate; which completely removes from them, even when using the highest magnification. Where loupes eventually generate eye fatigue, headaches, especially for the most powerful of them, the microscope can take the dentist to the end of the day with perfectly relaxed eyes, while offering the best vision possible in a comfortable posture, favouring quality of care and pleasure at work.

Implant Microsurgery:

All phases of implant treatment are possible using a microscope with magnification above x10. Because of the minimized tissue trauma associated with microsurgery, patient report little or no discomfort after the combination of microsurgical tooth removal, precise implant placement in the socket, and seating an anatomically correct provisional restoration.[22]

Recent Advances in Microsurgery:

TOMS (Three-Dimensional on-screen Microsurgery System):

The system consists of a video microscope, which projects a magnified stereoscopic 3-D image onto one or more video monitors. This setup is called three-dimensional on-screen microsurgery system (TOMS). Development of stereoscopic three-dimensional display technologies capable of providing a clear and accurate sense of depth perception has been a critical requirement for the rapidly evolving field of minimally invasive surgery (MIS). As an alternative to the operating microscope advances in video technology can now permit the surgeon to view a microsurgical field or a video monitor in three dimensions without the necessity of physically looking through the microscope eyepieces.

Components of Toms: (Fig.6)

- Two single-chip video cameras mounted on custom-fit eyepiece adapters.
- A dual-camera controller.
- A view/record image processor.
- A VCR for optional recording.
- A digital monitor.
- A synchronizing signal emitter.
- 120 MHz shutter glasses (stereo eyewear).

Stereoscopic microscope imaging system: (Fig.7,8)

There have been few reports on the evaluation of stereoscopy in surgery. Von Pichler and coworkers noted in their study on a laparoscopic model that stereoscopy made no difference to the operation time of an experienced surgeon, although it facilitated orientation and reduced operation time for inexperienced surgeons compared to monoscopic vision. Although the system can require all viewers to wear polarized filter glasses, the stereoscopic viewing impression is robust against position changes and the number of viewers. Stereoscopy devices have been used in the operation theatre before, either as a standalone solution or in combination with three-dimensional volume rendering from computer-assisted surgery. However, these devices have rarely served as the primary source of visual information for the surgeon, as their resolution is limited. In our study, stereoscopic video in high-definition resolution has been used to replace the direct microscopic view to perform surgical applications.

Robotic Microsurgery

From the early beginnings of microsurgery, development of instrumentation to assist the microsurgeon in complex microsurgical procedures has been ongoing.

The applicability of the robotic platform for microsurgery is improving due to the development of new microsurgery-specific robotic instrumentation. Since the first robot-assisted surgery in 1997 by Jacques Himpens and Guy Cardiere in Belgium, the technology has evolved and changed the landscape of modern-day medicine.

The robotic platform is novel adjunctive tools that provide enhanced optical magnification, micro-Doppler sensing of vessels down to a 1-mm size, vein mapping capabilities, hydro-dissection, micro-ablation technology (with minimal thermal spread–CO_2 laser technology), and confocal microscopy to provide imaging at a cellular level.[23]

CONCLUSION

Periodontal microsurgery is still in its infancy, but the scope for it in future is enormous. It is a skill that requires practice to achieve proficiency of the highest level in the area to which it is applied. The miniature world of microsurgery presents particular challenges inability and perception. Its execution is technique sensitive and is more demanding than conventional periodontal procedures. As the benefits of the microscopes are realized, it will be applied more universally. Future of periodontics will see increasing use of magnification in all areas of practice including Implantology.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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