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PERIODONTAL MICROSURGERY- THE GROWING WAVE OF MAGNIFICATION

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ABSTRACT

Over the past years, various innovative procedures have been introduced with the aim of obtaining the treatment outcome which is best for the patient in the field of Periodontology, one such advancement is the application of microsurgery in the treatment of various periodontal problems and conditions. The improved visual acuity of microsurgery aids in the surgical procedures and provide the advantages of less patient discomfort, rapid healing, improved esthetics and better patient compliance. The aim of this paper is to provide an overview of added benefits of periodontal microsurgery to conventional periodontal surgery.

KEYWORDS: Microsurgery, magnification loupes, surgical microscope, mucogingival surgery.

INTRODUCTION

Advancement in medical and dental fields have helped to achieve much desired therapeutic goals. Daniel RK. (1979)[1] broadly defined microsugery as surgery performed under the magnification provided by operating microscope. Microsurgery was described by Serafin (1980)[2] as a methodology which assures modification and refinement of existing surgical techniques using magnification to improve visualization, with applications to all specialties. Modern periodontology is linked to plastic surgery and esthetic dentistry.[3] Studies have demonstrated primary wound closure, less post-operative discomfort and better esthetic results.[4] The success criteria of treatments performed to improve esthetics may be different than those done to improve periodontal health.[5]

Principles of Microsurgery[6]

As a treatment philosophy, microsurgery incorporates three important principles:

1. First is enhancement of motor skills to improve surgical ability. This is evident in the smooth hand movements accomplished with increased precision and reduced tremor.
2. Second is the decreased tissue trauma at the surgical site, which is apparent in the use of small instruments and a reduced surgical field.
3. Third is the application of microsurgical principles to achieve passive and primary wound closure. The aim is the elimination of gaps and dead spaces at the wound edge to circumvent new tissue formation needed to fill surgical voids. A painful and inflammatory phase of wound healing can then be avoided.

Microsurgical Triad

The three elements, i.e. magnification, illumination, and refined surgical skills, are called the microsurgical triad (Fig. 1).

Magnification System

There is a wide range of simple and complex magnifying systems that are available, including three types of magnification loupes and the operating microscope. (Fig. 2).

Magnifying Loupes

Loupes are essentially two monocular microscopes with lenses mounted side by side and angled inward (convergent optics) to focus on an object. Surgical loupes for magnification enable the clinician to experience the ergonomic benefits of an increased working distance from viewing object as well as improved visual acuity.

Three types of loupes are commonly used.

1) Simple loupes

2) Compound loupes

3) Prism loupes

1. Simple loupes

Simple loupes are primitive magnifiers with limited capabilities, consisting 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.

Advantage

- Low cost.

Disadvantage

- Subjected to spherical and chromatic aberration, that ultimately distorts the image and color of the object that is being viewed.
- Their size and weight limits the practical application in dentistry, which is beyond a magnification range of 1.5 x, hence distorting the image.
- When positioned closed to the eye, it sacrifice depth of field for working distance.
- When positioned close to the object viewed, it sacrifice working distance for depth of field.[7]

2. Compound loupes

It consists of converging multiple lenses with intervening air spaces to gain additional refracting power, magnification, working distance and depth of field. Compound lenses are achromatic (limits the effects of chromatic and spherical aberration and brings two wavelengths into focus in the same plane) and substantially improved optical design. It is usually mounted on eyeglasses. It can be adjusted to clinical needs without excessive increase in size or weight. However, it become optical insufficient at magnifications above 3 x.

Advantages

- Better magnification
- Wider depths of field
- Longer working distances, and
- Larger fields of view

Disadvantages

- There is lack of variable magnification.
- Individual light source may be required.
- Protective coating of anti-reflective material to prevent loss of light transmitted.

3. Prism loupes

These loupes produce superior magnification since they contain Schmidt or roof-top prisms. Advantages include better magnification, larger surgical view with wider depths of field, and longer working distances. Furthermore, because of the shorter barrels of the prism loupes,

these loupes can be easily mounted on either eyeglass frames or head bands. But at magnifications of 3 x or greater, headband mounted loupes are more comfortable and stable than mountings on glasses due to increased weight. The incorporation of coaxial fiber optic lights in prism telescopic loupes has improved the operative site illumination to a greater extent.

Loupe magnification range

The surgical loupes provide a wide range of magnification 1.5 x to 10 x. In most of the periodontal procedures, prism telescopic loupes of 4x magnification, even though lower than the operating surgical microscope, provide an effective combination of magnification, field of view, and depth of focus. The major disadvantage of loupes is that the clinician's eyes must converge to view on the operate field, which can result in eye strain, fatigue, and even vision changes when poorly designed loupes are used. But, loupes are less expensive and initially easier to use.[8]

Choice of Loupes

Before chosing a magnification system, different loupes and appropriate time for a proper adjustment have to be considered. Ill fitting or 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 4 x and 4.5 x, either head band or front frame mounted, with a suitable working distance and a large field of view, seems to be instrument of choice.[9]

Surgical Operating Microscope

Surgical microscope utilizes the 'Galilean optical principles.'(Fig.3) Optimal magnification factor for the periodontal surgery ranges from 5 x to 12 x. It consists of a complicated system of lenses that allows stereoscopic vision at a magnification of approximately 4 – 40 ×. The microscope mountings are available for ceiling, wall mount, or on the floor. Clinicians are not affected by the weight of the instrument or the challenges of maintaining a stabilized field of vision since they are external to the body. Surgical microscope has both maneuverability and stability.

Loupes Versus Operating Microscope

Loupes and operating microscope both improve the visual power and both increase the optical working distance causing increased and efficient work. Problems that are common to

a dentist such as eye, neck, shoulder, and back pains may be eliminated by using the surgical microscope.

Advantages of loupes[10]

- Ergonomic benefits of an increased working distance from the viewing object as well as increased visual acuity.
- Loupes are less expensive and initially easier to use.
- They are also less cumbersome in the operating field and less likely to breech a clean operating field.

Disadvantages of Loupes

- Include fixed magnification or a lack of magnification variability.
- Potential need for additional light for magnification levels of 4 x or greater.
- Eyes must converge to view an image, which can result in eyestrain, fatigue, and even vision changes with prolonged use of poorly fitted loupes.
- As the length of the loupe increases to provide for more magnification, the weight of the lens also increases which becomes more uncomfortable.

Advantages of Operating Microscope

- It offers versatility due to an extended range of variable magnification from 2.5 x to 20 x and to excellent coaxial fiber-optic, shadow-free illumination.
- Availability of numerous accessories for digital still and video image case documentation.
- Increased operator eye comfort due to the parallel viewing optics provided by the Galilean system.

Disadvantages of Operating Microscope[11]

- Can be more cumbersome to use.
- More expensive
- Difficult to master the technique to use.

Ergonomics

Various postural and ergonomic ways of reducing unwanted hand movements with the use of surgical microscope result in more precise surgeries and greatly reduce surgical fatigue and development of spinal and occupational pathology.[3]

Hand Control

Physiologic tremor

Physiologic tremor is the uncontrolled movement arising from both the intended and unintended actions of our bodies. Awareness of its effect is magnified by visual enhancement. During microsurgery, physiologic tremor manifests as a naturally occurring unwanted hand and finger movement.[2] To minimize tremors, a microsurgeon must have a relaxed state of mind, good body comfort and posture, a well-supported hand, and a stable instrument-holding position. Attitude is also very important.[12] Mental focus and patience during the procedure are important factors in maintaining precise motor control skills.

In microsurgery, the hand should either directly or indirectly rest on an immovable surface or unwanted movements will occur. Only the fingertips move. All movements should be efficient and economical, and should be made with a unity of effort toward purposeful, deliberate motions. There are several factors that can influence a surgeon's physiologic tremor, including anxiety, recent exercise, alcohol, smoking, caffeine, heavy meals, hypoglycemia, and medication usage.[13]

Hand grips

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.[14,15] In the three-digit grip, an instrument is held exactly as a pen would be held when writing. The thumb and index and middle fingers are used as a tripod.

Microsurgical Instruments

A basic set comprises of a needle holder, micro scissors, micro scalpel holder, anatomic and surgical forceps, and a set of various elevators.[16] Several types of ophthalmic knives such as the crescent, lamellar, blade breaker, sclera and spoon knife can be used in the field of Periodontics.

Microsurgical knives

The knives which are commonly used in periodontal microsurgery are those which are used in ophthalmic surgery or plastic surgery.[7] These knives have their characteristic ability to create clean incisions to prepare the sharp flap margins for healing by primary intention. Ophthalmic knives offer the dual advantages of extreme sharpness and minimal size. This helps limit tissue trauma and promotes faster healing.[17] Various types of knives such as

crescent, lamellar, blade breaker, sclera, and spoon knife can be used.[18] Compared with standard 15 blades commonly used in periodontic, the smaller size ophthalmic knives facilitates surgical work.[19]

1. Blade-breaker knife has a handle onto which a piece of an ophthalmic razor blade is affixed. This knife is often used in place of a no. 15 blade.[20]

2. The Crescent knife can be used for intrasulcular procedures. It can be used in connective tissue graft procedures to tunnel, to prepare the recipient site, or to obtain the donor graft.[20]

3. The Spoon knife is often used to undermine the lateral sulcular region in preparation for placement of connective tissue grafts.[19]

Microsurgical scissors

These are used for the dissection of tissues, blood vessels, and nerves. The most commonly used microscissors are 14 cm and 18 cm long. To manage the delicate part of the tissues, 9 cm microscissors are preferable. Straight scissors cut sutures and trim the adventitia of vessels or nerve endings. Curved scissors dissect vessels and nerves.[10]

Microsurgical needle holders

A titanium needle holder is the best choice. Titanium instruments tend to be lighter, but are more prone to deformation and are usually more expensive. Stainless steel instruments are prone to magnetization, but there is a greater number and wider variety of them.[6] The most commonly used are 14 and 18 cm. Usually a delicate tip (0.3 mm) is used for 8-0 and 10-0 sutures. The needle holder with a 1-mm tip is used for 5-0 and 6-0 sutures.[18]

Microsurgical needles

Periodontists frequently use a reverse cutting needle of a significant size (16 to 19 mm). Microsurgical needles are made of stainless steel directly swaged onto the suture ends. The needle tip may be taper point, conventional cutting, reverse cutting, and spatula or side cutting.[3] Several needles with sizes ranging from 6.6 to 19 mm can be used in periodontics. For periodontal microsurgery, the 3/8" circular needle generally ensures optimum results.[17]

Microsurgical sutures

Suture Material

Although 4-0 or 5-0 sutures are typically used in periodontal microsurgery 6-0 to 9-0 sutures are appropriate.[18,19]

Knot tying

Knot tying using the microscope is done using instrument ties, with a microsurgical needle holder in the dominant hand and a microsurgical tissue pick-up in the nondominant hand.[20] Well tied microsurgical knots are stable and resist loosening, even under functional load.[21] The dominant and combination tying technique are the two most commonly used in dentistry.[23] Square knots are the best to guarantee the integrity of the knot. A surgeon's knot followed by a square knot is the preferred knot combination. Adding excess ties to a knot does not increase its strength or integrity; it only adds to the bulk of the knot.

Microsurgical Indications In Periodontal Surgery

With the high power magnification, dentist's vision can actually pass through tiny openings, such as pocket entrances and crestal gingival punched accesses. As a result, there would be no more need for traditional open flap surgery to create visibly large wounds. Without incision and tearing of periosteum, healing can be faster and more uneventful. Microsurgery benefits include improved cosmetics, rapid healing, minimal discomfort and enhanced patient acceptance. In periodontal practice, the tissues to manipulate are usually very fine resulting in a situation in which the natural vision capacity reaches its limits. Therefore, the clinical procedure may only be performed successfully with the use of magnification improving precision and, hence, the quality of work.[6]

Applications in periodontal flap surgery

Flap reflection in periodontics is to gain exposure of the underlying tissues i.e. bone and the root surface. By using microsurgical techniques, periodontal flap margins can be elevated with uniform thickness that has a scalloped butt-joint. This facilitates precise adaptation of the tissue to the teeth or the opposing flap in an edentulous area, thus eliminating the gaps and dead spaces circumventing the need for new tissue formation and enhancing periodontal regeneration. The use of surgical microscope increases surgical effectiveness and thus has become the indispensable part of periodontal surgical practice. Studies have shown improved initial healing in the sites with microsurgical approach due to more accurate and atraumatic handling of the soft tissues. Further, the coronal displacement of the flaps over the defects was found to be easier and had less tension with the microsurgical technique, which facilitates healing and return of the mucogingival line to its original position.[4,24]

Application in root visualization

The importance of root debridement is recognized universally as an essential component of periodontal therapy. The critical determinant of the success of periodontal therapy is the thoroughness of debridement of the root surface rather than the choice of grafting modality. Studies designed by Buchanan et al (1987)[25] and Caffesse et al (1986)[26] evaluated the effectiveness of calculus removal after scaling and root planing, with and without surgical intervention have noted that all calculus is seldom removed from the root surfaces. Magnification greatly improved the surgeon's ability to create a clean and smooth root surface.

Application in Periodontal Plastic Surgery

Improvement in esthetics is a major indication for periodontal plastic surgery. One way to achieve more consistent mucogingival surgical treatment results is to use microsurgical techniques. Periodontal microsurgery has proven to be an effective means of improving the predictability of root coverage procedures with less operative trauma and discomfort.[7]

Root Coverage Procedures

Success of root coverage procedure involves atraumatic surgical approach, dexterity of surgeon and excellent visualization of the operating field. All these factors can be fulfilled using a surgical microscope. In that respect Burkhardt et al (2005)[27] have demonstrated significant contribution (coverage 8%) by using microsurgical approach. In addition the degree of shrinkage is influenced by surgical approach. With microsurgical procedures providing significantly improved outcomes than conventionally performed mucogingival surgery.

Papilla Reconstruction Procedures

The reconstruction of lost interdental papillae remains a challenge. Predictable results are hindered by the small dimensions of the interproximal space and the pattern of vascular supply to this end organ. Many surgical techniques have been described to augment soft tissue around dental implants and teeth, which can create phonetic problems, saliva bubbles, and cosmetic deficiencies Among all techniques microsurgical procedure is an atraumatic procedure to position donor tissue under a deficient interdental papilla. Because of the small dimensions of the interdental papilla and the limited access, surgical magnification and microsurgical instruments are recommended, as they assist the surgeon by increasing

visibility, eliminating unnecessary releasing incisions or unintentional incisions, and facilitating access, thus improving the predictability of the process.[7]

Application for Microsugery for Periodontal Regeneration

Outcomes of periodontal regenerative procedures is dependent on a variety of factors like, depth of the intrabony defect, number of residual bony walls and/or probing depth. (Tonnetti et al 1996). Among the technical/surgical factors, membrane, graft exposure and contamination have been associated with reduced outcomes. Therefore Harrel (1998)[28] described a periodontal minimally invasive surgery technique for the placement of bone grafts in periodontal defects. He reported the bone grafting using minimally invasive surgery was appeared to give superior results. The minimally invasive surgery technique (MIST) was designed specifically to treat isolated intrabony defects using periodontal regeneration.

Application in aesthetic implant reconstruction, sinus lifts procedures

If attention is paid to details of maintaining the interdental papillae, gingival architecture, and alveolar bone, implant reconstruction can proceed without loss of the pre-existing dental anatomy. The execution of microsurgical technique limits collateral damage. When microsurgical principles are combined with an understanding of microanatomy, the surgeon becomes an architect of unique surgical method. The novel applications of microsurgery are in the sinus lift procedure and immediate implant placement. Studies show that motor coordination and accuracy is generally increased when surgeons use a microscope. Increased visual acuity, improved ergonomics, and body posture are closely related to those improvements. The surgical microscope can aid in visualization of the sinus membrane. Magnification achieved by the surgical microscope is instrumental in implant site development and placement. (Shanelec D 2005, Duello GV. 2012).[17,29]

Drawbacks of Microsurgery

As we upgrade our surgical maneuvers with the aid of microsurgical concepts, there are a few shortcomings of this modus operandi, which need to be considered prior to its application. It is much more demanding and technique-sensitive; the cost incurred to establish a microsurgical set up is also high. Magnification systems used also pose some difficulties including restricted area of vision, loss of depth of field as magnification increases, and loss of visual reference points. An experienced team approach mandates microsurgery and is time-consuming to develop. Physiologic tremor control for finer movements intra-operatively and a steep learning curve are required for clinical proficiency.[3]

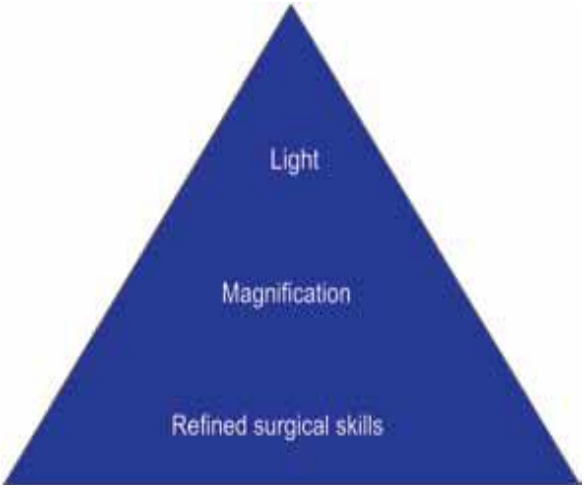

Figure 1: Microsurgical triad.

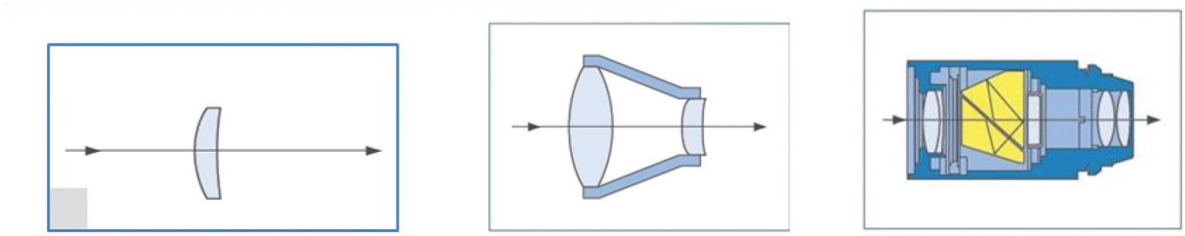

Figure 2: Types of loupes.

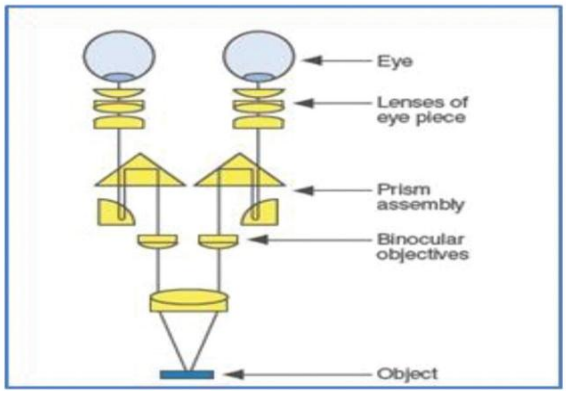

Figure 3: Surgical microscope.

CONCLUSION

Viewing periodontal surgery under magnification is an opportunity for the periodontal surgeon to overcome the coarseness of conventional surgical manipulation. What appears to the unaided eye as gentle surgery is revealed under magnification to be gross crushing and tearing of delicate tissues. Periodontal microsurgery is the transition from conventional surgical principles to a surgical ethic to permit the most accurate and atraumatic handling of

tissue to enhance wound healing. Periodontal microsurgery introduces the potential for, less invasive surgical approach in periodontics. Periodontal surgeons continue to notice the extent to which reduced incision size and surgical retraction are directly related to decreased postoperative pain and rapid healing.

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