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PERIODONTAL MICROSURGERY:EVOLUTION IN PROGRESSION OF PERIODONTICS.

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ABSTRACT To attain success an amalgamation of operator dexterity with a minimally traumatic approach and enhanced visual perception are mandatory. Over the past decade, the field of periodontics has seen increasing surgical refinement of many procedures. Consistent successful periodontal treatment procedures demand clinical expertise that challenges the technical skills of periodontists to the limit of and beyond the range of visual acuity. The purpose of this article is to introduce the history of microsurgery in the surgical disciplines.It reviews the benefits and potential applications of magnification and microsurgery in the specialty of periodontics.Periodontal microsurgery is the refinement of basic surgical techniques made possible by the improved visual acuity gained with the use of surgical microscope. In the hands of a trained and experienced clinician, microsurgery offers enhanced outcomes not possible with traditional macrosurgery, especially in terms of passive wound closure and reduced tissue trauma.The effect of periodontal microsurgery may include more predictable therapeutic results, less invasive procedure with reduced patient discomfort, more rapid healing, improved cosmetic results and greater patient acceptance. The improved visual acuity of microsurgery provides significant advantages to those who take the time to become proficient in microsurgical principles and procedures. Microsurgery is not a separate field as such but only a modus operandi applicable to any surgical field in health sciences.

KEYWORDS : microsurgery,periodontics,magnification,surgical microscope,loupes.

INTRODUCTION:

Periodontology has grown exponentially incorporating various advances in technology available today, microsurgery being one of them. Microsurgery is broadly defined as "surgery performed under magnification provided by the microscope"[1] .Periodontal microsurgery[2] is the refinement of basic surgical techniques made possible by the improvement in visual acuity gained with the use of the surgical microscope. In 1979, Daniel[1] defined microsurgery in broad terms as surgery performed under magnification by the microscope. In 1980, microsurgery was described by Serafin[3] as a methodology—a modification and refinement of existing surgical techniques using magnification to improve visualization, with applications to all specialties.

As a treatment philosophy, microsurgery incorporates three important principles[4]:

1. Improvement of motor skills, thereby enhancing surgical ability
2. An emphasis on passive wound closure with exact primary apposition of the wound edge
3. The application of microsurgical instrumentation and suturing to reduce tissue trauma.

Microsurgery represents an amplification of universally recognized surgical principles in which gentle handling of soft and hard tissues and extremely accurate wound closure are made possible through magnification, allowing for well-planned and precisely executed surgical procedures[5] .

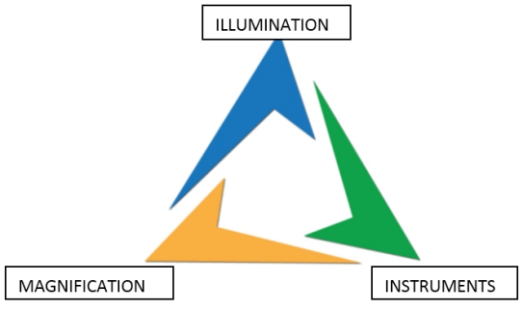
HISTORY:

Magnification for microsurgical procedure was introduced to medicine during the late nineteenth century [6]. Saemisch, a German ophthalmologist, introduced simple binocular loupes to ophthalmic surgery in 1876. In 1921, Carl Nylen, who is considered the father of microsurgery, first used a binocular microscope for ear surgery[7] .In 1922, Nylen first performed eye surgery under a microscope [1,8]. During 1950s, Barraquer began using the microscope for corneal surgery [8]. By the 1960s microsurgery was standard in many specialties such as neurology and ophthalmology[3,9]. A factor in its acceptance was lessened morbidity associated with smaller wounds. Apotheker and Jako first introduced the microscope to dentistry in 1978[10] .Microsurgery has been practiced in endodontics since 1986[11] . During 1992, Carr published an article outlining the use of the surgical microscope during endodontic procedures[12]. It was introduced to the specialty of periodontics in 1992. In 1993, Shanelec and Tibbetts presented a continuing education course on periodontal microsurgery at the annual meeting of the American Academy of Periodontology[13] .

PRINCIPLES AND CONCEPTS OF MICROSURGERY:

In the minds of many dental professionals, microsurgery is an interesting concept, The principles of microsurgery are an amplification of those applicable to any general surgical procedures. Of prime importance are gentle handling of tissues and passive wound closure aiding in primary uneventful healing, making the procedure more acceptable. The concept of microsurgery is based on three important elements which form the microsurgical triad (Fig. 1) that includes magnification, illumination and instruments[14].Without any one of these, microsurgery is not possible.

Fig 1- MICROSURGICAL TRIAD



CLINICAL PHILOSOPHY

Consistent application of the philosophy and techniques learned in basic microsurgery education is necessary for the operator to attain a level of experience and competence needed for various periodontal surgical procedures[2,4].Effective periodontal microsurgery allows the operator to consistently achieve clinical results that were once thought to be unlikely. Becoming a clinically proficient periodontal microsurgeon requires a willingness to adopt new values and ideas. Training with the microscope enhances the motor skills, which can translate to improved surgical skills. The methods of precise, delicate tissue handling, wound closure, and suturing require concentration and practice. The development of new thought patterns regarding surgical esthetics is necessary, and

attention must be paid to microanatomy, tissue manipulation, and surgical craftsmanship[4] .

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[3].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[4] .Mental focus and patience during the procedure are important factors in maintaining precise motor control skills. Physiologic tremor is usually associated with tension generated by the postural control "antigravity" muscles[5] .Since these muscles are a major cause of tremor, a relaxed and proper seating posture is essential. Proper ergonomics can help to prevent neck and back injuries resulting from poor chairside habits. During a surgical procedure, patient and chair position must be adjusted to the surgeon and the microscope.All movements should be efficient and economical, and should be made with a unity of effort toward purposeful, deliberate motions[2] .

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[8,15] . The thumb and index and middle fingers are used as a tripod. With the tripod formed by the fingers in the pen grip, the middle finger holds the instrument. The thumb and index finger are arranged on the instrument into contact with the underlying middle finger. When an instrument is held with the internal precision grip, the instrument can be opened and closed with very fine control. Using the pen grip, the flexor and extensor muscles of the hand are relaxed, resisting fatigue, while the intrinsic muscles that rotate the hand are well postured, resulting in the most accurate motion of which the hand is capable [16] .Accurate, exact hand movements with instruments of the correct length and design along with precision hand grips are crucial to good microsurgical results. The most precise rotary suturing movement for a right-handed person is from the 2 o'clock to the 7 o'clock position, while the most precise movement for left-handed people is from the 10 o'clock to the 4 o'clock position. Once command in suturing from the 2 o'clock to 7 o'clock position is gained from repeated practice, proficiency of the 10 to 4 position is necessary. Persistent practice of alternative positions around the entire 360-degree axis ultimately results in mastery of surgical skills necessary to render successful microsurgical treatment in all areas of the mouth[2] .

MICROSURGICAL INSTRUMENTS:[2,6,18]

An important characteristic of microsurgical instruments is their ability to create clean incisions that prepare wounds for healing by primary intention.In addition to the use of magnification and reliance on atraumatic technique, microsurgery entails the use of specially constructed microsurgical instruments, specifically designed to minimize trauma. Proper instrumentation is fundamental for microsurgical intervention. Magnification enables dentists to use smaller instrumentation with more precision. With microscopic magnification and the use of microsurgical instruments, tissue trauma and bleeding can be minimized. For high-precision movement, microsurgical instruments must be approximately 15 cm in length. For an average-sized hand, this provides adequate length for an instrument held in a pen grip to rest in the web between the thumb and index finger. Instruments should be circular in cross section to allow for a smooth rotation movement. To provide consistent manipulation of tissues, needles, and sutures, most microsurgical instruments are manufactured under magnification to high tolerances.Needle holders and tissue forceps are made of titanium. Properly cared for, such instruments are resistant to distortion from repeated use and sterilization, are nonmagnetized, and are lighter than surgical stainless steel instruments. Shorter instruments, as well as instruments with a rectangular cross-sectional design, do not allow as precise manipulation and therefore are not ideal for microsurgery[18].Several types of ophthalmic knives such as the crescent, lamellar, blade breaker, sclera and spoon knife can be used in the field of Periodontics. Ophthalmic knives offer the dual advantages of extreme sharpness and minimal size. This helps limit tissue trauma and promotes faster healing [20] .Because ophthalmic knives are chemically etched rather than ground, their sharper blades produce a more precise wound edge.[10]

Although the variety of microsurgical instrumentation designed for periodontal therapy is vast, the instrumentation can be divided into the following subgroups:

Knives

Common characteristics of these knives are their extreme sharpness and small size. This enables precise incisions and maneuvers in small areas .

Periodontal microsurgical knives(Fig 2): *1*- blade breaker; *2*-crescent; *3*-minicrescent; *4*-260° spoon; *5*- lamella, and *6*- sclera

Fig 2-Periodontal microsurgical knives.

Blade-breaker knife

- Has a handle onto which a piece of an ophthalmic razor blade is affixed.
- Allows for infinite angulations of the blade.
- Often used in place of a no. 15 blade.

The Crescent knife

- Can be used for intrasulcular procedures.
- It is available with one-piece handles or as a removable blade.
- It can be used in connective tissue graft procedures to obtain the donor graft, to tunnel under tissue, and to prepare the recipient site.

The spoon knife

- Beveled on one side, allowing the knife to track through the tissue adjacent to bone.
- Frequently used in microsurgical procedures to undermine tissue, enhancing the placement of a connective tissue graft.

Retractors and elevators have been downsized.

Scissors such as the micro-vannas tissue scissors are used for removal of small fragments of tissue.

Needle holders are also downsized from sizes designed for conventional periodontal surgery.

Tying forceps

- Are an essential component of two-hand microsurgical tying.
- They are available in two general styles: platform and nonplatform.
- Several designs of both needle holders and tying forceps are available.

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. Stainless-steel instruments are prone to magnetization, but there is a greater number and wider variety of them.

MICROSURGICAL NEEDLES AND SUTURES

An appropriate combination of properly selected needles and closure materials allows the surgeon to precisely position the suture and to approximate the tissue with as little trauma as possible while eliminating dead space and preventing movement of the wound. In the field of dentistry, particularly Periodontists frequently use a reverse cutting needle of significant size of 16mm to 19mm. Other forms such as spatula needle, which is 6.6mm in length and has a curvature of 140 degrees are used for accurate apposition closure and immobilization of connective tissue graft in microsurgery. An accepted surgical practice in existing condition is selection of smallest sutures that adequately mend the tissues. Although 4-0 or 5-0 sutures are typically used in Periodontics, in periodontal microsurgery 6-0 and 7-0 sutures are appropriate[2,18] .

MAGNIFICATION SYSTEMS: [2,3,18,30]

There are two types of optical magnification systems available to dentists which include :

1. Loupes
2. Surgical Operating Microscope

1. 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. Although loupes are widely used, their major disadvantage is that the eyes must converge to view an image, which can result in eye strain, fatigue and even vision changes with the prolonged use of poorly fitted loupes. Three types of loupes are commonly used:

A. Simple loupes.
B. Compound loupes.
C. Prism loupes.

A.Simple loupes - Simple loupes consist of a pair of single, positive, side-by-side meniscus lenses(Fig 3). Each lens has two refracting surfaces, with one occurring as light enters the lens and the other when it leaves. Its main advantage is that it is cost effective.The disadvantages include : 1)It is primitive with limited capabilities. 2)When positioned close to the object viewed, they sacrifice working distance for depth of field.3)When positioned close to the eye, simple loupes sacrifice depth of field for working distance.4) Because of their size and weight limitations, they have no practical dental application beyond a magnification range of 1.5 diameters, where working distances and depths of field are compromised.5) They are highly subjected to spherical and chromatic aberration, which distorts the image of the object.

Fig 3-SIMPLE LOUPES

B. Compound loupes - Compound loupes consist of converging multiple lenses with intervening air spaces to gain additional refracting power, magnification, working distance, and depth of field (Fig 4).They can be adjusted to clinical needs without excessive increase in size or weight. Compound lenses can be achromatic, in addition to improved optical design.This is a feature that dentists should seek when selecting any magnifying loupe because an achromatic lens consists of two glass pieces, usually bonded together with clear resin. The specific density of each piece counteracts the chromatic aberration of the adjacent piece. These are commonly mounted on eyeglasses.

Fig 4-COMPOUND LOUPES MOUNTED ON EYEGLASSES

C. Prism 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 (Fig 5). They lengthen the light path by virtually folding the light so that the barrel of the loupe can be shortened. They are superior to other loupes in terms of better magnification, wider depths of field, longer working distances and larger fields of view.The barrels of prism loupes are short and can be mounted on eyeglasses or a headband. But the increased weight, at magnifications of 3.0 diameters or greater, causes headband mounted loupes to be more comfortable and stable than mountings on glasses.

Fig 5-PRISM LOUPES MOUNTED ON HEADBAND

LOUPE MAGNIFICATION. [18]

Loupes with magnifications ranging from 1.5X to 10X can be purchased from a number of vendors. Those with magnifications of less than 4Xare usually inadequate for microdentistry or periodontal microsurgery. For most periodontal procedures, loupes of 4X to 5X provide increased visual acuity with an effective combination of magnification, field size, and depth of field. Loupes of 4.5X magnification or greater need to be thoroughly evaluated before purchasing, as their depth of focus and narrow field size can make them awkward to use.

SURGICAL OPERATING MICROSCOPE [18,21]

For the greatest flexibility and comfort in optical magnification, the properly equipped operating microscope is vastly superior to magnifying loupes. Operating microscopes combine the magnification of loupes with a magnification changer and a binocular viewing system. The parallel binoculars protect against eyestrain and fatigue. Operating microscopes incorporate fully coated optics and achromatic lenses with high-resolution and high-contrast stereoscopic vision. Operating microscopes are designed on Galilean principles. For use in the various areas of the mouth, the microscope must have extensive horizontal and vertical maneuverability, whether it is mounted to a wall, ceiling, or floor stand. The addition of inclinable binocular eyepieces gives a microscope great improvement in maneuverability. Surgical microscopes (Fig 6) use coaxial fiber-optic illumination. This type of light produces an adjustable, bright, uniformly illuminated, shadow-free, circular spot of light that is parallel to the optical viewing axis.

Fig 6-SURGICAL MICROSCOPE

ILLUMINATION[35]

Most of the manufacturers offer collateral lighting systems or suitable fixing options which are helpful, particularly for higher magnification in the range of 4X and more. Certain essential considerations need to be made in the selection of an accessory lighting source, these include total weight, quality, and the brightness of the light, ease of focusing and directing the light within the field of view of the magnifiers and ease of transport between surgeries.[22]

PERIODONTAL MICROSURGERY

The reason microsurgery has gained acceptance among some periodontists is not reduced morbidity. Rather, the end-point appearance of microsurgery is simply superior to that of conventional surgery. Improved outcomes obtained from the use of microscopic periodontal surgical procedures have resulted in a shift toward periodontal microsurgery. Over the past two decades, periodontics has seen increasing refinement of surgical procedures, requiring the development of more intricate surgical and motor skills. With a little training, an average periodontist can consistently produce more finely crafted work than can the most gifted conventional surgeon. Its methodology improves existing surgical practice and introduces the possibility for better patient care to periodontics.

1. Resective procedures, combined resective/periodontalmicro surgery and regenerative procedures
2. Guided tissue regeneration (GTR)
3. Guided bone regeneration (GBR) and other procedures where increasing the amount of bone needs special preparation forms of the soft tissue
4. Horizontal augmentation
5. Vertical augmentation
6. Connective tissue grafts
7. Pedicle or sliding flaps
8. Accurate split thickness flaps
9. Double papilla flaps
10. Apical or coronal repositioned flaps
11. Biopsies

Periodontal Plastic Microsurgery and Esthetic Surgical Procedures[2,18]

Knowledge of medical microsurgery offers a view as to what esthetic needs can be realistically achieved while treating periodontal problems. Improvement in esthetics is a major indication for periodontal plastic surgery. When attempting to restore gingival esthetics, several periodontal plastic surgery procedures are helpful, including pedicle soft tissue grafts and free soft tissue grafts. The pedicle soft tissue graft combined with the use of a membrane barrier, according to the principles of guided tissue regeneration, is also used as a treatment for root coverage. When using a guided tissue regeneration barrier, it is critical to maintain a space between the barrier membrane and the root surface for tissue regeneration. To correct small areas of recession without invasive major flaps, careful dissection and suturing can sometimes be used to place a graft. A subepithelial connective tissue graft is normally harvested from the palate by a "trap door" approach[23,24] which is minimally invasive and heals rapidly. Microsurgically transferring donor tissue removed from one area of the mouth to a new microsurgically prepared recipient site allows for correction of gingival esthetic problems[25] .Survival of the grafted tissue, whether the procedure is done macroscopically or microsurgically, is dependent on the recipient site having a blood supply to restore circulation to the transferred tissue[26] .Attempting to graft over a vascular root surfaces is a unique challenge in periodontics, but it has become more predictable, depending on the defect, with both macrosurgery and microsurgery . Autologous grafts[27], homologous grafts and heterologous grafts can be used in root coverage procedures. Complete root coverage of gingival recession is predictably achievable in Miller Class I and Class II defects. Only partial coverage may be expected in Class III or Class IV [28] defects.Full-thickness gingival grafts do not offer as good a color match as subepithelial connective tissue grafts and produce a less natural appearing result, but can usually restore narrow recession defects[29] .Wide recession defects can more predictably be restored by subepithelial connective tissue grafts.

Establishing an Esthetic Smile Line.[33]

An abnormal smile line may result from a number of causes, including gingival recession, abnormal eruptive patterns, incisal wear, and excessive tissue growth of various etiologies. The creation of an ideal esthetic smile with harmonious gingival contours involves many factors. Foremost among these are symmetry, lip position, and relative gingival levels of adjacent teeth.Complex periodontal plastic microsurgery involving removal of tissue on some teeth and replacement on others may be required.

Improved Root Visualisation.[20,36]

Lindhe and co-workers (1984) suggested that 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. Because stereomicroscopy is used to evaluate residual calculus on extracted teeth, it seems logical that a surgical operating microscope can enhance the operator's ability to see and remove calculus in vivo.

Minimal Invasive Surgery (MIS) For Regeneration[36]

MIS was introduced in 1999 by Harrel[31] .The salient difference between the minimally invasive approach and more traditional approaches for regeneration is in the use of much smaller incisions to gain surgical access and debride the periodontal defect prior to placing the bone graft and membrane.

Microsurgery In Implant Therapy[32,34,36]

All phases of implant treatment may be performed using a microscope. One of the novel applications of microsurgery is in the sinus lift procedure. 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.

ADVANTAGES:[33]

1. Microsurgery offers more rapid and comfortable healing phase for the patient.
2. Allows the operator to consistently achieve clinical results that were thought unlikely.
3. The improved visual acuity and ergonomics provide significant advantages to those who take the time to become proficient in microsurgical principles and procedures.
4. Cleaner incisions obtained
5. Reduced hemorrhage
6. Reduced trauma at surgical site
7. Closer wound apposition.
8. Healing occurs by primary intention
9. End point appearance of the tissues is superior.

DISADVANTAGES OF MICROSURGERY:[33]

1. 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.
2. It is much more demanding and technique sensitive,
3. the cost incurred to establish a microsurgical set-up is also high.
4. 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.
5. An experienced team approach mandates microsurgery and is time consuming to develop.
6. Physiologic tremor control for finer movements intra-operatively and a steep learning curve are required for clinical proficiency.

CONCLUSION:

Optical magnification has broadened the horizons of dentistry in general and Periodontics in particular. Microsurgical periodontics is technique-sensitive and more demanding than periodontal macrosurgery, but it results in more rapid healing because it is less invasive and less traumatic. Periodontal microsurgery is in its infancy but will play a role in the future. 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. As health care professionals and the public become familiar with the benefits of microsurgery, applications of this philosophy in periodontics will likely become a treatment standard. Microsurgical periodontics requires a different practitioner mindset. The improved visual acuity and ergonomics provide significant advantages to those who take the time to become proficient in microsurgical principles and procedures. Periodontal microsurgery provides a natural evolution in the progression of periodontics.

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