Periodontal Microsurgery: An Evolution in the Progression

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Abstract

The main purpose of this article is to provide a review of the challenges that are often faced in conventional surgery and how magnification has become an integral part of modern dentistry. The objective is to incorporate magnification for a minimally invasive periodontal microsurgery. This procedure requires clinical expertise and training. Different procedures ranging from GTR, crown-lengthening and root coverage to implantology and many diagnostic procedures are aided by periodontal microsurgery. In this challenging new era of technology, it claims to give more predictable therapeutic results with rapid healing and also improved cosmetic results whereas in other hands conventional surgery provides less visual acuity,delay in healing along with ergonomic problems.

Keywords: *Periodontal Microsurgery, Microscope, loupes.*

Introduction

Optical magnification has broadened the horizons of dentistry. The main aim of surgical intervention is not only a minimally invasive procedure but also to preserve the maximum amount of function of the organ. Periodontal microsurgery is reaching new heights of precision using loupes and surgical operating microscope. It emphasizes more on increasing visibility,minimize trauma and improve surgical results with the help of and microscalpelsmicro suture.

History: In 1876, a German physician Saemisch introduced loupes in medicine. A variety of magnification is there for surgeons ranging from simple loupes to prism loupes and most importantly the surgical microscope. Each of them has its pros and cons. It is now believed that magnification has more to do rather than just corrective vision. "In 1979, Daniel[1] defined microsurgery in broad terms as surgery performed under magnification using a microscope. Serafin described microsurgery as a methodology–modification and refinement of existing surgical techniques using magnification to improve visualization, with applications to all specialties."[2]

In 1981[3] Apotheker and Jako first introduced a commercial operating microscope to dentistry. At the annual meeting of the American Academy of Periodontology in 1993,it was subsequently conferred by Shanelec and Tibbetts on periodontal microsurgery. As treatment philosophy, microsurgery involves 3 important principles:

1. Advancement of motor skills thereby improving surgical ability
2. Passive wound healing with accurate apposition of the wound edge
3. Proper microsurgical instrumentation and suturing to reduce trauma to tissues.

Microsurgical Triad: There are 3 basic advantages provided by operating microscope i.e. illumination,

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magnification and increased surgical skills. Illumination of the field plays a crucial part in microsurgery. Clinicians who use loupes usually need a headlamp to compensate for the reduced amount of light passing through loupes. Essential criteria require while taking in consideration of accessory lighting source which includes quality, and brightness of the light and ease of focusing and directing the light within the field of view of the magnifiers and ease of transport between surgeries.

Magnification is the second most important criterion of the microsurgical triad. There are various types of magnifications available for surgeons ranging from simple loupes to prism telescopic loupes and surgical microscope. Each of them has benefits and drawbacks. The principle of optics needs to be understood that governs magnification systems to improve the accuracy of clinical and diagnostic skills. "Decrease in field of view and depth of focus should be taken into consideration as magnification increases which is a major problem with dental loupes and operating microscope."Microsurgery is an advanced surgical technique, which is defined as surgery performed under magnification of 10× or more which is performed under a surgical microscope.[4]

Magnifying Loupes: They are most commonly used for magnification in periodontology. They are primarily dual monocular telescopes with side-by-side lenses convergent to focus on an object."The magnified image formed by its convergence is called a Keplerian optical system."Despite being widely used, there is a major flaw in comparison with a microscope. The clinicians need to converge to get the operating view which leads to eye strain, fatigue, and also vision impairment with prolonged use of ill-fitted loupes. 3 types of Keplerian loupes are mostly: -

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

1. **Simple Loupes:** They consist of a single pair of side-by-side meniscus lenses and are limited to two refracting surfaces. Greater magnification can be obtained by increasing lens diameter and size. The size and its weight make it impractical for magnification beyond 1.5x. Spherical and chromatic aberrations are limitations of simple loupes. The shape of image and object color being viewed is also distorted due to this.[5,6]
2. **Compound Loupes:** They use multielement lenses with intervening air spaces to gain additional refracting surfaces.[7] Magnification can be increased without increasing the size and weight of the lens of lengthening the distance between the lenses. Along with this, a special optical feature that favors clinicians while selecting magnifying lenses is that it is achromatic. Hence it negates the chromatic aberration of the paired lens to produce a color correct image. However above 3x they become obsolete.
3. **Prism Loupes:** They are the leading loupes of optical magnification that employ Schmidt or "rooftop"prisms to elevate the light path using a series of switchback mirrors between the lenses.[8] Shortened barren of loupes provide improved magnification, wider field depth, longer working distances and also larger field views than other loupes. However, the heaviness of these loupes with magnification up to 4x makes headband mountings table and comfortable. Recent advances in these loupes are the incorporation of coaxial fiber optic lighting into the lens to enhance illumination.

Magnification range of surgical loupes: Dental loupes have a limited range of magnification ranging from 1.5x to 6x. The loupes less than 3x are usually inadequate for visual acuity necessary for the clinicians. Due to excessive weight, small field of view, shallow focal depth surgical loupes of magnification more than 4x are not practical in use. In some periodontal procedures, prism telescopic loupes with magnification 4x provide an adequate combination of magnification, field size and depth of focus. However, the surgical microscope offers much higher magnification and superior optics than any optical systems mentioned.

The surgical Microscope: Due to its extended range of magnification with superior optical performance and its greatest flexibility it has taken over the surgical loupes. Over 70-80% of periodontal microsurgery is performed under 10x-20x using a surgical microscope whereas under 6x-8x enhanced motor skills are acquired during microsurgery training sessions. Its design is based on Galilean optical principles and uses an inclinable binocular eyepiece which enhances maneuverability. "It incorporates fully coated optics and achromatic lenses with high resolution and high contrast stereoscopic vision. It uses Coaxial fiber-optic illumination produces an adjustable, uniformly illuminated, bright, and shadow-free circular spot of light that is parallel to

the optical viewing axis." It has better visualization of farther reaches of oral cavities, including into some subgingival pockets, angular defects, and root surface irregularities. Both provide enhanced vision and better ergonomics by increasing working distance. To reduce postural problems and eye strain in dentists there is an increase of 6-8 inches in working distance.[10]

Drawbacks include are:

1. As magnification increases there is a restricted area of vision and loss of depth of field.
2. Visual reference points are lost.
3. To avoid errors in instrument and suture placement,extra time is needed to achieve an experienced team approach.
4. Physiological tremors need to be controlled.

Ergonomics in microsurgery: While operating clinicians should be in a comfortable and relaxed state of mind and posture. A stable instrument-holding position and mental focus are needed for precise controlled movements of fingers. Finger movements are controlled by long flexor and extensor muscle. Physiologic tremor is unwanted movement and can be reduced by stabilizing the wrist and ulnar surface off forearm on a flat surface, angled in a dorsiflexion position at approx.20 degree.[11] To perform efficient and deliberate movement the operator should be erect with both feet flat and thighs parallel to the floor. Pen grip is mostly used or the internal precision grip which provides better stabilization than other hand grips due to tripod effect formed by the thumb, index and the middle finger which holds the instrument and the thumb and index finger are in contact with the underlying middle finger. Proper instrumentation is necessary for surgical intervention. The handle of the instrument should be round for better manipulation yet traction to execute fine controlled rotating movement. The most accurate rotary suturing movement of hand for a human body can perform is from 2 o'clock to 7 o'clock. Persistent practice of alternative positions around 360 degrees will result in better skills and good microsurgical results.

Microsurgical Instruments: The smaller instruments are used for high precision movement and minimize tissue trauma. The length of approx. 15cm is adequate for an average-sized hand to hold on to the instrument in a pen grip. The circular cross-section of the instrument used allows smooth rotational motion whereas the rectangular design does not allow such precise manipulation and hence not ideal for microsurgery.[12] The working tips are generally used that are quite smaller than those of regular instrument. They are manufactured under magnification to high tolerances to provide consistent manipulation to tissues. The surface of the instrument is usually colored to prevent unfavorable metal flare under the microscopic light. Each of them is around 15-20g in weight to avoid muscular fatigue of hand. The needle holders need to have an accurate working lock which should not exceed beyond a force of 50g (0.5N) as the precision is reduced in low locking forces and cause tremors in high locking forces. Titanium made instruments are stronger and lighter and non-magnetized than the stainless steel but are expensive and are resistant to distortion if properly cared for. A microscalpel holder, needle holder, micro-scissors, micro-forceps and elevators are the basic set of microsurgical instruments. To achieve wound healing by primary intention small size and sharp knives are used to place clean, non-ragged incision. The sharpest needles, spatula needles (6.6mm long with 140 degree) with microchips with reverse cutting-edge needles and taper tip are generally in practice to minimize tissue trauma and early tissue regeneration.[13,14]

The choice of suture needle size is crucial for atraumatic tissue passage. The most commonly used suture is 4-0 suture on a three-eight circle FS-2 reverse cutting needle. Most of the sizes range from 6-0 to 9-0.Among various suture materials, non-absorbable monofilament sutures are preferred and should be removed at the earliest biological time as they are bacteriostatic and non-inflammatory e.g. Vicryl® Plus (Ethicon®, Norderstedt, Germany). An ideal suture material is sterile,less reactive and resistant to shrinkage in tissues. It should be strong enough until wound healing to withstand its stress. The chord distance is an important component of needle design. It's the distance between the cutting point and the swaged end and radius is the arc of its circumference. The arc determines the ease of passing a suture between adjacent teeth. Also the angle of entry (less than 90degrees), bite-size (approx. 1.5times the tissue thickness) determines the proper wound approximation. Suturing plays a significant factor for a successful treatment. Though it takes motor skills and dexterity but through the visual guidance aided by the microscope knot tying requires minimal time. In microsurgery, the entry and exit of the needle should be perpendicular to the tissues and at equal distances. Under a microscope, with the help of instrument ties,the

microsurgical needle holder in the dominant hand and tissue is picked in the non-dominant hand using proprioception.[11] The best surgical knot is achieved with the surgeon's knot followed by a square knot. Integrity or strength is lost by adding excess ties to the knot. Well tied knots ensure there is no microinjury under function.

Uses of microsurgery in periodontics: Periodontal microsurgery has broadened the horizons of dentistry by descending the conventional surgery by its attempt to reduce surgical trauma and hence give better therapeutic results.

1.**Root preparation**: Root surface debridement is an important criterion for periodontal therapy. Clinical and research studies demonstrated that with stereo microscope there in better visual access and hence effective in root planing. It is reported that under illumination, root instrumentation is effective along with less postoperative pain and improved healing index.[15,16] Moreover, using micro ultrasonic instruments of size as small as 0.2-0.6mm in diameter and variable power settings(25,000-40,000 cycles per second) allows deep pocket cleaning and reduces the chances of over-instrumentation of the root surface.[17] All surface of instrument have active working sides and requires minimal water supply. The clinician could differentiate the calculus from the surface and biofilm to the microscopic level, hence morphological contours are determined for the working end to angle accordingly during instrumentation.[18]

2. **Minimally invasiveperiodontal surgery (MIPS) for regeneration:** Recent studies have found that clinical effectiveness for periodontal regeneration of intrabony defects is better through the microsurgical approach. Further more, treatment of isolated or multiple intrabony defects with increased accuracy and minimal trauma. There is no much significant differences of probing depth, clinical attachment level gainwith treatment of intrabony defects treated with MIPS than those with conventional surgical approach.[19] Isolated interproximal defects are ideal for bone grafting using MIPS while contra indicated for generalized horizontal bone loss and multiple interconnected intrabony defects. In MIPS, for proper debridement of the periodontal defect and root surfaces, a new operating microscope (Varioscope®)with appropriate illumination which allows visualization of defect easily from different angles.[20] It has also known to minimize marginal tissue recession and improved esthetics. Recently, a new microsurgical technique named "Entire Papilla Preservation" to maintain wound stability and limit the exposure of regenerative biomaterials such as bone grafts and enamel matrix derivatives.

3. **Periodontal plastic surgery:** Esthetic improvement is the major indication for mucogingival surgery. To restore normal gingival or alveolar mucosa anatomy, several surgical procedures including pedicle grafts and free soft tissue grafts are performed. This also includes rotational flaps(e.g., laterally sliding flap or double papilla flap) or without rotation or lateral movement(e.g., coronally placed flaps). This technique is used along with the membrane barrier using GTR as a treatment of root coverage. Subepithelial connective tissue graft is obtained from the palate by a "trap door[20,21] approach can heal rapidly and is less invasive and can restore wide recession defects. Root coverage grafting is easier through autologous grafts due to their rapid revascularization.Many interdental papilla augmentations could have a better outcome using proper microsurgical procedures.

4. **Microsurgery in implants:** Surgical microscope aids in indirect visualization of sinus membrane and minimize the chance of perforation through it and hence applied in sinus lift procedures. Also, implant failure and peri-implantitis management can be performed with more precision. Although there is no strong evidence of less postoperative pain following extraction and implant placement, its rationale suggests that microsurgery causes less trauma and rapid healing and postoperative morbidity.

Conclusion

With training and motor skills, an average periodontal microsurgeon can produce better-crafted work than the proficient conventional surgeon. Though it is technique sensitive but requires less time to produce promising clinical results and have more patient acceptance. Despite having applications and benefits microsurgery it also has many drawbacks that include limited vision, loss of depth of field and arduous learning curve with the high initial cost of setup.

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