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Review Article

MICROPERIODONTICS- Refining our professionalism

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ABSTRACT

Surgical Precision to restore both biologic and aesthetic demands of patients is most important in today's periodontal practice. Technical skills of the clinician are challenged by the limited range of visual acuity. Periodontal microsurgery increases the efficiency of basic periodontal surgical procedures by improving normal vision through magnification along with advance lighting system. Incorporation of magnification in periodontal practice gives precise outcomes which are not achieved with traditional macro surgery in terms of improved visual acuity, ergonomic benefits, decreased patient morbidity, enhanced patient acceptance, rapid healing, passive wound closure and reduced tissue trauma.The aim of this review is to enlighten about periodontal microsurgery, its role in magnification, micro-surgical instrumentation, microsurgical suturing techniques, clinical advancement and application.

Keywords: Ergonomics; magnification; microsurgery; precision; techniques

1 INTRODUCTION

Dental sciences have evolved through a lot of changes in its concepts and techniques. The aim of surgical therapy is not just the survival of a patient or an organ but also to restore its function and to improve patient comfort. These demands are mostly met owing to a minimally invasive surgical approach.[(1)]

This led to the entry of microscope into dental practice which led to the era of the greatest advances in modern dentistry. This article provides an overview of microsurgical principles, ergonomics, instruments, suturing techniques and various application of periodontal microsurgery.

1.1 History

In 1921, Carl Nylen, the father of microsurgery, was the first person to use a binocular microscope to correct otosclerotic deafness. Later in 1978 Apotheker and Jako introduced microscope to dentistry. Shenalec and Tibbetts conducted a course on periodontal microsurgery at the annual meeting of the American academy of periodontology in 1993.[(2)]

1.1.1. Principles of microsurgery

1. Improved motor skills, enhancing surgical ability.
2. Passive wound closure with primary apposition of the wound edge.
3. Micro surgical instrumentation and suturing in reducing tissue trauma.

1.1.2. Ergonomic in microsurgery

The operator must be in relaxed, with comfortable body posture, supported hand, and a stable hold on instrument.[(3)] Figure 1

To accomplish precise finger movements, the ulnar surface of the forearm and wrist should be supported on a flat surface, and angled at approximately 20° to reduce muscle tremor.[(4,5)]

The operator is seated upright (back straight and head erect) with feet flat on floor and thighs parallel to the floor. If the patient's head is assumed in the 12 o'clock position in front of and perpendicular to microsurgeon's chest, the most precise rotary suturing movement for a right handed

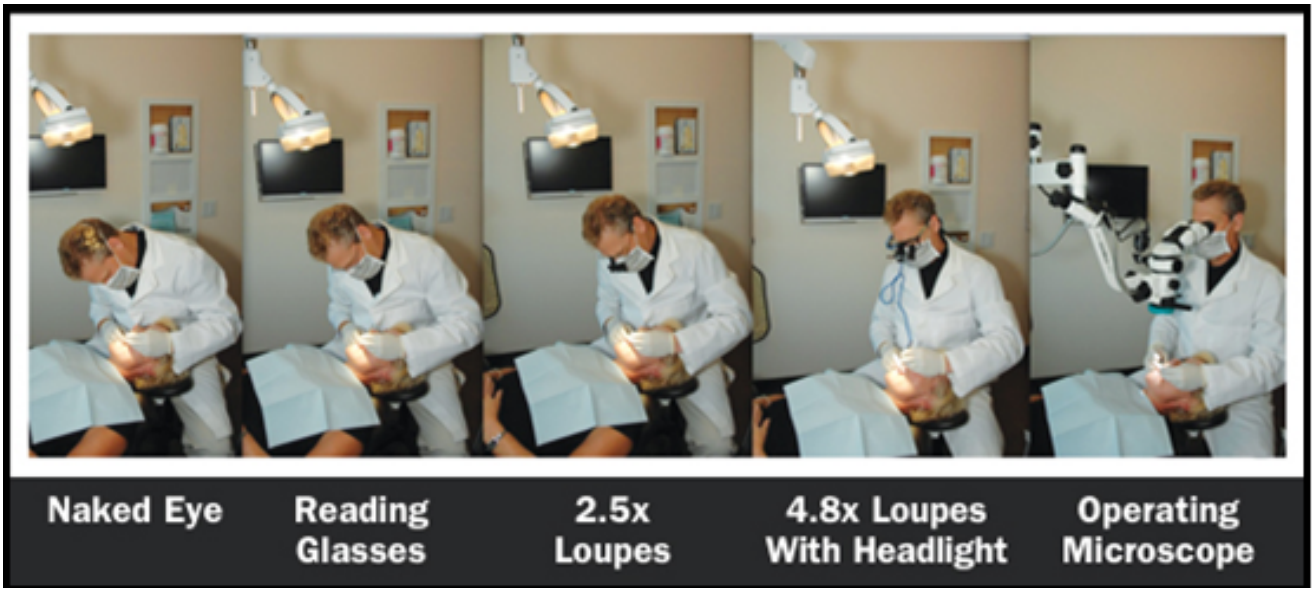

Fig. 1: The Magnification Continuum, showing the operator moving from the naked eye on the left to the operating microscope on the right. In this case, note the improved posture allowed with increasing levels of magnification; the longer working distance provides a more neutral and balanced posture.

person is from the 2 o'clock to the 7 o'clock position, while for left-handed people it is from the 10 o'clock to the 4 o'clock position. The forearm should be slightly supine, positioning the knuckles away from clinician, so that the ulnar border of his/her hand, wrist, and the elbow are all well-supported, allowing the weight of the hand to be on the ulnar border.

The most commonly used finger grip for micro-surgical procedures is pen grip also known as internal precision grip [Figure 2].[4,6]

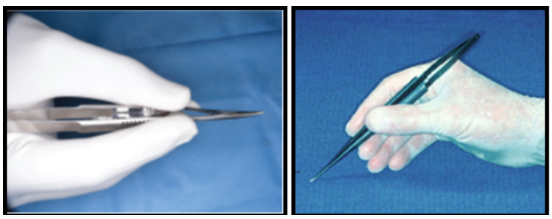

Fig. 2: Precision grip

Therefore, beneficial ergonomic aspect of magnification technique including diminished shoulder, neck, and back problems, improved vision, and reduced eye fatigue[7,8] may be the most influential factors in its adoption by the dental profession at large scale.

1.2 The micro surgical triad[2]

1.2.1. Illumination

Achieved through fibreoptic technology, improves the method of focusing light on site of interest which is an important feature of surgical microscopes.

1.2.2. Magnification

Can be achieved by using loupes and operating microscope. One should know the optical principles under which the loupes work namely Working distance, Depth of field, Width of field /field of view, Viewing angle, Magnification. Most periodontists find 2.5X magnification appropriate.

Based on these principles there are 2 mechanism under which it works.

1. **Keplerian optics**: Here it has 2 lenses where it angled to focus an object. Loupes works on this mechanics. (Figure 3 a)
2. **Gallilean optics:** It have binocular eyepiece which is joined by offset prisms to establish a parallel optical axis & permit stereoscopic vision without any eye strain and convergence. (Figure 3 b).[9]

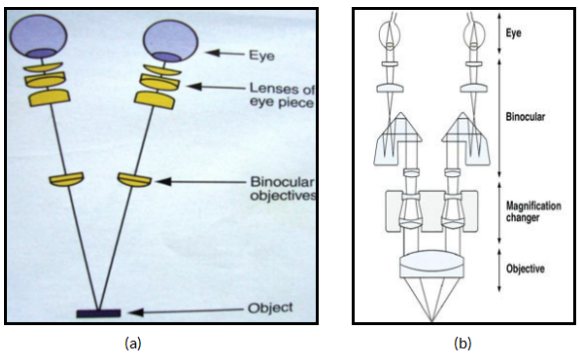

Fig. 3: a) Keplerian optics b) Gallilean optics

1.2.3. Increased precision in the surgical skills

The third component of microsurgical triad, is the synergistic result of illumination and magnification.

1.3 Microsurgical instrumentation

1.3.1. Magnifying instruments

(Table 1 and Figure 4)

1. Loupes

- Simple loupes
- Compound loupes
- Prism loupes

2. Operating microscope

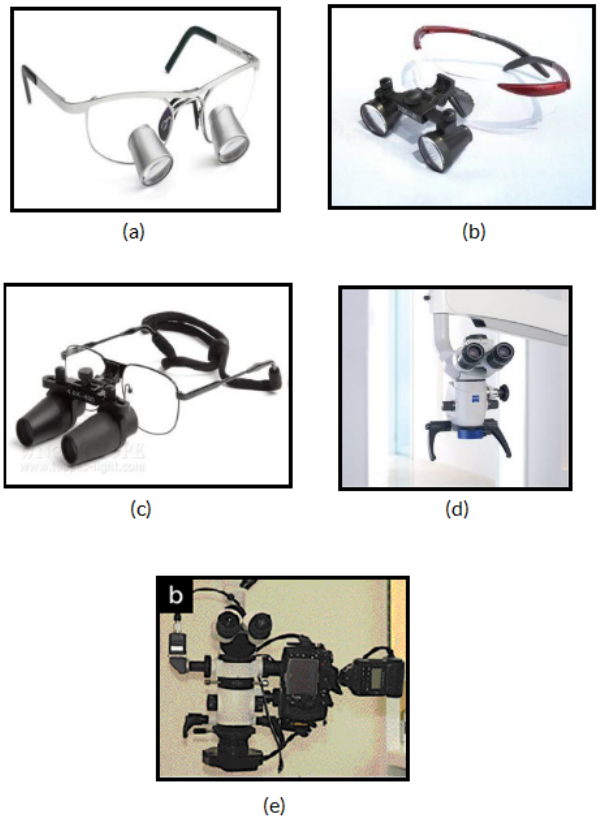

Fig. 4: a) Simple loupes b) Compound loupes c) Prism loupes d) Operating microscope e) Operating Microscope with HD digital video camera

1.4 Micro surgical instruments

(Table 2 and Figures 5, 6 and 7)

1. Microneedle holder (Straight, Curved)
2. Microforceps (Straight Jeweller Forceps, Curved Jeweller forceps)
3. Microscissors (Straight, Curved)
4. Micro Surgical Blades and Knives (Breaker, Crescent, Minicrescent, Spoon)
5. Micro Retractors and elevator
6. Micro osseous Hoes and Chisels
7. Micro needles and
8. Micro sutures

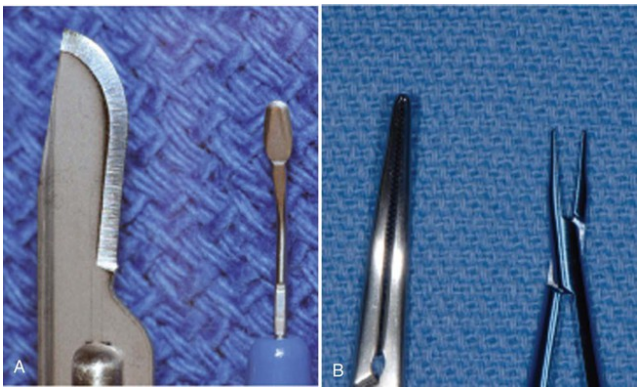

Fig. 5: Relative size of Conventional and Microsurgical a) Blade and b) Needle holder

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

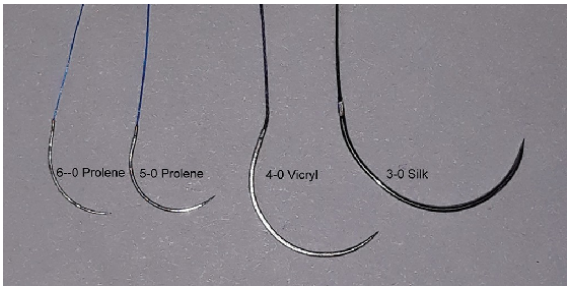

Fig. 7: Relative size of different sutures

Table 1: Differential features of Magnifying Loupes and Operating microscope [10]

Loupes			Microscope
Simple	**Compound**	**Prism**	
A pair of single positive side by side meniscus lenses. Most primitive system.	It uses converging multiple lenses with intervening air spaces to gain additional refractive index.	Most optically advanced type of long magnification.	Designed on Galilean principle. It uses the application of the magnifying loupes in combination with changer, binocular viewing system so that it employs parallel binocular for protection of the eyes.
The magnification can be increased only by the manufacturer to increase the size.	Poor magnification, working distance, & depth of field.	Contains Schmidt or roof top prism that lengthen for light path through a series of mirror reflection within the loupes	Surgical operating microscope is a system of lenses that allow binocular viewing of an object.
Highly subjected to chromatic aberration which destruct the image of the object that is being viewed.	It is achromatic	Achromatic	Contain fully coated optical and a chromatic lens.
Because of its size and weight limitation, they have no practical use beyond a magnification range of 1.5 X	Magnification can be increased by lengthening the distance between lenses without excessive increase in size or weight		In contrast to loupes, both light beams fall parallel onto the retinas of the observer so that no eye convergence is necessary and the demand of eye muscle is minimal.
Advantages: Light weight. Cheap. **Disadvantages**: Fixed focal length and working distances which lead to a poor working posture and possibly neck and back pain. Depth of field is not adjustable. Eye strain. Optical and chromatic aberration		**Advantages:** Better magnification. Wider depth of field. Longer working distances. Larger fields of view are produced by these loupes than other loupe types. Superior optical clarity. **Disadvantages:** More expensive.	The operating microscope consists of the magnification changer, objective lenses, inbuilt illumination, binocular tubes and eye pieces. Can be fixed to the floor or mounted on the wall or ceiling. Provides magnification of approximately 4 X to 40 X.

These instruments are made of titanium because of its strength, lightness and nonmagnetic characteristics and the working tips are much smaller than those of regular instruments andtheir handles should be rounded, so as to execute finely controlled rotating movements. [4,12]

The instruments should be about 18 cm long and should weigh around 15 to 20 gm in order to avoid arm and muscle fatigue.

Microsurgical instruments have colour coated surface in order to avoid the metallic reflection under the light of microscope. A basic set of micro surgical kit comprises of a needle holder, micro scissors, micro scalpel holder, anatomic and surgical forceps and a set of various elevators. [4,12,13]

1.4.1. Microneedle Holder

The length of most commonly used micro needle holder are 14 cm and 18 cm. The needle holder tip can be straight or gently curved. The nature of the suture determines the choice of the needle holder. Usually a minute 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. [14] A needle holder should ensure that a needle is held steadily without slipping.

1.4.2. Micro forceps

Micro forceps can make those manoeuvres that cannot be performed by hand. The most popularly used micro forceps are 15 cm long, with round handles and 0.2- to 0.3-mm tips.

There are variety of Micro forceps for different operations.

1. Straight Jeweller Forceps
2. Curved Jeweller Forceps

Table 2: Basic Microsurgical instruments used in periodontics [11]

NAME	TYPE	SUBTYPES	ADVANTAGE
Knives	a.Blade breaker knife b.Crescent knife c.Minicrescent knives d.Spoon knife e.Lamellar knife		Extremely sharp Small size Etched rather than ground produce more precise wound edge
Microsurgical Periodontal Knives	a.Orban periodontal knife (KO1/2MBH) b.Kramer-Nevins gingivectomy knife(KKN7MBH)		Very sharp
Microsurgical blades	a.Ophthalmic blade b.Blade no 15 c.Blade no 12 d.Blade no 390 e.Blade no 390 c	No.15c No.12d	Curved in a 'J' shape Can be run under the papilla to separate It from the underlying bone support, progressing in the narrow space of the dental embrasure Fine incision
Microsurgical Periosteal Elevator	a.Periosteal Schlee PPSCHLEE Handle 6 b.Prichard periosteal (PPRMBH) c.Hourigan periosteal (PH2MBHKD)		Precise undermining and release of flap
Microsurgical Periodontal Retractors	KP Retractors	a.KP 1 Retractor b.KP 2 Retractor c.KP 3 Retractor	Wider and thinner serrated ends provide better anchorage on bone and prevent accidental slipping
Microsurgical Tissue Forceps	a.Microsurgical anatomic tissue pliers TPASTMBH b.Microtissue forceps 180		Handle minute tissue without damaging
Microsurgical Periodontal Chisels	a.Rhodes chisel b.Wedelstaedt chisel c.Fedi chisel		Precise bone cutting
Microsurgical Periodontal Curettes	Lander curettes	a.SL1/2RMBH b.SL3/4RMBH c.SL5/6RMBH	
Microsurgical Periodontal Needle Holder	Microneedle holder schlee (NHSLSCHLEE)		Lock to firmly secure the needle Can be guided through coarse gingival tissue with controlled grip pressure Slender shape allows them to reach far into interproximal areas
Microsurgical Suturing Forceps			Can easily grab microsutures which can be torn with usual surgical suturing forceps
Microscissors	a.Micro-vannas tissue scissors b.Goldman-Fox scissors c.Ligature scissors FD252R		Smooth cutting of fine and coarse tissue Reduced tissue trauma
Microsutures	6-0 to 10-0	Vicryl polyglactin (7-0 to 10-0) Ethilon polyamide (7-0,9-0) Prolene polypropylele (8-0,10-0)	Better wound closure Minimizing gaps or voids at the wound, rapid healing with less post-operative inflammation, pain and risk of scar formation
Microsurgical Needles	a.Reverse cutting needles with precision tips b.Spatula needles with microtips		Shallow needle track and precise needle point allows extremely accurate apposition and closure of flap

Jeweller forceps are strong and cheap, with a variety of tips available. They can be classified as straight or curved at different degrees, such as 45° or 90°. They are usually 11–12 cm long and suitable only for superficial operations. Their handles are flat, which makes rotating and changing the direction of the instrument less efficient.

1.4.3. Micro scissors

These are used for dissection of tissues, blood vessels, and nerves. Most commonly used scissors are 9cm, 14 cm and 18 cm long. The tips of the scissor blades are of two types, straight and curved. Straight scissors are used to cut sutures and Curved scissors dissect vessels and nerves.

1.4.4. Surgical Knives

Surgical knives are extremely sharp and small in size.[14] Compared with the standard 15 blades commonly used in periodontics, the smaller size of the ophthalmic knives facilitates surgical work.[15]

1. **Blade-breaker knife** has an ophthalmic razor blade affixed to its a handle. This is used in place of a no. 15 blade.[16]
2. **The Crescent knife** is 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.
3. **The Spoon knife** is used to undermine the sulcular region in preparation for grafts site in regenerative surgical procedures.[15]

Recently developed instrument system of interchangeable blades and handles for flexible and efficient work is Feather Microsurgical Blades, which are made of high-quality stainless steel using high-precision grinding technology producing ultra-sharp cutting edges which allows pricise incision and minimize the risk of tissue injury. All blades are gamma-sterilized. The handles are available in different shapes and sizes. (Figure 8)

1.5 Three principle goals of using Micro Needles & Sutures in surgery are[15]

1. Eliminating dead space,
2. Closing with sufficient but appropriate tension,
3. Immobilizing the wound

1.5.1. Microsurgery Needles

Vary in size, shape and curvature, but most needles used in dental procedures are of 3/8 curvature. A reverse cutting needle of size 16 to 19mm is used most commonly in periodontal surgery.

Example is Spatula needle, 6.6mm in length and curvature of 140 degrees, allowing precise apposition, closure, and immobilization of the soft tissue graft.[16]

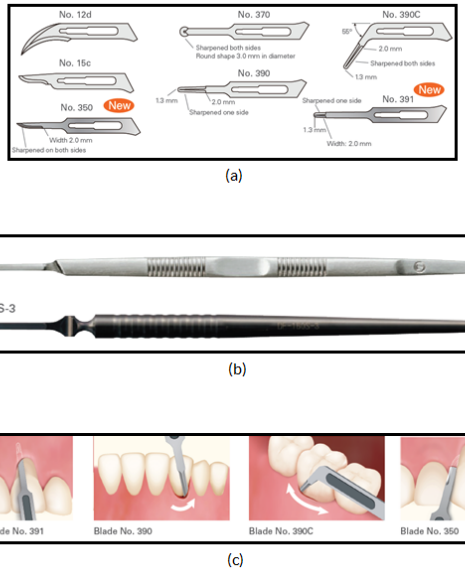

Fig. 8: Feather Microsurgical Kit a) blades and b) handles c) Feather Blades are appropriate for a wide variety of procedures such as sulcus incision on thin gingiva, creating flaps, molar surgery, papillary incisions, and much more.

1.5.2. Basic Suturing Techniques

Accurate dissection & suturing of tissues under the microscope depends on visual feedback which is affected by:

1. Magnification
2. Lighting intensity
3. Glare
4. Colour contrast
5. Other visual features, including visual health, binocularity, trained perception, skill, experience & fatigue

When variable magnification is available, higher magnification is used to place sutures & lower magnification to knot the sutures. Finer needles & suture materials are used in microsurgery, which, in turn, demand precision miniaturized needle holders & tissue forceps to handle the tissue gently for precise positioning. A skilled microsurgeon uses proper basic suturing techniques & skills as a foundation for the advanced techniques.[13]

1.5.3. Suture geometry

1. Angle of needle entry and exit should be slightly less than 90 degrees
2. Bite size of suture should be approximately 1 5 times the thickness of the tissue
3. Equal bite sizes on either side of the wound
4. Needle passage should be perpendicular to the wound

1.5.4. *Knot Tying*

Knot tying using the microscope is done using a microsurgical needle holder in the dominant hand and a microsurgical tissue pick up in the non-dominant hand. The working tip of the instruments only is visible in the microscopic field. Well tied microsurgical knots are stable and resist loosening, even under functional load.[6]

1.5.4.1. **Ethicon (1985) recommended the following principles for knot tying**[14].

1. The completed knot must be tight, firm and tied so that slippage won't occur
2. To avoid of wicking of bacteria, knots should not be tied on incision lines
3. Knots should be small with ends cut short (2-3mm
4. Avoid excessive tension to finer gauge materials because breakage can occur
5. Avoid using any jerking motion that may break the suture
6. Avoid crushing or crimping of suture materials by not using haemostat or needle holders on them except on the free end for tying.
7. Do not tie the suture tightly cause tissue necrosis can occur. Knot tension should not produce tissue blanching.
8. Maintain adequate traction on one end to avoid loosening the first loop while tying
9. The surgeons knot and square knot strength, generally not needing more than two throws, still will have increased strength with an additional throw.
10. Granny knots and coated and monofilament sutures require additional throws for securing the knot and to prevent slippage

1.5.5. *Ideal Needle–Thread Combination (Non -Resorbable) for use in Periodontal Microsurgery*

1. For buccal releasing incision following combinations can be used:

- A suture made up polypropylene (Prolene) of gauge 7-0, with the needle having a 3/8th curvature, cutting needle with precision tip and a length of 7.6 mm.
- A suture made up polypropylene (Prolene) of gauge 7-0, with asymptomatic curved needle, cutting needle tip with round body and a length of 8.9 mm.
- A suture made up polyamide (Ethilon) of gauge 9-0 with a spatula needle having a 3/8th curvature and a length of 5.2 mm.

2. In anterior areas interdental sutures can be placed with the following:

- A suture made up Polypropylene (Prolene) of gauge 6-0, with the needle having a 3/8th curvature, cutting needle with precision tip and a length of 11.2 mm.
- A suture made of Polyamide (Ethicon) of gauge 7-0, with the needle having a 3/8th curvature, cutting needle with precision tip & length of 11.2 mm.

1.5.6. *Clinical applications*

Periodontal microsurgery is the descendant of conventional periodontal surgery in an attempt to reduce the surgical trauma and opens the horizons for better patient care. (Table 3 and Figure 9 and Figure 10)

Fig. 10: Periodontal microsurgical procedures a) Before (A), during (B), and 8weeks after healing (C) of microsurgical connective tissue graft. b) Microsurgical connective tissue graft. Minimal tissue trauma during incisions, surgical manipulation, and suturing is accomplished after microsurgical principles.
c) Papilla reconstruction. A, Before surgery. B, Microsurgical view. C, After surgery.

1. **Root surface debridement**

This procedure is an essential component of periodontal therapy.[17] It is effective when done under illumination[18] along with an improved early healing index and less post-operative pain[19] and with micro ultrasonic instruments. The smaller size 0.2–0.6 mm in diameter and variable power settings 25,000 to more than 40,000 cycles per second of these instruments allows subgingival treatment in deep pockets.[20] Moreover, these instruments have active working sides on all surfaces; deliver ultrasonically activated lavage in the working area and can be used with minimal water spray.

2. Periodontal Regeneration

Microsurgical approach is used for the treatment of isolated or multiple intrabony defects. Isolated interproximal defects that are usually limited to interproximal site are considered ideal for bone grafting with Minimally Invasive Periodontal Surgery (MIPS).

Recently, a novel microsurgical approach for periodontal regeneration "Entire Papilla Preservation Technique" (EPP) technique is used,where an interdental tunnel is made through the defect associated papilla by a beveled vertical releasing incision in the buccal gingiva of the adjacent interdental space.[21] After removing granulation tissue and

Table 3: Differences between Traditional technique and Minimally invasive surgery (MIS) in periodontal surgeries [10]

MIS approach	Traditional approach
Case selection: An ideal site for bone grafting using MIS is an isolated, usually interproximal, defect that does not extend significantly beyond the interproximal site. MIS can be used for patients who have many isolated defects and treated as multiple separate sites within a single quadrant.	Generalized horizontal or multiple interconnected vertical bone defects are best handled with more traditional surgical approaches.
Surgical procedure: 1) Incision: The incisions for MIS are designed to conserve as much of the soft tissue as possible. Incisions should be made as separate incisions and should not be continuous across the interproximal tissue as in most other periodontal surgery procedures. By not making these incisions continuous, it is been able to retain more of the interproximal papillary tissues and tissue height	In most of the times, broad incisions which includes separating of interdental papilla are used.
2) Tissue reflection and flap elevation: The tissue/flap is elevated utilizing sharp dissection only. With care, the papillary tissue can be thinned to a thickness of 2-3 mm and the small flaps reflected. It is felt that the use of sharp dissection minimized trauma to the flap and preserves much of the blood supply to the soft tissues that is the probable reason for improved soft tissue healing and the minimization of post-operative soft tissue changes in MIS.	Comparatively broader instruments are used. Therefore, more of tissue trauma occurs, which affects wound healing.
3) Visualization: Visualization during MIS requires some form of magnification and a light source that can be focused into the surgical site. Various light sources can be used. A high intensity halogen head light mounted on a headband or a fiber optic light probe placed directly in the defect can also be helpful.	Visualization of the surgical site is compromised.
4) Debridement: The small surgical opening of MIS limits the instrumentation that can be used to remove granulation tissue and to debride the root surface. Successful MIS requires specialized instrumentation.	Granulation tissue removal is better
5) Placement of graft material: The root surface preparation and the placement of graft material into the defect is same as the traditional technique.	
6) Wound closure: The flaps will be closed using a 2-layered suturing approach. Usually 6-0 to 8-0 plain gent or monofilament polypropylene sutures were used for optimal wound closure. Smaller needles allow precise approximation of tissue edges, extremely accurate opposition, closure. Healing takes comparatively less time than traditional techniques.	Usually 3-0,4-0 or 5-0 black braided silk suture is used. Healing takes more time.
Refer Figure 9	

debridement of root surface, regenerative materials such as bone grafts and enamel matrix derivative is applied.

3. Mucogingival Surgery

Trained and skilled Periodontal Micro surgeon offers an evident positive result in root coverage procedures [22] and interdental papilla augmentation. [23] Microsurgical techniques have been shown to offer many advantages when compared with conventional macrosurgical techniques for treating gingival recession. Using micro surgical techniques, increases vascularity of the graft, [24] relatively enhanced root coverage, [24] a efficient increase in thickness and width of keratinized tissue, [25] an appreciable esthetic outcome, with decreased patient morbidity [26]

4. Implant Therapy

Different stages of implant treatment ranging from implant placement to implant recovery and peri-implantitis management is done with more precision under magnification. [27] One of the novel applications of microsurgery is in the sinus lift procedure with a success rate of 97%. [28] The surgical microscope can aid indirect visualization of the sinus membrane and minimizes the risk of perforations.

5. Crown Lengthening

Comparative studies of crown lengthening and ridge augmentation [29] with microsurgical methods are limited, still it is evident that magnification is beneficial in such procedures.

i. **Infection control**

Magnifying loupes get deposited with debris from various dental procedures. Ideally, all areas of loupe should be disinfected with high level disinfectant after every patient. Disinfecting with high ethyl alcohol solution is popularly recommended. If they are water resistant, Lysol disinfectant spray must be sprayed into a gauge sponge and used to wipe the frames and lenses.

ii. **Advancement**

Recent advances in microsurgery include 3D on-screen microsurgery system (allowing three-dimensional view of the working surgical field on a video monitor obviating the need of direct physical visualization) HDTV single camera 3D system (involves attachment of a high-definition display with microscope) [30] and mechanical optical rotating assembly interface allows the clinician to work at different seating positions.

iii. **Disadvantages**

Disadvantages include restricted areas of vision, loss in depth of field and visual reference point, steep learning curve, and a relatively higher initial cost of microsurgical setup.

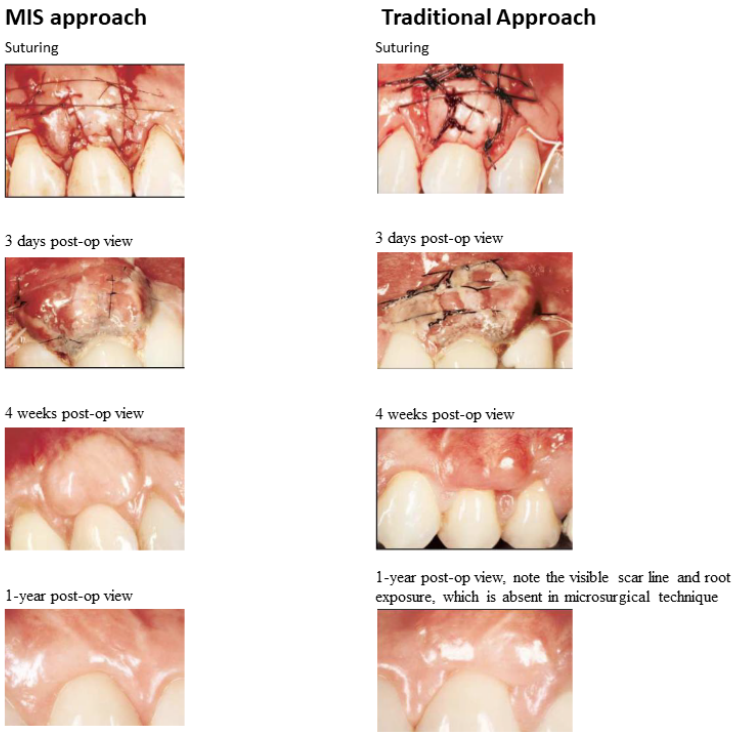

Fig. 9: MIS and traditional approach

2 SUMMARY

The world of microsurgery has challenges in dexterity and perception which when mastered can increase the innovative methods of treatment for better results. Its execution is technique sensitive and is more demanding than the conventional periodontal procedures. An important factor in recent public and professional acceptance of microsurgery is the significant decrease in morbidity. Microsurgery offers reduced trauma and relatively less painful, making it an efficient alternative to traditional surgical approaches. Periodontal microsurgery offers an improvement in predictability, cosmetic outcomes and patient comfort level than conventional periodontal surgical procedures.

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