Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 600-606 | ISSN:2251-6727

Beyond the Naked Eye: A Comprehensive Exploration of Periodontal Microsurgery

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(Received: 16 September 2024 Revised: 11 October 2024 Accepted: 04 November 2024)

KEYWORDS
Microsurgical triad, Magnification, Hand control, Hand grip, Robotic microsurgery

ABSTRACT:
The selection of procedures in periodontal plastic surgery is influenced by several factors, including economy, reproducibility, predictability of success, and morbidity. Minimally invasive techniques are used in modern operations to lessen pain and suffering, promote healing, increase patient happiness, and improve clinical results. This article aims to provide an overview of the history of microsurgery within the surgical fields. It goes over the advantages and possible uses of microsurgery and magnification in the field of periodontics. In order to illustrate the use of aesthetic operations, including periodontal plastic microsurgery, clinical instances are highlighted in the description.

Introduction:

In the past few decades, there has been a major development in periodontal plastic procedures. These days, there is a growing need for minimally invasive procedures that cause the least amount of discomfort to the patients. The selection of procedures in periodontal plastic surgery is influenced by several factors, including economy, reproducibility, predictability of success, and morbidity. Minimally invasive techniques are used in modern operations to lessen pain and suffering, promote healing, increase patient happiness, and improve clinical results [1]. The success criteria for aesthetic treatments may not match those of surgical procedures whose main objectives are to improve periodontal health and restore deteriorated function [2]. To ascertain whether gingival recession treatment with microsurgical devices provides a clinically and patient-oriented benefit over traditional surgery, a comprehensive review was organized.

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Historical Perspective:

In 1979, Daniel provided the following definition of microsurgery: "surgery performed using a microscope to magnify." "A methodology - a modification and refinement of existing surgical techniques using magnification to improve visualization, with applications to all specialties," was how Serafin defined microsurgery [4] in 1980. The improvement of surgical methods by improved visual awareness with the use of a surgical microscope is known as periodontal microsurgery [5]. 1992 saw the introduction of microsurgery to the field of periodontics [6]. Shanelec and Tibbetts then presented a continuing education session on periodontal microsurgery at the American Academy of Periodontology's 1993 annual meeting [7].

Principles of Microsurgery:

Microsurgery features three important principles as shown in Figure 1:

• The improvisation of motor abilities, which advances surgical expertise.

• To achieve passive wound closure, special attention should be paid to the primary apposition of the wound edge.

• Using sutures and microsurgical devices to lessen tissue stress [8].

Figure 1: Microsurgical Traid

Periodontal Microsurgical Instrument Types:

1. Diagnostic Instruments:

Flexible neck devices called micro mirrors can be used in a variety of ways to improve illumination. In particular, the tips of micro explorers are bent 90° on one end and 130° on the other. The short tip makes it easy to access the small boney crypt. Micro-mirrors and micro-explorers can reach places that are difficult to reach, such as the space distal to the last molar. When mouth opening is limited, these instruments might be used as diagnostic tools.

2. Surgical Instruments:

A. Incision and elevation (knives and elevators):

In periodontal microsurgery, spoon, mini-crescent, crescent, and blade breaker knives are among the instruments that are commonly utilized. A blade breaker can be used to make bevel cuts that are both internal and exterior. The handle of the Crescent knife can be detached or assembled in one piece. It can be used for both the placement of sulcular incisions and root covering treatments. The spoon knife can track through the tissue adjacent to the bone because of its beveled edge. Undermining tissue is a frequent procedure in microsurgical techniques to augment a connective tissue graft. Soft-tissue elevators are used to lift the gingiva and tissue from the underlying cortical bone with the least amount of tissue injury possible.

B. Tissue retraction:

There are different widths of tissue retractors that range in size from 8 mm to 14 mm. Retractors make ensuring that the surgical site is easily accessible and has good visibility during flap reflection. Certain retractors, like the KimTrac retractors, are made especially to accurately anchor against the cortical boney by means of serrated ends.

C. Osteotomy:

A 45° surgical handpiece with a Lindemann bur is the instrument of choice for implant procedures (Brasseler NSK and Morita). It is designed to direct water onto the cutting surface by channeling it along the surface of the bur while the air is ejected through the back of the handpiece [Figure 8]. Compared to a traditional handpiece, this produces less spatter and lowers the risk of emphysema and pyemia. The 45°

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www.jchr.org
JCHR (2024) 14(6), 600-606 | ISSN:2251-6727

tilted head of the hand piece facilitates easier visualization and operation in hard-to-reach places.

D. Curettage:

Surgical and periodontal curettes are examples of curettage devices. Micro curettes lessen soft tissue injury and aid in better root planing. Additionally, it speeds up and simplifies surface adjustment for curettes during precision debridement.

3. Suturing Instruments:

A. Needles and sutures:

Laschal micro-scissor, or any small-beaked scissors, are the most often used scissors for microsurgical procedures. The scissors and the Castroviejo needle holder make it simple to handle synthetic sutures (5/0 or 6/0), reduce inflammation, and avoid the consequent delayed healing. Needles used in microsurgical treatments typically have two common curvatures: one-half of an inch (12.7 mm) and three-eighths of an inch (10 mm). The most typical application for a specially made needle is in cosmetic periodontal microsurgical operations, such as with a spatula needle. Its curvature is 140°, and its length is 6.6 mm. In Periodontal Muco-Gingival surgery, a small needle tract and precise needle acquisition of the tissue allow for extremely accurate apposition and closure. [9].

Characteristics of Microsurgical Instruments:

Compared to conventional microsurgery, microsurgery uses thinner threads and needles to limit injury to soft tissues and achieve a tight primary wound closure with mild stress. Consequently, it affects the optimal primary wound healing in the surgical field. In order to be used under a magnified field of view, the tip of the instrument must be smaller than that of a regular instrument, be able to handle fine threads and needles, be able to reach tight spaces such the papillae and interdental space to execute the essential procedures, and be strong enough to handle thin gingiva. In order to enable delicate movement, micro instrument handles are typically shaped like a pen grip and rotate in a cylindrical fashion [15]. A length of 18 cm or more is ideal for proper handling, even if commercially available lengths of the instrument include 15 cm, 18 cm, and 21 cm. However, a 21-cm instrument might be too long, which would result in the back of the instrument hitting the objective lens and making handling difficult. When using a microscope, Asians should aim for a working distance of about 25 cm, or focus length. Consequently, when selecting the appropriate length, the surgeon's body size and the performance of the microscope should be taken into account. Generally speaking, it is recommended to utilize instruments that measure between 15 and 18 cm and are gripped firmly in a pen grip [5].

Magnification Methods:

In microsurgery, a sophisticated surgical technique, magnification is employed to restore normal vision. In contemporary periodontology, plastic surgery and cosmetic dentistry are closely connected disciplines. In an attempt to enhance vision, lessen soft tissue injury, and enhance surgical results, periodontal plastic microsurgery employs a surgical microscope [16]. Apotheker and Jako are recognized for bringing surgical operating microscopes to dentistry in 1978, even though Shanelac and Tibbett's are credited with first documenting and popularizing periodontal microsurgery in 1992 [17].

Types of Magnification

The two types of optical magnification available to dentists are

a) Magnification loupes

b) Surgical operating microscope (SOM) [18]

Loupes

In 1876, Saemisch brought loupes—the magnification tool most commonly used in dentistry today—to the field of medicine. Loupes are two types of monocular microscopes that concentrate on an object to produce a stereoscopic, magnified view. They have angled, side-by-side lenses [17].

Magnification loupes

An increased working distance from the viewing object and improved visual acuity are two ergonomic advantages of using surgical loupes for magnification for the physician. A configuration of convergent lenses is known as a Keplerian optical system. The three types of Keplerian loupes that are commonly used in periodontics are shown in Figure 3:

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JCHR (2024) 14(6), 600-606 | ISSN:2251-6727

Figure 3: Types of Loupes

Simple Loupes:

Simple loupes are early magnifiers that have two single meniscus lenses and can only focus on two refracting surfaces. The magnification of a lens can be enhanced by increasing its thickness and diameter. Simple loupes are impractical at magnifications more than 1.5X because of space and weight constraints. Spherical and chromatic aberration significantly distort the color and shape of the objects being observed, greatly affecting them.

Compound loupes:

Compound loupes converge many lenses with air spaces between them to achieve adequate magnification, refracting power, and working distance. To satisfy clinical needs, these lenses can be weighed or resized without unnecessarily growing in size. These lenses are popular among dentists because the distinct densities of each component counteract the chromatic aberration of the next piece. Compound loupes are frequently mounted in or on top of spectacles.

Prism Loupes:

Prism loupes, the most optically complex type of loupes, use Schmidt or rooftop prisms to lengthen the light path via a sequence of internal mirror reflections, folding the light to reduce the barrel of the loupes. Prism loupes outperform other forms of loupes in terms of magnification, depth of field, working distance, and field of view, especially at magnifications of 3.0 diameters and higher. Headband-mounted loupes are often more comfortable and stable than glasses-mounted loupes due to their increased weight [17].

SURGICAL OPERATING MICROSCOPE

A complex system of lenses called the surgical microscope enables binocular sight at magnifications ranging from around 4X to 40 X. Unlike loupes, which require eye convergence, both light beams fall parallel onto the observer's retina, minimizing the strain on the eye muscles. The binocular tubes, eyepieces, lighting unit, objective lenses, and magnification charger make up the surgical microscope. It can be installed on a wall, ceiling, or anchored to the ground [19].

Hand control

Physiologic Tremor:

The uncontrollable movement resulting from our bodies' purposeful as well as accidental movements is known as physiologic tremor. A surgeon's physiologic tremor may be influenced by a number of things, including as nervousness, recent physical activity, alcohol, tobacco, caffeine, large meals, hypoglycemia, and prescription use. A micro surgeon needs to maintain a steady instrument-holding position, a comfortable and well-supported hand, proper body alignment, and a calm mental state in order to reduce tremors. The surgeon needs to be sitting up straight, with both feet level on the ground and legs extended forward so that each leg's calf is at a right angle to the thigh. Holding the surgeon's head comfortably upright is important. Every action should be effective and directed toward a conscious, intentional goal.

Hand Grips:

The pen grip, also known as the internal precision grip, in which the thumb, index, and middle fingers are employed as a tripod, is the most often utilized precision grip in microsurgery. The wrist, elbow, and ulnar border of the hand should all be well supported by the forearm's slightly supine position, which allows the hand's weight to rest on the ulnar border. The ring finger and middle finger should be used to support the instrument while the middle finger firmly rests on the surface that supports the hand. When using the pen grip, the hand's flexor and extensor muscles are at ease and resistant to fatigue, and the intrinsic muscles that rotate the hand are positioned correctly for precise

The positioning of the micro surgeon in relation to the patient is crucial. When it comes to rotary suturing, the right-handed person's most accurate movement is from 2 to 7 o'clock, whereas the left-handed person's most accurate movement is from 10 to 4 o'clock. Continuous repetition of alternate positions along the 360-degree axis eventually leads to the mastery of surgical techniques required for performing successful microsurgical procedures on any part of the mouth [22].

Limitations of Microsurgery:

A sizable fraction of the research included for this review indicate that one of the main drawbacks of the robotic surgical systems now in use is the lack of suitable instrumentation made expressly for microsurgery. The da Vinci surgical robot was used in most published publications to evaluate the viability of robotic microsurgery. Open plastic reconstructive microsurgery is not recommended nor developed for this specific system, despite the fact that it is licensed for minimally invasive surgery in seven surgical specialties.

Most instruments that are compatible with the da Vinci are thought to be too big to be used for the delicate tissue manipulation that is typically required during microsurgery. The Black Diamond Micro Forceps from da Vinci have been successfully used to operate on tiny blood arteries and neurons [25–28]. However, managing sub-millimeter tissue and equipment is a difficult and time-consuming procedure in the absence of a complete set of suitable microsurgical instruments. When utilizing a surgical robot in place of a traditional microsurgery tool, common microsurgical tasks like cutting blood arteries, placing vessel clamps, and managing tiny sutures become more challenging.

The range of surgical instruments available does not fully address the range of tissues that may be encountered during microsurgery, in addition to the issue of large equipment. As of now, there isn't a robotic system that offers the instruments required to carry out operations involving all varieties of tissue. Therefore, surgical robotics alone cannot be used to undertake procedures involving both soft and hard tissues [29]. Furthermore, robotic utilization is inefficient due to the breadth of macroscopic and microscopic procedures employed in reconstructive surgery. As a result, it necessitates a laborious and drawn-out process of constantly switching between robotic-assisted and conventional microsurgery [20].

Application in Dentistry:

Endodontic:

In endodontic, a microscope can be used for various purposes such as clearing out broken instruments from the canals, obturating the back cavity, preparing the retrograde cavity obturation cavity, finding the pulpal chamber canals, performing retrograde cavity obturation, and treating periapical radiolucencies. Microsurgical techniques can also be successfully used to treat Endo-Perio lesions, which can occasionally become very difficult to treat due to inaccessibility and complications [23].

Oral Surgery:

Specifically approved for the surgical management of nerve-related lesions and injuries. When a patient has an inferior alveolar nerve lesion, microsurgical restoration improves their neurosensory function.

Prosthodontics:

High resolution magnification with a microscope is very helpful for polishing and finishing the prosthesis's final edges, inspecting the tooth/material obturation interface, and examining the adjustments of metallic components and porcelain edges [25].

Orthodontics:

While conventional orthodontic therapy is the best option for correcting many adult dental malposition, it can cause issues for patients with thin periodontal biotypes, since they may have recession and/or root dehiscence. A Piezosurgical approach that enables instantaneous application of biomechanical stress and microsurgical corticotomy around each root may help achieve these goals. By avoiding the periodontal tissue fibers, as required by conventional orthodontic movement, this approach prevents both periodontal and bone resorption [26].

Applications in Medical Field:

With its high magnification and sophisticated optics, microsurgery broadens the surgeon's field of

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JCHR (2024) 14(6), 600-606 | ISSN:2251-6727

vision, enabling the successful completion of reconstructive treatments that were previously unfeasible during traditional surgery, even with the use of magnifying loupes. Throughout the medical sciences, microsurgery has been applied in many different fields. For example, gynecology uses it to treat various pathological conditions of the female genital tract that can lead to infertility; urology uses it to reconstruct the male urogenital tract; plastic surgery is used to treat extensive burns, trauma, cancer excision, and radiation necrosis; neurosurgery is used to prevent and treat cerebral ischemia; ophthalmology is used for retinal surgery, and so on [27].

Future Perspectives:

Robotic Microsurgery

Less invasive surgical procedures are being replaced by robotic microsurgery. The system that controls equipment from a distance of ten feet is inserted through tiny incisions to carry out the delicate steps of the procedure. The Tele-robot's precision is demonstrated to the surgeon as he manipulates it and observes the procedure via a three-dimensional video. Additionally, it can finish the intricate process step by step, which was not conceivable before. To use this method in dentistry, more research in this area is needed [29].

CONCLUSION

Microsurgery offers new possibilities for less invasive periodontal therapy treatments. It improves therapeutic outcomes in terms of appearance, wound healing, patient discomfort, and patient acceptability. It also helps to make difficult-to-reach places visible and approachable. The functioning microscope, which enhances the quality of treatment and facilitates better diagnosis, is the main culprit in this. Periodontal microsurgery is definitely required for Perio-aesthetics.

The capacity of magnification to enhance visual acuity provides access to a completely new realm for anyone who dedicate sufficient time and energy to master the principles and methods of microsurgery. Potential periodontal microsurgery will create new opportunities to improve the therapeutic results of different periodontal operations. Magnification technology have opened up a whole new world for a lot of specialty surgeons.

The exact approximation, little tissue destruction, careful tissue manipulation, and strict hemostasis are the defining characteristics of the microsurgical technique. Magnification is being utilized increasingly frequently in several dental fields these days. Understanding the optical laws governing magnification is essential to its proper application in dental procedures.

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JCHR (2024) 14(6), 600-606 | ISSN:2251-6727

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