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Recent Advances in Micro Surgical Endodontics

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Abstract: *One of the main goals of periapical surgery is to maintain an endodontically infected tooth that cannot be otherwise maintained by conventional endodontic procedures. Maintenance of such tooth has become more predictable now with the advent of newer diagnostic tools, materials and surgical instruments. Success rates of up to 90% have been reported in various clinical studies. Various instruments are designed and are available in the market and hence it will be appropriate to discuss about those that are of significance to the microscopic component of peri apical surgery. The main objective of our review is to give a complete update on apical surgery to the reader.*
Key words: *Periapical, Surgery, Endodontically, Microscopic, Tooth.*

I. Introduction

Surgical Endodontics like other dental specialties has evolved considerably with the help of technology. Introduction of smaller equipment like ultrasonic filling tips, apex locaters, rotary files etc has helped us in doing a better job. Retro mirrors by Hu-Friedy offers the surgeon a much better and more accurate view of the root and apical region. The advent of MTA has had another positive impact as research found it to be superior to alloys and other biologic retrograde filling materials. The surgical loupes and operative surgical microscope has become an integral part of modern day endodontic surgery. They provide us with better visibility and illumination and magnification of the complex anatomy of the root and apex. They even help us in identifying abnormal anatomies, perforations and cracks. Systematic clinical studies comparing evidence based and clinical parameters has shown that microsurgical endodontic treatment gives a better choice for the operator and has more positive impact on the clinical success.

II. Incision and Flap elevation

After anesthesia is obtained, micro-scalpels (SybronEndo, Orange,CA,USA)[Fig.1] are used in the design of the tissue flap to incise delicately the interdental papillae when full-thickness flaps are required.

Fig1:. A variety of micro scalpels sized 1-5 used for precise incision.

Historically, tissues have been reflected with a Molt 2- 4curette or a variation of the Molt 2-4[Fig.2]. This instrument is double ended and the cross-sectional diameters of the working ends are 3.5 and 7 mm. Under low-range magnification, it can readily be seen that even the smallest end of this instrument is too large to place beneath the interdental papilla without causing significant tearing and trauma to the delicate tissues.

Fig.2: Rubinstein Mini-Molts

Rubinstein Mini-Molts (JEDMED Instrument Company) are now available in two configurations whose working ends are 2 and 3.5mm and 2 and 7 mm. The smaller ends of these instruments provide for atraumatic elevation of the interdental papilla making flap reflection more predictable and gentle to the tissues.Once the tissue has been reflected, instruments such as the Minnesota retractor have been used to retract the tissue away from the surgical field while assuring visual access. A series of six retractors (JEDMED Instrument Company) offering a variety of serrated contact surfaces that are flat, notched, and recessed have been introduced to allow the operator several options for secure placement in areas of anatomical concern. Among these are placements over the nasal spine, canine eminence, and mental nerve [Fig.3].

Fig.3: Minnesota retractor

III. Micromirrors

Another development in apical microsurgery has been the introduction of the surgical micro-mirror[Fig.4]. Among the early pioneers of micro-mirrors was Dr. Carlo Zinni, an otorhinolaryngologist from Parma, Italy. Being an early user of the microscope, Zinni recognized the need to view the pharynx and larynx indirectly for proper diagnosis. Zinni crafted the first polished stainless steel mirrors from which the early endodontic micro-mirrors were developed.

Micro-mirrors come in a variety of shapes and sizes, and have diameters ranging from 1 to 5 mm. There have been many surfaces used on micro-mirrors. Among them have been polished stainless-steel, polished tungsten carbide, and diamond-like coating. Recently introduced micro-mirrors have a rhodium coating. Rhodium is extremely hard and durable and is unsurpassed in reflectivity, clarity, and brightness. They are front surface, scratch resistant, and autoclavable. Using the SOM, it is now possible to look up into the apical preparation to check for completeness of tissue removal. Before using micro-mirrors, it was impossible to assess the thoroughness of apical preparation leading to incomplete removal old root canal-filling material and debris from the facial wall of the apical preparation

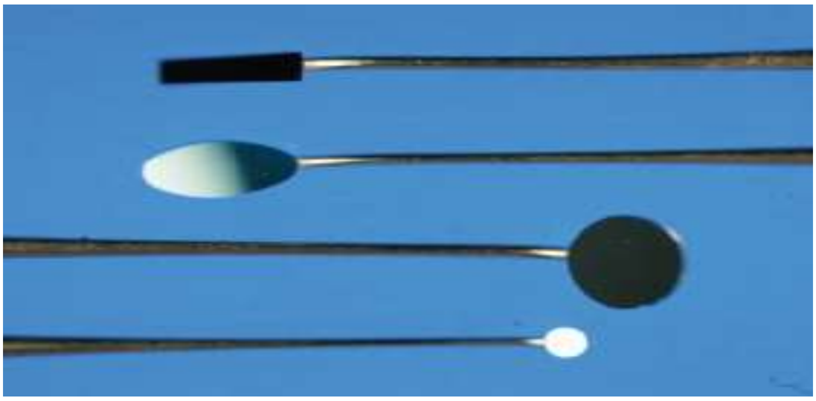


Fig.4: Micro mirrors

IV. Pluggers

A variety of small pluggers[Fig.5] ranging in diameters from .25mm to .75mm are available to condense the cushion of gutta percha. Facial wall debris can further be addressed by removal with a back action ultrasonic tip. Virtually all modern-day ultrasonic tips have some degree of back action in their design. This angle can vary between 70^0 and 80.

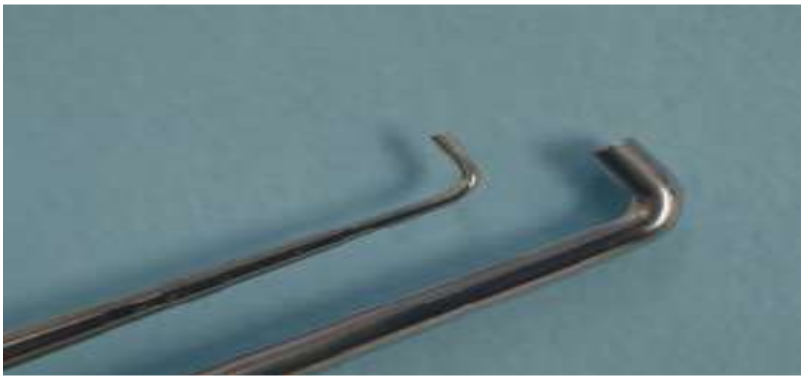


Fig 5. Comparison of a micro plugger with the normal one

V. Stropko irrigator

Once the apical preparation has been examined, it should be rinsed and dried. Traditionally, apical preparations were dried with paper points before placing retro filling materials. This allowed for thorough adaptation of retro filling materials against the walls of the cavity preparation and decreased the chances of creating material voids. Micro control of air and water is now accomplished by using a small blunt irrigating needle mounted on a Stropko Irrigator (SybronEndo). The irrigator fits over a triflow syringe and allows for the directional micro control of air and water. Air pressure can be regulated down to 4 psi. Now the beveled root surface and the apical preparation can be completely rinsed and dried before inspection with micro-surgical mirrors. Anatomical complexities, isthmuses, and tissue remnants are more easily seen when the cut surfaces are thoroughly rinsed and desiccated.

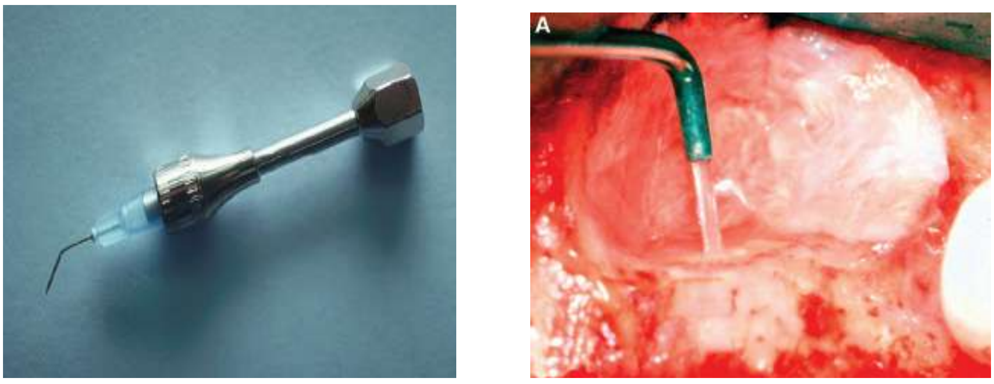


Fig.6. Stropko irrigator

VI. Impact –Air 45 Hand piece: [3]

The Impact-Air 45 handpiece[Fig.7] was introduced to prevent such an occurrence by providing a coolant only stream directed at the bur tip and exhausting air away from the cutting site. This handpiece head was angled at 45^0 to the shaft of the instrument originally to facilitate access to impacted third molars. This has proven to be a great advantage in surgical endodontics performed with the use of a microscope, as the head can be angled in such a way that the entire cutting portion of the bur is visible to the operator.

Fig 7. Impact-Air 45 handpiece

VII. MTA carrier systems: [5]

The Lee MTA Pellet Forming Block is a very simple and efficient device for preparing MTA to be carried to the REP. Properly mixed MTA is simply wiped onto a specially grooved block and the Lee Instrument is used to slide the desired length of MTA out of one of the appropriately sized grooves. The MTA adheres to the tip of the instrument, allowing for easy placement into the REP. With this method of delivery, fewer 'passes' are required to fill the REP adequately. If a plugger or small explorer is placed in contact with the MTA, and the gently touch the 'non-working end' of the instrument with an activated ultrasonic tip, the material 'flows,' entrapped air is released, and the density of the fill is increased . The radiographic appearance may also improve with 'ultrasonic densification'

Fig8. MTA carrier systems

VIII. Magnification and illumination in Endodontics: [6]

8.1. Loupes

Historically, dental loupes have been the most common form of magnification used in apical surgery. Loupes are essentially two monocular microscopes with lenses mounted side by side and angled inward (convergent optics) to focus on an object[Fig.9]. The disadvantage of this arrangement is that the eyes must converge to view an image. This convergence over time will create eyestrain and fatigue and, as such, loupes were never intended for lengthy procedures. Most dental loupes used today are compound in design and contain multiple lenses with intervening air spaces. This is a significant improvement over simple magnification eyeglasses but falls short of the more expensive prism loupe design.

Prism loupes are the most optically advanced type of loupe magnification available today. They are actually low-power telescopes that use refractive prisms. Prism loupes produce better magnification, larger fields of view, wider depths of field, and longer working distances than other types of loupes. Only the SOM provides better magnification and optical characteristics than prism loupes. The disadvantage of loupes is that 3.5– _ 4.5X is the maximum practical magnification limit. Loupes with higher magnification are available but they are quite heavy and if worn for a long period of time can produce significant head, neck, and back strain. In addition, as magnification is increased, both the field of view and depth of field decrease, which limits visual accuracy.

Visual accuracy is heavily influenced by illumination. An improvement to using dental loupes is obtained when a fiber optic headlamp system is added to the visual armamentarium. Surgical headlamps can increase light levels as much as four times that of traditional dental operatory lights. Another advantage of the surgical head lamp is that since the fiber optic light is mounted in the center of the forehead, the light path is always in the center of the visual field.

Fig9. Surgical Loupes

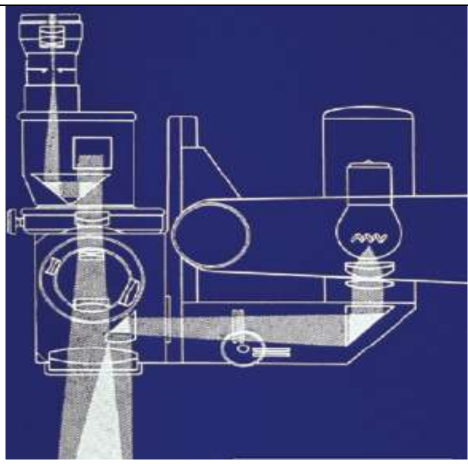
IX Dental Operating Microscope

Microscope is one of the key advancement that the endodontics has seen in the early 1990s.the incorporation of microscope in clinical endodontics has had profound effects on the way endodontics is done and has changed the field fundamentally[Fig.10]. The microscope provides great magnification and illumination and functions as an extension of loupes. It provides a magnification of 4X to 25X as compared to 2Xto 4X provided by loupes. The optimum magnification required for endodontic practice ranges from 8X to 24X which is needed to locate hidden canals, detect micro fractures, distinguish between chamber floor and dentin, and identify isthmuses and small anatomic entities, of which recognition and treatment are so important for the success of endodontic therapy.

In conventional endodontics, the microscope is most useful for locating canals after the access is made. It is extremely useful for post removal using ultrasonic instruments and for perforation repair. These were the procedures that previously were done largely by "feel." The advent of microscope in modern endodontic therapy facilitates a primarily visually guided, secondarily sensory aided endodontic procedure.

9.1. Advantages of microscopes:

1. Visualization of the surgical field.
2. Evaluation of surgical technique
3. Fewer radiographs required
4. Report to the referring dentists and insurance companies
5. Documentation for legal purposes
6. Patient education through video.
7. Video libraries used for teaching programmes.
8. Marketing the dental practice.
9. Less occupational stress.

	
Fig10. Zeiss OPMI PRO ergo (Carl Zeiss Surgical Inc	Fig10. Cross-sectional diagram of a typical 5-step SOM Thornwood, NY, USA) with magnetic clutches, power zoom, and power focus on the handgrips.

X. Conclusion

To conclude the explosive development of new technology in endodontics, as well as innovative solutions to the previously unanswered questions, are being developed and will continue at an exponential rate well into this new era. Although the latest tools for performing endodontics have elevated the specialty to sophistication attained never before, many of the areas remain that require significant advancement and research and such scenarios are not far off in the near future.

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