Apical Surgery — Parts I and II:
Preparation of the Patient and Atraumatic Flap Elevation

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The groundwork that allowed MicroEndodontics to become the new standard of excellence in endodontics was pioneered by Carr. His work has made the surgical operating microscope (OPM) a necessary tool for endodontic procedures that were considered impossible less than a decade ago. During the last seven years, his students as well as other professionals have made improvements in equipment, instruments, materials, and technology, but the basics have not changed significantly. The current protocol for apical microsurgical procedures is a result of the combined efforts of endodontists, manufacturers, and other professionals who have become caught up in the excitement of a new standard of excellence previously unparalleled in this specialty. The results attainable today are very predictable and can be achieved by anyone, provided the basic steps are followed in detail. It is of utmost importance that the clinician complete one step in its entirety before proceeding to the next one. Otherwise, the unfinished step will make subsequent procedures difficult and sometimes impossible to achieve the desired result. If the proper protocol is followed, according to a recent study by Rubinstein, the current apical microsurgical technique has a heal rate of over 91%.[1]

PREPARATION OF THE PATIENT

The preparation of the patient not only takes the individual into consideration, but also the entire surgical team. The microsurgical protocol we teach involves four people: the doctor ("pilot"); the surgical assistant with the co-observer scope for evacuation and retraction ("co-pilot"); the second surgical assistant using the monitor as a visual reference ("flight director"); and the patient ("passenger") (Figure 1).

The medical history and all necessary medications are reviewed with the patient to ensure they are taken at the appropriate times before the surgery appointment. The patient is also instructed to use a chlorhexidine rinse and to take an anti-inflammatory the night before and again on the morning of surgery. During the appointment, the patient is once again asked to perform the chlorhexidine rinse and then is seated in a comfortable fashion. The dental chair should have sufficient space to allow the patient to recline and to turn from side to side. An articulating headrest is an asset, but a curved pillow should be placed beneath the patient's neck for comfort (Figure 2). The smaller, straight "Tempur" pillow can also be placed beneath the small of the patient's back if necessary for more support. After the patient is comfortable in the chair, he or she is coached on how to make slow, small movements of his or her head (as necessary) during surgery. A surgical towel is draped around the patient's head and over his or her eyes for protection from the bright light of the microscope and any debris from the surgical procedure (Figure 3). The clinician should not tell the patient that he cannot move, as this can cause unnecessary panic in a patient who is already apprehensive about the procedure. In the author's experience in over 500 surgeries, only one patient has not remained still during the procedure.

At this point, the surgical team positions themselves with the patient, microscope, endoscope, and associated equipment. The clinician can par-focal the microscope and allow the first assistant to get the co-observer scope focused and in a comfortable position. The mutual comfort of the patient, the surgical assistant, and the dentist is of the utmost importance. The microsurgical technique may take an hour or more, so unnecessary adjustments for comfort's sake during the operation may cause considerable inconvenience. The clinician's surgical stool should have adjustable arms to support the elbows and serve as a reference point if it is necessary for this individual to reach for an instrument during the procedure. Ideally, neither the dentist nor the surgical assistant has to remove their eyes from the oculars of the OPM during the entire operation. The task of directing the operation belongs to the second surgical assistant, who also passes instruments to both the doctor and the first surgical assistant. The second surgical assistant has an overview of the entire surgical procedure and is the only one in position to keep track of everyone's needs. It is important that all possible surgical instruments are organized for ease of access during the operation.

Optimally, there are three Stropko Irrigators: one for water and air (dual Stropko), one with air only for drying (dedicated Stropko), and one fitted with a blue plastic tip for general flushing of the surgical area (Figure 4). The notched ends of 25-gauge irrigating needles (Monoject Endodontic, Sybron, Orange, CA) are removed using a Howe pliers and placed onto the irrigators. The endodontic irrigating needles are bent in the same configuration as the ultrasonic tip that is being used for the retropreparation. Also, since the lumen of the high-speed evacuator tips is so small, it is important for the team to have extra tips available if one should become clogged. It is also a good idea to have a container of NaOCl available so the assistant can occasionally clear the evacuator system of blood and tissue debris.

After topical anesthetic is placed, local anesthetic is administered using two or three 1.8 cc of warmed Marcaine for the blocks and/or infiltrations. The

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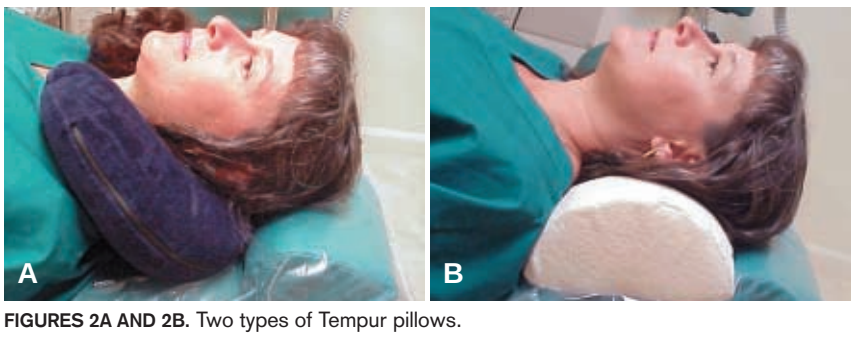
FIGURE 3. Patient's head is draped; the patient is connected to a Pulsoximeter.

FIGURE 4. Set of three Stropko Irrigators.

FIGURE 1. The six-handed team represents an ideal endodontic microsurgery team.



FIGURES 2A AND 2B. Two types of Tempur pillows.

APICAL SURGERY

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warmed anesthetic is injected slowly to avoid any unnecessary trauma to the tissue. Then, using 1:50,000 lidocaine with the bevel of the needle directed toward the bone and in an apical direction, the hemostasis staging injections are given buccally in three sites (mesiobuccal, buccal, distobuccal) over each tooth approximately 1.5 mm to 2 mm apical to the mucogingival line. Slow injection of just a few drops of the anesthetic causes a slight "ballooning" and blanching of the tissue in the immediate area. This is an important step since it causes the mucogingival line to become more pronounced, allowing the operator more accuracy with the following injections and providing better vision of the site. As the anatomy of the tissue unfolds during the injections, the operator should begin planning the incision. The amount and nature of the attached gingiva is an important consideration whether a full sulcular or a mucogingival (Leubke Ochsenbein) flap is used. In general, a full-thickness, sulcular flap is used unless there is an adequate zone of attached gingiva or if aesthetics is a concern.

Once all is ready, the patient is instructed to close on approximately eight thicknesses of 2×2 sterile gauze (four 2×2 pads folded over) for stability of the jaws and to keep any debris from inadvertently entering the oral cavity. A single 2×2 gauze pad is also placed distal of the tooth on which the operation is performed. When operating on the mandibular teeth, especially when a full sulcular flap is used, the operator may want to make the incision before placing the gauze. This sometimes makes it easier to position the scalpel for the incision since the patient is instructed to open his mouth slightly. With the aid of the OPM, using a syringe with a 20-gauge needle, the entire surgical site is rinsed again with the chlorhexidine solution to ensure the area is clean of debris and free of plaque (Figure 5). At this point, the surgical site is now ready for the next step in the procedure.

FIGURE 5. The entire surgical site is rinsed with chlorhexidine rinse.

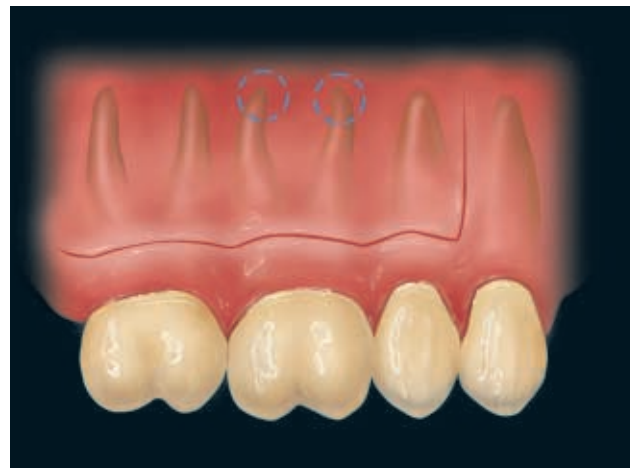

FIGURE 6. Illustration demonstrates the design for the full-sulcular flap.

> ***"Slow injection of just a few drops of the anesthetic will cause a slight 'ballooning' and blanching of the tissue in the immediate area, which causes the mucogingival line to become more pronounced for improved visualization."***
>
> **— John C. Stropko, DDS**

THE INCISION AND ATRAUMATIC FLAP ELEVATION

The incision is made using a microsurgical blade (CK2, SybronEndo, Orange, CA). With the smaller size of this blade, accurate incisions with a cleaner cut than those of the larger #15 or #15S Bard Parker blades can be made. It is advisable for the clinician to consider the suturing process while designing the incision, as a small variation in the design of the incision can make a big difference in atraumatic closure of the surgical flap. In general, the surgeon is working with relatively healthy tissue, and no attempt should be made to remove or alter the periodontium. This is particularly applicable when a full-sulcular flap is created. For this procedure, all flaps are full thickness; the split-thickness flap is to be avoided, as it is the most traumatic and can compromise healing.[2] In general, all flaps should extend to the mesial of the second tooth anterior to the apex of the root being surgerized. The flap design differs depending on: the integrity of the bone over the roots; the amount and nature of the attached gingival tissue; the anatomy of the jaw; and/or the absence or presence of fixed dental appliances. There are essentially two flap designs: the full sulcular and the Leubke-Ochsenbein.

FIGURE 7. Graphic illustration shows how the incision ideally preserves the healthy periodontal attachment.

FULL-SULCULAR FLAP

This design is routinely used in posterior quadrants. The full-sulcular flap should be used in the anterior if there is a thin zone of attached gingival tissue or there is a concern about the possibility of a dehiscence over the root of the tooth on which the operation is performed. The incision is made through the gingival crest and follows the curvature around the cervical of the teeth involved in the surgical area (Figure 6). The operator should attempt to incise the tissue through the crest of gingival to the osseous crest of bone, leaving the healthy gingival attachment intact (Figure 7).

LEUBKE-OCHSENBEIN FLAP

This flap is used only when there is an adequate amount of attached gingival tissue present and the periodontal probing is within normal limits. The

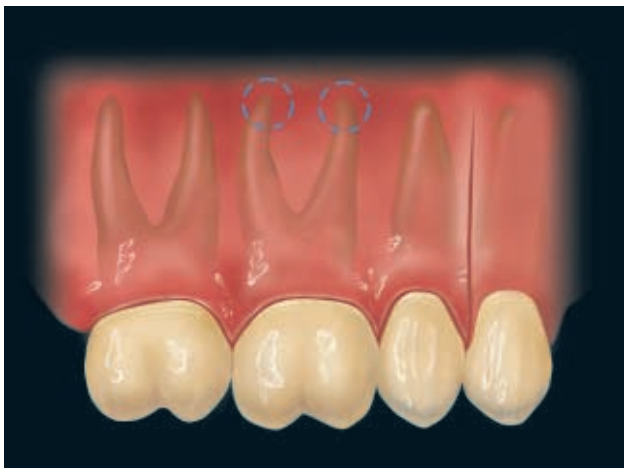

FIGURE 8. The Leubke-Ochsenbein flap is used when aesthetics is a concern and there is an adequate zone of attached gingiva.

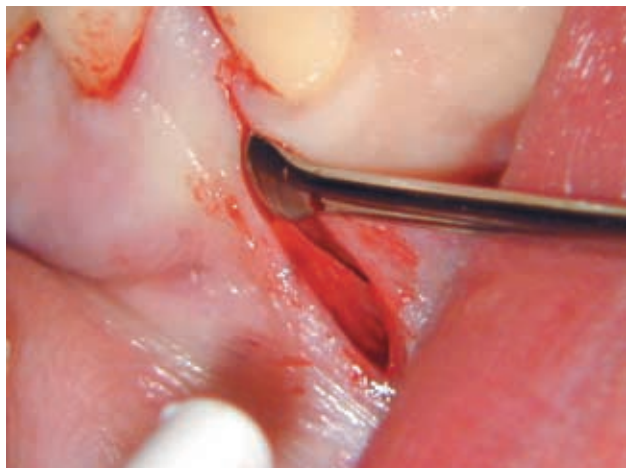

FIGURE 9. The most common cause of postoperative pain is tissue impingement by the retractor.

incision design should have rounded scallops that generally follow the architecture of the teeth and allow for easy repositioning upon completion of the apical microsurgical procedures (Figure 8). The releasing incision is made parallel to the long axis of the teeth. This is important because the blood supply to the area is also parallel to the long axis. If a "wide base" type of flap is made, some of the blood supply to the coronal tissue is interrupted, and healing is compromised.

The reflection of the flap is accomplished using a periosteal elevator (Molt; Ruddle R; Ruddle L, Sybron-Endo, Orange, CA). The working end of the instrument is gently inserted into the releasing incision, beneath the unattached gingival tissue and as far apically as the tissue and bony contours will allow. This motion is a gentle apical-to-coronal movement within the unattached gingival portion of the flap. Maintaining the same motion, the instrument is moved slowly toward the same apical position at the more distal extent of the flap. The working end of the elevator should be sharp so the reflection will be a "dissecting" process and thus avoid crushing or tearing of the tissue. If performed correctly, the attached gingival (ie, the coronal portion of the flap) will gently release from the osseous surface. This atraumatic elevation and reflection of the flap is a major contributor to the rapid healing response routinely observed only 24 hours postoperatively. It is important that the approximating surfaces of the flap are never touched after the incision is completed, as this can cause crushing injuries that inhibit or retard the healing process. An instrument such as the old wax spatula-shaped periosteal elevator has no place in the armamentarium of the endodontic microsurgeon.

Once the flap is gently and cleanly reflected, any "tissue tags" should be left intact as they will aid in the healing process. It is not necessary to clean the flap and exposed bone since these efforts are time consuming, can be traumatic to both the hard and soft tissue, and ultimately compromise the healing process.

The retraction of the flap should be accomplished in a gentle and atraumatic manner. The most common cause of postoperative pain and swelling arises from impingement of the tissue during the retraction process (Figure 9). The surgeon has to constantly monitor the end of the retractor to ensure there is no inadvertent impingement on the flap. An effective way to achieve atraumatic retraction is to prepare a groove in the cortical plate of the bone — well apical to the surgery site. A surgical length #8 round bur on a high-speed handpiece is used to create the groove. Handpieces that have air escaping from the working end should never be used because of the danger of air embolism. This groove creates a definite place for the retractor instrument to seat into and be positioned, which helps prevent slipping during the surgery and impingement of the tissue.

> ***"Apical surgery has achieved significant advances in recent years. The development of ultrasonic root-end preparation devices, expanded use of the surgical operating microscope, and renewed understanding of apical anatomy has increased the efficacy, ease, and speed of the procedure."***
> **— Stephen P. Niemczyk, DMD**

Retraction can be accomplished using one of the various available designs; the best for a given clinical situation is that which maintains visibility of the surgical area and is comfortable for the operator to hold during the procedure. After the flap is retracted, and if there is any tension on the flap, the vertical releasing incision can be extended, or an additional releasing incision at the other side of the flap can be made. In any case, it is imperative that the operator keeps in mind there should be no tension or stretching of the tissues. One should not hesitate to extend the incision to eliminate such tension, which can potentially cause ischemia. Generally speaking, the larger the flap, the easier it is to maintain during the surgical procedure. One of my instructors began each general surgery lecture with the words, "Treat the tissues with tender, loving kindness, and they will respond in a like manner." How many times I have heard those very words while performing apical microsurgery—it is truly a gentle technique.

The next issue of ***Endodontic Therapy*** will include Parts III (Access and Crypt Management) and IV (Bevel and Retropreparation) of the apical microsurgery technique. ■

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