-

ENDODONTIC LABORATORY

Lab. No. (1)

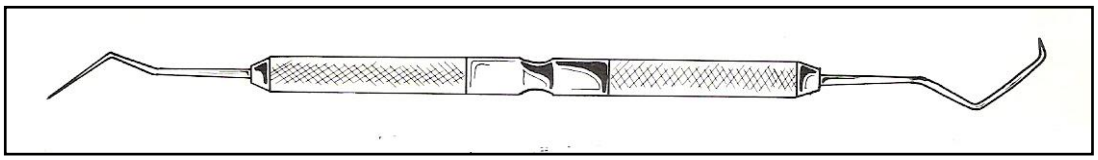
Endodontic instruments

PURPOSE:

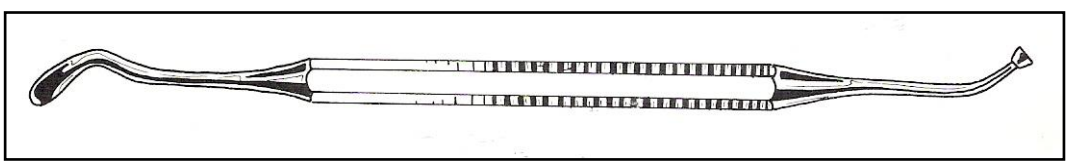
To describe most of the instruments used in conventional endodontics (features and uses).

Basic instruments

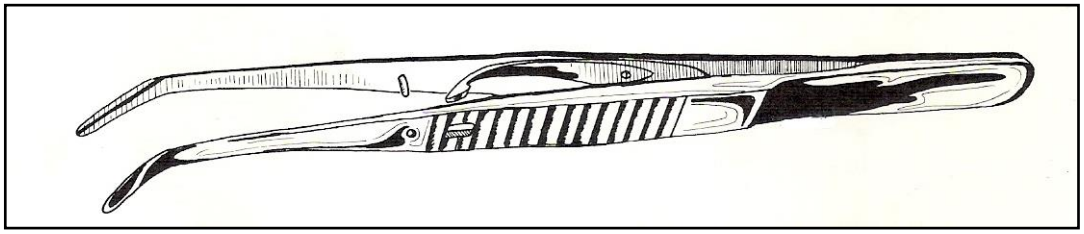
1-Endodontic explorer: The straight end of the explorer is designed to aid in location of root canal orifices, its tip is sharp & able to negotiate a small opening, and the instrument has sufficient rigidity to explore with controlled force. The L-shaped end aids in detection unremoved portions
of the pulp chamber roof.



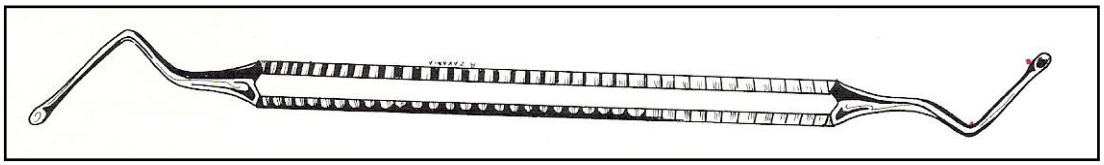
2-Plastic instrument: The blade like end of this instrument is used to carry & place the temporary filling materials. The opposite end is used as a plugger to condense filling materials in the pulp chamber.



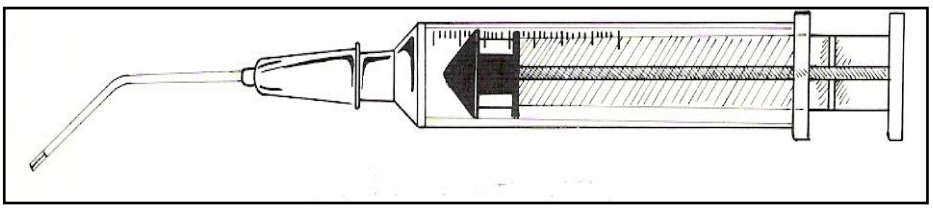
3-Endodontic locking pliers: It has a latch that permits materials to be held without continuous finger pressure. The grooved tips facilitate holding absorbent points and gutta-percha cones, which tend to loosen in ungrooved tips.



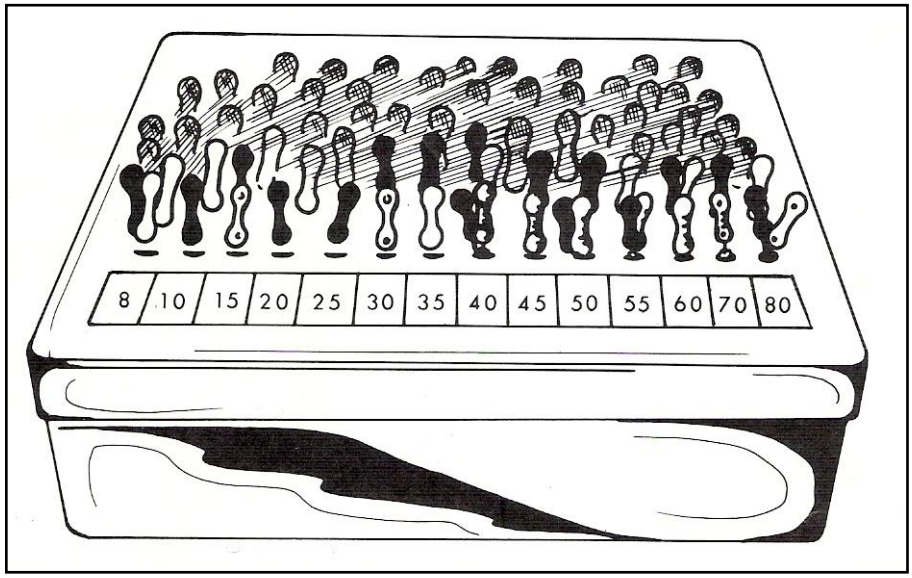
4-Endodontic excavator: The shape of this instrument allows curettage of the pulp chamber when conventional excavator will not reach the floor of the chamber (had long shank). It's also part of the surgery kit and is used to curette periapical lesion.



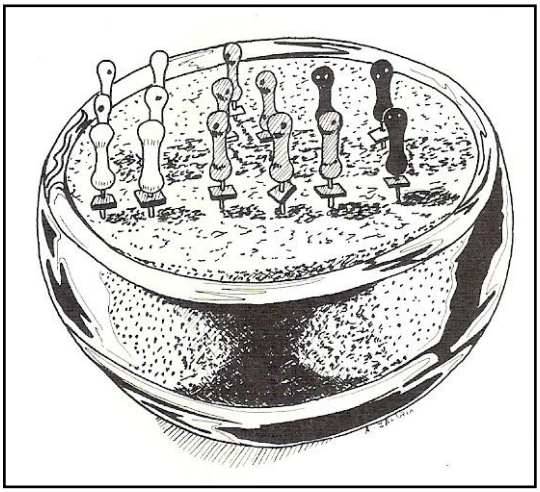
5-Endodontic syringe: It's used to carry the irrigants into the root canal. The needle tip is flat to prevent penetration into smaller canal diameter and grooved to allow irrigants that may be under pressure to flow coronolly rather than be forced through the apical foramen. When drying canals, most of the irrigant may be aspirated from the canal by pulling back on the plunger.



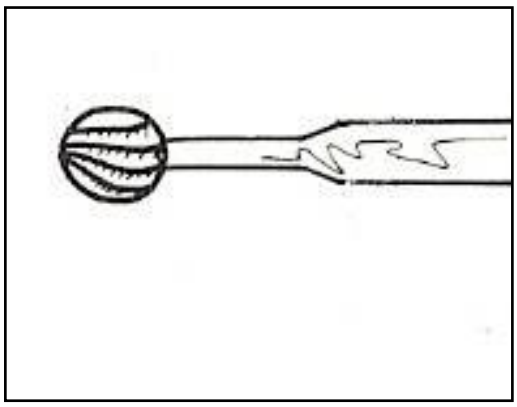
6-Instrument organizer: A means of organizing endodontic files according to size and length is a necessity. The organizer provides holes for the files, which are held vertically in a sponge allowing them to be grasped easily. The sponge is saturated with disinfectant solutions that maintain instrument sterility.



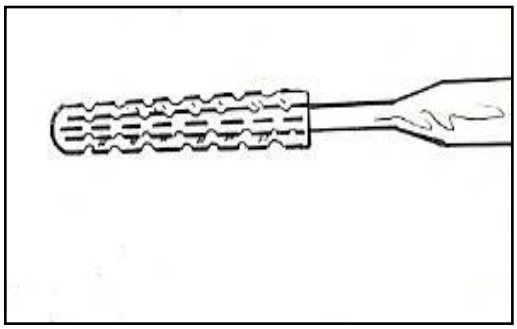
7-Transfer sponge: A banker's sponge is a convenient aid to hold files during root canal preparation. As an assistant or the dentist adjusts the elastic stops on each file. The instruments are placed in the sponge according to size. Each file is then easily grasped, used and replaced in the sponge. The sponge, which is saturated with disinfectant solution, also is useful to debride the instrument. If, during canal preparation, debris and dentin shaving accumulate on the file, they are easily removed by inserting the file into the sponge a few minutes.



8-Round bur: round burs, normal and extra-long, size 2, 4, and 6, are used to lift the roof off the pulp chamber and eliminate over-hanging dentin. The longer and smaller sizes can be used to find calcified canals.



9- safe-ended carbide bur: A safe-ended diamond or tungsten-carbide bur, the Endo-Z bur, both with a non-cutting tip, is used to taper & smooth the access cavity preparation. The non-cutting tip prevents gouging on the floor of the pulp chamber, where important landmarks could be lost in pinpointing the location of root canals.



LEARNING OBJECTIVES:

After this laboratory the student should be able to:

* Know the basic instruments with its uses and function.

ENDODONTIC LABORATORY

Lab. No. (2)

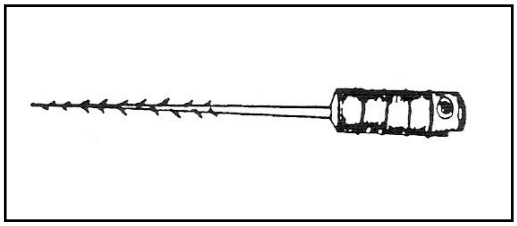
Root canal instruments

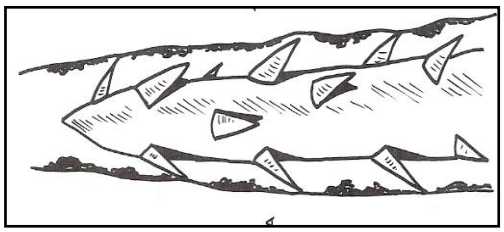
Root canal instruments may be arbitrarily categorized into four categories:-

1-Exploring instruments: used for locating the canal orifice and for determining or assisting in obtaining the patency of the root canal.
Example-endodontic explorers
2-Extirpating instruments: used to remove the pulp tissue, debris, absorbent points, cotton pellets and other foreign elements.
Example- barbed broaches.
3-enlarging instruments: used for shaping and cleansing the canal.
Example-reamer and files
4-Obturating instruments: used for placing or packing sealing agents into a root canal.
Example-root canal pluggers, lentulo spiral and root canal spreaders.

Intra canal instruments

1-Barbed broach: it is a tapered instrument of soft steel, which is notched to produce sharp barbs extending outward from the shaft.

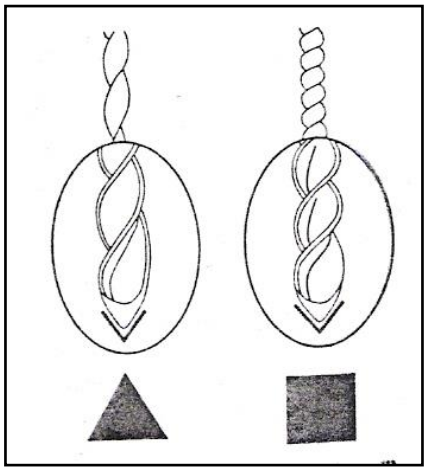




2-Reamers: reamers are manufactured also by twisting a tapered wire blank into pointed instrument, which has fewer flutes than the "K" file.

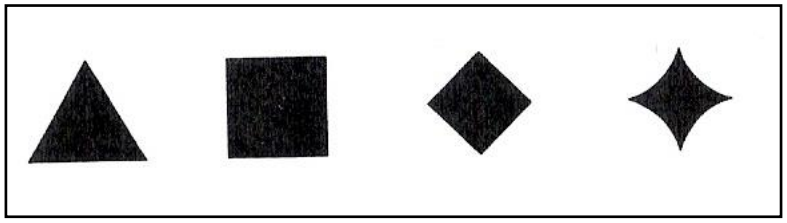
(A): K-Reamer (large)
(B): K-Reamer (small)

A



B

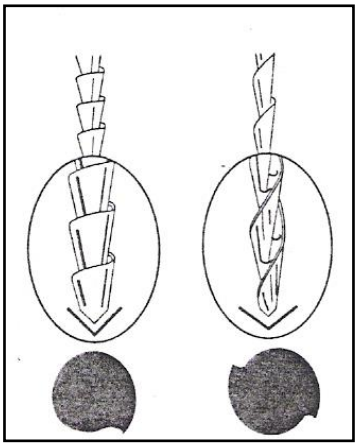
3-Files: most files are manufactured by tightly twisting tapered pointed stainless steel wire blanks. The wire blanks may be a variety of shapes i.e., triangular, square, rhomboid, diamond, etc.



4- Hedstrom File: have flutes that resemble successively smaller triangles, set one on another. They are manufactured by using a sharp rotating cutter to gouge triangular segments out of a tapered round wire shaft.

(A): Hedstrom
(B): Unifile
S-File

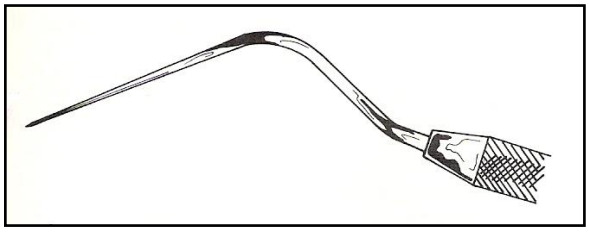
A



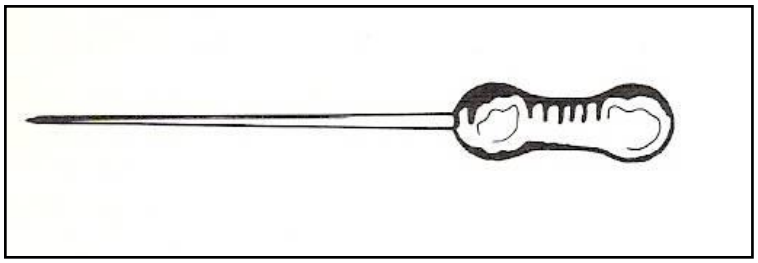
B

5- Nickel Titanium Files: are made by grinding three equally spaced u-shaped grooves around the shaft of a tapered nickel titanium wire. The flutes have a flat outer edge and cut with a planning action.

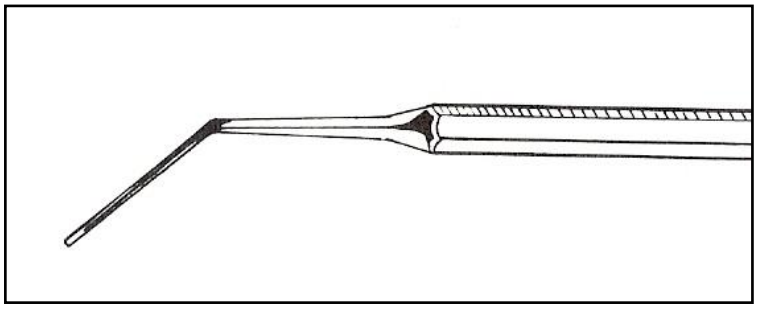
6-Hand spreader: Manufactured from stainless steel, land spreaders are designed to facilitate the placement of accessory gutta-percha points around a well-fitting master gutta-percha point during the lateral condensation method. Their diameter & shape are not standardized making it difficult to match spreaders with accessory gutta-percha points.



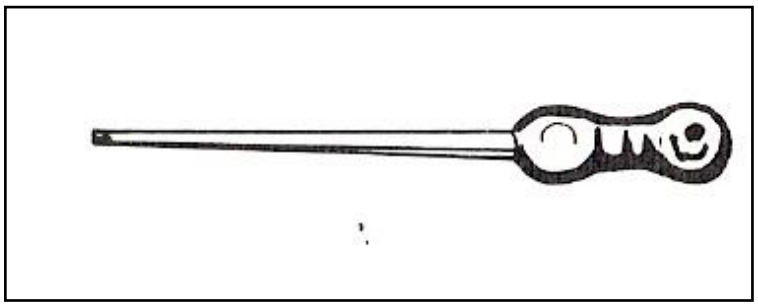
7-Finger spreader: These instruments are color-coded to match either standardized or accessory gutta-percha points. Their short length affords a high degree of tactile sense & allows them to rotate freely around their axis, thus freeing the instrument for easy removal.



8- Hand plugger: Endodontic pluggers consist of long-handled instruments which are of larger diameter than spreaders & have a blunt end; they are used to pack thermally softened gutta-percha into the root canal. The different-diameter pluggers have reference lines on the tips to allow the assessment of plugger depth.



9-Finger plugger: the finger plugger has the same shape and function as the hand plugger.



Styles of instruments:

Files and reamers come in different length, width s and various types of handles; metal or plastic. The slandered length instrument used by most practitioners is 25mm. however, the shorter 21mm instrument are excellent use foe posterior teeth. In extremely long teeth, particularly maxillary cuspid, instruments of 31mm length will be required. Long handled instruments may be used for maxillary teeth.

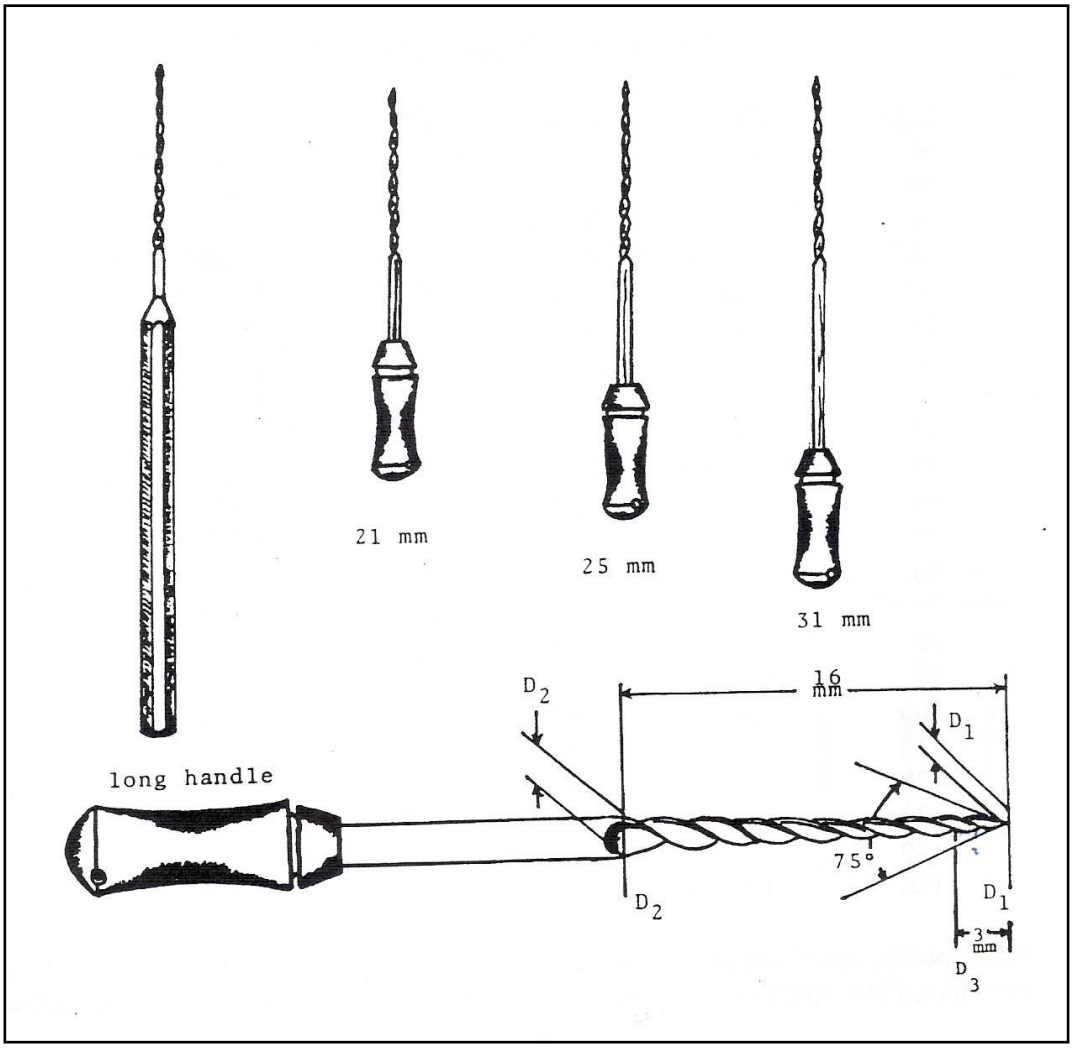
Standardization of instruments

1-Instruments shall number from 06 to 150. The number advance by five units from size 10 to size 60, then by units of tens to size 150 i.e. 10, 15 20,……..60,70,80, etc.
2-Each number shall representative of the diameter of the instrument in hundredths of a millimeter at the tip, e.g., #10, is 0.1mm, #25 is 0.25mm and #90 is 0.90 mm at the tip.
3-The position at which the cutting blades begin on an instrument is called D1, and the flutes extend up the shaft for 16mm to stop at D2.
4-The slop or taper of the instrument increase 0.02mm in diameter for every millimeter of length.

Hand files (stainless steel)

The remaining portion of the shaft extending to the handle is smooth. The length of the cutting edges (the distance between D1 and D2) remains 16mm, regardless of the length or style of the instrument. The diameter atD2 is 0.32mm wider than the diameter at D1. Therefore, the size of each instrument gives considerable information about its dimension. A size 10 file indicated to be 0.10mm in width at D1 and 0.42mm at a point 16mm farther up shaft at D2[10+(16 X0.02)=0.42mm].

HAND INSTRUMENT LENGTH AND STANDARDRIZATION



Instrument size	**D1= expressed in hundredths of a mm**
Diameter	**D2=D1 + 0.32mm**
Taper	**= 0.02mm per mm**
Tip angle	**$=75^{0}+15^{0}$ included angle**
Length blade(D1 to D2)	**=16.0 mm**

ENDODONTIC LABORATORY

Lab. No. (3)

Access preparations on anterior teeth

Armamentarium:

a-Extracted anterior tooth
b- High speed hand piece
c-Low speed hand piece
d-Round burs: #2, 4
e-Cutting end tapered fissure bur
f-Round end tapered fissure diamond bur
g-Endodontic explorer
h-Endodontic kit
i- Silver pencil

PURPOSE:

To create an access opening in the crown portion of anterior teeth to afford direct, unobstructed, **STRAIGHT-LINE ACCESS** to the root canal foramen, while preserving as much sound tooth structure as possible.

PROCEDURE:

(1) Before starting, review your notes on anterior pulp cavity anatomy, examine the demonstration models, and check opening diagrams in text.

(2) The initial penetration through the enamel is made at right angle to the long axis of the tooth (through the lingual surface). The ideal bur is cutting tapering fissure bur.

(3) Continuing with the high speed drill, the angle of the bur is rotated parallel to the long axis of the tooth. The shaft of the bur should ride on the lingual surface of the incisal edge of the tooth. After establishing the size and shape of the preparation, show it to the instructor.

(4) Advance no. 2 or 4 round bur in a slow speed contra-angle handpiece. In the central part of the preparation to penetrate the roof of the pulp chamber a sensation " dropping through" is usually be felt. This will, of course vary from tooth to tooth in

clinic setting. Calcified chambers don't produce this sensation. Once you "dropped through" the ceiling of the chamber, you should remove the entire roof with a sweeping in and out motion of the bur in a low speed hand-piece. The result should be a clearly visible the pulp chamber with a readily accessible orifice.

(5) Flare the walls of the preparation so that a funnel shaped preparation extended from the tooth surface down to the root canal orifice. Use tapered fissure diamond bur to accomplish this.

Note: all walls of the first mm of the access preparation should be parallel, and then taper/funnel to the orifice of the canal.

(6) Use endodontic explorer to locate the root canal orifice and irregularities on the walls of the preparation.

(7) Keep in close touch with your instructor. Remember, everything is checked with endodontic explorer.

Note: access opening should be made large enough so that direct access can be gained to the root canal orifice.

LEARNING OBJECTIVES

After this laboratory the student should be able to:

*** Create endodontic access opening on a variety of anterior teeth.**

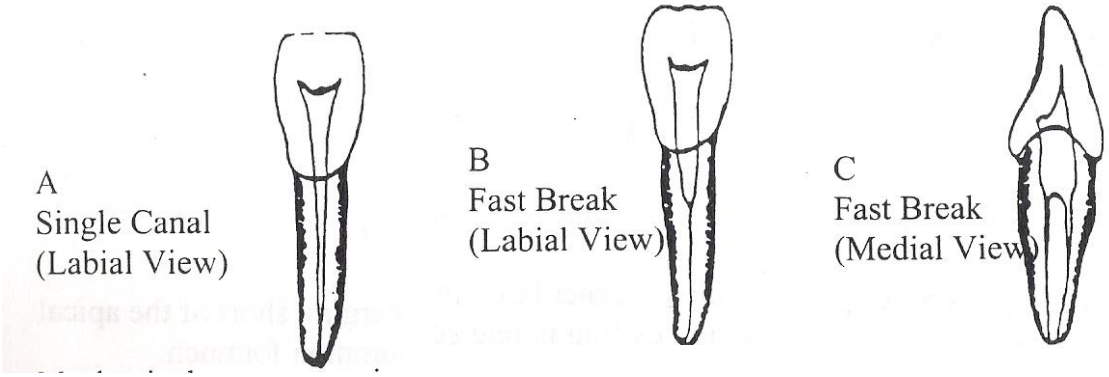
Major points to remember during instrumentation:

1-Great care must be taken in the removal of all pulpal remnants other wise tooth discoloration, exacerbation of an infective process and / or failure of the case may result.

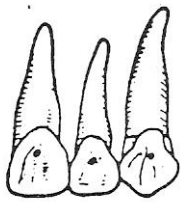
2-Maxillary central incisor is the only anterior tooth having an oval shaped canal in a mesiodistal direction. All other anterior canals are ovoid in a labio-lingual direction.

3- More than half of maxillary lateral incisor has a distal curvature to the root apex. (Failure to negotiate this curve is one of the reasons why the maxillary lateral incisor has the highest number of endodontic failures of the entire dentition).

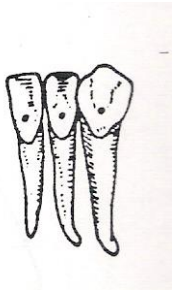
4-The mandibular incisors are almost invariably single rooted but, frequently have two canals. Radiographically the second canal is hidden unless multiple exposures are made at different horizontal angulations. Frequently, the clinician may predict the presence of a second canal by the shape of the pulpal cavity as it appears on the x-ray.



ACCESS OPENING OF MAXILLARY& MANDIBULAR ANTERIORS



A

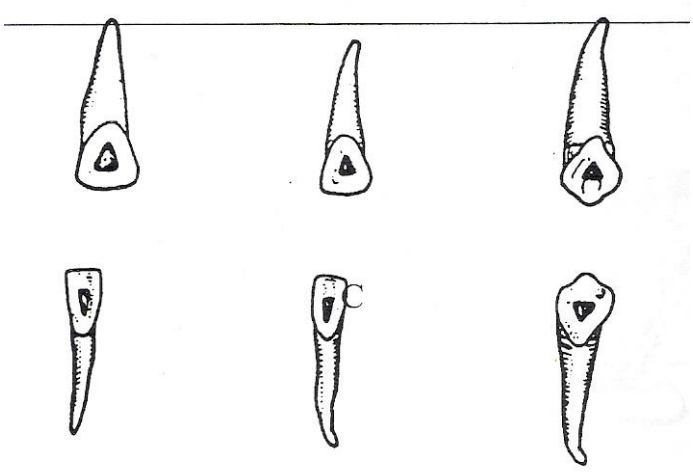


Maxillaries Mandibulares

B

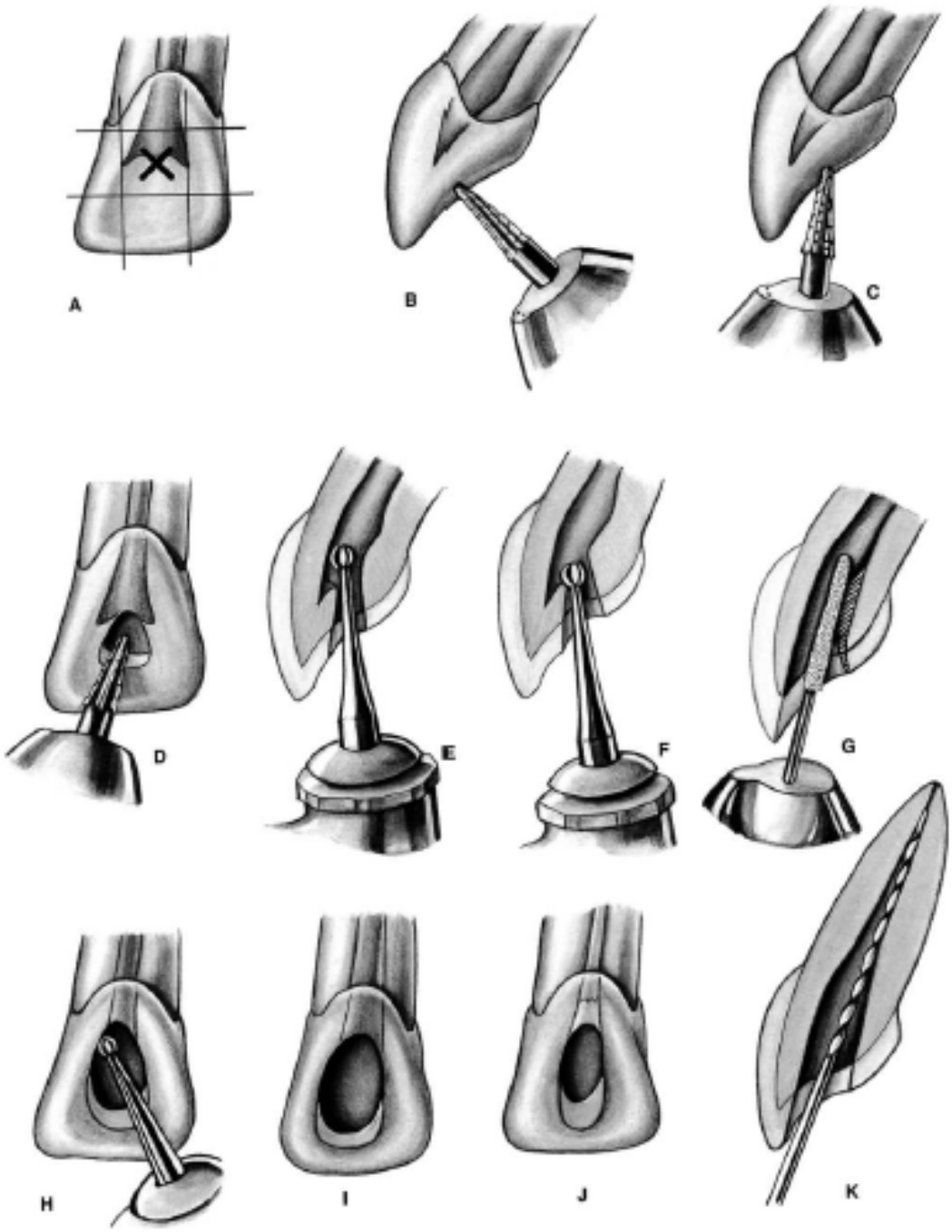
Maxillary mandibular

A. Initial points of penetration.
B. (1) Too far toward the gingival with initial opening
(2) Correct point of penetration.

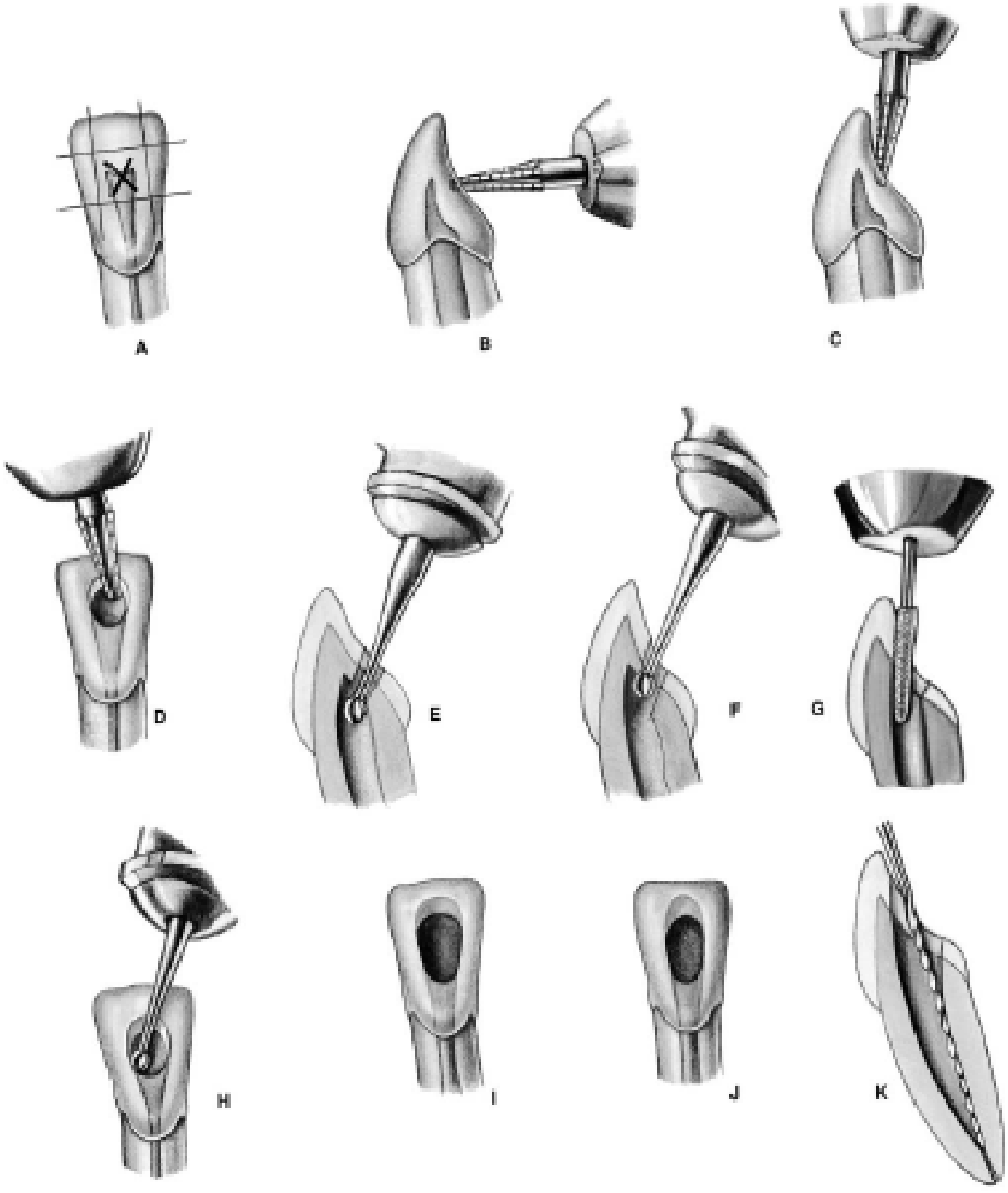


C. Access openings of maxillary and mandibular anterior teeth

MAXILLARY INCISOR ACCESS OPENING STEPS

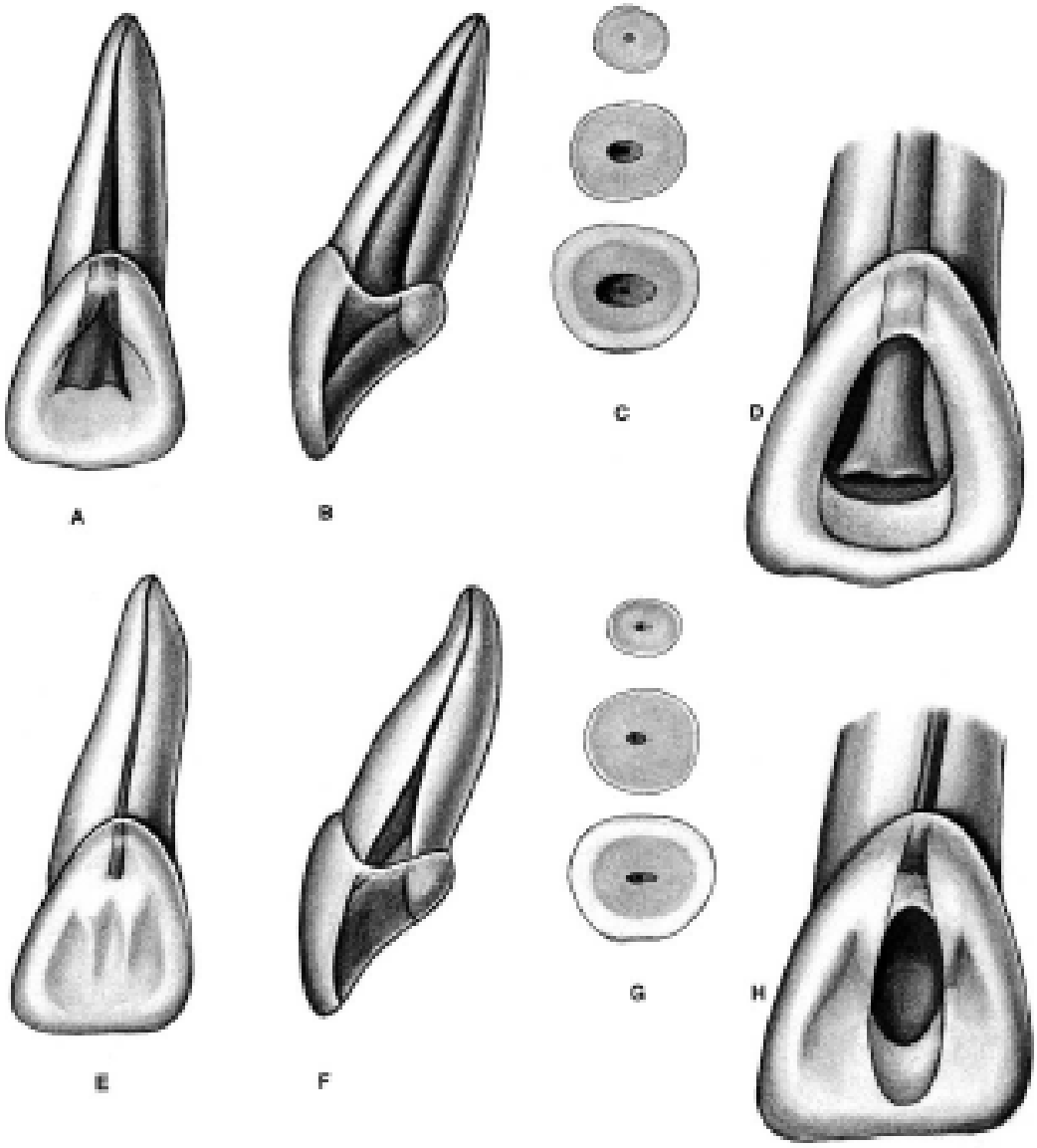


MANDIBULAR CENTRAL INCISOR ACCESS OPENING STEPS



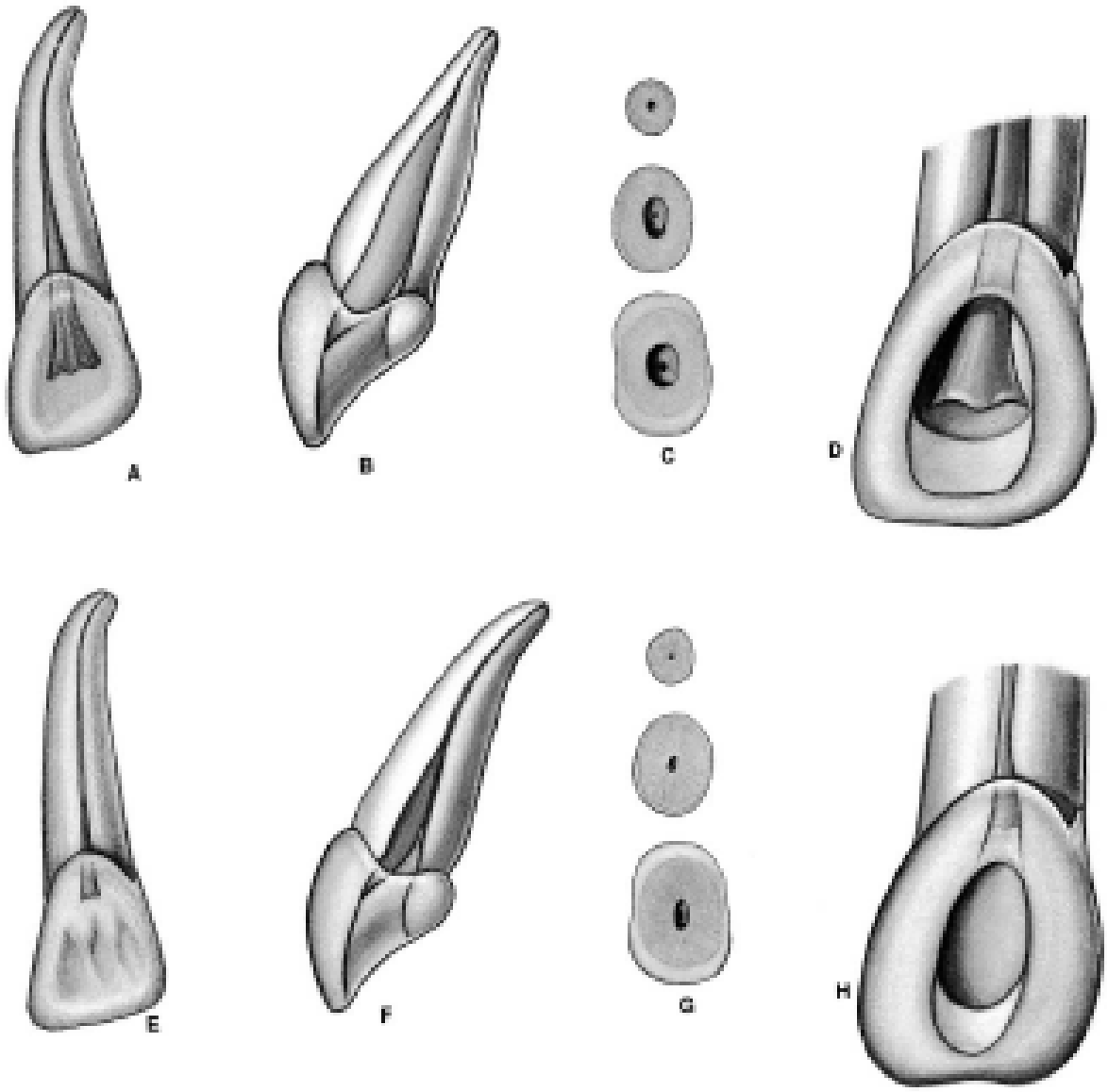
MAXILLARY CENTRAL INCISOR

Length of tooth[8]		Canal[9]	Lateral canals[10]	Apical ramifictions[10]	Root curvature[9]	
Average length	23.3mm	One canal	23%	13%	Straight	75%
Maximum length	25.6mm	100%			Distal curve	8%
Minimum length	21mm				Mesial curve	4%
Range	4.6mm				*Labial curve	9%
					*Lingual curve	4%
					*Not apparent in radiograph	



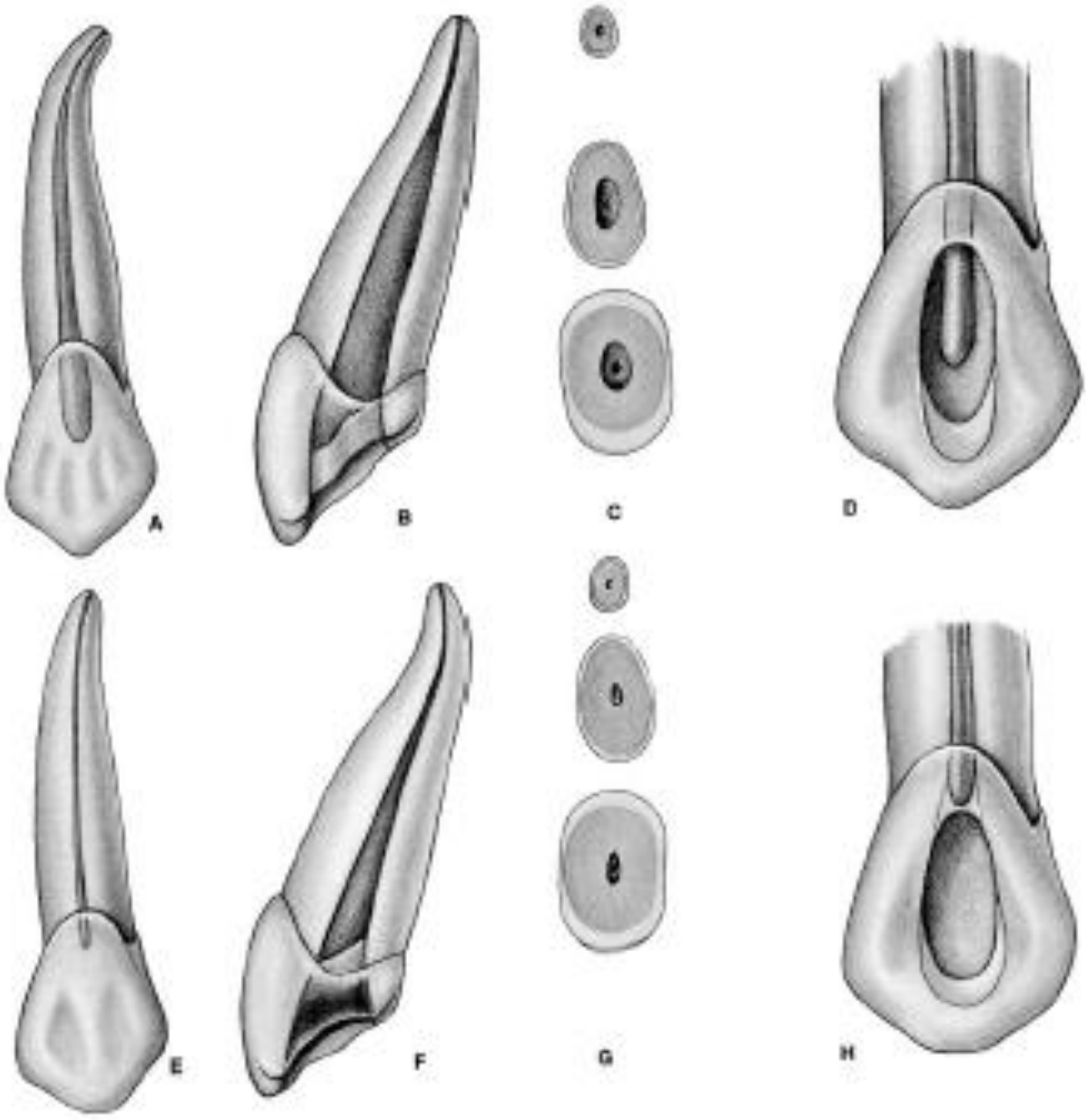
MAXILLARY LATERAL INCISOR

Length of tooth[8]		Canal[9]	Lateral canals[10]	Apical ramifictions[10]	Root curvature[9]	
Average length	22.8mm	One canal	10%	12%	Straight	30%
Maximum length	25.1mm	99.9%			Distal curve	53%
Minimum length	20.5mm				Mesial curve	3%
Range	4.6mm				*Labial curve	4%
					Bayonet and gradual curve	6%
					*Not apparent in radiograph	

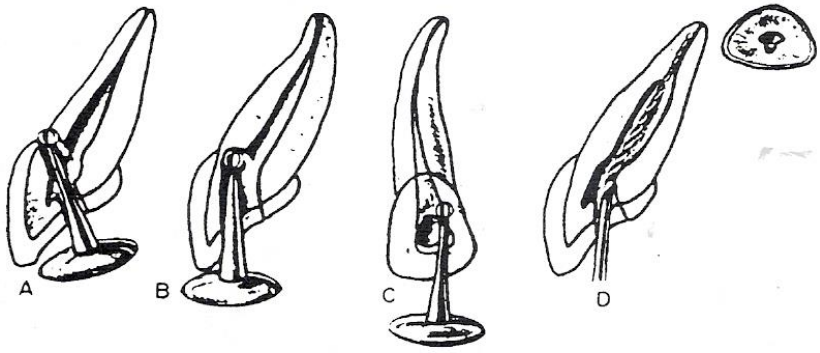


MAXILLARY CANINE

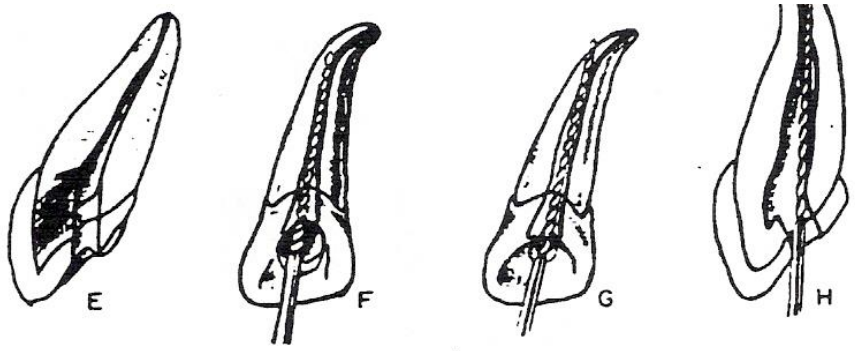
Length of tooth[8]		Canal[9]	Lateral canals[10]	Apical ramifictions[10]	Root curvature[9]	
Average length	26mm	One canal	24%	8%	Straight	39%
Maximum length	28.9mm	100%			Distal curve	32%
Minimum length	23.1mm				Mesial curve	0%
Range	5.8mm				*Labial curve	13%
					*Lingual curve	7%
					Bayonet and gradual curve	7%
					*Not apparent in radiograph	



MAXILLAEY ANTERIOR ACCESS OPENING ERRORS



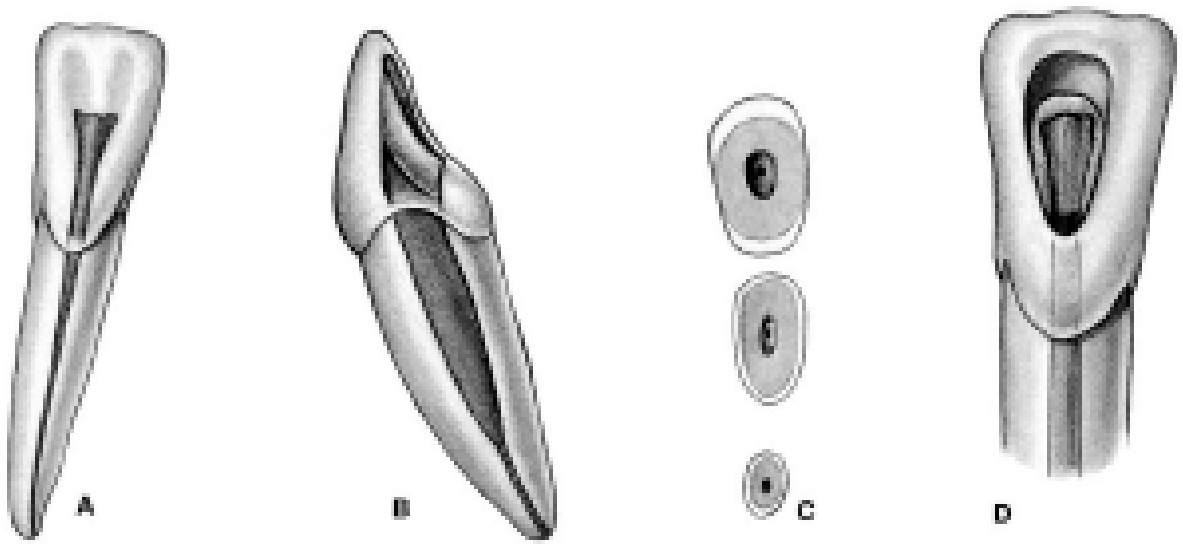
A. PERFORATION at the labiocervical surface caused by failure to complete the convenience extension toward the incisal, prior to entrance of the shaft of the bur.
B. GOUGING of the labial wall caused by failure to recognize the 20 degree lingual axial angulations of the tooth.
C. GOUGING of the distal wall caused by failure to recognize 16 degree mesial axial inclination of the tooth.
D. KEYWAY-SHAPED PREPARATION at the canal orifice caused by failure to complete the convenience extensions.

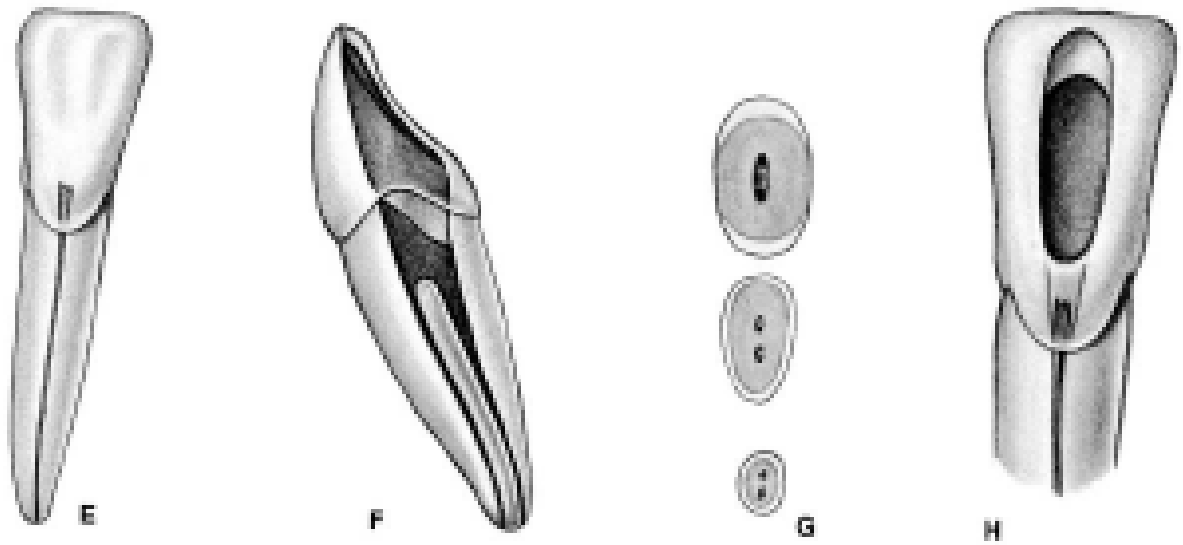


E. DISCOLARATION of the crown caused by the failure to remove pulpal debris. The access cavity is too far gingival with no extension.
F. LEDGE formation at the apical-distal curved caused by using an incurved instrument too large for the canal or no convenience form preparation.
G. PERFORATION at the apical-distal curve caused by using large instrument through a small access opening placed too far gingivally.
H. LEDGE formation at the apical- distal curve caused by failure to complete the convenience extension.

MANDIBULAR CENTRAL AND LATERAL INCISORS

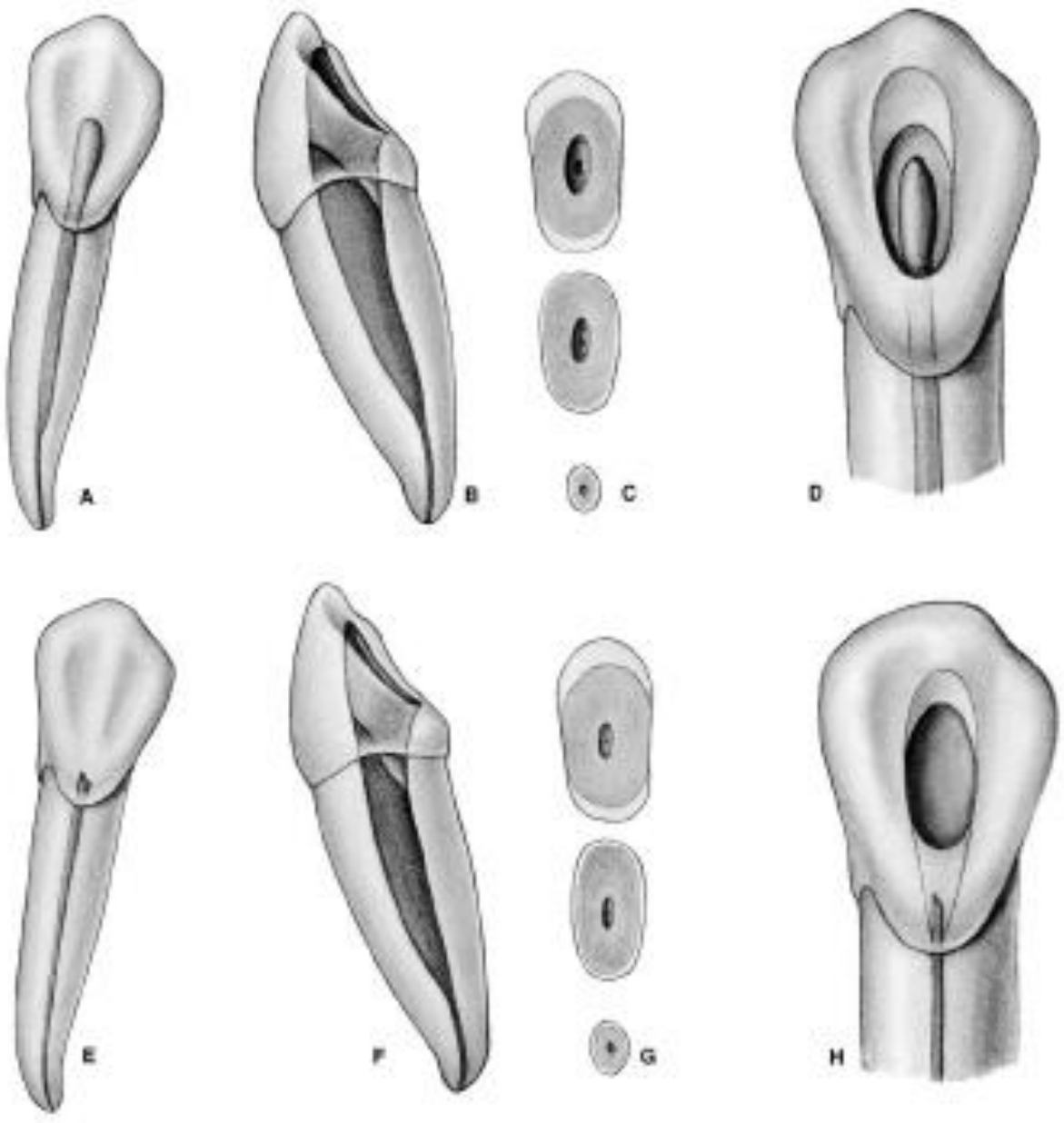
Length of tooth	Central Incisors	Lateral Incisors	Canals	Central Incisors	Lateral Incisors	Root curvature	
Average length	21.5mm	22.4mm	One canal	70.1%	56.9%	Straight	60%
			One foramen			Distal curve	23%
Maximum length	23.4mm	24.6mm	Two canals	23.4%	14.7%	Mesial curve	0%
			One foramen			*Labial curve	13%
Minimum length	19.6mm	20.2mm	Two canals	6.5%	29.4%	*Lingual curve	0%
			Two foramens				
Range	3.8mm	4.4mm	Lateral canal	5.2%	13.9%	*Not apparent in radiograph	



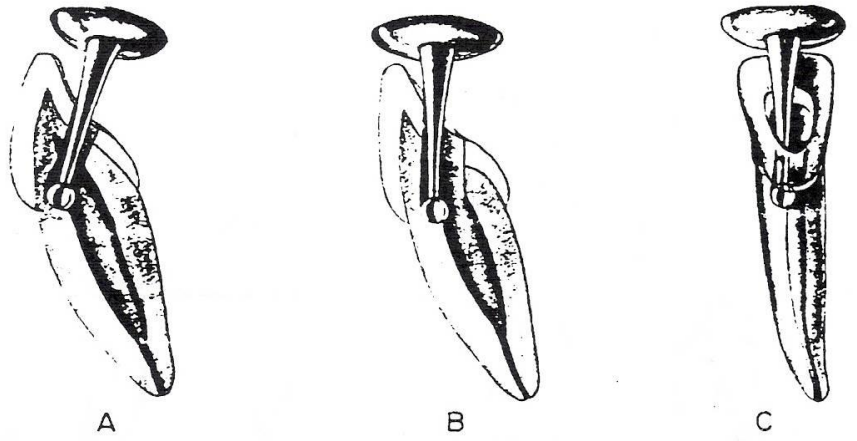


MANDIBULAR CANINE

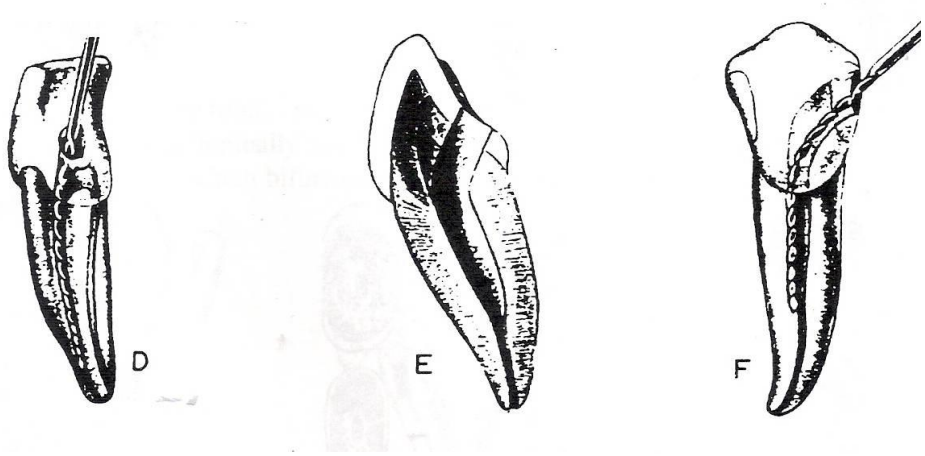
Length of tooth[8]		Canal[17]		Lateral Canals[9]	Root curveturr[17]	
Average length	25.2mm	One canal	94%		Straight	68%
Maximum length	27.5mm	Two canals			Distal curve	20%
Minimum length	22.9mm	Two foramens	6%		Mesial curve	1%
Range	4.6				*Labial curve	7%
					*Lingual curve	0%
					Bayonet curve	2%
					*Not apparent in radiograph	



MANDIBULAR ANTERIOR ACCESS OPENING ERRORS



A. GOUGING at the labiocervical caused by failure to complete the convenience extension toward the incisal prior to entrance of the shaft of the bur.
B. GOUGING of the labial wall caused by failure to recognize 20 degree lingual-axial angulations of the tooth.
C. GOUGING of the distal wall caused by failure to recognize the17 degree mesial axial inclination of the tooth.



D. FAILURE to explore for, debride, or fill a second canal by an inadequate access preparation.
E. DISCOLORATION of the crown caused by the failure to remove pulpal debris. The access cavity is too far to the gingival with no incisal extension.
F. LEDGE formation caused by complete loss of control of the instrument passing through an access cavity prepared in a proximal restoration.

ENDODONTIC LABORATORY

Lab. No. (4)

Access opening on premolars

Armamentarium:

a-Extracted premolar tooth
b- High speed hand piece
c-Low speed hand piece
d-Round burs:#2, 4
e-Tapering fissure bur (701 U)
f-Endodontic kit
g-Endodontic explorer
h-Silver pencil

PURPOSE:

To create an access opening in the crown portion of premolars to afford direct, unobstructed, **STRAIGHT-LINE ACCESS** to the root canal orifice, while preserving as much sound tooth structure as possible.

PROCEDURE:

(1) Before starting, review your notes on premolar pulp cavity anatomy, check access opening in the text, and also review the demonstration models.

(2) Using a sharp pencil, outline the access opening on the occlusal surface of the crown and show it to the instructor.

(3) By using tapering fissure bur in an accelerated- speed handpiece, cut the out line form 1 mm deep into the tooth. At this time, show the cut outline form to the instructor. Now, advance round bur #2 at low speeding the central part of the preparation to penetrate the pulp chamber. This will, of course, vary from the tooth to the tooth in the clinic setting. Remove the roof of the pulp chamber by lifting the #2 bur up and out, using a slow speed handpiece.

(4) Use a tapered fissure bur, # 701 U, to flare (buccolingual extension) and smooth the walls of the preparation.

(5) Use the endodontic explorer to locate the root canal orifices and irregularities on the walls of the preparation.
Access opening must be made large enough so that direct access is made to the root canal orifices.

(6) Checking regularly with your instructor. Remember to use the endodontic explorer for checking the preparation.

LEARNING OBJECTIVES

After this laboratory, the student should be able to:
1-Prepare endodontic access opening on premolar teeth.
2-Prepare an ideal endodontics access opening on a premolar.

Major points to remember during premolar access opening:

Maxillary premolars:

1-The maxillary first premolar almost always has two roots and the rest of the premolars usually have one root. However, the presence of more than one canal per root is very common. When the two canals are joined into one, the palatal canal usually exhibits a straight line access to the apex.

2-If the root canal shows a sudden narrowing or even disappears in periapical radiograph, this called (fast break). This fast break means that at this point the canal divided into two parts which either remains separate or merge before reaching the apex.

3-A cross section at the cervical line of maxillary premolars shows a ribbon- shaped or canal or one shaped like a figure eight, with the widest dimension bucco-lingually.

4- When a single canaled tooth entered, the canal orifice is located usually in the exact center its crown. However, when two canals are present, their orifices are located under their respective buccal and palatal cusps.

Mandibular premolars:

1-In mandibular premolars, a wide variation in canal morphology can exist. Even those teeth with a single canal can have several variations in canal morphology. The most uncomplicated form exhibits an oval canal that is broad bucco-lingually in the coronal half of the root and tapers to a single round canal apically. Therefore, the access opening is ovoid in shape with its widest portions bucco-lingually. In order to obtain an unobstructed entry to the canal orifice and foramen, additional, portions of the buccal incisal edge might have to be sacrificed due to the off centered position of the clinical crown to the root (Fig.4-1).

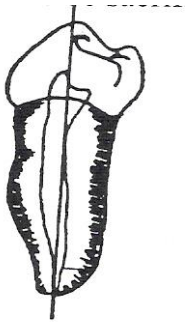
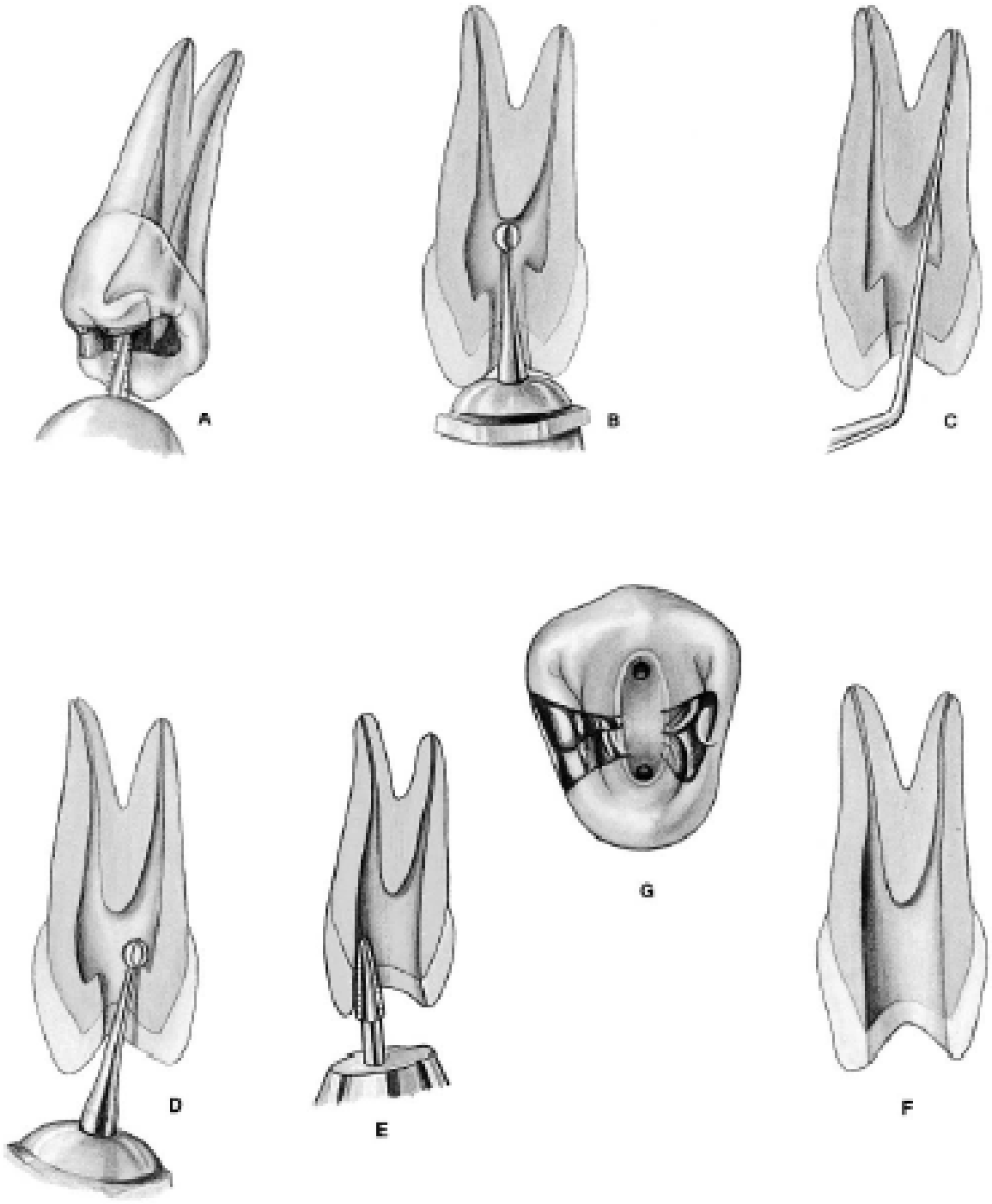


Fig.4-1

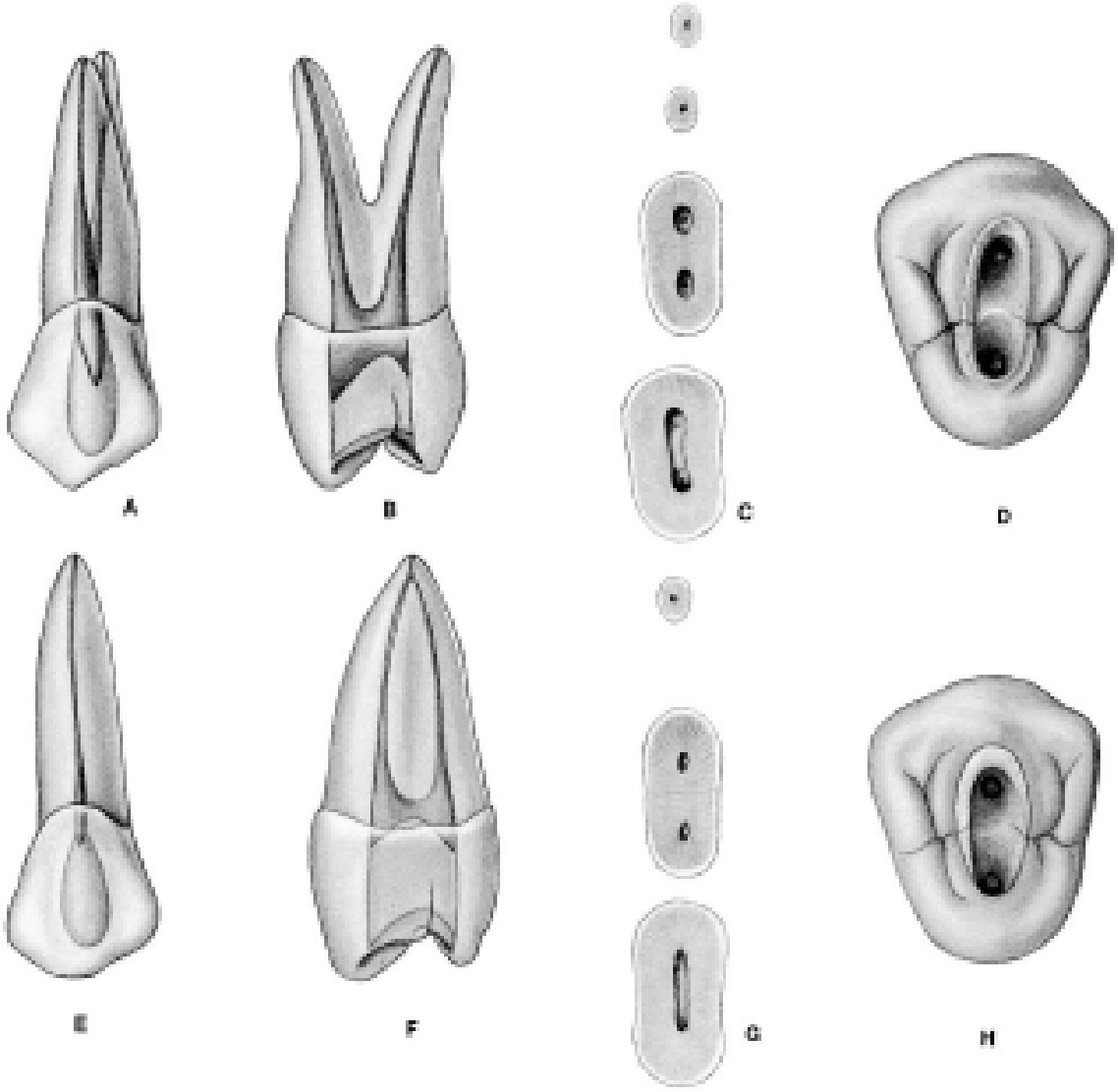
2-Second, third canals and/or calcified system may divide the root into multi-corridor channels at least twenty five percent of the time. These divisions may occur almost anywhere down the root. Shaping and sealing of these teeth can be extremely difficult because of the absence of direct access.

PREMOLAR ACCESS OPENING PROCEDURE



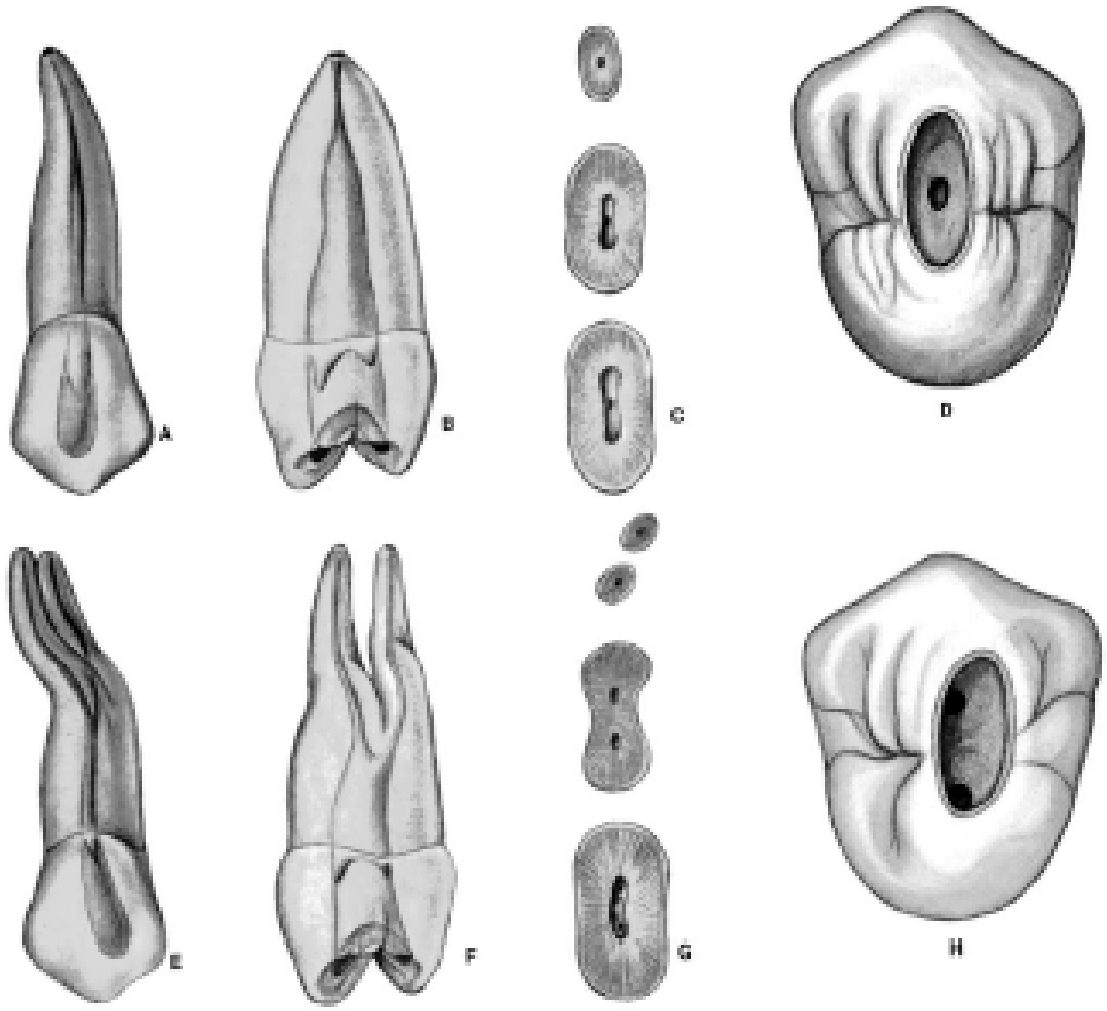
MAXILARY FIRST PREMOLAR

					Curvature of roots		
Length of tooth[8]		Canal[11]		Direction	Single Root	Double Roots	
						Buccal	Palatal
Average length	21.8mm	One canal		Straight	38%	28%	45%
Maximum length	23.8mm	One foramen	9%	Distal curve	37%	14%	14%
Minimum length	18.8mm	Two foramens		Mesial curve	0%	0%	0%
Range	5 mm	One foramen	13%	*Labial curve	15%	14%	28%
		Two canals		*Lingual curve	3%	36%	9%
		Two foramens	72%	Bayonet curve	0%	8%	0%
		Three canals					
		Three foramens	6%		*Not apparent in radiograph		

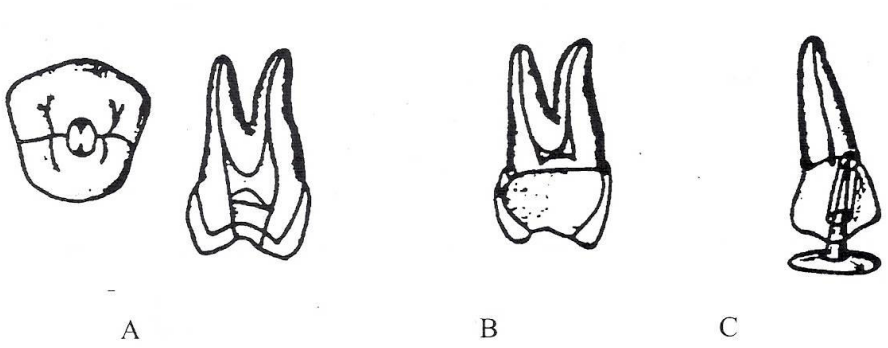


MAXILLARY SECOND PREMOLAR

Length of tooth[8]		Canals[12]		Curvature[12]	
Average length	21mm	One canal		Straight	9.5%
Maximum length	23mm	One foramen	75%	Distal curve	27.0%
Minimum length	19mm	Two canals		Mesial curve	1.6%
Range	4mm	two foramen	24%	*Labial curve	12.7%
		Three canals	1%	*Lingual curve	4.0%
				Bayonet curve	20.6%
				*Not apparent in radiograph	

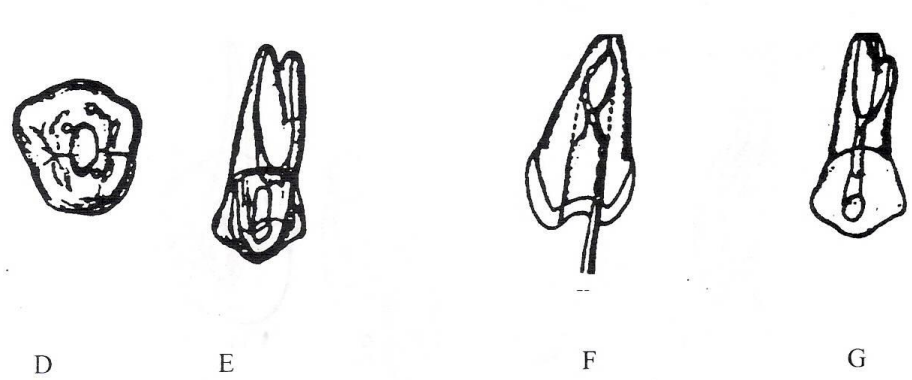


MAXILLARY PREMOLAR ACCESS OPENING ERRORS



A B C

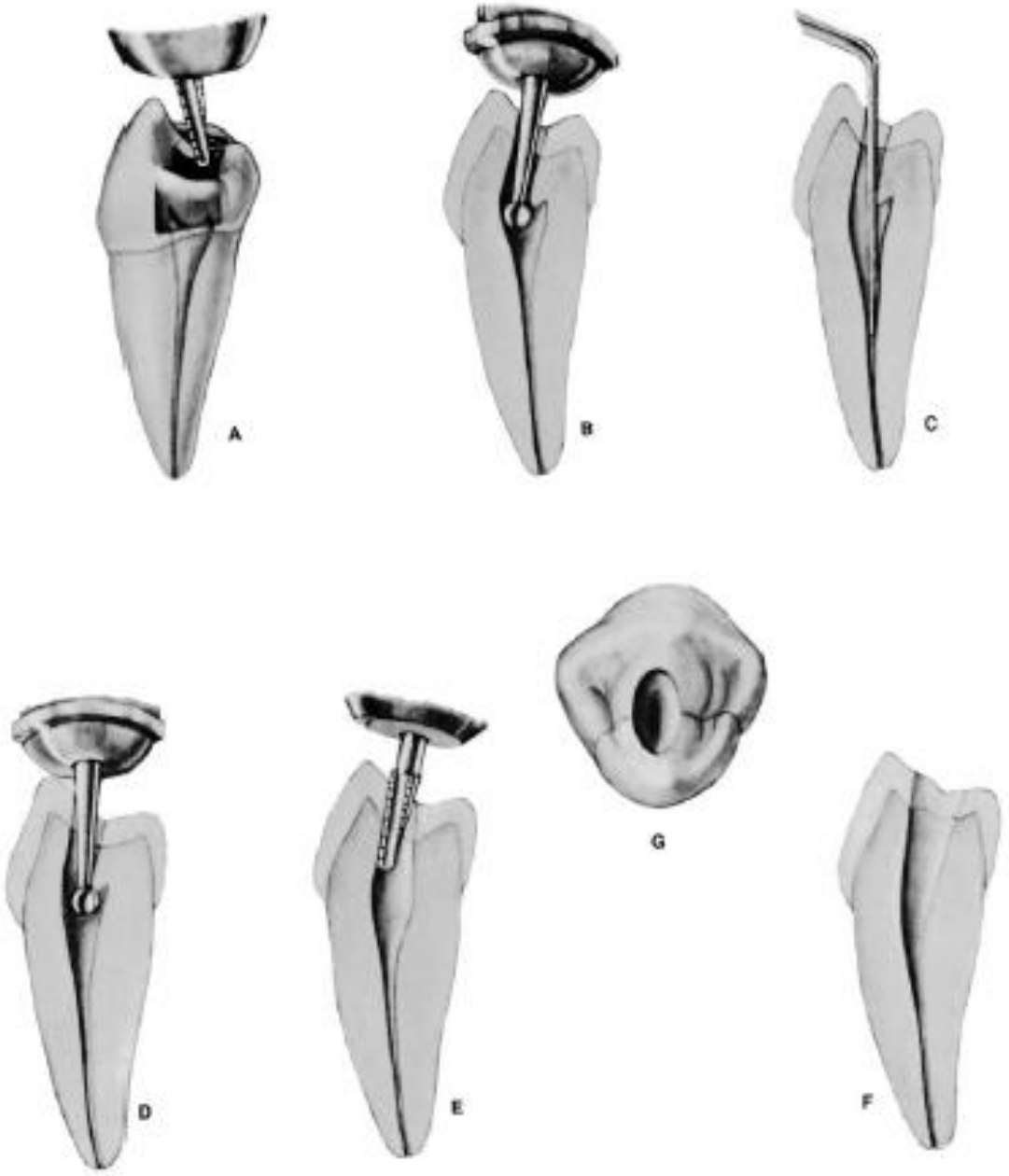
A. UNDEREXTENDED preparation exposing only the pulpal horns, control of the enlarging instruments is abdicated to the cavity walls. The white color of the roof of the chamber is clue to the shallow cavity.
B. OVER EXTENDED preparation from a fruitless search for receded pulp. The enamel walls have been completely undermined. Gouging relates failure to refer to the roentgenogram, which clearly indicates pulpal recession.
C. PERFORATION at the mesiocervical indentation. Failure to observe the distal-axial inclination of the tooth led to bypassing the receded pulp and the perforation.



D E F G

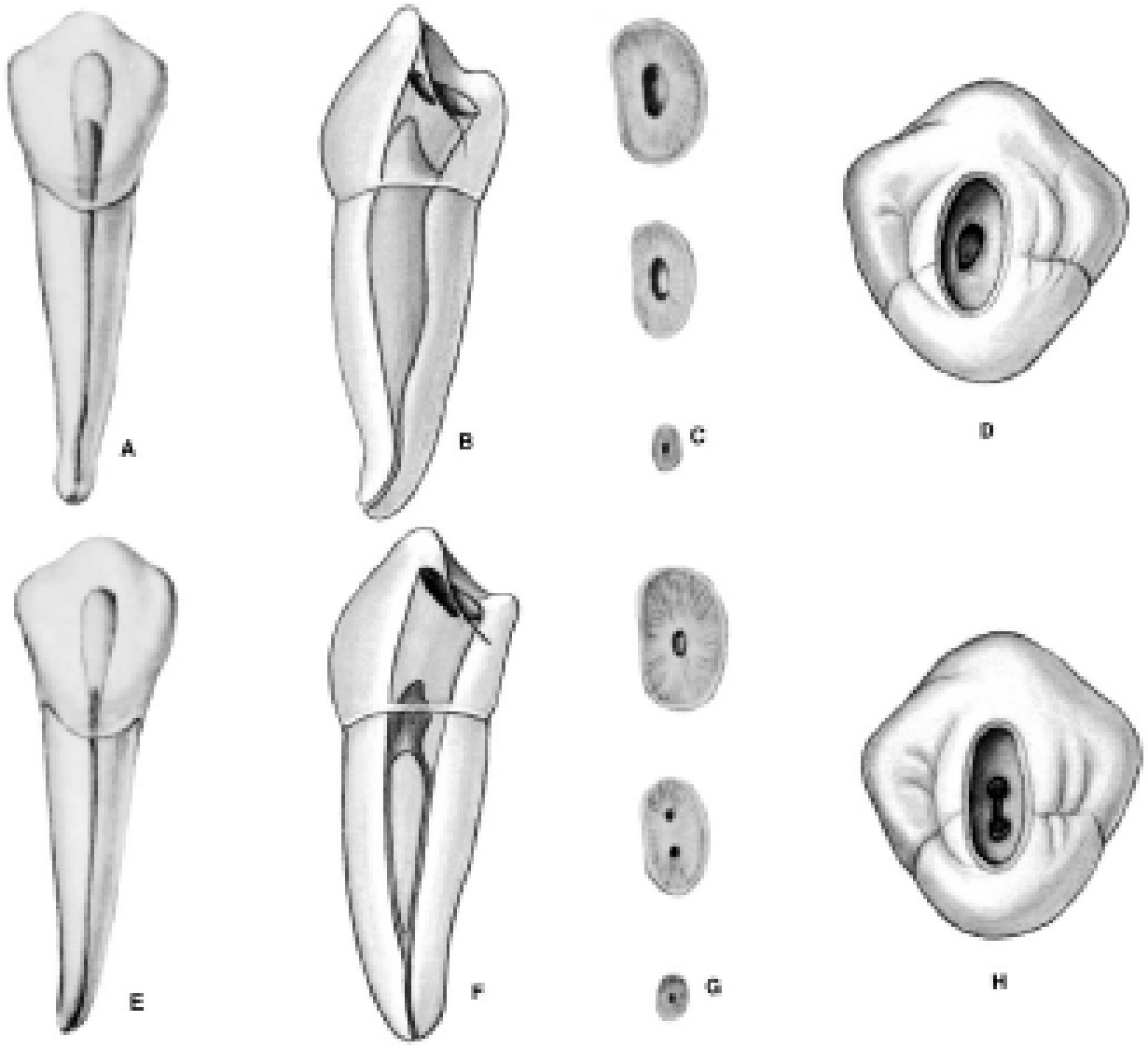
D. FAULTY ALIGNMENT of the access cavity through a full veneer restoration placed to "straighten" the crown of a rotated tooth.
E. BROKEN INSTRUMENT twisted- off a "cross-over" canal. This frequent occurrence may be obviated by filing the internal preparation to straighten the canals (dotted lines).
F. FAILURE to explore, debride, and obliterates the third canal of first premolar.
G FAILURE to explore, debride, and obliterates the second canal of second premolar**.**

ENDODONTIC PREPARATION OF MANDIBULAR PREMOLAR TEETH



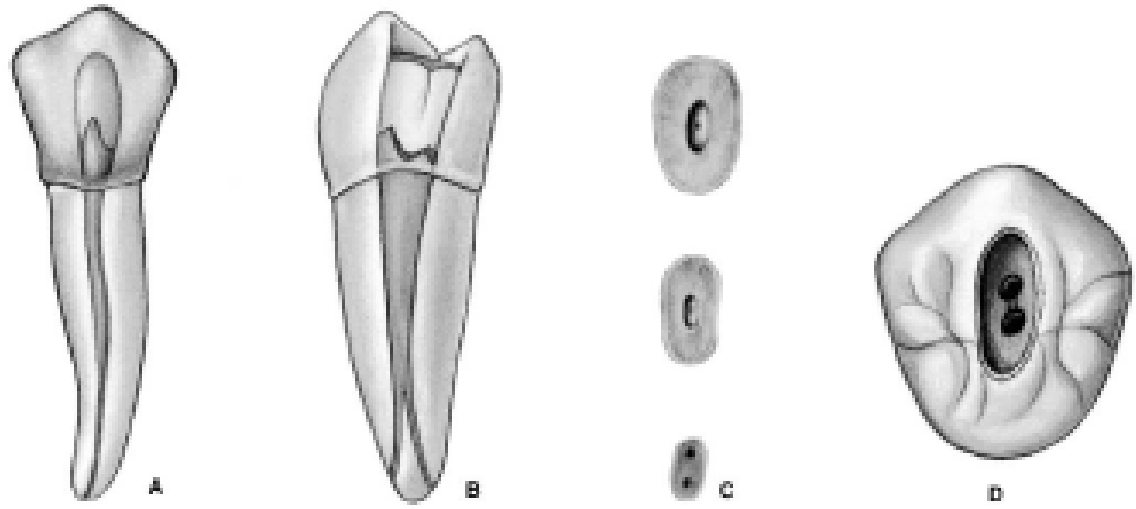
MANDIBULAR FIRST PREMOLAR

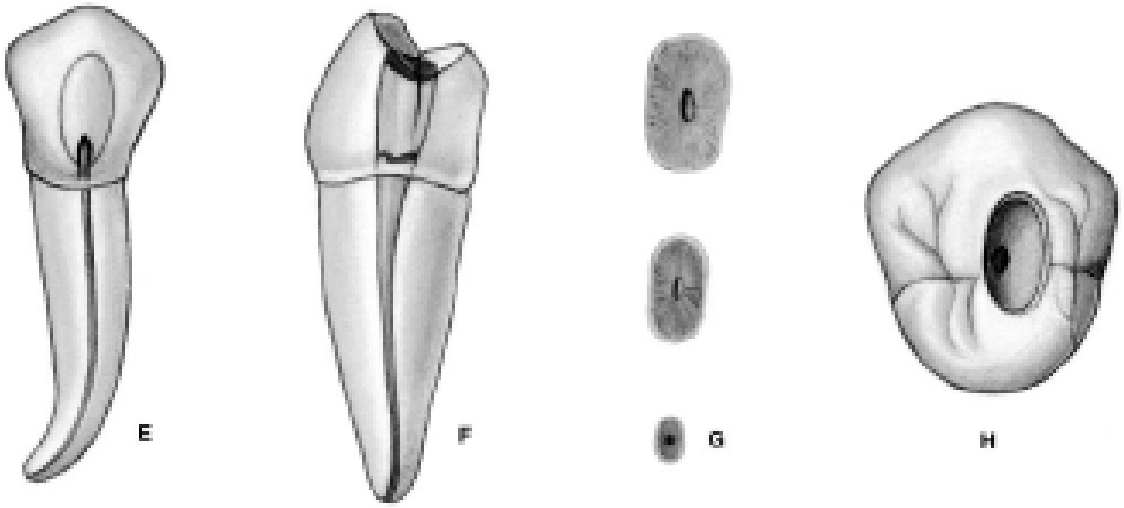
Length of tooth[8]		Canals[18]		Curvature of roo[18]t			
Average length	22.1mm	One canal		Straight	48%	*Labial curve	2%
Maximum length	24.1mm	One foramen	73.5%	Distal curve	35%	*Lingual curve	7%
Minimum length	20.1mm	Two foramens		Mesial curve	0%	Bayonet curve	7%
Range	4.0mm	One foramen	6.5%				
		Two canals					
		Two foramen	19.5%				
		Three canals	0.5%		*Not apparent in radiograph		



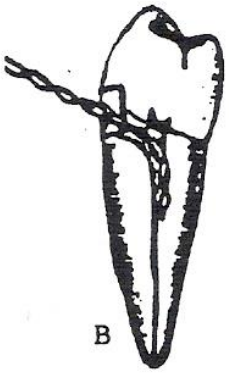
MANDIBULA SECOND PREMOLAR

Length of tooth[8]		Canals[18]		Curvature of root[18]			
Average length	21.4mm	One canal		Straight	39%	*Lingual curve	3%
Maximum length	23.7mm	One foramen	85.5%	Distal curve	40%	Bayonet curve	7%
Minimum length	19.1mm	Two foramens		Mesial curve	0%	Trifurcation curve	1%
Range	4.6mm	One foramen	1.5%	*Buccal curve	10%		
		Two canals					
		Two foramen	11.5%				
		Three canals	0.5%			*Not apparent in radiograph	





MANDIBULAR PREMOLAR ACCESS OPENNING ERRORS



A. PERFORATION at the distogingival caused by failure to recognize that premolar has a tilt to the distal.
B. INCOMPLETE preparation and possible instrument breakage caused by total loss of instrument control. Use only an occlusal access, never buccal or proximal access.

C. BIFURCATION of the canal completely missed caused by the failure to adequately explore the canal with a curved instrument.
D. APICAL PERFORATION of the invitingly straight conical canal.
E. PERFORATION at the apical curvature caused by failure to recognize, by exploration, the buccal curvature.

ENDODONTIC LABORATORY

Lab. No. (5)

Work length determination

Armamentarium:

a-Extracted tooth
b-Endodontic kit
c-Irrigation syringe
d-Radiographic film
e-Endodontic file
f-Millimeter endodontic ruler
g-Day light developer
h-Cauze

PURPOSE:

To verifying the working length by taking a radiograph.

PROCEDURE:

(1) Measure the tooth in diagnostic film from the reference point to the apex with a millimeter endodontic ruler (Fig.5-1).

(2) From the radiographic tooth measurement, subtract a 1mm"safety allowance for measuring error and possible image distortion.

(3) Place the rubber stop on file to the adjusted length (Fig.5-2).

(4) Place the file in the canal until the rubber stop is at the reference point. (Fig.5-3), it must fit tightly in the tooth so that it will not change its position when the x-ray is taken.

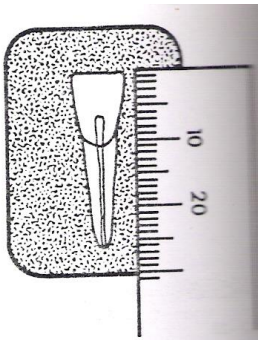


Fig.5-1. Measuring the length of the tooth from the reference point to the end of the root

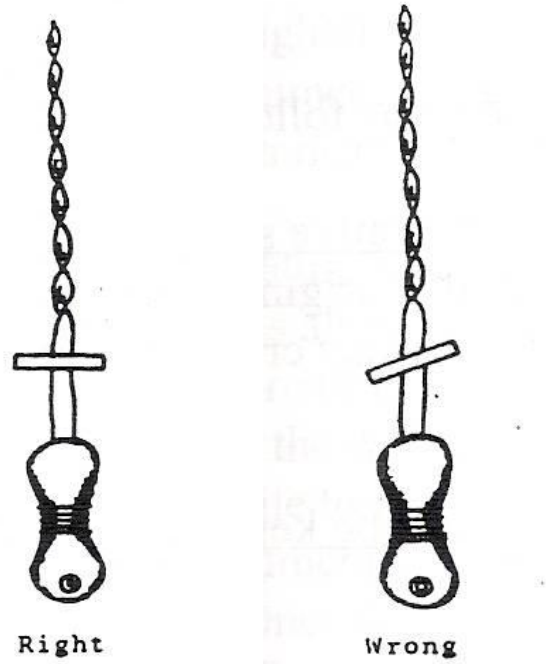


Fig.5-2. correct placement of rubber stops

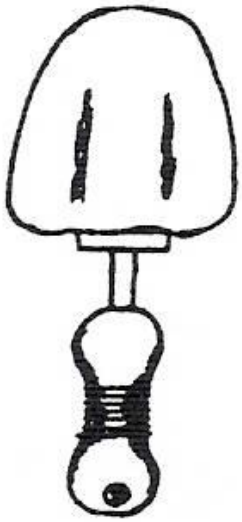


Fig.5-3.placement the file in the canal, rubber stops at the reference point

Note: the canal should slightly wet with irrigant.

(5) Expose the film with the file in place, develop.

(6) Calculating the working length if radiograph indicate 2mm or less of error:

(7) Measure the difference between the end of the radiographic image of the instrument and the radiographic image of the end of the root:

a- If the file set at the estimated working length is either too long or short but within 2.0mm of being correct. Add/ subtract an amount to / from of the canal determine in step 1 so that you are at radiographic apex. From this adjusted length of the tooth, subtract a 1.0 mm "safety factor" to conform to the apical termination of the root canal at the apical constriction (Fig.5-4,5,6)

b- If the file goes past the site of existing of the apical foramen into the periapical tissues by more than 2.0 mm, calculate the extent of the excessive length by holding a ruler adjacent to the image of the file, place the next size larger file into the canal, with stop set a length decreased by the amount of excessive penetration. Radiograph to confirm correctness. If slightly off, interpolate the amount of error and record the change as the corrected working length.

c- If the file is short of the desired length by more than 2.0 mm, calculate the lacking distance by holding a ruler adjacent to the image of the unpenetrated canal. Place the

next smaller size file into the canal with stop set to reflect the desire increased length. Radiograph to confirm correctness. If slightly off, interpolate the amount of error and record the change as the corrected working length.

(8) Rest the rubber stop on the exploring instrument to correspond to the newly established WORKING length.

(9) When the working length of the canal (s) has/ has been confirmed; record the measurement(s) and the point(s) of reference in the case sheet.

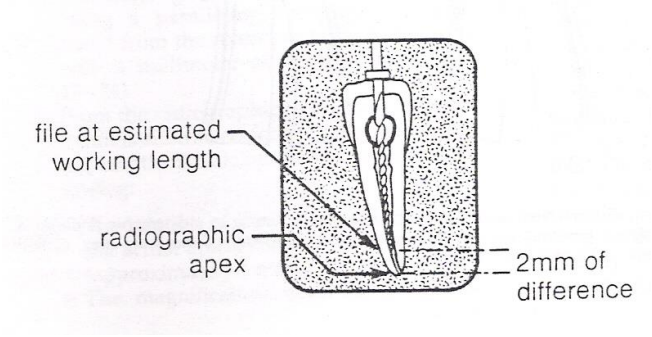


Fig.5-4. (1) mm must be added to obtain
The correct length

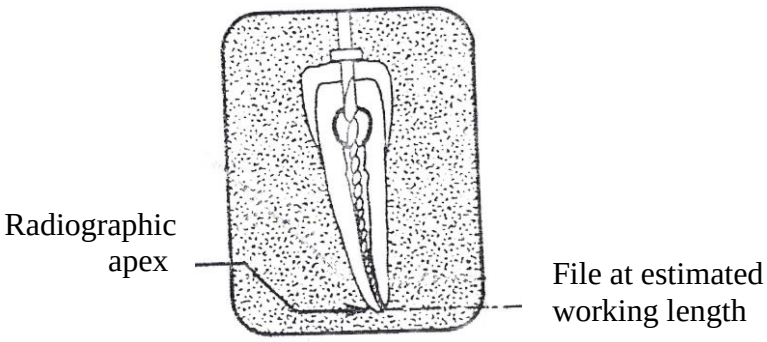
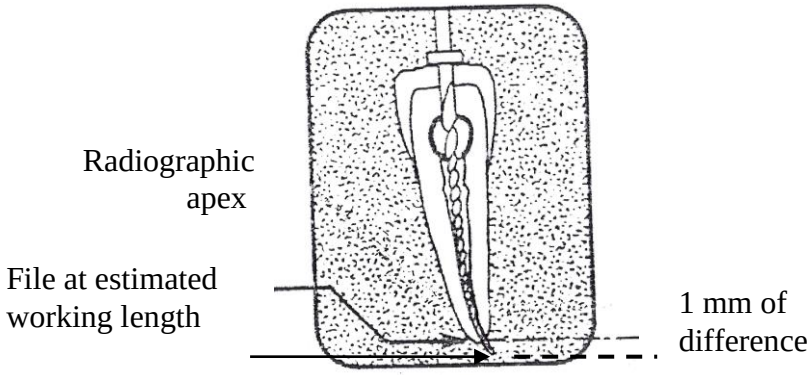


Fig.5-5. (1) mm must be subtracted to obtain the working length

Fig.5-6. (2) mm must be subtracted
to obtain the correct length.



LEARNING OBJECTIVES

After this laboratory, the student should be able to:

1-Determine the working length.
2-Correct selection of a reference point.

WORKING LENGTH

1-The primary objective of measuring and confirming the working length is to limit instrumentation and subsequent filling of the root canal to within the confines of the tooth. The apical termination of the canal is the junction of the internal dentine and the external cementum (CDJ).

2- #8 or # 10 are not used to take working length radiograph; the small tips fade put and are usually not visible, on molar radiographs, #15 file tips are often obscure and should not be used.

3-A reference point that will be easily visualized during preparation should be selected, usually the highest point on the incisal edge on anterior teeth, and a buccal cusp tip on posterior teeth (Fig.5-7).

4-A reference point that will not change during or between appointments should be selected. Example of unstable reference points are undermined cusps. If necessary to use an undermined cusp. It should be reduced considerably prior to access preparation.

5-Fracture crown must be adjusted, to provide a flat reference point to which the rubber stop can be returned during canal preparation (Fig.5-8).

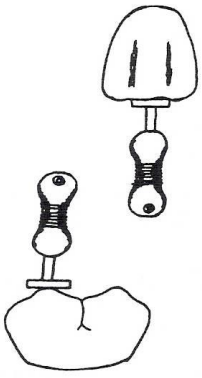


Fig.5-7. Reference point for posterior teeth is the buccal cusp tip. For anterior teeth is the incisal edge

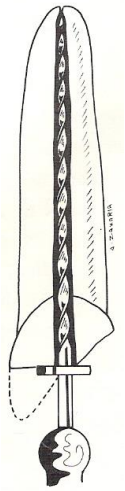


Fig.5-8. fractured crown must be adjusted, to provide a flat reference point.

ENDODONTIC LABORATORY

Lab. No. (6)

Root canal preparation

Armamentarium:

a-Endodontic explorer
b-Endodontic kit (with standardized files and reamers)
c-Endodontic locking pliers
d-Transfer sponge
e-Endodontic ruler
f-Irrigation syringe
g-Cotton applicator

PURPOSE:

Beginning root canal preparation, debridement and shaping of root canal with step-back technique (telescoping canal) to **CREATE A TAPERED FUNNEL** shaped canal.

PROCEDURE:

(1) Remove the temporary filling and cotton dressing from the pulp chamber.

(2) Remove all debris using the endodontics explorer and files. Assist debris removal by irrigating with water in the syringe. Flush the pulp chamber, but **NEVER** place an irrigation needle tightly in a canal so it binds.

(3) Set stops on files (#10 through 80) at the correct working length.

(4) Place the largest file that easily penetrates to the working length into the canal. Use a size 10 or 15 file initially and then larger ones until one fits snugly, this file will be consider as the **INITIAL SIZE:** is the first file, which inserted inside the canal and goes to full working length and has slight engagement to the walls. Show it to the instructor.

(5) Using a reaming or rasping motion, work the instrument against the canal walls until it fits loosely to the working length.

(6) Place the next larger file into the canal and place it to the working length.

(7) Repeat step (5).

(8) Repeat steps (6) & (5). The widest instrument that it used to the full working length is called the MASTER APICAL FILE (MAF). Show it to the instructor.

(9) Place a file one size larger than the MAF into the canal to 1mm short of the working length and, using filing and rasping motion, work the instrument against the walls until it loose within the canal. The place MAF in the canal to the working length to ensure that the entire canal has remained patent- that is, to ensure that debris or ledge formation has not blocked the canal.

(10) Repeat step (9) with next wider file, penetrating approximately 1mm shorter than the previous one. Again verify canal patency by placing the MAF to the working length.

(11) This flaring is continued until a size 60 or larger file is used in the canal. In any case it is very important that the MAF always be used to the full working length after each shorter and wider file is used for flaring. Failure to do this may result in a blocked canal.

Note: Using the suggested technique to develop a flared preparation removes most of the canal contents however; the final canal debridement takes place after completion of the canal enlargement. At this time the irrigating syringe is placed well into the canal and there by ensures that the solution reaches the apical portion of the preparation. After the canal is flared, there is sufficient room to perform circumferential filing using a file one or two size smaller than MAF. The presence of irrigant during circumferential filing accomplishes canal debridement.

(12) Dry the canal with paper point and put the dressing material.

LEARNING OBJACTIVES

After executing this exercise, the student should be able to:

1-Debride and prepare the root canal system, using proper technique (step-back technique).
2-Development of apical constriction ''barrier''

Shaping of thin and/ or curved canal (Telescoping a canal):

1-Esimated the working length on the basis of the preoperative straight and angled radiographs.
2-Using the estimated length, enlarge the canal initially with a size 10 file, in some very narrow canals, a size 8 may be needed (curve the file at the apical two millimeters); with circumferential filing, enlarge to size 15. Avoid rotation of the instrument and confine your self to rasping action only.
3-With the size 15 file in place, take a radiograph to verify the working length, make any corrections necessary and record the corrected working length.
4-The curved portion of the canal is enlarged by filing to at least a number 25 instrument insert the instrument until it binds, rotate 1/4 turn and withdraw 3 to 4mm. continue until instrument works loosely in the canal at the working length
5-Successively larger files are then employed at decreasingly shorter lengths. Thus as each larger instrument is employed, the "length-of – tooth" measurement is shortened by one millimeter. A series of concentric steps (telescoping) is therefore created (Fig.6-1).
6-This operation is continued until the entire curved portion of canal has been prepared.
7-The instrument that last went to the working length is used after each successively larger instrument is worked, i.e., if the #25 went the working length and telescoping is started with number 30 instruments, the sequence of instrumentation would be, #25 working length, #30-1mm, #25 working length, #35-2mm, #25 working length, #40-3mm, etc.

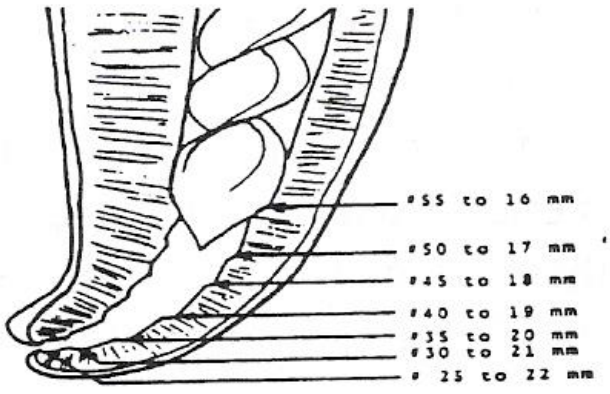


Fig.6-1.Step-Back Technique

Flare, Step-Back, Telescoping

#10 - W
#15 - W
#20 - W
#25 - W
#30 - 21mm
#25 - W
#35 - 20mm
#25 - W
#40 - 19mm
#25 - W
#45 - 18mm
#25 - W
#50 - 17mm
#55 - 16mm
#25 - W
#60 - 15mm
#25 - W
#25 - W

Enlargement of the pulp canal:

To enlarge the pulp canal both reamers and files may be used in either reaming or filing motion. Rotary files can be used as well as in conjunction with hand files.

Reaming: Reaming involve placement of the instrument toward the apex until some binding is felt and then turning the handle in a clockwise direction 1/4 to 1/2 of turn this instrument is then withdrawn from the canal (Fig 6-2).

Filing: Filing involve the placement of an instrument toward the apex until it binds, then removing it by scraping against one dentinal wall without turning the handle (Fig.6-2). While it is possible to utilize a reamer for filing, it is far less effective than a file. The most efficient instrument that can be used with filing action is the hedstrom file; however, it is very fragile.

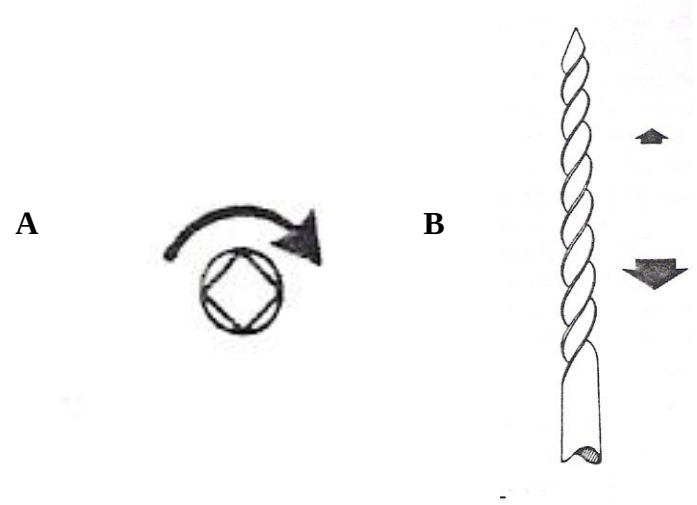


Fig.6-2. A, Reaming. B, Filing

Rules for canal shaping

To achieve the best possible result in canal shaping, certain basic rules must be followed:

1-The preparation must enlarge the canal while still retaining its preoperative shape. One of the most common faults encountered during canal shaping is the altering of the original configuration of the canal. Overuse of reaming action and failure to precurve instruments may create a preparation that does not retain the original shape.

2-Once the working length of tooth is determined; the entire instrument must be kept within the confines of the canal.

3-Instrument must be used in sequential order without skipping of sizes. At no time should file sizes be skipped. If a file is used out of sequence, it may veer off from the true canal and start its own "false" canal, causing a ledge or perforation of the root. Breaking the instrument in the canal can also occur.

4-Instrument may be replaced often, particularly in the smaller sizes. Every time a file or reamer is removed from the canal, it should be wiped from any debris with sterile gauze or other suitable material. At this time, the flutes of the instrument must be examined for any signs of stress, fatigue or alteration of shape. If any doubt exists as to the condition of the instrument it should be immediately discarded, particularly in smaller sizes which are more prone to breakage.

5-Canal must be prepared in a wet environment. Frequent irrigation must be done during canal preparation. The use of an irrigant flushes debris from the canal. In addition, use of an irrigant will lubricate the instruments, thereby reducing fatigue of the flutes and potential breakage.

6-Always use curved instruments in curved canal. Utilizing straight instruments in curved canals can lead to ledging of canals, root perforation and broken instruments. This applies to stainless steel instruments only.

7-Clean and re-sterilize files each time they are removed from the canal or place in clean strand filled with 5.25% sodium hypochlorite.

8-Check the distribution of filing along the cutting blades of the instrument. Instrumentation is completed when clean filing are obtained along the apical 4-5mm.

9-Never rotate a bent instrument more than a 1/4 turns.

10-in curved canal, the apical 2mm of the instrument should be curved. The curve should correspond to the curvature of the canal, and score the handle of the instrument to indicate the direction of the bend.

Determination of two canals with a common foramen:

When the clinician is confronted with multi- canaled teeth, occasionally one cannot determine from the radiograph whether the bicanaled root has two separate foramen or one common foramen. The mesial root of mandibular and maxillary premolars is the teeth most likely to present this problem. Occasionally, the buccal object rule when radiographing the teeth, may aid in separating the canals, but this is not possible in every case. Therefore, intracanal instrument manipulation is the only true method of determining the presence of a common foramen. In this procedure, two instruments are placed, one in each canal. If both go to full measurement, one of two possibilities is evident:

a-there are two separate foramen, or,
b-the instruments are small enough to allow both files to measurement even in teeth with a common foramen.

If the second possibility in this case, both canal are instrumented to measurement with larger size files. The procedure is tried again; first one instrument is placed to measurement. Then the second file is placed into the second canal. If it goes to measurement, there are separate foramens, but if the second instrument does not reach measurement, then there is a possibility of a common foramen. To confirm this, the first

instrument, which previously went to measurement, is slightly withdrawn from the canal and the second file, which originally did no go to the WORKING LENGTH can be moved apically to the working length. Then there exists a common apical foramen.

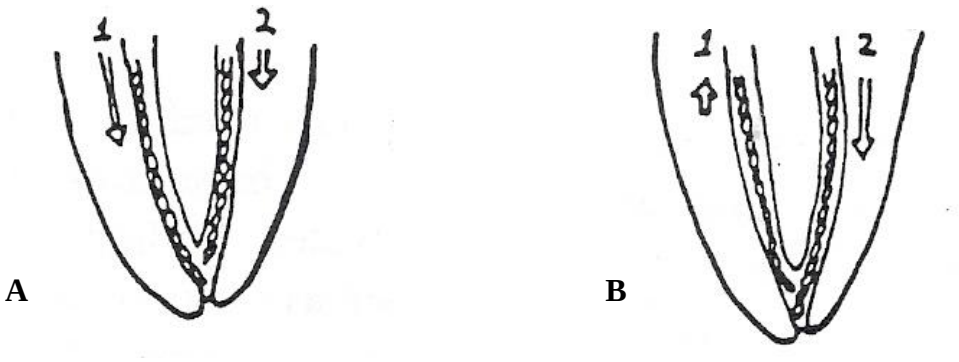


Fig.6-3.Schematic drawing showing the four steps necessary to detect a common foramen with intracanal instruments.

1-Instrument #1 is brought to measurement (A).
2-Instrument# 2 is placed as far apically as it can go (A).
3-Instrument #1 is withdrawn a few millimeters (B).
4-Instrument #2 is inserted to measurement; now instrument #1 will not go to measurement (B).

Apical stop: The "apical stop" is a term in root canal instrumentation procedures to describe the anatomical resistance to the passage of a certain root canal instrument past working length. The term is used in the following way. Suppose, for example, you are beginning root canal treatment on a tooth and notice that both#15 and a #20 file will slide past your determined working length, but that a file #25 or larger will not. You can describe this situation by use of the term " apical stop", and can now say that you have a "stop" at size #25, or that you are "stopped" to a #25 file. Not that the term "stop" is often used as an abbreviated form of the term "apical stop" (Fig.6-4)

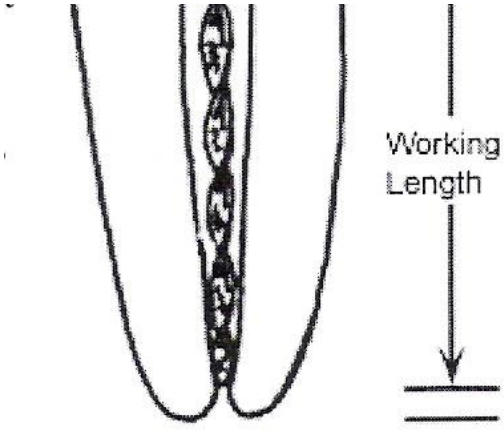


Fig.6-4. Apical stop: the instrument stops at the working length

A-Procedure for Checking the Apical Stop during Instrumentation

We have alluded to the importance of maintaining the integrity of the natural apical stop in order to reduce the possibility of subsequent overfilling during condensation procedures. It is therefore necessary that you determine the size of the stop prior to beginning instrumentation and also that you check its size during the course of instrumentation.

During instrumentation, the stop should be checked after each instrument is used. The procedure for checking the stop simply involves first determining the original size instrument to which you are stopped and testing the stop with the original size instrument after the use of each successively higher sized instrument. For example, suppose you are instrument the root canal of a maxillary central incisor. You have determined that working length is 20mm and that you are "stopped" at working length to a size #30 instrument. You should now proceed as follows:

1-After you file the canal to#35 at working length, you should return to the #30 file to make sure that it goes to 20 mm, but not further. If the #30 file could not be pushed past working length with light apical pressure, then you have maintained the integrity of the stop.

2-Now you should proceed with instrumentation using a size #40 file. Again, after you have completed instrumentation with the size #40 file, return to the #30 file and check the stop.

3-As you enlarge the canal during instrumentation, you should return to the original instrument (in this case a #30) after each increasingly larger size instrument is used to the if you are maintaining the original size of the apical stop.

B-Checking the final stop size after instrumentation is completed

Once instrumentation has been completed, check the final size of the apical stop with the smallest instrument to which you were previously stopped (#30 in the previous example). If you are still stopped to the original sized instrument, then also check the stop with decreasing sized instruments (#25-20-15, etc.). Many times you will find that the apical stop has actually decreased in size from the original instrument size to which the canal was stopped. This is frequently due to packing dentin filings into the foramen during instrumentation and should not be a cause for alarm as long as the working length has been maintained.

You can now see that the final stop size relative to the original stop size can vary. As noted above, when instrumentation is properly carried out, the final stop size may be the same as the original stop size or may actually be smaller. Of special concern at this point, however, is the situation in which the final stop size is actually larger than the original stop size because of inadvertent enlargement of the apical foramen by the root canal instrument.

Determining the correct width of the canal preparation(s):

In general the following quid lines should be used in determining the correct width of the canal preparation or when do you stop instrumenting the canal(s).

1-The operator should shape a canal until clean white dentinal filings are obtained from the entire length of the canal.
2-A canal should be enlarged at least three file size beyond first file that binds in a canal.
3-The apical area of the canal should be widened at least to a size 25 file. It is virtually impossible to obdurate a canal with gutta-percha that has been not enlarged to at least that diameter. If at all possible, all minor or narrow canals should be enlarged to at least that diameter.

NOTE: You must pay careful attention not to excessively flare the canal, as this may result in a weakened root, incapable of supporting heavy occlusal or lateral forces, or at worst, a root perforation may result (Fig.6-5). Because most roots have their greatest dimension in a buccolingual direction, it is generally recommended that you do most of your filing in a buccolingual direction. On the other hand, some teeth, such as maxillary centrals, usually have round roots, and should therefore be filed in all directions. However, filing all of the walls of a mesial canal of a lower molar can result in a perforation in a mesiodistal direction because of its narrow width mesiodistally.

In addition to having a general understanding of the morphology of the roots of teeth, you should study the radiographs of the particular tooth that you are treating, and closely examine the size and shape of its roots.

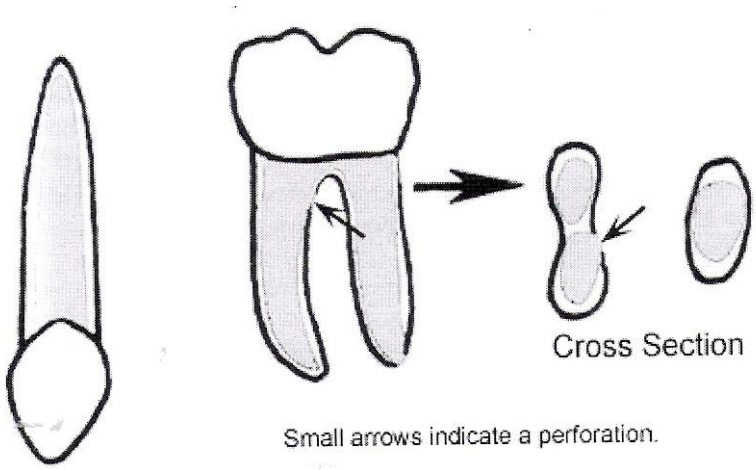
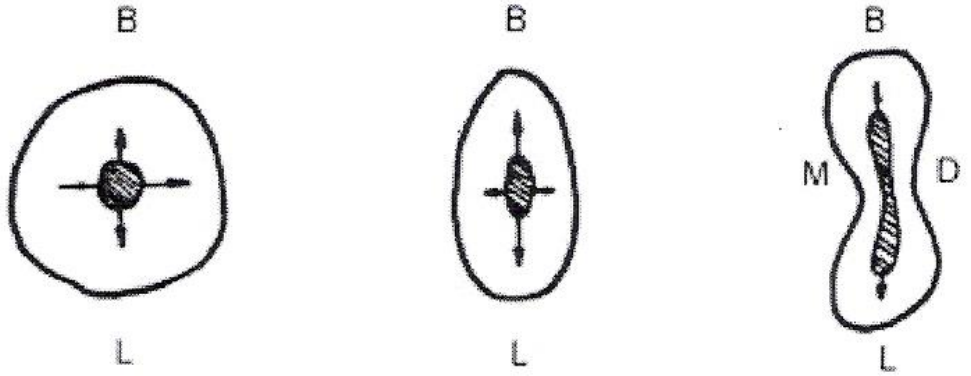


Fig.6-5. excessive flaring the cana1 result in a weakened tooth or perforation

Excessive flaring has reduced the capability of the anterior tooth root to support heavy occlusal or lateral forces by thinning the walls of the root structure. Excessive flaring of the molar canals has weakened the root structure and has resulted in a perforation in the fluting of the mesial root proximal as shown by the small arrows.

It is difficult to establish specific criteria which define how much a particular canal can be flared before encountering the problems just mentioned. The diagrams below (Fig.6-6) show the proper directions in which to file, given the usual root shapes you will encounter.



A. Round root

B. Ovoid root

C. Mesiodistal fluting necessitates extreme caution while filing mesiodistaly

Fig.6-6. A, round root. B, ovoid root. C, eight shape

ENDODONTIC LABORATORY

Lab. No.(7)

Root canal obturation

Armamentarium:

Standard tray setup (Lab. No. 6)
Other items
a-Endodontic spreader
b- Root canal plugger.
c-Absorbent points
d-Gutta-Percha (standardized and accessory cones)
e- Root canal sealer
f- Glass slab and spatula
g-Bunsen burner

PURPOSE:

To continue, and complete the root canal therapy by fitting a master gutta-percha point, filling the root canal system by means of the lateral condensation technique, and removing excess gutta-percha in the pulp chamber.

PROCDURE:

(1) Remove the temporary filling, and dressing cotton.

(2) Dry the canal thoroughly with paper points, with taper and diameter similar to those of the preparation. Insert the paper point one at a time into the canal until is removed with no sign of moisture. This can be checked by wiping the tip of the point on the mirror and noting the presence of a moist streak.

Note: NEVER USE COMPRESSWD AIR for drying the canal.

(3) Fit master point: the selection of the proper master point should begin with one size larger than the last file used during instrumentation. Measure the point by placing the master cone in the blue measuring block to the working length or slightly short of it (i.e., 0.5mm). Crimp the gutta-percha point with a college plier; place the master cone into tooth.
Note: <u>always</u> use college pliers when fitting your master point. <u>Never handle the gutta-percha with your fingers!!!.</u> Do not allow point to go beyond the working length.

Four possibilities exist in regard to length and tug back when fitting the master point:

a-The point goes to the proper measurement, but fits loosely (Fig.7-1): try the next higher size. If the next size will not insert to the proper length, take the original size point and remove 1mm from the narrow end with a scissors, and continue removing if necessary until the point fit snugly (a loose fit is evidenced by a dark line between the point and the canal walls on the radiograph).
b-The point dose not go to the proper measurement but dose have a tug back (Fig.7-1): select the next smaller cone or perform an additional enlargement and use the same cone until an acceptable fit is accomplished.
c-The point passes beyond the working length through the apical foramen (Fig.7-1): re-prepare the canal with larger instrument until a distinct stop is created at the end point of preparation, or to remove 1mm increment from the point until its diameter is sufficient to bind in the canal at the working length.
d-If the point fits snugly to proper length with "tug back" , take a radiograph and check the film for position of the point with respect to the apical constrictor and tightness of fit at the apical 4-5mm and show it to the instructor. Crimp the point at the fitted length, using the cusp tip (or other reference point) as a guide (Fig.7-2).

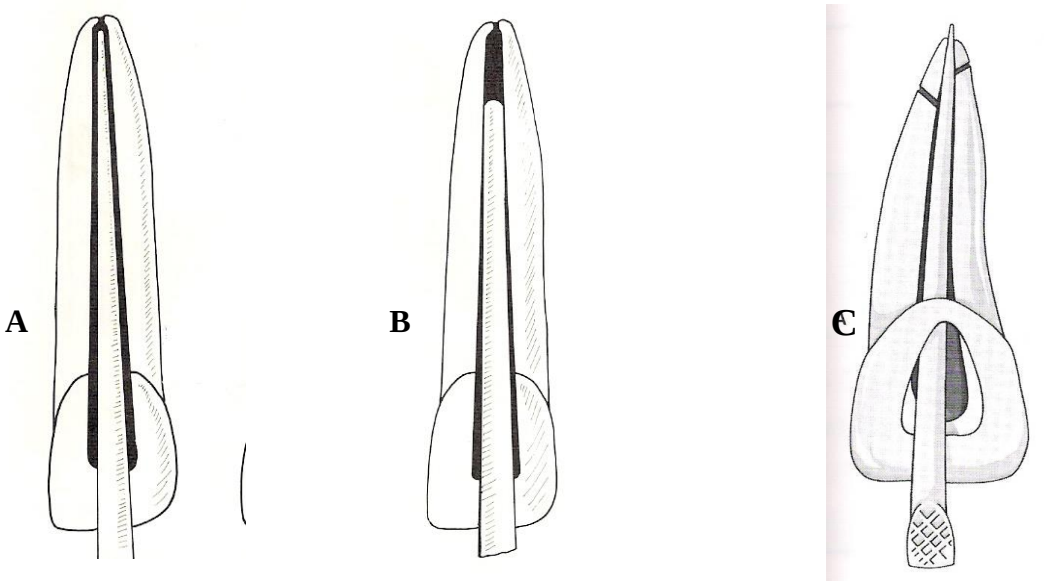


Fig.7-1.Fitting the master gutta-percha cone. A, Correct length, loose fit. B, Too short. C, Pass beyond foramen

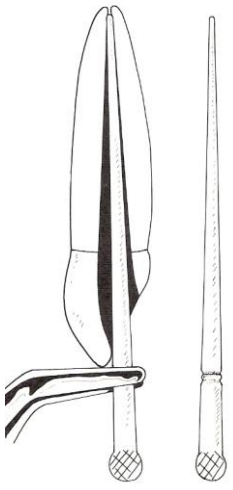


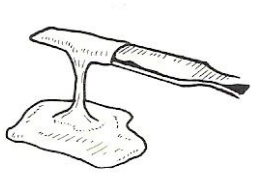
Fig.7-2. A, when the gutta-percha cone fits the canal with tug back and penetrates to the working length, crimp it at the reference point.
B, Depression made in the cone marks the distance to which the cone must be inserted when filling the canal.

(4) Mixing and placing the cement sealer: on a glass slab mix the powder into the liquid until there is a smooth consistency. Make sure there are no particles of powder remaining. The cement should be a bout the consistency of yogurt. Ask the instructor to check it is consistency (Fig.7-3)

(5) Coat the canal walls with root canal sealer using file one size smaller than the last working length file. The file is spun in a counter-clockwise direction to push the sealer in apical direction .Coat the master point with sealer and gently ease it (let it float) to the obturation length.

(6) Laterally condense using spreader with stop set 1mm short of the working length, once the correct depth has been reached, the master point is laterally and vertically compacted, moving the instrument in 180- degree arc. In curved canals this arc is reduced relative to the degree of canal curvature. During this movement the cone is compacted against canal wall while, at the same time, space is created lateral to the master cone for additional accessory gutta-percha (Fig.7-4).

A



B

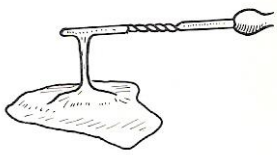


Fig.7-3. A, Mix the root canal sealer to a thick creamy consistency. B, Coat the tip of a file with sealer

7) Place an accessory gutta-percha point into the space created by spreader, which has compressed the gutta-percha into the apical preparation as well as into the canal irregularities. Reinsert the spreader into the canal and force it apically to compress the accessory cone (Fig.7-4). Then add another auxiliary cone, compress it, add another cone etc., until the root canal space is filled (Fig.7-5).

(8) Upon completion of lateral condensation, before burning off the excess gutta-percha tack a check radiograph of the condensation, process it, show it to the instructor.

(9) Using a hot instrument, remove the excess gutta-percha from the chamber as far down as the instrument will reach. Clean all gutta-percha and sealer fro the walls of the pulp chamber (Fig.7-6).

Hint: a small pledged of cotton with alcohol will help clean sealer from chamber.

The radiographs for the department record should mount on the four film mount and should include the:

1- pre- treatment film
2-determination of length film.
3-final instrument or master cone try-in.
4-final film after obturation.

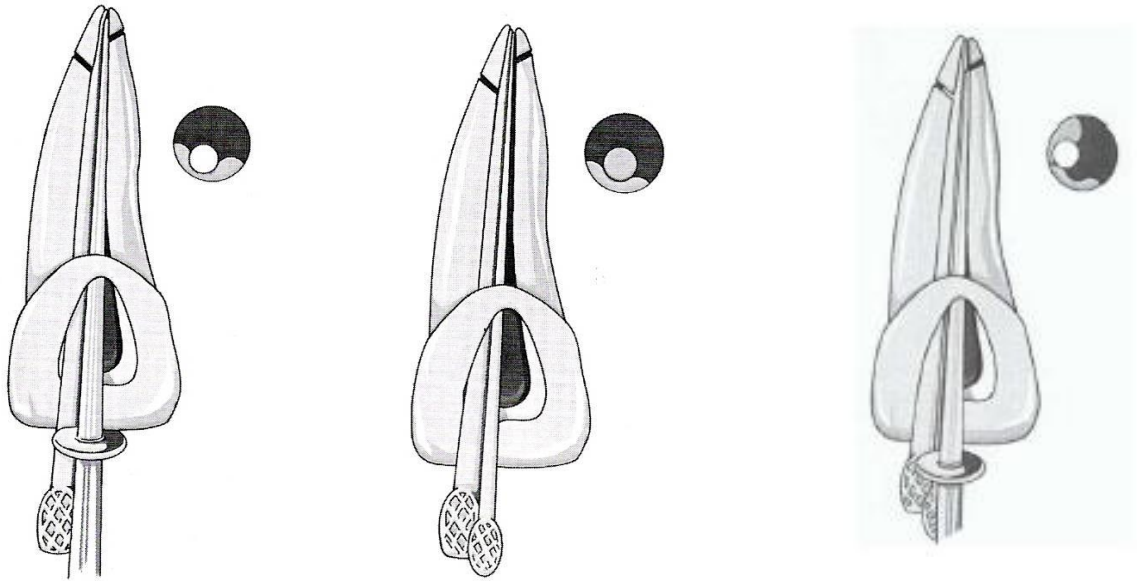


Fig.7-4 A, Spreader is placed along the master cone to proper depth. B, after careful removal of the spreader, an accessory cone lightly coated with sealer is placed to the apical depth created by spreader. C, As the obturation process continues, the depth of apical penetration of spreader is lessened and the accessory cones gradually obturate the canal

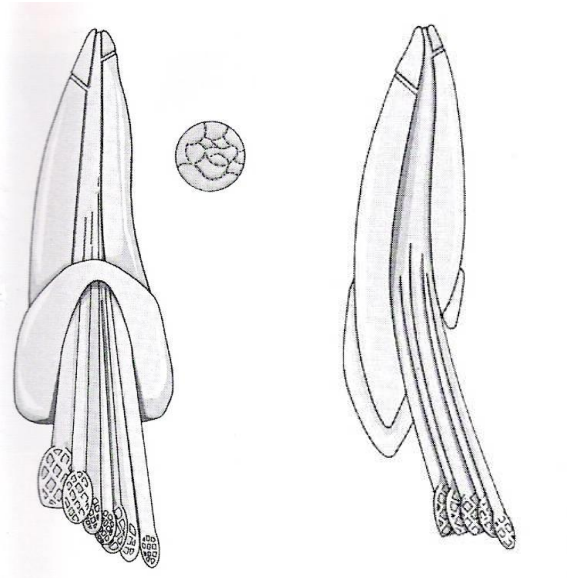


Fig7-5 A, Complete canal obturation as viewed and, B, Proximally

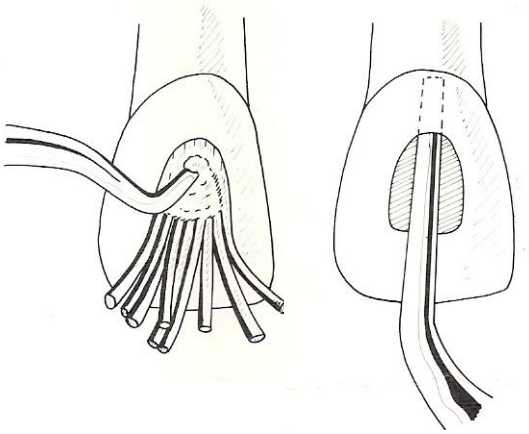


Fig.7-6 A, Excess gutta-percha is removed to the cervical line by inserting a hot instrument into the pulp chamber. B, Plugger is used to compress the remaining warm gutta-percha

LEARNING OBJECTIVES

After this laboratory work, the student should be able to:
1-Fit master gutta-percha point in canal.
2-Obturate the root canal system by means of the lateral condensation technique.
3-Expose and process a radiograph of an obturated root canal system.

Major points to remember during obturation:

1-Clinically, if the tip of the point has a reddish or brownish color, (on removal from the canal) it has passed through the apical foramen into the periapical tissue. This is easily verified by measuring the length to which the point has been inserted to determine if it exceeds the working length. If it does, the point must be cut shorter and grasped at the working length to prevent further irritation of the periapical tissue.

2-Once the master cone has been fitted satisfactory; it should not be manipulated any more than necessary. Continuously inserting the cone into the canal may deform it and lessen its rigidity as well as affect its fit. If at any time the cone is bent or it buckles, it should be discarding and replaced.

3-Coat the master point with cement and gently and slowly place point in canal. Do not push point with one motion to length or it will push cement out of the end of the root. Tap the point a few millimeters at a time and allow the cement to flow around the point.

4-At any time during lateral condensation you can burn out the excess (coronal portion) gutta-percha points to CEJ to give better vision and ability to continue condensation.

5-Clean the spreader from sealer after each use.

6-If there is any question as to the fit of the gutta-percha in the apical portion of the canal, a radiograph should be taken after the placement of the first or second accessory cone. If the radiograph shows that the cones have failed to reach the desire position or the canal does not appear obliterated, the cone should be removed, a new master cone fitted, and the fill procedure begun again.

Compactor selection

Before sealer placement, the compacting instruments are chosen. Sterile (or thoroughly disinfected) compacting instruments are used during the cleaning and shaping phase to determine the proper shaped has been prepared for depth of instrument placement (Fig.7-7).

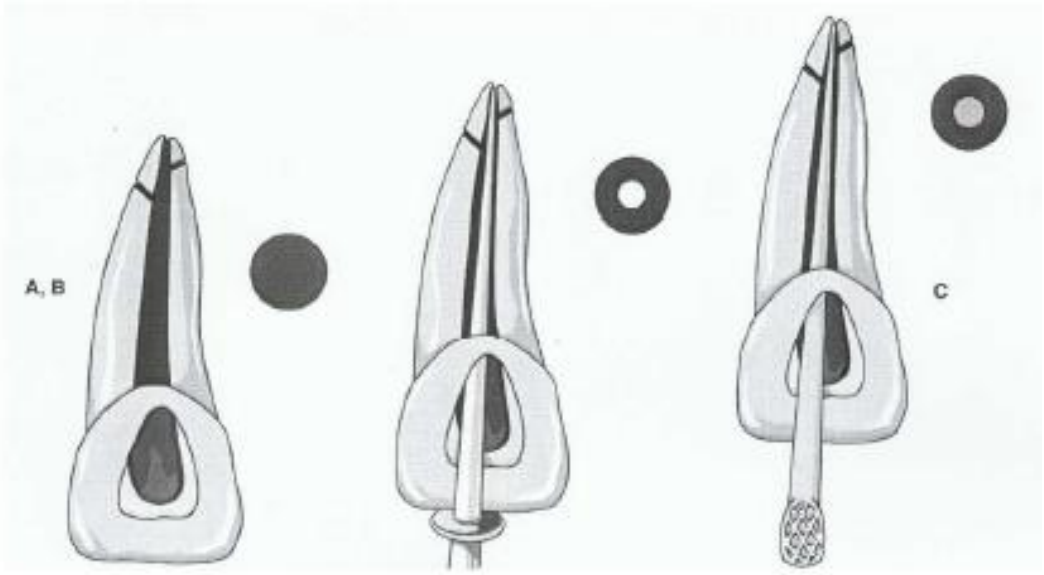


Fig.7-7 A, Diagram of prepared canal system in the shape of a funnel. B, spreader fit to the proper depth. Not the space available adjacent to the spreader. This instrument must reach the proper apical depth without binding. C, fit of master gutta-percha cone

Lateral compaction is achieved with a hand spreader or finger spreader (table 7-1). The instrument chosen should reach the canal working length without binding in an empty canal. This implies the need for proper length and taper of the compacting instrument relative to canal shape, size, and curvature (table 7-2). In curved canals a stainless steel instrument can be curved before placement in the canal, or a NiTi instrument can be used. Whenever possible a rubber stop is placed on the instrument at the working length.

TABLE 7-1 ROOT CANAL SPREADERS

R00t Canal Spreader (RCS)Code	Diameter 1 mm from the tip (mm)	Diameter 16 mm from the tip (mm)
RCS3*	0.35	0.88
RCSD11*	0.50	1.01
RCSD11S*	0.28	0.80
RCSD11T*	0.34	1.01
RCSD11TS*	0.25	1.01
RCSGP1*	0.24	0.75
RCSGP2*	0.24	0.82
RCSGP3*	0.30	0.68
RCSMA57*	0.22	0.79
RCSWIS*	0.36	0.91
RCSW2S*	0.39	0.97
RCS30*	0.30	0.70
RCS40*	0.45	0.77
RCS50*	0.50	0.85
RCS60*	0.55	0.92
S20+	0.23	0.52
S25+	0.30	0.60
S30+	0.33	0.63
S40+	0.44	0.73
S50+	0.42	0.82
S60+	0.55	0.90
*Hu-Friedy Co.		
+Caulk M-series.		

TABLE 7-2 SUGGESTED SPREADERS AND PLUGGERS CORRESPONDING TO MASTER GUTTA-PERCHA CONES

Final apical size	Recommended Spreader (Hand or Finger Spreader)	Recommended Plugger (Hand or corresponding Finger Plugger)
25	D11S, D11TS, GP1, GP2, WIS, S20, S25 (depending on canal taper and length)	P30, 8, 8A1/3(depending on canal taper, length, and desired depth penetration)
30	Same as for no. 25 except use S30, MA57 or GP3 can be used in long canals.	P30, 8, 8A,1/3
35	Same as for no. 25 except use D11T or S35	P30, 8, 8A,1/3
40	D11T, GP2, W2S, S40	P30, 8, 8A,1/3
45	D11T, GP2 or GP3, S40	P40, 81/2, 81/2A,1/2
50	D11, D11T, GP2, GP3, S50	P50, 9, 9A, or 91/2, 91/2A, PL1
55	D11, S3, S50	P50, 9, 9A, or 91/2, 91/2A, PL2
60	D11, S3, S60	P60 , 9, 9A, or 91/2, 91/2A
70	D11, S3, S70	P70, 9 1/2, 91/2A, 10, 10A, 101/2, 10 1/2A
80	D11, S3, S80	P80, 10, 10A, 10 1/2, 10 1/2A, PL3, 5/7
90	D11, S3, S80	P80, 10, 10A, 10 1/2, 10 1/2A, PL3, 5/7
100	D11, S3, S80	P80, 10, 10A, 10 1/2, 10 1/2A, PL3, 9/11
110	D11,MA57, S3, S80	PL3 or PL4, 9L11, 11, 11 1/2, 11A, 11 1/2A

Accessory cones selection:

Accessory cones are chosen based on the size of the spreader used, the size of the canal, and the position of space created in the canal (Table 7-3). For example, to the depth of the first spreader penetration, an accessory cone in the range of extra-fine to fine-fine is used. Both of these cone sizes match well with D11T or D11TS hand spreader or a no. 25 or no.30 finger spreader. Other combinations of spreaders and specific cone sizes also exist and are seen in.

TABLE 7-3 RECOMMENDED ACCESSORY CONE SIZES CORRESPOINDING TO THE CHOSEN SPREADER

Spreader	Recommended Accessory Cones
D11TS, GP1, and GP2,S20,MA57	Extra fine or size No. 20
D11TS, D11T, GP3, S25	Fine or sizes No. 20 or 25
D11T, S3, WIS, W25, S30	Fine or size No.25
D11,S40, S50	Medium fine

ENDODONTIC LABORATORY

Lab. No.(8)

Rubber dam application

Armamentarium

a-Rubber dam
b-Clamps
c-Rubber dam punch
d-Rubber dam forceps
e-Dental floss
f-Frame

PURPOSE:

Complete isolation of the treated toot, to obtain **DRY AND CLEAN** filed.

PROCEDURE:

A- Single isolation:

(1) Select an appropriate clamp and check its fit on the tooth

(2) Select the proper weight rubber dam for the tooth to be treated.

(3) Punch hole in the center of rubber dam for any tooth, and stretch the rubber dam on the frame (Fig. 1-8)

(4) Insert the clamp through the hole from the operator's side of the dam up to the connector arm (Fig.2-8).

(5) Tie a length of dental floss to the clamp.

(6) Place the forceps in the wing holes and slide clamp over the tooth (Fig.3-8).

(7) Remove forceps and slide rubber dam off the clamp so that it seats below the wings of the clamp around the tooth, this is accomplished most efficiently with a push finger tip; however, at times it is necessary to use an instrument to release the dam(Fig.4-8).

(8) If the dam has not pulled through the interproximal contact, dental floss is used to help draw it through the contact (fig.5-8).

(9) Wipe down the tooth and wash with alcohol to disinfect area (Fig.6-8).

Note: you can insert the dam and clamp on the tooth, and then put the frame. Or you can insert the clamp and then the dam and frame.

B- Multiple isolation:

(1) Punch hole for each tooth to be isolated. For posterior teeth the holes are lined up vertically and for anterior teeth are horizontal (Figs.7-8, A&B).

(2) Stretch the dam over the teeth, the Ivory no. 0 clamp is used to hold the dam in place for anterior teeth (Fig.8-8), while the same clamps used for single-tooth isolation are used for posterior teeth (Fig.9-8).

(3) If the clamp interferes with treatment, you can put a portion of rubber dam material stretched through the interproximal area which will replace it and secure the dam (Fig.10-8).

LEARNING OBJECTIVE
After this laboratory the student should be able to:
1-proper applying of rubber dam.
2-know the rubber dam equipments (frame, clamp, etc.)

Placement of the rubber dam:

Use of the rubber dam is an essential part of endodontics treatment. It is essential for maintenance of an aseptic environment and prevention of accidental aspiration of endodontics instruments. In spite of the many documented cases of instrument aspiration, it is still a common occurrence in private practice for practitioner not utilizing a rubber dam, the safety of the patient should be of prime consideration at all times.

Before placement of the rubber dam on the tooth, the access opening outline form should be made(do not enter the pulp chamber).this is done to avoid the possibility of placing the dam on the wrong tooth and proceeding to gain access to the pulp cavity of a tooth adjacent to the tooth indicated for treatment.

Steps of single tooth isolation

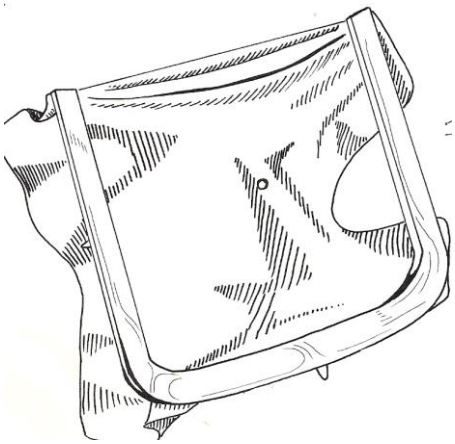


Fig.8-1.Dam is prepared for application by attaching it to frame stretching it tightly across the top and bottom

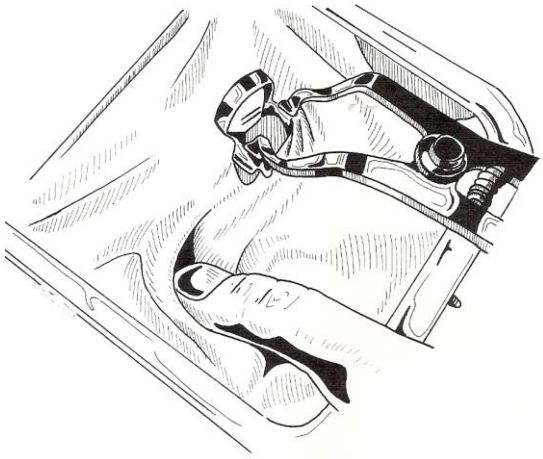


Fig.2-8.Clamp insert in the hole of the frame

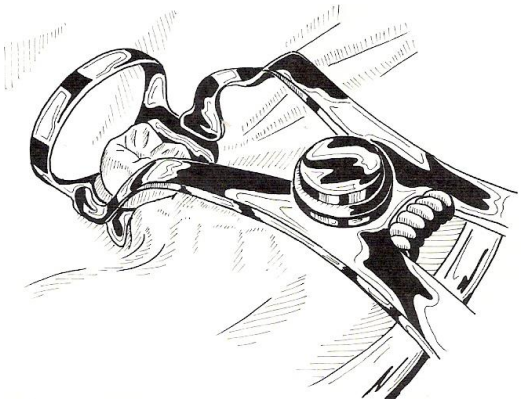


Fig.3-8. Clamp is placed on the tooth

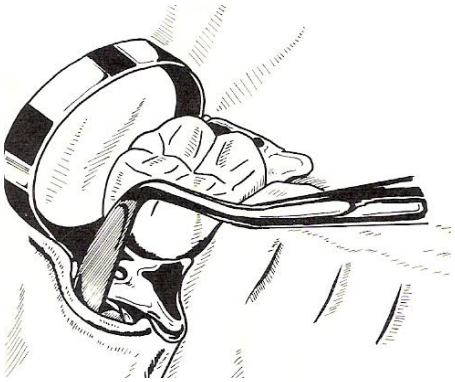


Fig.4-8. Release the dam from the clamp wings with an instrument

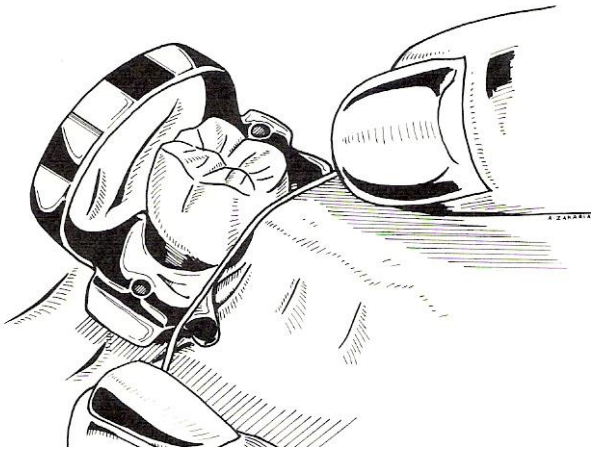


Fig.5-8 Dental floss is used to pulled dam through the interproximal contact

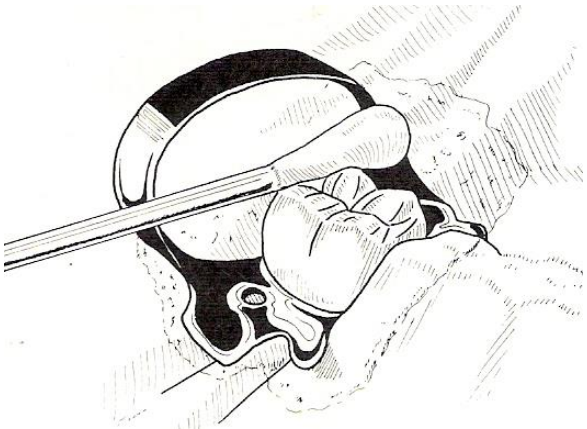


Fig.6-8. Swab the isolated tooth with adjacent dam with suitable disinfectant

Steps of multiple teeth isolation

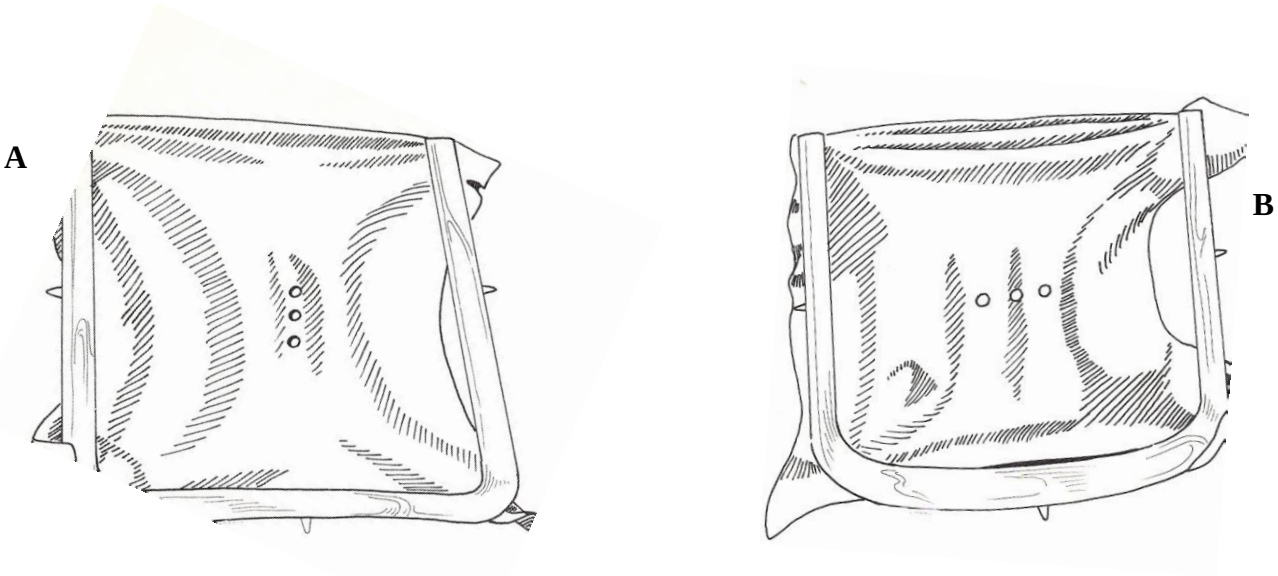


Fig.7-8. A.Position of holes for multiple isolation of posterior teeth.
B. And anterior teeth.

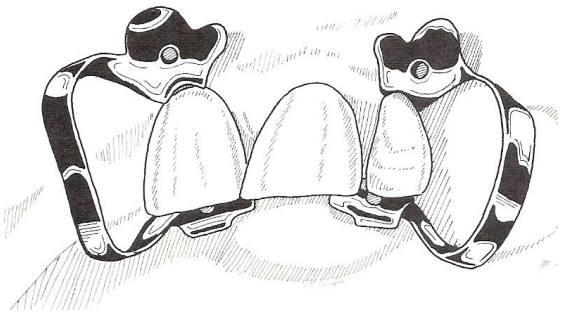


Fig.8-8. I vary no. 0 is used to hold the dam in place.

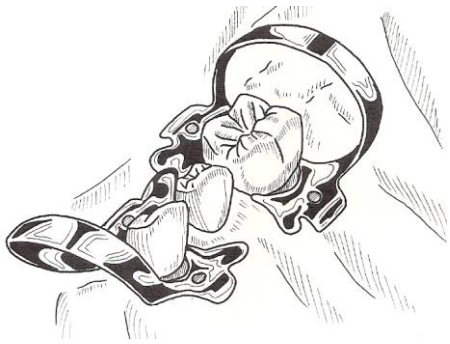


Fig.9-8. The same clamps used for single-tooth isolation are used for posterior teeth

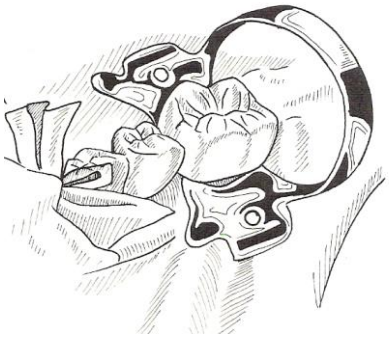


Fig.10-8. If the clamp interferes with treatment, a portion of rubber dam material stretched through the interproximal area will replace it and secure the dam

Rubber dam equipments:

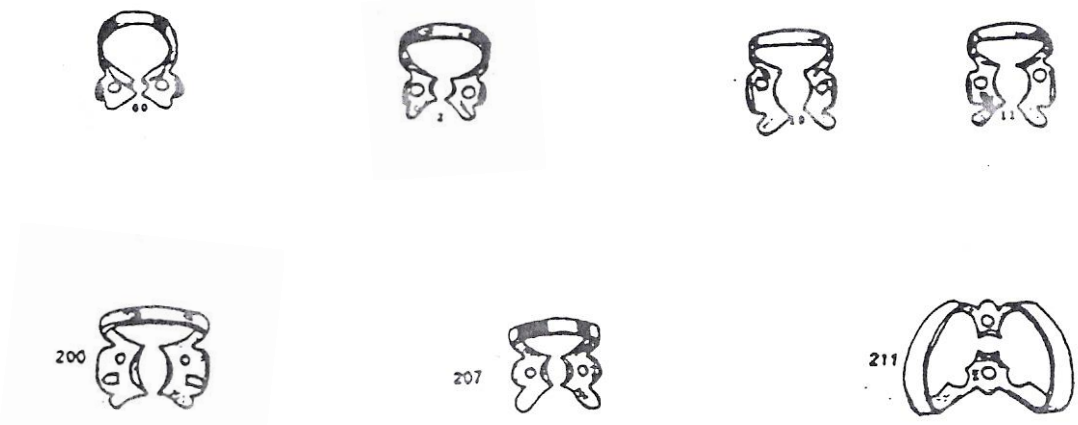
1-Frame: This holds the free edges of the sheet of the rubber and prevents them from falling into the mouth or back against the patient face. Is available in several designs (Young's frame, Nygaard, Starlite Visiframe, and Articulated frame).

2-Dam material: is supplied in ready cut square sheets, or roll. Is available in a variety in colors (green or blue), thickness (thin weight, medium, and heavy) and sizes.

3-Clamp: metal or plastic clips, which fit the neck of the tooth and hold dam in position, and may enhance gingival retraction.

Rubber dam clamps
(Most frequently used)

maxillary	First choice	Alternates
Centrals	SSW # 211	I vory #2 ASH#9
Laterals	SSW # 211	I vory 00,#2or ASH#9
Cuspids	SSW # 207	I vory #2 or SSW#4
Bicuspids	SSW # 207	I vory #2 or SSW#4
Molars	SSW # 200	I vory # 10or 11
Mandibulars	First choice	Alternates
Centrals	SSW # 211	I vory #00 or #2
Laterals	SSW # 211	I vory #00 or #2
Cuspids	SSW # 207	I vory #00 or #2
Bicuspids	SSW # 207	I vory #00 or #2
Molars	SSW # 200	I vory # 10 or #12
Large fabricated crown	7A/7B	
Broken teeth	13A,26,8A,14,14A	



4- punch: used to great a sharp clean hole in the dam material.

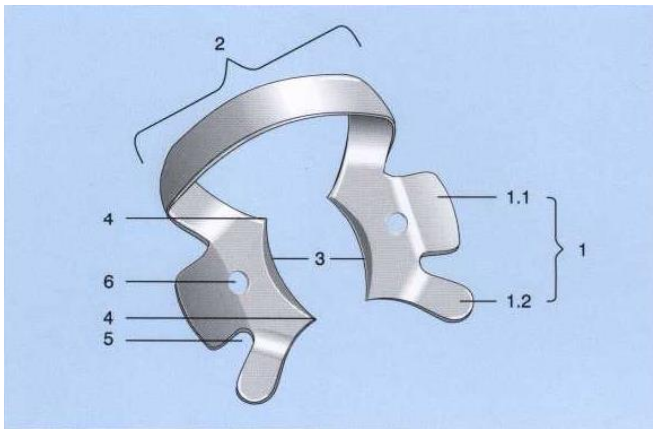
5-forceps: used to hold and carries the clamp during placement and removal.

A

B

C

A, Punch. B, Forceps (Holder). C, Frames



Rubber dam clamp
1 Clasp arm
(lingual and buccal) with:
1.1 central wing
1.2 anterior wing
2 Bow (distal)
3 Jaws
4 Contact point
5 Notch
6 Perforation

ENDODONTIC LABORATORY

Lab. No. (9)

New concepts in instrumentation and obturation

NEW NICKEL-TITANIUM ROTARY INSTRUMENTS

1-ProFile Taper rotary instruments:

ProFile nickel-titanium endodontics instruments allow efficient preparation and cleaning of all sections of the root canal. They are designed for continuous rotation at 150 to 350 rpm. in a contra angle, and are eminently suitable for use with crown-down technique. Profile instruments incorporate numerous innovations. They allow simple and quick preparation of all root canals, closely respecting the original path of the canal and retaining the original position of the foramen, and produce a conveniently tapered opening.

ProFile rotary instruments unique radial-landed U- shaped flutes (Fig.9-1). Provide a smooth surface that helps keep the file centered in the canal. Reducing the chance of zipping, transporting or ledging. The design lets you create a clean, continuously tapering preparation from the orifice to the apex- ideal for obturation.

The range of the instruments:

The ProFile range comprises 3 instrument types, each type in different length. The types are easily identifiable by the colored ring on the shanks:

*** ProFile O.S.:** Taper 5 to 8%, No. 1 to 6 (20 to 80), length 19mm. the handle carries 3 colored ring (Fig.9-2).
ProFile O.S. is used for preparing the coronary section of the canal or for removing gutta-percha before inserting a root post.

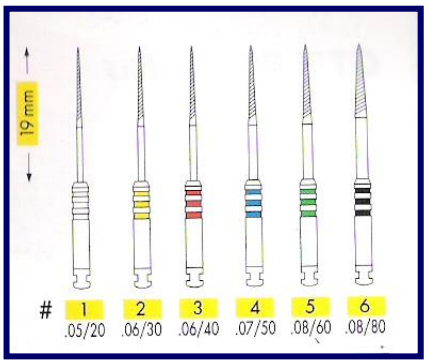
***.06 ProFile:** Taper 6%, No. 1 to 6 (15 to 40), length 21 mm and 25mm. The handle of instruments carries 2 colored rings (Fig.9-3).
The .06 ProFile are used for preparing the middle section of the canal (usable as far as the apex in moderately curved canals).

***.04 ProFile:** Taper 4%, No. 1 to 9 (15 to 90), length 21mm, 25mm and 31mm. The handle of .04 ProFile Instruments carries a single colored ring (Fig. 9-4).
The .04 ProFile are used most often for preparing the terminal part of the canal.

A

PROFILE ORIFICE SHAPERS

Color code	Taper Mm/mm	Diameter D0 in mm	Diameter D16 in mm
Gold	.05	.20	0.70
Blue	.06	.30	0.90
black	.06	.40	1.00
Gold	.07	.50	1.20



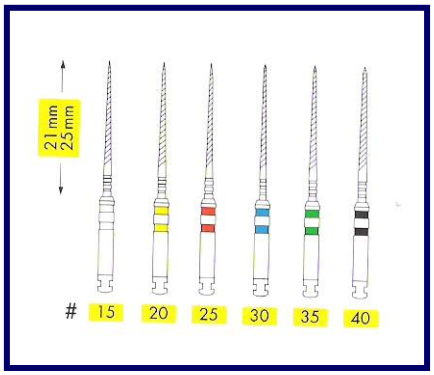
B

Fig.9-2 **A**, Summary of four ProFile orifice shapers. **B**, 0.20, 0.30, 0.50, and 0.60 orifice shapers. **Note** their various tapers

A

PROFILE .06 TAPERS

Color code	Taper mm/mm	Diameter D0 in mm	Diameter D16 in mm
Gold	.06	.20	1.16
Red	.06	.25	1.21
Blue	.06	.30	1.26
green	.06	.35	1.31



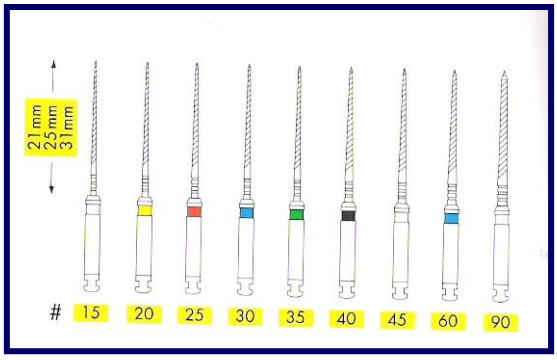
B

Fig.9-3 **A**, Four of the instruments from the set of ProFile no. 0.06 tapered file. **B**, 0.20, 0.25, 0.30, and 0.35, 0.06 tapered ProFile.

A

PROFILE .04 TAPERS

Color code	Taper mm/mm	Diameter D0 in mm	Diameter D16 in mm
Gold	.04	.20	0.84
Red	.04	.25	0.89
Blue	.04	.30	0.94
green	.04	.35	0.99



B

Fig.9-4 **A**, Four of the instruments from the set of ProFile no. 0.04 tapered file. **B**, 0.20, 0.25, 0.30, and 0.35, 0.04 tapered ProFile.

2- ProFile GT rotary instruments:

ProFile GT (greater taper) rotary file are made of nickel titanium alloy, and their intended purpose is to create a predefined shape in a single canal.

The range of instruments:

The profile GT system consists of six instrument sizes, three GT file, and three GT Accessory file:

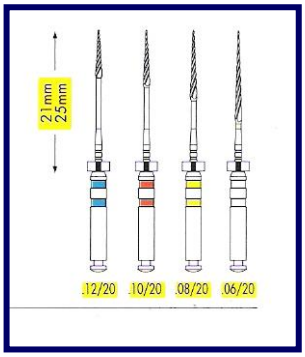
***GT Rotary file:** Taper 6 to 12%, No. 1 to 4, length21mm and 25mm. All GT file having a constant ISO non cutting tip diameter of 0.20mm (ISO size 20).
The 0.06 taper is designed for moderate to severely curved canals in small roots, the 0.08 taper for straight to moderately curved canals in small roots, and the 0.10 taper for straight to moderately curved canals in large roots (Fig.9-5).

***GT Accessory file:** Taper 12%, No. 1to 3, length 21mm, and 25mm. varying tip diameters of 0.35, 0.50, and 0.70mm (Fig.9-6).
The accessory GT file is used for unusually large root canals having apical diameters greater than 0.3mm. When used in canals with large apical diameters, they are typically able to complete the whole shape with one file.

A

GT ROTARY FILE

Color code	Taper mm/mm	Diameter D0 in mm	Diameter D16 in mm	Cutting flutes in mm
White	.06	.20	1.00	14
Yellow	.08	.20	1.00	10
Red	.10	.20	1.00	8
blue	.12	.20	1.00	6



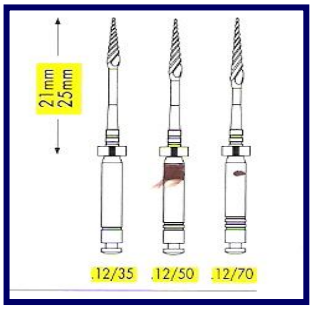
B

Fig. 9-5 **A**, Summary of the rotary GT files. **B**, 0.06, 0.08, 0.10, and 0.12 tapered rotary GT files

A

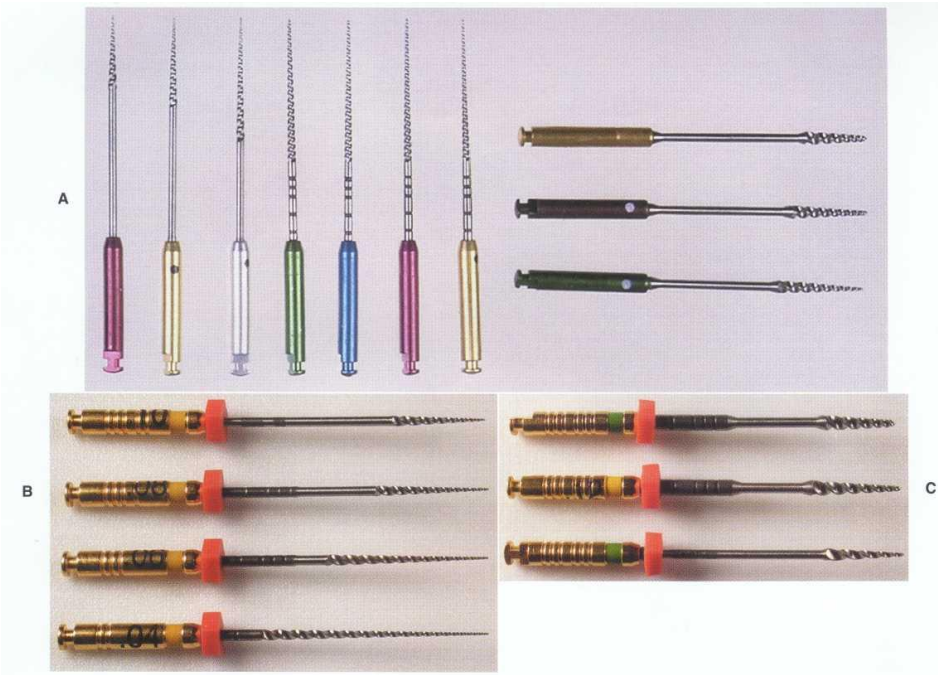
GT ACCESSORY FILES

Color code	Taper mm/mm	Diameter D0 in mm	Max flute diameter
Green	.12	.35	1.50
Brown	.12	.50	1.50
Gold	.12	.70	1.50



B

Fig. 9-6 **A**, Summary of the three accessory GT files. **B**, the three accessory GT files. GT files



A, Profile GT starter kit. From left to *right:* Red 20/.10, Gold, 20/.08, Silver 20/.06, Green 35/.04, Blue 30/.04, Red 25/.04, Gold 20/.04. Profile GT accessory files, from *bottom* to *top:* Green 35/.12, Brown 50/.12, and Gold 70/.12.
B, The ProSystem 20 series. The instrument tips are 0.20 mm and the instruments have (from *top* to *bottom)* tapers of .10, .08, .06, and .04. Note the color coding for tip diameter and markings for instrument taper. Each ring represents a taper of 0.02 mm. The ProSystem 30 and 40 series instruments are similar, with tip diameters of 0.30 and 0.40 mm, respectively.
C, The ProSystem GT accessory series consists of instruments with (from *top to bottom) tip* diameters of 0.70 mm, 0.50 mm, and 0.35 mm. The taper is 0.12 mm for each instrument, as designated by the six rings.

3-ProTaper rotary system:

According to the developers, proTaper (progressively tapered), nickel-titanium rotary files are especially designed to instrument difficult, highly calcified and severely curved root canals. The distinguishing feature of the pro taper system is the progressively variable tapers of each instrument that develop a "progressive preparation" in both vertical & horizontal directions. Under use, the file blades engage a smaller area of dentin, thus reducing torsional load that leads to instrument fatigue & file separation. During rotation, there is also an increased tactile sense when compared with traditionally shaped rotary instrument.

ProTaper Benefits:

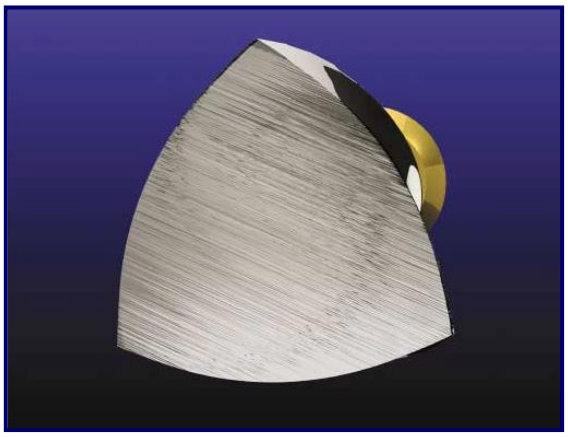
1-The progressive (multiple) taper design improves flexibility & "carving" efficiency, an important asset in curved & restrictive canals.

2-The balanced helical angles of the instrument optimize cutting action while effectively auguring debris coronally, as well as preventing the instrument from screwing into the canal.

3-Both the "shapers" & the "finishers" remove the debris & soft tissue from the canal & finish the preparation with a smooth continuous taper.

4-The triangular cross-section of the instruments increase safety, cutting action, & tactile sense while reducing to lateral contact area between the file & the dentin.

5-The modified guiding instrument tip can easily follow a prepared glide path without gouging side walls.



The range of instruments:

The ProTaper system consists of only six instrument sizes, three shaping files and three finishing files:

***Shaping files: the shaping files are labeled S-X, S-1, S-2**

S-X: Taper (D_0= 0.19mm, D_9=1.1D_{14}=1.2mm), length 19mm, cutting flutes 14mm (Fig 9-7). The S-X shaper is an auxiliary instrument used in canals of teeth with shorter roots or to extend & expand the coronal aspects of the preparation, similar to the use of Gates-Glidden drills or orifice openers.

S-1: Taper (D_0= 0.17mm, D_{14}= 1.2mm), length 19mm, cutting flutes 14mm (Fig.9-7). This file is designed to prepare the coronal one third of the canal.
S-2: Taper (D_0= 0.20, D_{14}= 1.2mm), length 19mm, cutting g flutes 14mm (Fig.9-7). This file is used to enlarge and prepares the middle third in addition to the critical coronal region of the apical third. The handle of all instruments carries a single color ring.

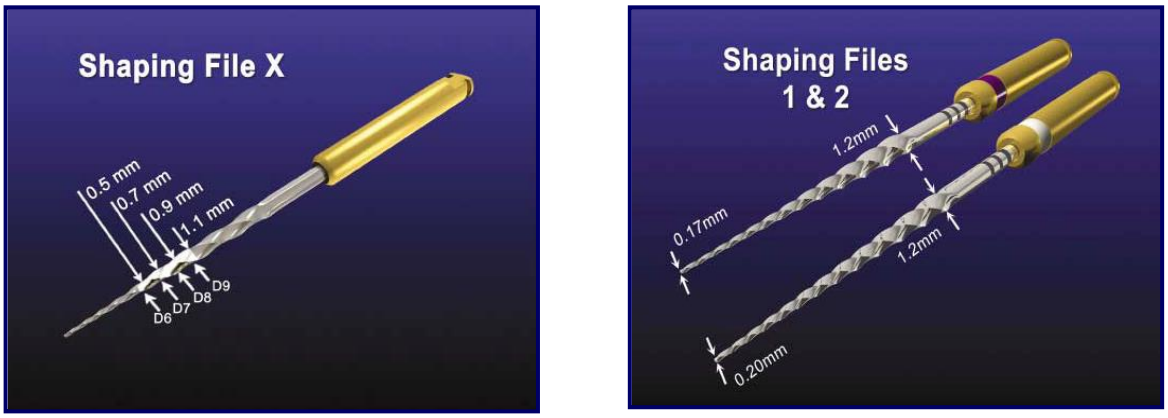


Fig.9-7 **A**, Shaping file X . **B**, Shaping file 1and 2

***Finishing files: The Finishing files are labeled F-1, F-2, F-3.**
F-1: Tip size (D_0)=20, between D_0 & D_3, the taper rate 0.07mm, from D_4 to D_{14}, decrease in taper to improve flexibility.
F-2: Tip size (D_0)=25, between D_0 & D_3, the taper rate 0.08mm, from D_4 to D_{14}, decrease in taper to improve flexibility.
F-3: Tip size (D_0)=30, between D_0 & D_3, the taper rate 0.09mm, from D_4 to D_{14}, decrease in taper to improve flexibility.
Although primarily designed to finish the apical third of the canal, finishers do progressively expand the middle third as well. Generally, only one instrument is needed to prepare the apical third to working length, & tip sizes (0.20, 0.25, or0.30) will be selected based on the canals curvature & cross-sectional diameter (Fig. 9-8).

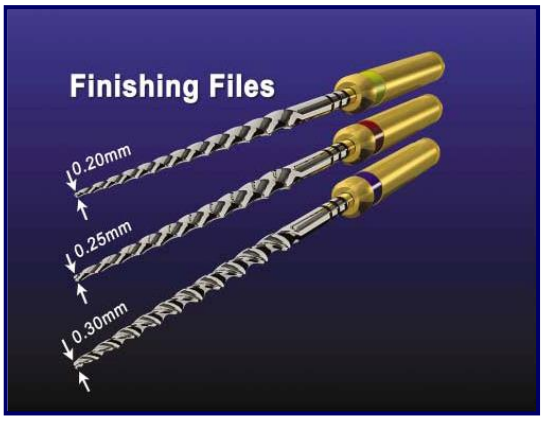


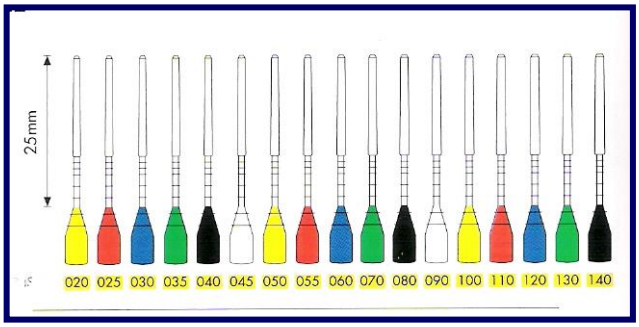
Fig. 9-8 Three finishing file, 0.20, 0.25, 0.30

NEW OBTURATION CONCEPT

ThermaFil technique

In this technique, a series of carriers are made from nickel-titanium or plastic. Special gutta-percha coats the shaft of the device, making the warmed material sticky and adhesive but with excellent flow characteristics (Fig 9-10).The system now includes an oven to warm the obturators in a controlled and reproducible manner. In addition, a series of uncoated carriers is provided to check the diameter of the end-point preparation and to simplify the selection of the appropriately sized obturator. Within the last few years a variety of similarly precoated carriers made by other companies has been marketed.

A



B

Fig.9-10 **A**, ThermaFil carriers. **B**, ThermaPrep plus heating system

PROCEDURE:

(1)-Following preparation and drying of the canal, an uncoated carrier is inserted to the full working distance. If it passes down to the end-point of preparation without using force, the equivalent size of obturator is selected and the working distance marked with the silicone stop.
(2)-The obturator is then placed in the heating chamber of the oven for the appropriate time. The canal is dried further, and then coated with a small amount of sealer placed at the entrance to the orifice. The obturator is removed from the oven and immediately seated into the canal until it reaches the desired length. The excess gutta-percha in the chamber is removed and the remainder condensed vertically to enhance the coronal seal (Fig-9-11).
(3)-After the gutta-percha has cooled, the shaft is severed with a bur and the handle discarded. The canal preparation is modified as less coronal flare is required.

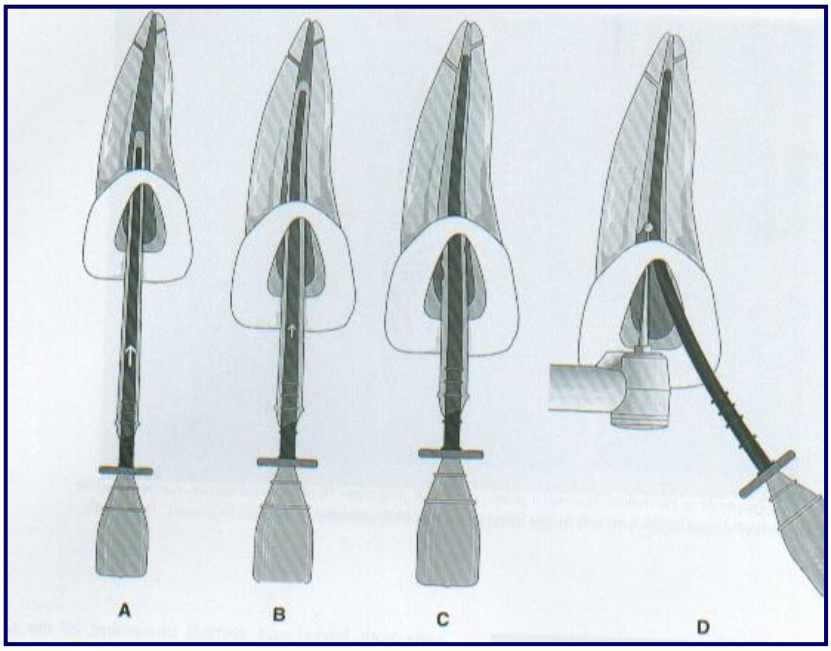


Fig. 9-11 A, Heated carrier is positioned in the canal orifice and placed slowly into the canal without twisting. B, As the carrier is placed deeper, the softened gutta-percha contacts the walls of the canal and beings to flow apically and laterally. C, As the core reaches the apical third, the softened gutta-percha reaches the canal constriction, slows the apical movement of the gutta-percha, and delivers a resistance to further apical movement of the core material. D, The core is cut at the canal orifice with a prepi bur or round bur; this is followed by further apical compaction.