Endodontic Instruments- Part I

Learning Objectives

- To gain thorogh knowledge of instruments used in endodontic treatment.
- To understand the application of various instruments in various clinical situations

Contents

- History
- Endodontic Instrument Standardization
  - Recommendations of Ingle and Levine
  - Modifications
- Material Used
  - Carbon steel
  - Stainless steel
  - Nickel Titanium Instruments
  - Titanium Aluminium Instruments

- Classification Of Endodontic Instruments

- Instruments Used For Initial Examination
  - Mouth Mirror
  - Endodontic Pliers
  - Endodontic Spoon Excavator
- Instruments Used For Exploring the Canal
  - Maellifer Micro Opener
  - Micro Debrider
  - DG -16 Endodontic Explorer
  - Access Opening Burs
  - Smooth Broach

ENDODONTIC INSTRUMENT STANDARDIZATION :

- 1955 a serious attempt was made to correct these abuses, and in 1959, a new line of standardized instruments and filling materials was introduced into profession.

1. A formula for the diameter and taper in each size of instrument and filling material was agreed on.

2. A formula for a graduated increment in size from one instrument to the next was developed.

3. A new instrument numbering system based on instrument metric diameter was established.

4. This numbering system, last revised in 2002 using numbers from 5 to 140, was not just arbitrary but was based on the diameter of the instruments in hundredths of a millimeter at the beginning of the tip.

- In 1959, ingle and Levine using an electron microscope found variations in diameter and taper for same size instruments and suggested a definite increment in diameter as the size progressed while maintaining the constant taper of all blades regardless of size.

RECOMMENDATIONS OF INGLE AND LEVINE :

- Instruments shall be numbered from 10 to 100, then to advance by 5 units from 10 to 60 and then by 10 units to 100 size.
- Each number shall be representative of the diameter of the instrument in hundredths of millimeter at the tip. Eg: No.10 is 0.1 mm diameter at tip.
- The working blade (flutes) shall begin at the tip and extend exactly 16 mm up the shaft.

- The tip of the blade is designated as “D_1”. This D_1 represents the number of the instrument.

- The 16 mm up the shaft from the tip is designated as “D_2”. The diameter at D_2 will be 0.32 mm greater than D_1.

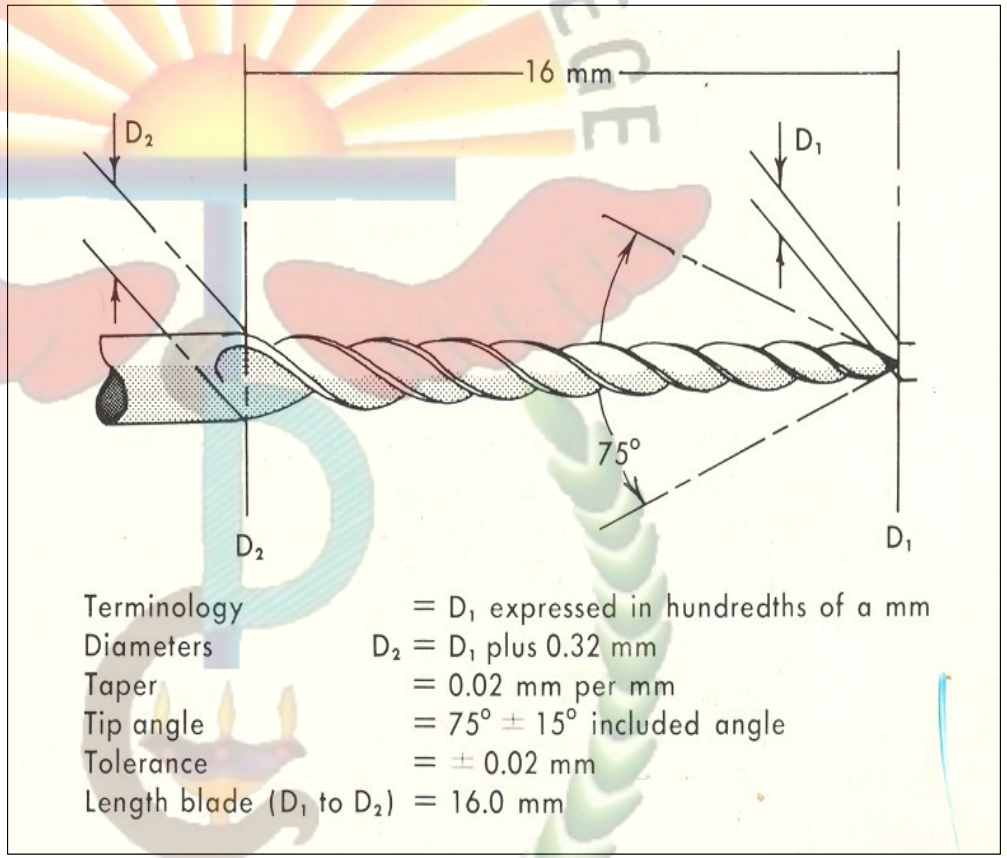
- There is a constant increase of the taper from D_1 to D_2 by 0.02 mm per mm for every instrument regardless of the size.

  Eg: No. 20 reamer

  D_1 is 0.20 mm

  D_2 is 0.20 + 0.32

  = 0.52 mm



Standardization of Endodontic Instruments

Other specifications added later:

- The tip angle of an instrument sizes should be 75 ± 15^0

- Instrument sizes should increase by 0.05 mm at D_1 between Nos. 10 and 60
- Eg: No. 10, 15, 20, 25
- Instruments should increase by 0.1 mm from Nos. 60 to 150
- Eg: No. 60, 70, 80.
- No. 6 and 8 have been added for the increased instrument selection.
- Instrument handles have been color coded for easier recognition.

Old number	Color code	New number	D_1 (mm)	D_2 (mm)
000	Pink	6	0.06	0.38
00	Gray	8	0.08	0.40
0	Purple	10	0.10	0.42
1	White	15	0.15	0.47
2	Yellow	20	0.20	0.52
3	Red	25	0.25	0.57
4	Blue	30	0.30	0.62
5	Green	35	0.35	0.67
6	Black	40	0.40	0.72
-	White	45	0.45	0.77

7	Yellow	50	0.50	0.82
-	Red	55	0.55	0.87
8	Blue	60	0.60	0.92
9	Green	70	0.70	1.02
10	Black	80	0.80	1.12
11	White	90	0.90	1.22
-	Yellow	100	1.00	1.32
12	Red	110	1.10	1.42
13	Blue	120	1.20	1.52
14	Green	130	1.30	1.62
15	Black	140	1.40	1.72
-	White	150	1.50	1.82

- Available in lengths 21, 25, 28 and 30 mm

- Ordinarily instruments 25 mm long are used, but occasionally, 21 mm instruments are needed for molars, especially when the patient cannot open mouth wide.

- 28 and 30 mm instruments are necessary for cuspids and other teeth in which 25 mm cannot reach the apical foramen. Reamers are also available in 40 mm lengths for use in preparing root canals for endodontic implants.

MODIFICATION OF THE MATERIAL USED :

- Until 1960, root canal instruments were produced of carbon steel. There were many draw backs in the carbon steel instruments like sterilization of these instrument cause decreases in torque and angular deflection and stainless steel instrument were then introduced.

- **STAINLESS STEEL INSTRUMENTS**
  - Flexible and hence less likely to fracture when strained.
  - Less susceptible to corrosion usually caused by contact with sodium hypochlorite.

- **Drawbacks of Stainless steel files :**
  - In vitro study of stainless steel files at Connecticut demonstrated that significant wear and potential loss of efficiency occurred after only one used of 300 strokes.
  - Study in Brazil concluded that stainless steel instruments in small sizes should be used once and the No: 30 could be used three times.

- Webber et al used a linear cutting motion in moist bovine bone and found that there was a wide range of cutting efficiency between each type of instruments, both initially and after successive use.

- A group of Margnette university compared K-type files with five recently introduced brands in three different sizes No: 20, 25 and 30. Wear was noticed by all instruments after three successive three minute test periods.

- A group in Michigan studied the cutting ability of the K-files and reported a wide variance in the cutting ability of individual files.

- Luck has shown that smaller reamers and files may be easily broken by twisting the blades beyond the limits of metal until the metal separated.

- Study of 360 degree clock wise rotation (ISO revision of ADA specification No: 28) found only 5-K-files failing of 100 instruments tested. They were sizes 30 to 50 all from one manufacturer

NICKEL TITANIUM INSTRUMENTS :

- **Super elasticity :**
- It shows super elasticity, undergo a stress-induced martensitic transformation from a parent structure which is austenite.

- On release of the stress the structure reverts back to austenite, recovering its original shape.

- Deformations involving as much as a 10% strains can be completely recovered.

- Super elasticity also occurs over a limited temperature. Minimal residual deformation occurs at approximately room temperature.

- A composition consisting of 50% nickel and 50% atomic titanium seems ideal both for instrumentations and manufacture.

- **Advantages :**
- They are effective or better than comparable stainless steel instruments in machining dentin
- They are more wear resistant.
- New prototype rotary motors offer improved torque control with automatic reversal that decreases rotary instrument breakage.
- Files are biocompatible

- **Drawbacks :**

- When testing the resistance to fracture for 21 brands they found that No: 25 stainless steel files had a higher resistance than Ni-Ti files.

- While studying cyclic fatigue using Ni-Ti light speed instruments, Pruett et al determined that canal curvature and the number of rotations determined file breakage. Separation occurred at the point of maximum curvature of the shaft.

TITANIUM ALUMINIUM INSTRUMENTS :

- **Composition :**
- These instruments contain – 90% titanium , 5% aluminium by weight
- These instruments have same resistance to fracture as flexible stainless steel instrument but have increased flexibility.
- They have similar cutting efficiency like stainless steel instrument
- Titanium-aluminium instrument fail to produce superior preparation results in curved canals.

- **Torsional strength and separation :**
- The clinician switching from stainless Ni-Ti hand instruments should not confuse super elasticity properties with torsional strength.

- **Nickel titanium precautions and prevention :**
- Too much force should not be applied to the file never force a file
- The straighter canal should first be enlarged to working length and then the other canal. If not Ni-Ti file may reverse its direction at this juncture, bending back on itself and damaging the instrument.
- Curved canals that have high degree and small radius of curvature are dangerous.
- Files should not be over used

- Instrument fatigue occurs more often during the initial stages of learning curve.
- Ledges that develop in canal allow space for deflection of a file then instrument may curve back itself.
- Ni-Ti file should not be used to bypass ledges.
- Teeth with S-type curves should be approached with caution. Flaring of the coronal third to half of the canal will decrease the problem.

- Avoid creating canal the same size and taper of the instrument being used. The only exception is in use of Buchanan GT file concept
- Avoid cutting with entire length of the file blade
- Sudden changes in the direction of instrument must be avoided
- Poor access preparation will lead to procedural errors.

- Advancing or pushing instrument into canal in too large an increment causes of to act as a drill or piston and greatly increases stress on the metal.

- Do not get in a hurry

- Prior to insertion and on removal look at the blade

- Do not assume that the length of files is always accurate; measure each file. Some files are longer from handle to tip them others. Files may also become longer or shorter if they are unraveled or twisted.

CLASSIFICATION OF ENDODONTIC INSTRUMENTS

1. Group I hand use only :

- Files both K type and H type
- Reamers K type
- Broaches
- Plugger
- Spreaders

2. Group II :

- Engine driven latch type : same design as group I but made to be attached to handpiece. Also included are paste fillers.

3. Group III :

- Engine driven latch type drills or reamers such as gates glidden (G type); Pesso (P type) as well as host of others – A,D,O,KO,T,M type reamers and Kurer root facer.

4. Group IV :

- Root canal points
- Gutta-percha, silver, paper

II. ACCORDING TO GROSSMAN:

- Root canal instrument may be divided into 4 types based on their function.

- **Explorer :** To locate the canal orifice and to determine or assist in obtaining patency of the root canal.

  Eg : Smooth broaches ,Endodontic explorers

- **Instruments used for Debridement:** To extirpate the pulp and to remove debris and other foreign material.

  Eg : Barbed broaches, H file, Rasps

- **Instruments used for shaping:** To shape the root canal laterally and apically.

  Eg : Reamers and Files

- **Instruments used for obturating:** To cement and pack gutta-percha into the root canal.

  Eg : Pluggers, spreaders, lentulospirals.

- **Power assisted R C instruments:**
  - Reciprocating hand pieces
  - Ultrasonic instrumentation
  - Sonic instrumentation
  - The SET canal finder system

- **Electronic canal measuring devices**

- **Measuring instruments, gauges and stands**

Instruments for the retrieval of broken instruments and posts Masseran kit

- **Instruments used in filling of root canal**
  - Lateral and vertical compaction
  - Thermomechanical compaction
  - Thermoplasticized injectable gutta-percha
  - Obtura system
  - Ultrafil system
  - The endotec thermal endodontic condenser
  - Spiral root canal fillers.

- **Equipment for storage and sterilization of instruments.**

INSTRUMENTS USED FOR INITIAL EXAMINATION

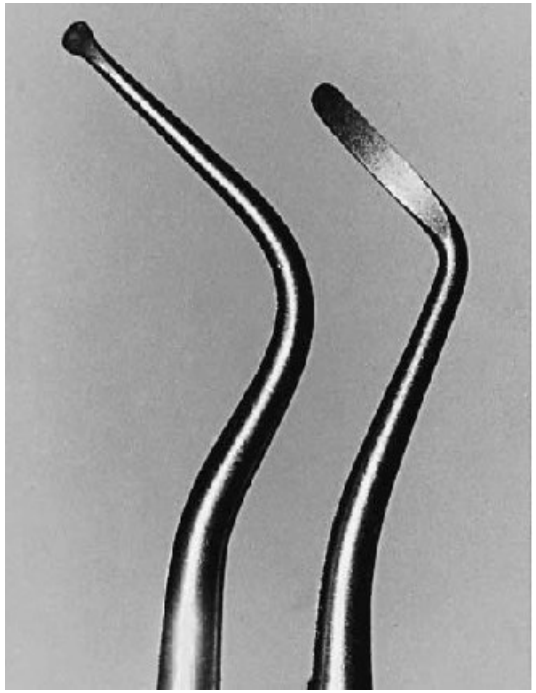
- **DIAGNOSTIC INSTRUMENTS**

- MOUTH MIRROR
  - Mirrors can be of two types
    - Rear surface are aluminium coated under vacuum on
  - The reverse side of the glass to eliminate scratch damage
    - Front surface will not give a double image, they are
  - Ideal for endodontic procedures

- **ENDODONTIC PLIERS**
- Working part has grooves
  - For holding gutta percha and absorbent points
- Available as
  - Locking
  - Non-locking
- For secure transfer of points

- **ENDODONTIC SPOON EXCAVATOR:**

- Longer offset than regular spoon from the long axis.
- Aid in better reach used to remove pulp
  - from the pulp chamber;
  - coronal pulp tissue,
  - caries and
  - flick away pulp stones



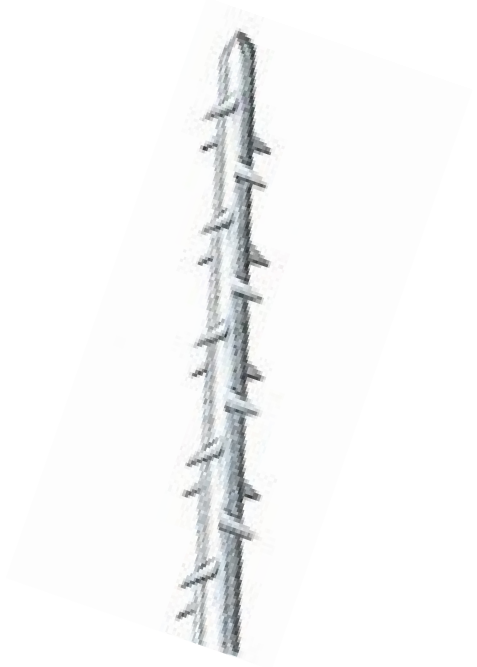
- **ACCESS OPENING BURS**
- Small standard round bur
- 16 mm bur Shank 3mm longer than standard bur
- Long shank round bur (23 mm)
- Goose neck round bur

- **SMOOTH BROACHES :**
  - The smooth broaches had been used as path finder by practioners as an initial instrument to explore the patency and the walls of the canal.
- **Uses :**

  It is used as the initial instrument to explore the patency of the walls of the canal.
- **Draw backs :**
  - This instrument will be placed initially without removing the tissue bulk which may lead to forcing of any inflamed or necrotic tissue through the apex.

- **BARBED BROACHES :**

- The barbed broaches are short handled instruments used primarily for vital pulp extripation.
- ISO specification No.
- 63 sets the standards for barbed broaches.



- **Manufacturing :**
  - Barbed broach is a tapered instrument of soft steel that is notched by a shredder to produce sharp barbs.
  - They are manufactured from round wire.
  - The barbs are bent at a right angle from the long axis.

- **Mode of use :**
- Barbs should be coronally placed.
- The barbs are used to engage the pulp as the broach is carefully rotated within the canal until it begins to meet resistance against walls of canal.
- The broach should never be forced into a canal beyond the length where it first begins to bond.
- Forcing it apically causes the barbs to be compressed by the canal walls.
- Subsequent efforts to with draw the instrument will embed the barbs in the walls.

- **Applications :**
  - The are primarily used to extripation of the vital pulp.
  - They are also used to loosen debris in necrotic canals.
  - They are used to remove paper points or cotton pellets.

- **Draw backs :**
  - The design is responsible for the frequency of breakage because the notching weakens the shaft by providing a place for fracture if stress or torque is applied.
  - Can not be used in narrow canals.
  - Increased pressure to retrieve the instrument results in breaking of barbs or shaft.
  - The broken instrument embedded in the canal in seldom retrievable
  - Can remove only vital pulp tissue.

INSTRUMENTS USED FOR EXPLORING THE CANAL

- Maellifer micro opener
- Micro debrider
- DG-16 endodontic explorer

- **MICRO OPENER :**
  - It is supplied by maellifer
  - It is the instrument with K-type flutes.
  - It is available in 0.02, 0.04 and 0.06 tapers.
  - It is mounted like a spreader.
  - It is used to uncover, enlarge and flare the orifices.

- **MICRO DEBRIDER :**
  - Micro debrider is a new addition to findings and enlarging canal orifices
  - It is available in ISO 0.02 tapers
  - It is a H-type file
  - It is used to further flare down the canal.

- **DG-16 ENDODONTIC EXPLORER**

- DG 16 explorer is an integral part of endodontic tray; considered to be an extension of the endodontists finger.
- It has two straight and very sharp ends angulated in two different directions; one side its almost perpendicular to the long axis, on the other side it's a bin-angle.
- Used to locate orifice of pulp space.

CONCLUSION

- The technical demands and level of precision required for successful performance of endodontic procedures have traditionally been achieved by careful manipulation of hand instruments within the root canal space and by strict adherence to the biologic and surgical principles ,essential for disinfection and healing.
- The recent popularity of mechanized or automated systems for preparation of root canal may be interpreted to be the professions preference for improving the speed or efficiency of treatment .
- Neverthless scientific technologic advances have significantly increased the ability of the modern practitioner to provide a higher level of care than was achievable in the past

Take home message

- The knowledge of endodontic instruments would enable appropriate use of each instrument pertaining to various clinical situations.

- Various complications and mishaps can be avoided when one has complete information on the instuments being used.

Probable SAQs and LAQs

- Classification of endodontic instruments
- GG drills