Operative dentistry

Lec.2 DENTAL ROTARY AND HAND INSTRUMENTS د.شذى

Removal and shaping of tooth structure are essential aspects of restorative dentistry. Initially, this was a difficult process accomplished entirely by the use of hand instruments. The introduction of rotary, powered cutting equipment was a truly major advance in dentistry.

Hand instruments

- It is hand-powered dental instruments.
- G.V. Black is credited with the first acceptable nomenclature and classification of hand instruments. His classification system enabled both dentists and manufacturers to communicate more clearly and effectively in regard to instrument design and function.
- For many years, carbon steel was the primary material used in hand instruments because they were harder and maintained sharpness better than stainless steel.
- Stainless steel is now the preferred material because stainless steel instruments remain bright with steam or dry heat sterilization, and because the properties of stainless steel have improved by incorporating a significant amount of chromium imparts corrosion resistance and carbon imparts hardness.
- Hand instruments used in operative dentistry may be categorized as:

l. Cutting instruments and,

2. Non cutting instruments.

1. Cutting instruments

These instruments are used to cut hard or soft tooth structures. Hand cutting instruments are composed of three parts: handle, shank and blade. For non-cutting instrument; the part corresponding to the blade is termed the nib or working end.

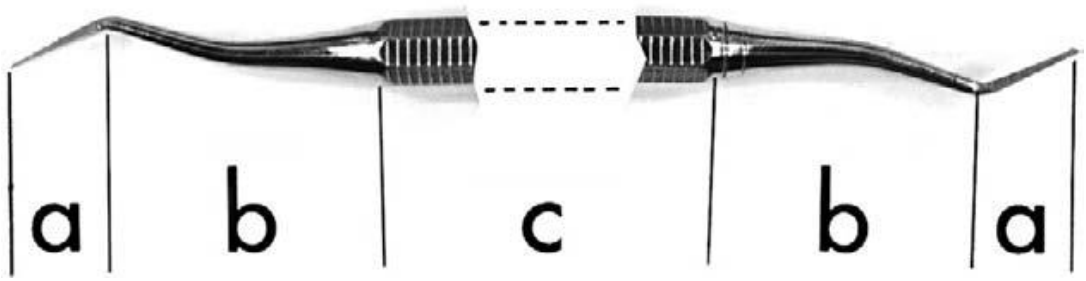


Figure (1): Double-ended instrument illustrating three component parts of hand instruments: blade (a), shank (b), and handle (c)

- **The blade or nib;** is the working end of the instrument and is connected to the shank. Some instruments have a blade on both ends of the handle and are known as double ended instruments. The blades have many designs and sizes, depending on the function they are to perform.
- **The Shank;** serves to connect the handle to the blade of the instrument. The shank may be straight, mon-angle (with one angle), bin-angle (with two angles), triple-angle (three angles), or quadrangle (four angles).

The term contra-angle refers to shank in which two or more angles are present. The angles in the shank are important to keep the blade edge within 1-2 mm to the long axis of the instruments. This is a basic factor to concentrate the force onto the blade for balancing the instrument during use and prevent its rotation.

- **The Handle;** is the part that is grasped by the operator hand while he is using the instrument.

❖ **Instrument Formula Given by G.V.Black:**

<u>3 Number instrument formula:</u> Cutting edge of the Instrument is at a right angle to the blade:

a. First number- Width of the blade in tenths of a millimeter.

b. Second number - Length of the blade in millimeter.

c. Third number - Angle the blade forms with the axis of the handle in centigrade. Example: Enamel hatchet. Fig2

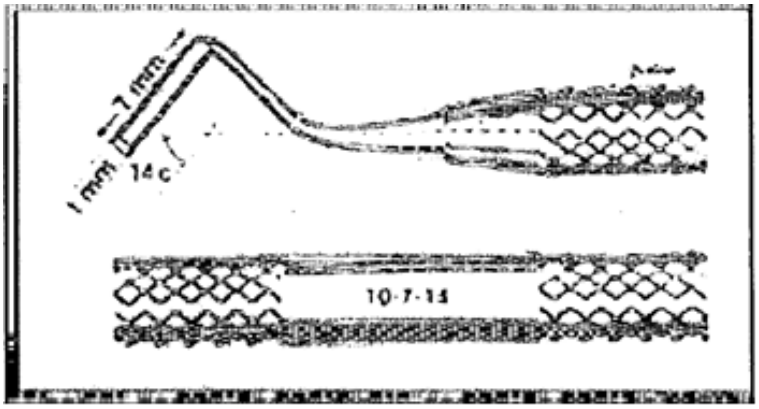


Figure 2: Enamel hatchet formula

4 Number instrument formula: Cutting edge of the Instrument is at an angle other than a right angle to the blade.

a. First number - Width of the blade in tenths of a millimeter.

b. Second number - The second number of a four-number code indicates the primary cutting edge angle, measured from a line parallel to the long axis of the instrument handle in clockwise centigrades. The angle is expressed as a percent of 360 degrees (e.g., 85 = 85% × 360 degrees = 306 degrees).

c. Third number - Length of the blade in millimeter.

d. Fourth number - Angle the blade forms with the axis of the handle in centigrade.

Example: Gingival marginal trimmer & angle former. Fig3

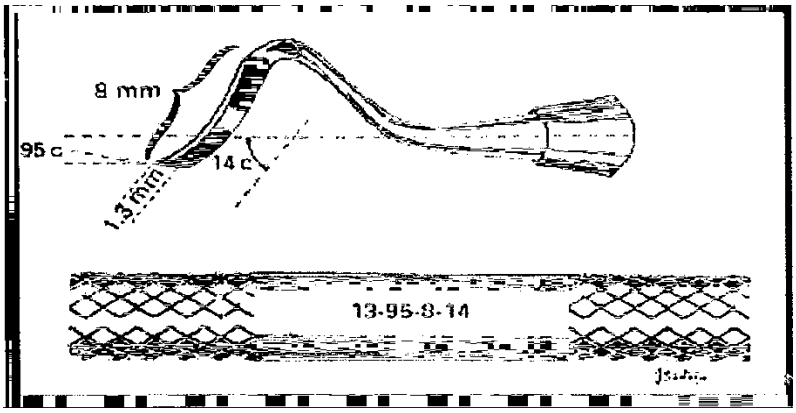


Figure3: Gingival marginal trimmer formula

Examples of the cutting instruments are:

1. Chisel: - either has a straight shank or with slight blade curvature or bin-angle chisel, and the blade has bevel only on one side of the edge. Its cutting edge is perpendicular to the axis of the handle. The chisels are used for cutting enamel and dentin with pushing motion. The shank and blade of the chisel (Fig. 4 A, B, C).

2. Hoe: - It is like chisel with cutting edge is perpendicular to the axis of the handle (Fig 4D), however its blade has a greater angle from the long axis of the handle than does that of the chisel. It has the same uses of the chisel.

3. Hatchet: - also called enamel hatchet. The cutting edge of the hatchet is parallel to the long axis of the handle and beveled only from one side (Fig. 5 A). It is used for cutting enamel and dentin and comes as right or left types for using on opposite sides of the preparation.

4. Gingival margin trimmer: - This instrument is used for beveling of the gingival enamel margin of proximo-occlusal preparations. Also it is using for beveling of axiopulpal line angle of two surface preparation as in class II cavities. It is similar in design to the hatchet, except the blade is curved, and cutting edge is at an angle to the long axis of the blade (Fig. 5, B and C). It is made as right and left types. Also it is made so a right and left pair is either a mesial pair or a distal pair. When the second number in the formula it 90 to 100, the pair is used on the distal gingival margin. When this number is 75 to 85, the pair is used to bevel the mesial margin.

5. Spoon excavator:- The blade is curved and the cutting edge at the end of the blade is in the form of a semicircle. This gives the instrument an outer convexity and inner concaving that makes it looks like a spoon Fig. (6). Like the hatchet the cutting edge at the end of the blade is parallel to the handle, therefore there are left cutting and right cutting spoons. The shank of some spoons holds a small circular (disk blade) or claw - like blade at its end. The disk blade is known as a discoid, where the claw - like blade is termed a cleoid (Fig 7, A and B).

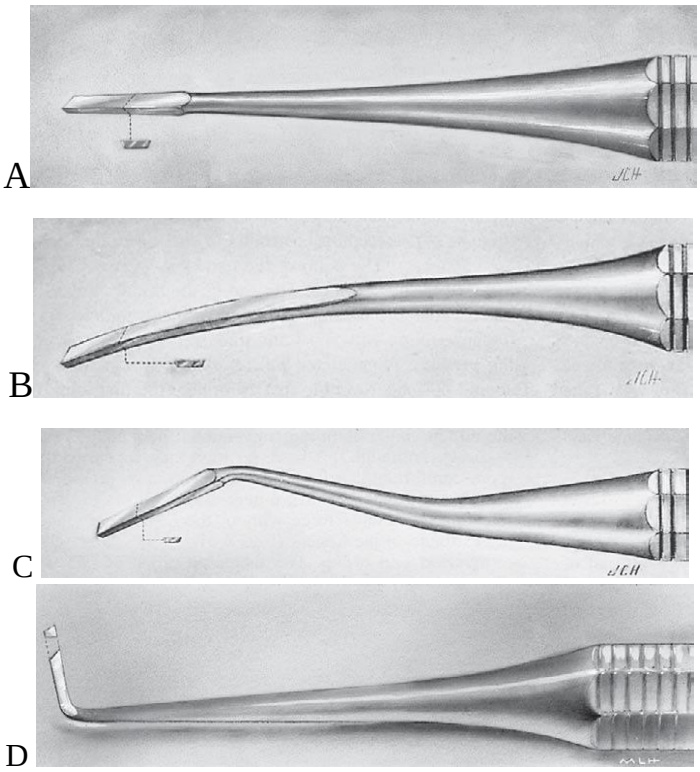


Figure (4): Examples of hand instruments called chisels (with corresponding instrument formulas). A, Straight (12-7-0). B, Wedelstaedt (11'/2-15-3). C, Bin-angle (107-8), D,Hoe.

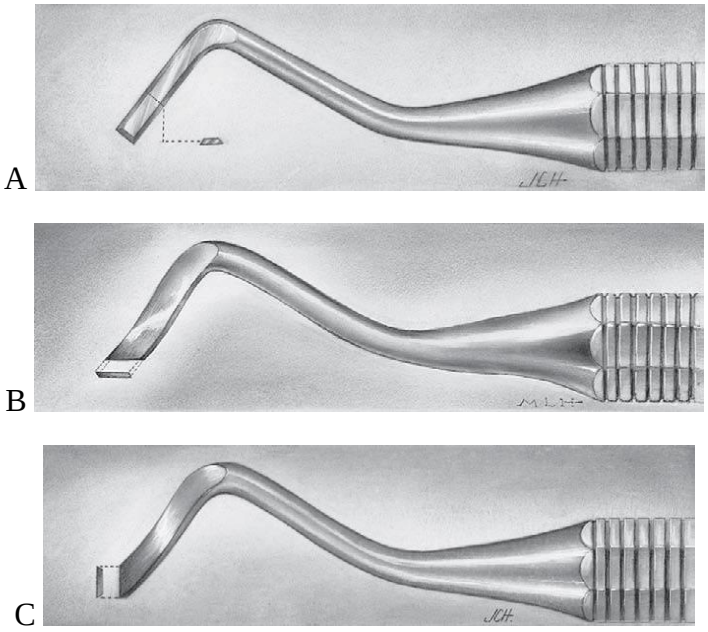
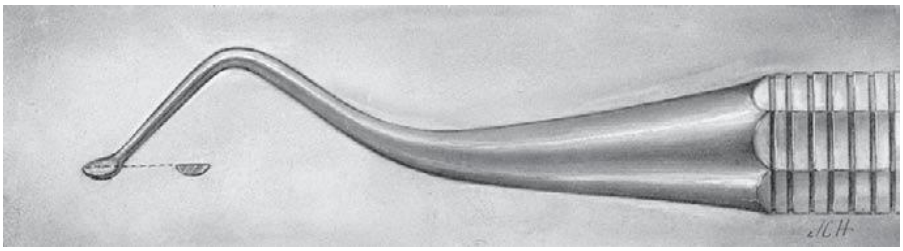


Figure (5): Examples of hand cutting instruments (with corresponding instrument formulas). A, Enamel hatchet (10-7-14). B, Gingival margin trimmer (12 1/2-100-7-14). C, Gingival margin trimmer (12'/2-75-7-14).

A



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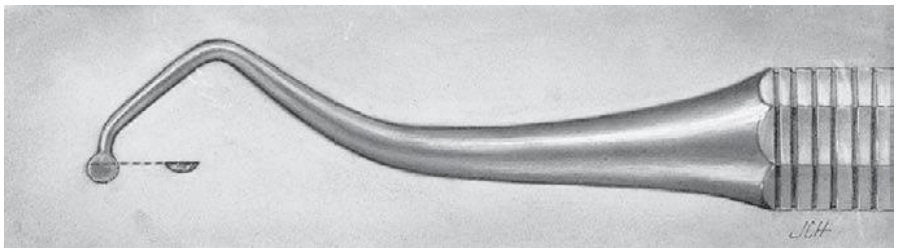

Figure (6): Examples of hand instruments called spoon excavators of discoid blade (with corresponding instrument formulas). A, Binangle spoon (13-7-14). B, Triple-angle spoon (13-7-14).

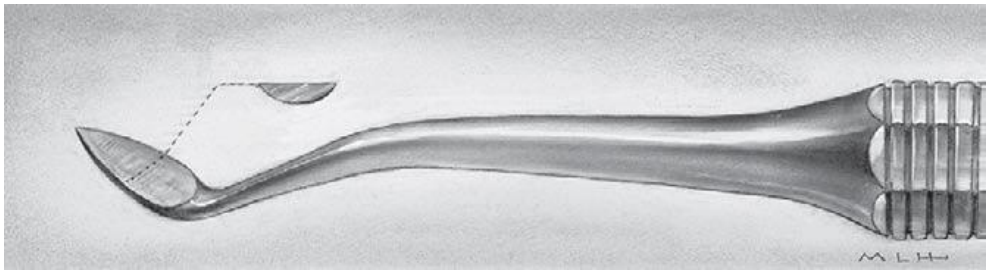

Figure 7: Cleoid blade spoon.

❖ Hand instrument grasping

1. Pen grasp: - as implies, it is similar to that used in holding a pen. Pads of the thumb, index and middle fingers hold the instrument, while the tip of the ring finger, or tips of ring and little fingers, is placed on a nearby tooth surface of the same arch as arrest. The palm of the hard generally is facing away from the operator. (Fig 8, B).

2. Inverted pen grasp: - the finger position are the same as of pen grasp, but the hand is rotated so that the palm more toward the operator. This grasping is used mostly for preparing of upper teeth with indirect viewing technique. (Fig 8, C).

3. Palm and thumb grasp: - the handle of the instrument is placed in the palm of the hand and grasped by all fingers, while the thumb is free of the

instrument and used for resting on a nearby tooth of the same arch (Fig 8, D).

* A proper instrument grasp must include a firm rest to steady the hand during operating procedures. The closer the rest areas are to the operating area, the more reliable they are.

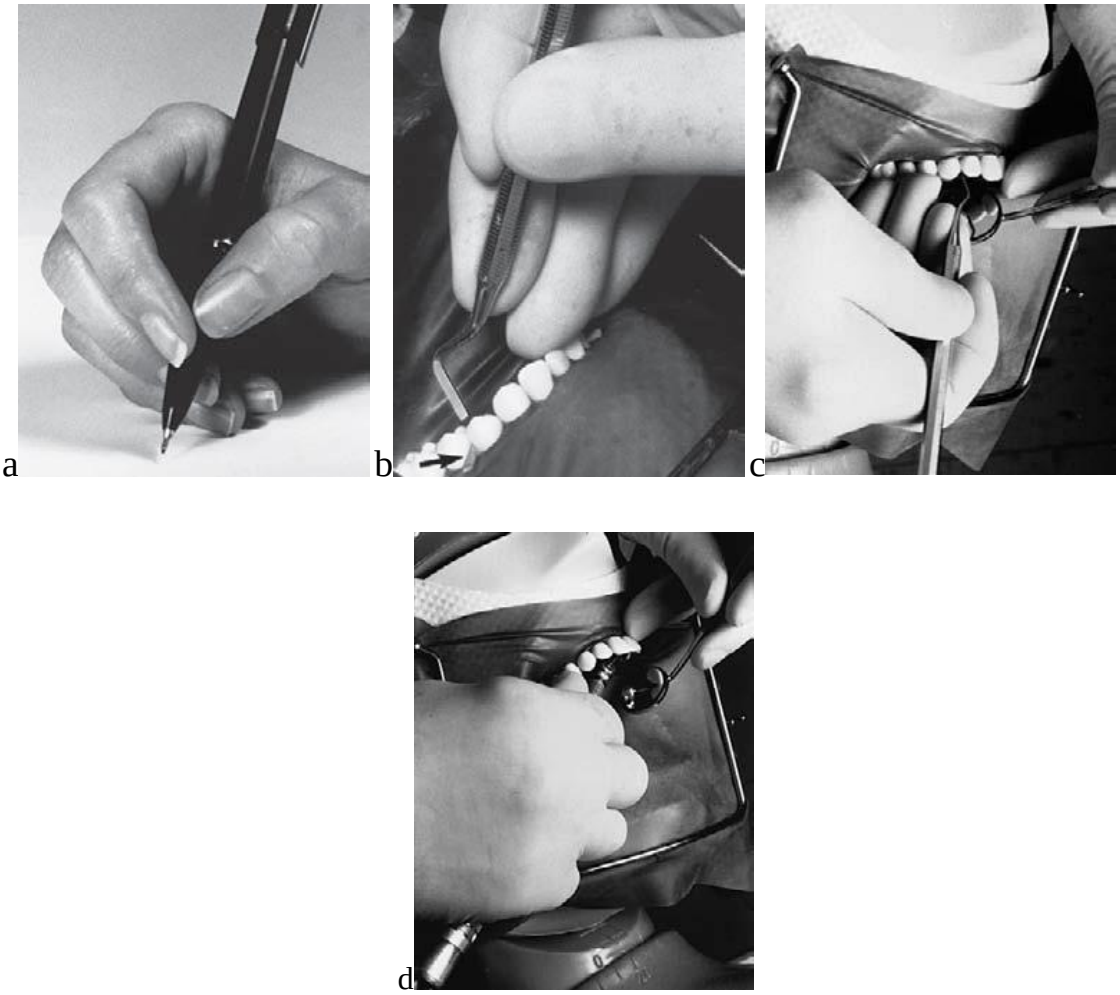

Figure .(8): Instrument grasping A, grasping of ordinary pen. B, pen grasping of hand instrument with correct position of middle finger is near the "topside" of the instrument for good control and cutting pressure. The rest is tip(s) of ring finger (ring and little fingers) on tooth (teeth) of same arch. C, Inverted pen grasp, palm faces more toward operator. D, Palm-and-thumb grasp. This grasp has limited use, such as preparing incisal retention in a Class III preparation on a maxillary incisor. The rest is tip of thumb on tooth in same arch.

Non cutting instruments: In these instruments the blade is replaced by a nib or point. These are divided according to function into:

I. Diagnostic instruments:-

These are basic instruments that will be needed during each appointment for diagnosis and treatment (Fig. 9), including:

1- Mirror:- used for indirect visualization of any tooth surface that cannot be seen by the eye, also reflection of light into the area being examined or treated. The mirror also served as a retractor of soft tissue (tongue, cheek and lip) to aid access and visualization.

2- Probe or explorer:- pointed instruments used to feel tooth surface for irregularities and to determine the hardness of exposed dentin and caries detection. Probes have different shapes either sickle; straight or angled as appear in Fig. (9).

3- Tweezer or cotton forceps:- used for aiding the operator to carrying small items to the mouth of the patient.

Figure (9): Diagnostic instruments.

II. Plastic instruments:

Or plastic filling instrument are used to carry and shape tooth colored restorative material such as composite resin and glass ionomer, or for packing temporary filling material inside unfilled cavity preparation, or for placing of basing and lining material into the cavities. In past these instruments are made of plastic, but now are available in either hard plastic or metal.

- Ash 6 is one of plastic instrument similar to carver but the margin of its working end is not sharp.

- Ash 49 is double ended instrument with cylindrical nibs and rounded ends .

- Dycal applicator is small hand instrument with small round nib used for mixing and placing dycal lining material in the cavity.

- Cement spatula: - it is used for mixing variety of material which required mixing (such as cement or temporary filling material) on glass or on a paper pad.

III. Amalgam instruments:

Those instruments used to place dental amalgam, and to a certain extent, resin composite restorative material.

1- Condensers:- condensers are used to compress the amalgam into all areas of the prepared cavity. The working end or nib of the condenser is usually round with flat end (face), but also the nibs may have different shapes as triangular, rectangular or diamond shape ends. Condenser may also be used to place resin composite material by pushing or patting into the prepared cavity.

2- Burnisher:- burnishers have different nib shapes which may be round , oval or rounded cone shapes, also with different sizes. Burnishers are used for several functions such as; burnishing of the amalgam on the margins of the cavity, and also smoothing of the carved amalgam surface. Burnishers also used for shaping metal matrix band to have more desirable contours for restoration. Other uses of the burnishers are to bend cast gold restoration (inlay or onlay) near the margin of the prepared cavity to narrow the gap between gold and the tooth.

3-Carver:- carvers are used to shape amalgam or resin composites (tooth colored) material after they have been placed in the tooth preparations. Carvers have many shapes but usually the nibs are flat with sharp margins for carving.

4- Amalgam carrier:- used to carry the amalgam and place into the prepared cavities.

Rotary instruments:

Handpieces:

Two basic types of handpieces, the straight handpiece and contra angle handpiece. The straight is used more frequently for laboratory work, while contra angle used in the mouth. The contra - angle handpiece are classified according to their speed of rotation into:

Low speed handpiece:- these handpiece have atypical free running speed range from 500 to 15,000 rpm (revolution per minute).

Low speed contra - angle handpiece, with round bur rotating slowly, are used for removal of carious dentin. Also low speed handpiece may be used with different bur shapes to finish the prepared cavity (e.g. rounding of sharp edges, or flatting of the floor), and used in finishing and polishing of restorations Fig (10 A).

High speed handpiece: - have a free running speed above 160,000 rpm and some have speed up to 500,000 rpm.

High speed techniques are generally preferred for cutting enamel and dentin. Penetration through enamel and extension of the cavities outline are more efficient at high speed. Small diameter burs should be used in the high speed handpiece. High speed generates considerable heat during cutting, even with small diameter burs and should be used with water coolant and high efficiency evacuation Fig (10 B).

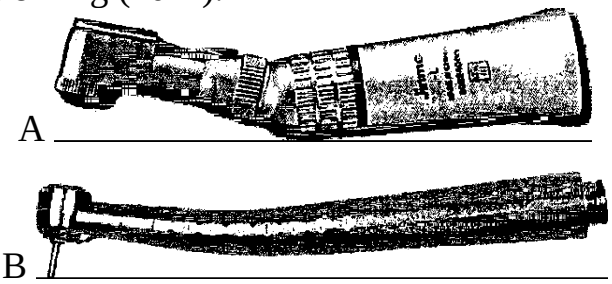

Figure (10): Contra-angle handpieces,A low speed, B high speed handpiece.

Burs:

A group of instruments that can turn on an axis with different speed of rotation to perform different types of work. The characteristics of this work are either cutting , abrasive, finishing or polishing.

Burs used for cutting are manufactured from different materials, which may be stainless steel, carbide or diamond. Each bur consist of three parts: shank, neck, and head (Fig. 11). Shank is the part that fit into the handpiece, accepts the rotation motion from handpiece, and which the bur is locked inside the

handpiece head. Neck is the part of the bur that connects the head to the shank. Head is the working part of the bur which contains the cutting edges or points, and burs are classified according to the shapes of their heads.
The burs have hundreds of shapes and sizes. The basic bur shapes are round, inverted cone or fissure burs. Fig. (12).
Round bur: the head is spherical so it is used for initial entry into the tooth, preparation of retentive holes or for removal of carious dentin.
Inverted cone bur: the head is a cone - shape with the apex of cone directed toward the bur shank. This bur is used for flatting the floor of the cavity, increasing the depth of cavity or for providing undercuts in cavities preparation.
Fissure bur: - is an elongated cylindrical head bur used for obtaining the outline form of the cavity and to cut walls, floor, or margins of the cavity, we have straight and tapered fissure burs.

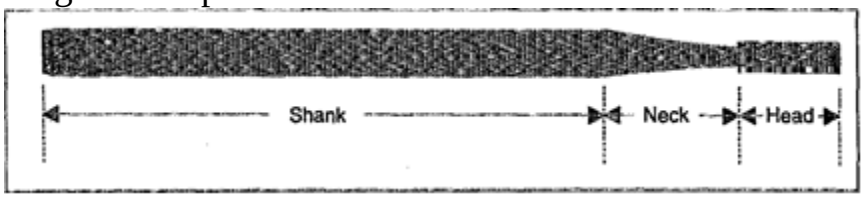

Figure (11): Normal designation of three parts of rotary cutting instruments.

Figure(12): Basic bur head shapes.