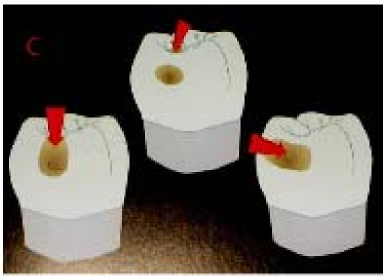
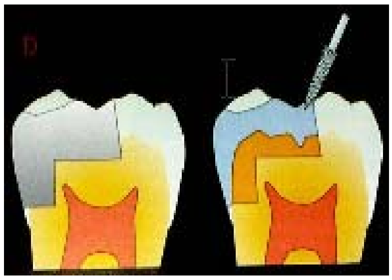
MANUAL FOR OPERATIVE DENTISTRY





Dr.Shawfekar
BDS, BEd, MSc, MDS
Kulliyyah of Dentistry
IIUM
Malaysia.

CONTENTS

Other abrasive instruments.

Cutting recommendations.

Hazards with cutting instruments.

1. Introduction to the Operating Technique

Operative dentistry is the art and science of the diagnosis, treatment, and prognosis of defects of teeth that do not require full coverage restorations for correction. Such treatment should result in the restoration of proper tooth form, function, and aesthetics, while maintaining the physiologic integrity of the teeth in harmonious relationship with the adjacent hard and soft tissues, all of which should enhance the general health and welfare of the patient. Although operative dentistry once was considered the entirety of the clinical practice of dentistry, today many of the areas previously included under operative dentistry have become specialty areas. As information increased and the need for other complex treatments was recognized, areas such as endodontics, prosthodontics, and orthodontics became dental specialties. Operative dentistry is still recognized, however, as the foundation of dentistry and the base from which most other aspects of dentistry evolved. There are three main operative technique, such as direct techniques, semi direct techniques, and indirect techniques.

Classification of techniques and restorative strategies

Esthetic restorative technique for teeth can be categorized into three groups; the direct techniques consist only of intraoral procedures requiring a single appointment, the semidirect techniques include intraoral as well as extraoral steps to produce luted chairside restorations, and as opposed to the indirect techniques, which require several appointments and the collaboration of dental laboratory.

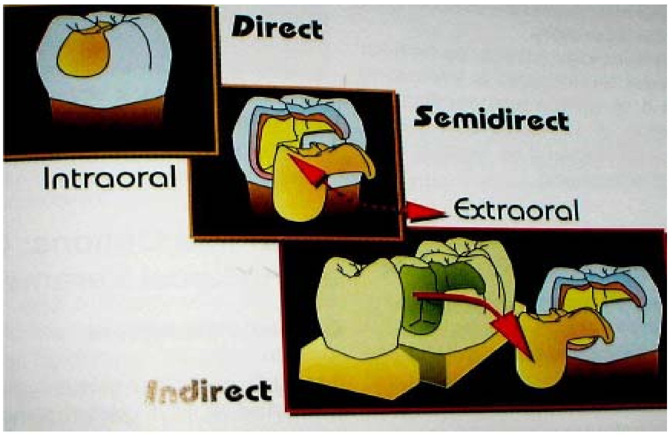


Fig-1.1 Three main restorative techniques

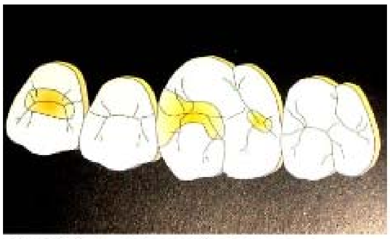


Fig-1.2 A Direct technique.


Fig-1.2B Preoperative tooth.


Fig-1.2C Prepared Cavity.


Fig-1.2D Postoperative tooth

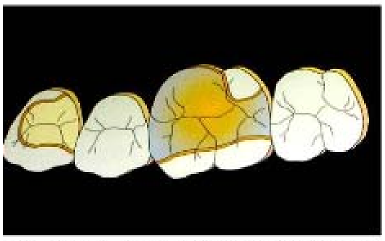


Fig-1.3 A Semidirect Technique


Fig-1.3B Preoperative tooth.


Fig-1.3C Luted model.


Fig-1.3D Postoperative tooth.

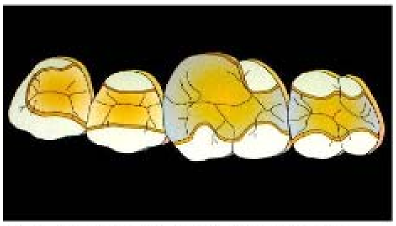


Fig-1.4A Indirect Technique


Fig-1.4B Preoperative tooth.

Fig-1.4C Model with Inlay/Onlay

Fig-1.4D Postoperative tooth.

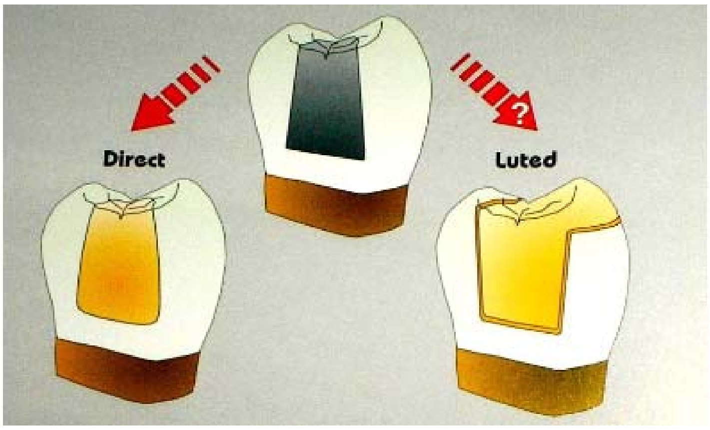


Fig-1.5 Due to particular anatomy, premolars require special attention in case of large amalgam replacements. Modification of the conventional preparation for a luted restoration.

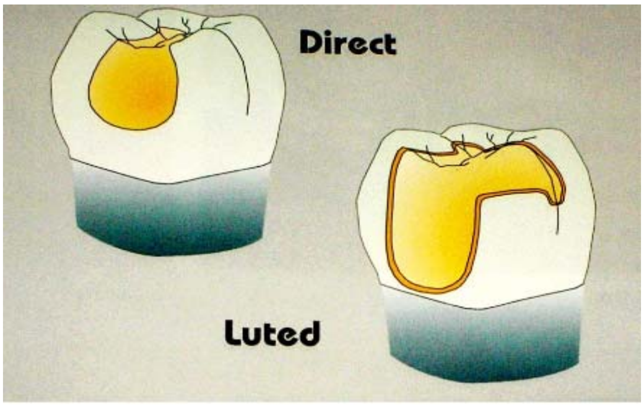


Fig-1.6 For small restorations with thick gingival enamel, direct restorative techniques are indicated. For large preparation with thin gingival enamel (less than 1 mm in thickness and height), a luted restoration (semidirected or indirect) is indicated.


Fig-1.7 A Preoperative View.


Fig-1.7 B View of working model.


Fig-1.8Composite inlays, PFM crowns.


Fig-1.7C Postoperative View.


Fig-1.8A Preoperative View.


Fig-1.8 B Preoperative radiograph.


Fig-1.8C Restorated with PFC.


Fig-1.8D Postoperative radiograph.

Tooth preparation

Optimal adhesion can be obtained by micromechanical retention to enamel rods, acid etched perpendicularly to their long axes. The bevelling of enamel margin is therefore a prerequisite for any direct adhesive technique, which can never fully compensate for composite resin polymerization shrinkage. This basic concept remains valid for new restorative techniques (Fig-1.9).

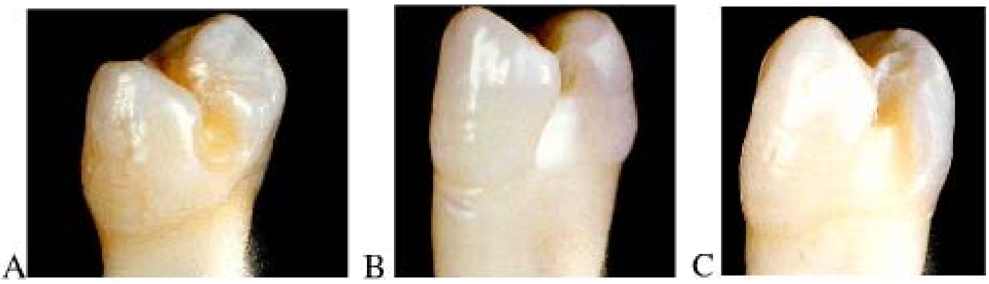


Fig-1.9 (A)Typical example of an adhesive preparation with thick enamel margins bevelled, (B) SEM view of the transitional line between the bottom of the cavity and the bevel, (C) At a higher magnification, it appears that prisms are exposed mainly perpendicular to their long axes on the bevel, which provides a more efficient bond to acid-etched enamel.

Tooth preparation for direct techniques

A distinction should be made between the treatment of decayed but unrestored teeth and the replacement of existing restorations; Preparation for preventive restorations; for superficial fissure caries, decayed tissue may be removed by selective ameloplasty. This is the most conservative approach for limited decay on posterior teeth (fig-1.10A). For direct adhesive fillings, the conventional geometry of Black cavities is not optimal. Lutz and co-workers described the adhesive preparation as consisting of a conservative round or ovid proximal box and occlusal extensions, including bevelling of enamel margins (Fig-1.10B).

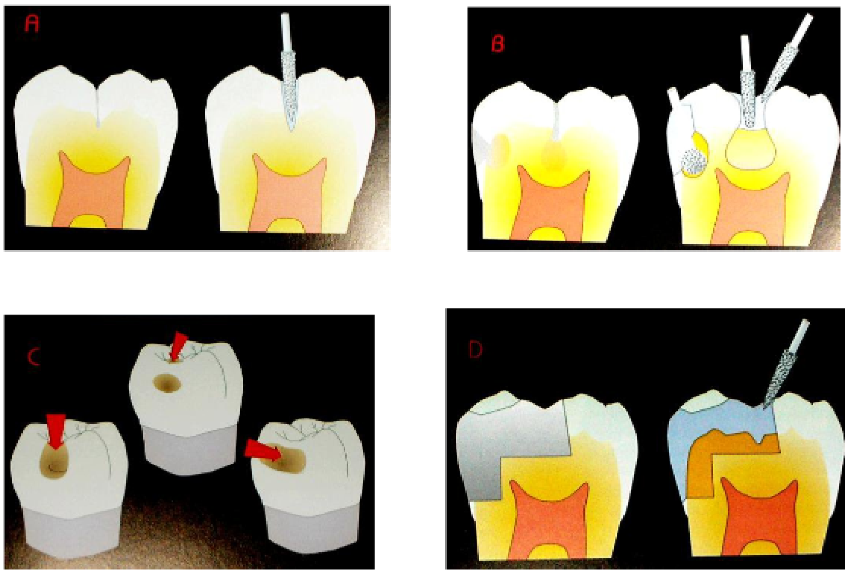


Fig-1.10 Different preparation designs for direct techniques.

(A) Preventive preparation

(B) More deeply preparation. All sound structures are maintained so that the general cavity design is ovid with some area of unsupported enamel.

(C) Buccolingual preparation

(D) For replacement of existing metallic restorations, the modification of the cavity design in preparation for an adhesive technique requires the bevelling of all margins. This is the bevelled conventional preparation

Tooth preparation for semi- or indirect technique.

Semidirect and indirect (luted) restorations require tapered cavities, usually with butt margins. Internal undercuts should be filling with a base material to avoid destructive preparations. Here also, rounded internal and external lines are preferred (Fig-1.11). This design improves more accurate ceramic inlays / onlays (Fig-1.12).

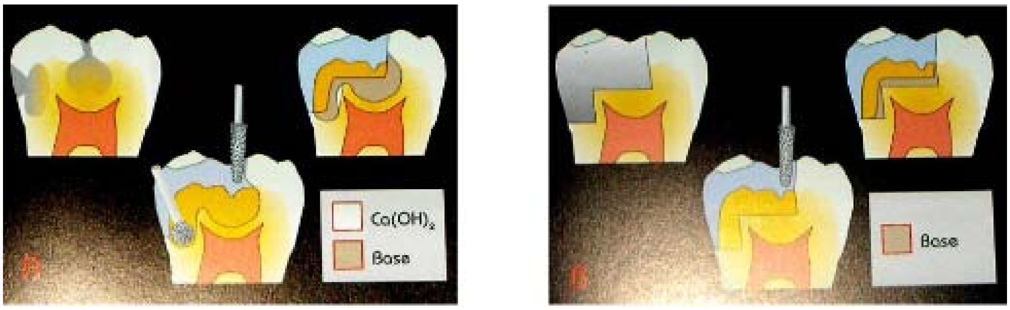


Fig-1.11 Different preparation designs for luted adhesive restorations.

(A) Severe carious lesions preparation,

(B) Preparation for replacement of large existing restorations.

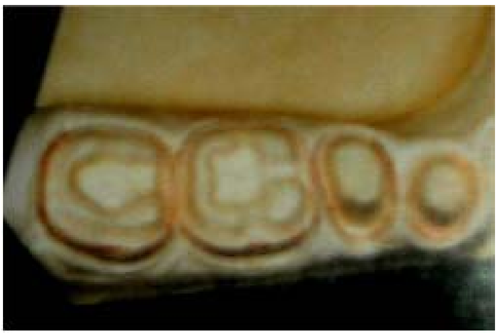


Fig-1.12A Ceramic overlays model.

Fig-1.12 B fitting restorations.

Fig-1.13A Ceramic inlays preparation

Fig-1.13B. After 15 years.

Fig-1.14 A Overlay margin on molars

B. Finishing design

Fig-1.14 C Full crown preparation.

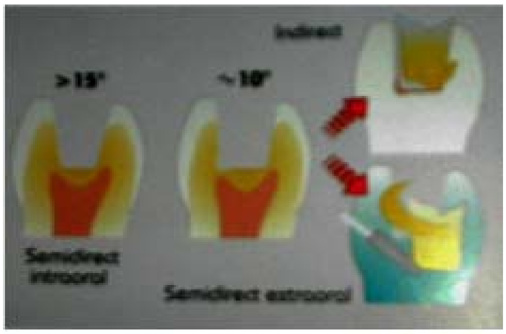


Fig-1.15 Semidirect intraoral more taper

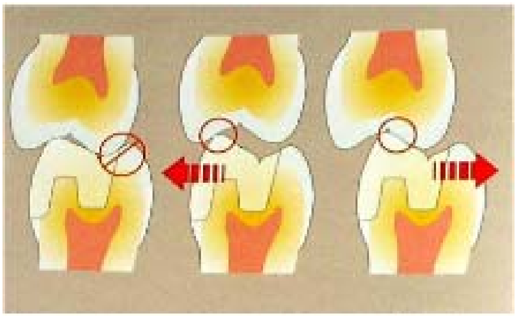


Fig-1.16A Occlusal contacts.

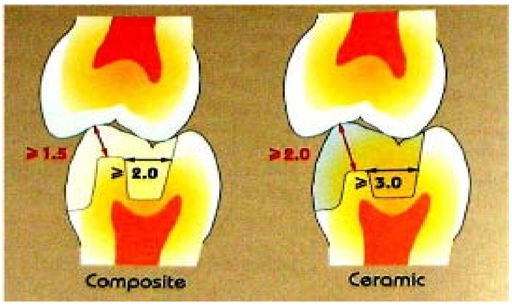


Fig-1.16 B Minimal thickness and width.

Fig-1.16C Minimum width, proximal contact.

Direct Techniques

There are many direct filling techniques, including simple one, like the "bulk" restoration, and more sophisticated one, like „three-sited light-curing technique. Direct techniques are generally indicated for preventive, small to medium size restoration (Fig-1.17). The choice of filling method is based on the size and volume of the preparation.

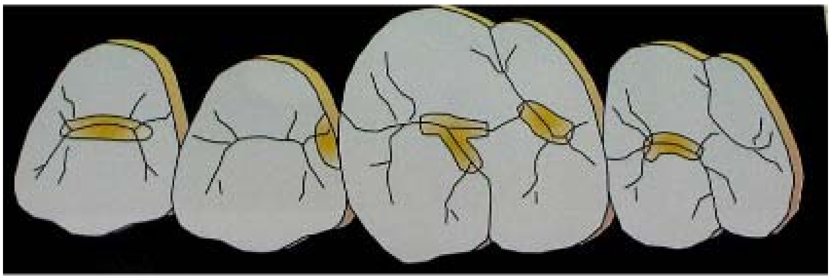


Fig-1.17A Preventive restoration

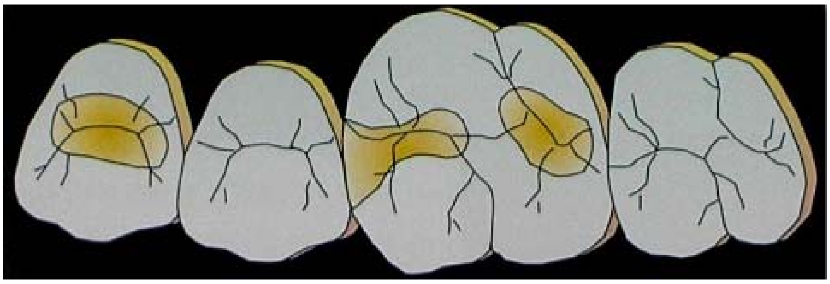


Fig-1.17 B Small Class I and Class II restoration

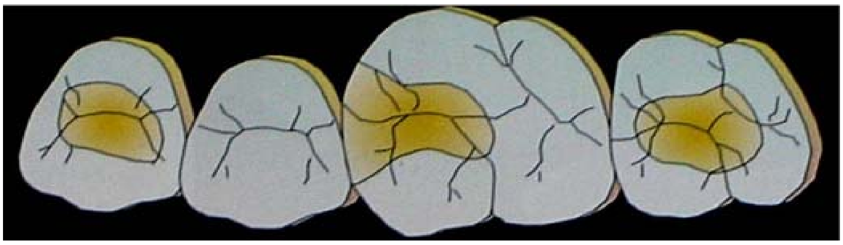


Fig-1.17C Medium Class I and Class II restoration

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Preventive restoration: a single application of composite and subsequent polymerization may be performed (bulk technique) (Fig-1.18 to Fig-1.20)

Fig-1.18 The bulk technique is indicated only when the cavity volume is minimal.

Fig-1.19 A Initial carious lesions involving the occlusal grooves of posterior mandibular teeth and distal surface of the tooth.

Fig-1.19 B Very conservative preparation were made.

Fig-1.19C Restored in the simplest manner, with a bulk of composite.

Fig-1.19 A Superficial proximal carious lesion

Fig-1.20B Prepared the cavity. with a bulk technique.

Fig-1.20 C Restored with composite

Small class I and class II restoration: for such preparation, a multilayer technique is advocated and conventional horizontal layering should be carried out (Fig-1.21 to Fig-1.22). For class II cavities, this technique is based on the used of conventional metallic matrix, which improves polymerization by light reflection (Fig-1.23). Tunnel restorations (Fig-1.24) are appropriate only for very superficial lesions in which decayed tissues can be completely removed without excessive weakening of the occlusal ridge. An adhesive restoration will bond to all cavity walls, including the tunnel, currently appears to be the best restoration option.

Fig-1.21Horizontal layering is to be applied in narrow but deeper cavities to compensate for composite resin.

Fig-1.22A Preoperative view of a failed composite restoration.

Fig-1.22 B The prepared cavity.

Fig-1.22 C Filled with horizontal composite increments.

Fig-1.22D Completed restoration

Fig-1.23 A Preoperative view of decayed first upper molar.

Fig-1.23B Prepared Cavity.

Fig-1.23 C Placed a clear plastic matrix band.

Fig-1.23 E Placed the bonding and Light-cure glass ionomer.

Fig-1.23 F Remaining cavity volume was filled.

Fig-1.23G Filled last increment.

Fig-1.23H Internal characterization was applied to give the restoration a more natural appearance.

Fig-1.23 I Final view of restoration.

Fig-1.24 A Preoperative radiograph of amalgam restoration.

Fig-1.24 B Removed old amalgam filling and prepared canal.

Fig-1.24 C The neighbouring tooth bonding, was properly protected.

Fig-1.24 D Placed the etching,

Fig-1.24 E Filling with occlusal cavity with composite.

Fig-1.24 F Completed restoration.

Medium class I and Class II restoration: since horizontal layering can theoretically not fully compensate for polymerization shrinkage, medium size class II cavities should be restored using better performing techniques. In this situation, as far as direct techniques are concerned, the three-sited light-curing techniques should be provide optimal proximal adaptation and seal (Fig-1.25). The rationale of this technique is first to place a traditional glass-ionomer base to reduce the area to be filled with composite and than used an original multilayer method (Fig-1.26).

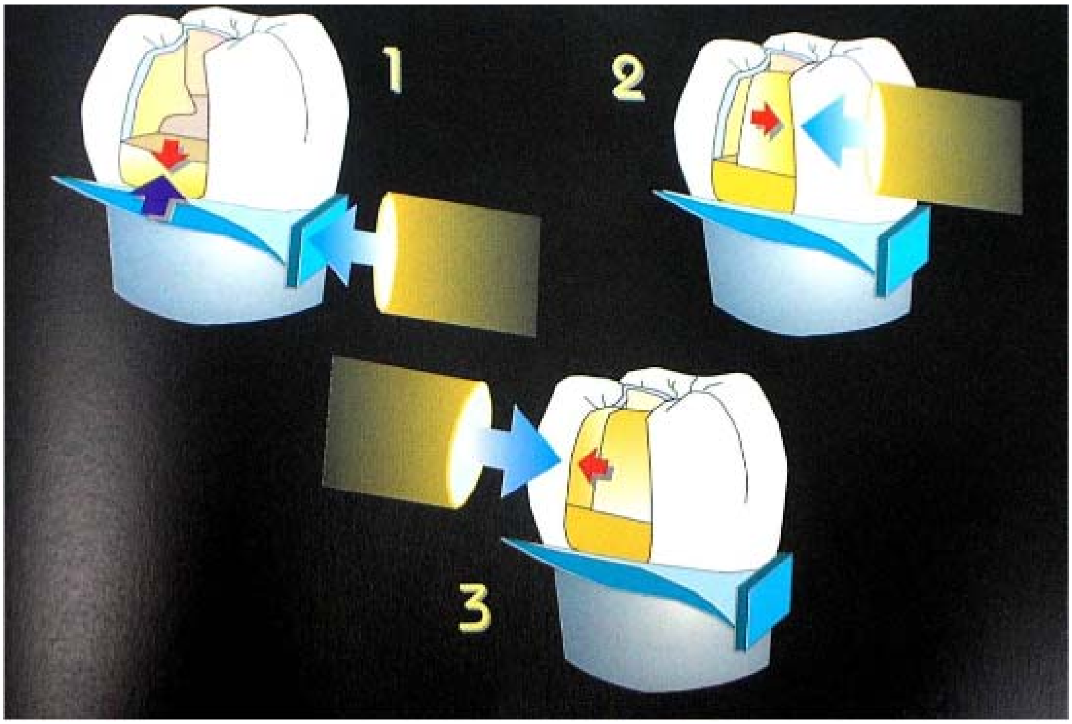


Fig-1.25 The three sited light-curing technique.

Fig-1.26 A Preoperative amalgam filled lower first molar.

Fig-1.26B A cavity is completed.

Fig-1.26C The clear matrix and translucent reflecting wedge was placed And the first composite layer was placed.

Fig-1.26D The second composite layer and then third composite layer was placed.

Fig-1.26 E Placed Composite occlusal part.

Fig-1.26 F The occlusal anatomy shape is given to the last increcement.

Fig-1.26G Postoperative view.

- The quality of contact point may be improved by using special instrument, such as the contact pro, designed to push the matrix efficiently against the neighbouring tooth (Fig-1.27).
- The use of polymerization tips (fig-1.28) or ceramic inserts (Fig-1.29) has been proposed as an alternative technique for controlling polymerization shrinkage.
- Occlusally, when the cavity walls are weakened, the composite may be applied in oblique layers to be cured through the cusps (Fig-1.30 to Fig-1.31).
- A more natural appearance may be achieved through appropriate composite layering and by the application of intense colourings resins, on the restoration either surface or, preferably, under the last composite layer (Fig-1.32).
- A functional anatomy can also be obtained with specific modelling instruments (Fig-1.33). this final touch greatly facilitates occlusal adjustments and save precious chair side operating time.

Fig-1.27 A Clear plastic matrix

Fig-1.27B Matricing the tooth

Fig-1.27 C place the wedge

Fig-1.27C Completed restoration

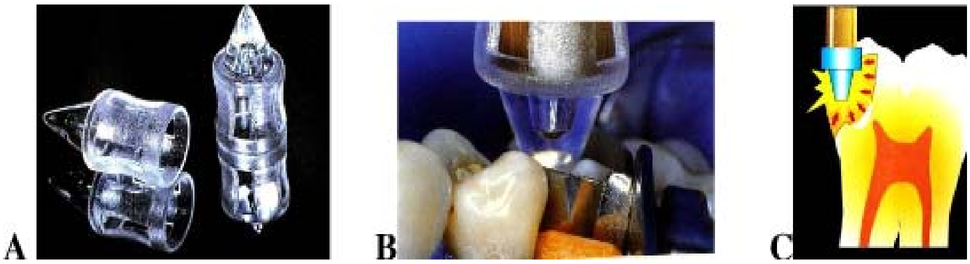


Fig-1.28 Polymerization tip placed on light-cure top and curing.

Fig-1.29 A Ceramic Inlay, B Placed inlay, C completed procedure

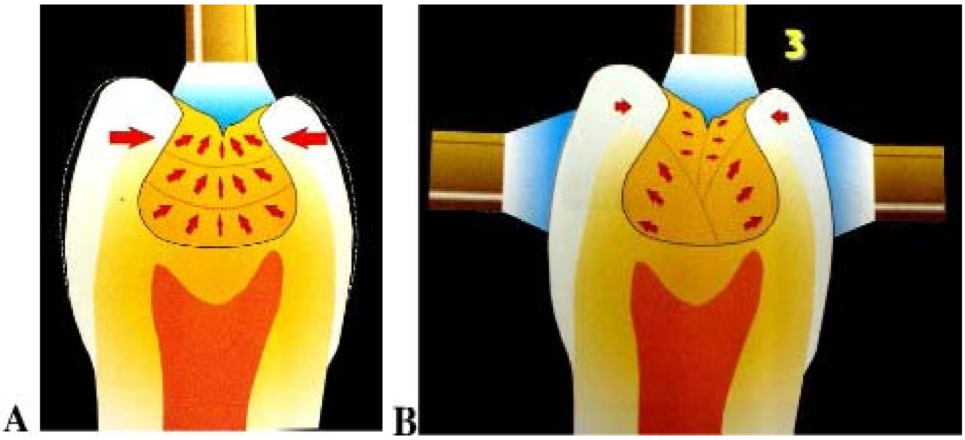


Fig-1.30 For medium class I cavities, horizontal layering is not ideal because of the tension that will be exerted on opposing walls (A),In this situation, marginal quality benefits from the use of an oblique incremental technique (B) (vectors of polymerization are indicated by arrows).

Fig-1.31 A Old filling to be replaced.

Fig-1.31B Prepared Cavity.

Fig-1.31C Placing Composite

Fig-1.31D Placing Composite.

Fig-1.31E Colored liquid resin.

Fig-1.31 F Restore anatomy occlusal

Fig-1.31 G Brushing the tooth.

Fig-1.31 H Completed restoration.

Fig-1.32 Composite layer.

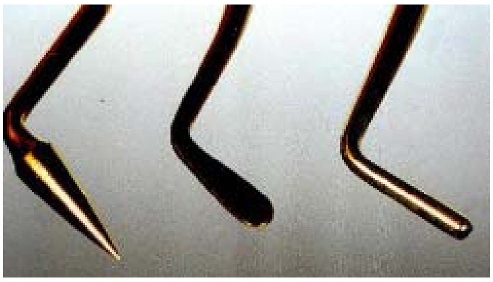


Fig-1.33 specific modelling instruments

Semidirect Techniques

When cavity dimensions or extension toward the cementoenamel junction contraindicates a direct filling method number of teeth are concerned at the same time semidirect techniques are best indicated (Fig-1.34). The semidirect approach is providing the patient with luted restorations without the cost of indirect lab-made inlays or onlays (Fig-1.35 to 1.36). Actually, as already stated, adequate proximal contours and contacts of direct class II restoration may be particularly difficult to achieve (Fig-1.37), to improve the quality of large class I and II restorations, can be performed chairside with intra-, and extraoral steps, during a single appointment. The composite or ceramic restorations fabricated are to be luted exclusively with an adhesive technique.

Intraoral Composite Inlays

The inlay is made by placing one or two composite increments inside the insulated and coffered cavity (Fig-1.38). After in-mouth polymerization, the inlay can be removed, showing that the cavity has been properly tapered and is free of any undercut. For MOD or complex cavities, should be use another semitechnique (Fig-1.39). Actually, the microretentions created by coarse diamonds may be sufficient to lock the restoration inside the cavity (Fig-1.40).

The technique should be applied mainly to one- and two-surface restorations.

There should be sufficient preparation taper.

The general design should be even.

The preparation walls should be smooth.

A proper insulation medium should be used.

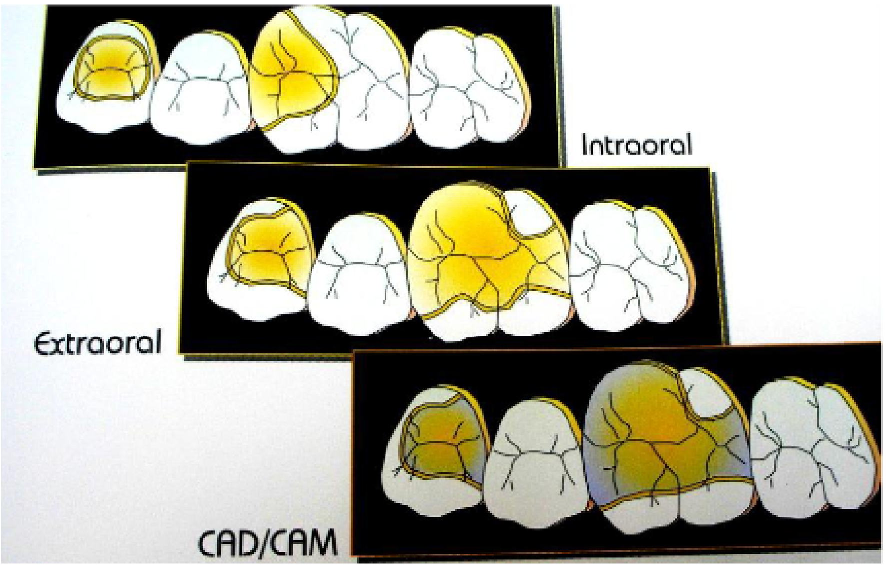


Fig-1.34 General indications for semidirect techniques.

Fig-1.35 A Preoperative Radiograph showing carious lesions.

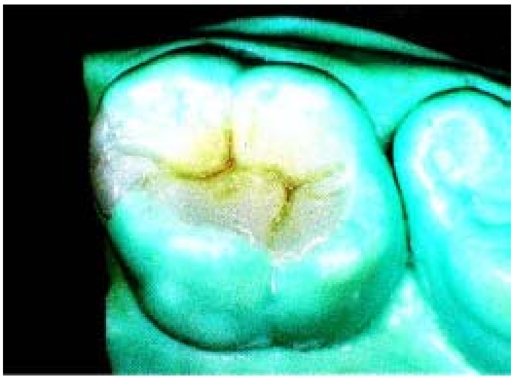


Fig-1.35B Decayed Tooth.

Fig-1.35 C Restoration done.

Fig-1.36 A large carried tooth.

Fig-1.36B Restoration completed.

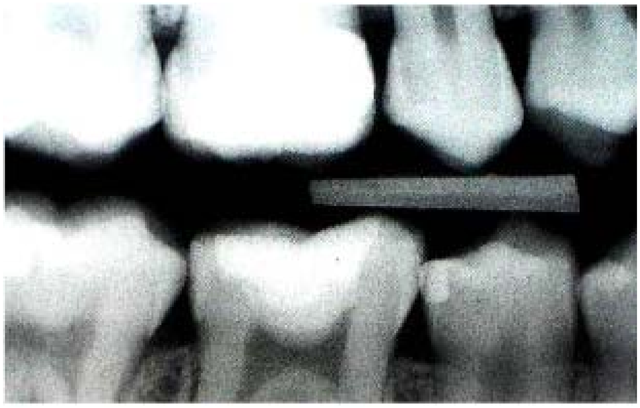


Fig-1.36 C After 1 year Postoperative Radiograph.

Fig-1.37 The absence of distoproximal contact is evident after completion of the composite restoration on the second premolar. This demonstrates a common problem encountered with direct filling methods, especially when plastic matrices are used.

Fig-1.38A Severely decayed tooth.

Fig-1.38B Prepared cavity.

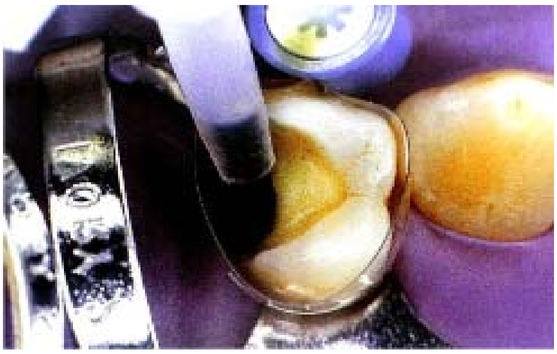


Fig-1.38C Coffered and insulated.

Fig-1.38D Built-up restoration

Fig-1.38E completed anatomical shape.

Fig-1.38F Inlay is taken out for postcuring.

Fig-1.38 G Cemented Inlay.

Fig-1.38 H Completed Inlay

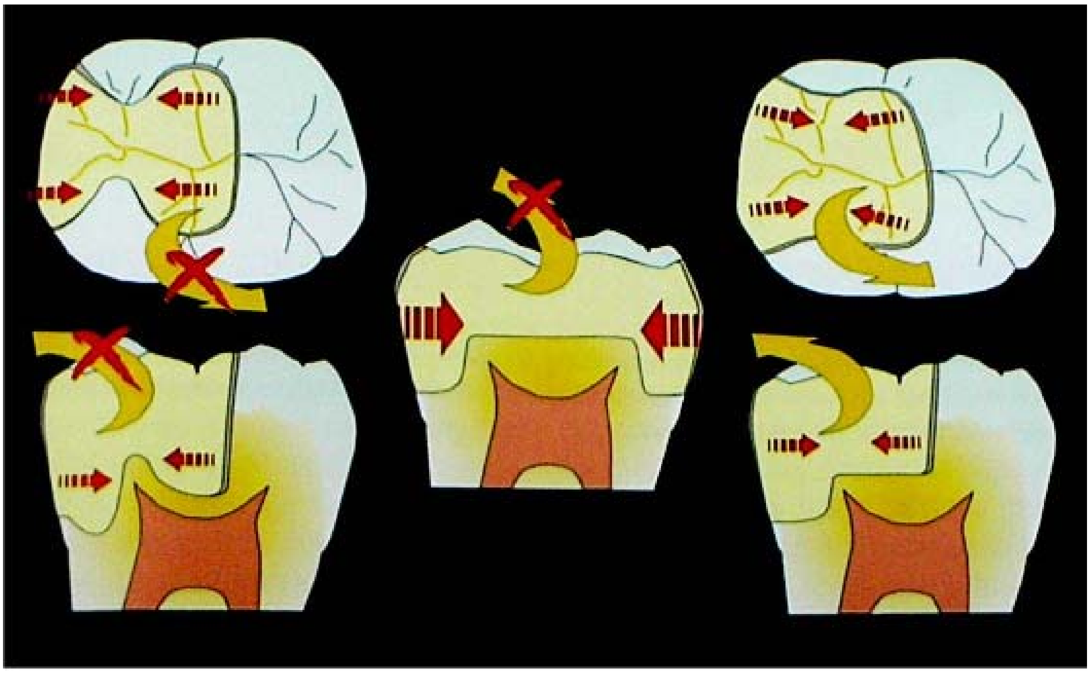


Fig-1.39 General design of preparations for intraoral semidirect techniques.

Fig-1.40A Decayed molar tooth.

Fig-1.40B Cavity is insulated.

Fig-1.40 C Filled with composite.

Fig-1.40 C Eliminated filling.

Extraoral Composite Inlays / Onlays

The interesting feature of this approach (Fig-1.41) is the extemporaneous fabrication of the inlay / onlay over a model, extraorally. The use of a simple alginate or, ideally, of a condensation silicone for making the impression is highly recommended (Fig-1.42). compared to semidirect intraoral restorations, those made extraorally exhibit generally enhanced esthetic potential and anatomy, thanks to application of better performing and sophisticated layering (Fig-1.43). CAD / CAM (computer Aid Design / Computer Aid Manufacturer) restoration require very specific procedures.

Before cementation, the semidirect composite restorations are preferably subjected to a photothermic treatment (postcuring process) in a special oven (Fig-1.44). This procedure allows the optimal resin conversion rate to be reached in a few minutes, ensuring dimensional stability (Fig-1.45).

For both intra- and extraoral techniques, occlusion is preferably checked before postcuring and adhesive cementation (Fig-1.46). Actually, if necessary, occlusal anatomy and proximal contacts may be adjusted and reshaped extraorally.

For economic reasons, indications for extraoral composite restorations may sometimes extend to more complex cases, provided the practitioner‟s skill and experience make it sensible (Fig-1.47).

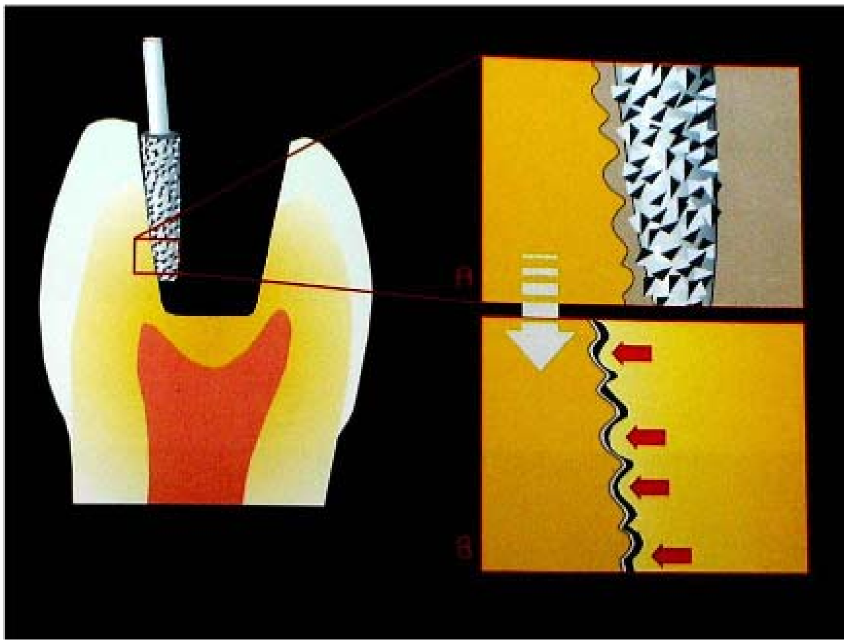


Fig-1.41 Special attention should be paid to preparation finishing. Microretentions created by coarse diamond burs (A) may be sufficient to impede the removal of intraorally made inlays, despite the use of a separating medium (B).

Fig-1.42A Preoperative View.

Fig-1.42B Prepared Cavity.

Fig-1.42C Model is separated.

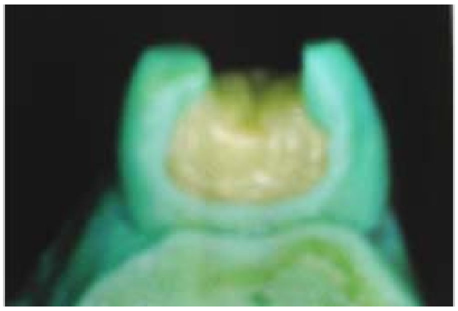


Fig-1.42D Dentin shade is placed.

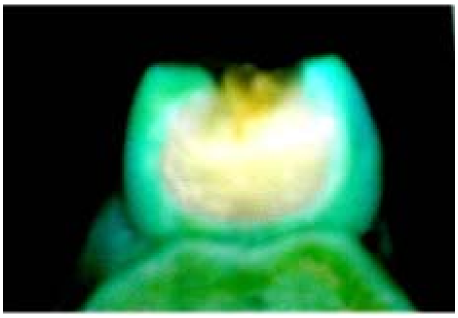


Fig-1.42E Enalmel,incisal layers are subsequently deposited.

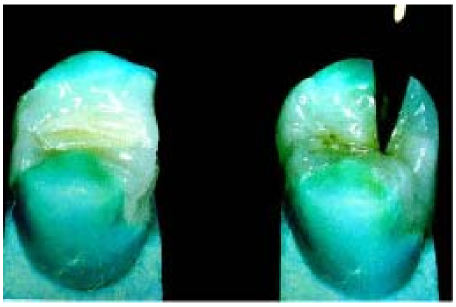


Fig-1.42 F Completed restoration on the working models.

Fig-1.42G Precementation inlays.

Fig-1.42H Cementing.

Fig-1.42I Postoperative anatomy view.

Fig-43A Special silicon die on working model.

Fig-1.43B Restoration shapes is completed.

Fig-1.43C Finalizes the restoration.

Fig-1.44 Composite inlays.

Fig-1.45 Photothermal treatment

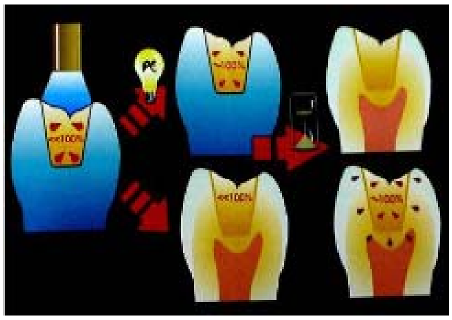


Fig-1.46 Postcuring process

Fig-1.47 Try-in of inlay to control accuracy.

Fig-1.48A Preoperative radiograph.

Fig-1.48B Decayed teeth.

Fig-1.48C Working model.

Fig-1.48D Finished restoration.

Fig-1.48E after 2 years view.

Indirect Techniques

Serial class II cavities or full coronal coverages cannot be properly restored using the techniques already reviewed, composite and ceramic indirect methods are best indicated for such cases (Fig-1.49). The choice between ceramic and composite as restorative materials has become increasingly complicated since composite materials have improved in their physicomechanical properties, wear resistance, and esthetic potential (Fig-1.50). For serial class II restorations without cusp coverage, indirect composite inlays seen preferable (Fig-1.51). There are several comparison parameters of clinical importance in evaluating both materials (Table-1).

Table-1 Comparison parameters of ceramics and composites.

Evaluation parameters	Ceramics	Composites
Convenience of clinical procedures	+	+ +
Practicability of laboratory procedures	+	+ + +
Repair potentiality and feasibility of In-mouth corrections	-	+ +
Esthetics: - short term	+ + +	+ + +
- long term	+ + +	++
Polishability	+ / -	++
Wear resistance of the restorative material	+ + +	++
- of the antagonists	+ + / -	+++
Elasticity module, brittleness	+	+ +
Coefficient of thermal expansion	+++	+
Efficiency of bonding procedures	+ +	+ +
Chemical stability	+++	+
Biocompatibity	+++	+ +
Clinical follow-up	+	+
Cost	-	+

(+ + +) = ideal; (+ +) = satisfactory; (+) = acceptable; (-) = unsatisfactory.

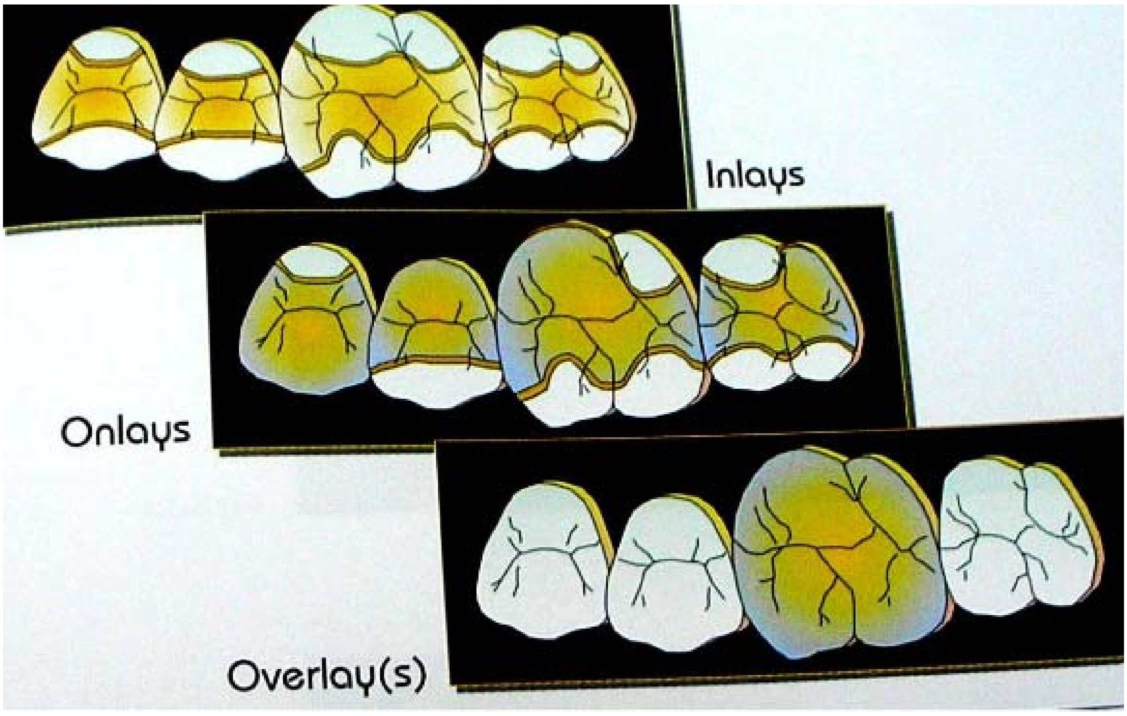


Fig-1.49 General indications for indirect techniques. These techniques are advocated for the treatment of serial inlays, onlays, and single or multiple overlays.

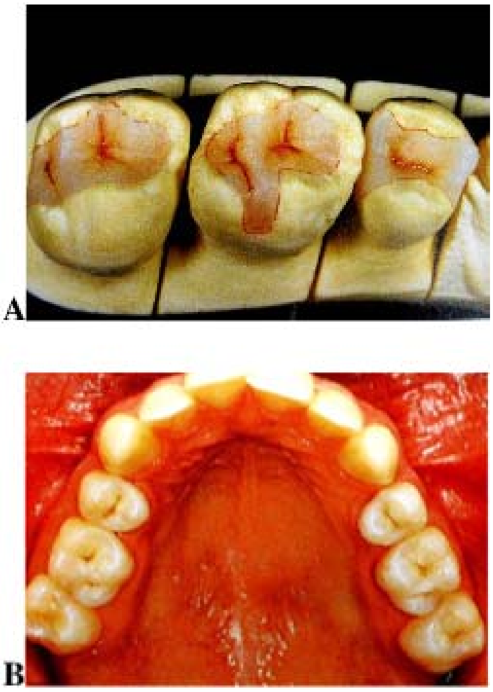


Fig-1.50 The esthetics potential of modern composite resin is incontestable. As shown on this working model, composite inlays now exhibit an appearance similar to those made of ceramic (A). View after two years restoration of clinical service was demonstrate the satisfactory behaviour of composite for indirect technique (B).

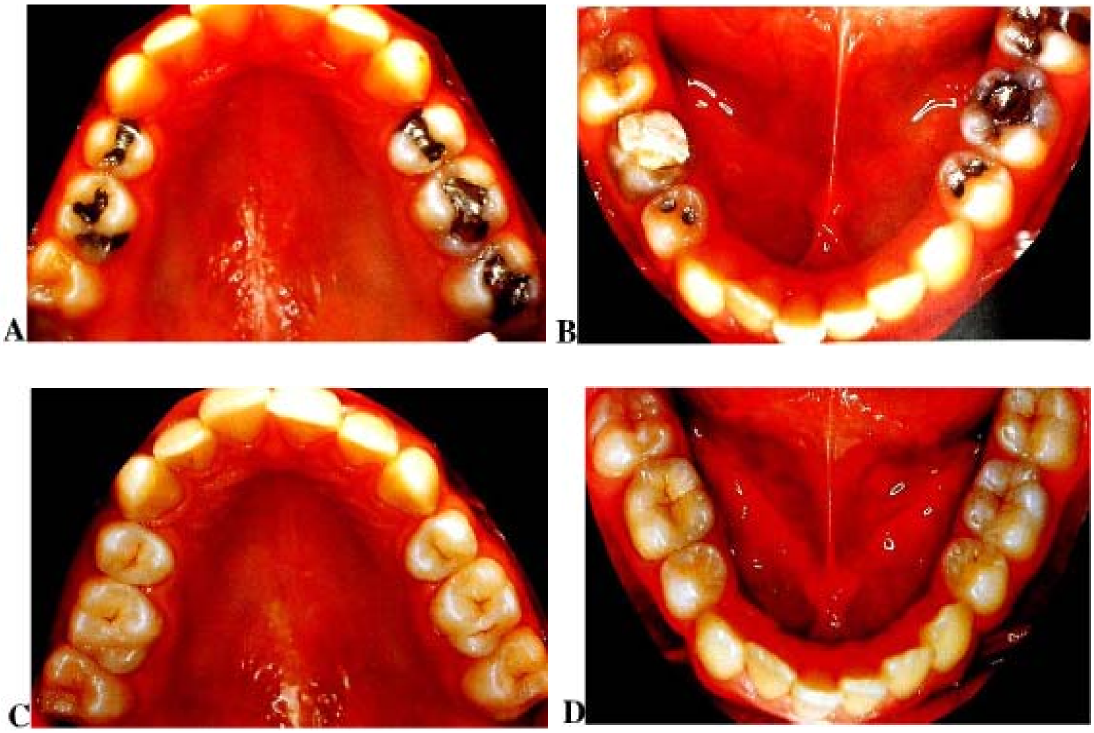


Fig-1.51 Preoperative views of a full mouth to be restored because of failed amalgam fillings and new interprocemal carious lesions (A-B) The completed composite inlays (C-D), but lower premolars were Restored using a direct method.

The use of ceramic can also be advised (Fig-1.52).bonded ceramic restoration exhibit more fractures (Fig-1.53) than composite restorations. The ceramic inlay is less apt to absorb functional strains and supposedly transmits more mechanical stresses to the adhesive interface than do the softer composite restorations (Fig-1.54). For large serial class II restorations including cusp coverage, the use of ceramic indirect inlays/onlays is favoured (Fig-1.55). in the particular case of total occlusal coverage in vital teeth with a short clinical crown, indirect ceramic restorations are also indicated (Fig-1.56). when enough supporting enamel remains, the bonded-to-tooth overlay is the last conservative approach before the conventional prosthetic solution (Fig-1.57).

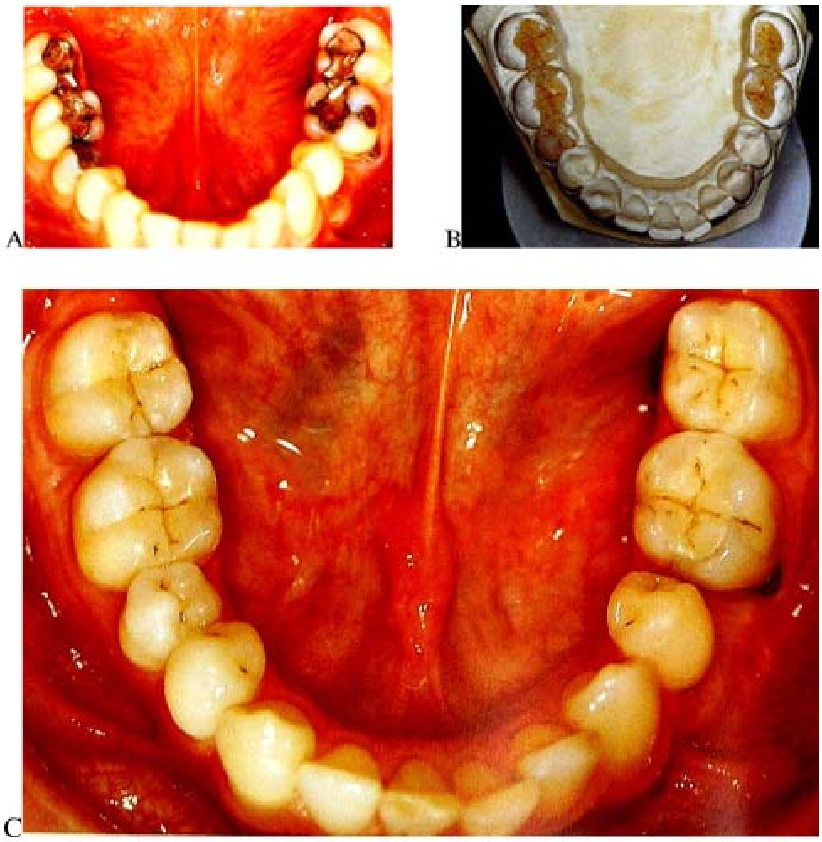


Fig-1.52 Ceramics are still considered appropriate for fabricating serial inlays, as indicated here for the replacement of failed amalgam filling (A). However, the softer and smoother materials, such as a low-fusing ceramics, were preferred in this particular configuration (B). Completed LFC inlays in mouth (C).

Fig-1.53 Typical example of a fractured inlay made with conventional fired ceramic. This frequent event drove researchers to develop stronger materials and consider more seriously the use of composite resin.

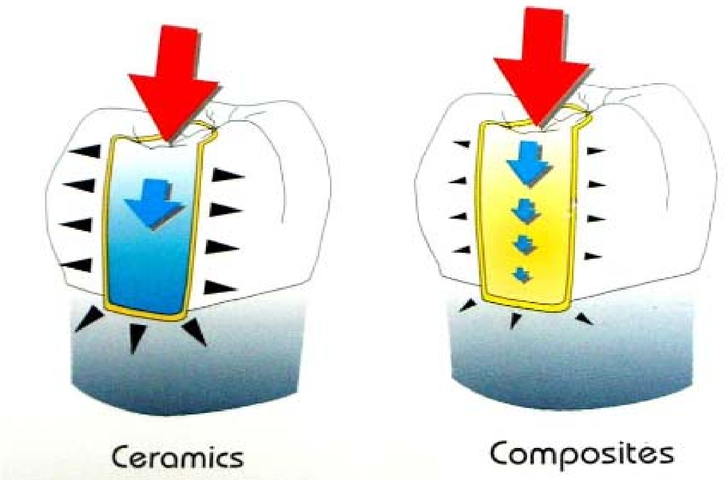


Fig-1.54 A theroretical concept that suspects the high rigidity of ceramics of having a negative influence on the marginal adaptation of intracoronal restorations. Actually, they seem less likely than composites to absorb functional stresses that are transmitted to the adhesive interfacesly than composites to absorb functional stresses that are transmitted to the adhesive interfaces.

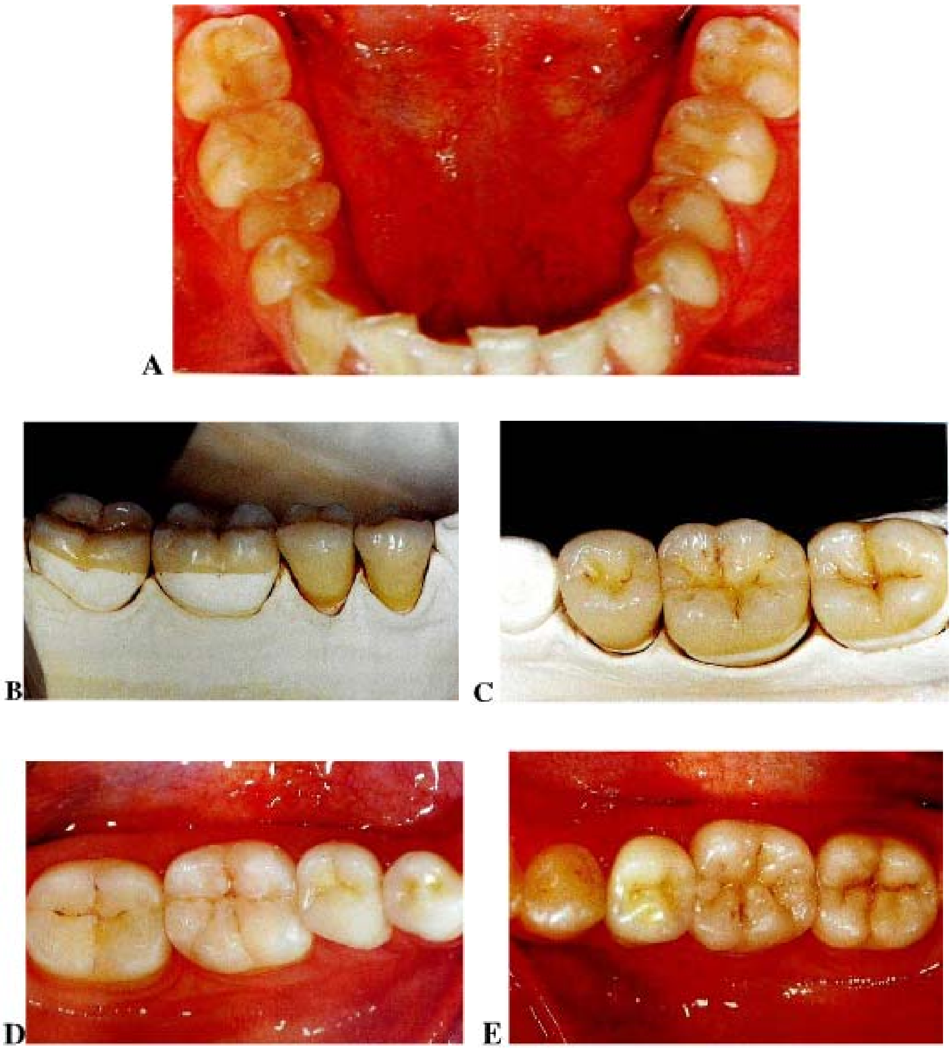


Fig-1.55 For very large restorations, such as serial onlays and overlays, the mechanical resistance of the restorative material is a primary consideration. To rebuild the posterior teeth (A), a high-strength material (In-Ceram; Vita) was used for fabricate crowns and bonded-to-tooth overlays (B-C), Postoperative view of the restored posterior teeth (D-E).

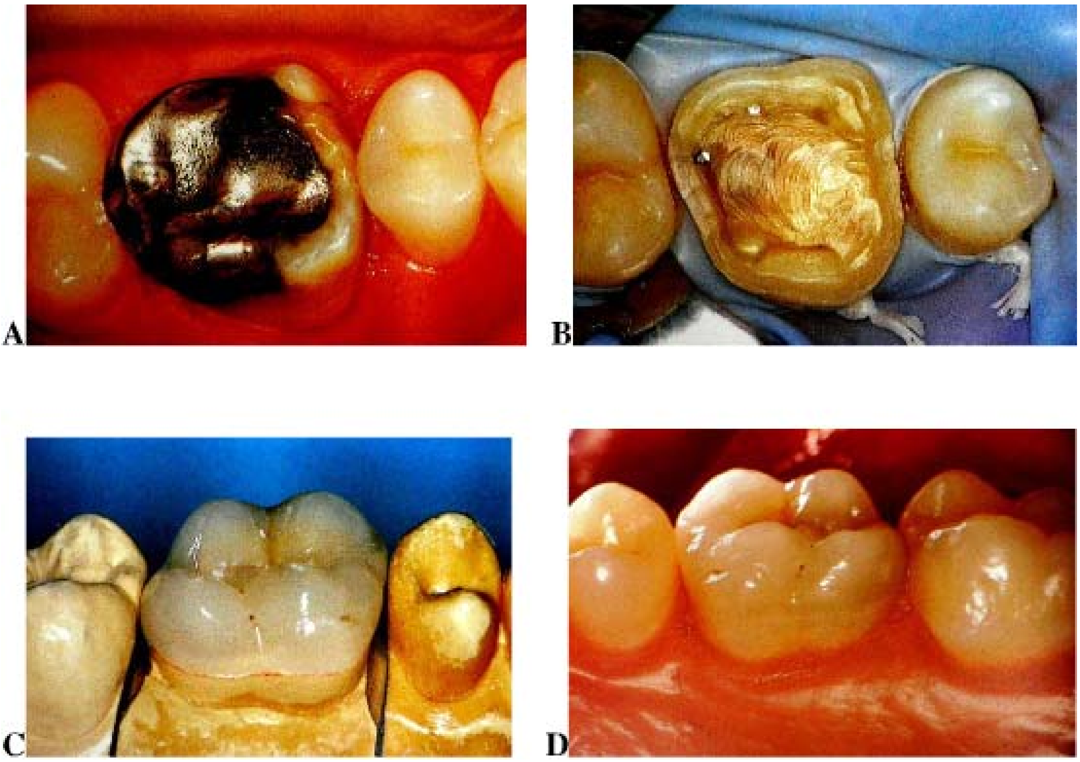


Fig-1.56 The restoration of a single tooth with a bonded ceramic overlay is a conservative option for extended decay (A) that would normally require a prosthetic solution. Tooth preparation shown that enough enamel is present on margins to provide ideal conditions for a fully bonded restoration (B). The ceramic overlay is presented on the working model (C). Final clinical view (D).

Fig-1.57 Comparison of a traditional and an adhesive prosthetic restoration. The advantage of the adhesive option regarding tissue conservation is evident.

Base lining for indirect restoration:

to prevent restoration fractures, some weak materials, such as calcium hydroxide cement, zinc-phosphate cements, and possibly even traditional type III glass ionomers, are contraindicated as a base or lining (Fig-1.58). The first choice materials for use as a base under indirect restorations are the compomers or restorative composites (Fig-1.59).

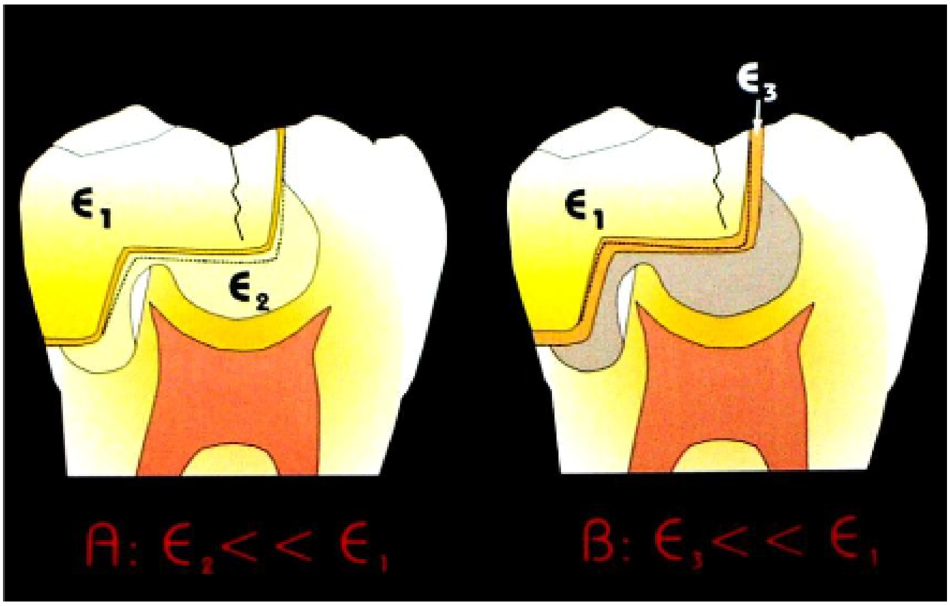


***Fig-1.58** Deformation of the restoration over insufficiently resistant bases should not be discounted as a possible cause of ceramic fracture. Considering the dentin as a reference for elastic behaviour and resistance to compression, only compomers and composite restorative materials should be used. E = elasticity module.*

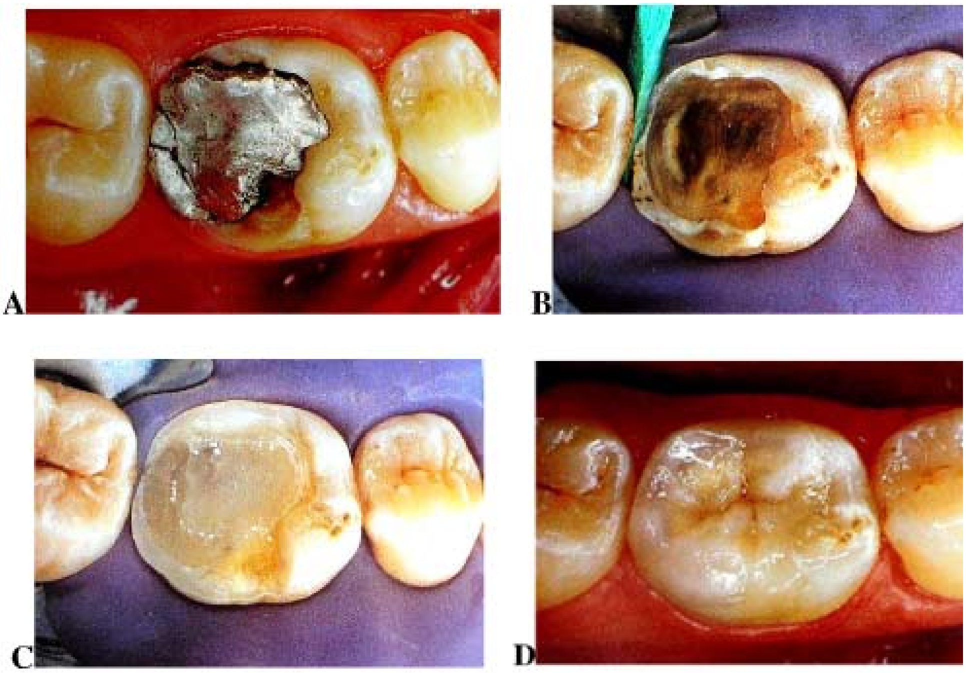


***Fig-1.59** In this clinical example, after removal of the old amalgam filling and decayed tissue, the cavity does not provide the necessary confuration for a luted restoration (A-B). A mechanically resistant base of compomer (C) was placed to make an indirect ceramic restoration possible (D).*

Provisionalization:

Provisionalization is necessary first to protect the pulpodentinal complex from any bacterial, mechanical, and thermal aggression. Subsequently, it will stabilize relations with proximal and antagonist teeth, as well as maintain an acceptable function (Fig-1.60). the use of soft light-curing resins such as Fermit (Vivadent) is particulary simple and appears to be clinically an acceptable provisionalization technique for a short duration, although no cement is used (Fig-1.61 to Fig-1.62). Because there is a high probability of marginal leakage with these materials, their in-mouth stay should be restricted to a few days, preferably in lined cavities. For other cases, the classic method, which makes use of a self-curing acrylic material for fabricating cemented temporaries has to be applied (Fig-1.63). Therefore, the eugenol-free temporary cements do not provide a definitive advantage regarding contamination of cavity surfaces. The bacteriostatic property of eugenol stays beneficial, provided a total-etch will later be applied (Fig-1.64).

Fig-1.60 Interim restorations are mandatory for biologic and mechanical protection of the pulpodentinal complex. They also assume a functional role, especially for restorations that include cusp coverage.

Fig-1.61 Soft light-cured material for interim restorations, without Cementation, is particularly Convenient for short-term Provisionalization.

Fig-1.62 Light-cured temporaries can also be used for serial cavities, they are considered comfortable by patients, and they are easily removed.

Fig-1.63A Cavity with acrylic resin.

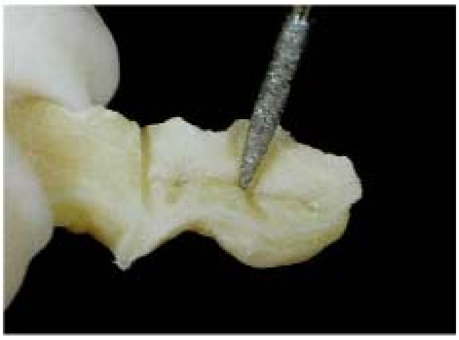


Fig-1.63B Shaped with bur or disks.

Fig-1.63C Ready inlay

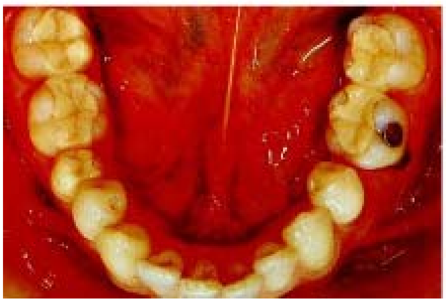


Fig-1.63D Completed restoration.

Fig-1.64A ZnO eugenol temporary Cement.

Fig-1.64B View postoperative.

Fabrication methods:

For Composite Resins: Modern composite lab kits generally include the same materials as those designed for chairside use mainly light-cured small particle hybrids (Fig-1.65).

For Ceramics: Dental ceramics for use in adhesive dentistry can be processed in several ways;

firing

pressing

casting

machining There are some parameters to consider when selecting a ceramic system. In relation to objectives of each case, one has to choose from the followingceramic systems (Fig-1.66 to 1.70).


A

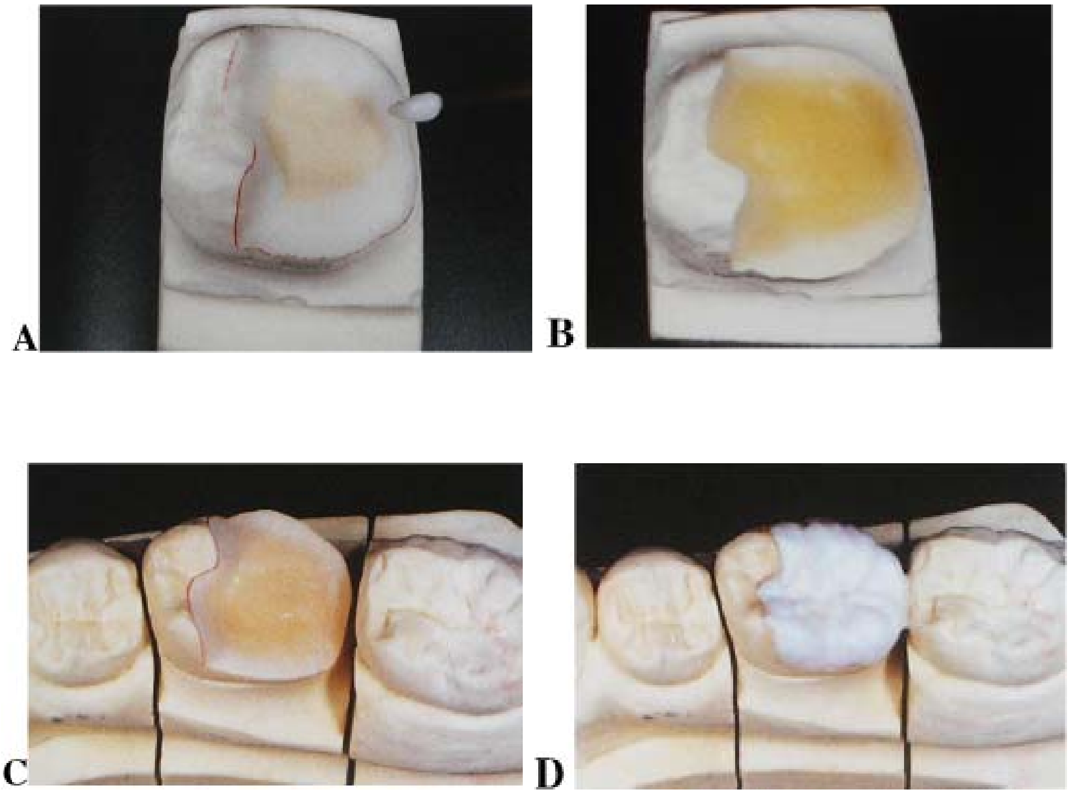

B


C


D


E

Fig-1.65 Specific procedures for the fabrication of an indirect composite restoration. The first step consists of placing a dye spacer on the bottom of the preparation (A). Colour dentin masse is used as the first layer (B). Subsequent increments of enamel(C) and translucent incisal (D) masses are added. Completed restoration on working model (E).



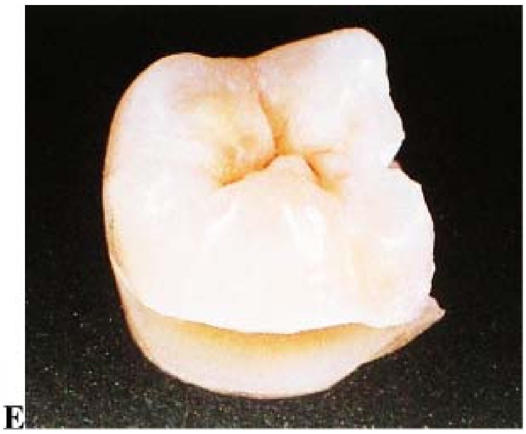


Fig-1.66 Specific procedures for the fabrication of a low-fusing ceramic restoration (LFC). The initial step involves preparing a base of conventional porcelain over a refractory dye (A). The fired base is viewed on its refractory dye (B) and after transfer to the working model (C). Then build-up the low-fusing ceramic directly on the working model, without having to integrate the refractory dye inside the working model (D). Final view of the restoration made of two constituents; the base of conventional porcelain covered by the LFC material (E).

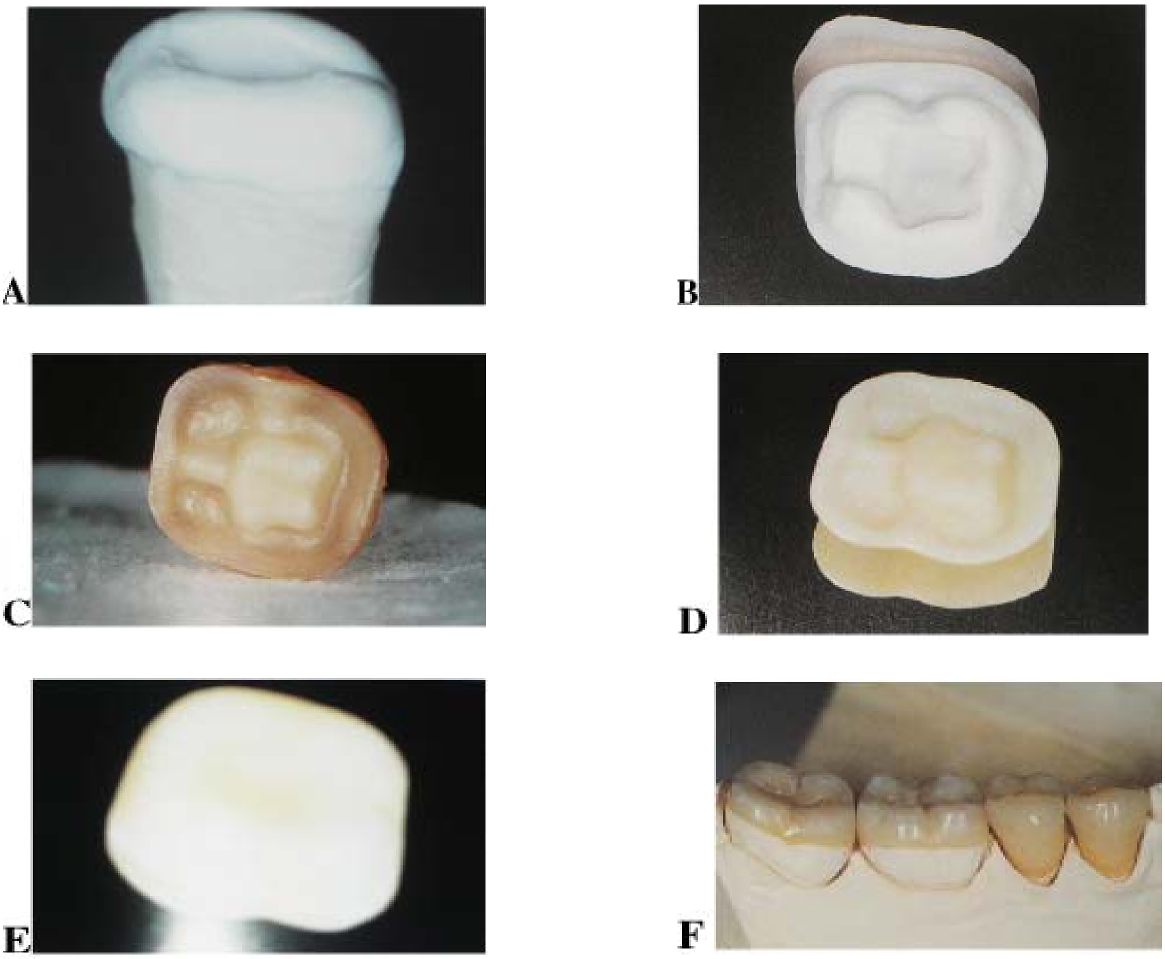


Fig-1.67 Specific procedures for the fabrication of a restoration with the slip-casting technique. The first step involves the application of the spinell suspension over a special refractory material (A) after the first firing; the base is removed from the dye and reshaped (B). The second firing consists of impregnating the base with colored glass (C) the base's inner and outer surfaces are viewed after the removal of glass excesses (D-E). The base is then transferred to the working model for veneering with a conventional reinforced porcelain. View of the completed restorations showing the in-ceram crown and in / onlay materials, used to restore the premolars and molars (F).

Fig-1.68

Specific procedures for the fabrication of conventionally fired ceramic inlays. View of the master model with dye spacers (A). The hard stone dyes have to be replicated and transferred onto the working model so that the ceramic is built-up with the required anatomic and functional references (B). The two porcelain inlays are shown at the completion of stratification and modelling (C). During a last firing, their surfaces are characterized and glazed (D). The restorations are ultimately transferred to the master model for final adjustments (E).

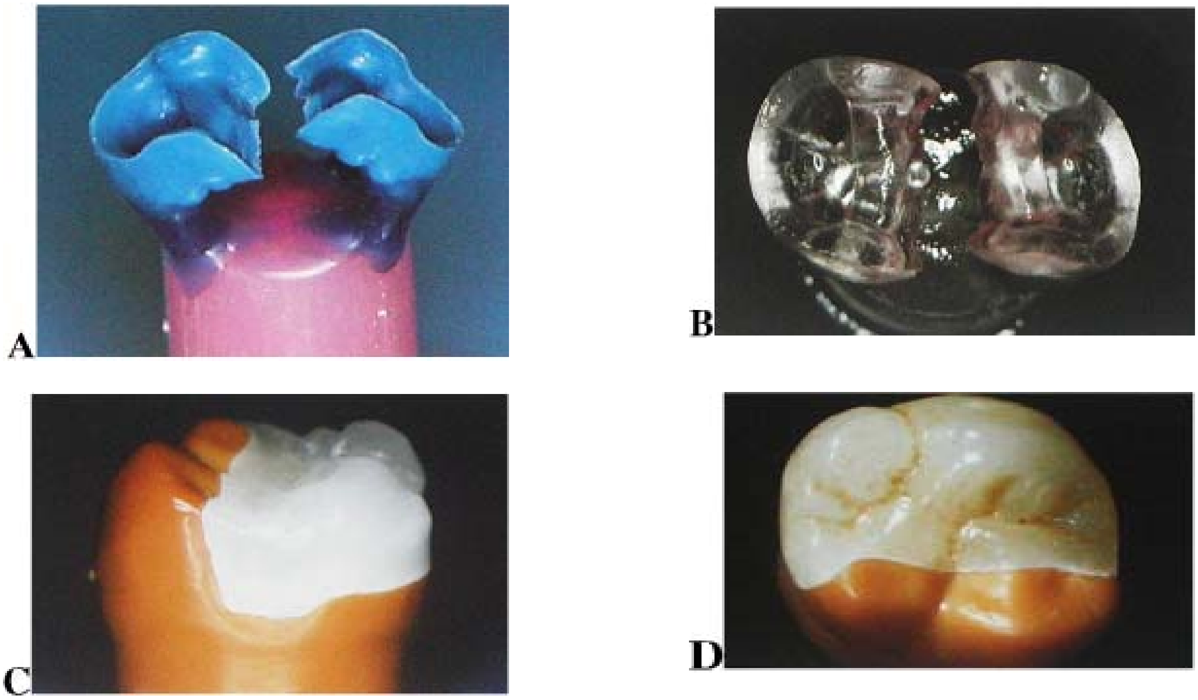
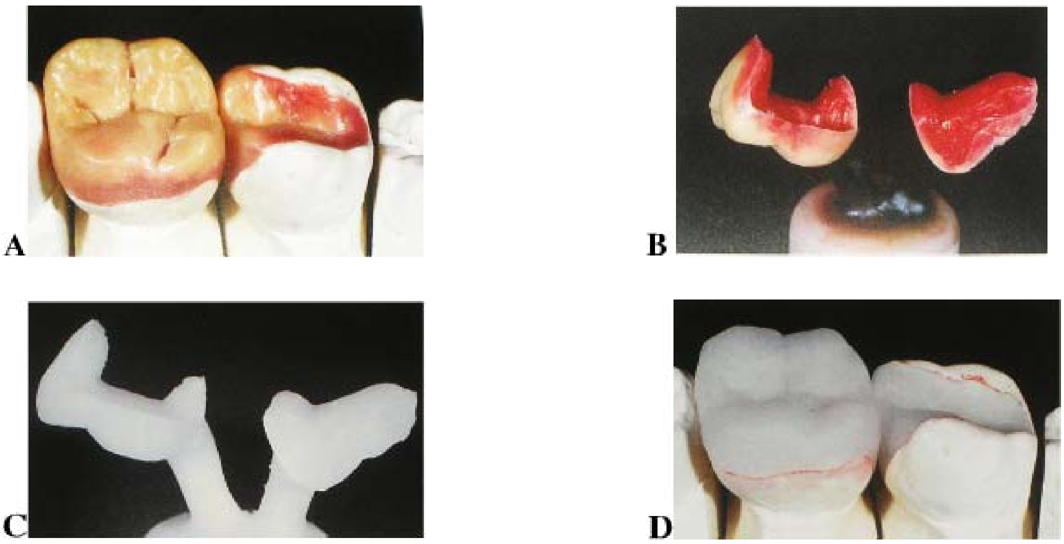


Fig-1.69 Specific procedures for the fabrication of a restoration using the cast ceramic technique. The first step consists of modelling the future restoration with wax and preparing it for casting (A). View of the casted restoration; in the glass state, they appear totally transparent (B). The restorations are then subjected to a thermal ceramization process. This demonstration onlay is viewed after it has been adjusted and reseated on its original dye (C). Completed restoration after the last firing of superficial stains (D).



E

F

Fig-1.70 Specific procedures for the fabrication of a restoration with the pressed ceramic technique. The initial steps are very similar those of the dicor cast-glass technique; the restorations are first modelled in wax (A) and mounted on a sprue before investment and pressing (B) pressed inlay as they appear after investment removal (C). The restorations must then be prepared and adjusted to fit the original master model (D). They appear translucent but monochromatic; they require esthetic characterization, carried out during the last firing of intensive ceramic surface stains (E) completed restorations (F).

Machined restoration:

The most widespread system is the CELAY pantograph. Recently, a full-automated pantograph was also developed. These devices are used to replicate a resin master restoration in ceramic through the simultaneous action of the sensor (manually or automatically controlled) on all prototype surfaces and of diamond burs and discs in the ceramic block. Initially advocated for chairside application, the Celay milling machine now seems to be more popular for lab use. Although the idea of applying pan-tography to dentistry was attractive, the clear advantage of semidirect composite restorations regarding practicability and efficiency considerably limits the future of this technique. CAD/CAM is also applicable to lab work, but their use still very limited.

New technologies for tooth colour restoration

1. CAD/CAM System

The growing application of computer-aided design (CAD) and computer-aided manufacture (CAM) in the automobile and aerospace industries since the 1970s is a good example of a profitable synergy between the evolution of new technologies and production needs. The main goal was certainly not to question the ability of dental technicians to produce accurate, functional, and natural-looking indirect restorations. A logical objective of pioneers in CAD/CAM systems was to simplify, make more profitable, and standardize the production of dental restorations.

2. Objectives and Potentials of CAD/CAM System

to eliminate traditional impression methods to design, for example, with the aid of a computer, the future restoration in accordance with the preparation, the function, and the natural anatomy to produce the restoration chair side to machine the restoration (ie,by rotating device, sono- or electro-erosion, laser, etc.) to improve restoration qualities: mechanical resistance, marginal fit, surface quality, and esthetics. (1) Full integrated CAD/CAM devices (CEREC and CEREC11, Siemens), for a chairside restorative approach, and (2) systems that consist of several modules with, at least, distinctive CAD and CAM stations. These two basic modules may theoretically operate through different schemes:

CAD and CAM stations are located in the dental office and operate successively, following impression taking, for a chairside elaboration of the restoration.

The impression (optical or other)is taken in the dental office, where the CAD operation is carried out. Date are transmitted to a central CAM station for restoration manufacturing.

The impression (optical or other) is taken in the dental office; collected information is then transmitted to a central station, where CAD and CAM modules operate.

3. CEREC and CEREC 2

The basic philosophy of the CEREC unit was to associate an optical impression method with a computer-driven fabrication module in a single mobile workstation. The system development included computer-aided 3-D imaging designing and numerically controlled machining of the restoration. In vitro tests demonstrated that durable and satisfactory margin adaptation was achieved with the first CEREC computer-machined ceramic inlays (Mormann et al, 1984). CEREC computer restorations have also been tested in vivo for 5 to 9 years and, thus, have demonstrated their clinical validity (Schmalz et al, 1994; Walther et al, 1994). CEREC restoration includes several distinct and original steps;

Optical impression

Powdering of the preparation

Computer-aided design of the restoration

Computer-driven milling of the restoration

In-mouth development and refinement of occlusal anatomy.

A.The optical impression

Only preparations that meet certain design criteria can be measured; inlay and onlay preparations meet this demand because all parts of interest are clearly visible by the scan head when oriented along the future line of insertion (Fig-1.70).

Fig-1.70 The CEREC system uses a miniaturized camera to take optical impressions of the preparations. The camera is viewed in action.

B.Powdering

The differences in reflection and absorption of the incident light between cusps and steep walls due to the cavity geometry and dissimilar optical properties of dental tissues requires the entire field of view to be coated with a thin opaque layer. The projection of titanium dioxide over the prepared tooth produces a uniform scattering of light, which is appropriate for the optical impression (Fig-1.71).

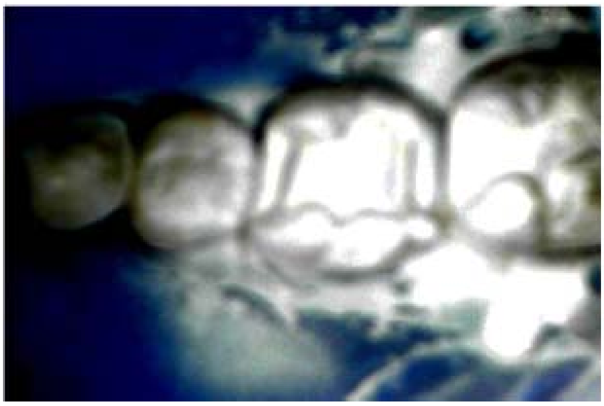


Fig-1.71 The cavity preparation, covered with special opaque powder, is ready for impression taking.

C.Data acquisition and imaging

Before we can measure our object in 3-D, we have to make sure that the scan head is properly positioned to its target. Currently a search mode precedes the impression. During the search mode, the scan head functions like a conventional video camera, producing a live image on the monitor. The search mode is initiated by activating the foot switch; release triggers the 3-D capture (Fig-1.72). some point or lines have to be identified and drawn by the operator as a starting point for the computer 3-D synthesis of the restoration (Fig-1.73)

Fig-1.72 Triggered image of the Preparation, as viewed on the CEREC 1 monitor screen.

Fig-1.73 Visualization of the cavity outline as identified by the operator and the machine. On the left part of the screen, bottom and occlusal surface profile lines can be seen.

D.Milling of the Restoration

For computer inlays, overlays, and veneers, industrially preformed ceramic blocks are being used (Vita CEREC blocks; Vitazahnfabrik; Dicor-CEREC blocks; Dentsply international) (Fig-1.74) which is almost frees from pores and do not require high glazing (Bieniek and Marx, 1994). The CEREC 1 used a single diamond-coated disk for the ceramic machining. It appeared that the majority of the restorations could be accommodated with this simple device. The milling head was initially driven by a pressurized water jet, which simultaneously cooled and cleaned the cutting disk (Fig-1.75). An electrically driven device later replaced this first version of the CEREC 1 milling system. Milling of the restoration in the ceramic blank results from three basic movements of the computer-driven machining module (Fig-1.76). In CERCE 2, the CAM module was implemented with a second form-milling tool, which provides six milling axes instead of three.

Fig-1.74 Milling module.

Fig-1.75 CEREC milling unit.

Fig-1.76 Three axis Milling.

E.Finishing and polishing of CEREC Restorations

When they are applied to the specific CEREC industrial ceramics, such in-mouth finishing procedures generate a restoration surface quality compatible with occlusion toward antagonist natural teeth (Fig-1.77).

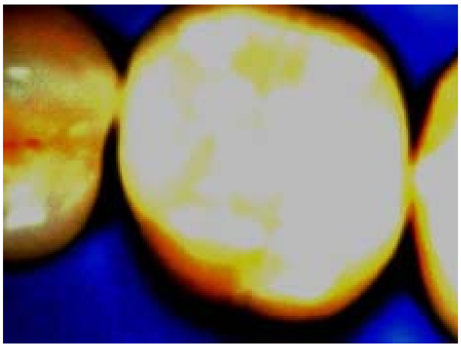


Fig-1.77 Completed CEREC restoration.

F.Indications for CEREC Restorations

The CEREC restoration lies perfectly within the indication area of the semidirect techniques. This includes a direct restorative approach and do not justify laboratory procedures. This corresponds in particular to large but isolated lesions (Fig-1.78). The development of occlusion in the very dense machinable ceramics proved to be too time-consuming for obtaining acceptable anatomy (Fig-1.79 to Fig-1.80). Regarding the colour, it can only be said that CEREC restorations are tooth colored (Fig-1.81 to Fig-1.83). Actually, the precision and balance of the resulting occlusal function is far less predictable than that obtained with conventional laboratory procedures (Fig-1.84).

Fig-1.78 Preparation is too extensive for a direct restorative technique. The even design of the cavity is suitable for a semidirect CAD/CAM application.

Fig-1.79 Immediate try-in of the Restoration, produced by the CEREC 1machine.

Fig-1.80 Representative aspect of the restoration after recontouring and Occlusal refinement

Fig-1.81 For this case, an attempt was made to improve the esthetic outcome by fifing ceramic stains in the restoration Occlusal fissures.

Fig-1.82 Cemented restoration in the mouth, producing CEREC restorations of high quality require extensive training, effort, and extended chairside time.

Fig-1.83 The same restoration, After some weeks of function.

Fig-1.84 Serial restorations can be managed with the CEREC system but indirect restorations are highly recommended.

4. Other CAD/CAM Dental Methods

There are now several systems that can be used to produce CAD/CAM restorations. These devices are aimed at fabricating full crowns, copings, or bridge framework out several materials, such as composite resins, ceramics, or metals. In general, however, these systems were not developed for the particular configuration of intracoronal or partial restorations. Different concepts were applied to the 3-D recording of the preparation than to the generation of the final piece. The complexity of the overall device may vary greatly depending on the system considered. Currently, apart from the CEREC and Duret systems, other available CAD/cam systems involve a 3-D preparation recording on a stone cast, although originally, it was expected to alleviate the needs of conventional impression procedures. Several different methods were employed to record spatial coordinates of the prepared teeth;

Laser holography (Duret, 1988)Laser scanners (Uchiyama, 1991; Miasaki et al, 1995) (Microdenta system; CAP system; Nissan CAD/CAM system) Stereo photographs (Rekow, 1988) Mechanical digitizer (Strupowsky, 1994; Hegenbarth, 1995) (Precident DCS system; Procera system)

The common characteristic of all these systems is the computer processing of acquired data for 3-D object reconstruction. The way external contours and anatomy are elaborated may differ, depending on the structure to be manufactured. For complete restorations, functional anatomy may be developed by using a library of preregistered natural tooth forms, to be integrated within neighbouring structures and adapted to recorded interocclusal relations.

5. Future of CAD/CAM in Dentistry

It is obvious that only a part of the initial objectives, such as those described at the beginning of this chapter, can be fulfilled by used of the aforementationed technologies. Currently, the CEREC is the only system that gives the dentist an integrated production means of manufacturing porcelain restorations without the need for a dental laboratory. However, as already mentioned, the indications of the technique remain limited by its concept and the procedures involved. To achieve natural esthetics and anatomy with CEREC restorations is still challenging and lacks reliability. A certain number of obstacles to the further development of these technologies, relating to practical, economical, and philosophic considerations, may be foreseen;

CAD/CAM application in industry, dentistry requires the fabrication of unique pieces.

An ideal system should integrate some important steps and functions (such as impression taking, intrinsic color elaboration, surface taking, intrinsic color elaboration, surface finishing, and polishing).

CAD/CAM and some other high-technology systems to face restrictions in their use and to play only a minor role in dentistry, for at least the next decade.

6. Other Technology

Celay

The Celay is a well-known hand-operated system. First, a pro-inlay is produced in the patient‟s mouth or on a model. The proinlay, made of wax or composite resin, is fixed on the scanning side of the machine. Ceramic inlays, onlays, coping, and even three-unit bridge substructures can be fabricated.

CERAMATIC

The CERAMATIC is an integrated automatic copy-milling unit for all-ceramic and aluminium oxide materials. The system concept is similar to the Celay, and it uses CEREC Vita blocks (MKll ceramic).

Sono-erosion

The sono-erosion is high-resistance ceramics machine.

Sonicsys micro

This preparation technique is not limited to extremely small direct restoration. Every proximal preparation, for both direct and indirect restorations, metal or metal-free, can be finished effectively with SONICSYS instruments (Fig-1.85 to Fig-1.89)

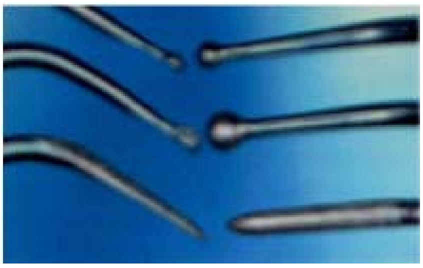


Fig-1.85 Microprep set.

Fig-1.86 Preparation with the small Lens from SONICSYS instrument.

Fig-1.87 Restoration after completion of Finishing.

Fig-1.88 Preparation cavity.

Fig-1.89 Mesial & distal proximal Preparation instruments (size 3 is shown).

Sonicsys approx

A special set of six instruments, three sizes for mesial and distal are offered for finishing the margins and standardizing small to medium size class II cavities (Fig-1.89 and Fig-1.90). Proximal inlays respond to these instruments (Fig-1.91). This system is directly place the inlay into the tooth, no try-in required, both proximal surfaces in an MOD cavity could be restored in a single step.

Fig-1.90 SEM view prep: with SONICSYS approx instruments.

Fig-1.91 Computer-aided design of a SONICSYS proximal inlay.

Luting procedures

While traditional gold inlays and onlays are retained principally by means of micromechanical retention and friction provided by the cement, semidirect and indirect esthetic restorations are maintained by micromechanical or chemical adhesion between the adhesive cement, dental tissues, and restorative material. This makes the luting procedures a clinical step of the whole treatment.

1. Cleaning of cavity surface

If interim restorations were placed, the complete removal of temporary cement is the first step. This is performed with hand instruments and pumice brushed over the cavity surfaces, or with an air-powder abrasive device, which proved the most effective final cleansing methods.

2. Restoration try-in

Thickness of the cementing space:

it is recognized that thin resin cement layers, the polymerization shrinkage is mainly directed uniaxially. The marginal fit of semidirect and indirect restoration (composite or ceramic) should lie within 100 microns; internal gaps may be greater up to 300 microns because of the use of dye spacers and adjusting procedures, therefore should provide better adaptation, and seal (Fig-1.192).

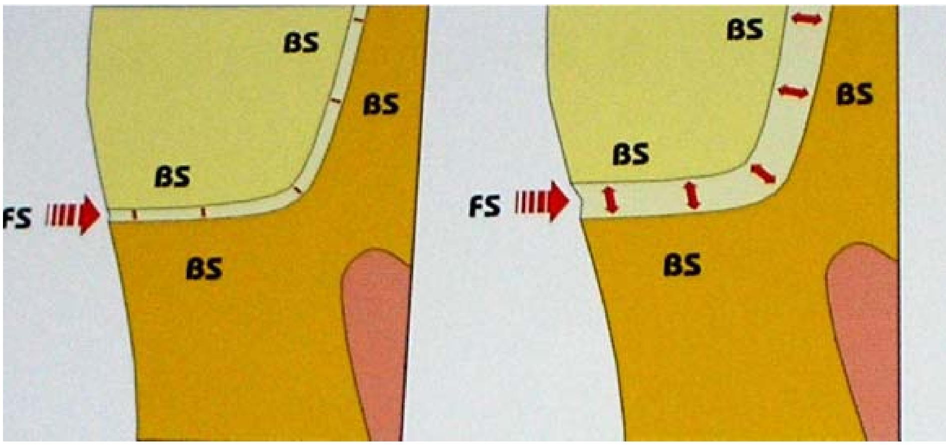


Fig-1.192 The particular configuration of thin cementing spaces where the ratio of bonded surface (BS) to free or unbonded surface (FS) is extremely high.

Compensatory movements:

it is probable that perfectly fitting units will lock inside the cavity during insertion and impede any compensatory movements, such as restoration descent and flexion of remaining wall (Fig-1.193).

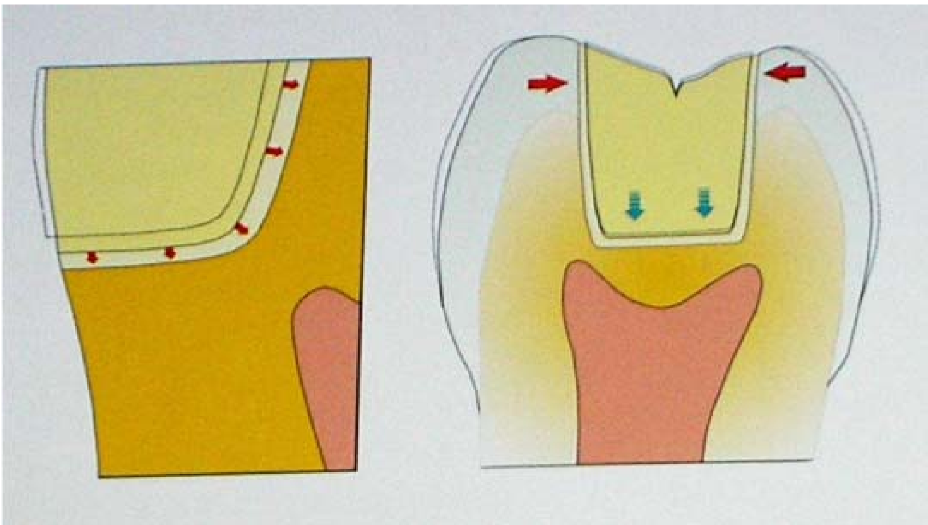


Fig-1.193 The typical compensatory movements that can occur during the cementation of adhesive restorations, such phenomena are more likely to take place with large cementing spaces.

Adhesion potential:

Because of insufficient adhesion potential for light cure GIC, only compomers and composite resin should be considered for luting procedure.

Wear of the luting cement:

Luting composite undergoes more wear than the restorative composites and that occlusal wear is proportional to the interfacial gap (Fig-1.194). Therefore, it seems important to reduce the cementing gap, at least occlusally.

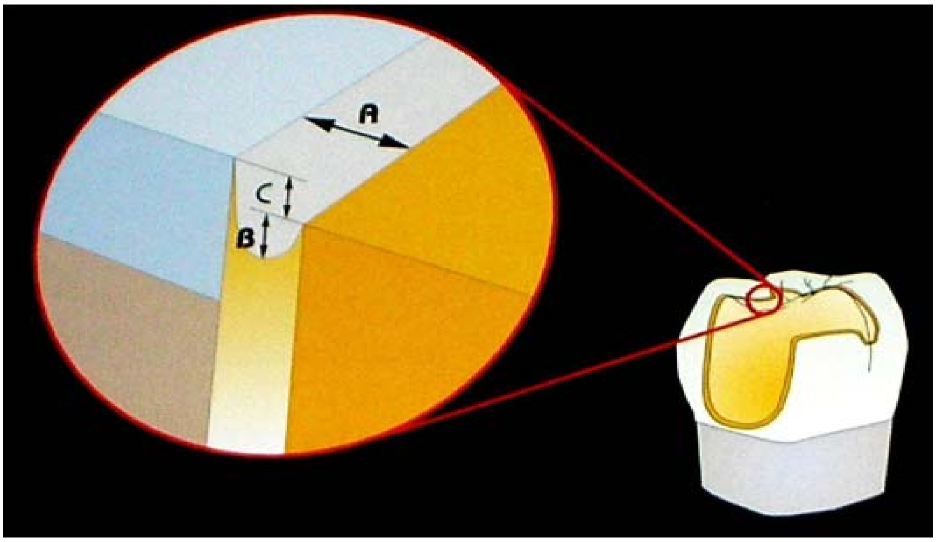


Fig-1.194 The wear pattern of composite luting cements with occlusal surfaces. The cement rapidly undergoes vertical wear unit approximately half of the cementing space width is attained; from this point, materials loss should be reduced to a minimum.

Practical and clinical considerations:

It appears that precise restorations are preferable because they will reduce polymerization stresses within the internal gap, limit wear of the cement, and facilitate the removal of cement excesses, providing restoration margins (Fig-1.195).

A

Fig-1.195 (A) Try-in of composite inlay.


B

Fig-1.195 (B) Just after cementation.


c

Fig-1.195 (C) After two years view of clinical service.

3. Material selection

The flow and removal of cement from the cementing gap is problematic in proximal areas. In this respect, high-viscosity materials permit the cement excesses to be cut rather than wiped off, which generally spreads the luting composite and contaminates larger surfaces. Sufficient working time is critical to placing the restoration in its correct position and eliminating cement overflow before chemical curing Fig-1.196).

Fig-1.196 A Immediate post-luting radiograph of ceramic inlay.

Fig-1.196B Post operative radiograph of ceramic inlay.

4. Surface treatments

The luting of semidirect or indirect restorations implies a double bond; one between the luting composite and the tooth, the other between the luting composite and the ceramic or composite restoration.

Tooth substrate

Bonding to ceramics

Bonding to composite

5. Clinical application

The cement is preferably placed or injected inside the cavity to facilitate manipulation of the restoration (Fig-1.197). Insertion of the restoration has to follow immediately, as polymerization activation will speed up at mouth temperature. Clinically, the technique of two-phase insertion (partial insertion- removal of main cement excesses-composite insertion) is tricky and, of course, contraindicated when using fast-curing dual cement.


A

Fig-1.197 (A) Lab made Composite restoration was inserted,

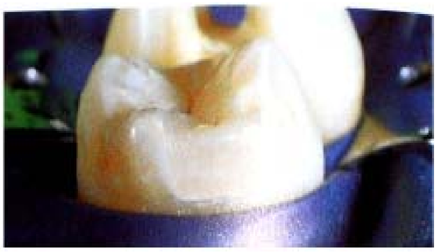

B

Fig-1.197 (B) Checked adaptation,


C

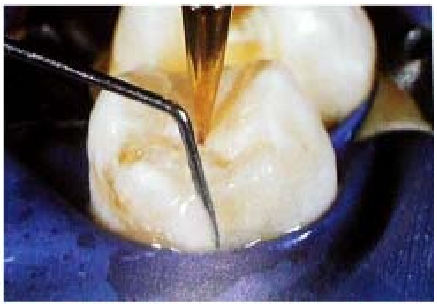
Fig-1.197 (C) The cavity is etched,

D

Fig-1.197 (D) Adhesive is applied

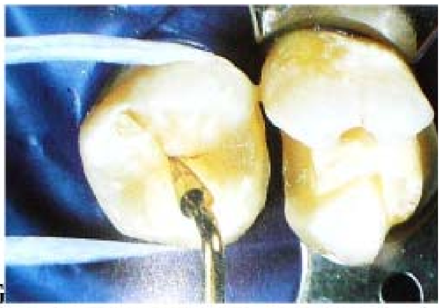
E

Fig-1.197 (E) The luting cement is placed or injected into the cavity



F

Fig-1.197 (F) proximal excesses are removed with a probe



G

Fig-1.197 (G) Flossing interdental areas

H

Fig-1.197 (H) Excesses cement wipe off with a probe

I

Fig-1.197 (I) Finally, levelled with a brush

J

Fig-1. (J) Glycerine gel is applied

K

Fig-1. (K) Before light cure

6. Polymerization of luting composite

The composite polymerization of luting composite by means of single light activation can be obtained only under a thin layer of translucent and clear restorative materials (less than 1.5 to 2.0 mm, depending on its translucency and shade). The use of dual-cure materials is more validated for luting of adhesive restoration. Therefore, powerful light-curing is mandated. It is also strongly recommended that each restoration surface be exposed to the curing light for at least one minute.

Finishing and polishing procedure

The function, adaptation, anatomy, and esthetics of the restorations are determined during the restorative procedures. The objectives of finishing and polishing are

1.Level the occlusal and proximal margins so that the restoration is in perfect continuity with the dental tissues.

2.Smooth the irregular surfaces or preserve those already finished.

3.Correct any existing marginal defects.

These objectives have the restoration quality, which preserved or improved during the last restorative steps (Fig-1.198).

A


Fig-1.198 (A) Preoperative view

B


Fig-1.198 (B) Completed direct composite restoration

C


Fig-1.198 (C) Postoperative view

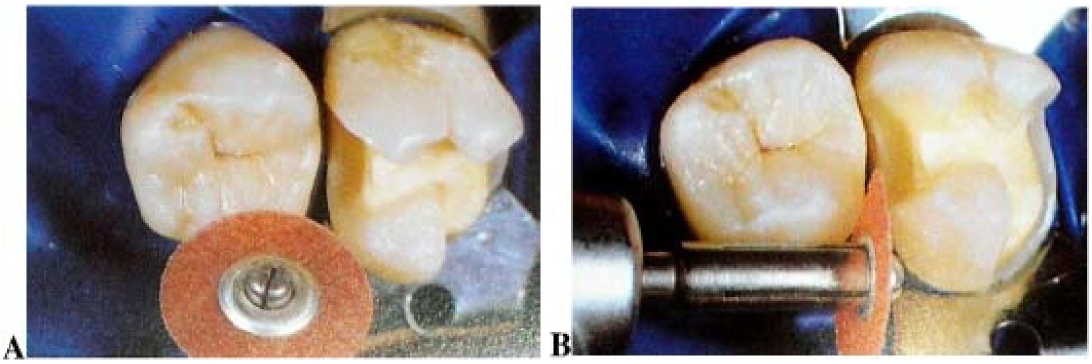
1. Polymerization of the composite top layer

The hardening of the resin surface is known to be affected by the presence of oxygen, during the final light curing to obtain complete resin polymerization. This procedure seems beneficial to both direct and luted restoration (Fig-1.199).

Fig-1.199 The final light curing is done with the restoration surface isolated from oxygen by a glycerine gel to achieve a perfect hardening of the composite top layer.

2. Restoration reshaping and recontouring

The accessibility and relief of the margins have to be taken into consideration as they will determine which kind of instrumentation is best indicated (Fig-1.200). The use of an EVA-type reciprocating handpiece with diamond tips (Fig-1.201) is considered only for removing bulk overhangs, which should only occur in exceptional cases.



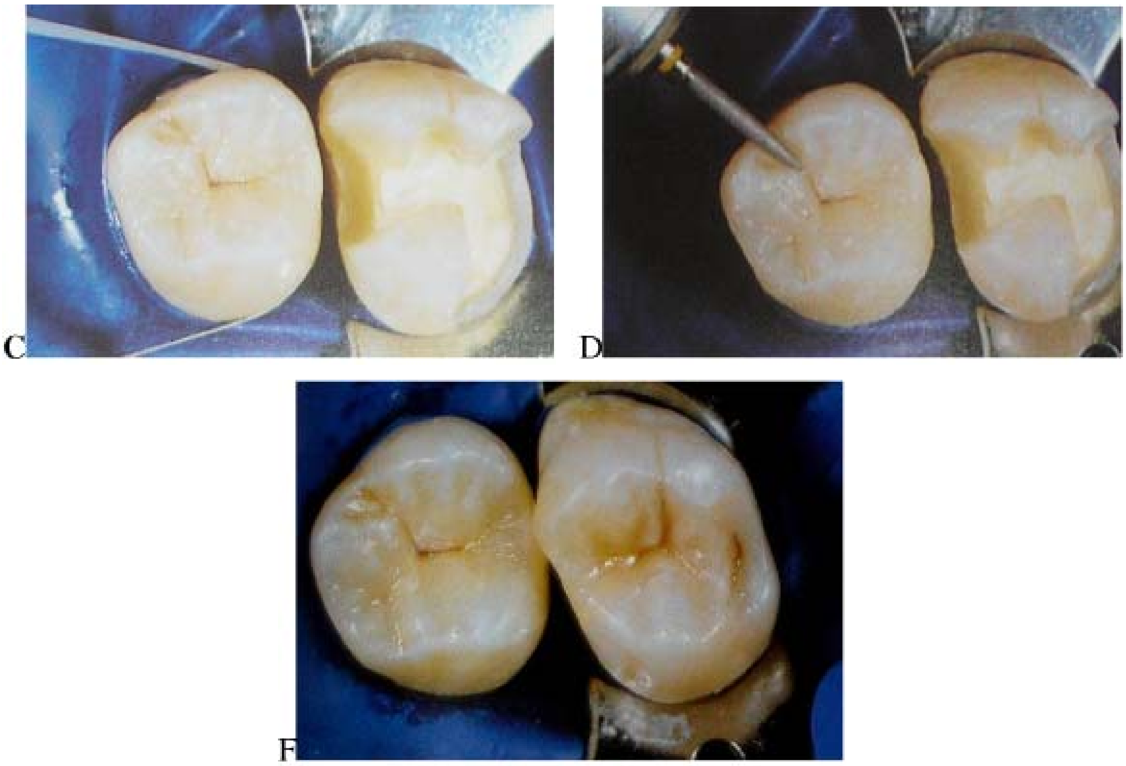


Fig-1.200 Accessible margins with flexible disks (A & B), Gingival margins are finished and polished with strips (C), For occlusal, irregular, and surface margins used superfine diamond burs (D & E), Completed restoration.

Fig-1.201 EVA-type handpiece with fine diamond-coated tip for removal of gross restorative material excess.

3. Polishing

To obtain a perfectly smooth composite surface may often be difficult and results only in an ephemeral gloss, which disappears rapidly after wear and degradation of the surface takes place.

Composite Materials:

Flexible discs appear to be reliable polishing instruments for most of the materials. They should be considered as the basic system for flat and accessible surface. For irregular surfaces and margins, fine diamond burs, multifluted carbide burs, silicone points, and polishing pastes can be utilized. However, no general consensus regarding the optimal polishing instrumentation for these areas (Fig-1.202). a final polishing with pastes and brushes seems profitable only for particular areas such as occlusal grooves or during extraoral and laboratory procedures. Gingival margins are still finished in a traditional manner with aluminous or glass metal strips.

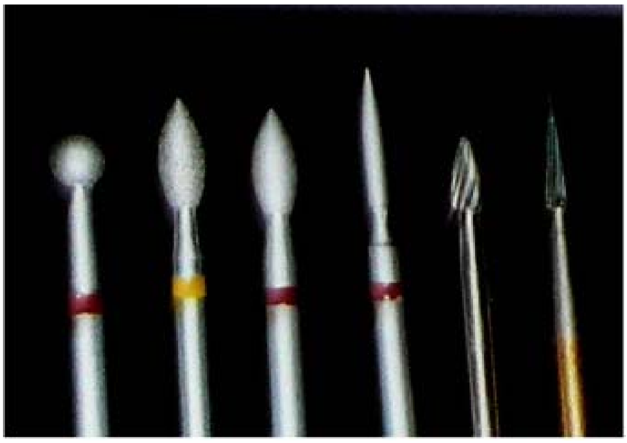


Fig-1.202 A variety of finishing and polishing rotary instruments.

Ceramics:

Pore-free ceramics, such as low-fusing ceramics or mechinable ceramics, can be quit easily polished to a clinically satisfactory gloss with flexible discs, fine diamond burs, silicone points containing aluminium oxide or silicon carbide, and special diamond or aluminium oxide polishing pastes (Fig-1.203) for other kinds of ceramics, finishing procedures should be reduced to occlusal adjustments because these materials are more difficult to repolish in the mouth.

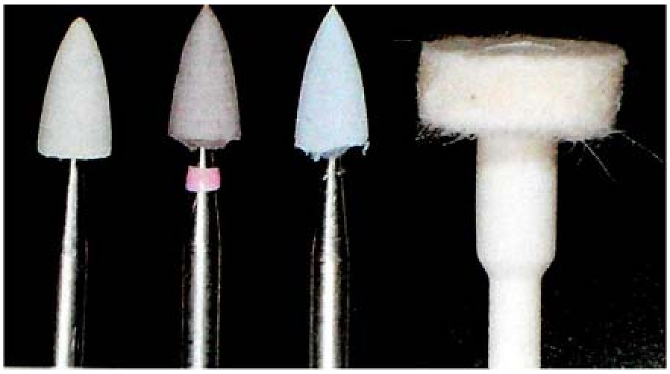


Fig-1.203 Special rubber points and soft wheels containing fine abrasive particles proved to be efficient in the finishing and polishing of ceramics.

4. Sealing the restoration margins and surface

The rebonding of the restoration margins with low-viscosity resin was therefore recommended as a serviceable finishing procedure (Fig-1.204). The long-term clinical significance of this operation is, unknown. The sealing of composite surface with a low-viscosity resin may also reduce restoration wear by penetrating porosities and microcracks.

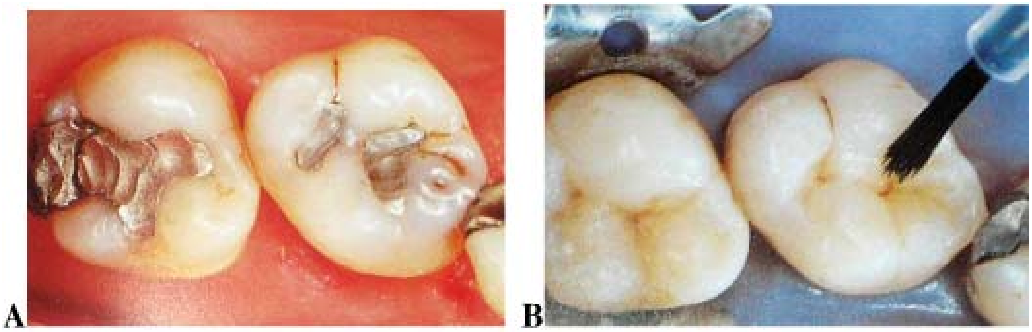


Fig-1.204 Preoperative View (A), Apply the liquid resin to penetrate all surface microdefects.

Hand instruments

Black also organized the naming and numbering of hand instrument such as cutting instruments and non-cutting instruments. Cutting instruments, which he called excavators, were to be used in shaping the tooth preparation.

Metals: For many years, carbon steel was the primary material used in hand instruments for operative dentistry because carbon steels were harder and maintained sharpness better than stainless steels. Stainless steels are now the preferred materials for hand instruments, because all instruments must be sterilized with steam or dry heat between patients and because the properties of stainless steels have improved.

"**Cutting Instruments":** Before rotating instruments were available, dentists could cut well-shaped cavity preparations using sharp hand instruments alone. The advent of the dental handpiece in 1871, first attached to a foot-operated engine, allowed increased speed of tooth preparation. Most tooth preparation today with rotary instruments but hand cutting instruments are still important for finishing many tooth preparation

Design: Hand cutting instruments are composed of three parts: handle (or shaft), shank, and blade (Fig-2.1). The primary cutting edge of a cutting instrument is at the end of the blade (called the working end), but the sides of the blade are usually bevelled and also may be used for cutting tooth structure (Fig-2.2). Blade of instrument is normally short and use with minimal force (Fig-2.3). A variety of handles configurations are available (Fig-2.4).

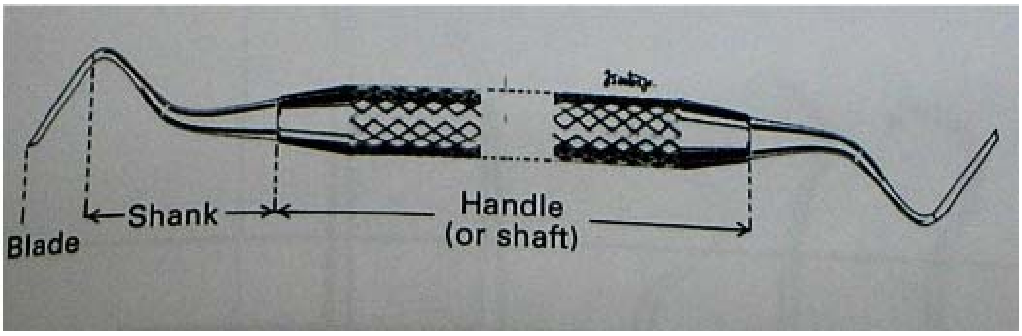


Fig-2.1 Components of hand instrument.

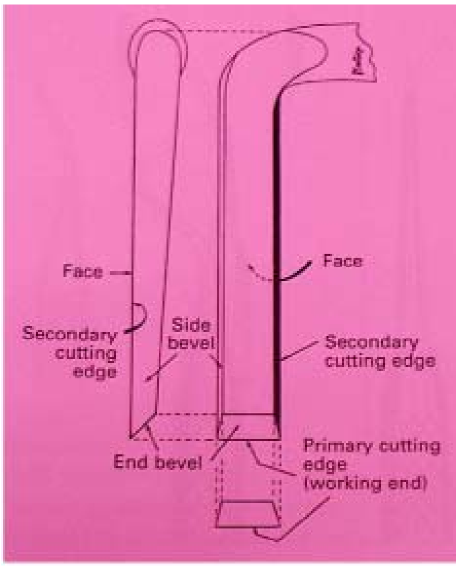


Fig-2.2 The design of blade bevels.

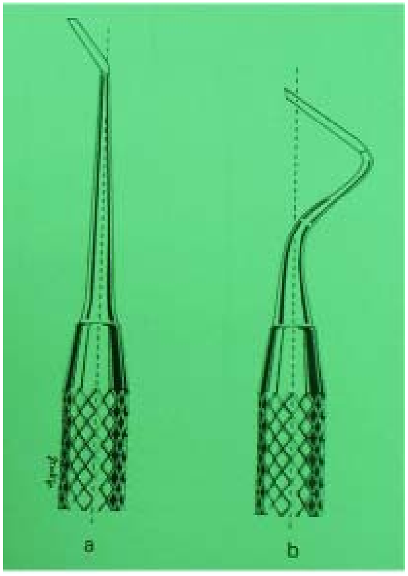


Fig-2.3 The design of shank.

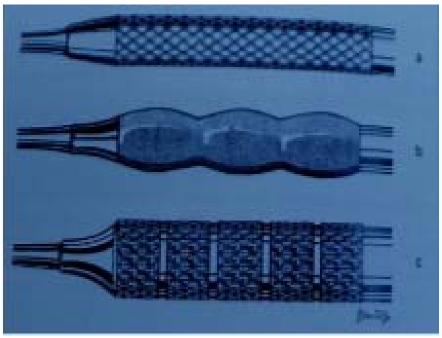


Fig-2.4 Various type of handles.

Nomenclature:

The terminology organized by black in the early part of the last century is still used today with minor modifications. Most names Black assigned to cutting instruments were based on the appearance of the instrument, such as hatchet, hoe, spoon, and chisel. Instruments classified by the number of angles in the shank (Fig-2.5).

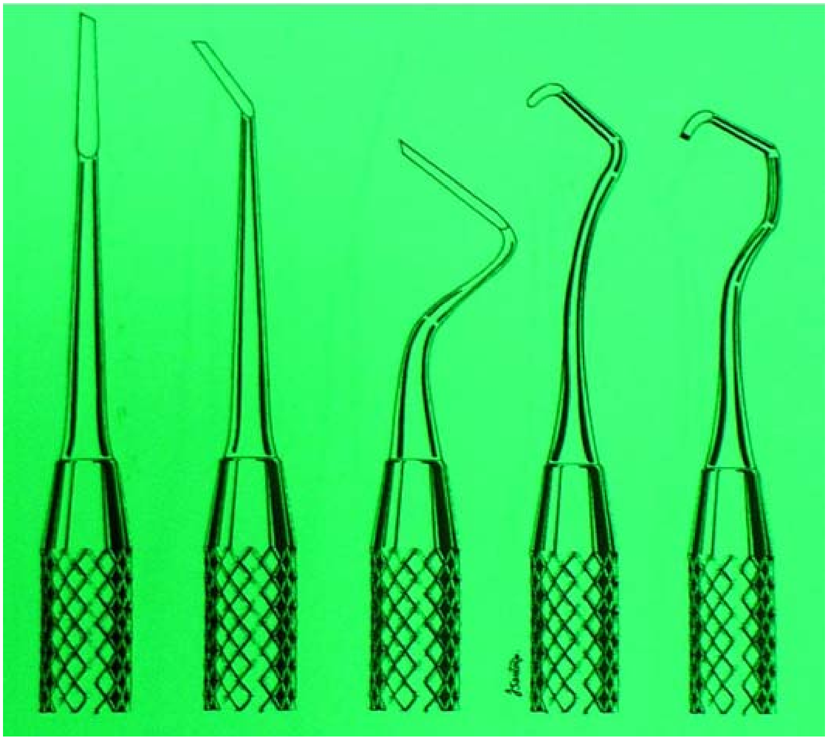


Fig-2.5 Instruments classified by the number of angle in the shank,

a.straight,

b. monangle,

c. binangle,

d. triple angle,

e. quadrangle.

Hatchet:

In a hatchet (also called an enamel hatched), the blade and cutting edge are on a plane with the long axis of the handle; the shank has one or more angles (Fig-2.6 and Fig-2.7).The face of the blade of the hatchet will be directed either to the left or the right in relation to the handle, and the instrument is usually supplied in a double-ended form. There are left-cutting and right-cutting ends of double-ended hatchet.

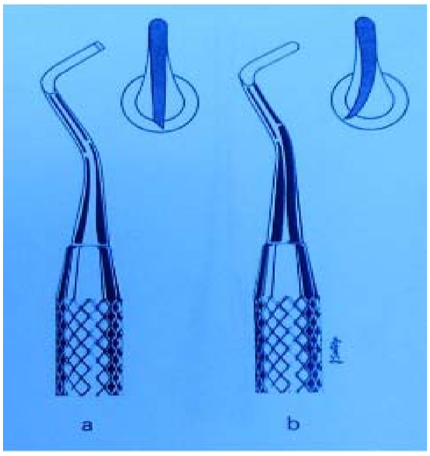


Fig-2.6A

(a)Binangle hatchet,

(b)binangle spoon.

A double end hatchet or spoon would have a left-cutting end and a right cutting end.

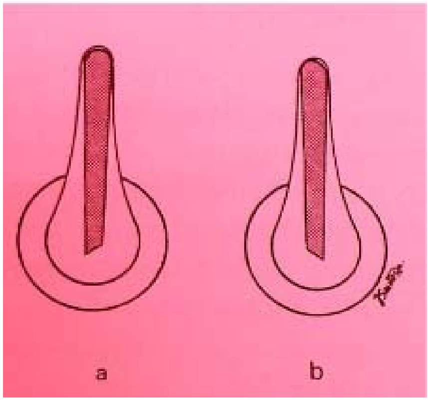


Fig-2.6B End view of binangle hatchets paired, a right-cutting, b left-cutting. A double-end binangle hatchet has left cutting and right-cutting end

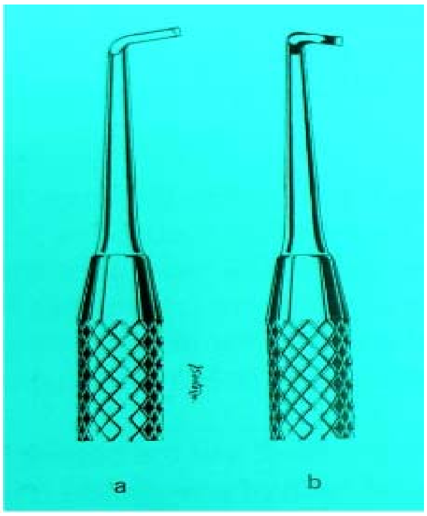


Fig-2.7 Monangle harchets (left cutting).

Chisel:

A chisel has a blade that is either aligned with the handle, slightly angled (Fig-2.8A), or curved (Fig-2.8C) from the long axis of the handle, with the working and at a right angle to the handle.

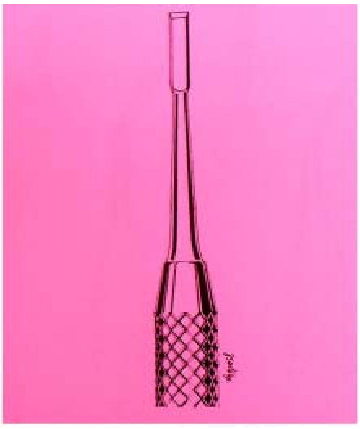


Fig-2.8A Straight chisel.

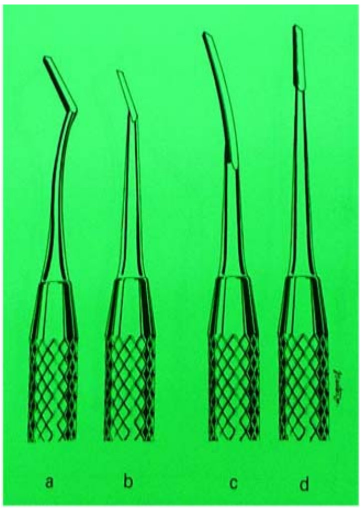


Fig-2.8 B Chisels;(a) binangle, (b) monangle, (c) wedelstaedt, (d) straight. The blade for a, c, and d are slightly rotated to visualize the face, as well as the side bevel.

Hoe.

A hoe has a cutting edge that is as a right angle to the handle, like that of a chisel. However, its blade has greater angle from the long axis of the handle than does that of the chisel; its shank also has one or more angle (fig-2.9).

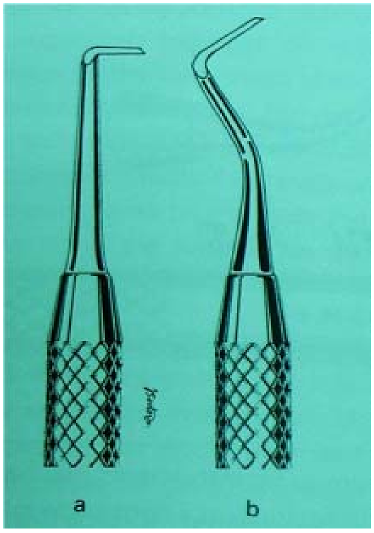


Fig-2.9 Design of Hoe,(a) monangle,(b) binangle. The blade of A hoe has an angle from long axis of the handle of greater than 12.5 centigrades.

Spoon:

the blade of a spoon is curved, and the cutting edge at the end of the blade is in the form of a semicircle (Fig-2.10). The shank of some spoons holds a small circular, or disk-shaped, blade at its end and the cutting edge extends around the disk except for its junction with the shank, these are called discoid spoons (Fig-2.10).

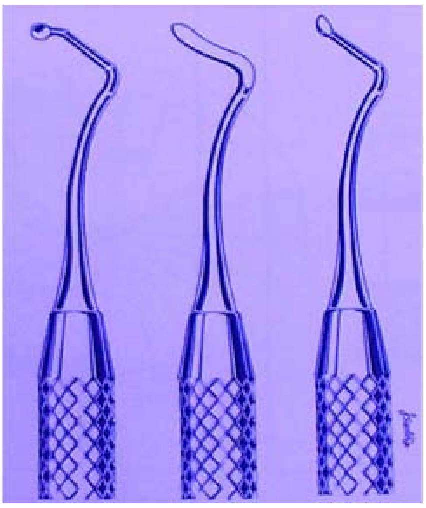


Fig-2.10 Spoon or excavators

Gingival margin trimmer:

A gingival margin trimmer is similar to an enamel hatchet, except that the blade is curved and bevel for the cutting edge at the end of the blade is on the outside of the curve and its face is inside of the curve

Fig-2.11 Gingival marginal trimmer.

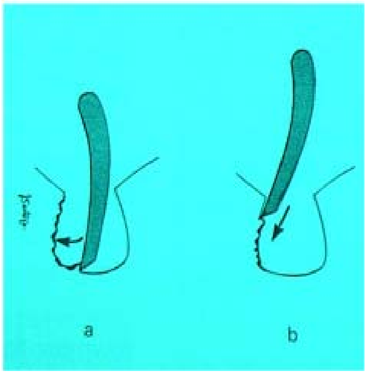


Fig-2.12 Cutting edge bi-bevelled

Numeric formulas:

Black developed a system of assigning numeric formulas to instruments (Fig-2.13, 14). For designating the degree of angulation, centigrades are used (Fig-2.15).There are available Three-number formula (Fig-2.13, 2.14) and Four-number formula (Fig-2.16)

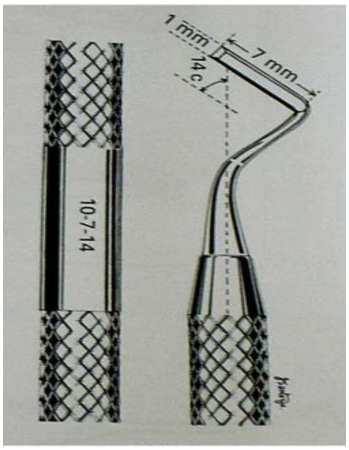


Fig-2.13 Three number Formula of blade

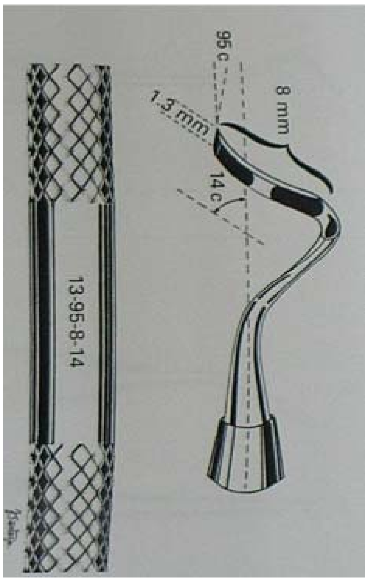


Fig-2.14 Four number formula

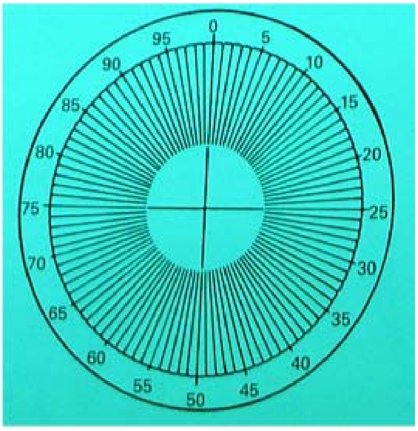


Fig-2.15 Centigrade scale, divide into 100

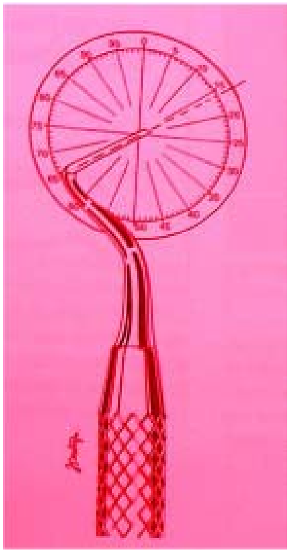


Fig-2.16 Indication to 16 centigrades

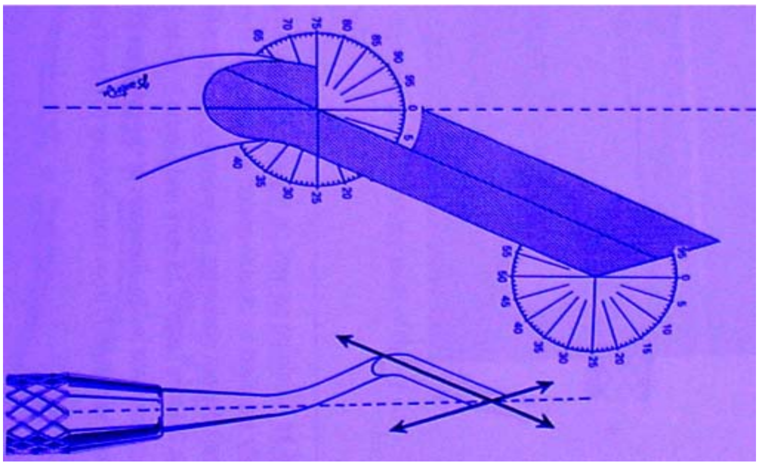


Fig-2.16B Centigrade scales inset to show angulation indicator of 7.0 centigrades for the blade angle and 95.0 centigrades for cutting edge angle of this gingival margin trimmer (four number formula).

"**Noncutting Instruments**": Non-cutting instruments are similar in appearance to cutting instruments; except that the blade used for tooth preparation is replaced with a part has a totally different use.

Amalgam carrier: Amalgam is placed into the preparation with an amalgam carrier, which has a hollow cylinder that is filled amalgam (Fig-2.17).

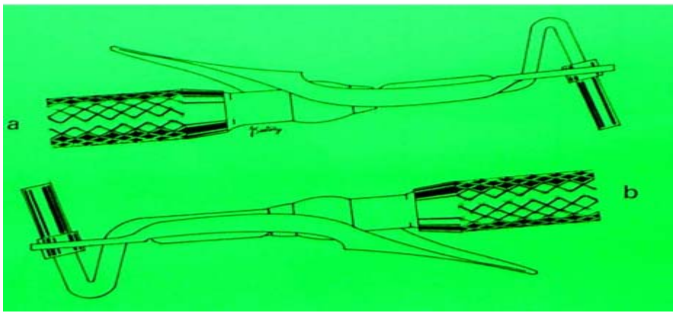


Fig-2.17 Amalgam Carriers

Condensers:Condensers are used to compress amalgam or to push resin composite or glass-ionomer materials into all area of the preparation (Fig-2.18).

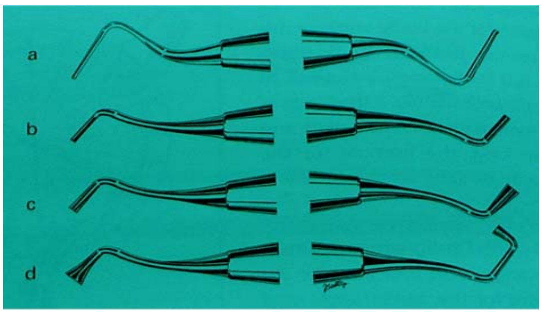


Fig-2.18 Various types of Condensers.

Carvers:Cavers are used to shape amalgam, resin composite, and other tooth colored materials after they have been placed in tooth preparation (Fig-2.19, Fig-2.20, Fig-2.21).

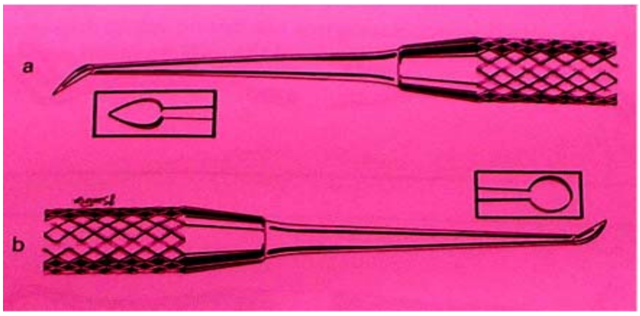


Fig-2.19 Cleoid-discoid carver: a cleoid end, b discoid end

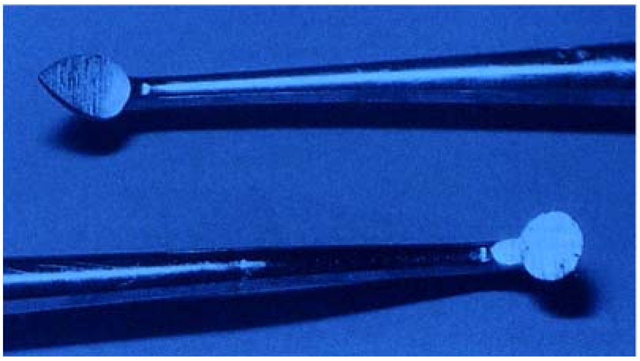


Fig-2.20 Cleoid (top) and discoid (bottom) ends of the cleoid-discoid carver.

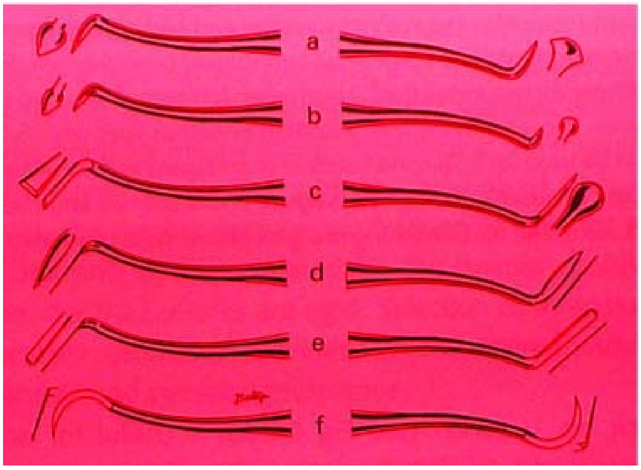


Fig-2.21 Various types of carvers.

Burnishers: Burnishers are used for several functions, to make shiny or lustrous, especially by rubbing to polish and to rub (a material) with a tool for compacting or smoothing or for turning an edge (Fig-2.22).

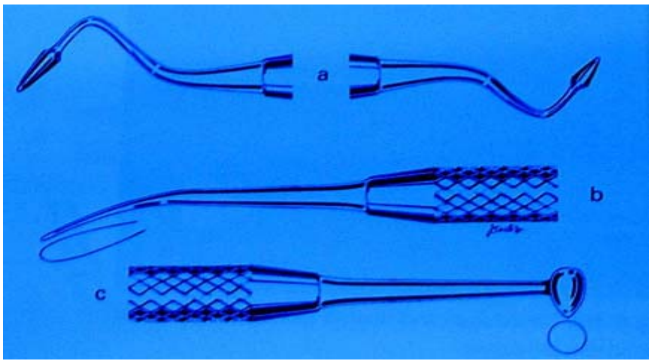


Fig-2.22 Various types of Burnishers.

Plastic instruments: Plastic instruments (or plastic filling instruments) were used to carry and shape tooth colored restoration. It is useful for placing the cement materials and composite material into the prepared cavity (Fig-2.23).

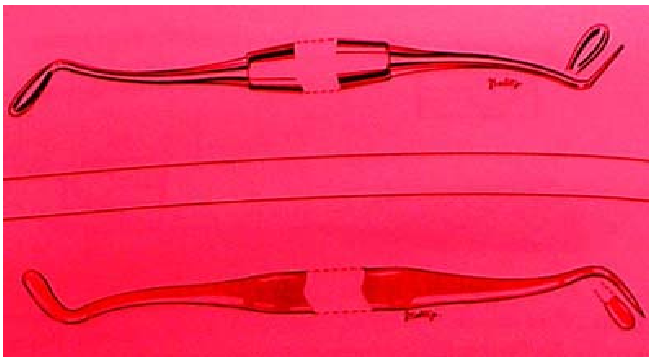


Fig-2.23 Plastic instruments, made of stainless steel, is useful for placing a rubber dam, placing and shaping resin composite and other tooth-colored restorative materials, and packing gingival retraction cord into the sulcus around a crown or abutment preparation before an impression is made.

Cement spatulas: A variety of materials in operative dentistry requires mixing, some on a glass slab, and others on a paper pad. Several spatulas are available with various size and thickness (Fig-2.24).

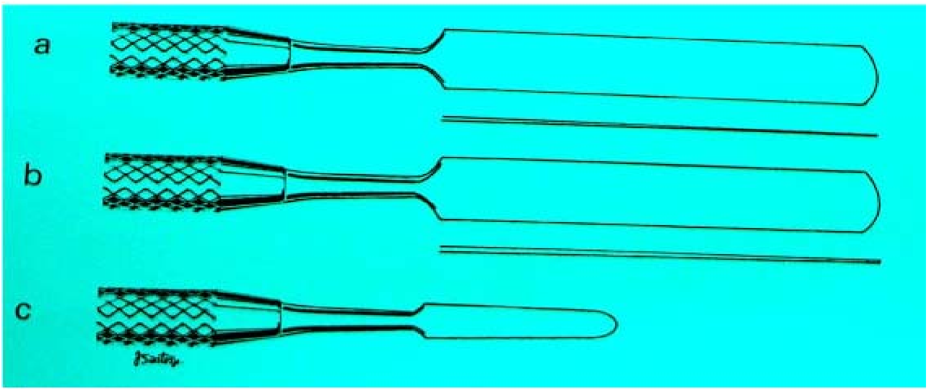


Fig-2.24 various sizes and shapes of cement spatulas.

Mirrors: For every procedure performed in the mouth, needed mouth mirror for clear version and to retract the soft tissue (tongue, cheeks, or lip) (fig-2.25).

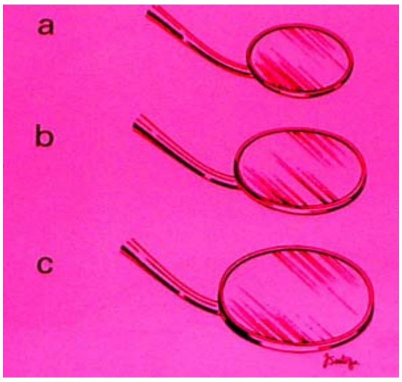


Fig-2.25 Various types of mouth mirrors.

Explorers: Explorers are pointed instruments, which are used to feel tooth surfaces for irregularities and to determine the hardness of exposed dentin (Fig-2.26).

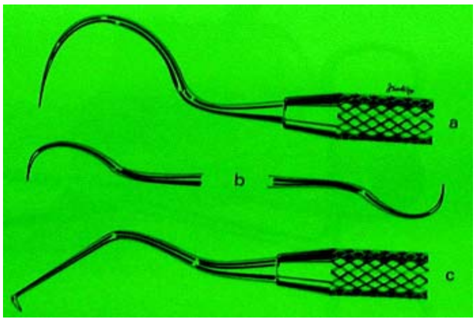


Fig-2.26 Various sizes and shapes of dental explorers.

Periodontal probes:Periodontal probes are designed to detect and measure the depth of periodontal pockets. In operative dentistry, they are also used to determine dimensions of instruments and various features of preparations or restorations (Fig-2.27)

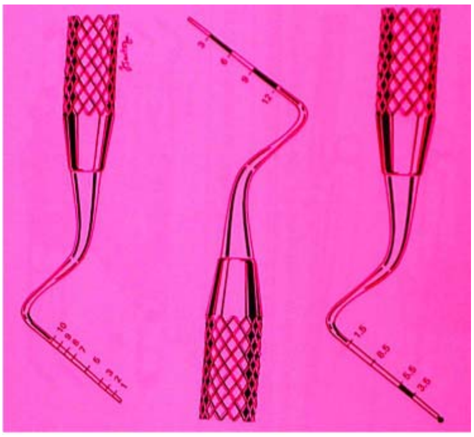


Fig-2.27 Various types of periodontal probes.

Forceps: Forceps of various kinds are useful in operative dentistry. Cotton forceps are used for picking up small items, such as cotton pellets, and carrying them into the mouth (Fig-2.28). Other forceps useful in operative dentistry include haemostatic forceps (Fig-2.29) and articulating paper forceps Fig-2.30).

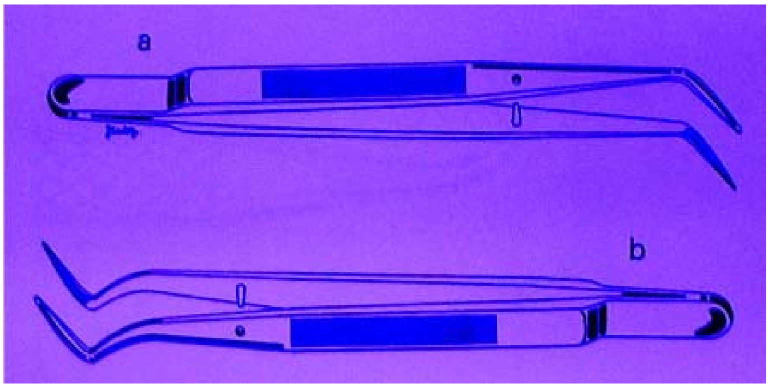


Fig-2.28 Cotton forceps; (a) College (no.17), (b) Meriam (no-18)

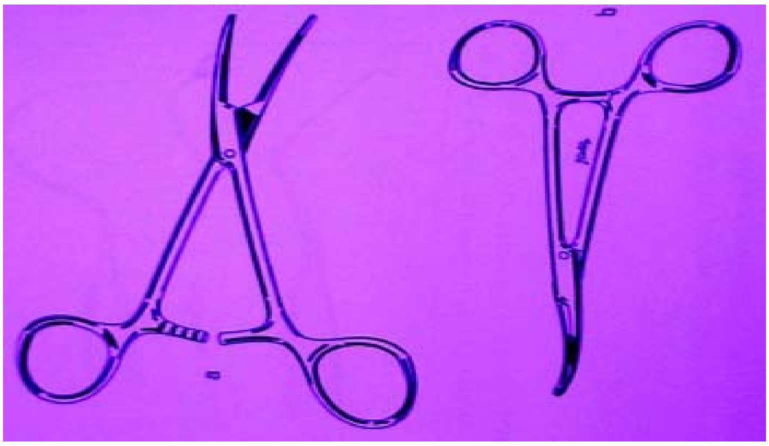


Fig-2.29 Hemostats: (a) Halstead mosquito straight 6-inches, (b) mosquito curved 5-inches

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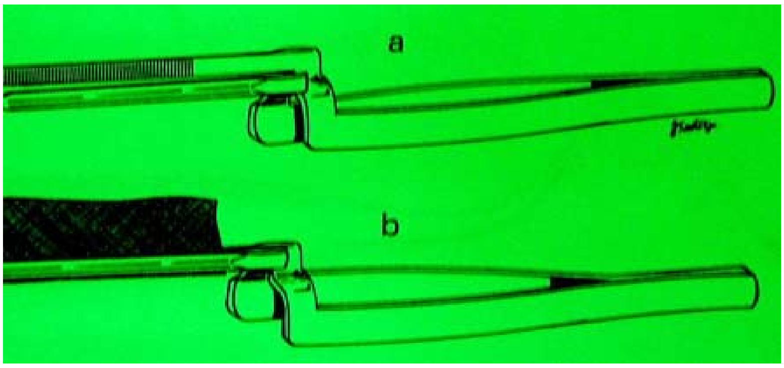


Fig-2.30 Articulating paper forceps.

Instrument Grasps: Usually one-handed grasps are used, but occasionally two-handed instrumentation is needed to make refinement of a preparation more precise (fig-2.31).

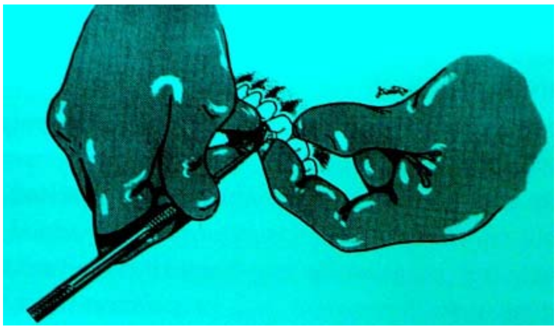


Fig-2.31 Two handed instrumentation.

Pen grasp; the most frequently used instruments grasps in operative dentistry (Fig-2.32,33,34).

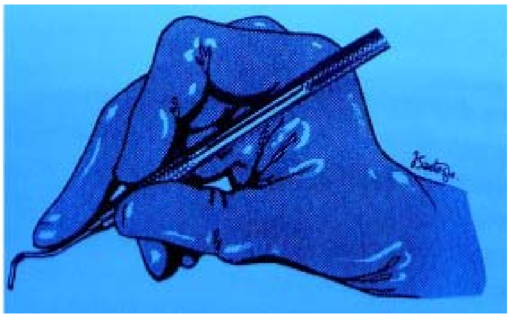


Fig-2.32 Pen-grasp

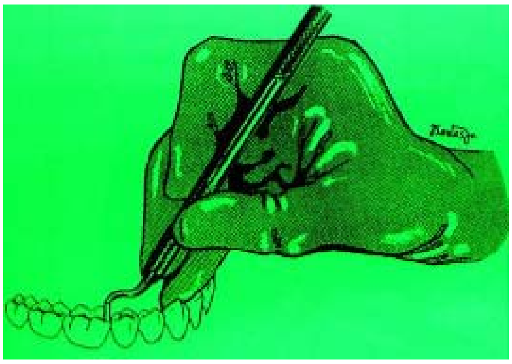


Fig-2.33 Pen-grasp used in chopping (downward) motion

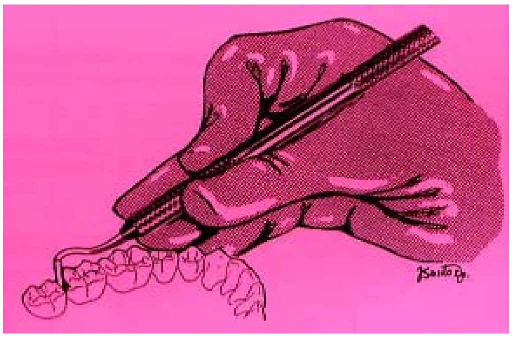


Fig-2.34 Pen-grasp is used more in posterior teeth.

Palm or palm-grasp; in this grasp, the thumb serves as a brace (Fig-2.35). Side to side, rotating or thrusting movements of the instrument by the wrist and fingers are controlled by thumb, which is firmly in contact with the teeth (Fig-2.36).

Instrument Motions

1.chopping

2.pulling

3.pushing

4.rotating

5.scraping

6.thrusting

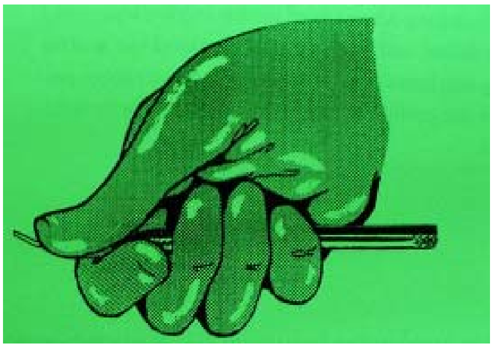


Fig-2.35 Palm-thumb grasp.

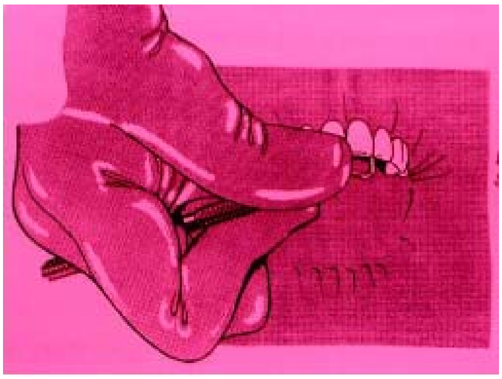


Fig-2.36 The palm-thumb grasp is used frequently when a hand cutting procedure

Rotary instruments

Handpieces:

In dentistry two basic types of handpieces are used, the straight handpiece (Fig-2.37) and the contra-angle handpiece (Fig-2.38). In the straight handpiece, the long axis of bur is the same as the long axis of the handpiece. The straight handpiece is used more frequently for laboratory work but is occasionally useful in clinically. There are two types of contra-angle handpiece, slow speed, and high-speed handpieces. Low-speed range is 500 to 15,000 rpm, some are able to slow to 200 rpm, and others are achieving to 35,000 rpm. High-speed handpieces have a free-running speed range greater than 160,000 rpm, and some handpieces attain free-running speeds up to 500,000 rpm. In the United States, most dentists are accustomed to air-turbine high-speed handpieces. The speed of these handpieces during tooth preparation is 180,000 rpm and lower, depending on the application pressure and the power of the handpiece. For air-turbine handpiece, speeds during tooth preparation are significantly less than their free-running speeds.

Fig-2.37 Straight handpiece

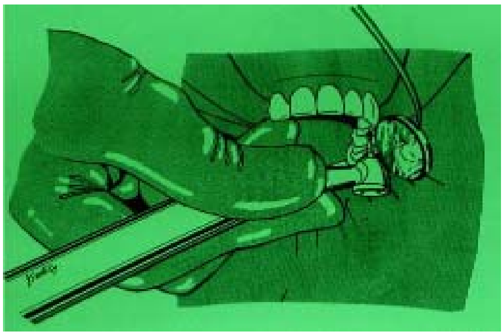


Fig-2.38 Contra angle handpiece.

Burs:

Hand-rotated dental instruments have been used since early 1700s, the foot engine was used in 1871, and electric engine was used in 1872. High-speed was used in 1947. Burs have three major parts, the head, the neck, and the shank (fig-2.39, 2.40). The bur in Fig-2.41 has a negative rake angle. The basic shapes of tooth preparation burs used in operative dentistry are shown in Fig-2.42. The head of some trimming and finishing burs are shown in table 2-1.and table-2.2.

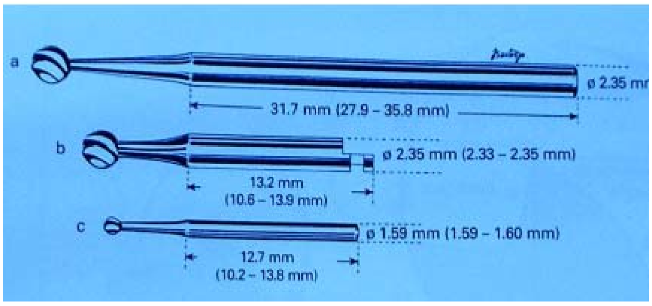


Fig-2.39 Round burs for both handpieces.

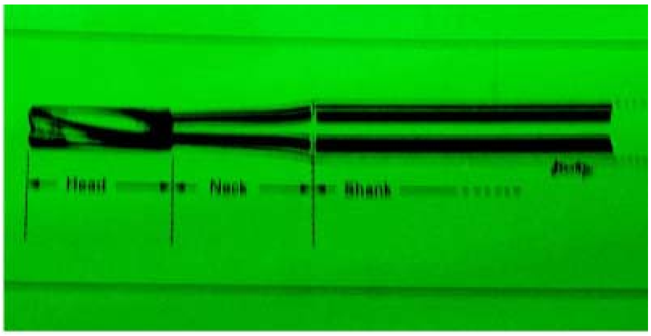


Fig-2.40 Burs; head, neck, and shank

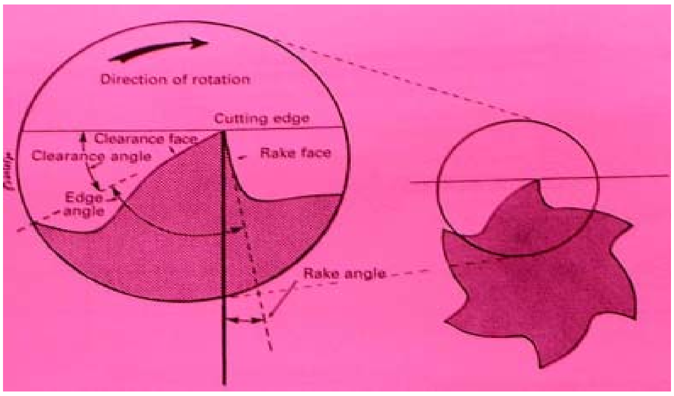


Fig-2.41 Typical bur head.

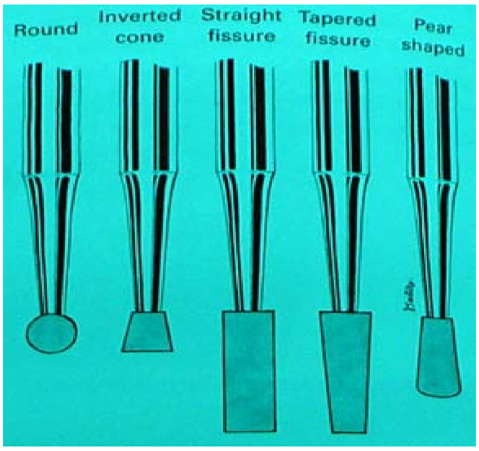


Fig-2.42A Basic Bur head shapes

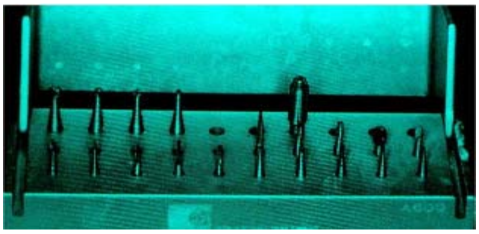
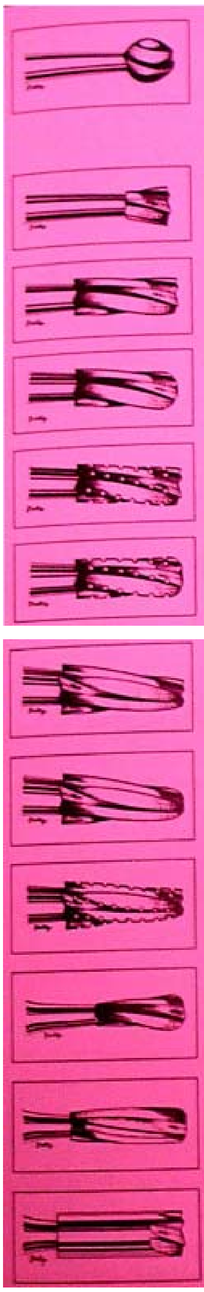


Fig-2.42B Recommended burs kit.



Round

Bur size	[illegible]	[illegible]	[illegible]	[illegible]	1	2	3	4	5
Diameter (mm)	.30	.40	.50	.60	.80	1.0	1.2	1.4	1.6
Bur size	6	7	8	9	11				
Diameter (mm)	1.8	2.1	2.3	2.5	3.1				

Inverted cone

Bur size	33½	34	35	36	37	39	40
Diameter (mm)	.60	.80	1.0	1.2	1.4	1.8	2.1

Straight fissure'

Bur size	55½	56	57	58	59	60
Diameter (mm)	.60	.80	1.0	1.2	1.4	1.6

Straight fissure, rounded end (straight dome)'

Bur size	1156	1157	1158
Diameter (mm)	.80	1.0	1.2

Straight fissure, crosscut'

Bur size	556	557	558	559	560
Diameter (mm)	.80	1.0	1.2	1.4	1.6

Straight fissure, rounded end, crosscut (straight dome crosscut)

Bur size	1556	1557	1558
Diameter (mm)	.80	1.0	1.2

Tapered fissure'

Bur size	168	169	170	171
Diameter (mm)	.80	.90	1.0	1.2

Tapered fissure, rounded end (tapered dome)'

Bur size	1169	1170	1171
Diameter (mm)	.90	1.0	1.2

Tapered fissure, crosscut'

Bur size	699	700	701	702	703
Diameter (mm)	.90	1.0	1.2	1.6	2.1

Pear'

Bur size	329	330	331	332
Diameter (mm)	.60	.80	1.0	1.2

Long inverted cone, rounded corners (amalgam preparation)

Bur size	245	246
Diameter (mm)	.80	1.2

End-cutting

Bur size	956	957
Diameter (mm)	.80	1.0

Thable-2.1 Shapes and diameters of regular carbide burs used for tooth preparation (US designation).

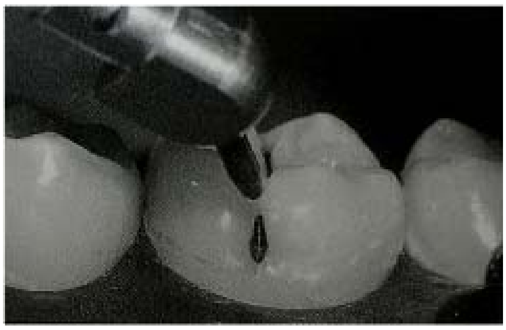
Shape								
Egg	Bur size	7404	7406	7408				
	Diameter (mm)	1.4	1.8	2.3				
Bullet	Bur size	7801	7802	7803				
	Diameter (mm)	.90	1.0	1.2				
Needle	Bur size	7901	7902	7903				
	Diameter (mm)	.90	1.0	1.2				
Round	Bur size	7002	7003	7004	7006	7008	7009	7010
	Diameter (mm)	1.0	1.2	1.4	1.8	2.3	2.7	3.1
Flame	Bur size	7102	7104	7106	7108			
	Diameter (mm)	1.2	1.4	1.8	2.3			
Cone	Bur size	7202	7204	7205	7206			
	Diameter (mm)	1.0	1.4	1.6	1.8			
Long pear (inverted taper)	Bur size	7302	7303	7304				
	Diameter (mm)	1.0	1.2	1.4				
Straight fissure	Bur size	7572	7583					
	Diameter (mm)	1.0	1.2					
Taper	Bur size	7702	7713					
	Diameter (mm)	1.0	1.2					

Table-2.2 Shapes and diameters of some of the available 12-bladed carbide finishing bur used for smooth cut in tooth preparation and finishing restorations (US designations) .

Air abrasion technology:

In the 1940s, an instrument called the Airdent (SS White) was introduced as a means of cavity preparation, and then its was reintroduced in 1980s. A large number of air-abrasion units are being used for opening fissure, for some cavity preparation (Fig-2.43).

Fig-2.43A Air-abrasion handpiece



B Cavity class I preparation.

Magnifiers:

the quality, and the serviceability and longevity of dental restoration is dependent on the ability of the operator to see what he or she is doing. Magnification devices are helpful in restorative procedure. Among the finest magnifiers are the telescopes (Fig-2.44,45).

Fig-2.44 Binocular telescopes (A,B,C).

Fig-2.45 Binocular lopes (A,B,C).

Position of operator

The position of dental team is shown in Fig-2.46). Criteria for proper positioning of the seated operator (Fig-2.47).

1. The operator is seated in an unstrained position with back straight, feet flat on the floor, and thighs angled so that the knees are slightly lower than hip level.

2.The operator should position elbows close to sides, and shoulders should be relaxed.

3.The oral cavity should be positioned at the operator"s elbow height.

4.The operator"s head should be positioned facing forward with eyes focused downward.

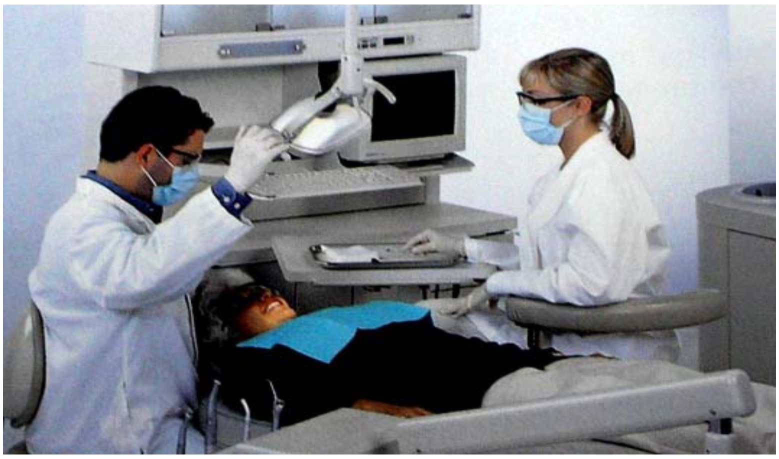


Fig-2.46 The operators position themselves correctly for procedure.

Fig-2.47 Proper positioning for a seated operator.

5. The table 2.3 and Fig-2.48shown zones for a right-handed and a left-handed operator.

6.An instrument is retrieved from the tray setup using the thumb, index, and middle finger of the left hand (Fig-2.49)

7.The used instrument is retrieved at the end of the handle, or opposite end of the working end, using the last two fingers of the left hand (Fig-2.50).

8.The new instrument is transferred in the transfer zone and positioned firmly into the operator"s grasps (Fig-2.51).

Thable-2.3 Operating Zones

Zones	Description
Static zone	Directly behind the patient. A dental unit and a mobile cabinet can be positioned here.
Operator's zone	To the side of the patient. The dentist is seated and moves in this area.
Assistant's zone	To the opposite side of the patient from the operator.
Transfer zone	Directly over the patient's chest. This is the area where the instruments and dental materials are exchanged. Special caution must be taken not to transfer anything over the patient's face

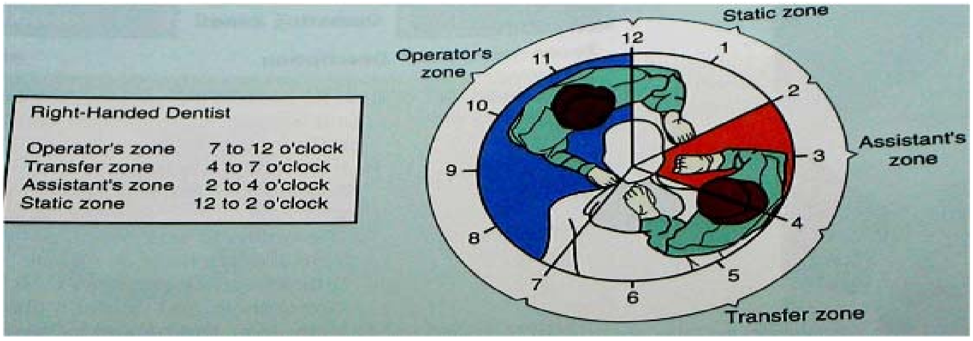


Fig-2.48(A)Operating position for a right handed dentist, left zones.

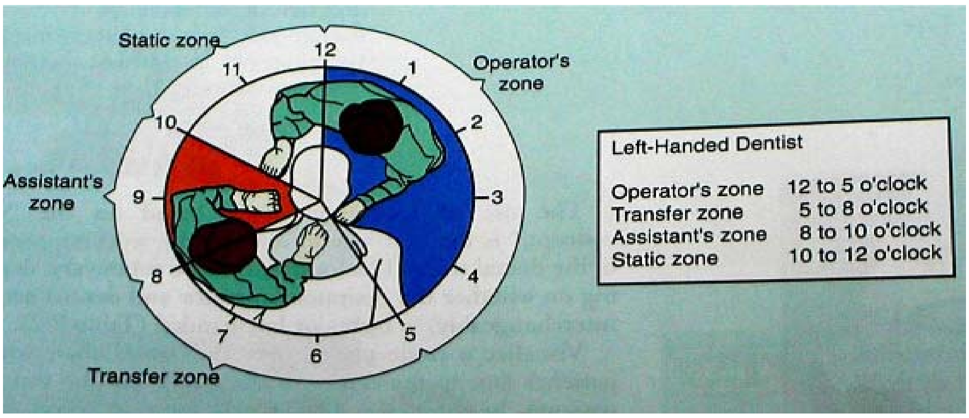


Fig-2. 48(B) Right zones for left handed dentist.

Fig-2. 49Retrieving an instrument from the tray setup.

Fig-2.50 The used instrument is retrieved from the operator.

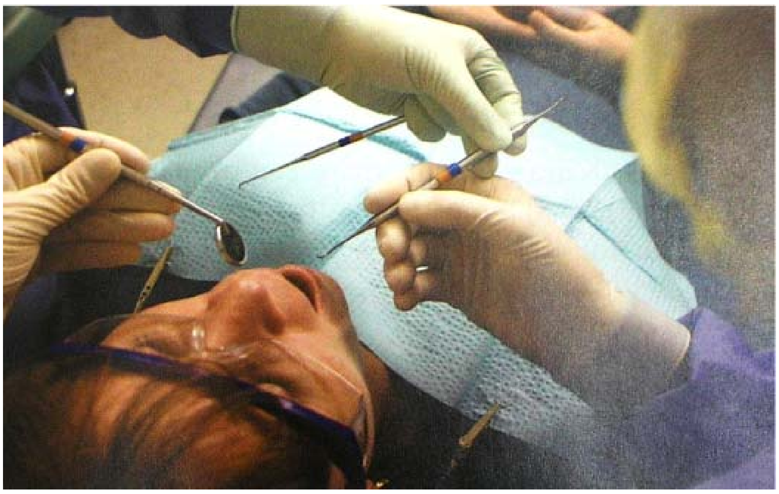


Fig-2.51 The new instrument is positioned in the operator's grasp.

9.Operator"s grasp in receiving an instrument depends on type of instruments (Fig-2.52).

10.Beginning a procedure, transferring the mouth mirror and explorer (Fig-2.53).

11.Transferring the hinged instrument and cotton pliers (Fig-2.54,55). All dental instruments and materials are generally delivered to operator near the patient"s chin.

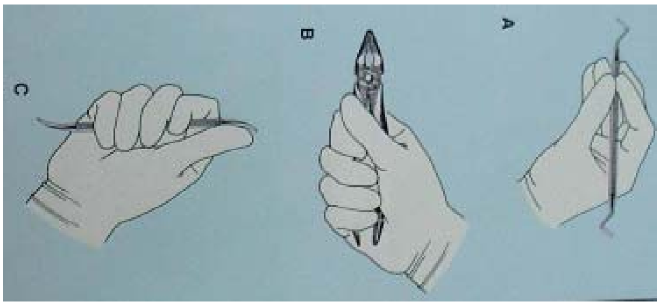


Fig-2.52 Basic instrument grasps used By operator, A pen, B Palm, C Palm-thumb

Fig-2.53 Transferring the mirror and explorer.

Fig-2.54 Transferring cotton pliers. instrument.

Fig-2.55 Transferring a hinged

3. Dental Caries.

What is caries?

Dental caries is a process that may take place on any tooth surface in the oral cavity where a microbial biofilm (dental plaque) is allowed to develop over a period of time. Although there are some 300 bacterial species in dental plaque. Plaque formation is a natural, physiological process, which is an example of a biofilm, a community of micro-organism attached to the tooth surface. The bacteria in the biofilm are always metabolically active, causing minute fluctuations in pH. These may cause a net loss of mineral from the tooth when the pH is dropping. This is call demineralization. Alternatively, there may be a net gain of mineral when the pH is increasing. This is call remineralization. The cumulative result of de- and remineralization process may be a net loss of mineral and a carious lesion can be seen. Alternatively, the changes may be so slight that a carious lesion never becomes apparent (Fig-3.1)Levine (1977) established the chemical relationship of enamel plaque and the factor which determined the movement of mineral from saliva/plaque to enamel and vice-vesra, which he termed as the ionic see saw mechanism (Fig-3.2).

Fig-3.1 Upper (with plaque), lower (removed plaque).

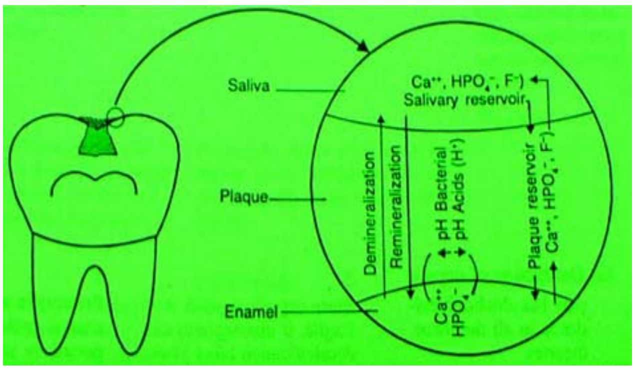


Fig-3.2 Levine's ionic see saw theory of dental caries.

There are also can be seen figure of various type of caries. The classifications of dental caries are as follow;

1.Pit and fissure:

2.Smooth surfaces

3.Enamel caries

4.Root caries (Geriatric caries)

5.Primary caries

6.Secondary or recurrent caries

7.Residual caries

8.Active carious lesion

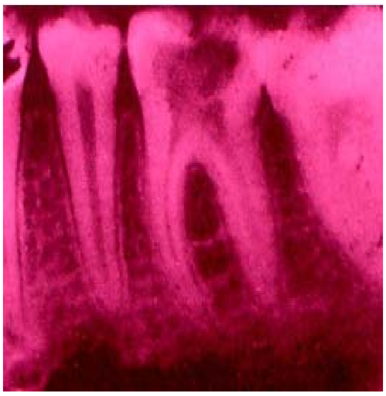
9.Inactive or arrested carious lesion

10.Rampant caries.

11.Early childhood caries (adolescent caries)

12.Bottle caries or nursing caries.

Fig-3.3 Caries in the pit, fissure, and smooth surfaces



caries on the smooth surface (Buccal surface) as see in the radiograph

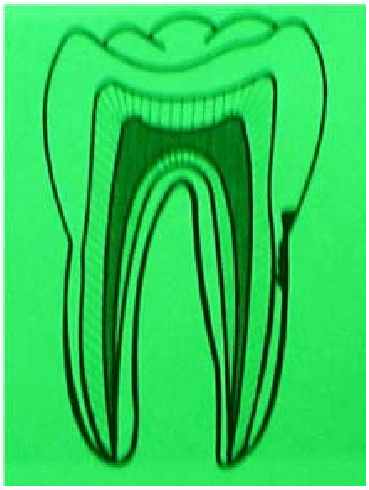


Fig-3.4 Root caries

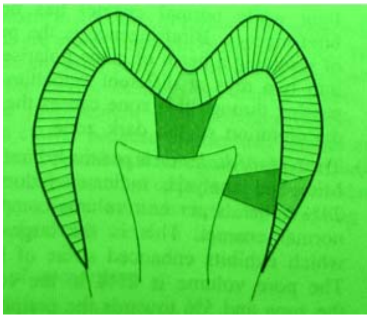


Fig-3.5 Progress of caries in the pit, fissure, and smooth surface.

Fig-3.6 Secondary caries on the On the margin of amalgam restoration.

Fig-3.7 Secondary caries on On the margin of tooth colour Restoration

These dental caries also can be three groups as follow;

A. According to morphology (anatomy) of teeth: Pit and fissure caries (type I), occurring on anatomical pit and fissure of all the teeth. Smooth surface caries (type II), occurring on smooth surface of the teeth. Root caries occurring at the cemento-enamel junction or cementum. This occurs in older age when the gingival recession, it is also known as geriatric caries.

Fig-3.8 Fissure caries on occlusal.

Fig-3.9Smooth surface caries C-II.

Fig-3.10 Caries on the root surface.

B. According to severity and progress of lesion:

Incipient caries appears as a white opaque region on any tooth surface. A white lesion or incipient lesion can undergo remineralization thereby reversing the process. Rampant caries, involving at lest two teeth and two surfaces. Arrested caries may become arrest, if there is a change in oral environment, it appears as a dark brown pigmentation with smooth surface, and it will be on occlusal as well as interproximal surfaces. Recurrent caries occurs at interface of tooth and restorative material because of many factors such as defective cavity preparation, microleakage, and combination of these. **Radiation** caries, one of the complications of radiotherapy of oral cancer lesions is xerostomia, which leads to an early development of widespread caries.

Fig-3.11 Arrested caries (A) Second molar, (B) First molar, (C) second molar.

Fig-3.12 Rampant caries in a 19 years old man, teeth look clean

Fig-3.13 Rampant caries, teeth not clean.

(poor oral hygiene)

Fif-3.14 teeth discoloured to obvious

plaque deposits.

Fig-3.15 Radiation caries. This patient has been irradiated in the region of the salivary glands for the treatment of a malignant tumour. Heavy plaque deposite are obvious over the lesions.

C. According to age pattern:Nursing bottle caries, in early infancy period, bottle-fed babies develop caries usually on maxillary incisors. The prolonged breastfeeding especially at night can also result in such caries. Adolescent caries, acute caries attack is usually seen at 4-8 yrs of age. Caries attack after this period is usually characterized as adolescent caries. Geriatric caries occurs in older adults around age of 50 or so is referred to as geriatric caries. Usually caries of cementum falls under this category.

Fig-3.16 Nursing bottle caries (rempant).

Fig-3.17Early childhood caries.

Fig-3.18 Arrested (geriatric) caries can be seen on the gingival margin of teeth.

The carious process and the carious lesion

The word caries is used to denote both the carious process and the carious lesion, which forms as a result of that process. The carious process occurs in the biofilm at the tooth or cavity surface and the carious lesion that form on the tooth tissue; the interaction of the biofilm with dental tissues result in the lesion in the tooth. The metabolic activity in the biofilm cannot be seen, but the lesion, which is its reflection or consequence, can be seen. Thus the dentist is working on a reflection, and there is a danger that the dentist might forget that the action in the biofilm. Carious lesions can form on any tooth surface, thus they can form on enamel, cementum, or dentine.

Dental plaque

Dental plaque is an adherent deposit of bacteria and their products, which forms on all tooth surfaces and is the cause of caries. The plaque is a biofilm- a community of microorganisms attached to a surface (Fig-3.13,Fig-3.14,Fig-3.15, and Fig-3.19). The organisms are organized into three-dimensional structure enclosed in a matrix of extracellular material derived from the cells themselves and their environment. Dental plaque formation can be described in sequential stages;

1. Formation of pellicle: an acellular, proteinaceous film, derived from saliva, which forms on a naked tooth surface.
2. Within 0 – 4 hours, single bacterial cell colonize the pellicle, a large proportion of these are streptococci (S. sanguis, S. oralis, S mitis). There are also Acintomyces species and Gram-negative bacteria. Only about 2% of the initial streptococci are mutans streptococci, and this is of interest because these organisms are particularly associated with the initiation of the carious process.
3. Over the next 4 –24 hours, the attached bacteria grow, leading to the formation of distinct microcolonies.
4. In 1-14 days, the Streptococcus- dominated plaque changes to a plaque dominated by Actinomyces. Thus, the population shifts; this is called microbial succession. The bacterial species become more diverse and microcolonies continue to grow.
5. In 2 weeks, the plaque is mature but there are considerable site-to-site variations in its composition. Each site can be considered as unique and these local variation may explain why lesion progress in some sites but not other in the same mouth.

Epidemiology of dental caries

Epidemiology is the study of health and disease states in population rather than individuals. The epidemiologist defines the frequency and severity of health problems in relation to such factors as age, sex, geography, race, economic status, nutrition, and diet. Epidemiological surveys are importance

to politicians because they should indicate areas of need where public money may be spent appropriately.

1. **measuring caries activity**: in the case of dental caries, the measurements of disease are used as follow,the number of decayed teeth with untreated carious lesions (D)

the number of teeth which have been extracted and are therefore missing (M)

the number of filled teeth (F).

The measurement is known as DMF index

2. **practical problems with DMF and def indices:** there are some potential problems in the use of these indices. In young children missing deciduous teeth may have been last as a result of natural exfoliation, and these must be differentiated from teeth lost due to caries. Permanent teeth are lost for reasons other than caries, such as trauma, extraction for orthodontic purpose and periodontal disease, or to facilitate the construction of dentures. For this reason missing teeth may be omitted from the indices and only decayed and filled surface included.
3. **the relevance of diagnostic thresholds:** the recording of caries in epidemiological surveys is usually carried out at the caries into dentine level of diagnosis, enamel lesions are not recorded, which mean that epidemiological surveys inevitably underestimate the caries problem.
4. **Caries prevalence:** dental caries is the main cause of tooth loss in people of all ages. The regular use of fluoridated toothpastes, perfectly twice a day is single factor for caries prevalence.
5. **the position in the UK:** National surveys of dental , carried out in UK every 10 years, show the most dramatic improvement in young adults but in elderly people have particular problem because;

oral hygiene may be poor if people are not able to brush or forget to do so salivary flow may be reduced by medications diet may change, with more sugar consumed.

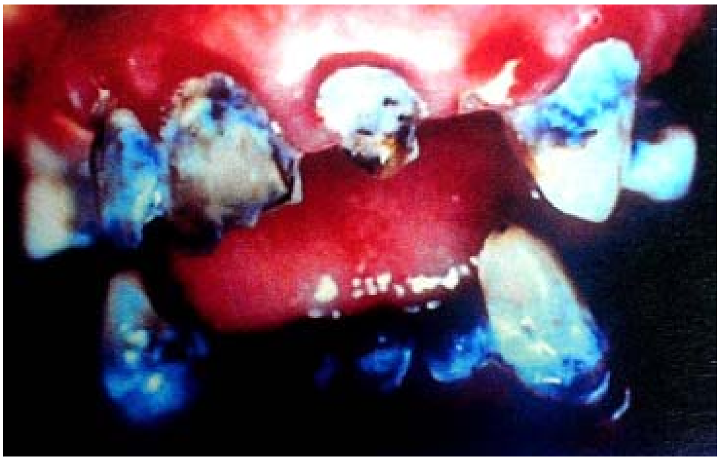


Fig-3.19 Old people (Poor Oral Hygiene) of residential home.

Modifying the carious process

Caries is a multifactorial disease. The cause is pH fluctuations in the bacterial plaque, but these in turn may be influenced by such factors oral hygiene, diet, fluoride, and salivary flow. Also important such as social class, income, education, knowledge, attitudes and behaviour. The basis of preventive, non-operative treatment is modification of one or more of the factors involved in the carious process. Since the process usually takes months or years to destroy the tooth, time is on the patient‟s side. The dentist can help the patient modify the carious process in a number of ways:

1.Oral hygiene instruction.

2.Dietary advice

3.Appropriate use of fluoride

4.Operative treatments.

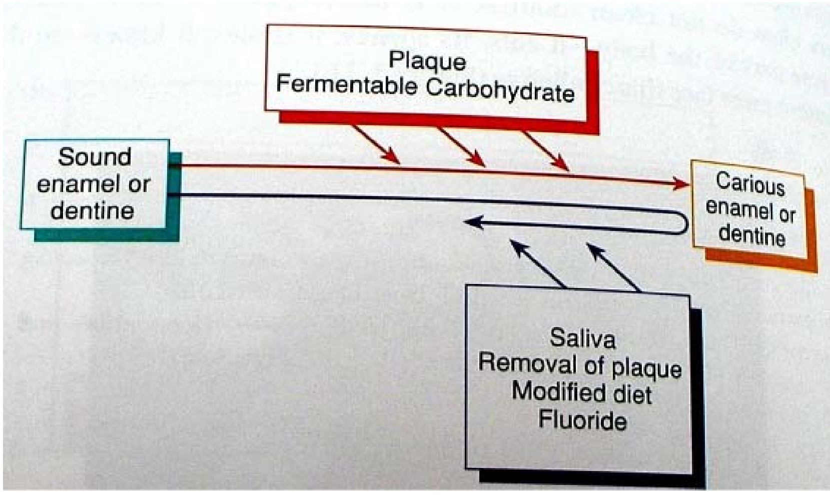


Fig-3.20 A diagrammatic representation of the carious process as an alternating process of destruction and repair. Sound enamel or dentine will become carious in time if plaque bacteria are given the substrate they need to produce acid. However, progression of lesions can be arrested by improving plaque control, modifying diet, and using fluoride appropriately

The first visible sign of caries in an enamel surface

The earliest visible sign of enamel caries is the white spot lesion; to see the white spot lesion, the plaque overlying it must be removed with a brush the tooth thoroughly dried with a three-in-one syringe (Fig-3.21), this can be done occlusally (Fig-3.24) as well as buccally (Fig-3.25) or lingually.

Fig-3.21 White spot cover with plaque.

Fig-3.22 A red dye used to stain.

Fig-3.23 Plaque removed with toothbrush

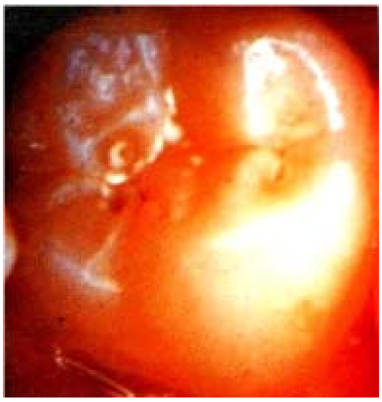


Fig-3.24 White spot on FS of MT.

Fig-3.25White spot on the buccal surfaces

The microbiology of dentine caries

The first wave of bacteria infecting the dentine is primarily acidogenic. Since demineralization precedes bacteria penetration, the acid presumably diffuses ahead of the organisms. The pH of carious dentine can be low, and members of the dentine bacterial community in active lesions tend to be acidogenic. Infected dentine has higher proportions of Gram-positive bacteria, thus lactobacilli predominate, with fewer mutans streptococci.

Active and arrested lesions in dentine

The rate of progress of caries in dentine is highly variable and under suitable environment conditions, the carious process can be arrested (Fig-3.26) and the lesion may even partly regress. The caries of dentine (Fig-3.27 and Fig-3.28) does not automatically progress. Before the enamel surface is cavitated these lesions can be arrested by preventive treatment

. It is a dentist‟s responsibility

to explain to patient how they may arrest the disease in their mouth. Once the biofilm is sitting on the dentine, demineralization can spread laterally along the enamel-dentine junction, undermining sound enamel (Fig-3.29).

Fig-3.26 Arrested lesion on the buccal aspect of the lower first molar. A small amalgam restoration is also present. These lesions are likely to have formed years earlier at the gingival margin

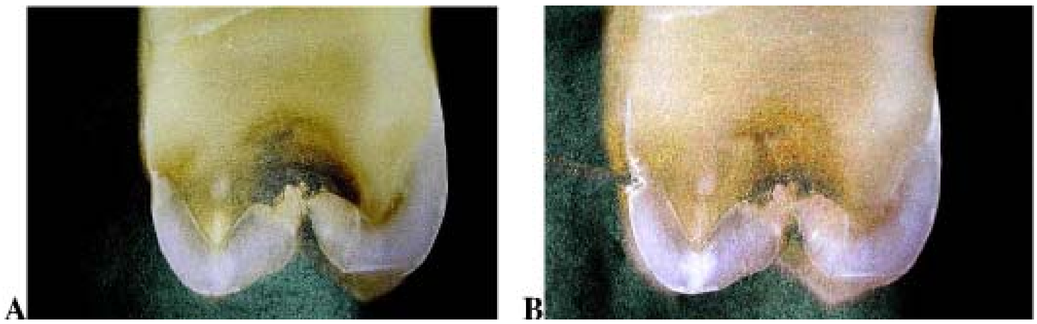


Fig-3.27 A sharp probe has been jammed into the white spot lesion on the buccal aspect of this extracted molar, (A) shows the lesion before probing and (B) shows the lesion with probe which damaging. On the occlusal surface, the enamel lesion has formed on the wall of the fissure and the lesion at the enamel-dentine junction is much under than the lesion at the enamel surface.

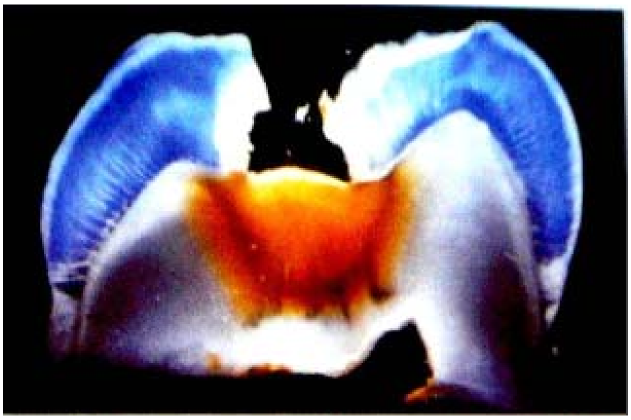


Fig-3.28 A hemisected occlusal lesion where there is a cavity in the tooth down to the dentine. At this stage, the lesion spreads laterally along the enamel dentine junction. Notice the shape of the cavity; it is wider at the base than at the top. This will prevent the patient cleaning plaque out of the hole.

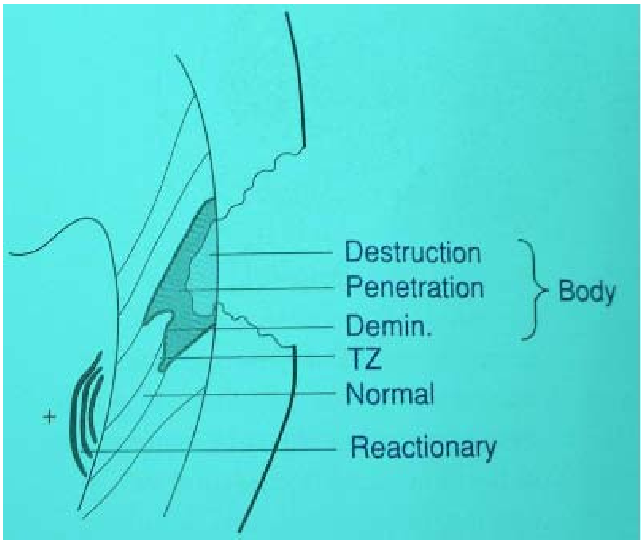


Fig-3.29 Diagram of histological changes after cavitation. Note that demineralization of enamel precedes bacterial penetration.TZ (translucent zone), DEMIN (demineralization).

Root caries

Root surfaces become exposed, these surfaces are susceptible to root caries and also appear more vulnerable than enamel to mechanical wear and chemical damage (Fig-3.30, Fig-3.31). Exposed root surface occur following gingival recession, which is usually associated with periodontal disease, and so it is hardly surprising that root caries is more commonly seen in older people. If the biofilm is regularly disturbed with a toothbrush and a fluoride containing toothpaste, the root surface will not develop a clinically detectable lesion. Despite the presence of these bacteria, active, soft root carious lesions can be converted into arrested lesion (Fig-3.32), which is minimally infected. Placing a restoration does not confer immunity on the tooth, and secondary or recurrent caries may occur in the tooth tissue adjacent to the filling material secondary caries is the same as primary caries but located at the margin of a restoration (Fig-3.33)

Fig-3. 30Root caries on (M), margin.

Fig-3.31 Caries on (B) close to gingival

Fig-3.32 Arrested lesion. Tooth brushing only can arrest it.

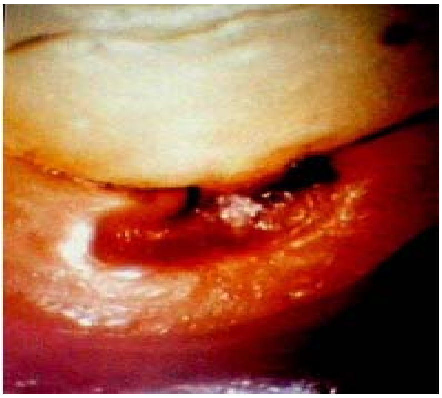


Fig-3.33 Secondary caries at the margin of tooth coloured restoration.

Secondary or recurrent caries

Secondary or recurrent caries is primary caries next to a filling caused by the biofilm at the tooth surface or the surface of any cavity. Thus, it is most often localized gingivally where plaque is most likely to stagnate (Fig-3.33, Fig-3.34, Fig-3.35, Fig-3.36). It can be arrested by regular disturbance of biofilm with fluoride-containing dentifrice. This emphasizes the point that the best way of managing caries is by preventing lesion progression and not by filling holes in teeth, even the very best operative dentistry is a poor substitute for unblemished enamel and dentine, and operative dentistry must be seen as making good a failure to prevent disease from progressing in the first place.

Operative dentistry also enables the patient to resume effective plaque control by filling the hole where plaque may stagnate

Fig-3.34 Caries on the margin of white colour restoration

Fig-3.35 Caries on the margin of amalgam restoration.

Fig-3.36 Secondary lesions (A,B, C) on the margin of previous restoration.

Residual caries

When preparing a carious tooth to receive a restoration, the dentist removes soft, infected dentine. This is a part of carious lesion, but not all of it. Demineralization of dentine precedes bacterial infection and beyond the demineralised area is the region of tubular sclerosis. The parts of the carious lesion that remain after cavity preparation are called residua caries. The nature of this tissue will depend on where the dentist has decided to stop removing tissue.

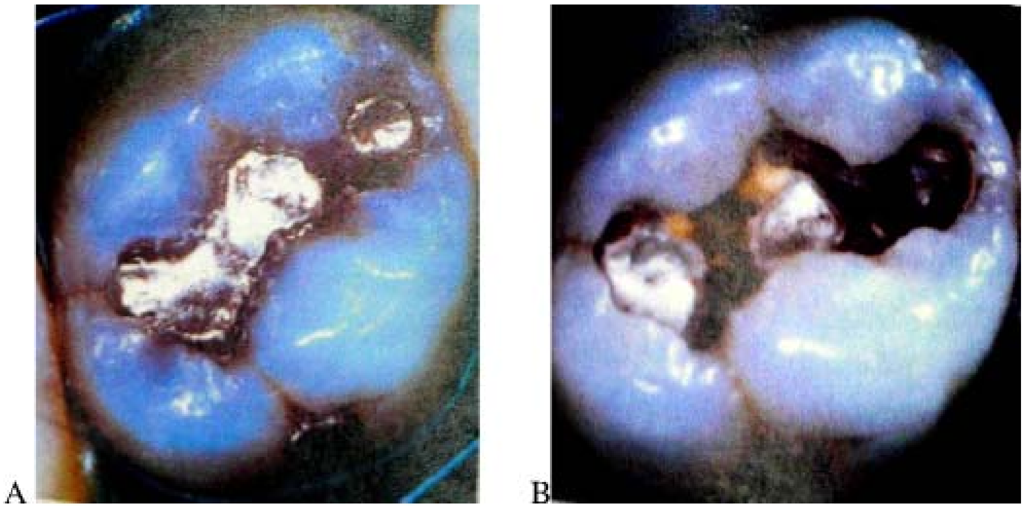


Fig-3.37 This amalgam restoration has ditched margins and the enamel around the filling is stained. The amalgam has been dissected out of the cavity. The dentine beneath is stained brown and in places has a dry and crumby texture. This is residual caries that the dentist left when the tooth was originally restored.

Why is dentine caries brown?

The possibilities seem to be;

1.The colour is comes exogenous stain absorbed from the mouth (e.g. from tea, coffee, red wine).

2.The colour comes from pigment-producing bacteria.

3.The colour is the product of a chemical reaction called the Maillard reaction. A brown colour is produced when protein breaks down in the presence of sugar (think of cutting up an apple and leaving it).

Prevention of caries by plaque control

The carious process is the metabolic activity in the plaque (biofilm). Plaque is the cause of caries, and a tooth, which is completely free of plaque, will not decay. People are not able to completely remove plaque themselves even with supervision. Increased sugar intake, decreased salivary flow speed up the carious process, and the fluoride tends to decrease the rate of mineral loss. Brushing twice daily with fluoride toothpaste has been advocated by the profession for many years. Patient should always be asked whether, and how often, they brush their teeth and what toothpaste they used. Moat toothpaste contains fluoride, but not all, and it is important to check this. The most simple and effective way to control the development and progression of caries at the individual level is to brush away plaque with fluoride toothpaste. Professional personal cleaned the teeth at regular intervals. White spot lesion can be developed in the enamel in 2-3 weeks. The prevention of caries by mechanical removal of plaque (Fig-3.38 to Fig-3.45), and a chemical agent for plaque control (the most effective is 2 % of chloehexidine mouth).

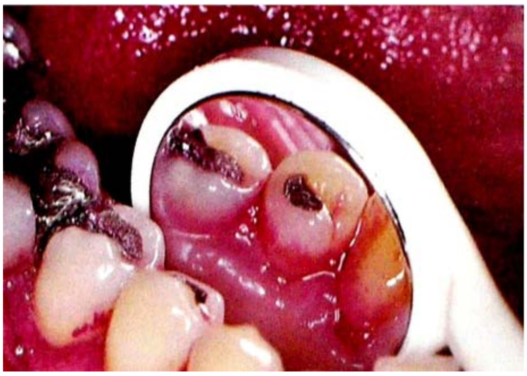


Fig-3.38 A disposable mouth mirror allows the patient to see plaque on lingual and interproximal area.

Fig-3.39 A powered toothbrush with a small, circular head that performs rotating movements (A).

Fig-3.39 The bass method of tooth brushing. Note the angulations of the bristle against the tooth surface and the direction of the vibratory motion (B)

Fig-3.40 Cleaning a partly erupted tooth with a toothbrush, bring the brush in at right angles to the arch.

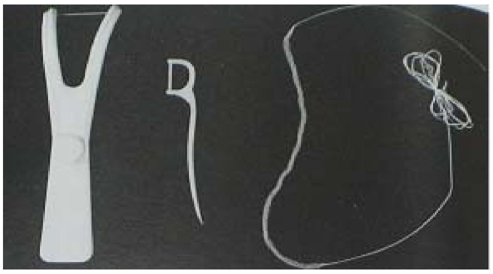


Fig-41 The use of dental tape for interproximal cleaning of upper teeth, and floss holders and super floss. Note how the controlling fingers are close together and the tape is wrapped around the surface of the tooth being cleaned.

Fig-3.42 The use of dental tape for interproximal cleaning of the lower teeth. Two index fingers are used to control the floss.

Fig-3.43 The use of super floss to remove plaque under a bridge.

Fig-3.44 The use of an interdental brush.

A


Fig-3.45 Interdental brush in various sizes

Fig-3.45 The use of a single-tufted brush for cleaning the lingual surface of a lower molar

Diet and caries

Dietary advice has an important role in the management of the carious process, in conjunction with oral hygiene and use of fluoride. Sugar is the most important dietary item in caries aetiology. Sugar is metabolized to acid by plaque microogranism. Fermentable carbohydrate and cariogenic plaque need to be present on a tooth surface for acid to produce when bacteria degrade sugars. The acid is produced by bacteria metabolism of the carbohydrate substrate. The process is well illustrated in Fig-3.19. This figure illustrates that that the resting pH attained can vary with the tooth surface under rest. Thus, plaque within active occlusal carious cavities has lower resting pH value than plaque on inactive occlusal carious lesions or sound surface. Both frequency and amount of sugar are associated with dental caries. It is more practical to advice limiting frequency of intake in sugar

Classification of sugars for dental health purposes: Sugars integrated into the cellular structure of food (e.g. in fruit) are called „intrinsic sugars". Sugars present in free form (e.g. table sugar) or add to food (e.g. sweets, biscuits) and called „extrinsic sugar"These may be more readily available for metabolism by the oral bacteria and are therefore potentially more cariogenic. Milk contains lactose but is not generally regarded as cariogenic. Cheese and yoghurts, without added sugars, may be considered safe for teeth. Thus, the most damaging sugars for dental health are „non-milk extrinsic sugars" (NMES).

Recommended and current level of sugar intake: The recommended intake of non-milk extrinsic sugars is a maximum of 60 g/gay, which is about 10 % of daily energy intake. In young people aged (4-18) years, intake of NMES was 85 g/day for boys and 69 g/day for girls. The main sources of these sugars were soft drinks and confectionery.

Starch, Fruit, and Fruit sugars: Raw starch (e.g. raw vegetable) is low cariogenicity. Cooked and highly refined starch (e.g. crisps) can cause decay, and combination of cooked starch and sucrose (e.g. cakes, biscuits, sugared breakfast cereal) can be highly cariogenic. Currently dietary advice recommended at least five portions of fruits and vegetables per day. Fruit contains sugars (fructose, sucrose, and glucose) but fresh fruit appear to be of low cariogenicity. Although the fruit juice, juicing process releases the sugars from the hole fruit, and these drinks are potentially cariogenic. Dry fruit also cariogenic, and the drying process releases some of the intrinsic sugars.

General advice: It is impossible to cut sugar completely but can be reduce the total amount of sugar intake, and restrict sugar intake mainly in meal times. Sugary foods or drinks between meals are harmful, fruit, peanuts, or cheese may be acceptable, although peanuts should not be given to children under 5 years, as a real risk of death due to inhalation of a single nut. The bedtime snack or drink is important for plaque pH may remain low during sleeping at night

Nutrational recommendations for good health;

1.Enjoy your food

2.Eat a variety of different foods

3.Eat the right amount to be a healthy weight

4.Eat plenty of foods rich in starch and fibre

5.Eat plenty of fruit and vegetables

6.Don't eat too many foods that contain a lot of fat

7.Don't have sugary foods and drinks too often

8.If you drink alcohol, drink sensibly

***Foods and drinks with low potential for dental caries*.**

1.Bread (sandwiches, toast, crumpets, pitta bread).

2.Pasta, rice, starchy staple foods

3.Cheese

4.Fibrous foods (e.g. raw vegetables)

5.Low sugar breakfast cereals (e.g. shredded wheat)

6.Fresh fruit (whole and not juices)

7.Peanuts (not for children under 5 years)

8.Sugar-free chewing gum

9.Sugar-free confectionery

10.Water

11.Milk

12.Sugar-free drinks

13.Tea and coffee (unsweetened)

Protective foods: The consumption of some foods after sugar has been shown to raise plaque pH. Cheese is useful in this respect, and can be recommended as the last course of a metal or as a safe snack. Chewing gums containing xylitol have also been shown to raise salivary pH after a sugar snack.

Fluoride supplementation

It was possible to reduce caries by supplying optimal level of fluoride. In 1930, the research of UK and US showed excessive fluoride in the drinking water, related to a low prevalence of dental caries. There is a great deal of scope to affect the fluoride concentration of enamel since it can be deposited in three stages of enamel development. Low concentrations, reflecting the low levels of fluoride in tissue fluids, are incorporated in the apatite crystals during their formation. After calcification is complete, but before eruption, more fluoride is taken up by the surface enamel which is in contact with tissue fluids. Finally, after eruption and throughout the life, the enamel continues to take up fluoride from its external environment. Enamel from newly erupted teeth also takes up more fluoride than mature enamel. Caries is chemical dissolution of the dental hard tissues by the acid produced when bacteria degrade sugars. Under the normal condition, oral fluids are supersaturated with both hydroxyapatite and fluorapatite. However, as pH is lowered in the plaque fluids below the critical pH of 5.5, plaque fluids becomes undersaturated with hydroxyapatite and a carious lesion forms. The first sign of excessive intake of fluoride during the tooth eruption, the tooth with fluorosed or mottled enamel. When fluorosis is mild, enamel merely loses its lustre and, when dried, opaque white flecks or patches can be seen (Fig-3.46).Mild fluorosis (Fig-3.47) shows in a child where the water is fluoridated. Fluoride occurs naturally in water supplies, at low concentration. In USA, artificially added fluoride in water supplies. The effect water fluoridation on dental caries show a reduction in caries in both deciduous and permanent dentations of about 50 %. Water fluoridation is the most cost-effective public health measure to control dental caries. The materials, fluoride supplements are as follow;

1.Fluoride in drinking water

2.Salt fluoridation

3.Fluoride in toothpaste

4.Fluoride mouthwashes

5.Fluoride varnish

Fig-3.46 Mild fluorosis. Note white flecks on upper anterior teeth (A). Moderate fluorosis. Note white striations and yellow-brown discolouration on central incisors (B). Severe fluorosis. Note loss of enamel.

Fig-3.47 This patient shows mild fluorosis and spent his childhood in Birmingham, UK, where the water is artificially fluoridated. There is cloudy, diffuse mottling in the incisal third of the teeth, blending with the surrounding enamel, cervically, horizontal white lines can be seen.

Saliva and caries

Saliva is very important in countering pH drops, and this is one reason why people with dry mouths are a high risk of active caries. Saliva is a complex oral fluid consisting of a mixture of secretions from the major salivary glands and the minor glands of the oral mucosa. Ninety percent of saliva is produced by the three pairs of major glands; parotid, submandibular, and sublingual. The rest of it is produced by thousands of minor salivary glands distributed throughout the mouth and throat. Most of the saliva is produced at meal times as a response to stimulation due to tasting and chewing. For the rest of the day, saliva flow is low, the constant slow flow of saliva, which moistens, and helps to protect the teeth, tongue, and mucous membranes of the mouth and oropharynx. The flow rate peaks during the afternoon and virtually stops during sleep. Saliva aids swallowing and digestion. The causes of reduced salivary flow are radiotherapy, drugs, disease, and age. Saliva can influence the carious process in several ways.

1.The flow of saliva can reduce plaque accumulation on the tooth surface and increase the carbohydrate clearance from oral cavity.

2.The diffusion into plaque of salivary components such as calcium, phosphate, hydroxyl, and fluoride ions can reduce the solubility of enamel and promote remineralization of early carious lesions.

3.Saliva proteins could increase the thickness of acquired pellicle and so help to retard the movement of calcium and phosphate ions out of enamel.

The pH of saliva shows great variation as compared to the pH of blood. The pH at which any particular saliva ceases to be saturated with calcium and phosphate is referred to as the critical pH. The typical pattern of caries development is shown in Figure-3.48.

Fig-3.48 A typical patterns of carious attack in a patient with xerostomia, in this case caused by radiotherapy in the region of the salivary glands. The cusp tips and incisal edges are typically attacked because dentine is often exposed by tooth wear in this area. Dentine is more susceptible to caries than enamel.

CARIES CONTROL STRATEGIES

- The patient should see the dentist at least every 3 months. Plaque control needs to be excellent, and professional plaque control should be considered.
- Until salivary flow returns to normal limits, the risk of caries is high. Therefore, stimulated flow rates should be measured every 3-4 months to help to establish the level of caries risk

- Rigid dietary control is impractical. However, each time the patient is seen, the opportunity should be taken to reinforce the importance of avoiding sweet drinks and snacks. The bedtime sweet drink is particularly dangerous. Taste sensation is lost during radiotherapy but when it returns, 2-4 months later, there often is a sudden craving for sweet foods and drinks. Patients should also be discouraged from attempts to stimulate salivary flow by sucking sweets. Instead, chewing a sugar-free gum containing xylitol will be safer and more effective. The use of a saliva substitute until salivary flow returns will also be helpful.
- Patients should use a sodium fluoride (0.05 % NaF) mouthrinse daily for several years to help arrest any initial carious lesions. It will also help to alleviate sensitivity from pre-existing areas of exposed dentine which have lost the protective action of saliva. A low-alcohol or water-based product with a mild taste should be chosen.

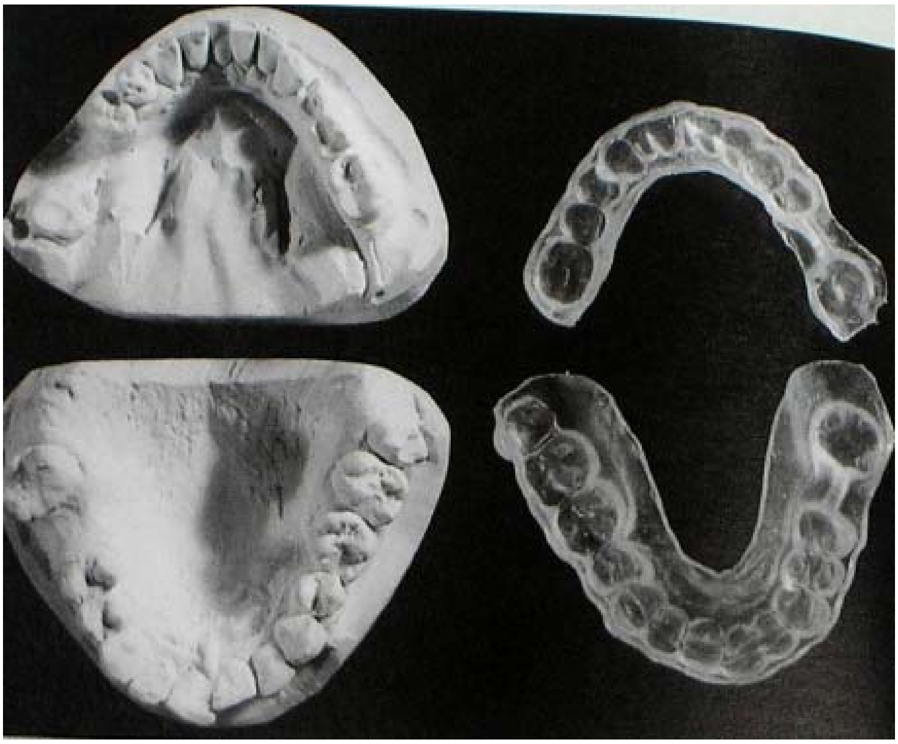


Fig-3.49 Custom-made flexible, vacuum-moulded trays for self-application of chlorhexidine or fluoride gel.

- A 1% chlorhexidine gel (Corsodyl) should be applied by the patient in custom-made applicator trays for 5 minutes every night for 14 days. This is repeated every 3-4 months until salivary flow returns to normal. Such treatment has been shown to keep the level of mutans streptococci in control for at last 3 months. Compliance with this regime can be checked before and after treatments by use of proprietary kits to measure levels of mutans streptococci. Any possible chlorhexidine staining can be removed when these patients are seen at their regular recall visits. It is important to note that chlorhexidine is inactivated by sodium lauryl sulphate, the detergent present in most toothpaste. Patients should therefore be instructed to rinse toothpaste out thoroughly before any application of chlorhexidine.

- Any patient with dry mouth should avoid smoking, alcohol, and caffeine-based drinks since any of these can exacerbated the problem.

Caries diagnosis

Diagnosis is identifying a disease from its signs and symptoms. Carious lesions may be diagnosed at any level of the carious process. For convenience, the levels are graded D (decay) follow by the number. The higher number is the more advanced the lesion.

- D1 are clinically detectable enamel lesions which intact surfaces
- D2 are clinically detectable cavities limited to enamel
- D3 are clinically detectable lesions in dentine
- D4 are lesions into the pulp.

The diagnosis of caries requires good lighting and dry, clean teeth. If deposits of calculus or plaque are present, the mouth should be cleaned before attempting accurate diagnosis. Remember to brush plaque out of the fissures because it is easy to miss a white spot lesion at the entrance to a fissure unless the surface is clean (Fig-3.50). Good bitewing radiographs (Fig-3.51) are also essential in diagnosis. Diagnosis the caries shown in (Fig-3.53 to Fig-3.59).

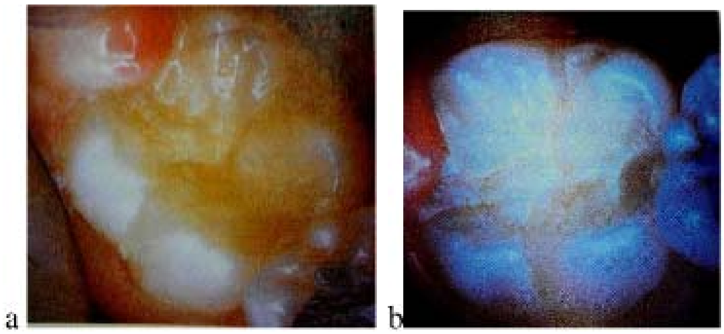


Fig-3.50 This fissure looks both clean and caries free (a). The plaque has been brushed away and the surface has been dried. The lesion is now visible as white areas at the entrance to the fissure (b).

Fig-3.51 A biteweing radiograph showing occlusal caries in the first molar. Clinically there was no obvious cavity although the enamel was discoloured (a, and b).

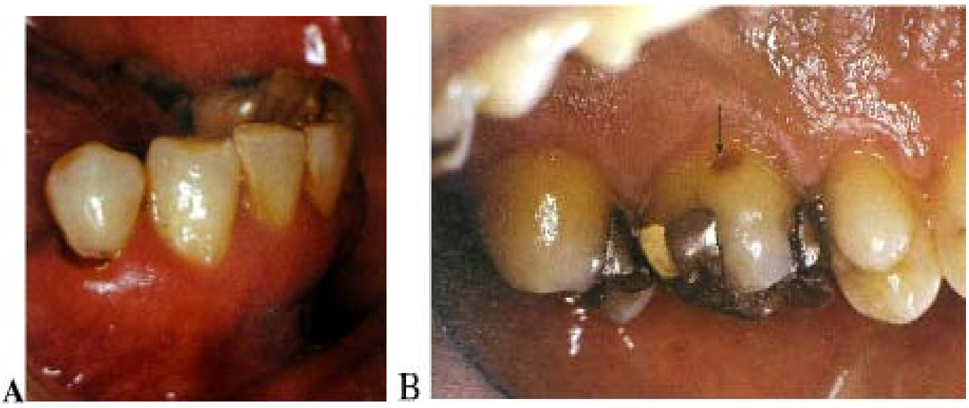


Fig-3.52 Root surface caries in an area of plaque stagnation close to the gingival margin (A). Arrested root caries in a plaque free area, coronal to the gingival margin (B).

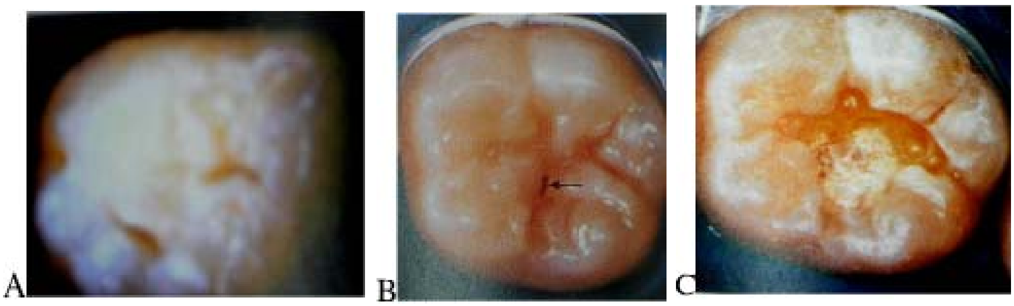


Fig-3.53White and brown spot lesions on the occlusal surface of a molar (A). A microcavity, looking like a slightly enlarge, brown fissure on a first molar (B). The soft demineralised dentine has now been removed from the tooth (C).

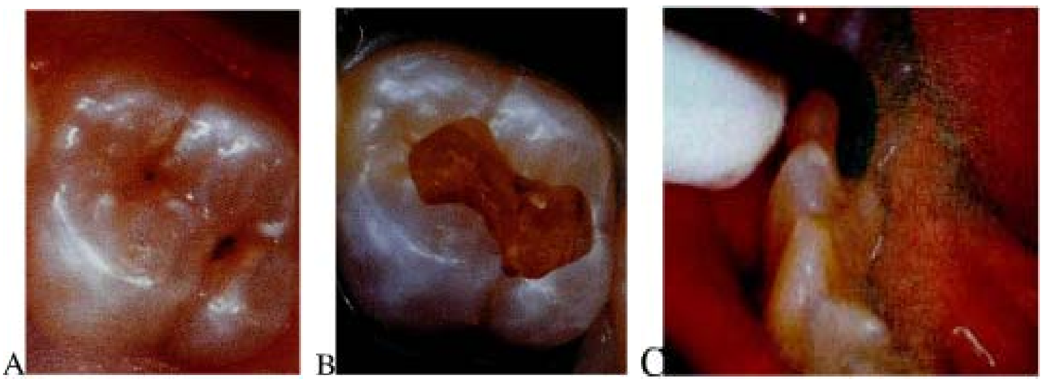


Fig-3.54 Caries on occlusal surface (A). Prepared cavity (B). The machine in use with the tip on the occlusal surface of a premolar. The surface should be clean and dry.

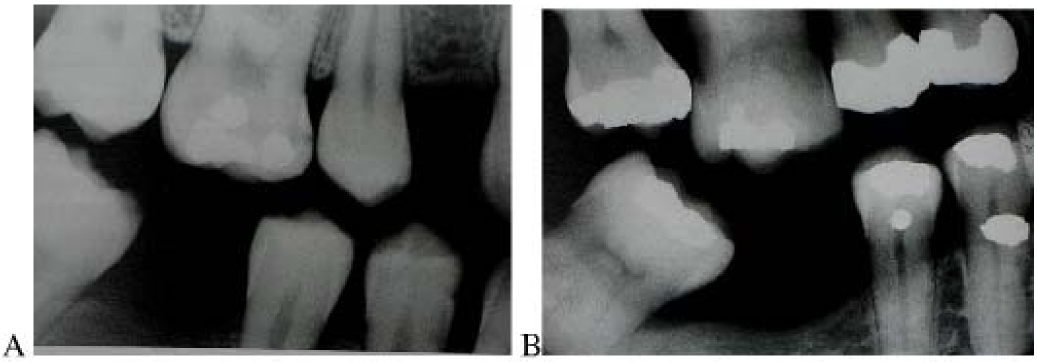


Fig-3.55 A bitewing radiograph showing caries in enamel and dental on the molar mesial (A) and distal (B) aspect of the upper first molar.

Fig-3.56 A mirror view of the palatal aspect of the upper anterior teeth. Lesions are visible mesially and distally on the upper right central incisor

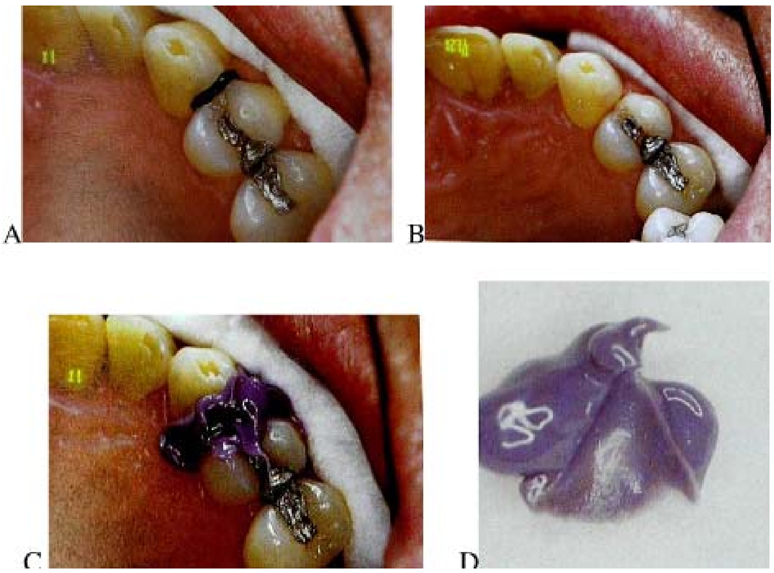


Fig-3.57 Separator is placed between the canine and first premolar (A). Separation achieved 48 hours later (B). Taking an elastomer impression of the contact area (C). Elastomer impression of the contact area showing no cavitation on the distal aspect of the canine, a restoration is not needed.

Fig-3.58 Ditched amalgam restorations

A  B 

Fig-3.59 A large amalgam restoration (A). An orthodontist's nightmare. The brackets have been removed from the teeth and multiple white spot lesions have formed because oral hygiene was poor and many sugary snacks and drinks were consumed.

The operative management of caries.

Practising dentist spend a major part of their time, and derive of their income, from repairing the ravages of dental caries. The under graduate may come to believe that the operative dentistry is the treatment of carious process, now dental school teach cariology together with operative dentistry so that student can appreciate that the carious process can be modified by preventive treatment. Thus, treatment of carious process involves both preventive and operative treatment. The preventive treatments demand the full cooperation of the patient and the operative treatment that dentist needed to place restoration for high-risk patients. The most important reason for placing a restoration is to aid plaque control. If the patient is unable to clean plaque out of a hole in a tooth, the carious process is almost bound to progress. The reasons for recommendating restorative treatments are;

- The tooth is sensitive to hot, cold and sweet. Dentine is good but when a tooth is cavitated, some of this insulation is lost. Sensitivity is less likely in chronic lesions where tubular sclerosis and tertiary dentine have reduced dentine permeability.
- The pulp is endangered
- Previous attempts to arrest the lesion, but failed and there is evidence the lesion is progressing (this usually requires an observation period of months or years)
- Function is impaired
- Drifting is likely to occur through loss of a contact point.

For aesthetic reasons. The cosmetic improvement can be very satisfying and the dentist will enjoy restoring teeth, smiles, function and dental health (Fig-3.60), cavities on free smooth surface (fig-3.62), (fig-3.63).

Fig-3.60 A Before operative restoration.

Fig-3.60 B After operative restoration.

Fig-3.61 Cavities on free smooth surfaces.

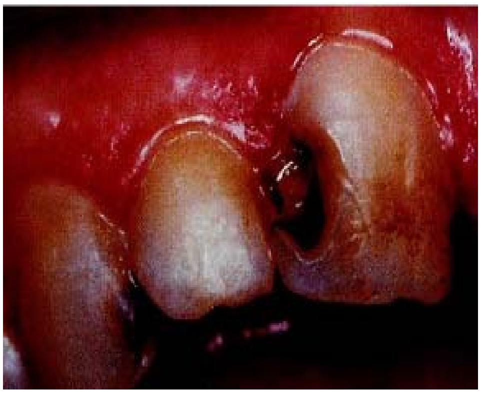


Fig-3.62 Secondary cavity on the margin of the filling.

1. Fissure Sealant procedure

Isolation

Cleaning the teeth

Etching

Washing

Drying the etched enamel

Mixing the resin

Sealant application

Checking the occlusion

Recall and reassessment

Fig-3.63(A) a wingless clamp in position on an upper molar. Floss has been attached to the holes of the clamp so that the dentist can retrieve it should the clamp fracture across the bow. (B) The floss is now threaded through the punched and lubricated hole in the rubber dam. (C) The dentist now slides the rubber over the bow of the clamp, one side and then the other side. The dental nurse gently pulls on the floss as the rubber is placed.

Fig-3.64 (A) a winged rubber dam clamp engaged in the hole in the rubber. (B) Clam and rubber are being placed on the tooth simultaneously. The dental nurse should gently retract the rubber so that the dentist can see the tooth clearly. (C) A flat plastic instrument is used to disengage the rubber from the wings of the clamp.

Fig-3.65 A rubber dam separated from the face by a soft paper towel. A rubber may be trimmed to avoid contact with the nose of the patient.

Fig-3.66 Application of the etchant gel to the occlusal surface of a lower second molar.

Fig-3.66 The dried etched area appears matt and white.

Fig-3.66 The completed fissure sealant. Note it has been applied within the etched area to ensure marginal seal.

Fig-3.67 Part of the sealant has been lost and it should be repaired.

2. Stepwise excavation

Stepwise excavation is a technique where only part of the soft dentine caries is removed at the first visit during the active phase of caries progression.

3. Caries removal

This section is going to be contentious! The current operative tradition is:

- Remove necrotic carious dentine and infected tissue with an excavator or slowly rotating round bur until hard dentine is reached.
- Now remove sufficient tooth structure to obtain a cavity suitable for the filling material of choice.
- Protect the pulpo-dential complex from further damage by placing a restoration that seals the cavity. It appears important to prevent penetration of microorganisms. Research seems to show that it is this bacterial ingress that potentially damages the pulp, rather than any toxological effect of the dental material.

However, this concept does not really fit with present knowledge of the carious process which occurs in the biofilm. It is the interaction of this biofilm with the dental tissues that results in the carious lesion. In the meantime, the author would suggest the following approach in the clinic;

- When removing caries make the enamel-dentine junction hard but do not worry about stain unless there is an appearance problem. E.g. in an anterior tooth. Staining is irrelevant to bacterial recovery.
- Excavate demineralised dentine over the pulpal surface to the level of firm dentine provided there is no likelihood of pulpal exposure
- Deep lesions, in symptomless vital teeth, should be gently excavated; soft demineralised dentine may remain where its removal might expose the pulp. A permanent restoration is placed. Do not re-enter
- Where it is not possible to remove soft, infected dentine (perhaps the patient is anxious or not cooperative), seal in the infacted dentine, in a sysptomless, vital tooth, this should have a high success rate.

4.*Active disease with temporary dressing*.

When a patient presents with multiple carious lesions, a combined preventive and operative approach will be required. This approach must include a creful history and examination, diagnosis of the cause of disease, extraction of teeth which are obviously unsavable, institution of preventive measures, and stabilization of large, active lesions. All lesions where pulpal involvement looks likely on a radiograph should be treated in the following way.

- The tooth should initially be tested to determine whether the pulp is vital. If it is, a local anaesthetic is given and access gained to the carious dentine, and demineralised tissue removed as described in the previous section. A glass ionomer cement temporary dressing is placed.
- Where caries has resulted in frank exposure of a vital pulp, removal of the pulp is often advisable to prevent pain. Eventually such teeth require root canal therapy it they are to be saved, but initially the pulp cavity may be dressed with a mild antiseptic on cotton wool and the tooth restored with a glass ionomer cement as a temporary filling. Where inadequate anaesthesia or insufficient time preclude complete removal of the coronal and radicular pulp, a vital exposure can be dressed with a corticosteroid antibiotic preparation before placing a temporary filling. These products are unrivalled in their ability to suppress the inflammatory process and hence the pain of pulpitis, but root canal therapy is the eventual treatment of choice if the tooth is to be saved.

- Where grossly carious teeth are found to be non-vital, but the teeth are restorable, the pulp cavity may be dressed with a mild antiseptic on cotton wool and the tooth restored temporary. If, however, the patient has symptoms of acute apical infection, thorough debridement of the root canal system is required before placement of a mild antiseptic dressing I the coronal pulp chamber and temporary restoration of the tooth.

4. Sharpening of Hand Instrument.

Selecting the proper cutting, instrument with dull cutting edges cause more pain, prolong operating time, more difficult to control, and reduce quality and precision in tooth preparation

Stationary sharpening stones

The most useful sharpening equipment consists of a block or stick of abrasion material called a „stone". Stationary stones are often called oilstones because of the common practice of applying a coating of oil to them as an aid to the sharpening process. Stationary stones are available in coarse, medium, or fine grit. Only fine grit stone is suitable for final sharpening of dental instrument to be used for tooth preparation. Coarse and medium grit may be used for initial sharpening of a badly damage instruments. Coarse stones cut more rapidly, but produce a rougher surface. Sharpening stones are made from any of several natural or synthetic materials. Four types of materials are in common use for sharpening stones.

1.Arkansas stone; It was naturally occur mineral containing microcrystalline quartz, white or grey in color, and hard enough to sharpening steel but carbide instruments.

2.Silicon carbide; It is the most commonly used for grinding wheels and sandpapers and for sharpening stone, it is hard enough to cut steel but not hard enough to sharpen the carbide instruments, it is normally in dark color, often black or greenish black

3.Aluminum oxide; Coarse and medium grit stones are generally brownish in color. Fine grit stones usually in white color and have superior properties.

4.Diamond; It is hardest and most effective for cutting and shaping hard materials. It is only material capable of sharpening carbide and steel instrument.

Mechanical sharpeners

As high-speed rotary cutting instruments have been improved and their use has increased, the use of hand cutting instruments and the need for resharpening has decreased. As a result, some dental office personnel do not do enough hand sharpening to remain confident of their proficiency. Under such circumstances, the use of a powered mechanical sharpener is beneficial. The Rx Honing Machine (Rx Honing Machine Corp Mishawaka IN) is an example of a mechanical sharpener (Fig- 4.1).

This instrument moves a hone in a reciprocation motion at a slow speed, while the instrument is held at the appropriate angulation and supported by a rest. This is much easier than having to hole the instrument at the proper angulation while moving it relative to the hone. Interchangeable aluminum oxide hones of different shapes and coarseness are available to accommodate the various instrument sizes, shapes, and degrees of dullness. Restoration of the cutting edge is accomplished more easily and in less time than by other sharpening methods. This type of sharpener is also very versatile and, with available accessories, can fill almost all instrument sharpening needs.

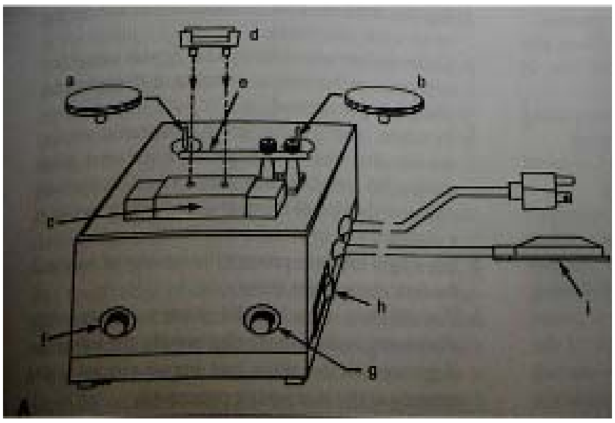


Fig-4.1 Type of mechanical sharpener

Fig-4.1Sharpening enamel hatchet.

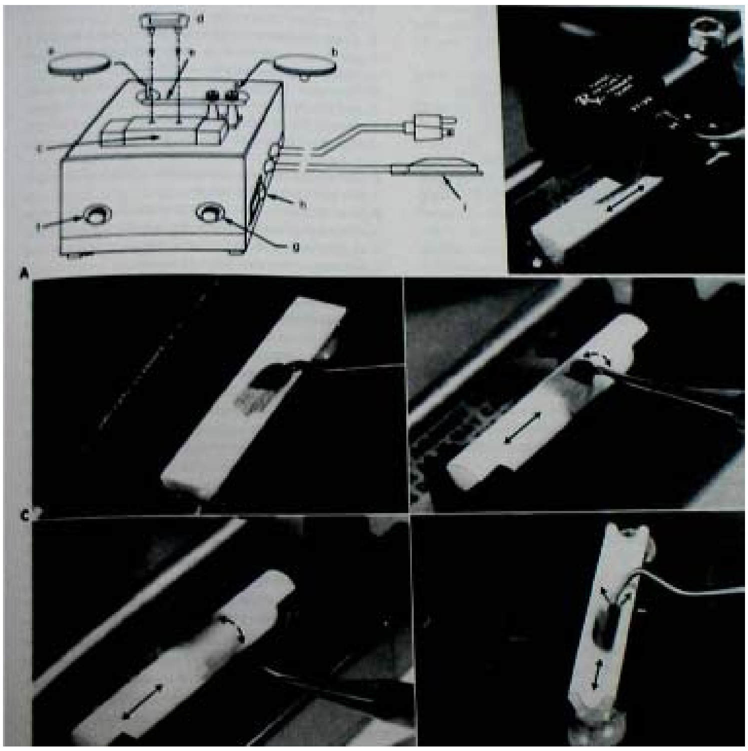


Fig-4.1 An example of a mechanical sharpener.

Handpiece sharpening stones

Mounted SiC and aluminum oxide stones for use with straight and angle handpieces are available in various size and shapes (see section on other abrasive instruments). Those intended for use in straight handpieces, particularly the cylindrical instruments with straight-sided silhouettes, are more useful for sharpening hand instruments than are the smaller points intended for intraoral use in the angle handpieces. Because of their curved periphery, it is difficult to produce a flat surface using any of these instruments. These stones also may produce inconsistent results because of the speed variables and the usual lack of a rest or guide for the instrument. Satisfactory results can be obtained, however, with minimal practice, especially on instruments with curved blades.

Principles of sharpening

The choice of equipment used for sharpening is up to the dentist. In the use of any equipment, several basic principles of sharpening should be followed:

1.Sharpen instruments only after they have been cleaned and sterilized.

2.Establish the proper bevel angle (usually 45 degrees) and the desired angle of the cutting edge to the blade before placing the instrument against the stone, and maintain these angles while sharpening.

3.Use a light stroke or pressure against the stone to minimize frictional heat.

4.Use a rest or guide whenever possible.

5.Remove as little metal from the blade as possible.

6.Lightly hone the unbeveled side of the blade after sharpening, to remove the fine bur that may be created.

7.After sharpening, resterilize the instrument along with other items on the instrument tray setup.

8.Keep the sharpening stones clean and free of metal cuttings.

Mechanical sharpening techniques

When chisels, hatchets, hose, angle formers, or gingival margin trimmers are sharpened on a reciprocating honing machine (i.e., sharpener), the blade is placed against the steady rest, and the proper angle of the cutting edge of the blade is established before starting the motor. Light pressure of the instrument against the reciprocating hone is maintained with a firm grasp on the instrument. A trace of metal debris on the face of a flat hone along the length of the cutting edge is an indication that the entire cutting edge is contacting the hone (see Fig.-1.B).

Stationery stone sharpening techniques

The stationary sharpening stone should be at least 2 inches wide and 5 inches long because a smaller stone is impractical. It also should be of medium grit for hand cutting instruments. Before the stone is used, a thin film of light oil should be placed on the working surface. In addition to establishing the proper 45-degree angle of the bevel and the cutting edge to the stone, several fundamental rules apply to using the stationary stone:

1.Lay the stone on a flat surface, and do not tilt the stone while sharpening.

2.Grasp the instrument firmly, usually with a modified pen grasp, so that it does not rotate or change angles while being sharpened.

3.To ensure stability during the sharpening strokes, use the ring and little finger as a rest, and guide along a flat surface or along the stone. This prevents rolling or dipping of the instrument, which results in a distorted and uneven bevel.

4.Use a light stroke to prevent the creation of heat and the scratching of the stone.

5.Use different areas of the stone‟s surface while sharpening because this

helps prevent the formation of grooves on the stone that impair efficiency and accuracy of the sharpening procedure.

6.When the sharpening chisels, hatchets, or hoe on the stationary stone, grasp the instrument a modified pen grasp, place the blade perpendicular to the stone and tilt the instrument to establish the correct bevel (Fig-4.2).

7.It may be expedient to use a palm-and-thumb grasp when sharpening a trimmer with a 95- or 100-centigrade cutting edge angle (Fig-4.3).

8.The blade is tilted to form small acute angle with the surface of the stone, and the stroke is straight along the stone and toward the edge of the blade only (Fig-4.4).

9.the stone may be placed on flat surface or held in the hand (Fig-4.5), and a small cylindrical stone is pass back and forth over the surface.

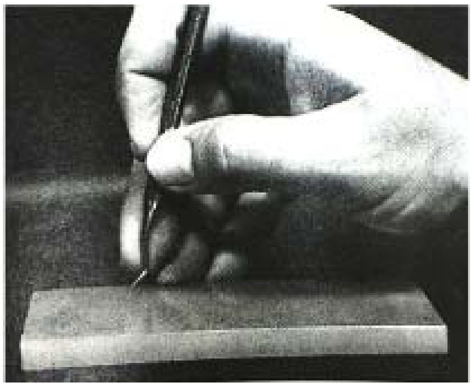


Fig-4.2 Sharpening the Instrument holds by modified Pen grasp

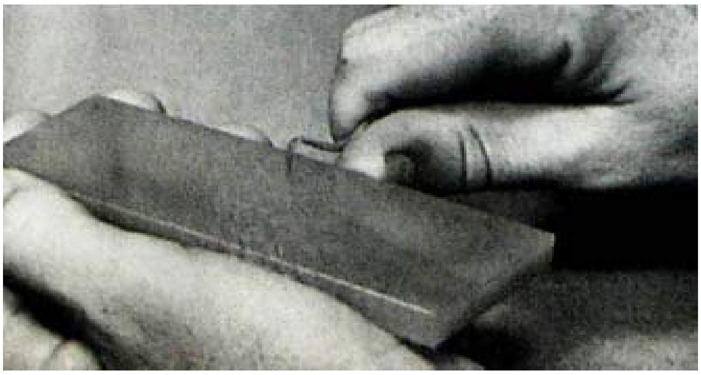


Fig-4.3 Sharpening the instrument holds by Palm-grasp.

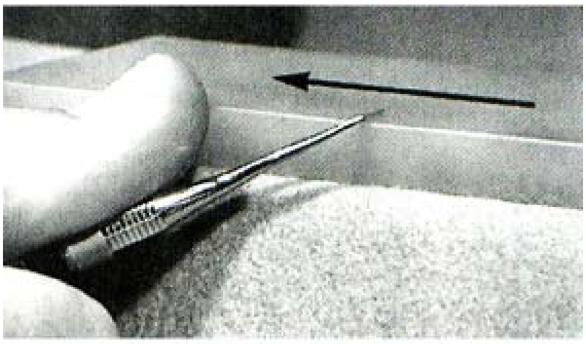


Fig-4.4 Sharpening amalgam or gold knife.

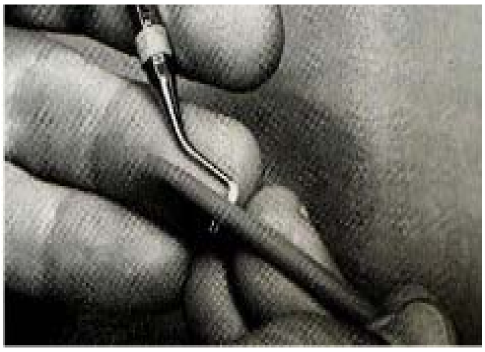


Fig-4.6 Used a small cylindrical stone

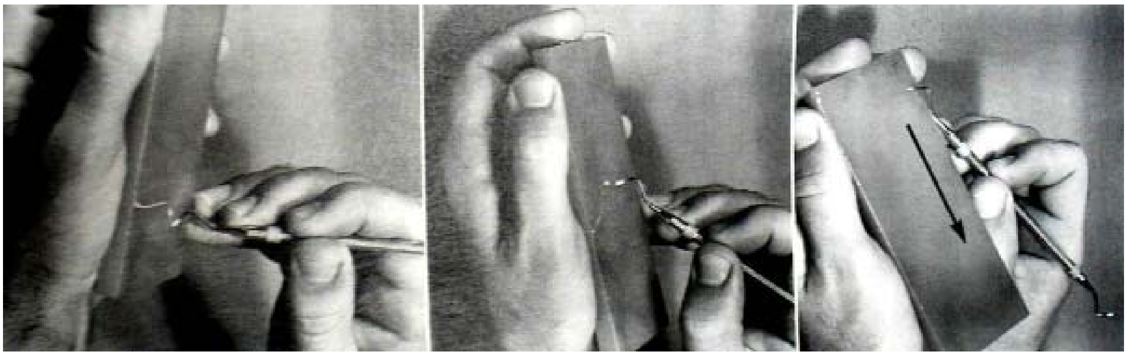


Fig-4.5 Sharpening a small spoon excavator.

Sharpness test

Sharpness of an instrument can be tested by lightly resting the cutting edge on a hard plastic surface. If the cutting edge digs in during an attempt to slide the instrument forward over the surface, the instrument is sharp. If it slides, the instrument is dull. Only very light pressure is exerted in testing for sharpness. The principles and techniques discussed provide sufficient background for the operator to use proper methods in sharpening other instruments not discussed. It cannot be overemphasized that sharp instruments are necessary for optimal operating procedures. It also has been found prudent to have multiple tray setups so that a substitute instrument is available if necessary, or substitute sterile instruments should be available so that other sterile tray setups are not disrupted by the borrowing of instruments.

It is important for the dental study of anatomy (the study of the structure of the human body) and physiology (how the human body functions). This chapter also introduces the basic terms and definition of dental physiology.

Structure of the head and neck

As a dental study, the knowledge and understanding of the structures of the head and neck will be useful for most of the dental treatment procedure. There are two type of bone;

a.Compact bone: also known as cortical bone is hard, dense, and very strong. The outer layer of bones is needed for strength, so that the outer layer of the mandible is made of a compact bone.

b.Cancellous bone: also known as spongy bone is lighter in weight and not strong as compact bone. It is found in the interior of bone, and the inner layer of the maxillary bone is made of cancellous bone. The periosteum is the specialized connective tissue covering of all bones in the body. The cranium bone was protected the brain, which is the bone of skull (Fig-5.1 to Fig-5.7).

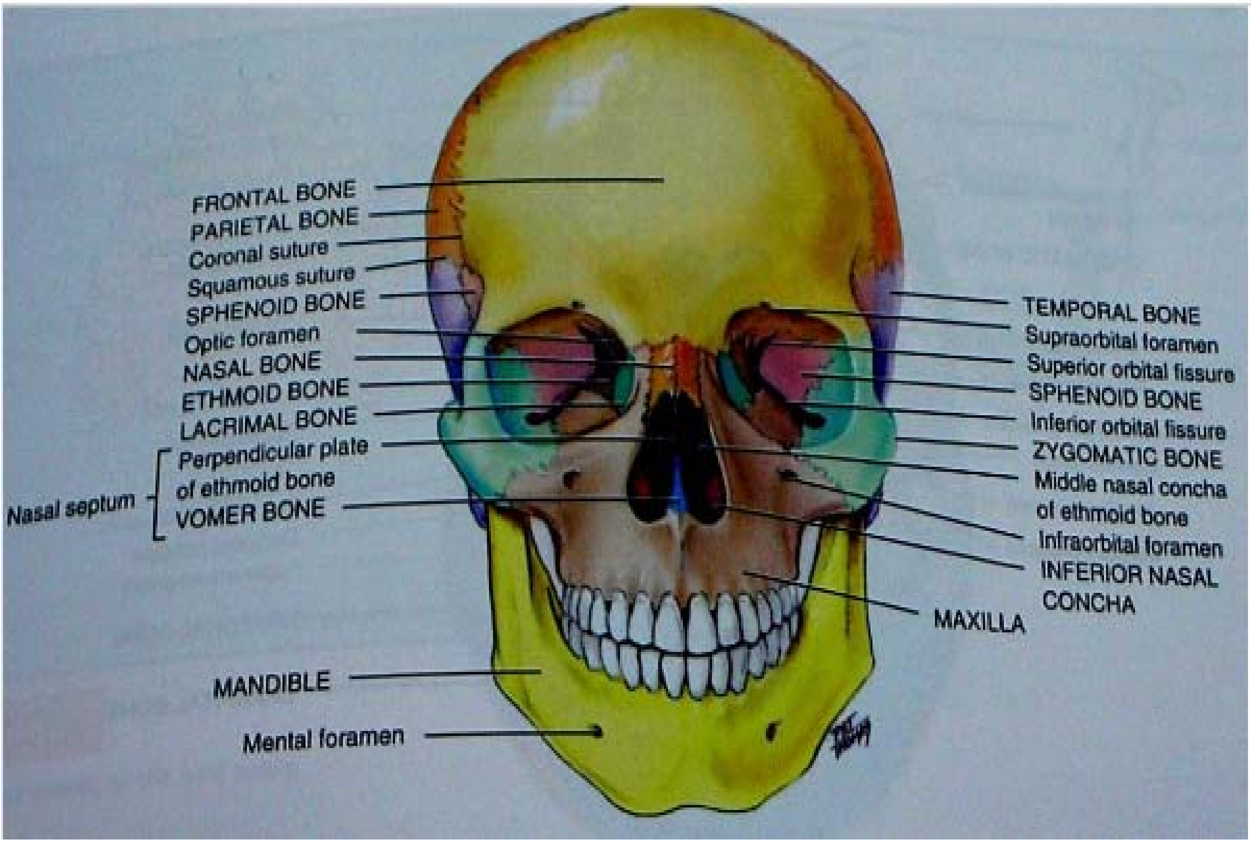


Fig-5.1 Frontal view of the skull

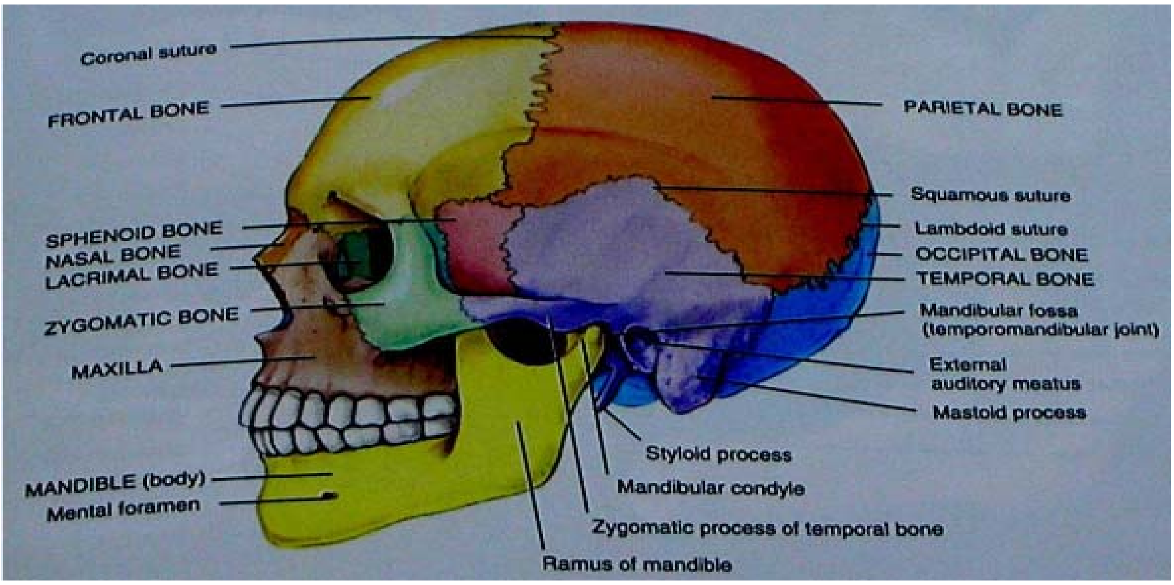


Fig-5.2 Lateral view of the skull.

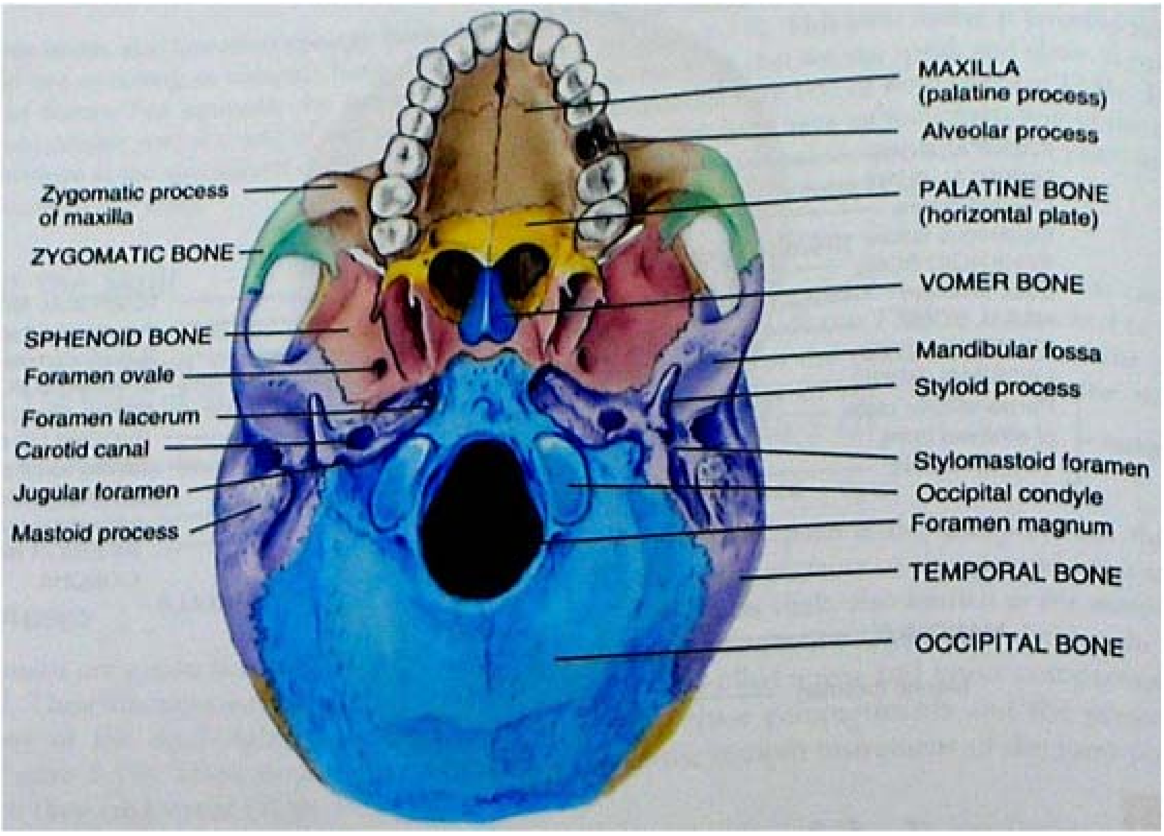


Fig-5.3 Base of skull.

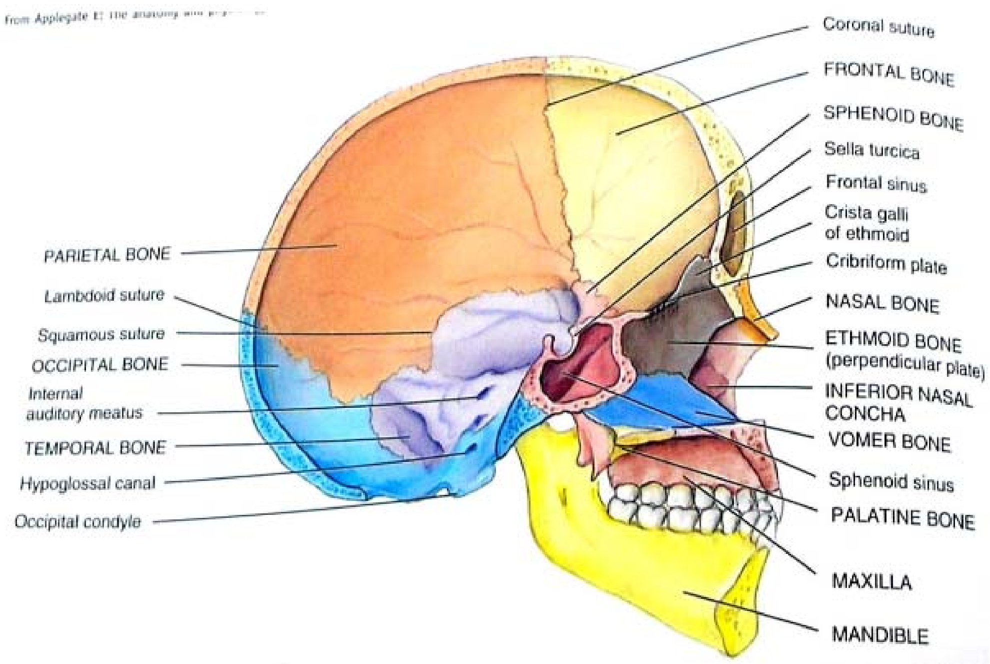


Fig-5.4 Midsagittal view of the skull.

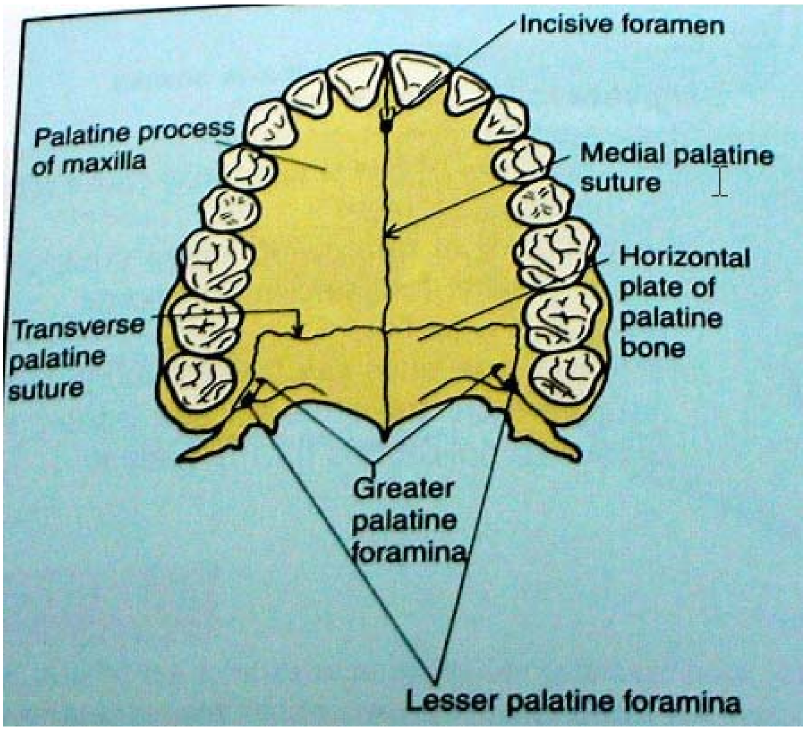


Fig-5.5 Bones and landmarks of the hard palate

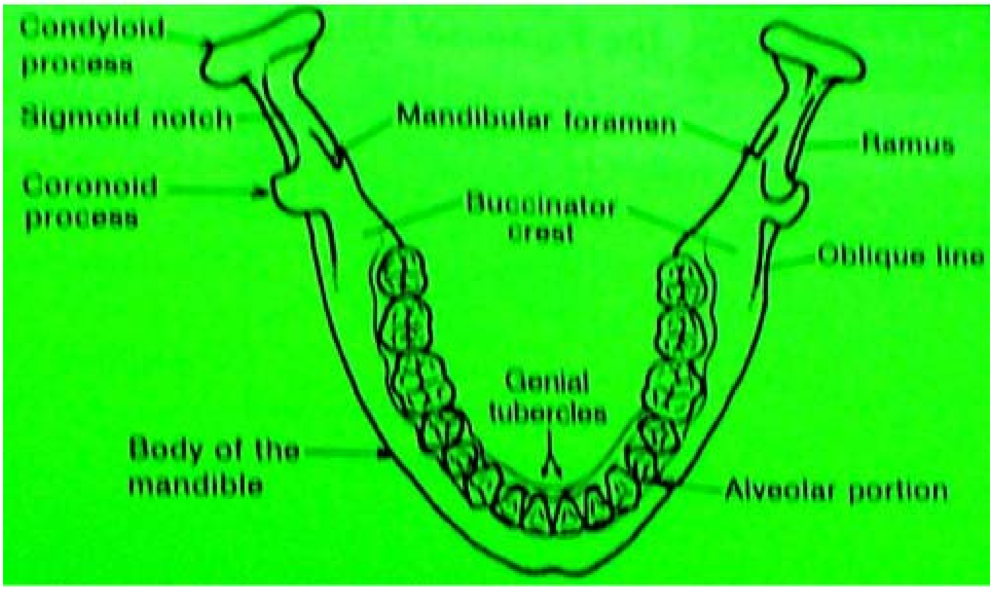


Fig-5.6 Topical view of the mandible.

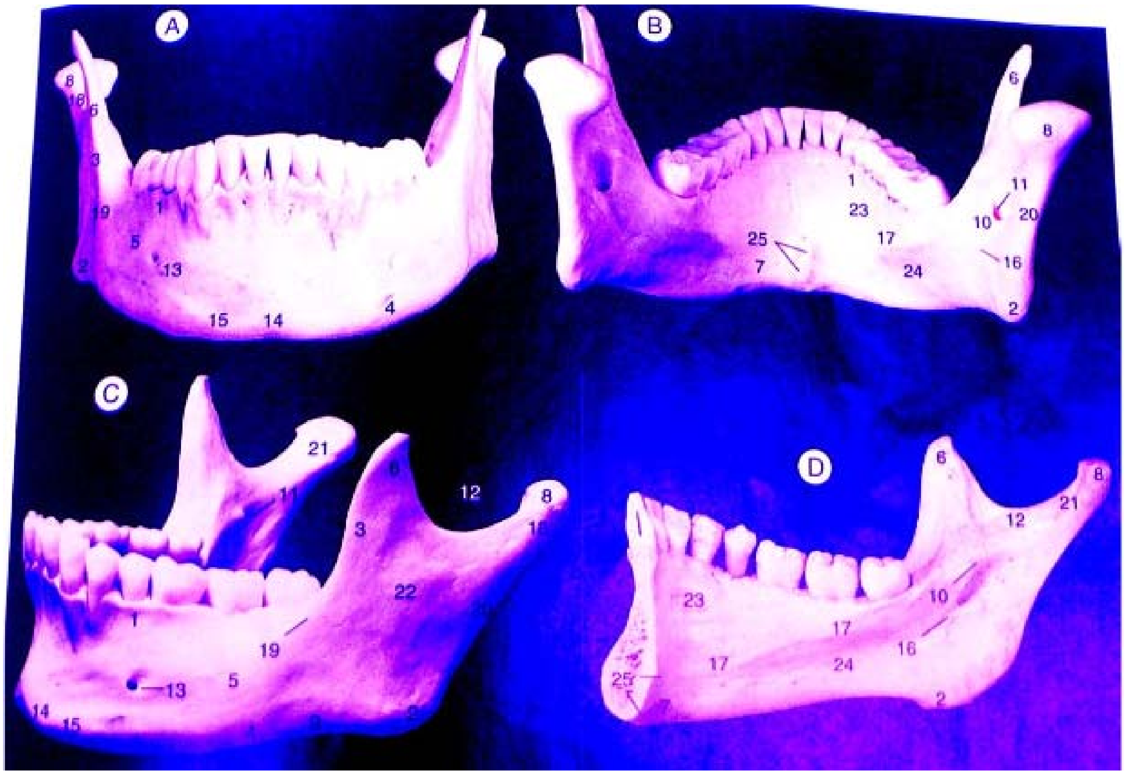


Fig-5.7 View of mandible. A, from the front. B, from behind and above. C, from the left and front. D, internal view from left.

c.The paranasal sinuses; are spaces that contain air within the bones of the skull. Their functions include providing mucus, making the bone of the skull lighter, and helping to produce sound (Fig-5.8). These sinuses are named for the bones in which they are located (Table-5.1).

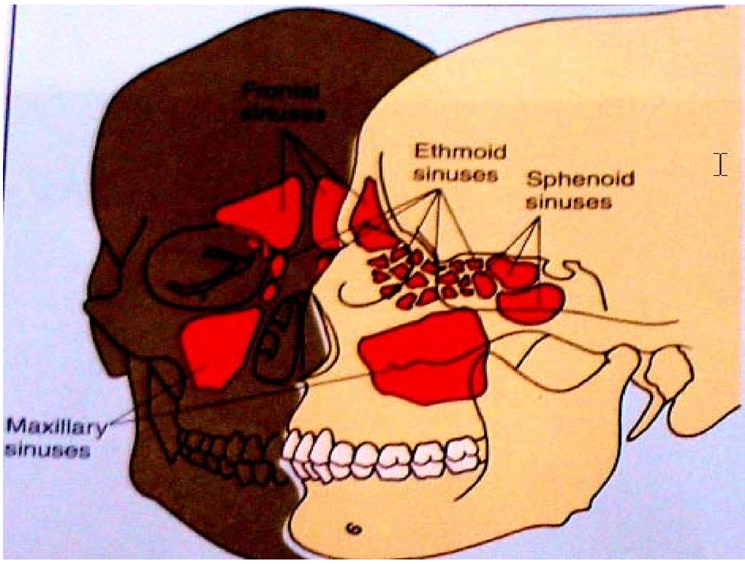


Fig-5. 8 The paranasal sinuses.

Table-5.1 The paranasal sinuses and it function.

Name of sinuses	Location	Significant of sinuses
Maxillary sinuses	In the maxillary bones, they are the largest sinuses.	Infection in any of the sinuses may causes pain in the maxillary teeth. The symptoms of sinusitis (inflamed sinuses) are headache, foul-smelling discharge, fever, and weakness. Infection in one sinus can travel through the nasal cavity to the other sinuses, leading to serious complications for the patient.
Frontal sinuses	In the frontal bone, within the forehead, just above the eyes.	
Ethmoid sinuses	In the ethmoid bone, irregularity shaped air cells separated from the orbital (eye) cavity by a very thin layer of bone.	
Sphenoid sinuses	In the sphenoid bone close to the optic nerves.	An infection in these sinuses may damage vision and / or the brain.

d.A joint (TMJ) is the junction between two or more bones. The temporomandibular joint (TMJ) is located on each side of the head where the temporal bone and the mandible join (Figure-5.9). This joint makes it possible for the lower jaw to move so that we can speak and chew. A patient may have a disorder with one or both of their TMJs. The dental professional must have an understanding of the anatomy of the TMJ, the normal movements of the joint, and any possible disorders of the joint (Figure-5.10).

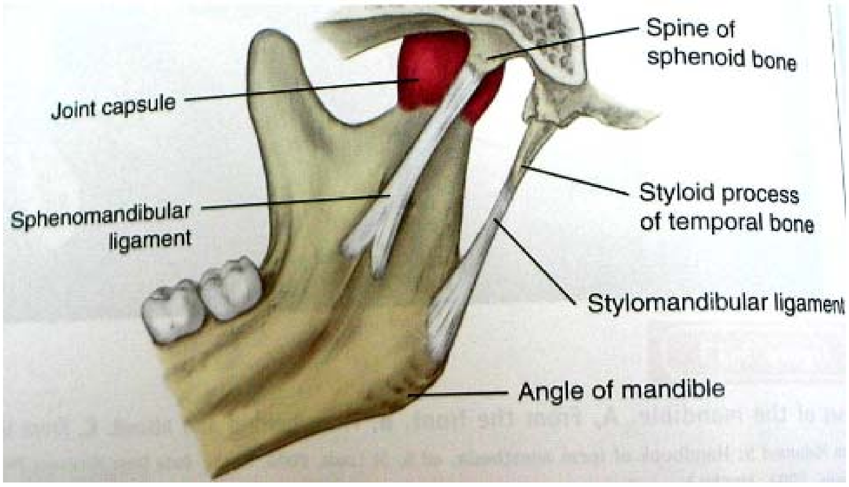


Fig-5.9 Lateral view of the skull showing the mandible and the temporomandibular joint.

Fig-5.10 Palpation of the patient during movements of both temporomandibular joints.

e.The capsular ligament is a dense fibrous capsule that surrounds the TMJ. It is attached to the neck of the condyle and to the nearby surfaces of the temporal bone. The ligaments of the TMJ attach the mandible to the cranium (Figure-5.11).

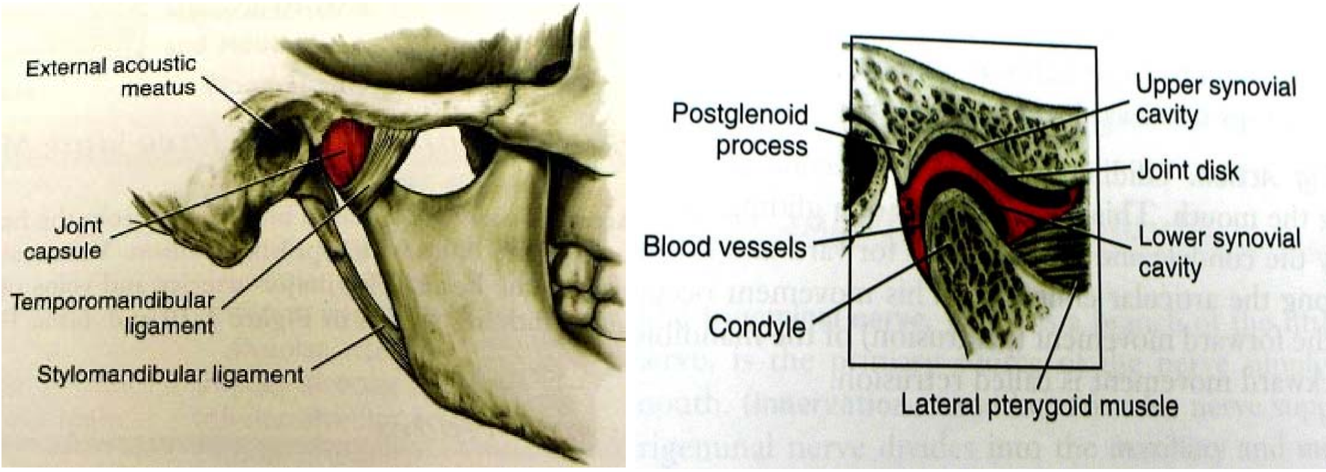


Fig-5. 11Lateral view of the joint capsule of the temporomandobular joint And its lateral ligament.

f.The articular space is the area between the capsular ligament and the surface of the glenoid fossa and the condyle. The articular disk, also known as the meniscus, is a cushion of dense connective tissue that divides the articular space into fluid-filled upper and lower compartments. The structure of these compartments and the presence of the fluid make the smooth movement of the joint possible.

g.The TMJs are constructed for specialized hinge-and-glide movement, which allow the mouth to open and close (Figure-5.12). Hinge action is the first phase in opening the mouth. During this movement, the body of the mandible drop downward and backward. Gliding action is the second phase in opening the mouth. This phase consists of a gliding movement by the condyle and articular disk forward and downward along the articular eminence. This movement occurs during the forward movement (protrusion) of the mandible. The backward movement is called retrusion.

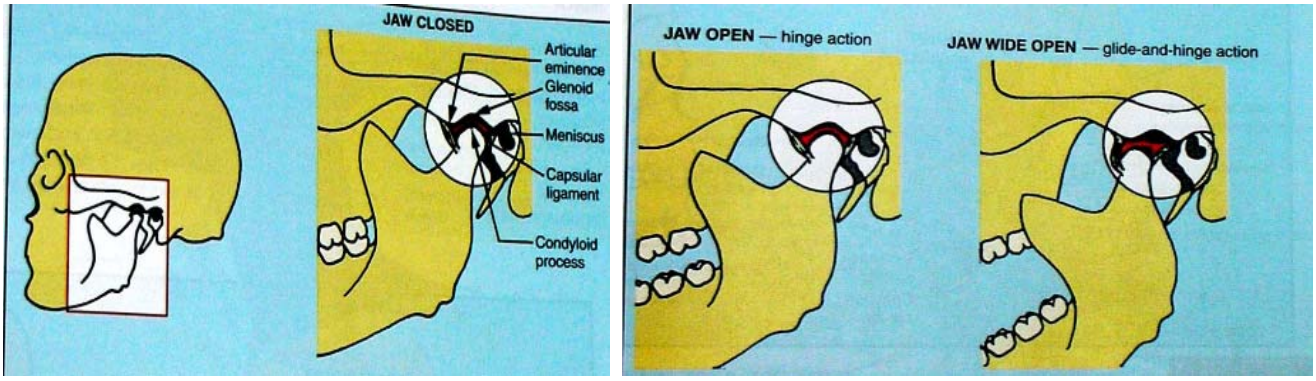


Fig-5.12 Hinge and gliding actions of the temporomandibular joint.

Major muscles of mastication and facial expression

The muscles of mastication are responsible for closing the jaws, bringing the lower jaw forward and backward, and shifting the lowaer jaw side to side. The muscles of mastication work with the TMJ to accomplish these movements (table-5.2) and Fig-5.13.

Table-5.2 The muscles of mastication and facial expression.

Muscle	Function
Buccinator	Compresses the cheeks and holds food in contact with the teeth.
External (lateral) pterygoid	Depresses, protrudes, and moves the mandible from side to side.
Internal (medical) pterygoid	Close and aids in sideways movement.
Masseter	Raise the mandible, close the jaws, and occludes the teeth.
Mentalis	Raise and wrinkles the skin of the chin and pushes up the lower lip.
Orbicularis oris	Close and puckers the lips, aids in chewing by pushing the food against the teeth.
Temporal	Raise the mandible, close the jaw, and occludes the teeth.
Zygomatic major	Draws the angles of the mouth upward and backward, as in laughing.

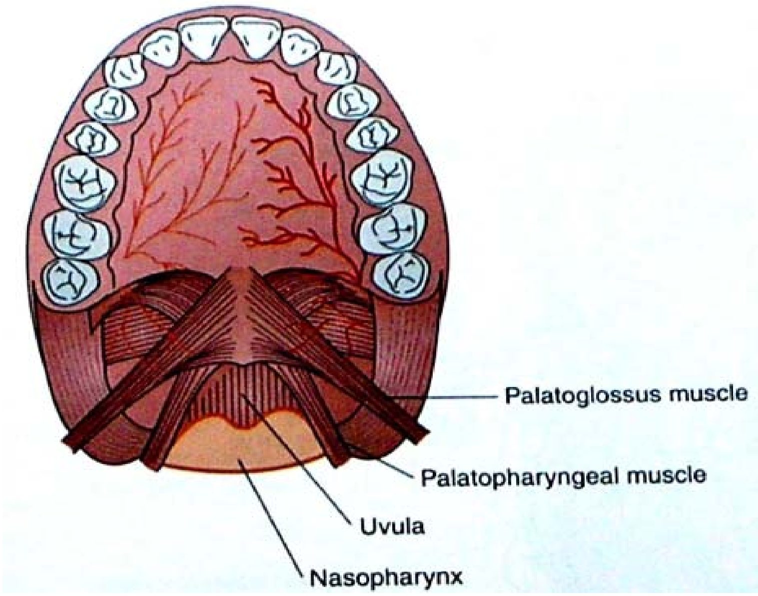


Fig-5.13 Muscle of the soft plate.

Blood supply to the face and mouth

Arteries carry oxygenated blood away from the heart to all parts of the body with a pulsing motion. Veins carry blood back to the heart. The major arteries and veins of the face and mouth are shown in Figure-5.14 and Table-5.3.

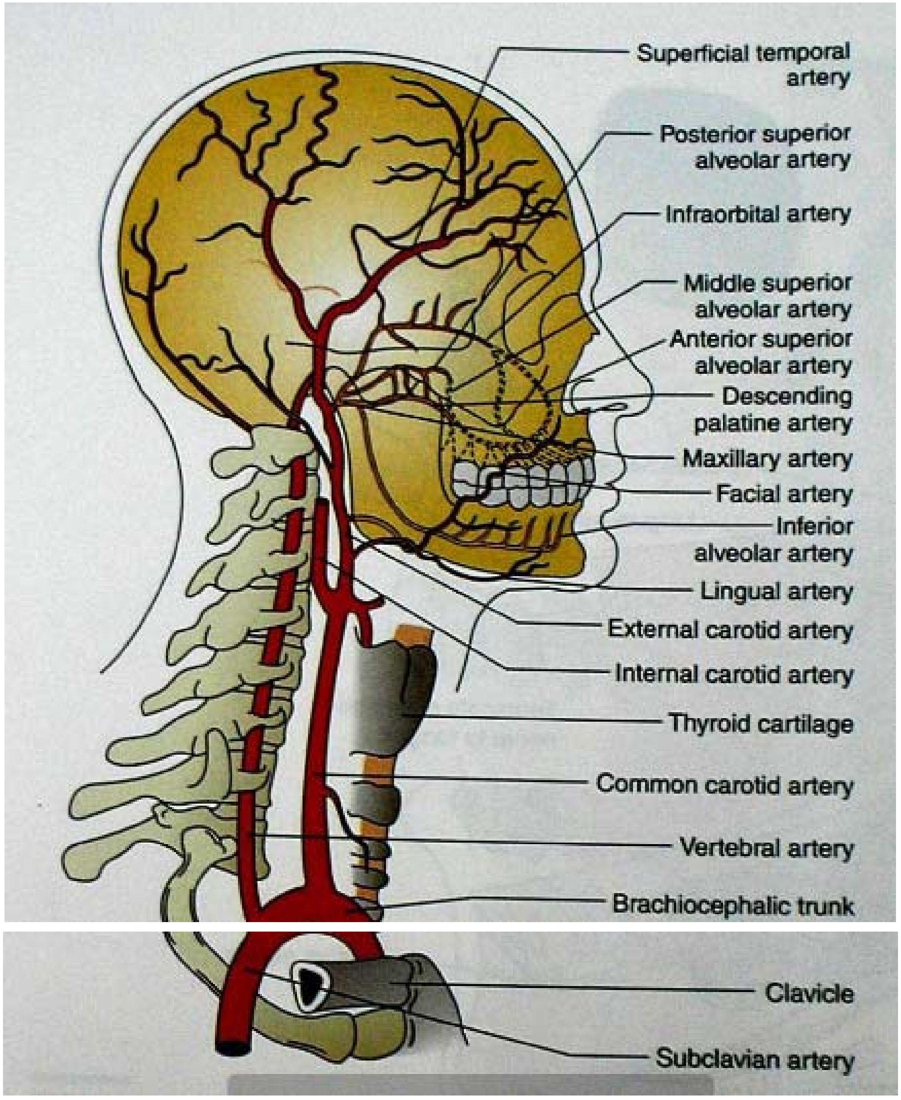


Fig-5.14B Facial Arteries

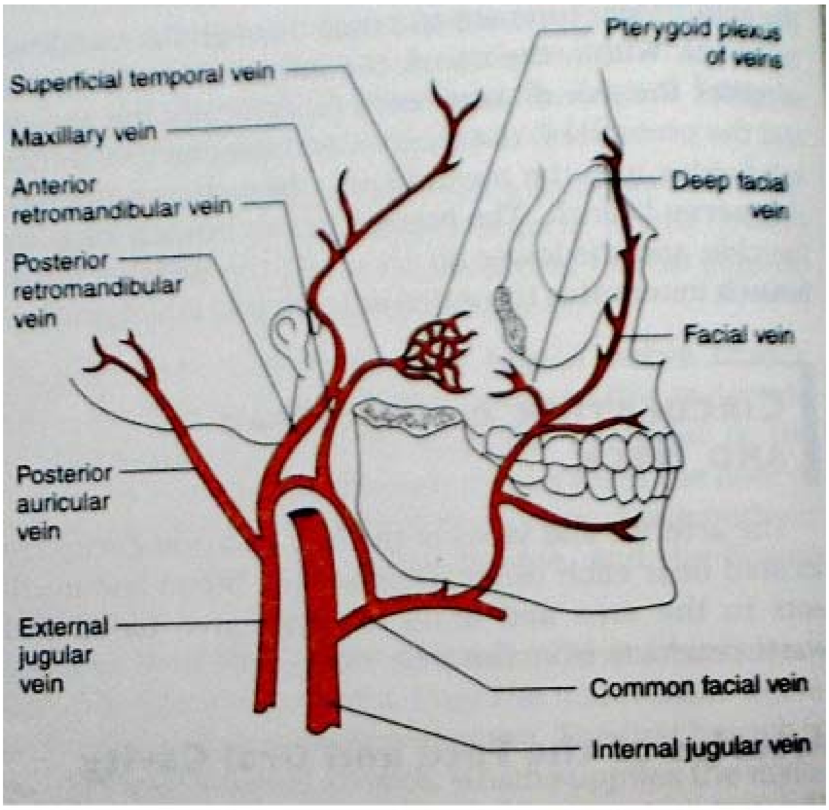


Fig-5.14 C Facial veins.

Table-5.3 Major arteries of the face and mouth.

Structure	Blood supply
Muscles of facial expression	Branches and small arteries from maxillary, facial, and ophthalmic arteries
Maxilla	Anterior, middle, and posterior alveolar arteries
Maxillary teeth	Anterior, middle, and posterior alveolar arteries
Mandible	Inferior alveolar arteries
Mandibular teeth	Inferior alveolar arteries
Tongue	Lingual artery
Muscles of mastication	Facial arteries

Lymph nodes

Lymph nodes are small round or oval structures located in lymph vessels .In some infections and immune disorders, the lymph nodes become swollen and tender. During the examination, the dentist examines the nodes of the neck to detect signs of swelling or tenderness. The lymph nodes of the face and neck are shown in Figure-5.15, A and B.

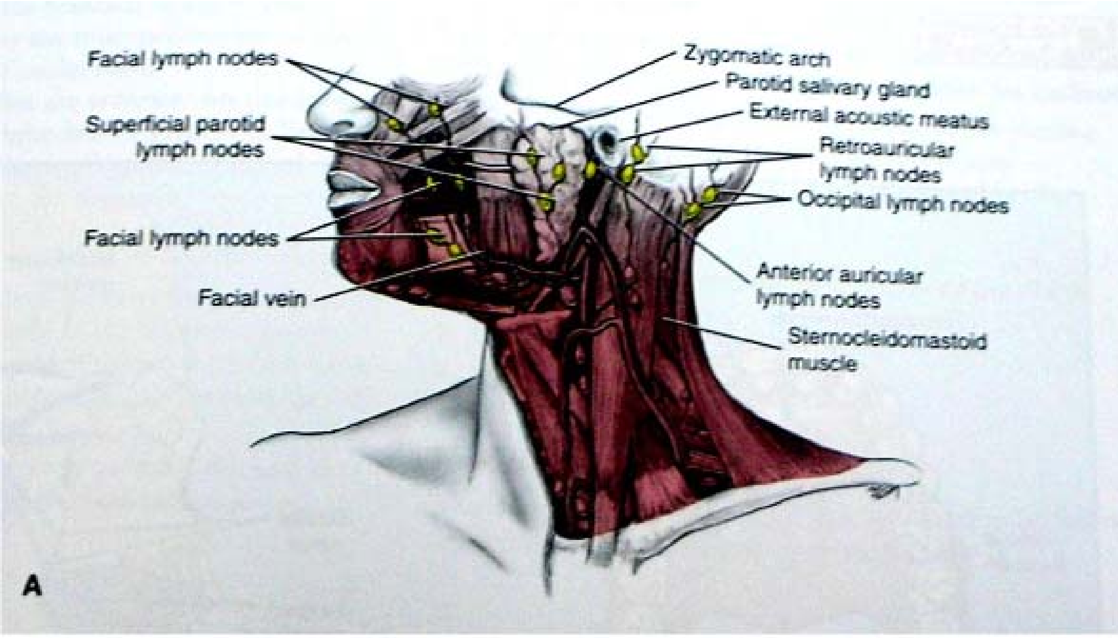


Fig-5.15 A Superficial lymph nodes of the head and associated structures.

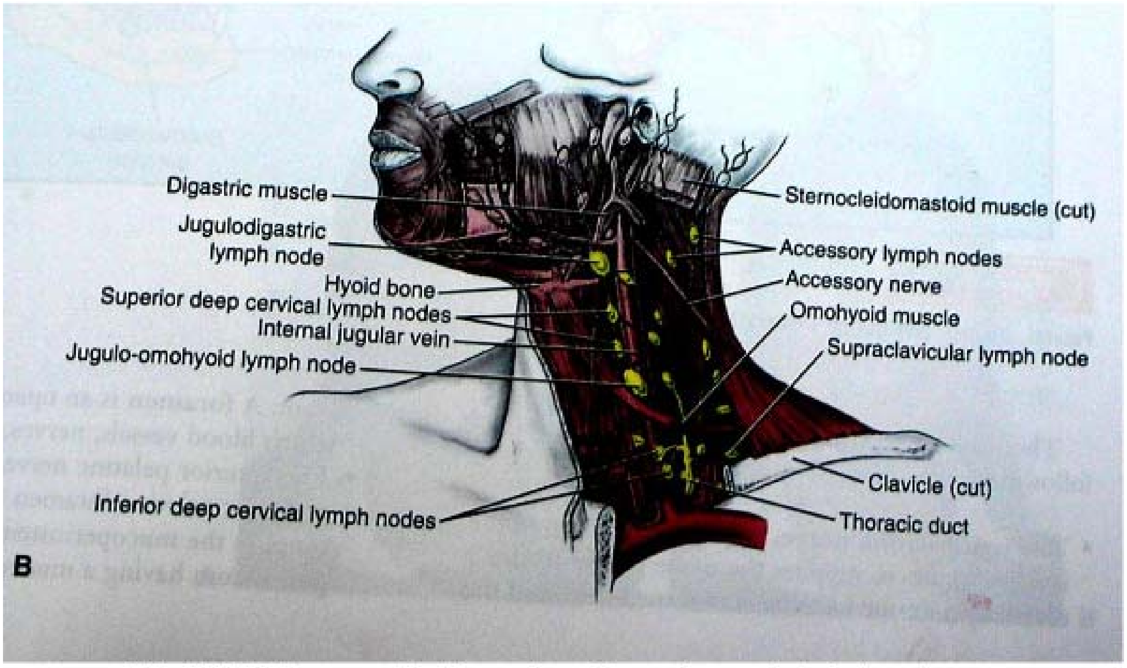


Fig-5.15B Deep cervical lymph nodes and associated structures.

Nerve supply to the mouth

The trigeminal nerve, which is a branch of the fifth cranial nerve, is the primary source of the nerve supply for the mouth. (Innervation is another term for nerve supply.) The trigeminal nerve divides into the maxillary and mandibular branches to serve the mouth (Figures-5.16 and 5.17).

Maxillary Innervation; the maxillary division of the trigeminal nerve supplies the maxillary (upper) teeth, periosteum, mucous membrane, maxillary sinuses, and soft palate. Mucous membrane is the specialized tissues that line the inside of the mouth. The maxillary division further subdivides to provide the following routes of nerve supply;

The **nasopalatine nerv,** which passes through the incisive foramen, supplies the tissue palatal to the maxillary anterior teeth.

(**Anterior** mean toward the front. A foramen is an opening in a bone through which blood vessels, nerves, and ligaments pass)

The anterior palatine nerve, which passes through the posterior palatine foramen and forward over the palate, supplies the mucoperiosteum. (**Mucoperiosteum** is periosteum having a mucous membrane surface). The anterior superior alveolar nerve supplies the maxillary central, latera,and cuspid teeth plus their periodontal membrane and gingivae. The nerve also supplies the maxillary sinus.

The **middle superior alveolar nerve** supplies the maxillary first and second premolars, the mesiobuccal root of the maxillary first molar, and the maxillary sinus.

The **posterior superior alveolar nerve** supplies the other roots of the maxillary first molar, second, and third molars. It is also branches forward to serve the lateral wall of the maxillary sinus.

The **buccal nerve** supplies branches to the buccal mucous membrane and to the mucoperiosteum of the maxillary and mandibular molar teeth. (**buccal** means pertaining to or directed toward the neck.

Mandibular Innervation;

The mandibular division of the trigeminal nerve subdivides into the buccal, lingual, and inferior alveolar nerves.

The **buccal nerve** supplies branches to the buccal mucous membrane and to the mucoperiosteum of the maxillary and mandibular molar teeth

The **lingual nerve** supplies the anterior two third of the tongue and give off branches to supply the lingual mucous membrane and mucoperiosteum. **(Lingual** means of, or pertaining to, the tongue).

The **mylohyoid nerve**, which supplies the mylohyoid muscles and the anterior belly of the digastrics muscle

The **small dental nerves**, which supply the molar teeth and premolar teeth, alveolar process, and periosteum of the mandible

The **mental nerve**, which moves outward through the mental foramen and supplies the chin and mucous membrane of the lower lip.

The **incisive nerve**, which continues interiorly and give off small branches to supply the cuspid, lateral, and central teeth.

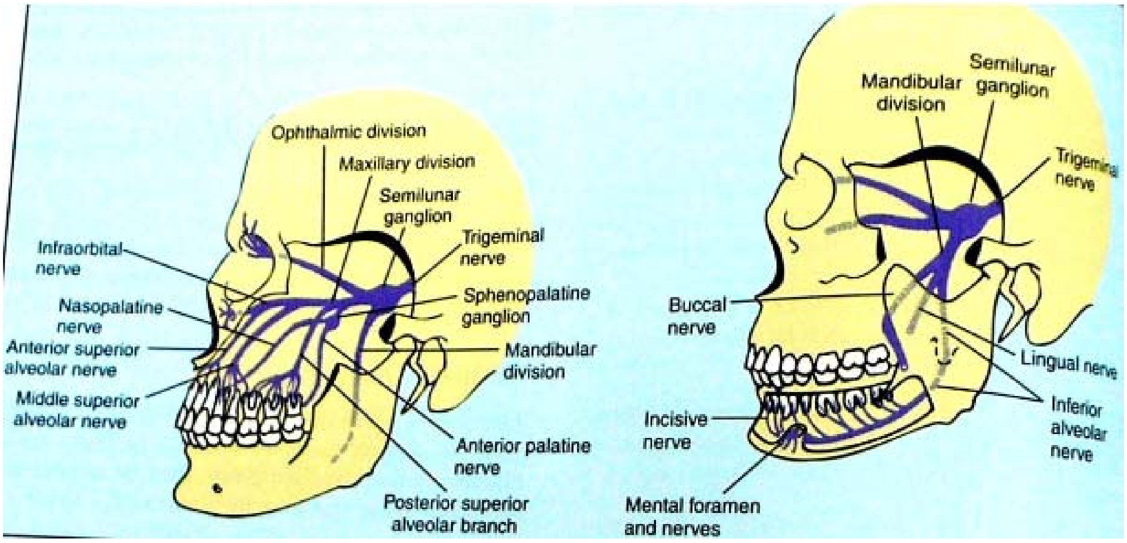


Fig-5.16A Maxillary and mandibular innervations.

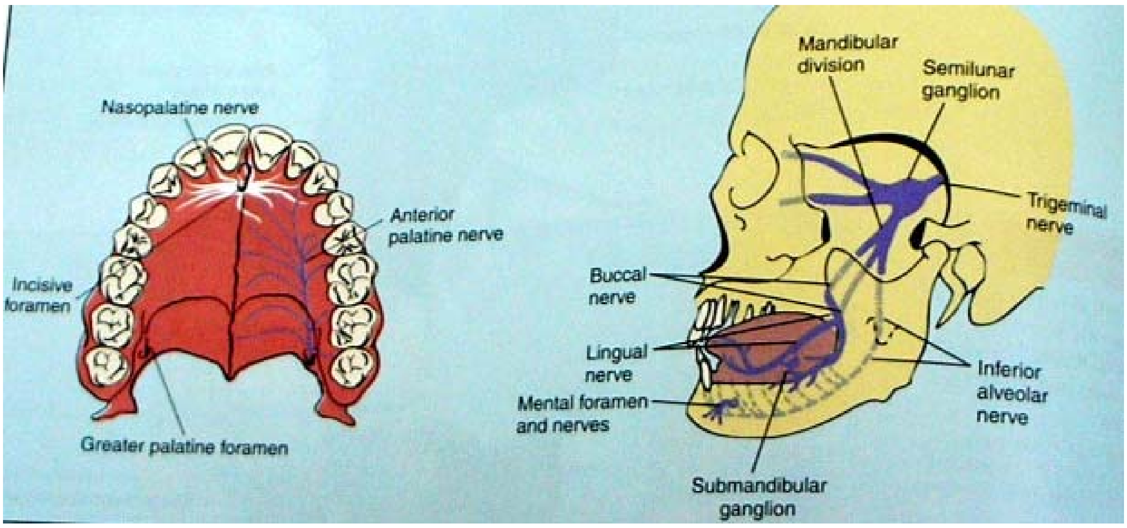


Fig-5.16B Palatal, lingual, and buccal innervation

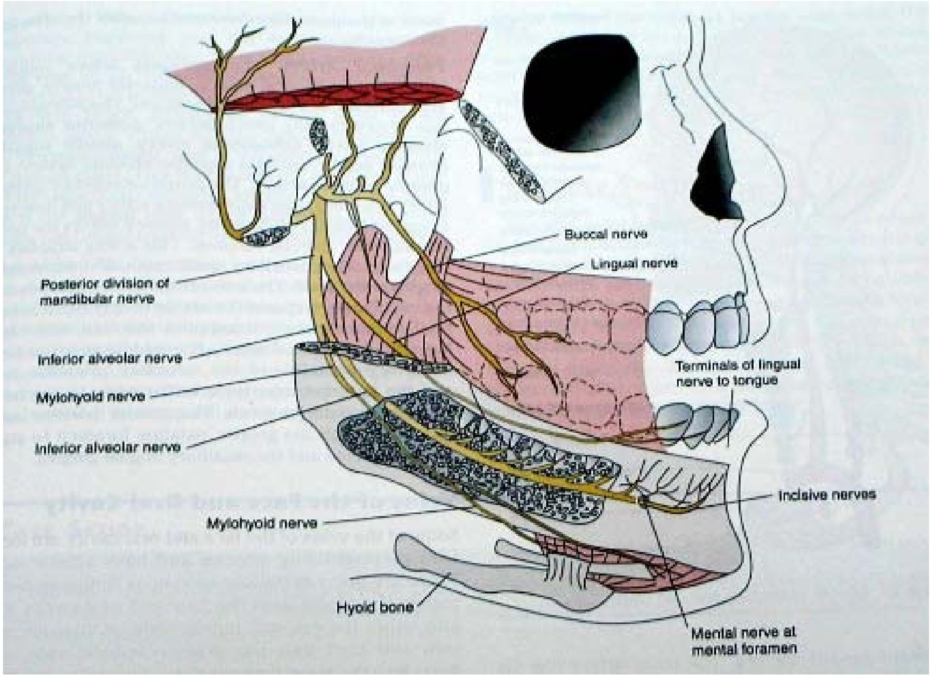


Fig-5.17 A Mandibular nerve.

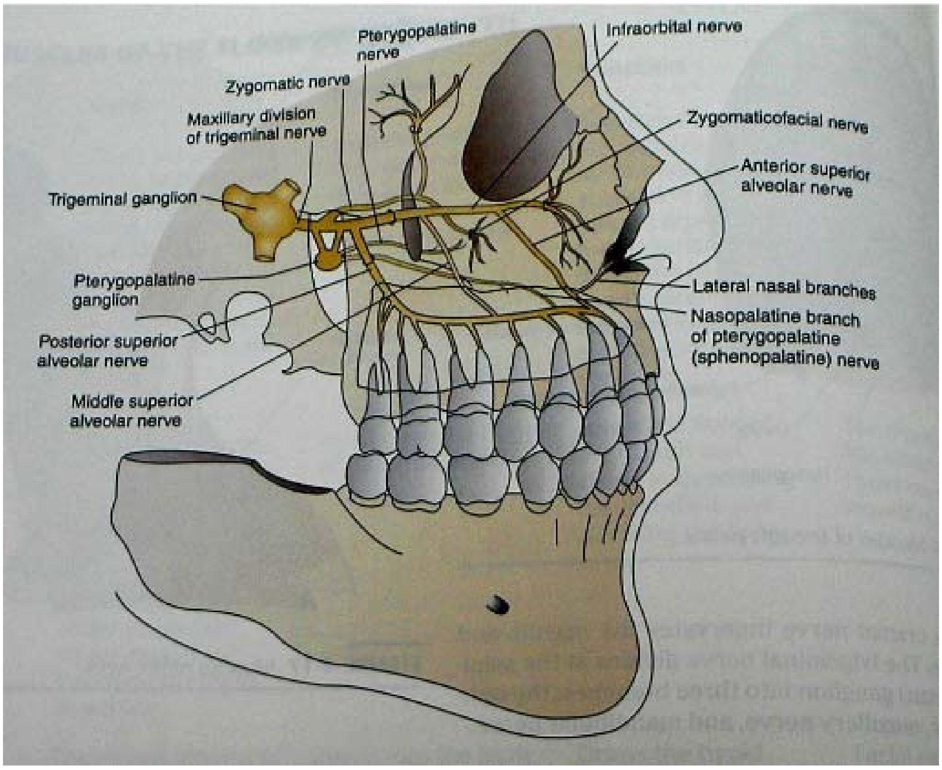


Fig-5.17B Maxillary arch nerves.

Structures of face and oral cavity

Before beginning more advanced procedures, such as exposing dental radiographs or assisting with intraoral procedures, you must learn the terms and locations of various structures of the face and oral cavity

Regions of the face

The facial region can be subdivided into nine areas, as follow (Fig-5.18).

1.Forehead, extending from the eyebrows to the hairline.

2.Temples, or temporal area posterior to the eyes

3.Orbital area, containing the eye and covered by the eyelids

4.External nose

5.Zygomatic (malar) area, the prominence of the cheek

6.Mouth and lip

7.Cheeks

8.Chin

9.External ear.

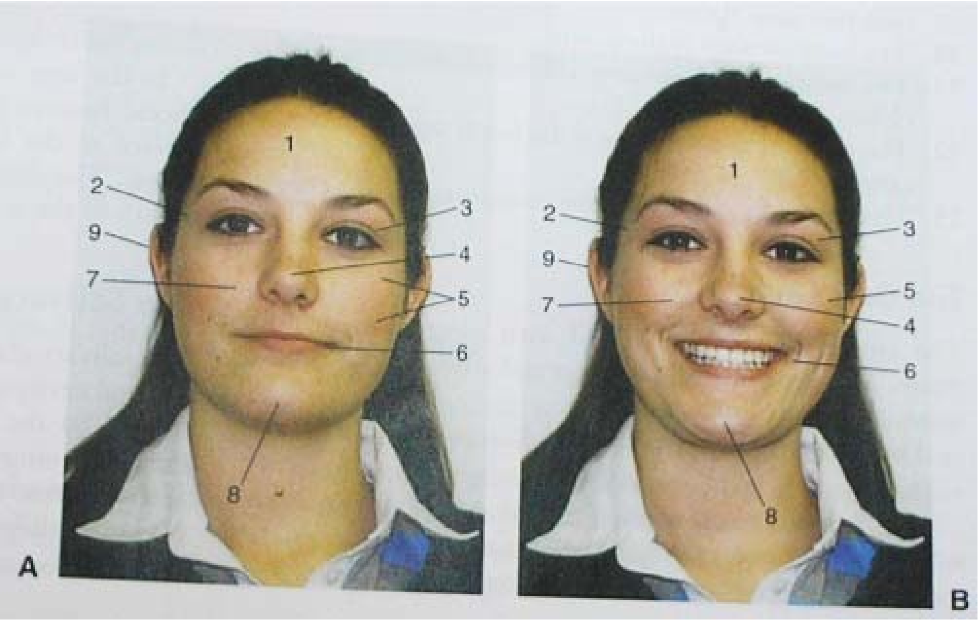


Fig-5.18 A and B are regions of the face

Features of the face

The dental student should be able to identify the following important facial landmarks (Fig-5.19).

1.The outer **canthus** of the eye is the fold tissue at the outer corner of the eyelids.

2.The inner canthus of the eye is the fold of tissue at the inner corner of the eyelids.

3.The **ala of the nose** is the winglike tip on the outer side of each nostril.

4.The **philtrum** is the rectangular area between the two ridges running from under the nose to the middle of the upper lip.

5.The **tragus** of the ear is the cartilaginous projection anterior to the external opening of the ear.

6.The **nasion** is important between the eye just below the eyebrows. On the skull, this is the point where the two nasal bones and the frontal bone join.

7.The **glabella** is the smooth surface of the frontal bone, also the anatomic area directly above the root of the nose.

8.the **root** is commonly called the bridge of the nose

9.The **septum** is the tissue that divides the nasal cavity into two nasal fossae.

10.The **anterior naris** is the nostril.

11.The **mental protuberance** of the mandible forms the chin.

12.The **angle of the mandible** is the lower posterior of the ramus.

13.The **zygomatic arch** creates the prominence of the cheek.

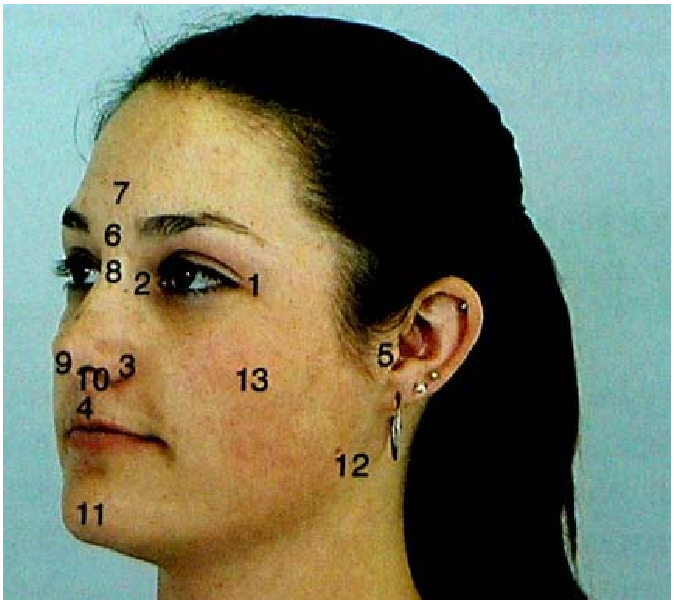


Fig-5.19 Features of the face.

The oral cavity

The entire oral cavity is lined with mucous membrane tissue. This type of tissue is moist and adapted to meet the needs of the area it covers. The oral cavity consists of the following two areas;

1.The vestibule is the space between he teeth and the inner mucosal lining of the lips and cheeks.

2.The oral cavity proper is the space on the tongue side within the upper and lower dental arches.

The tongue: it is composed mainly of muscles, covered on top with a thick layer of mucous membrane and thousands and thousands of tiny projections called papillae. Inside the papillae are the sensory organs and nerves for both taste and touch. On a healthy tongue, the papillae are usually pinkish-white and velvety smooth (Fig-5.20 and Fig-5.21). The functions of tongue are as follow

Speaking

Positioning the food while eating

Tasting and tactile sensations

Swallowing

Cleaning the oral cavity

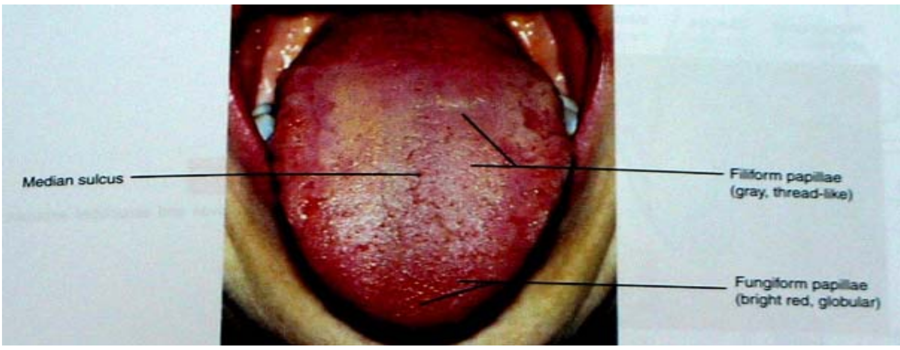


Fig-5.20 Dorsum of the tongue.

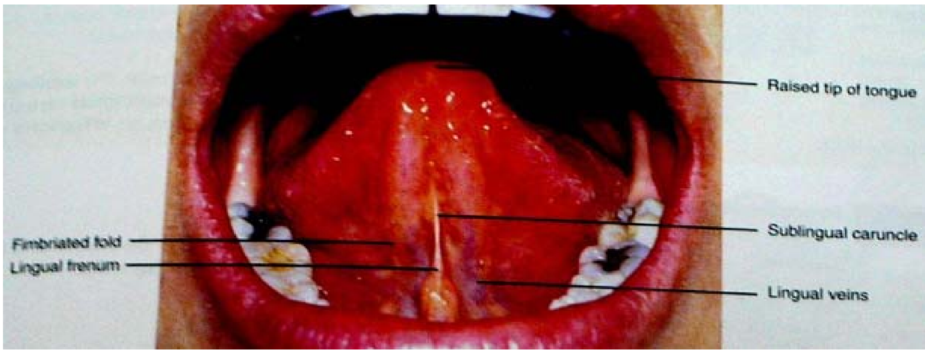


Fig-5.21 Sublingual aspect of the tongue.

The frenum: It is a narrow band of tissue that connects two structures. The maxillary labial frenum passes from the oral mucosa at the middle of the maxillary arch to the mid-line of the inner surface of the upper lip. The mandibular labial freunm passes from the oral mucosa at the mid-line of the mandibular arch to the midline of the inner surface of the lower lip (Fig-5.22). in the area of the first maxillary permanent molar, the buccal frenum passes from the oral mucosa of the outer surface of the maxillary arch to the inner surface of the cheek. The lingual frenum passes from the floor of the mouth to the mid-line of the ventral border of the tongue.

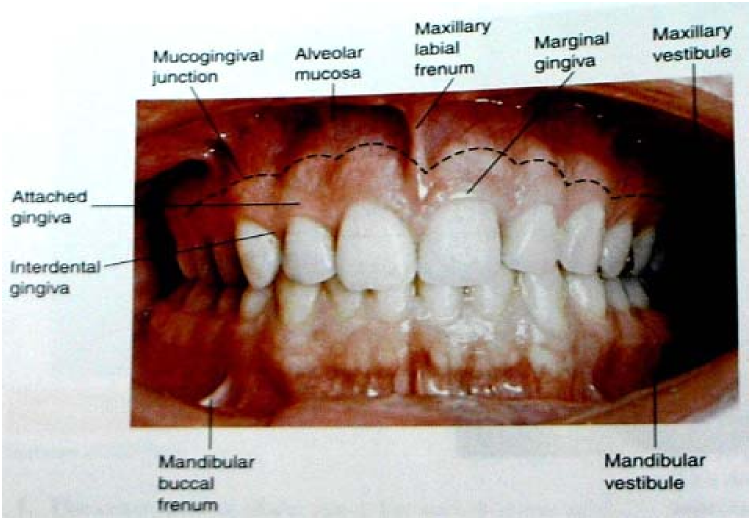


Fig-5.22 View of the gingivae and associated anatomic structures.

The salivary gland:

the salivary glands produce saliva that lubricates and cleans the oral cavity and helps in digestion. The nervous system controls these glands. The salivary glands have ducts (openings) to help drain the saliva directly into the oral cavity, where the saliva is used. The salivary glands may become enlarged, tenders, and possibly firmer due to various disease processes. Certain medications or disease processes may result in decreased or increased production of saliva by these glands (Fig-5.23).

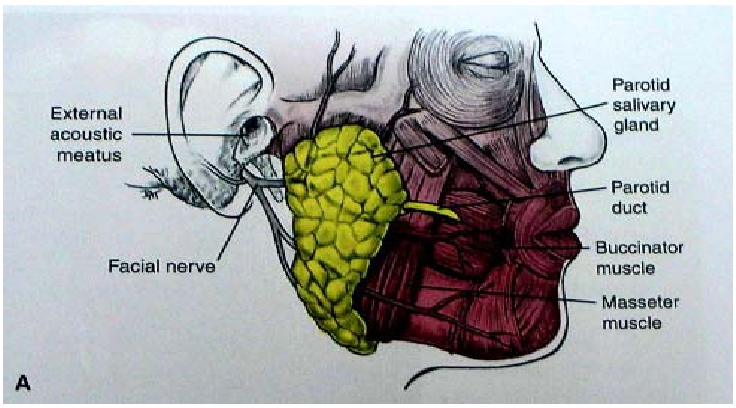


Fig-5.23A Parotid salivary glands.

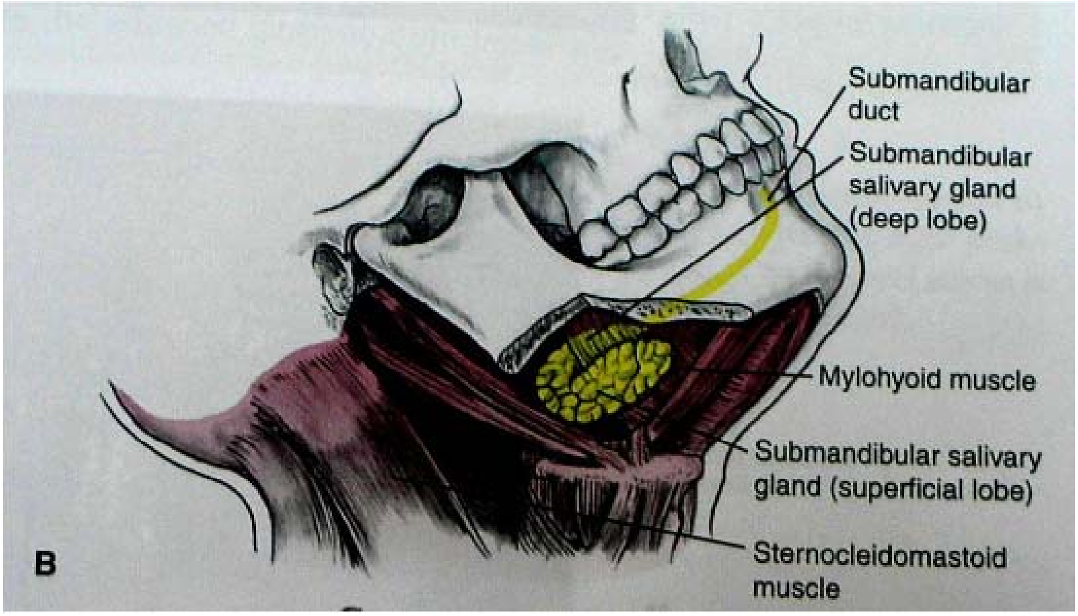


Fig-5.23B Submandibular salivary gland.

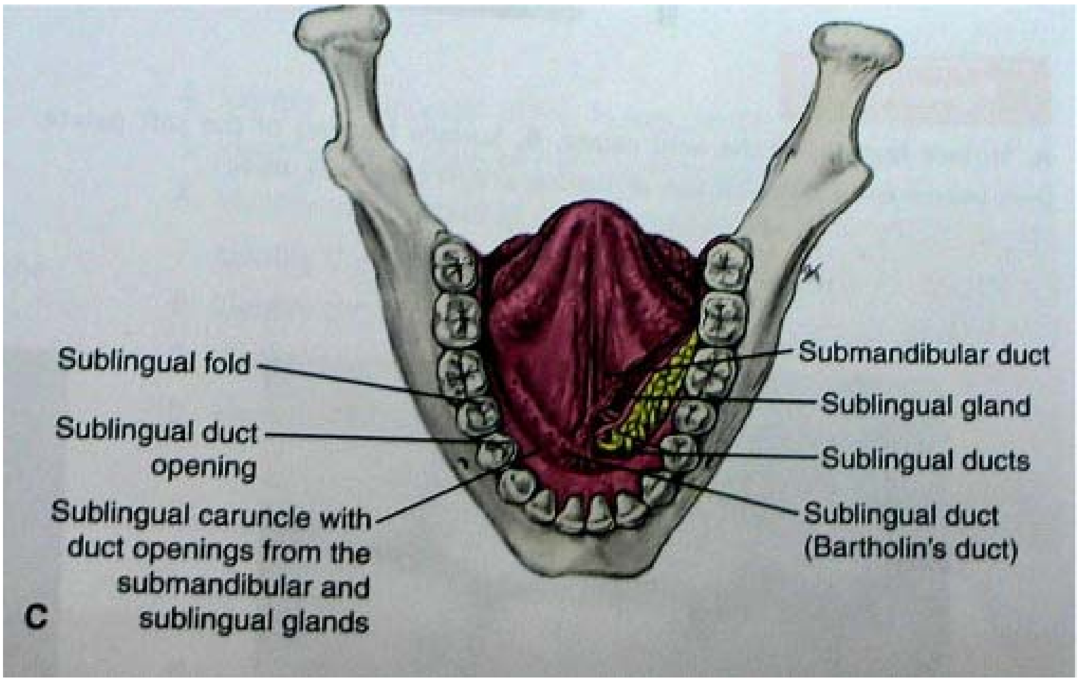


Fig-5.23C Sublingual salivary gland.

The hard and soft plate: The hard and soft palate serves as the roof of the mouth and separate it from the nasal cavity (Fig-5.24).

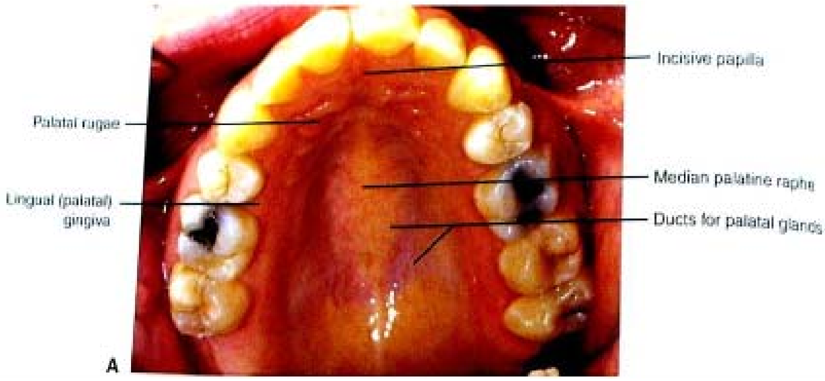


Fig-5.24 A Surface features of the hard palate.

Fig-5.24B Surface features of the soft palate.

The gag reflex: The gag reflex is an involuntary protective mechanism located in the posterior region of the mouth. This very sensitive area includes the soft palate, the uvula, the surrounding tissue, and the posterior portion of the tongue. Contact of a foreign body with the membrane of this area causes gagging, retching, or vomiting when placing impression trays or working in the mouth. It is very important to avoid stimulating the gag reflex.

The alveolar process: The alveolar process is the extension of the bones that form the mandible and the maxilla. The teeth are held firmly in place within the bone of the alveolar process.

The cortical plate is known as cribriform plate, is the dense outer layer of bone covering. The alveolar process that provides strength and protection. The cortical plate of mandible is dense with a few openings but the cortical plate of maxilla is not as dense. The alveolar crest is the highest point of the alveolar ridge. In an unhealthy mouth, the alveolar crest can be destroyed. The alveolar socket is the space within the alveolar process in which the root of a tooth is held in place by the periodontal ligament (Fig-5.25).

Fig-5.25 The alveolar crest as it appears in a radiograph.

The oral mucosa: the entire mouth is lined with mucous membrane tissue (Fig-5.26). There are two types of oral mucosa. The ventral surface of the lining mucosa covers the inside of the cheeks, vestibule, the lips, the ventral surface of the tongue, and the soft palate. This is tissue is delicate and thin, and is easily injured. The mesticatory mucosa covers the gingivae (Gums), the hard pate, stand the vigorous activity of chewing and swallowing food. and the dorsum of the tongue. This tissue is firmly attached to the bone and is very dense. It is designed to withstand the vigorous activity of chewing and swallowing food.

The gingivae: the gingivae are the tissues that surround the teeth (Fig-5.26). The gingivae (Plural gingivae), commonly referred to as gum is masticatory mucosa that cover the alveolar process of the jaw and surrounds the necks of the teeth. Healthy gingivae cover the alveolar bone and attach to the teeth on the enamel surface just above the neck of the tooth. This is known as the epithelial attachment. The free gingivae are the part of the gingival that extends higher than the epithelial attachment. The gingival sulcus is the space between the free gingivae and the tooth.

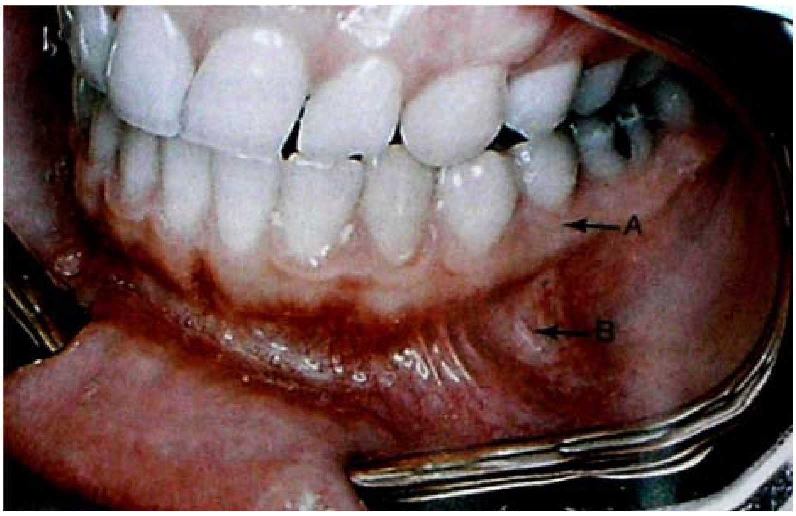


Fig-5.26 A dense masticatory type of mucosa makes up the gingival, B the delicate lining type of mucosa covers the vestibule.

The teeth

Each tooth consists of a crown and one or more roots. The size and shape of the crown and the size and number of roots vary according to the type of the tooth. Humans eat a diet that includes meats, vegetables, grains, and fruits. To accommodate this variety in our diet, our teeth are designed for cutting, shearing, or incising, tearing, and grinding different types of food (Table-5.4).

Table-5.4 Type of teeth and their function.

Type of tooth	Characteristics	Functions
Incisors	Single-rooted teeth with a relatively sharp and thin edge. Located at the front of the mouth.	Designed to cut food without heavy force.
Canines	Also known as cuspids, they are located at the "corner" of the dental arch. The crown is thick, with one well-developed pointed cusp .Because of their long root; canines are the most stable teeth in the mouth and usually the last teeth to be lost.	Designed for cutting and tearing of food that requires the application of force.
Premolars	Also known as, bicuspids are similar to canines in that they have points and cusps. The have a broader chewing surface. There are no premolars in the primary dentition.	Designed for grasping and tearing, they also have a broader surface for chewing.
Molars	primary dentition. The molars have more cusps than the other teeth in the dentition. They have shorter, blunter cusps to provide a chewing surface.	Designed for chewing and grinding solid masses of food those require the application of heavy forces.

6. High Speed Technique.

Development of rotary equipment

The availability of some method of cutting and shaping of tooth structure and restoration of teeth. Although archeological evidence of dental treatment dates from 500 B.C, little is known about the equipment and methods used then. Early drills powered by hand are illustrated in Fig-6.1 and Fig-6.2. Much of the subsequent development leading to present powered cutting equipment can be seen as a search for improved sources of energy and means for holding and controlling the cutting instrument. This search has culminated in the use of replaceable bladed or abrasive instruments held in a rotary handpiece, usually powered by compressed air.

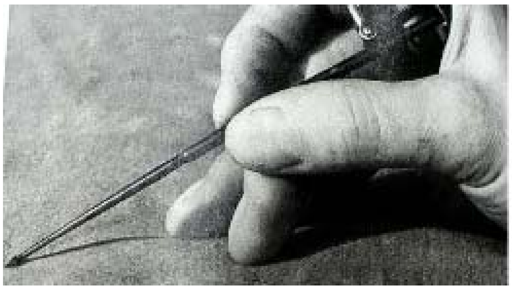


Fig-6.1 Early Straight hand drill.

Fig-6.2 Early angle hand drill.

A handpiece is a device for holding rotating instruments, transmitting power to them, and for positioning them intraorally. Handpieces and associated cutting and polishing instruments developed as two basic types, straight and angle (fig-6.3). Most of the development of methods for preparing teeth has occurred within the last 100 years. Effective equipment for removal (or preparation) of enamel has been available only since 1947, when speeds of 10,000rpm were first used along with newly marketed carbide burs and diamond instruments. Since 1953, continued improvements in the design and construction of instrument. Table-6.1 summarizes some significant development of high-speed dental equipments. In 1914, a dental unit was introduced as initial handpiece and operating speed 5000 RPM, it was remain until 1946 (Fig-6.4). In 1950, speeds of 60,000 rpm and greater had been attained by newly designed equipment employing speed-multiplying internal belt drives (Fig-6.5). The contra angle handpiece with internal turbine drives in the contra-angle head with water driven unit (fig-6.6), and air driven unit (Fig-6.7A). The design of straight handpiece turbine provided the high torque for low-speed operation (fig-6.7B). Since 1955, angle headpieces have had an air-water spray feature to provide cooling cleansing and improved visibility (fig-6.8) and the most modern-angled handpieces include fiberoptic lighting (Fig-6.8B).

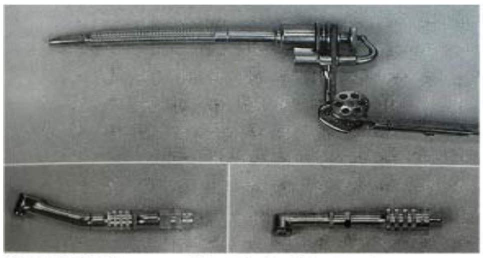


Fig-6.3 Conventional designs of handpieces.

Fig-6.4 Typical equipment with electric motor.

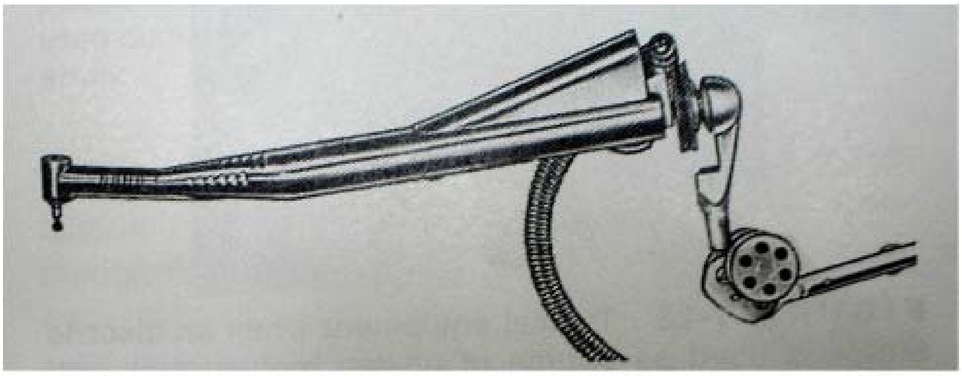


Fig-6.5 First belt-drive angle handpiece (1955) at speed > 100,000.

Fig-6.6 Turbo-jet portable Unit (Circa 1955)

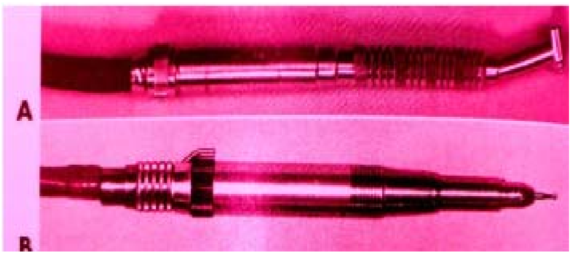


Fig-6.7 Air-turbine handpiece, A. Airoto (1957), B. Straight handpiece (1980)

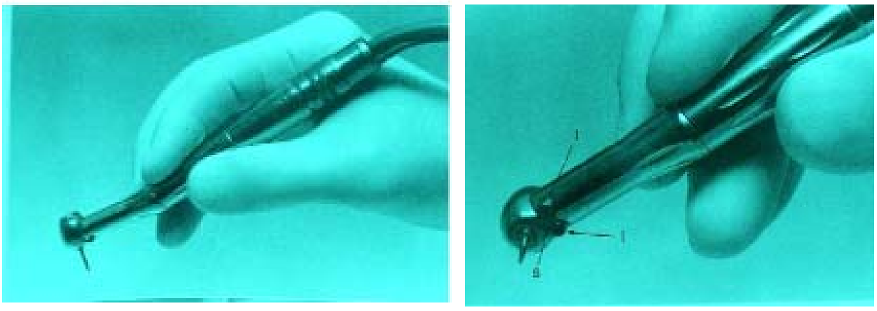


Fig-6.8 Contemporary air-turbine handpiece (Circe 1994), A. Contrangle handpiece, B. Contrangle handpiece with fiberoptic

Table-6.1 Evolution of rotary equipment in dentistry.

Date	Instrument	Speed (RPM)
1728	Hand-rotated instruments	300
1871	Foot engine	700
1874	Electric engine	1000
1914	Dental unit	5000
1942	Diamond cutting instruments	5000
1946	Old unit converted to increase speed	10000
1947	Tungsten carbide burs	12000
1953	Ball bearing handpiece	25000
1955	Water turbine angle handpiece	50000
1955	Belt-driven angle handpiece (Page-Chayes)	150000
1957	Air turbine angle handpiece	250000
1961	Air turbine straight handpiece	25000
1962	Experimental air bearing handpiece	800000
1962	Contemporary air turbine handpiece	300000

Rotary speed range

The rotational speed of an instrument is measured in revolutions per minute (rpm). Three speed ranges are generally recognized: low or slow speeds (< 12,000 rpm), medium or intermediate speeds (12,000 – 200,000 rpm), and high speeds (> 200,000 rpm). At high speed, the surface speed needed for efficient cutting can be attained with smaller and more versatile cutting instruments. This speed is used for tooth preparation and removing old restorations. Other advantages are the following:(1) Diamond and carbide cutting instruments remove tooth structure faster with less pressure, vibration, and heat generation; (2) the number of rotary cutting instruments needed is reduced because smaller sizes are move universal in application;(3) the operator has better control and greater ease of operation; (4) instruments last longer; (5) patients are generally less apprehensive because annoying vibrations and operating time are decreased; and (6) several teeth in the same arch can and should be treated at the same appointment. For infection control, all the handpieces must be sterilized.

Laser equipment

Lasers are devices that produce beams of coherent and very high intensity light. Numerous current and potential uses of lasers in dentistry have been identified that involve the treatment of soft tissues and the modification of hard tooth structures. The word laser is an acronym for light amplification by stimulated emission of radiation. Several types of lasers (Fig-6.9) are available (table-6.2) based on wavelengths. The laser range from long wavelengths (infrared), through visible wavelengths, short wavelengths (UV).

Several lasers are practical importance to medicine and dentistry (Table6-3). The most currently interest to dentistry are Nd: YAG (Fig-6.9A).

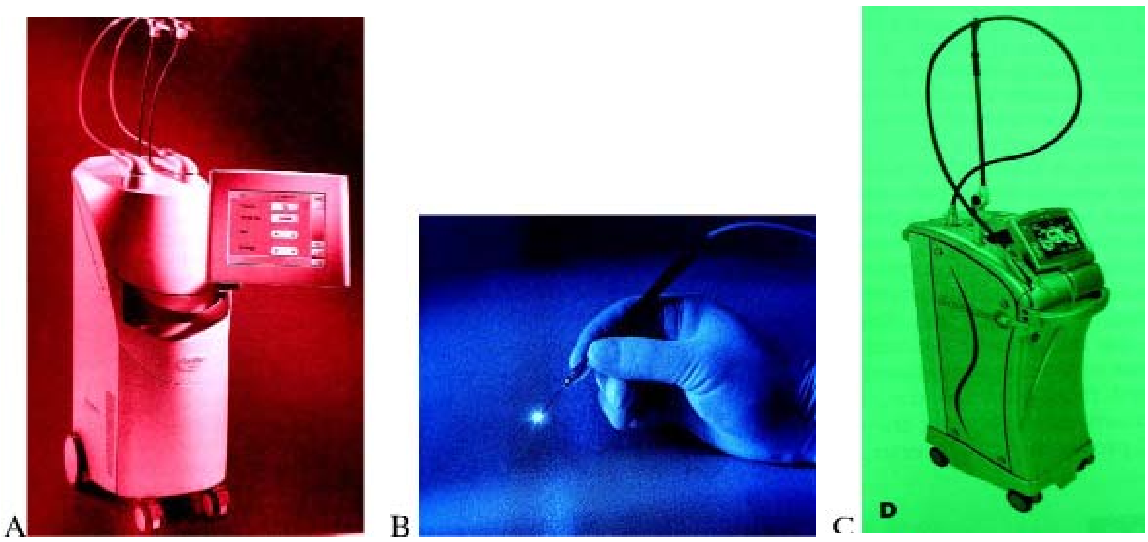


Fig-6.9A. Er;YAG & CO2 laser, B. Nd;YAG laser, C.Er;Cr:YSGG laser Unit.

Table 6-2 Laser Types by Source and Wavelength

Type	Source	Wavelength (nm)	Mode
Infrared	**CO2**	**10,600**	**Continuous**
	Er,Cr: YSGG	**2780**	**Continuous, Pulsed**
	Er: YAG	**2940**	**Continuous, Pulsed**
	Ho: YAG	**2060**	**Pulsed**
	Nd: YAG	**1064**	**Pulsed, Continuous**
Visible	**Diode Laser**	**812;980**	**Pulsed, Continuous**
	HeNe	**633**	**Continuous,**
Ultraviolet (Excimer)	**KTP**	**532**	**Continuous,**
	Argon	**514,488**	**Continuous,**
	XeF	**351**	**Pulsed**
	XeCl	**308**	**Pulsed**
	KrF	**248**	**Pulsed**
	ArF	**193**	**Pulsed**

Table6-3 Suggested Dental Applications for Some Laser Types

Applications	CO2	Ho:YAG	Nd:YAG	HeNe	Argon	Excimers
Cutting and coagulation	X	X	X		X	
Stimulation of healing						
Analgesia (low power)			X	X		X
Fissure sealing	X	X	X	X		X
Caries treatment	X	X	X		X	
Composite curing						X
Surface modification	X	X	X			X
Root canal	X	X	X			
Apicoectomy	X	X	X			X
Root sealing	X	X				
Gingivectomy	X	X				

Other equipment

Alternative methods of cutting enamel and dentin have been assessed periodically. In the mid-1950s, air-abrasive cutting was tested, but several clinical problems precluded general acceptance. Most importantly, no tactile sense was associated with air-abrasive cutting of tooth structure. This made it difficult for the operator to determine the cutting progress within the tooth preparation. Additionally, the abrasive dust interfered with visibility of the cutting site and tended to mechanically etch the surface of the dental mirror. Preventing the patient or office personnel from inhaling abrasive dust posed an additional difficulty. Contemporary air abrasion equipment (Fig-6.10) is helpful for stain removal, debriding pits and fissures before sealing, and micromechanical roughening of surfaces to be bonded (enamel, cast metal alloys, or porcelain). The energy transfer event is affected by many things, including powder particle, pressure, angulations, surface composition, and clearance angle variable (Fig-6.11) and the tooth-cleaning unit (Fig-6.12).

Fig-6.10 Example of contemporary air abrasion unit for removal of superficial enamel defects or stains, debriding pits and fissures for sealant application, or roughening surfaces to be bounded or luted.

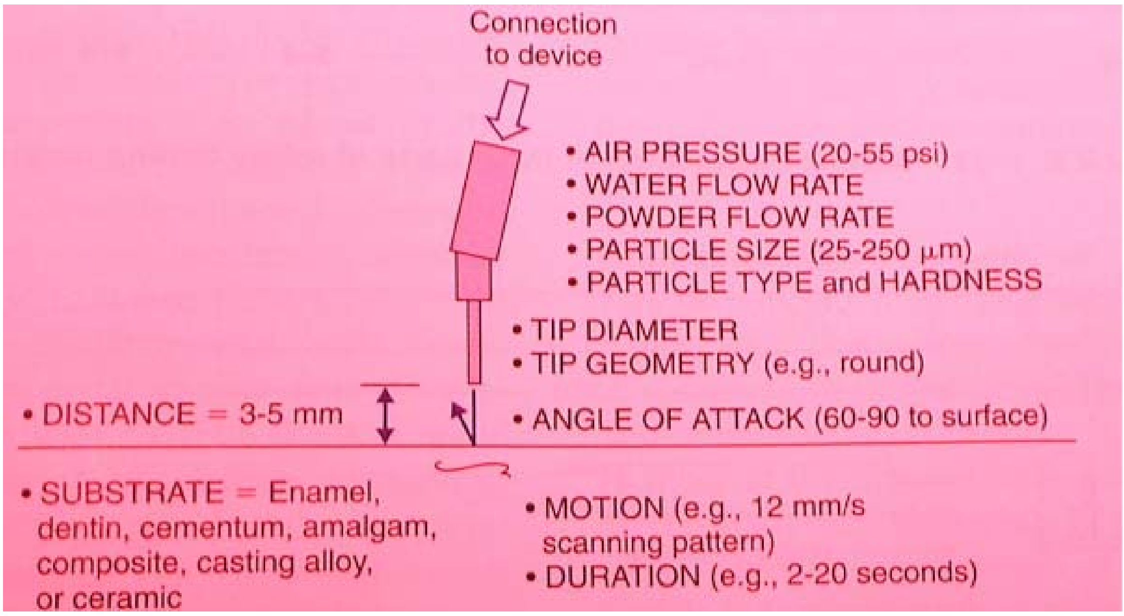


Fig-6.11 Schematic representation of range of variables associated with any type of air abrasion equipment.

Rotary cutting instruments

Common Design Characteristics

Despite the great variation among rotary cutting instruments, they share certain design features. Each instrument consist of three parts (1) shank, (2) neck, and (3) head (Fig-6.13). Each has its own function, influencing its design and the materials used for its construction. There is a difference in the meaning of the term shank as applied to rotary instruments and to hand instruments.

Fig-6.13 Normal design for three part of rotary cutting instrument.

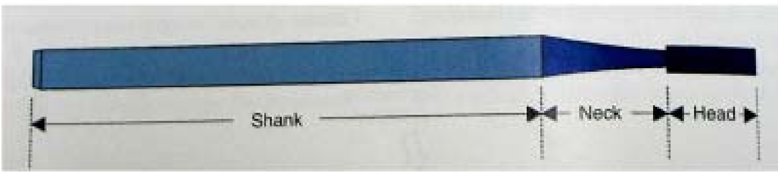


Fig-6.13 Normal design for three part of rotary cutting instrument.

Shank design.

The shank is the part that fits into the handpiece, accepts the rotary motion from the handpiece, and provides bearing surface to control the alignment and concentricity of the instrument. The shank design and dimensions vary with the hand-piece for which it is intended. The American dental association (ADA) Specification No.23 for dental excavating burs includes five classed of instrument shank. Three of these burs (Fig-6.14) are the straight handpiece shank, the latch-type angle handpiece shank, and the friction-grip angle handpiece shank-are commonly encountered. The shank portion of the straight handpiece instrument is a simple cylinder. It is held in the handpiece by a metal chuck that accepts a rang of shank diameters. Precise control of the shank diameter is not as crucial as for other shank designs. Straight handpiece instruments are now rarely used for preparing teeth except for caries excavation. They are commonly used, however, for finishing and polishing completed restorations

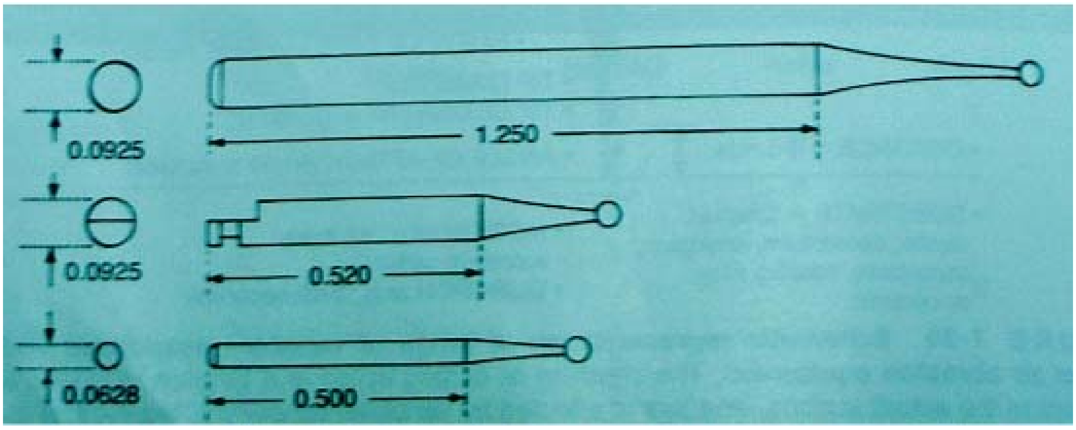


Fig-6.14 Typical dimensions (in inches) of three common instrument shank for straight handpiece, latch-angle handpiece, and friction-grip angle handpice type

Neck Design.

As shown in Fig-6.15, the neck is the intermediate portion of an instrument that connects the head to the shank. Head Design. The head is the working part of the instrument, the cutting edge or points that perform the desired shaping of tooth structure. The shape of the head and the material used to construct it are closely related to its intended application and technique of use. The head is rotary instrument and it is divided into blade and abrasive instruments.

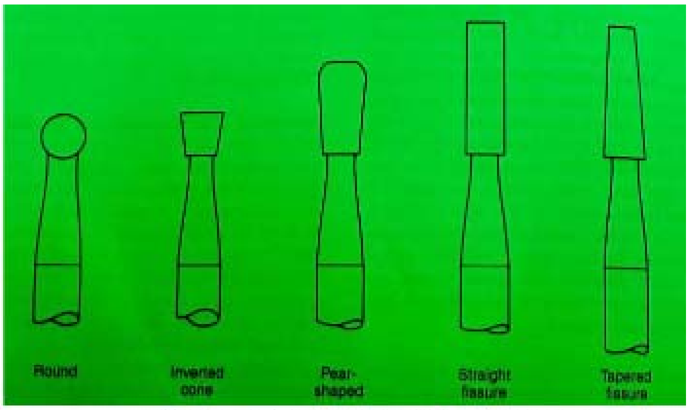


Fig-6.15 Basic bur head shape.

Dental Burs.

The term bur is applied to all rotary cutting instruments, which have blade-cutting heads. This includes instruments intended for finishing metal restorations and surgical removal of bone and instruments primarily intended for tooth preparation.

Bur Classification Systems.

To facilitate the description, selection, and manufacturer of burs, it is highly desirable to have some agree-on shorthand designation, which represents all variables of a particular head design by some simple code. In USA, dental burs described in terms of arbitrary numerical code for head size and shape (e.g., 2 = 1-mm diameter round bur, 57 = 1-mm diameter straight fissure bur, 34 = 1-mm diameter inverted cone bur). New classification by international dental federation and international standards organization, tend to use separate designations for shape (A shape name) and size (the head diameter in tenths of a millimetre) (e.g., round 101, straight fissure plain 010, inverted cone 008).

Shapes. The term bur shape (Fig6-16), refers to the contour or silhouette of the head. The basic head shapes are

Round bur; used for initial entry into the tooth, extension of preparation, preparation of retention features, and caries removal.

Inverted cone bur; use for undercuts in tooth preparation.

Pear shape bur; use for normal length in class I tooth preparation for gold foil and long-length for preparation of amalgam restoration.

Straight fissure bur; use for amalgam tooth preparation.

Tapered fissure bur; use for tooth preparation of indirect restoration.

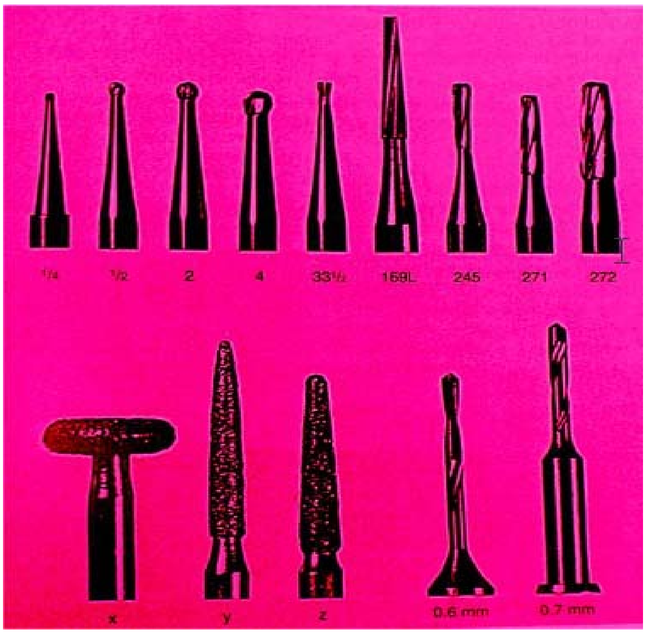


Fig-6.16 Burs used in recommended procedures. (X. wheel shape, Y. Flame shape, Z. Tapered cylinder)

In resent years, progress toward the development of an international numbering system for basic bur shapes and sizes are shown in Fig-6.16 and table 6-4.The lateral view and a cross-sectional view of crosscut tapered fissure bur is shown in Fig-6.17. The actual cutting action of a bur occurs in a very small region at the edge of the blade (Fig-6.17).

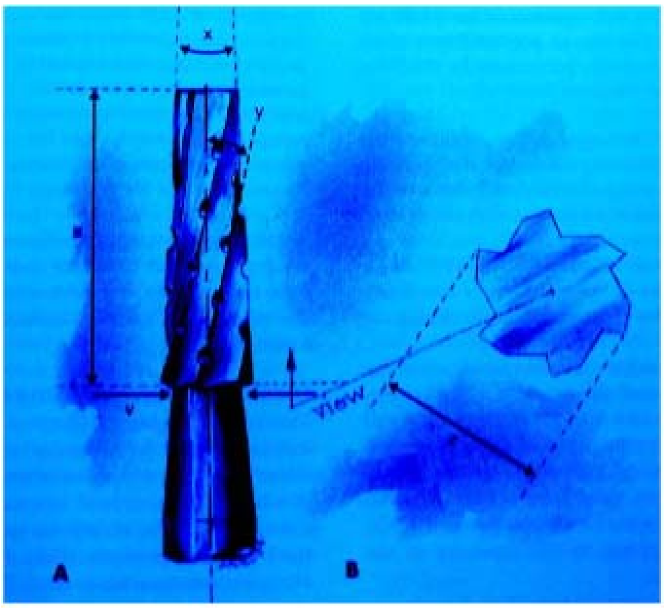


Fig-6.17 Design features of bur head.

Table-6.4 Name and key dimensions of recommended burs

Manufacturer's size number	ADA size number	ISO size number	Head diameter (mm)	Head length (mm)	Taper angle (degree)	Shape
¼	¼	005	0.50	0.40	-	Round
½	½	006	0.60	0.48	-	Round
2	2	010	1.00	0.80	-	Round
4	4	014	1.40	1.10	-	Round
33 S	- 006	0.60	0.45	12		Inverted cone
33 ½	33 ½	006	0.60	0.45	12	Inverted cone
169	169	009	0.90	4.30	6	Tapered fissure
169 L	169 L	009	0.90	5.60	4	Elongated TF
329	329	007	0.70	0.85	8	Pear, normal length
330	330	008	0.80	1.00	8	Pear, normal length
245	330 L	008	0.80	3.00	4	Pear, long length
271	171	012	1.20	4.00	6	Tapered fissure
272	172	016	1.60	5.00	6	Tapered fissure
		- 0 0 6 -				

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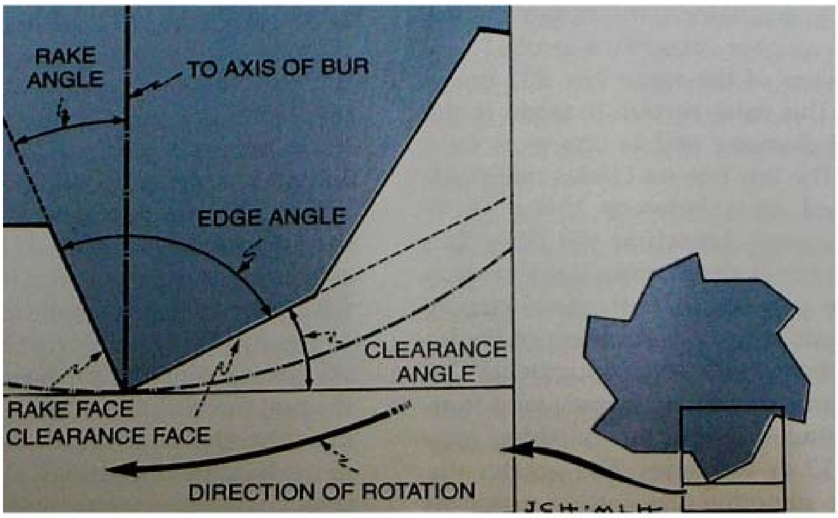

Fig-6.18 Bur blade design.

Diamond abrasive instruments

The second major category of rotary dental cutting instruments involves abrasive rather than blade cutting. Abrasive instruments are based on small, angular particles of a hard substance held in a matrix of softer particles protrude from the matrix, rather than along a continuous blade edge. This difference in design causes definite differences in the mechanisms by which the two types of instruments cut and in the applications for which they are best suited.

Terminology; Diamond instruments consist of three parts: a metal blank, the powdered diamond abrasive, and a metallic bonding material that holds the diamond powder onto the blank (Fig-6.19). The blank in many ways resembles a bur without blades. It has the same essential parts: head, neck, and shank.

Classification; Diamond instruments currently are marketed in myriad head shapes and sizes (Table 7-5) and in all of the standard shank designs. Parallel those for burs (Fig-20).

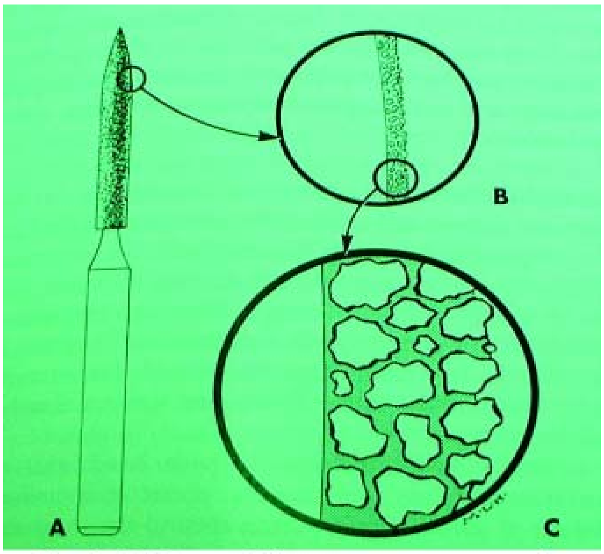

Fig-6.19 Diamond instrument construction.

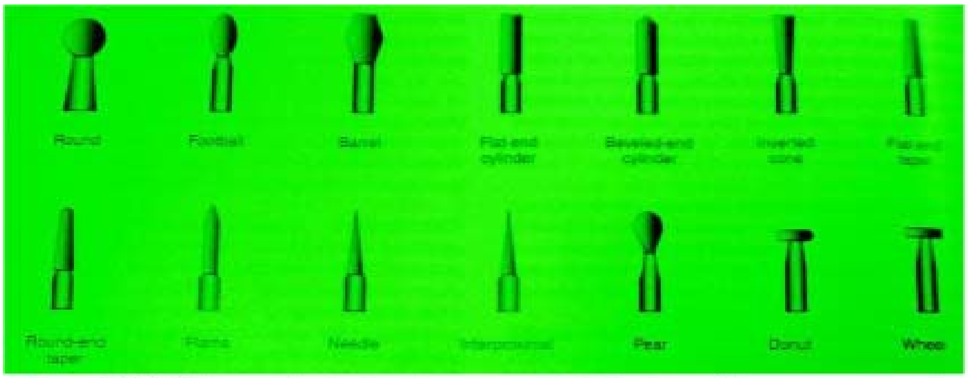

Fig-6.20 Characteristic shapes and designs for a range of Diamond cutting instruments.

Table-6.5 Standard Categories of shapes and sizes for Diamond Cutting Instrument

Head Shapes	Profile Variation
Round	--
Football	Pointed
Barrel	--
Cylinder	Flat-, bevel-, round- or , sate end
Inverted cone	--
Taper	Flat-, round-, or safe end
Flame	--
Curettage	--
Pear	--
Needle	Christmas tree
Interproximal	Occlusal anatomy
Doughnut	--
Wheel	--

Head Shapes and Sizes;

Diamond instruments are available in a wide variety of shapes and in sizes that correspond to all except the smallest-diameter burs. The greatest difference lies in the diversity of other sizes and shapes in which diamond instruments are produced. Even with many subdivisions, the size range within each group is large compared with that found among the burs. More than 200 shapes and sizes of diamonds are currently marketed.

Cutting recommendations

1. Evaluation of cutting
2. Blade cutting
3. Abrasive cutting
4. Cutting recommendations

Hazards with cutting instruments

1. Pulpal precautions
2. Soft tissue precautions
3. Eye precautions
4. Ear precautions
5. Inhalation precautions

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