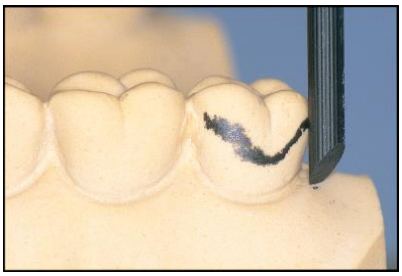
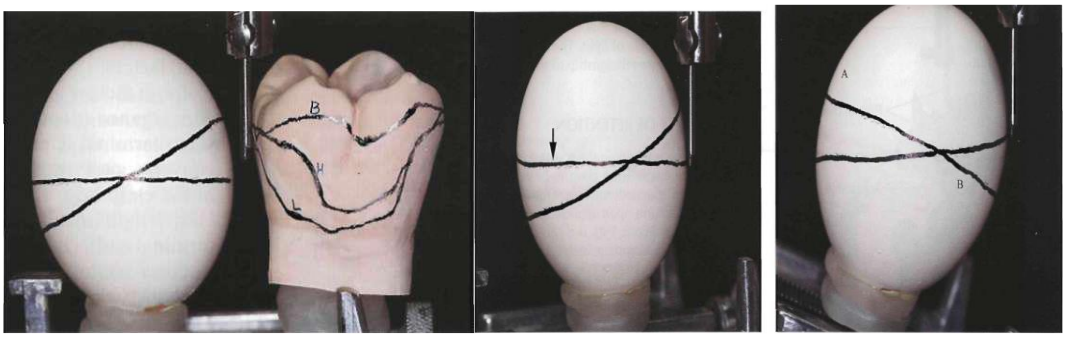
Principles of surveying

- Surveying a tooth consist of locating accurately the height of its maximum contour in relation to the plane in which the cast is positioned.
- Modifying the proximal tooth surfaces so that the prosthesis goes smooth in place without interferences.
- The fact that the majority of the natural teeth crowns are bulbous in shape (have a suprabulge region), where this suprabulge region could occur anywhere between the occlusal surface and the gingival margin. When a vertical arm is brought into contact with the convex surface, they will contact only at one point that is the point of maximum convexity, where this surface is rotated, and is still in contact with the vertical arm, an imaginary line will be traced at the greatest circumference, when we substituted this vertical analyzing rod with a carbon marker then an actual line will be produced at the level of the maximum tooth bulge, this line is called the survey line.



- The area of a tooth occlusal to the survey line is a non undercut area, while the area gingival to this line is an undercut area. When a tooth is tilted or rotated in relation to the analyzing rod, another survey line will be traced, as a result, the extent of non undercut area and the undercut area are consequently changed. That means the survey line can vary according to the angle formed by contact of the vertical analyzing rod with the tooth surface.



- Alteration of undercut area can be done by anterior or posterior tilting of dental cast. So that the effect of tilting a cast on the surveyor will be:

1. Redistribution of undercuts to the desired areas.
2. Allow a more favorable path of insertion.
3. Allow the use of a desired type of clasp for better function and esthetics.
4. Allow the use of a design to minimize food impaction, food entrapment and plaque accumulation.

Types of undercuts established by surveying

1. Contour: due to natural contour of the tooth.
2. Positional: due to tilting of cast on surveyor.
3. True: an undercut which is present in relation to the analyzing rod and to the path of displacement.
4. False: an undercut which present only in relation to the analyzing rod but not in relation to the path of displacement.

Path of placement (Insertion)

The specific direction in which a prosthesis is placed on the residual alveolar ridge, abutment teeth, dental implant abutment(s), or attachments.

Factors that determine and affect the path of placement (insertion) and removal of the RPD

1. Guiding Planes

Guiding planes are parallel surfaces of abutment teeth that direct the insertion and removal of a partial denture. *The path of insertion should be parallel to the guiding planes*. Proximal tooth surfaces that bear a parallel relationship to one another must either be *found* or be *created* to act as guiding planes.

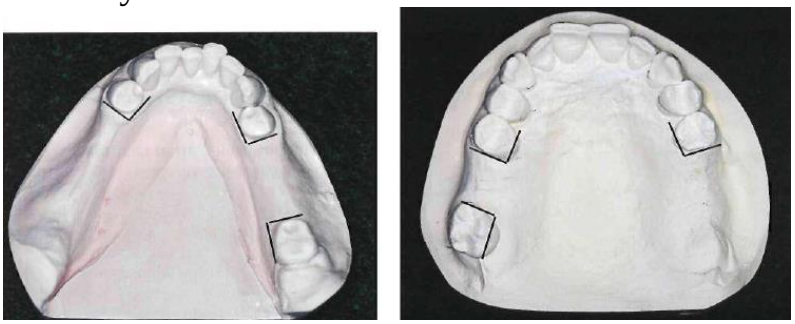
To do so this, proximal plates (part of the RPD contact guiding planes) should, whenever possible, be the ***initial portions of the partial denture to contact the abutments***.

The components of the denture that contact the guiding planes during placement of removable partial denture are:

Tooth surface which act as guiding planes	**Component of the denture which contact this guiding planes**
A- Proximal tooth surface	1. Minor connector that joins the occlusal rests and clasp to the saddle. 2. Proximal plates are used with I-bar or R.P.I. system.
B-Axial or lingual tooth surface	1. Reciprocal clasp arms. 2. Lingual plates that act as reciprocal arm. 3. Minor connector that joins the auxiliary rest to the major connector.

Function of guiding plane:

- The denture can be easily placed and removed by the patient without strain on the teeth contacted or on the denture itself and without damage to the underlying soft tissues.
- Can provide bracing or stabilization when placed in the axial tooth surfaces.
- Ensure clasp assembly function including retention and stabilization.
- The friction forces of contact of prosthesis with the guiding planes wall will contribute significantly to the retention of the RPD.



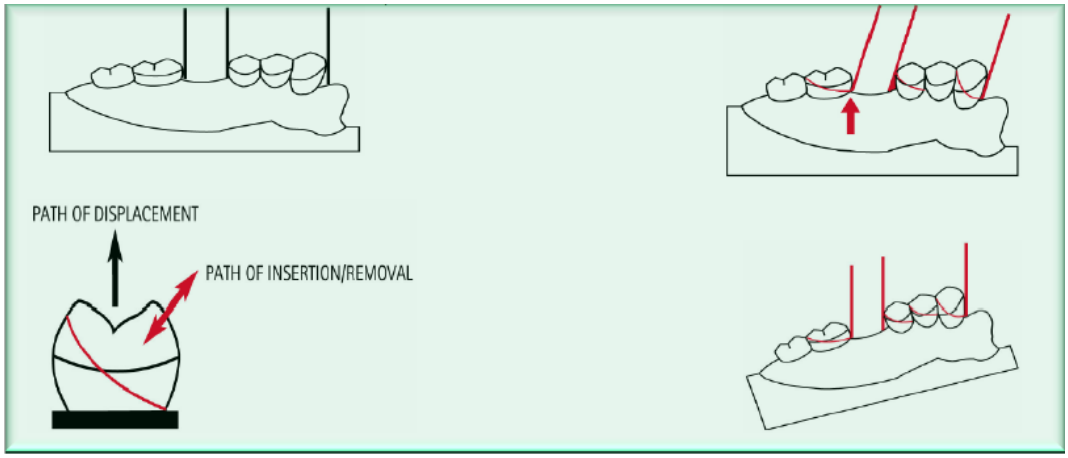
2. Retentive Areas

Retentive areas must exist for a given path of placement and must be contacted by retentive clasp arms that are forced to flex over a convex surface during placement and removal.

Fairly even retention may be obtained by one of two means:

- Change the path of placement to increase or decrease the angle of cervical (Gingival) convergence of opposing retentive surfaces of abutment teeth.
- Alter the flexibility of the clasp arm by changing its design, its size and length, or the material of which it is made.

<u>For a clasp to be retentive</u>; ***its path of escapement*** must be ***other than parallel to the path of removal of the denture itself***; otherwise, it would not be forced to flex and thereby generate the resistance known as retention. Clasp retention therefore depends on the existence of a definite path of placement and removal.



3. Interference

The prosthesis must be designed so that it may be placed and removed without encountering tooth or soft tissue interference (areas of interference like the proximal tooth undercut, maxillary or mandibular lingually or labialy or buccally incline teeth, bony exesistosis and tissue undercuts).

A path of placement may be selected that encounters interference only if the interference can be eliminated:

- During mouth preparations.
- On the master cast by a reasonable amount of blockout.

Interference may be eliminated during mouth preparations by:

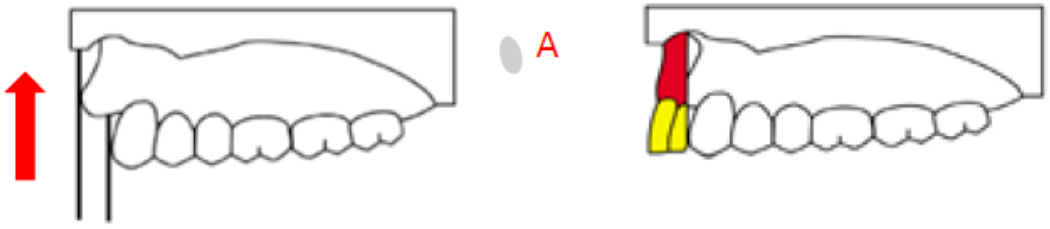
- Surgery.
- Extraction of the tooth or teeth.
- Modification of interfering tooth surfaces.
- Or alteration of tooth contours with restorations.

If the interferences cannot be eliminated or minimized, then a different path of insertion must be considered, even if less desirable guiding plane and retentive areas must be selected.

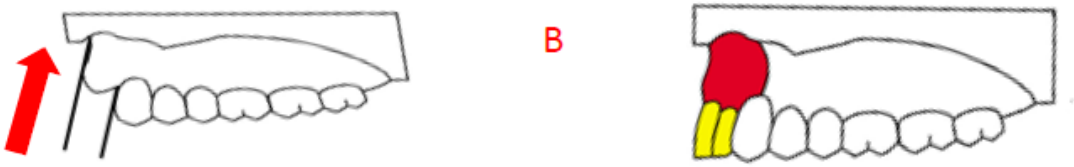
4. Esthetics

A path of insertion should be selected to provide the most esthetic placement of artificial teeth and the least amount of visible metal on the abutment teeth. Retentive areas must be selected to optimize retention purposes with esthetic requirements.

- Metal component must be concealed. Less metal will be displayed (most esthetic location of clasps) if the retentive clasp is placed at a more *distogingival area* of tooth surface made possible either by changing the path of placement selected or by the contour of the restorations.
- Esthetics also may dictate the choice of path selected when missing anterior teeth must be properly positioned in the partial denture. In such situations so that neither the artificial teeth nor the adjacent natural teeth will have to be modified excessively.



(A) The first path of insertion (zero tilt), the less esthetic removable partial denture.
(B) The most esthetic path of insertion, the most esthetic removable partial denture.



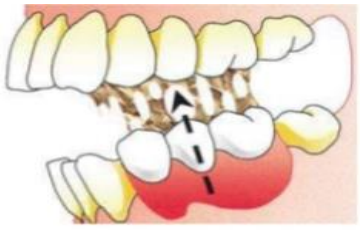
CAN YOU NOTICE THE DIFFERENCES WHICH MAKE THE SECOND REMOVABLE DENTURE IS MOST ESTHETIC DENTURE?

Rules of surveying

1. The undercut areas cannot be created or produced by tilting the cast.

2. All casts are originally surveyed with the occlusal plane is parallel to the base of surveyor; this is what we called ***zero tilt***, in which the retentive undercut must be present on the abutment teeth.

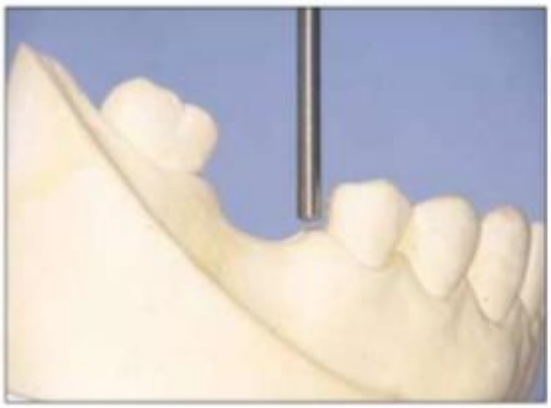
Most patients will tend to seat the partial denture under force of occlusion. If the path of insertion is other than vertical to the occlusal plane such seating may deform the clasps. Also dislodging forces are always directed perpendicular to the occlusal plane.



3. The retentive tip of the clasp must engage the undercut area, which are present when the cast is surveyed in certain position.

4. Wherever possible, the undesirable undercut and area of interference are removed during mouth preparation by recontouring teeth or making necessary restoration.

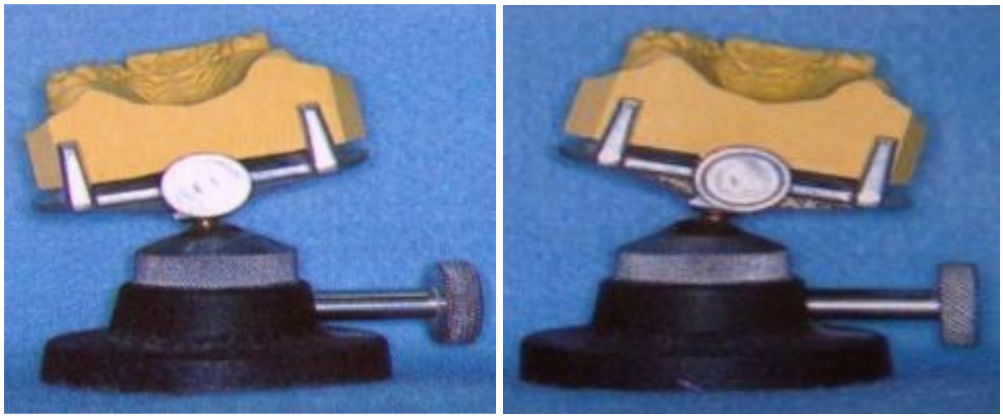
5. ***Anteroposterior tilt:*** anterior tilt will increase the mesial undercut, while the posterior tilt will increase the distal undercut. Such as in free end extension partial denture tilting the cast anteriorly will decrease or eliminate the distal undercut where the path of insertion will be changed, thus getting rid of undesirable undercut located distally, therefore the tilting of the cast is to minimize or equalize the undesirable undercut.



Anterior tilt ('heels up')

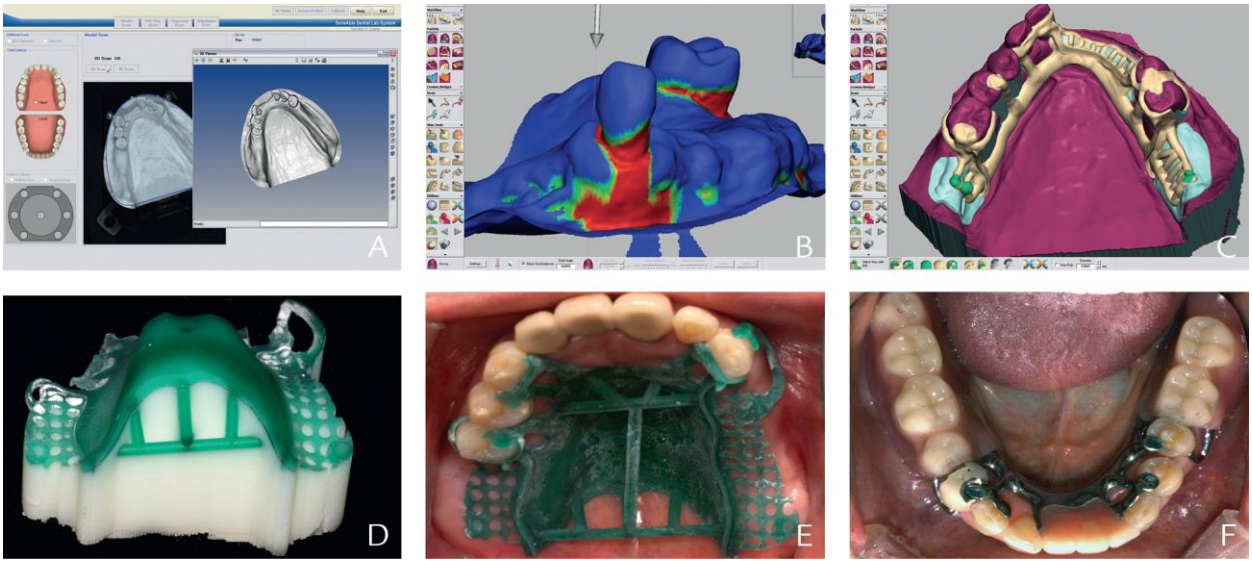
Posterior tilt ('heels down').

6. ***Lateral tilt:*** dealing with retentive undercut situated buccally or lingually on posterior teeth.



Computer aided designing and manufacturing (CAD - CAM) of removable partial dentures: Digital surveying:

The framework of the RPD was designed by setting a surveying axis and computing the undercut to determine an ideal path of insertion and removal (B).



Procedure for digital removable partial denture fabrication. A, Model scanning. B, Electronic surveying. C, Definitive framework design. D, Pattern built with 3-dimensional printer. E. Intraoral view of pattern resin framework. F. Definitive prosthesis.