Surveying

Surveying: is the determination of the relative parallism of two or more surfaces of the teeth or other parts of the cast of a dental arch.

To survey: is the procedure of the locating and delineating the contour and position of the abutment teeth and associated structures before designing a removable partial denture.

Objectives of surveying: in order to plane those modifications to fabricate a removable partial denture this can be easily inserted in the mouth and retained in place during function.

Dental surveyor: A dental surveyor is an instrument used to determine the relative parallelism of two or more surfaces of teeth or other parts of a dental arch.

This instrument, which is essentially a parallelometer, is one of the Corner stones of effective RPD design and construction. The surveyor allows a vertical arm to be brought into contact with the teeth and ridges of the dental cast, thus identifying parallel surfaces and points of maximum contour.

Ideally the clinician, rather than the dental technician, surveys the study cast in preparation for designing an RPD.
Types of surveyors: the most widely used surveyor is
1. Ney surveyor with non swiveling horizontal arm.
2. Jelenko surveyor with swiveling horizontal arm

Parts of dental surveyor:
1. Platform with the base is moved.
2. Vertical arm or upright column supports the superstructures.
3. Horizontal arm from which the surveying tools suspend.
4. Table to which the cast is attached.
5. Horizontal surveyor base on which the table swivels.
6. A mandrel for holding special tools.

The tools which are used for surveying are: analyzing rod, carbon marker, undercut gauges and wax trimmer

1. The analyzing rod: is a rigid metal rod used for diagnostic purposes in the selection of the path of placement and to determine the undercut areas prior to scribing the height of contour with the carbon marker. This metal rod is placed against the teeth and ridges during the initial analysis of the cast to identify undercut
areas and to determine the parallelism of surfaces without marking the cast.

2. *The carbon marker:* is used for the actual marking of the survey lines on the cast. A metal shield is used to protect it from breakage. The graphite marker is moved around the tooth and along the alveolar ridge to identify and mark the position of maximum convexity (survey line) separating non-undercut from undercut areas. When surveying a tooth, the tip of the marker should be level with the gingival margin allowing the side of the marker to produce the survey line as shown in the illustration.

3. *The undercut gauges:* are used to measure the extent of the undercuts on abutment teeth that are being used for clasp retention, usually there are three sizes 0.01, 0.02 and 0.03 of an inch.
4. *The wax trimmer:* is used to trim excess wax that may be inserted into those undercut areas which are to be obliterated to obtain the proper form of the wax pattern.

This instrument is used to eliminate unwanted undercuts on the master cast. Wax is added to these unwanted undercut areas and then the excess is removed with the trimmer so that the modified surfaces are parallel to the chosen path of insertion.

Whenever possible, casts should be surveyed with the occlusal plane parallel to the base of the surveyor so that the path of insertion is vertical to the occlusal plane. Most patients will tend to seat the partial denture under force of occlusion. If the path of insertions is other than vertical to the occlusal plane such seating may deform the clasps.

**Purposes of surveying**
1. Determine most acceptable path of insertion and removal.
2. Identified proximal tooth surfaces that can act as guide planes.
Guide planes are proximal tooth surfaces that are parallel to one another and act to assure a definitive path of insertion and to insure positive clasp action. These parallel axial surfaces on abutment teeth which can be used to limit the path of insertion and improve the stability of a removable prosthesis. Guide surfaces may occur naturally on teeth but more commonly need to be prepared.

3. Locate and measure areas of teeth that may be used for retention.
4. Determine most suitable path of insertion to satisfy esthetic.
5. Aid in determining restorative procedure and mouth preparation.
6. Delineate height of contour (survey line) on abutment teeth and locate undercuts which may need blocking prior to duplication.
7. Record the cast position in relation to a selected path of insertion for futural references (tripod placement on the cast of three dotes or line one anterior and two posterior) to permit its reorientation.

8. Determine most soft or bony tissue undercuts that would act as interferences.

**Types of undercuts established by surveying:**

Undercuts:

→ Undercuts on abutment teeth lie below the height of contour, which is the most bulbous and convex part of the tooth also called maximum bulge.

→ **Types of undercuts:**

A: Height of contour  B: Undercut area  C: Non undercut area
1. Desirable undercuts:-
→ Used for retaining the RPD against the dislodging forces by incorporating retentive flexible clasp arms, or by the denture base engaging a tissue or bony undercut.

2. Undesirable undercuts:-
→ Undercuts other than those used for retention are considered undesirable and should be eliminated.
→ this is done by:
a- Blocking-out the undercut with wax on the master cast.

b- The preparation& reduction of the tooth surface in the mouth.

c- Placing a properly contoured crown restoration on the tooth abutment.
**Principles of surveying:**
Surveying a tooth consisted 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 supra bulge area) where this supra bulge point 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 that 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.

Path of insertion and factors affecting the path of insertion
It's the specific direction in which prosthesis is placed on the abutment teeth.
The factors affecting the path of insertion are:

1. **Interferences**: certain area of the mouth may interfere with the insertion of the partial dentures. These are usually the proximal tooth undercut, to max. Or mand., lingually or mesially inclined teeth, bony exostoses, as well as tissue undercuts.

   Such areas are to be eliminated by:
   1. Changing the path of placement.
   2. Relief of the denture.
   3. Surgically partial or complete removal.
   4. Any combination of above

2. **Retentive undercuts**:
   A retentive undercut must be present on the abutment teeth, both at the horizontal or zero tilt and at the selected path of placement tilt, for contracting the dislodgement of the denture in that direction.

3. **Esthetics**:
   The surveyor can be used to study configuration of anterior edentulous spaces, to be evaluated the cosmetic opportunity and other problems if present or when faced; sometimes tilting the cast is used to avoid an interference that may result from putting a clasp in an unfavorable position for esthetics.
When a maxillary cast, containing an anterior edentulous area, is surveyed with the occlusal plane horizontal it will often be found that there are undercuts on the mesial aspects of the abutment teeth. If the RPD is constructed with this vertical path of insertion there will be an unsightly gap between the denture saddle and the abutment teeth gingival to the contact point.

This unsightly gap can be avoided by giving the cast a posterior (heels down) tilt so that the analyzing rod is parallel with the mesiolabial surface of the abutment tooth. With this posterior path of insertion the saddle can be made to contact the abutment tooth over the whole of the mesiolabial surface and a much better appearance results.
4. Guiding planes:

These are areas present on the enamel surface of the teeth that are created so that they are almost or approximately parallel to the path of insertion. They are prepared after the path of insertion is selected according to the three previous factors. These are found or formed in the proximal-axial or lingual surfaces of the teeth in the occlusal third. They extend buccolingually according to the width of the component that is contacting them. The surveyor will delineate guiding plane surface. Guiding plane will assist in providing a clear passage of the prosthesis along the chosen path of placement. The components of the denture that contact the guiding planes during placement of R.P.D. are:

1. Contacting proximal surfaces are the minor connector that joins the clasp to the saddle, and proximal places used with I-bar or R.P.I clasps.
2. Contacting axial or lingual surfaces are reciprocal clasp arms, lingual plates that act as reciprocal arm, and minor connector that joins the auxiliary rest to the major connector.
**Functions of guiding planes:**
1. Guides the prosthesis in and out of the mouth without any undesirable forces against remaining teeth.
2. The frictional forces of contact of the prosthesis with the guiding planes wall will contribute significantly to the retention of R.P.D.
3. Can provide bracing or stabilization when placed in the axial tooth surfaces.

**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.
3. The retentive tips of the clasps must engage undercuts areas which are present when the cast is surveyed in certain position.
4. Wherever possible undesirable undercuts and areas of interferences are removed during mouth preparation by recontouring teeth or making necessary restorations.
5. Anterioposterior tilt: anterior tilt will increase the mesial undercut while the posterior tilt increase the distal undercut. Such as in free end extension P.D. tilting the cast anteriorly will decrease or eliminate the distal undercut where the path of insertion will be changed, thus getting rid of undesirable undercuts located distally, therefore the tilting of the cast is to minimize or equalize the undesirable undercuts.
6. Lateral tilt dealing with retentive undercuts situated or buccally or lingually on posterior teeth.

**Ideal situation**
- A partial denture should have a single path of insertion
  - this is only possible for dentures with bounded saddles
  - for dentures with free-end saddles 2 or more
paths of insertion will be possible