FUNDAMENTALS OF REMOVABLE PARTIAL PROSTHODONTIC DESIGN
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CHAPTER 11
Laboratory Steps in Fabricating a RPD Framework
SURVEYING:

OBJECTIVE: To locate and delineate the contours and prominence of the abutment teeth and associated structures related to the design of a removable partial denture

PRINCIPLES:

• identify tooth surfaces that are either parallel or are so related that they can be modified to be parallel to act as guiding planes
• locate and measure areas of the teeth that may be used for retention
• determine tooth and tissue contours that would act as interferences and need to be modified
• determine the most acceptable path of placement and removal
• determine the most appropriate path of placement to meet esthetic considerations

INDICATIONS:

• formulating a removable partial denture design
• recontouring teeth
• contouring wax patterns
• placing intracoronal rests or retainers
• machining cast restorations
• surveying and blocking out the master cast

ITEMS NEEDED:

• dental surveyor
• assigned casts
• red, blue and green pencils
• correctable erasing pencil
PROCEDURES:

DENTAL SURVEYOR:

DEFINITION: a paralleling instrument used in construction of a removable partial denture to locate and delineate the contours and relative positions of abutment teeth and associated teeth and structures.

Surveyor

A - friction knob to secure vertical arm
B - knob to secure stylus
C - moveable vertical arm
D - storage for stylii
E - platform for survey table

Surveying table

A - knob to secure cast
B - knob tilts table
C - cast platform
Styliii Used for Dental Surveying

A. Carbon marker in metal sheath
B. Wax knife
C. 0.01 inch undercut gauge (silver)
D. 0.02 inch undercut gauge (bronze)
E. 0.03 inch undercut (black)
F. Analyzing rod
DIAGNOSTIC SURVEY:

OBJECTIVE: To select the best possible path of placement and removal for the prosthesis. This path should minimize interferences and identify the mouth preparation necessary to optimize guiding planes, retention, and esthetics.

Items Needed:

- Dental Surveyor
- Four Assigned Casts
- Colored Pencils
- Erasing Pencil

PROCEDURE:

1) Place analyzing rod in movable arm

2) Place the diagnostic cast on the survey table
   a. Secure the cast on the surveying table using knob A (Figure 1-3)
   b. Set the initial position of the table approximately parallel to the occlusal plane and lock it in place with knob B (Figure 1-3)

3) Place table and cast under surveyor
   a. Hold the surveyor as shown, the right hand is used to raise and lower the stylus while the other hand manipulates the survey table. The right hand is also used to adjust knob B allowing the cast to tilt either laterally or anterior-posteriorly
   b. Path of Placement. At the starting position use the analyzing rod as a reference and tilt the cast position until the surfaces of the teeth that will be prepared as guiding planes are a parallel as possible

*Note: the tilt should not exceed 10 -15 degrees*
Guiding planes:

Ideal

path of placement is achieved primarily by suitable **anterior-posterior** tilting to provide the greatest combined areas of parallel proximal surfaces that may act as guiding planes with minimal grinding (grinding is within the enamel not requiring a restoration)

Errors

cast tilted too far to achieve guiding planes would require excessive preparation

teeth are under prepared resulting in multiple paths of placement

path of placement follows tilted tooth requiring excessive modification of other abutments
c. **Retention.** The cast is tilted laterally to establish reasonable uniformity of height of contour on all principal abutments, this should be done without affecting the previously determined **anterior-posterior** tilt. The ideal position of the height of contour is at the junction of the middle 1/3 and gingival 1/3 of the tooth. If the height of contour is too occlusal the tooth must be modified to lower it. If the height of contour is too low then crowns must be considered to raise it.

INDICATE INTERFERENCES TO AREAS OF RETENTION IN RED

---

**Areas of retention:**

**Ideal**

areas of retention are identified by tilting the cast laterally. The resulting position is one that provides for acceptable and equal retention on all the abutment teeth.

**Non-ideal:** some teeth have either too high or too low a height of contour
d. Interferences. The remainder of the cast is checked and areas of interference to the determined path of placement are noted. The only undercuts desirable for a given path of placement are those which will be utilized by the terminal one third of the retentive clasp arms. All other undercuts are neither wanted nor needed. Some areas of the cast will be undercut but they will not involve the prosthesis, so these areas are not of concern. Other areas which involve the prosthesis may have slight amounts of undercut. However, these can either be modified or blocked out (the process of relieving the prosthesis of intimate contact). It is only excessive undercut in the areas listed below that must be recognized. If these undercuts cannot be dealt with, we must modify the teeth to accept the desired path of placement or alter our path of insertion to eliminate them and then retrace our steps to determine new areas to be prepared as guiding planes and retentive areas.

e. Esthetics. Check the esthetics of the survey. The retentive areas should show as little as possible; the placement of denture base and teeth should be pleasing. These factors must be considered in determining final survey.

Common areas of interference include:

1. Proximal surfaces that are crossed by guiding planes or minor connectors

2. Bony undercuts that offer interference to seating of a denture base.

3. Buccally inclined maxillary posterior teeth that interfere with rigid portions of a clasp arm or the origin (proximal portion) of a circumferential clasp arm.

4. Bony prominences and lingually inclined mandibular teeth that interfere with a lingual bar major connector.

5. Tooth surfaces upon which reciprocal arms and stabilizing components or retentive clasp arms will rest. Sufficient area should exist above the height of convexity for the placement of these components. These components are best located between the middle and gingival third of the crown rather than the occlusal third.

6. Distal line angles of premolars and mesial line angles of molars that serve as abutments. These areas frequently interfere with the origin of circumferential clasp arms.
Areas of Hard and Soft Tissue Interference

Ideal prosthesis can be placed without encountering tooth or soft tissue interference

Error path of placement shows interference
TRIPODING

Record this position of the cast by tripoding the cast.

1. Tripod procedures
   a. fix the analyzing rod in position with the setscrew.
   b. mark three widely divergent points on the cast with a pencil without lifting analyzing rod to maintain a plane (circle with a red pencil for identification)
   c. Alternate technique if desired, groove the tripod points are located at the periphery of the cast and marked as grooves for reproduction in the refractory cast.

The resulting position is the most advantageous one that demonstrates the best possible proximal surfaces to be prepared to act as guiding planes and retentive areas on the abutment teeth. Combining the information from this diagnostic survey along with the results of the clinical and radiographic exam, a design with its required tooth modifications can be determined.
REFERENCES:

BASIC COMPONENTS OF A PARTIAL DENTURE

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1. CLASP ASSEMBLY

A. FUNCTION

To provide resistance to vertical forces of dislodgement, i.e. force of gravity, adhesiveness of food or forces related to opening the jaws. This retention is achieved by the resistance of metal (retentive arms) to deformation.

B. COMPONENTS OF A CLASP

- A - Rest
- B - Retentive Arm
- C - Reciprocal Arm
- D - Minor Connector
- E - Minor Connector, serving as a proximal plate
C. REQUIREMENTS OF A PROPER CLASP DESIGN

1. SUPPORT - Resistance to the vertical component of masticatory force. This is provided primarily by the rest with some contribution from the portions of the clasp arms located above the height of contour.
   - Prevents tissueward displacement of the partial denture
   - Distributes masticatory load to the abutment teeth
   - Prevents damage to periodontal structures

2. STABILIZATION - (Bracing) Resistance to horizontal component of force. It is provided by the nonretentive portions of the clasp arms, the minor connectors, and the rests.
   - Resist horizontal movement of prosthesis
   - Distribute stress equally to all abutment teeth

3. RETENTION - Resistance to dislodgement in an occlusal direction.
   - Resists occlusal displacement
   - Provided by the terminal one third of the retentive clasp arm
   - Retentive portion of the clasp arm needs to be perpendicular to the dislodging force to be effective
   - Flexibility of the metal determines amount of usable undercut
   - Retentive areas should be distributed throughout the dental arch
   - Retention should be the minimum necessary to resist reasonable dislodging force

4. RECIPROCITY - Each force exerted on a tooth by a clasp arm must be offset by an equal and opposite force.
   - Opposes forces during insertion and removal of the prosthesis
   - Provided by reciprocal arms and other rigid components
   - Prevents tooth movement from over-adjustment of clasp arms
   - True reciprocation is usually possible only through the use of crown surfaces made parallel to the path of placement.
   - Contributes to bracing (stabilization)

5. ENGAGEMENT - Encircles the tooth more than 180 degrees or tripods a tooth.
   - Prevents tooth movement out of the clasp assembly
   - Prevents clasp from slipping off the tooth
   - A minimum three points contact is necessary

6. PASSIVITY - When the clasp is completely in its designated terminal position on the tooth, it exerts no force on the tooth.
D. FACTORS IN CLASP DESIGN

1. The edentulous condition whether the case is tooth supported or tooth and tissue supported.

2. The position of the survey line and the location of the undercut are the determining factors in clasp selection.

3. The occlusal rest can not interfere with the occlusion, must be sufficiently thick to withstand the stresses of mastication and should not be placed on inclined surfaces.

4. When anterior teeth are replaced, lingual or incisal rests should be placed in prepared rest seats adjacent to edentulous spaces for increased support.

5. Flexibility may be increased by curving and thus lengthening the retentive arm. Circumferential clasps should not cross the tooth in a straight line. This results in a clasp with a minimum of flexibility.

6. Uniform taper in thickness and width is essential for either the approach arm of a bar clasp or the arms of the circumferential clasp. The clasp arms should be about one half the thickness at the tip as it is at its attachment to the body.

7. There should be no thick or thin spots in clasp arms. Strain lines will concentrate at a thin area and metal breakage may occur.

8. There should be no sharp bends in the clasp arms.

E. FACTORS AFFECTING THE RESILIENCY OF A CLASP

1. The diameter or thickness of the retentive arm.

2. The cross sectional form of the retentive arm (round, 1/2 round, 1/2 ovoid).

3. The length and width of the clasp arm.

4. The uniform taper of the clasp arm. Proper taper of the clasp arm will greatly increase the resiliency.

5. The type of metal alloy and the ratio of the constituent metals to each other. A cast metal is not as resilient as a wrought metal.

6. Handling during fabrication heat treatment or work hardening.

<table>
<thead>
<tr>
<th>DIMENSIONS in mm</th>
<th>premolar</th>
<th>molar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Body</td>
<td>Tip</td>
</tr>
<tr>
<td>Width</td>
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<td>0.8</td>
</tr>
<tr>
<td>Thickness</td>
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<td>0.5</td>
</tr>
<tr>
<td>Length</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>
F. TYPES OF CLASP DESIGN

1. Suprabulge

a. Circumferential  Arms originate at the minor connector above the height of contour and contact the tooth throughout the extent of the clasp. This is the basic fundamental clasp of all tooth supported RPDs because of its retentive and stabilizing ability. This clasp utilizes an 0.01 inch undercut away from the body of the clasp.

b. Embrasure clasp - This is essentially two simple circumferential clasps joined at the bodies. It is most often used on a side of an arch that has no edentulous space. The other side of the arch may be tooth supported or a distal extension. Since this clasp must cross occlusal surfaces and pass through and occupy buccal and lingual occlusal embrasures, ample space must be provided for the clasp shoulders so that they do not interfere with the opposing occlusion. Rests must be placed on both teeth to prevent any wedging effect that might occur from the clasps and to shunt food away from the contact areas. In the preparation of the recesses on these teeth for an embrasure clasp which can be best done on castings, care must be exercised to preserve enough of the natural tooth contact to assure support. This clasp uses a 0.01 inch undercut.
c. **Combination:** A circumferential clasp that has one cast and one wrought wire arm which is a drawn wrought wire that is soldered to the retentive latticework of the framework. The wrought wire arm is retentive and usually is made with 19 gauge (0.036) inch round wire composed of a cobalt chromium alloy, nickel chromium alloy, gold, or titanium. It can be used when the undercut is excessive or on a distal extension base when the undercut is on the side of the tooth away from the extension base. This clasp uses a 0.01 to 0.02 inch undercut.

2. **Infrabulge**

a. **Bar:** Originates below the height of contour extending from a major connector or denture base, passing adjacent to the soft tissues and approaches the tooth from a gingivo-occlusal direction. The undercut is usually the side of the tooth closest to the extension base for the t or ½ t bar, or at the greatest mesiodistal contour of the tooth for the I bar. It is seldom used on the lingual surface and can not be used if there is a shallow vestibule (minimum 5 mm), severely tilted tooth, or excessive tissue undercut (greater than 2 mm) present in the area of the approach arm because of patient discomfort and food entrapment. This clasp uses a undercut of 0.01 inch. Types are the t-bar, half sqt-bar and I bar.
b. RPI bar: This clasp utilizes a buccal undercut or an undercut on the side of the tooth away from the edentulous area. The entire clasp is composed of a rest (R), with its minor connector, proximal plate (P), and an "I" bar clasp. The "I" bar contacts the tooth anterior to the greater buccal curvature of the tooth. There are other components of this mode of clasping that the student should understand by referring to his or her lecture notes. Because of its unique requirements, this clasp is best accomplished when the abutment tooth is being crowned. This clasp is utilized on distal extension bases but has the same limitations as any infrabulge clasp in its usage. This clasp uses an undercut of 0.01 inch.
2/3 width of cusps

GP

1.0mm overlap of guide plane

2-3mm

PP

Distal view
3. Reciprocal arms

Except for the RPI bar clasp which develops reciprocation by utilizing vertical surfaces (lingual edge of the minor connector which contacts the guiding plane), all retentive clasp arms need a corresponding horizontal reciprocal component to brace the tooth as the retentive clasp flexes over the height of contour to enter the undercut zone. The reciprocal clasp is at or above the height of contour, never in an undercut and placed as low in the middle 1/3 of the tooth as the survey line allows. While most all retentive clasps need a reciprocal clasp, additional reciprocal clasps may be placed (e.g., for horizontal stabilization) without the placement of corresponding retentive clasp.
II. REST

A rigid extension of a removable partial denture that prevents movement toward the mucosa and transmits occlusal functional forces to the teeth

A. FUNCTION OF REST

Primary function is to provide vertical support for the partial denture.

1. Maintain components in their planned positions
2. Maintain established occlusal relationships by preventing settling of the denture.
3. Prevents impingement of soft tissues.
4. Directs and distributes occlusal load to abutment teeth.

B. ADDITIONAL FACTORS

1. Must have sufficient thickness of metal to insure rigidity.
2. Should be contoured to prevent food stagnation.
3. Should direct forces along the long axis of abutment teeth.
4. Should not be placed on an inclined surface.
C. TYPES OF RESTS

Rests are named for the surface of the tooth on which they are prepared.

1. Occlusal rest: a rigid extension of a partial denture that contacts the occlusal surface of a tooth

2. Cingulum rest: a rigid extension of a partial denture that contacts the cingulum of a tooth

3. Incisal rest: a rigid extension of a partial denture that contacts a tooth at the incisal edge
III. MAJOR CONNECTOR

The part of a removable partial denture that joins the components on one side of the arch with those on the opposite side. The single most important aspect of a major connector is its rigidity. It is only through rigidity of the major connector that all other component parts of the partial denture may be effective.

In general, major connectors should have the following attributes.

- made from an alloy compatible with oral tissues
- rigid for broad stress distribution
- non-interfering to the tongue
- no substantial alteration to the natural contour of the lingual surface of the mandibular alveolar ridge or the palatal vault
- no impingement of tissues when the RPD is placed, removed or rotated in function
- covers no more tissue than is necessary
- does not trap food
- has support from other elements of the frame work to minimize rotational tendencies in function

Maxillary Major Connectors

In addition to its function of unification, the maxillary major connector also can contribute substantially to the support and retention of the prosthesis. Support comes from the fact that broad palatal coverage of some maxillary major connectors greatly adds to the surface area covered by a prosthesis and this broad coverage contributes to adhesive, cohesive and surface tensional retention of the prosthesis much as that of a complete denture. Maxillary major connectors ordinarily require no relief. The intimate contact between the connector and the tissue provides the support and retention desired. Exceptions to this rule are maxillary tori and a prominent median palatal suture line. The gingival tissue of the remaining natural teeth shall never have impingement. Therefore, the borders of the palatal connector should be placed a minimum of 6 mm away from gingival margins and should be located parallel to their marginal tissue. The gingival tissue underlying the minor connectors should be relieved. Anterior and posterior borders of the major connector should be lightly beaded to insure intimate contact with the mucosa.
**Types of Maxillary Major Connectors**

1. **Palatal strap**

   This connector is indicated for unilateral or bilateral edentulous areas of short spans in a tooth-supported RPD where the need for palatal support is minimal. The width of the strap varies with the length of the edentulous span. The strap should be made wide and thin rather than narrow and thick to achieve the required rigidity and to be as innocuous as possible to the tongue. The anterior border follows the valleys between the rugae as nearly as possible at right angles to the median suture line. The posterior border is also at right angles to the median suture line.
2. Broad Palatal:

This connector is similar to the previous type except its width is extended to cover much more palatal area. It is indicated in unilateral or bilateral edentulous arches having a large edentulous space or distal extension base with good residual ridges that can lend excellent support and/or strong abutment teeth.
3. Full Palatal Coverage

The full palatal connector covers a wider area of the palate than any other connector and so contributes maximum support and retention to the prosthesis. Posteriorly, it extends to the junction of the hard and soft palate just anterior to the vibrating line and passes through each hamular notch. Anteriorly, it extends to cover the rugae zone and can even extend to cover the lingual aspects of the remaining maxillary teeth. The connector can be all metal, all acrylic or some combination of the two. It is indicated in those situations where maximum support and retention are needed because of few remaining teeth or teeth that have compromised alveolar support. This would include arches with only six or less remaining anterior teeth, bilateral edentulous arches with 1 to 4 premolars and some or all anterior teeth missing, unilateral or bilateral edentulous cases where the remaining alveolar ridge span is long and severely resorbed and arches that have one or two distal extension bases and periodontally involved teeth. The connector may be all metal or a combination of all metal and metal lattice covered with acrylic.
Full Palatal Coverage
4. The Anterior-Posterior Bar - (A-P bar, O bar):

The anterior-posterior bar is used when the anterior and posterior abutments are widely separated and other palatal connectors are not used for one reason or another. The two bars may be made wide or thin, as dictated by the needs and the available space. Specific indications are unilateral and bilateral arches in which excellent abutment and residual ridge support exists, long edentulous spans that are tooth bound, when anterior teeth must be replaced by the partial denture and additional rigidity is needed for the anterior bar and in the presence of an inoperable palatal torus. This connector has relatively narrow (8 to 10mm.) anterior and the posterior palatal strap 6 to 8mm.) with an opening in the center; the lateral palatal straps are 7 to 9mm. wide and run parallel to the gingival margins, at least 6mm. away from it. The anterior strap is not placed farther anteriorly than the anterior rests and never closer than 6mm. to the gingival margins. It follows the valleys of the rugae and is at right angles to the median palatal suture. The posterior palatal strap has its posterior border located at the junction of the hard and soft palate just anterior to the vibrating line, is at right angles to the median palatal suture and is half oval in shape.
5. U-shaped Palatal (horseshoe):

The U-shaped palatal major connector is probably the poorest design of all palatal major connectors because it lacks the rigidity of other types of connectors. When it is used, it must have support over and above its principal rests by the use of additional rests. Its main indications are in the presence of a large palatal torus that negates the use of another connector type or when only anterior teeth are absent. In the case of an anterior supply where all the posterior teeth remain, this is the major connector of choice. To be rigid, this type of connector must have bulk where the tongue needs the most freedom which is in the rugae zone. Without sufficient bulk, the U-shaped design leads to increased flexibility and movement at the open ends.
Mandibular Major Connectors: Mandibular major connectors have a limited capability for support, but it may contribute to indirect retention, a function which a maxillary connector does not ordinarily perform. The basic form of a mandibular major connector is the half-pear-shaped lingual bar. The inferior border of the bar must be located so that it does not impinge on the tissues in the floor of the mouth as they change elevations during normal activity. At the same time, the bar should be located as far inferiorly as possible to avoid interference to the tongue and trapping of food particles. Additionally, the more inferiorly a lingual bar can be located, the farther the superior border of the bar can be placed from the lingual gingival margins. The superior border of the lingual bar should be at least 4 mm. from the gingival margins.

Types of Mandibular Major Connectors

1. Lingual Bar:

This connector is utilized most of the time on mandibular RPDs. It is half-pear shaped with the thicker part making up the inferior border and the superior border should be tapered to the soft tissue. It is indicated for use when there is sufficient space between the slightly elevated alveolar lingual sulcus and the lingual gingival margins. The connector should be placed no closer than 4 mm. from the free gingival margin. Relief is necessary along the inferior edge on distal extension bases when the most distal rests are located close to or on the anterior teeth.
Lingual Bar
2. Linguoplate:

This mandibular major connector is half-pear shaped with the thickest portion inferiorly located. A thin metal apron extends superiorly to contact cingula of anterior teeth and lingual surfaces of involved posterior teeth at their height of contour and interproximally to the height of the contact points. The superior border is finished flush with the teeth and the inferior border is at the height of the alveolar lingual sulcus in function. All undercuts on involved teeth must be blocked out parallel to the path of insertion and all the underlying gingival margins should be relieved. This connector is indicated when there is insufficient space between the gingival margin and the alveolar lingual sulcus for the adequate width of a rigid lingual bar or when the presence of an inoperable lingual torus makes the placement of a lingual bar impossible. It is also indicated where more resistance to horizontal movement of the framework is needed because of flat resorbed alveolar ridges, or the teeth are to be used in "group function" because of periodontal instability to resist the horizontal rotation of a distal extension base. Still other indications are for an abnormally high lingual frenum making the placement of a lingual bar impossible, the need for an indirect retainer on a 6-tooth partial denture or when the future replacement of one or more incisor teeth is contemplated.

Note: The plate is supported by a rest where it starts and finishes.
IV. MINOR CONNECTORS:

The connecting link between the major connector or base of a removable partial denture and other units of the prosthesis, such as clasps, indirect retainers, and occlusal rests. Minor connectors arising from the major connector should do so at approximately a right angle to provide for maximum gingival freedom.

A. Function

1. Transfers functional stress to the abutment teeth (prosthesis to abutment).

2. Transfers the effect of the retainers, rests and stabilizing components to the rest of the denture.

B. Form of Minor Connector

1. It must have sufficient bulk to be rigid.

2. It is thickest toward the lingual surface, tapering toward the lingual contact area of the tooth.

C. Placement of Minor Connectors

1. Location:
   a. Embrasure space between adjacent teeth;
   b. Contact guiding plane surface of abutment teeth;
   c. Serve as the lattice connecting the major connector to the acrylic resin base.
2. There must be 5mm. of space between vertical minor connectors.

3. A minor connector when crossing gingival tissues should join the major connector at rounded right angles. It must cover as little of the gingival tissue as possible.

D. Considerations for Minor Connectors

1. It should not be located on a convex surface.
   - Wherever possible, position the minor connectors at interproximal spaces to avoid tongue interference.
   - It must pass vertically from the major connector to the other components.
   - It is thickest toward the lingual surface, tapering toward the contact area.

2. When the minor connector contacts tooth surfaces on either side of an embrasure, it must be tapered to the teeth. Sharp angles and spaces are avoided.

3. The minor connector contacts guiding plane surfaces of the abutment teeth. When used as a proximal plate, the minor connector should contact an area of the abutment from the marginal ridge to two-thirds the distance between the tips of adjacent buccal and lingual cusps of the abutment tooth.

4. The metal that covers the residual ridge which carries the acrylic resin, is designed so that the buccal brace of the metal is made 1-2mm. buccal to the crest of the ridge.

5. Tissue stops used on distal extension base partial dentures are to hold the end of the frame in position while packing acrylic resin.
V. INDIRECT RETAINERS

Part of a removable partial denture that assists the direct retainers in preventing the displacement of distal extension denture bases away from the tissue by functioning through lever action on the opposite side the fulcrum line. This action depends on the proper functioning of the direct retainers to work. The indirect retainer is more effective the further it is from the fulcrum line. However, as a single rest, the indirect retainer should rest on an abutment tooth that has the health and periodontal support needed to withstand the load, or else the indirect retainer may be fabricated as a continuous bar to contact several teeth and distribute the load.

Factors influencing the effectiveness of Indirect Retainers

1. Location
2. Distance from the fulcrum line
3. Length of the extension base
4. Rigidity of the connectors
VI. LATTICE WORK

A. Function

The partial denture framework retention lattice-work is that part of the casting that extends on to the edentulous ridge and retains the replacement teeth and acrylic base. This latticework is actually a minor connector that connects the framework to the acrylic resin denture base. In tooth bound cases, its extension is arbitrary and does not have a major supportive function, but one of the esthetics and convenience for the attachment of teeth. In distal extension bases, its function is expanded to include support, stability and retention. The majority of its bulk is to the lingual aspect of the ridge with a buccal extension just over the crest and extending 1-2 mm. on the buccal side of the ridge. This is so the metal framework will not interfere with either tissue reflections or the esthetic setting of replacement teeth. The length of the lattice in relation to the ridge differs from maxillary to mandibular:

B. Placement

Mandibular Distal Extension – lattice extends two-thirds of the edentulous area;
Maxillary Distal Extension – lattice extends to the tuberosity.

The lattice is retentive to the processed resin by virtue of the fact that there are large spaces placed in it and it is cast with a slight relief from the ridge enabling the resin to encircle the metal. Large spaces in the latticework have been shown to be more effective in retaining the resin than many smaller spaces and so it is this type that is recommended for routine use.
C. Finish lines

This is the junction of the major connector and the retention latticework. Sharp, definite, butt-type finish lines are incorporated into the metal because it is here that the acrylic resin meets the metal.

External finish lines (oral side) should be formed in the wax pattern in a way that provides ample thickness of both metal and resin.

Internal finish lines (tissue side) are also formed by the edge of the saddle relief wax which is placed on the master cast prior to duplication.

D. Beading

Palatal major connectots should have a specially prepared seal along the border of the connector where it contacts the soft tissues. This seal will form a beading at the border of the connector that will displace the soft tissues very slightly, thus preventing food from collection under the maxillary major connector. This bead is made approximately 1/2mm. deep and 1/2mm. wide. It follows the leading edge of the design of the maxillary major connector. The groove must fade out of at least 6mm. away from the gingival tissues to prevent tissue displacement of the marginal gingiva. It also may fade out over the center of the cast when a hard midline suture is present. Beading is readily accomplished with a cleoid carver. A slightly rounded groove is preferred to an a-shaped groove.
VII. ACRYLIC BASE

That part of the denture which rests upon the oral mucosa and to which the denture teeth are attached. The extensions of the base are determined by the extent of the master cast impression or in the case of a distal extension base, the altered cast impression.

A. FUNCTIONS

1. Provide support for artificial occlusal surfaces (masticatory function).
2. Esthetics
3. Stimulation of underlying tissue
4. Oral cleanliness

B. CONSIDERATIONS

1. Support should be the primary consideration in selecting and designing a denture base for an extension base denture.
2. The total support comes from both the abutment teeth and the following underlying structures:
   - Residual ridge
   - Buccal shelf
   - Palate
   - Pear-shaped pad

NOTE: The two most resistant areas of bone to resorption supporting the mandibular extension base partial denture are the buccal shelf and the pear-shaped pad areas. In the maxilla, the most resistant area is the palate. Whenever possible, these areas must be covered with the denture base.

3. The quality and contour of the underlying bone and mucosa are definite influencing factors on the support that can be derived from the extension base.

4. In an extension base partial denture, the base should cover the greatest surface area possible without impingement of movable tissue.

5. Maximum tissue support can be obtained only by using broad accurate denture bases. The principle of "snow-shoe" is that broad coverage furnishes the best support with the least load per unit area. The bases close to the abutment are primarily supported by the abutment teeth. Further away from the abutment, support of the base is primarily derived from the underlying tissue.

6. Selection of the type of base to be used for a given partial denture is influenced by whether it can be economically modified, relined or rebased much more readily than metal.

VIII. TEETH

May be made of porcelain, resin or metal.

1. Denture teeth
2. Facings
3. Metal teeth
PRELIMINARY DESIGN:

OBJECTIVE: to develop a tentative design for the partial denture and determine what tooth modifications may be necessary in order to complete the prosthesis.

PRINCIPLES: the design should be such that the RPD will be properly supported, stabilized, retentive, and esthetic while will not transmitting damaging forces to the remaining teeth or supporting tissues.

PROCEDURE:

• systematically locate rests, major connectors, minor connectors, retainers and denture base areas
• note the areas of the natural teeth that you think will need to be modified to accommodate the component parts of your design.
• note the type of restoration that may be necessary to accomplish these modifications.
• note areas which may require surgical intervention for placement of the partial denture.
• note any teeth which may need to removed before construction of the partial denture

*For purposes of this exercise, the student may assume that all emergency conditions have been treated, all endodontic and periodontal therapies have been completed.*
Resurvey the diagnostic cast considering the tentative design and choose the best PI & R (path of insertion and removal).

1. Select guiding planes and outline the areas for modification in blue

   Note:
   a. In making a choice between having a good guide plane on one tooth and none on another as against having to contour both teeth, the latter is preferred because the goal is to provide the greatest area of parallel proximal surfaces possible that may act as guiding planes.
   b. In making a choice between having the guide plane contact only the cervical area or the marginal ridge area the latter is preferred because the guide plane can be achieved with only recontouring where the former requires a casting to achieve a guide plane

<table>
<thead>
<tr>
<th>Dimensions of Guiding Planes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontally:</td>
</tr>
<tr>
<td>2/3 distance buccal between lingual cusps</td>
</tr>
<tr>
<td>Vertically:</td>
</tr>
<tr>
<td>2/3 enamel crown MR to CEJ</td>
</tr>
<tr>
<td>1/2 enamel crown MR to CEJ - RPI Clasp only</td>
</tr>
</tbody>
</table>

2. Mark the height of contour on the abutment teeth (teeth next to edentulous spaces) with the carbon marking rod.
3. Place the 0.010” undercut gauge in the surveyor and note the contact of the gauge on the buccal surfaces of all the abutment teeth. Use a newly sharpened red pencil to record where the gauge contacts the tooth. Do this by placing a series of dots. Connect the dots to form a line. Using this line along with the recorded height of contour as guides you must determine what if any recontouring of the tooth is necessary so the terminal one third of the retentive clasp engages the undercut and is at right angles to the path of insertion. Also the rest of the tooth may need recontouring so the shoulder and body of the clasp assembly have the proper relation to the tooth. This amount of retention is usually reserved for cast clasps.

4. Place the 0.020” undercut gauge in the surveyor and note the contacts this gauge makes with the buccal surfaces of all the abutment teeth. This amount of retention is usually reserved for wrought wire clasps. Use this information to make the same type of determinations as in step #3.
5. Place the 0.030" undercut gauge in the surveyor and note the contacts this gauge makes with the buccal surfaces of all the abutment teeth. This amount of retention is **seldom used** being reserved for wrought wire clasps made of gold wire. Use this information to make the same type of determinations as in step #3.

6. Using the information from steps 3-5 select the areas of retention and determine the clasp designs; remember retention should be sufficient only to resist reasonable dislodging forces.

7. Mark the areas of tooth modification in red

**NOTE:** Proper tilting of a cast on a surveyor may have the following effects with regards to the clasps of the partial denture.

1. Redistribute undercuts to a desired area
2. Allows a more favorable path of insertion
3. Allows the use of a desired type of clasp
4. Improves esthetics
5. Minimizes food impaction
8. Locate the primary rests on all teeth that have an edentulous space adjacent to them. In addition, other rests are placed to give quadrilateral or triangular support and/or for indirect retention on distal extension bases.
9. Select the major connector design most appropriate for the situation

10. Draw the design for your future partial denture on your work sheet

11. Reconfirm the areas needing mouth modifications to achieve the determined design and mark them on the surveyed cast as follows:

   a. Indicate necessary guiding plane modifications areas in blue

   b. Indicate necessary tooth preparation by selective grinding in red

   c. Indicate necessary rest preparation areas in green

When this is accomplished, present the surveyed casts and the drawn designs on paper to the instructor for evaluation grading. One of the surveyed diagnostic casts must be on the surveyor at the proper tilt. The casts must be tripoded so that the instructor can place it on the survey table easily at the proper tilt. When the project is complete, the instructor will collect the sign-off sheet.
TOOTH MODIFICATIONS:

OBJECTIVE: To optimize the design and function of a partial denture through modification of the remaining teeth.

PRINCIPLES: To do the modifications in conjunction with the path of insertion determined with the survey.

INDICATIONS:

1. To create guiding planes which:
   a) provide one path of insertion and removal for the prosthesis
   b) ensures the proper function of the reciprocal, retentive, and stabilizing components of the prosthesis

2. To improve or create retention by tooth modification procedures which place retentive areas close to the gingiva or create retentive areas on teeth where none exist.

3. To eliminate interferences improving the partial design and minimizing excessive blockout and subsequent food entrapment.

4. To improve esthetics by the elimination of excessive gingival embrasures.

5. To prepare rests that direct stress along the long axis of the tooth.

INSTRUMENTATION:

Straight diamond burs- medium, fine
Round diamond burs-#6,#8

PROCEDURE:

Once the final survey and design are determined it is recommended that tooth modifications be made on the diagnostic casts before being attempted intraorally. This is to acquaint the operator not only with the teeth that may need recontouring but also the amount of tooth reduction that will be necessary as well as the plane of orientation in which the modifications take place. After completing the necessary modifications on the study cast then the operator can proceed to the mouth with confidence. In the mouth, these reductions would be accomplished with fine grit diamonds. For our laboratory exercise however, these modifications will only be made only on the working casts. Care must be exercised if rotary instrumentation is used on stone models because of the ease of reduction. It is recommended therefore that any reduction on stone teeth be done using hand instruments.

NOTE: The knife carver that is supplied with the surveyor should not be used for tooth modifications because it is meant for modifying wax ups of crowns and will become quickly dulled on stone.
SEQUENCE OF ABUTMENT MODIFICATION

1. Guiding Planes
2. Tooth Surfaces to Accomodate Clasp Form
3. Interferences
4. Esthetics
5. Rests

MODIFICATION STEPS

1. GUIDING PLANES: After the path of insertion and the abutment teeth have been determined, the axial surfaces of the abutment teeth are prepared parallel to the path of insertion and to each other. These modified surfaces are referred to as guiding planes. There should be little if any modification done at the C-E junction because of lack of sufficient enamel thickness, the ideal area for modification is the marginal ridge. Necessary modifications which cannot be done with minimal grinding must be achieved by using restorations on the tooth. The abutment teeth requiring the least amount of modification are prepared first. Teeth requiring restorations are then modified so the restoration follows the determined path of insertion. The net result is to create the greatest area of guiding plane surfaces possible.

In creating guiding planes on interproximal tooth surfaces, no distinction should be made between a tooth supported and a distal extension base RPD. The guiding plane should extend approximately two thirds the length of the interproximal surface for both a tooth supported or a distal extension base RPD. The difference is in the minor connector acting against the guiding plane. In a distal extension partial denture, the minor connector should extend one half the length of the interproximal surface on the distal abutment tooth. This is done to minimize the leverage induced stress created by the rotational movement of the distal extension base in function. The tooth supported RPD the minor connector extends the whole length of the guiding plane. The RPI clasp is the only exception in that the guiding plane is prepared one half the length of the interproximal surface.

<table>
<thead>
<tr>
<th>DIMENSIONS OF GUIDING PLANES</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIDTH</td>
</tr>
<tr>
<td>2/3 width of B-L cusps</td>
</tr>
<tr>
<td>1/3 B-L width tooth</td>
</tr>
</tbody>
</table>
GUIDING PLANE MODIFICATION

IDEAL

A. Start
B. Prepared guiding plane

ERROR

Too much reduction

Not enough reduction

Handpiece followed tooth contour, not the path of insertion

Modification attempted where enamel is too thin

CORRECTION

A restoration is placed to give ideal contour
RELATION OF GUIDING PLANE TO THE MINOR CONNECTOR

Tooth Supported RPD

Distal Extension Base RPD

Distal Extension Base RPI Design RPD
2. TOOTH SURFACES TO ACCOMODATE CLASP FORM

A. RETENTIVE SURFACES: These modifications are done to create more ideal retentive surfaces.

Ideal

The retentive area is placed in the gingival 1/3 of the tooth so the retentive tip of the clasp arm is approximately 1-2 mm above the gingival margin. The amount of undercut is appropriate for the clasp design 0.01" for a cast clasp and 0.02" for wrought wire clasp.

Common Modifications

a. Lower the survey line: A retentive surface may have a survey line that is very high on the tooth. This would place the retentive arm high on the tooth which increases leverage on the tooth, creates poor esthetics, and increases the overall occlusal dimension of a tooth. It is recommended in this situation to modify the tooth and lower the survey line.
b. Increase the retentive area: In some instances, retentive undercut does not exist on the abutment tooth. At times this can be easily corrected by a slight recontouring of the enamel surface to create a area of undercut into which the retentive clasp tip will fit. The recontouring should be done where the enamel is comparatively thick and where the clasp terminus is usually placed. If recontouring can not be achieved then a restoration must be placed.

c. Reduce the undercut: The amount of undercut present exceeds the modulus of elasticity for the clasp design or material.
B. RECIPROCAL SURFACES

Ideal

The reciprocal surface of the tooth is parallel to the path of insertion allowing contact throughout the entire path of insertion and removal.

Common Modifications

Frequently, the height of contour on the reciprocal surface of the tooth is too high to allow the reciprocal arm to perform its functions of stabilization and reciprocation. The survey line should then be lowered on the reciprocal side so that it will be in contact with the tooth when the retentive arm is flexing over the supra bulge. When the retentive arm is elevated to the height of contour, it then starts to flex and impart a force to the tooth. If the reciprocal arm were placed as it is in the first diagram, it would be off the tooth when the force from the retentive arm is exerted. By lowering the height of contour as it is on the second diagram, proper reciprocation is assured.
3. INTERFERENCES: Interferences can be located on different tooth surfaces for many different partial denture components.

Ideal

There are no interferences by either hard or soft tissues to the determined path of insertion.

Common Modifications

Rigid Components

Reduce interference at the shoulder of the clasp: The part of the tooth which will contact the proximal portion of a clasp arm may have an excessively high height of contour. This survey line should be lowered to accommodate proper clasp form as well as improving esthetics.
INTERFERENCES FOR PLACEMENT OF MINOR CONNECTORS:

Tilted tooth causes an indirect retainer to create a large food trap between the connector and tooth. This undercut should be eliminated or at the very least reduced by careful reduction of the enamel surface.

INTERFERENCES FOR PLACEMENT OF MAJOR CONNECTORS:

On the mandibular arch, a lingually tipped tooth may prevent proper placement of the major connector. The tooth must be modified so the major connector can be placed in the most advantageous position.
4. ESTHETICS: In addition to the recontouring of teeth for a more esthetic location of clasp arms, modifications to the teeth may be done to improve the general esthetic effect of the RPD when there is an anterior edentulous space present.

Common Modifications

Missing anterior incisors: Usually the teeth adjacent to the space are bell shaped canines which may be tipped or rotated compounding the interference. In these cases, lateral tilting of the cast is usually ineffective because as one side is improved the other is worsened and vice versa.

1. The interfering proximal surfaces of these teeth severely limit the achievement of a natural appearance of the replacement teeth by either the presence of large gingival embrasures or the existence of an inadequate space for the normal complement of replacement teeth.

2. The bell shaped crowns of the canines are causing excessive gingival embrasures and space problems which result in poor esthetics.

3. Modification of guiding planes along the path of insertion increases the space available to place the artificial teeth and achieves a more esthetic appearance.
Changing the path of insertion before tooth modification to improve esthetics:

1. The minimal embrasure space present on the central at this path of insertion does not allow for modification to increase space for the lateral

2. The cast is tilted to better distribute the space

3. Modification of the guiding planes to further enhance esthetics
5. **RESTS**: Only after the modifications are completed for the guiding planes, clasp assemblies and correction of the interferences can the location of the rest seats in relation to the marginal ridges be determined. This is because the surface modifications will change the marginal ridge affecting the rest position. It is a good practice to make a impression of the prepared surfaces, form a cast and survey the modified areas to insure the necessary modifications have been completed before going on to rest seat preparation.

**PROCEDURE**

In a clinical situation rest preparations are made with carbide burs and round or straight diamonds. If the preparation depth perforates the enamel a restoration must be placed to accommodate the required depth. Caution should be exercised in preparing any rest seat to avoid creating sharp edges or line-angles in the preparation. This is to allow the partial some freedom of movement without transmitting lateral stress to the tooth and to prevent any sharp internal line angles in the casting which could be a potential fracture. Rest preparations should be carefully made on the stone models using either the handpiece with appropriate burs or hand instruments.

---

**RESTS**

Sequence of Modification of Tooth Surfaces to Accommodate Clasp Design

1. Retentive Surfaces
2. Reciprocal Surfaces
3. Interferences
4. Esthetics
5. Rests
REST PREPARATION:

A. Occlusal Rest: This is most common type of rest made on the occlusal surface of a bicuspid or molar. The rest is triangular or spoon shaped with the point of the spoon facing the center of the occlusal of the tooth.

REST DIMENSIONS

WIDTH:
one-half the distance between the tips of the buccal and lingual cusps

LENGTH:
one-third mesial-distal length of occlusal surface (for premolars)
one-fourth mesial-distal length of occlusal surface (for molars)
DEPTH:
the rest seat is lowered 1 mm to permit enough bulk of metal for strength and rigidity without interfering with the opposing occlusion. This is especially critical in the area of the marginal ridge where fracture could occur.

SHAPE:
the floor of the occlusal rest should be inclined slightly toward the center of the tooth so that the angle formed by the horizontal rest and the vertical minor connector is less than 90 degrees. The marginal ridge should be rounded and the guiding plane checked to insure it remains the proper dimension after rest preparation.

INSTRUMENTS:
Molar
Body of rest 36006-137 round ended diamond
Floor of rest 36006-136 round ended diamond
Premolar
Body of rest 36006-136 round ended diamond
Floor of rest 36006-135 round ended diamond
Polish using fine diamonds, finishing carbide burs, stones, blue and green points
MODIFICATION OF RESTS TO ACCOMODATE EMBRASURE CLASPS:

The marginal ridges must be reduced to allow space for the shoulder of the clasp arms to pass through. Care must be taken to maintain an adequate contact point when reducing the marginal ridges.

SHAPE:
A uniform reduction of 1 mm is made to the marginal ridge area. The buccal and lingual areas must be widened and flared to permit entry of the minor connector on the lingual and passage of the rigid portions of the clasp arms on the buccal.

INSTRUMENTS:
marginal ridge-36006-137
Polish fine diamonds, finishing carbide burs, stones, blue and green points
B. Lingual Rest: Prepared on canines and incisors, preferably on canines since these are stronger abutments by virtue of their alveolar support. If the slope of a canine is gradual rather than more parallel to a vertical minor connector, a lingual rest may be placed in enamel at or just incisally to the cingulum. This type of rest is usually confined to the maxillary canine. The lingual slope of the mandibular canine is too steep for an adequate lingual rest preparation to be placed in enamel i.e., one in which the forces are directed parallel to the long axis of the tooth. In order for a lingual rest to be used on a mandibular canine, usually some form of restoration must be placed in the tooth for the rest to be made. Lingual rest preparations may be made in three ways on maxillary canines.
1. Ledge rest- prepared at or above the cingulum area. Because of the degree of preparation in such a rest seat, it is preferred to make this rest in a restoration. Occasionally in maxillary teeth with a large cingulum this rest can be made in tooth structure without going into dentin.

REST DIMENSIONS

WIDTH Buccal Lingual:
This preparation must be 1 mm. in width at the lingual midpoint of the tooth.

LENGTH:
Lingual of tooth, line angle to line angle

DEPTH Occlusal Gingival:
the rest seat is 1.5 mm deep and less than 90° to long axis of tooth.

SHAPE:
the ledge preparation inclines slightly downward toward the center of the tooth and continues mesially and distally to include the marginal ridges. This rest type usually does not have a reciprocal arm; reciprocation is gained from a parallel lingual surface above the rest preparation so the rest serves both as rest and reciprocal arm.

INSTRUMENTS:
body of rest -837-016 straight diamond round internal angles round diamond or round ended diamond Polish fine diamonds, finishing carbide burs, stones, blue and green points.

Note: Amount of enamel on the lingual
Maxillary canine--1.0 - 1.5mm
Mandibular canine--0.5mm
2. Lingual Spoon rest - similar in general shape to an occlusal rest. It is made just laterally to the mid-point of the lingual surface at or above the level of the cingulum. This rest generally cannot act as a reciprocal arm. This rest is intended for use on Maxillary Canines.

REST DIMENSIONS

WIDTH: 
This preparation is slightly larger than a #6 round bur

DEPTH Occlusal Gingival: 
the rest seat is 1 mm deep

SHAPE: 
the preparation inclines slightly downward toward the center of the tooth the floor. The floor of the preparation must be perpendicular to long axis of the tooth.

INSTRUMENTS: 
- body of rest -#36006-136, 36006-137
  coarse and fine diamonds
- round internal angles- round end diamond
- polish-finishing carbide burs, blue and green points
3. Inverted V-shaped ledge - this rest is only made when there is a prominent cingulum. The rest preparation is made incisal to the cingulum. The ledge has a mesial and distal slope and the floor of the ledge is inclined apically or toward the center of the tooth to a slight degree. This rest may or may not act as a reciprocal arm.

REST DIMENSIONS

WIDTH:
Labial-lingual width is 1 mm.

LENGTH:
The mesio-distal length should be 2.5 - 3 mm.

DEPTH Occlusal Gingival:
The incisal apical depth is 1.5 mm at the center tapering down at the edges

SHAPE:
The preparation follows the shape of the cingulum and forms a angle of approximately 120 degrees

INSTRUMENTS:
- body of rest-inverted cones #805-012
- to round internal angles-small tapered round end diamond
- polish-finishing carbide burs, blue and green points
C. Incisal Rests: Usually placed on lower canines or incisors because thin enamel on the lingual make it impossible to prepare a rest without perforating the enamel. These rests are the least desirable of any because they are esthetically poor and are located at a maximum distance from the center of rotation on a tooth. Therefore, the leverage that they can exert is also at a maximum. The preparation is usually made at the distal incisal edge although it can also be made on the mesial.

*NOTE: The preparation is begun toward the center of the tooth and is then extended distally or mesially to the marginal ridge. If the preparation is made in the other direction, the possibility exists of making the rest preparation too deeply and into dentin.*
WIDTH:
the preparation is angled lingually so there is more reduction on the lingual side of the incisal edge than on the labial side. This is to display less metal and so improve esthetics

LENGTH:
extends one-third of the mesial-distal length of the incisal edge or minimum of 2.5 mm.

DEPTH Occlusal Gingival:
the rest seat is at least 1 to 1.5mm deep

SHAPE:
the ledge preparation inclines slightly downward toward the center of the tooth and continues mesially and distally to include the marginal ridges. The inner portion of the rest seat should be slightly deeper than at the proximal surface and all angles should be rounded.

INSTRUMENTS:
- body of rest #837-016 -straight diamond
- to round internal angles-small tapered round ended diamonds
- polish-finishing carbide burs, blue and green points
# Tooth Modifications

## Maxillary

<table>
<thead>
<tr>
<th>CRITERIA:</th>
<th>TEST</th>
<th>EXCELLENT (E)</th>
<th>GOOD (G)</th>
<th>UNACCEPTABLE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Guiding Planes</strong></td>
<td>Check with surveyor</td>
<td>Orientation: parallel to path insertion and other GP</td>
<td>Orientation: convergent within 3' of the P.O.I. apically</td>
<td>Orientation: varies &gt; 6' from the determined P.O.I.</td>
<td><strong>CRITERIA NOT MET</strong> (N)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contour: -cylindrical B-L</td>
<td>Contour: -slight irregularities</td>
<td>Contour: -flat or spherical OG</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-smooth</td>
<td>-slight roughness</td>
<td>-created sharp B or L line angles</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dimension: -width B-L 2/3 distance between summit cusps</td>
<td>Dimension: size B-L 1/2 to 2/5 width cusps</td>
<td>Dimension: size B-L &lt; 1/2 or &gt; 2/3 width cusps</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-extends from marginal ridge to junction of middle and gingival 1/3</td>
<td>O-G 1/2 to 3/4 length crown</td>
<td>size O-G &lt; 1/2 length crown or on the root surface</td>
<td></td>
</tr>
<tr>
<td><strong>2. Tooth Contours</strong></td>
<td>Check with surveyor</td>
<td>Retentive area: -gingival 1/3</td>
<td>Retentive area: -slight malposition coronal/gingival M-D</td>
<td>Retentive area: -insufficient retention &lt; 0.01&quot;</td>
<td><strong>CRITERIA NOT MET</strong> (N)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-2.5 mm above free gingival (CEJ)</td>
<td>-undercut slightly extensive/insufficient</td>
<td>-too great an undercut &gt; 0.01&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.01&quot; or 0.02&quot; depth depending on clas design</td>
<td>Reciprocal area: -slight divergence</td>
<td>-placed above gingival 1/3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reciprocal area: -parallel to GP</td>
<td>Reciprocal area: -contour compromised slightly M-D</td>
<td>Reciprocal area: -not present</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-extends to junct of middle &amp; gingival 1/3</td>
<td>-slight malposition coronal/gingival</td>
<td>-excessive tooth modification</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-follow natural contour of tooth M-D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3. Rests</strong></td>
<td></td>
<td>Shape: -correct shape and smooth throughout</td>
<td>Shape: -correct shape with minimal roughness</td>
<td>Shape: -sharp edges internally or at marginal ridge</td>
<td><strong>CRITERIA NOT MET</strong> (N)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-angle of floor of rest and guiding plane &lt; 90°</td>
<td>-angular at marginal ridge</td>
<td>-same depth throughout</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-wider and rounded at marginal ridge</td>
<td>-angle of floor of rest and guiding plane &lt; 90°</td>
<td>-rough, uneven and/or undercut</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Occlusal: -B-L 2.5mm or 1/2 dist. summit cusps</td>
<td>Occusal: -2.5mm wide</td>
<td>-angle iso 90°</td>
<td>-does not follow anatomy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-M-D 1/3 premolar length of crown</td>
<td>Lingual spoon: -1-1.5mm LL, 1 mm deep</td>
<td>Occlusal: -1.5mm at M.R.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-1.0 mm deep at M.R</td>
<td>Inverted V: -1.5mm LL, 1 mm deep</td>
<td>Lingual spoon: -&lt;1.5mm at M.R.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lingual spoon: -1.5mm LL, 1 mm deep</td>
<td>Lingual spoon: -1.5mm LL, 1 mm deep</td>
<td>Lingual spoon: - &lt;1.5mm at M.R.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inverted V: -1.5mm LL, 1 mm deep</td>
<td>Lingual spoon: -1.5mm LL, 1 mm deep</td>
<td>Inverted V: -&lt;1.5mm at M.R.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inverted V: -2.5mm deep</td>
<td>Lingual spoon: -1.5mm LL, 1 mm deep</td>
<td>Inverted V: -&lt;1.5mm at M.R.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cingulum: -1.5mm LL midpoint, 2mm deep OG</td>
<td>Cingulum: -1.5mm LL, 1mm deep OG</td>
<td>Cingulum: -1.5mm LL, 1mm deep OG</td>
<td></td>
</tr>
<tr>
<td><strong>4. Cast</strong></td>
<td></td>
<td>Accurate reproduction of prepared mouth</td>
<td>Accurate reproduction of prepared mouth</td>
<td>Poor reproduction of prepared mouth</td>
<td><strong>CRITERIA NOT MET</strong> (N)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tripod marks: -clearly marked</td>
<td>Tripod marks: -small bubbles or positives</td>
<td>Tripod marks: -poorly marked</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-well separated</td>
<td>-not separated</td>
<td>-not on the same plane</td>
<td></td>
</tr>
</tbody>
</table>
## Tooth Modifications
### Mandibular

<table>
<thead>
<tr>
<th>CRITERIA:</th>
<th>TEST</th>
<th>ACCEPTABLE</th>
<th>UNACCEPTABLE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Guiding Planes</strong></td>
<td>Check with surveyor</td>
<td>Orientation - parallel to path insertion and other GP</td>
<td>Orientation - convergent within 3° of the P.O.I. apically</td>
<td>Orientation - varies &gt; 6° from the determined P.O.I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contour - cylindrical B-L</td>
<td></td>
<td>Contour - no guiding surface</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- smooth</td>
<td></td>
<td>- flat or spherical OG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dimension - width B-L 2/3 distance between summit cusps</td>
<td></td>
<td>- created sharp B or L line angles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- extends from marginal ridge to junction of middle and gingival 1/3</td>
<td></td>
<td>- rough, pitted, or scratched</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Orientation - convergent within 3° of the P.O.I. apically</td>
<td></td>
<td>- overreduced</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contour - slight irregularities</td>
<td></td>
<td>Dimension - size B-L &lt; 1/2 or &gt; 2/3 width cusps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- slight roughness</td>
<td></td>
<td>- size O-G &lt; 1/2 length crown or on the root surface</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dimension - size B-L 1/2 to 2/3 width cusps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>O-G 1/2 to 2/3 length crown</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2. Tooth Contours</strong></td>
<td>Check with surveyor</td>
<td>Retentive area - gingival 1/3</td>
<td>Retentive area - slight malposition coronal / gingival M-D</td>
<td>Retentive area - insufficient retention &lt; 0.01&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 2 mm. above free gingival (CEJ)</td>
<td>- slight malposition coronal / gingival M-D</td>
<td>- too great an undercut &gt; 0.01&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 0.01&quot; or 0.02&quot; depth depending on clasp design</td>
<td>- too great an undercut &gt; 0.01&quot;</td>
<td>- placed above gingival 1/3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reciprocal area -parallel to GP</td>
<td>- too great an undercut &gt; 0.01&quot;</td>
<td>- excessive tooth modification</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- extends to junct. of middle &amp; gingival 1/3</td>
<td>- placed above or below middle 1/3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- follow natural contour of tooth M-D</td>
<td>- excessive tooth modification</td>
<td></td>
</tr>
<tr>
<td><strong>3. Rests</strong></td>
<td></td>
<td>Occclusal - B-L 2.5mm or 1/2 dist. summit cusps</td>
<td>Occclusal - B-L 2.5mm or approx. 1/2 dist. summit of cusps</td>
<td>Occclusal - B-L 2.5mm or approx. 1/2 dist. summit of cusps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- M-D (premolar premolar length of crown)</td>
<td>- M-D approx. 1/4 length of crown</td>
<td>- M-D &lt; or &gt; required length of crown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 1.0mm deep at M.R</td>
<td>- 1.5 mm deep at M.R</td>
<td>- depth at M.R. &lt; 1 or &gt; 1.5 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Distal Incisal - 1/3 M.I. 1.5mm deep</td>
<td>Distal Incisal - 1/3 M.I. 1.5mm deep</td>
<td>Distal Incisal - 1/3 M.I. 1.5mm deep</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- wider lingual than buccal</td>
<td>- wider lingual than buccal</td>
<td>- wider buccal than lingual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- axial floor BL is slightly &lt;8° to P.O.I</td>
<td>- same depth buccal as lingual</td>
<td>- axial floor BL is &lt;8° or &lt;95° to P.O.I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- axial wall is parallel to F.O.I</td>
<td>- axial floor BL is &lt;8° or &lt;95° to P.O.I</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>internal angle is rounded</td>
<td>- wider at midpoinet than at marginal ridge</td>
<td>- border between buccal and lingual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shape - correct shape</td>
<td>- slight change in depth at center</td>
<td>Shape - sharp edges internally or at marginal ridge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- angle of floor of rest and guiding plane &lt; 90°</td>
<td>- angle of floor of rest and guiding plane &lt; 90°</td>
<td>- same depth throughout</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- wider at marginal ridge</td>
<td>- smooth throughout</td>
<td>- roughness and uneven</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- rounded at marginal ridge</td>
<td></td>
<td>- rest is undercut</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- angle is &lt; 90°</td>
</tr>
</tbody>
</table>
## Tooth Modifications

### Rests

<table>
<thead>
<tr>
<th>CRITERIA:</th>
<th>ACCEPTABLE</th>
<th>UNACCEPTABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Occlusal Rests</strong></td>
<td></td>
<td>CRITERIA NOT MET (N)</td>
</tr>
<tr>
<td>Shape</td>
<td></td>
<td>Shape</td>
</tr>
<tr>
<td>- correct shape and smooth throughout floor of rest and guiding plane &lt; 90°</td>
<td>- incorrect shape</td>
<td>- sharp edges internally or at marginal ridge</td>
</tr>
<tr>
<td>- wider and rounded at marginal ridge</td>
<td>- same depth throughout</td>
<td>- rough, uneven and/or undercut</td>
</tr>
<tr>
<td>Occlusal</td>
<td>- B-L 3.5mm or 1/2 dist. summit cups</td>
<td>- same at M.R. &lt; 1 or &gt; 1.5 mm</td>
</tr>
<tr>
<td></td>
<td>- M-D 1/4 mol, 1/3 premolar length of crown</td>
<td>- wider at midpoint than at marginal ridge</td>
</tr>
<tr>
<td></td>
<td>- 1.0 mm deep at M.R.</td>
<td></td>
</tr>
<tr>
<td>Marginal Ridge and Sluiceways</td>
<td></td>
<td>Marginal Ridge and Sluiceways</td>
</tr>
<tr>
<td>- marginal ridge, buccal and lingual embrasures have been reduced 1-1.5 mm to allow for clasp</td>
<td>- marginal ridge, buccal and lingual embrasures have been reduced &lt; 1 mm or &gt;1.5 mm to allow for clasp</td>
<td></td>
</tr>
<tr>
<td>- no undercut</td>
<td>- undercut</td>
<td></td>
</tr>
<tr>
<td><strong>Embrasure</strong></td>
<td></td>
<td><strong>Canine Rests</strong></td>
</tr>
<tr>
<td>Marginal Ridge and Sluiceways</td>
<td></td>
<td>Lingual spoon</td>
</tr>
<tr>
<td>- marginal ridge, buccal and lingual embrasures have been reduced 1-1.5 mm to allow for clasp</td>
<td>- &lt;1.5mm or 2mm LL &lt;1 or &gt;1.5mm deep</td>
<td></td>
</tr>
<tr>
<td>- no undercut</td>
<td></td>
<td>Inverted V</td>
</tr>
<tr>
<td>Lingual spoon</td>
<td>- &lt;1.1mm width LL</td>
<td>- &lt;1mm or &gt;1.5mm BL</td>
</tr>
<tr>
<td>- 2mm wide</td>
<td>- MD short of MR 0.5mm</td>
<td>- MD extends through MR</td>
</tr>
<tr>
<td>- 1.1mm deep</td>
<td>- OG at thickest thickness of cingulum ± 1mm</td>
<td>- too high or too low on cingulum</td>
</tr>
<tr>
<td>Inverted V</td>
<td>- follows cingulum</td>
<td>Ledge</td>
</tr>
<tr>
<td>- 1.1mm width LL</td>
<td>- 1.1.5mm deep</td>
<td>- &lt;1mm or &gt;1.5mm LL midpoint</td>
</tr>
<tr>
<td>Distal Incisal</td>
<td>- MD short of MR 0.5mm</td>
<td>- &gt;2mm deep OG</td>
</tr>
<tr>
<td>- 1/3 MD, 1.5mm deep</td>
<td>- OG at thickest thickness of cingulum ± 1mm</td>
<td>Distal Incisal</td>
</tr>
<tr>
<td>- wider lingual than buccal</td>
<td>- follows cingulum</td>
<td>- &lt;1/3 MD or &gt;1/3 MD</td>
</tr>
<tr>
<td>- axial floor BL is slightly &gt;90° to POI</td>
<td>- wider buccal than lingual</td>
<td>- &lt;1.0mm or &gt;2mm deep</td>
</tr>
<tr>
<td>- axial floor BL is 85° to 95° to POI</td>
<td>- wider buccal than lingual</td>
<td>- axial floor MD is &lt;80° or &gt;95° to POI</td>
</tr>
<tr>
<td>Lodge</td>
<td>- 1.1,5mm LL, midpoint</td>
<td>- &gt;2mm deep OI</td>
</tr>
<tr>
<td>- 1.1mm width LL, midpoint</td>
<td>- 2mm deep OG</td>
<td>Distal Incisal</td>
</tr>
<tr>
<td>- 1.5mm deep</td>
<td></td>
<td>- &lt;1/3 MD or &gt;1/3 MD</td>
</tr>
<tr>
<td>- wider lingual than buccal</td>
<td></td>
<td>- &lt;1.0mm or &gt;2mm deep</td>
</tr>
<tr>
<td>- axial floor BL is slightly &gt;90° to POI</td>
<td></td>
<td>- wider buccal than lingual</td>
</tr>
<tr>
<td>- axial floor MD is 85° to 95° to POI</td>
<td></td>
<td>- axial floor MD is &lt;80° or &gt;95° to POI</td>
</tr>
</tbody>
</table>
DRAWING THE FINAL DESIGN ON THE MASTER CAST:

Once all modifications and rest preparations are completed the design is drawn on the master cast before sending it to the laboratory. In this course the distributed casts, after modification, will be used as master casts. The final design is made on each cast. The use of different colored pencils aids in the delineation of various partial components and differentiation between survey lines and partial components. The exact sequence to be followed in drawing the design is immaterial, but a systemized routine is recommended so a neat, orderly, concise sketch can be made that is easily understood by the dental technician.

1. **Resurvey:** Place the master cast on the surveyor table and orient to the determined path of insertion. For the laboratory project use the tripod marks to do this. Then with the carbon marker, protected by the metal sheath, rescribe the height of contour or survey line around each of the abutment teeth. They should now be in the ideal position for placement of the component parts of the clasp assembly. Remember, if the clasp components do not contact the tooth surfaces in their designated position the clasp assembly will not function as planned!

2. **Mark Undercuts:** Replace the carbon marker with an undercut gauge of proper size and locate the gauge on the abutment tooth so the barrel contacts the tooth at the survey line. Move the gauge to the predetermined retentive area of the tooth and slide it up or down until the lip of the gauge contacts the tooth in the precise spot that will be contacted by the retentive portion of the tip at the same time that the barrel or gauge contacts the survey line. A small mark is made on the tooth at the exact point the lip of the gauge contacts.
3. Drawing the components:

**Major connectors:** General rules for defining the connectors:

a. The gingiva must be either completely covered by a adequately relieved component of the RPD or the components must be placed at least 4mm (mandibular) or 6mm (maxillary) away from the gingival margins

b. All crossings of the gingival margin must be made at 90 degree angle

c. Try to finish the borders of the connector in low areas of the tissues rather than on a prominence

d. Mandibular major connectors:
   - Lingual bar- superior border no less than 4mm inferior to gingival margins, inferior border at the height of the alveolar lingual sulcus when the tongue is elevated.
   - Linguoplate-superior border follows the cingulum of the teeth rising to the contact points, inferior border is the same as the lingual bar

e. Maxillary major connectors:
   - rugae area - follow the valleys as much as possible, when crossing rugae do so at 90 degree angles to the crests
   - lateral borders - follow parallel to gingival margin at least 6mm away
   - medially - parallel to the junction of vertical and horizontal parts of the palate
   - posterior border - straps and bars traverse palate just anterior to vibrating line
   - placement of straps - place strap so it covers area where it is in two planes giving it more rigidity
Minor connectors: Join the direct and indirect retainers to the major connector. They should be approximately 2mm wide except those which are acting as proximal plates which should be two thirds the width of the summit of the cusps of the abutment tooth. They should be placed whenever possible in a interproximal space and fill the space as much as possible for patient comfort. Remember they must cross the gingival margin at 90 degrees and should not join the major connector with sharp angles. Adjacent connectors must be at least 5mm apart for oral health.

Retentive mesh: The minor connector which retains the acrylic base and artificial teeth. It should always extend over the crest of the ridge to prevent fractures. Adequate bulk and strength in the metal at the junction of the grid and the major connector is necessary. The mesh should extend extend to just anterior to the retromolar pad on the mandibular and over the tuberosity on the maxillary. It should not interfere with tooth placement.

Clasp arms: using a pencil with a sharp point, draw the retentive arm red so that it passes from the rest to the retentive undercut. It should pass gracefully from supra to infra bulge as it crosses the survey line. The lower border of the clasp tip should end precisely on the mark that indicates the proper depth of undercut. The reciprocal arm is drawn, maintaining its inferior border at or above the survey line. The occlusal, lingual or incisal rest is then outlined. The width of the arms at the terminal tip should be one half the width of the arm at the shoulder.

---

<table>
<thead>
<tr>
<th>Criteria for clasp arms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cast clasp</strong></td>
</tr>
<tr>
<td>- uniform curve and taper</td>
</tr>
<tr>
<td>- 2:1 ratio</td>
</tr>
<tr>
<td>- shoulder flows from superior edge proximal plate</td>
</tr>
<tr>
<td>- retentive U3 is 90° to the P.O.I.</td>
</tr>
<tr>
<td>- placed into embrasure</td>
</tr>
</tbody>
</table>

---
Lastly any additional notations such as different types of teeth, areas to be relieved, areas of beading, finish lines, and any areas of notation that further clarify the design are made.

Remember that the drawing is not rough sketch; it is a precise line drawing of the partial framework placing the various components exactly where intended. The quality of the work you provide the technician is directly proportional to the quality of the work you will receive in return. If the width of the clasp arms are excessively thick or thin or poorly shaped, don’t be surprised if the final casting is the same; if the major connector is drawn too close to the marginal gingiva expect the same in casting; if one forgets to draw a clasp arm or rest expect the same in the casting unless you are employing a technician more astute or conscientious than yourself.
COLOR CODE FOR DRAWING DESIGN FOR A RPD FRAMEWORK ON THE MASTER CAST

1. BLACK LEAD
   • Contour Lines
   • Tripod Marks

2. RED
   • Retentive Clasp Arms
   • Finish Lines
   • Circle Around Tripod Mark

3. BLUE
   • Major Connector
   • Minor Connectors
   • Reciprocal Arms
# Master Cast

## Maxillary

<table>
<thead>
<tr>
<th>CRITERIA:</th>
<th>TEST</th>
<th>ACCEPTABLE</th>
<th>UNACCEPTABLE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Major Connector</td>
<td>Check with Boley gauge plastic ruler periode probe</td>
<td><strong>EXCELLENT (E)</strong>&lt;br&gt;- Position: borders at least 6 mm from G. margin&lt;br&gt;- inferior border at junction of vertical and horizontal planes&lt;br&gt;- Finish lines: butt joint with minor connectors located 2 mm lingual to the teeth&lt;br&gt;- Correct Tripod</td>
<td><strong>GOOD (S)</strong>&lt;br&gt;- Position: borders 5-6 mm from gingival margins&lt;br&gt;- inferior border slightly above junction of vertical and horizontal planes&lt;br&gt;- Finish lines: slightly curved or out of place</td>
<td></td>
</tr>
<tr>
<td>2. Minor Connectors</td>
<td>Check with Boley gauge plastic ruler periode probe</td>
<td><strong>EXCELLENT (E)</strong>&lt;br&gt;- may not be placed on convex surfaces&lt;br&gt;- arise from MC at 90° with rounded junctions&lt;br&gt;- minor connectors must be 5 mm apart&lt;br&gt;- Shape: if associated with a guiding plane is the same width as the guiding plane&lt;br&gt;- tapering away from the rest to the MC&lt;br&gt;- Indirect retainer: as far as possible from the fulcrum line&lt;br&gt;- Retention lattice: open lattice&lt;br&gt;- extends to tuberosity and 1-2 mm over the buccal</td>
<td><strong>GOOD (S)</strong>&lt;br&gt;- Position: arise from MC 80-90° with rounded junctions&lt;br&gt;- Shape: if associated with a GP the connector is 3/2 the width of the plane&lt;br&gt;- minimal taper&lt;br&gt;- Indirect retainer: ahead of the fulcrum line&lt;br&gt;- Retention lattice: extends over the buccal &lt;1 mm&lt;br&gt;- extends to the tuberosity</td>
<td></td>
</tr>
<tr>
<td>3. Clasp Assembly</td>
<td>Check with surveyor contour lines Boley gauge plastic ruler periode probe</td>
<td><strong>EXCELLENT (E)</strong>&lt;br&gt;- Most acceptable design for this RPD&lt;br&gt;- Provides for encirclement &gt;180°&lt;br&gt;- Retentive arms: placed in correct amount of undercut&lt;br&gt;- uniform curve + taper 1 mm at tip&lt;br&gt;- infrabridge clasp&lt;br&gt;- infrabridge clasp approach arm&lt;br&gt;- horizontal part 4 mm from gingiva, vertical part crosses at gingiva at 90°&lt;br&gt;- 5 mm from other vertical components&lt;br&gt;- suprabridge clasp&lt;br&gt;- retentive 1/3 is 90° to P.O.I.&lt;br&gt;- 2 mm from gingival margin&lt;br&gt;- Reciprocal arms: at the height of contour&lt;br&gt;- junction of gingival and middle 1/3&lt;br&gt;- uniform 1.5 mm thick</td>
<td><strong>GOOD (S)</strong>&lt;br&gt;- Assembly acceptable design for this RPD&lt;br&gt;- Retentive arms: slightly less than .01 mm undercut&lt;br&gt;- uniform curve + taper 1 mm at tip&lt;br&gt;- infrabridge clasp&lt;br&gt;- infrabridge clasp approach arm&lt;br&gt;- horizontal part 3-4 mm from gingiva, vert. part crosses at gingiva at 85-95°&lt;br&gt;- 4.5 mm from other vertical components&lt;br&gt;- suprabridge clasp&lt;br&gt;- retentive 1/3 is 80° to 100° P.O.I.&lt;br&gt;- 1-2 mm from gingival margin&lt;br&gt;- Reciprocal arms: above the height of contour&lt;br&gt;- junction occlusal and middle 1/3&lt;br&gt;- same shape as ret. arm</td>
<td></td>
</tr>
<tr>
<td>4. Work Authorization</td>
<td>Compare to design</td>
<td>Correct design&lt;br&gt;- same as cast&lt;br&gt;- Work Detail: includes 8 required points to be legal&lt;br&gt;- Written in ink&lt;br&gt;- Work detail is correct and complete&lt;br&gt;- Drawing: excellent&lt;br&gt;- external finish lines indicated</td>
<td>Work detail: not detailed enough&lt;br&gt;- Drawing: minimally acceptable</td>
<td></td>
</tr>
<tr>
<td>CRITERIA:</td>
<td>TEST</td>
<td>EXCELLENT (E)</td>
<td>ACCEPTABLE</td>
<td>GOOD (S)</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1. Major Connector</td>
<td>Check with Boley gauge plastic ruler porlo probe</td>
<td>Position</td>
<td>- borders at least 4mm from G. margin</td>
<td>Position</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- inferior border at depth of L. border</td>
<td>- 4mm wide</td>
<td>- inferior border slightly above L. border</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Finish lines</td>
<td>- butt joint with minor connectors</td>
<td>Size</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Correct Tripod</td>
<td>- slightly curved or out of place</td>
<td>Finish lines</td>
</tr>
</tbody>
</table>
WORK AUTHORIZATION:

OBJECTIVE: To familiarize the student with the written procedures necessary for communication with the laboratory technician.

PROCEDURE: The Work Authorization is a written direction for laboratory procedures to be performed in the fabrication of dental restorations by a laboratory technician. The purpose of this document is to provide the laboratory with clear, concise understandable instructions concerning work to be done and to protect the patient from the illegal practice of dentistry.

There are legal and ethical implications concerning this matter. Presently, no federal statutes governing the operation of dental laboratories or the working agreement between the dentist and technician exist. This authority lies with the individual states. Generally, these laws state that the technician cannot service any patient directly and he can legally perform only work authorized by a dentist. As a means of implementing this arrangement, most states require that the technician perform laboratory work only after he has been authorized to do so by a written order from the dentist. The written order is called a work authorization. The primary purpose is to protect the patient from illegal dentistry. The dentist has an ethical obligation to protect the health of his patient by not delegating any work to a less qualified person that requires the professional expertise and competence of a dentist.

The dentist has a further responsibility to closely supervise the work of all auxiliary personnel. The dentist who does not honor these legal, ethical and moral commitments by assuming his full responsibilities is betraying his personal integrity. If such irresponsibility becomes widespread, the general public will seek to change the laws so that certain phases of dental practice can be performed by others less trained and qualified. There are people ready to assume this role and we as dentists will have no one to blame but ourselves. The dentist is responsible for all phases of a removable partial denture service. He may request a dental technician to engage in certain mechanical phases but the technician is responsible to the dentist and never to the patient. The dentist who relegates the survey and design of a partial denture to a technician is committing a grave injustice to the trust the patient has placed in him.
Content of a work authorization

Must Include:
1.) name and address of the dental laboratory
2.) name and address of the originating dentist
3.) date the case is sent
4.) date to be returned
5.) patient identification
6.) work detail
7.) signature of dentist
8.) dentist’s license number

REMovable prosthodontics
Laboratory Work Authorization

To: _____________________________ Date: _____________________________
Address: ______________________________________________________________________________________

Student: ___________________________ Instructor: _____________________________
Patient: ___________________________ S.S. #: _____________________________

General Request: __________________________________________________________________________________

Date & Time Req.: ___________________________ Alloy for Framework: _____________________________

General Instructions for RPD framework:
1. Orient cast to surveyor rod using tripod marks. Use parallel blockout of undercut areas crossed by rigid parts of framework. Follow design exactly as drawn on cast.

2. Relieve the following:
   □ Gingival crevices and margins crossed by major or minor connectors
   □ Tori or prominent median palatal raphe
   □ Inferior border of mandibular major connector-26 GA wedge shaped
   □ Under retentive latticework-26 GA to form an internal finish line

Specific Instructions:

Student Dentist’s Sig. _____________________________
Instructor Sig. _____________________________ Lic. #: _____________________________
The **work detail** should be a clear, concise description of the work required. The technician should not be expected to wade through a poorly organized, wordy composition, nor should he be forced to make an educated guess at what the dentist wants. The work detail should be in outline form and include the following topics in the case of a partial denture framework construction.

- the type of metal to be used. This could be gold or one of the various cobalt-chromium alloys. One would also explain the use of a wrought clasp here, specifying its shape, makeup and gauge.

- Major connector, type, food dam bead if necessary.

- Abutment tooth list the specific tooth (abbreviation is ok, eg. 1st premolar) and the number to identify it.

   Then list:
   1. Rests - the type of rest and where on the tooth it is located, e.g. spoon rest on mesial occlusal surface.
   2. Retention - type of clasp and the retentive area, e.g., mesial buccal undercut.
   3. Reciprocation - type and location, e.g., cast arm on the lingual surface.

- special instructions, this will vary with the individual case and may include such things as type of retention latticework to use, the placement of special types of replacement teeth, the mode of tripoding used, special waxing specifications, special finishing procedures.

The work detail, along with the drawing of the design on the cast, should relate to the laboratory technician everything he must know for the individual case in order to fabricate it properly. Tasks that must be performed on all cases and common to all cases such as duplication of models, polishing, etc. need not be included on the work detail.
Relationship between Dentist and Technician

Dentist’s Responsibility

The dentist must plan the prosthesis in its entirety. He must plan for all preparatory mouth treatment and then proceed to do it. Sufficient space must be available for each structural element, abutment teeth must be properly prepared and contoured to receive guide planes, rests and clasp arms. The dentist must also prescribe all materials to be used. He must be responsible for impressions, jaw records, fitting the framework in the mouth and final insertion of the finished case. He is also responsible for patient instruction in its care and post insertion adjustments and maintenance.

Technician’s Responsibility

The technician is responsible for fabrication of the prosthesis with the materials prescribed in accordance with the directions received on the work authorization form.

The importance of establishing a good working relationship between the dentist and technician cannot be overemphasized. It is based on a common understanding of the overall objectives, an awareness of each person’s role and an appreciation of the problems that each person might encounter. Within this framework, legal and ethical considerations can be established along with the basis for sound business management. The purpose of all this is to best utilize the expertise of two trained people to deliver to a patient the maximum in health care in the most efficient manner. To do this so it is profitable to all; patient, technician and dentist, the dentist must be the one to assume the initiative, ultimate leadership and delegation of responsibilities.
USE OF CAST RESTORATIONS ON ABUTMENT TEETH:

OBJECTIVE: To improve the contours of the abutment tooth to further compliment the determined design of the RPD

PRINCIPLES:

ADVANTAGES:
1. Heavily restored tooth can be strengthened
2. Multiple cavosurface margins reduced to single finish line
3. Disadvantageous morphology may be improved

DISADVANTAGES:
1. Increased cost
2. Increased complexity of the procedures both clinical and technical

Never should you design a cast restoration in a semi edentulous situation before first determining the design of any RPD that may be necessary even if the RPD is not being fabricated at that time. The same holds true about fabricating a RPD before evaluating the abutments for cast restorations and completing the ones indicated.

PROCEDURES:

1. Survey the study cast and design the RPD
2. Determine the type of any restorations needed
3. Make all tooth modifications necessary not involving the teeth indicated for castings
4. Prepare the abutment tooth
5. Make a complete arch working cast with necessary die or dies
6. Fabricate a surveyed restoration
7. Try in the restoration
8. Complete arch impression with the casting in place
9. Survey resulting master cast and write up work authorization
10. Send to laboratory for fabrication of framework
11. Try in framework with the castings
12. Castings usually are cemented when the completed RPD is inserted
CUSTOM MATRIX:

OBJECTIVE: To provide an easy method of relating the position of teeth to the residual ridge for purpose of locating portions of the framework particularly retentive loops or posts.

INSTRUMENTATION REQUIRED:

- Cast
- Denture teeth
- #7 Wax spatula
- Bunsen burner
- Baseplate wax
- Hollenbeck carver
- Alcohol torch
- Handpiece and burs

PROCEDURES:

1) Place a groove in the lingual of each tooth to receive the retentive post
2) Set the anterior teeth and wax to full contour
3) Alcote the adjacent teeth and place the beading wax

4) Pour stone matrix
5) Boil out the baseplate wax and lute the teeth back to the matrix with sticky wax

6) Fit the matrix back to the cast
7) Locate the retentive wax posts in the grooves on the lingual of the teeth

8) Finished framework on cast showing retentive posts
PLACEMENT OF BLOCKOUT AND RELIEF WAX:

OBJECTIVE: To acquaint the student with the principles of blockout and relief and to familiarize him/her with the parts of the procedure that are the responsibility of the dentist

INSTRUMENTATION REQUIRED:

- Cast needing block out
- Ney Block out wax or relief wax
- #7 Wax spatula
- Surveyor with wax knife
- Bunsen burner
- Hollenbeck carver
- Alcohol torch

Some cases due to their complexity may require the practitioner to do the initial block out on the master cast. For these cases, in addition to an accurate drawing the master cast should also have laboratory place blockout wax on the guiding planes to the intended width of the finished guiding plate. This will make it easier for the technician to orient the cast and protect from having the technician over relieve the guiding planes. We also recommend the clinician place relief where arms cross gingival margins, and any other areas requiring special consideration. The laboratory can then place routine block out and relief on the remainder of the cast.
When using a parallel blockout wax technique, considerable care must be exercised in placing the wax. If the wax is not trimmed sufficiently to expose guide planes after applying it with a hot spatula, then the casting will be relieved away from the tooth and will not contact the tooth and so we lose the function of that guide plane. If too much wax is placed or not trimmed sufficiently after it has been placed in a deep interproximal space beneath a minor connector or linguo plate, then this part of the casting will have needless space between it and the tooth and serve as an unnecessary food trap. If on the other hand, we are over zealous in trimming back the wax, it is easy to scuff or abrade the stone tooth surface. This would lead to a casting that fits the model but would strike prematurely in the mouth and not go to place.

In applying the blockout wax, the Ney high fusing undercut wax supplied in the student kit should be used. A high fusing wax such as this (actually a wax-clay mixture) is necessary to withstand distortion from the heat of the duplicating material which is poured at about 120°. The blockout wax is applied to the teeth with a #7 wax spatula or large P.K. Thomas waxing instrument. The spatula must be hot enough to cause the melted wax to satisfactorily stick to the tooth or it will be pulled off when an attempt is made to carve it with the surveyor blade. At the same time the wax should not be so hot to be drawn into unwanted areas by capillary attraction. The student should experiment on a few trial teeth before attempting anything on his working cast to get the feel of handling this material.
After the wax is applied, it is trimmed first grossly with hand instruments such as a Cutler carver or Hollenbeck carver and then with the surveyor blade trimmer. Trimming can be facilitated by slightly warming the blade with an alcohol torch.
ASSESSING A PARTIAL DENTURE FRAMEWORK:

OBJECTIVE: Although the typical dentist today in his practice neither fabricates a wax-up for a partial denture framework nor constructs a partial casting, it is important that he/she is able to assess a framework for clinical acceptability. He/she does this for a number of reasons;

- to gain an understanding of the work delegated to a dental technician
- to see the contours and thicknesses needed in a properly constructed casting
- to enable the student/dentist to evaluate the finished casting received from the technician to maintain quality control

PROCEDURE:

Pre-insertion evaluation on the cast
On the cast
  • design
  • placement
Off the cast
  • fit - condition of master cast
  • finish
Intra-oral Intraseal evaluation
  • fit
  • retention
  • occlusion

Pre-insertion Evaluation
Framework on the cast
**Major Connectors:**

Three main criteria must be evaluated:

- design
- shape and size
- position

1. **Design.** The design must follow the one specified by the laboratory work authorization. The technician may not change this without consulting and prescribing the dentist first.

2. **Shape and size.** Thickness is important because, it along with the design, is necessary to gain the needed rigidity that is absolutely crucial to insure the effectiveness of the major connector and ultimately the partial denture.

3. **Position.** In locating the major connector, one must either support the connector with rests and relieve the gingiva it contacts and approaches or locate the connector far enough away from the gingival to avoid impingement. On the maxilla this distance is usually 6 mm., on the mandible the distance is usually 4 mm.

**Mandibular Major Connectors**

A mandibular lingual bar connector should be half-pear shaped with the thickest part placed inferiorly. It should be no narrower than 4 mm incisal-gingivally and 1/2 the thickness of a #6 gauge sprue inferiorly. Placement is as close to the reflection of the floor of the mouth as possible inferiorly and at least 4 mm from the gingival margin superiorly.

A mandibular linguoplate is used when there is insufficient room for the lingual bar. It is the same size and shape inferiorly as the bar but it extends over the lingual surface of the teeth to cover the contact point and cingulum superiority.
Maxillary Major Connectors

The maxillary major connectors are for the most part made with a double thickness of 26 gauge sheet wax cut out to the desired contour and width or anatomic replica pattern equivalent to a 22 gauge wax sheet which is a duplication of the palatal portion of a maxillary cast. The anatomic replica pattern is usually preferred because patients become accustomed to the anatomic replica palate much more readily than to a smooth highly polished or to the concentrated bulk of palatal bars. The irregular surface also seems to be an aid in mastication because the tongue can separate softer foods more easily. Anatomic replica patterns can be slightly thinner than standard because their irregular shape gives more rigidity. In applying the pattern to the maxillary cast no matter what form is used, an attempt should always be made to place the form in two different planes because this will give the major connector more rigidity for the same amount of bulk. A major connector involving 2 planes gives much more rigidity than same width connector in 1 plane. In a combination anterior-posterior bar major connector the anterior bar is made with a double thickness 26 gauge wax sheet or anatomic replica pattern equivalent to a 22 gauge wax sheet and the posterior bar is made with a half round 6 gauge wax. Because the posterior bar is relatively narrow, the half round 6 gauge wax shape is used rather than the wax sheet to gain the rigidity.
Minor Connectors:

- size
- location
- shape

A minor connector that will make up the body of the clasp is the size of a #6 or #8 gauge wax sprue. Here the minor connector must be wide enough to utilize the guiding plane to its fullest advantage. Where it gives rise to a clasp arm, it should be tapered to the tooth below the origin of the clasp. The junction of the minor connector and clasp should have rounded angles. If no clasp arm is present such as when a bar clasp originates elsewhere, it should be tapered to a knife edge the full length of its buccal aspect.

When an artificial tooth will be placed against a proximal minor connector, the buccal and occlusal aspect is thinned to a minimum and the greater bulk is placed to the lingual. This is to enable the buccal placement of the artificial tooth as close to the natural tooth as possible for esthetics and still insure enough bulk for rigidity of the minor connector.
A minor connector contacting the axial surface of an abutment should never be located on a convex surface but instead in an embrasure where it will be least noticeable to the tongue. It may be formed using a 10 gauge round wax shape and should conform to the interdental embrasure, pass from the major connector to the other components. An interproximal minor connector such as that supporting a rest for an indirect retainer is wedge shaped, thickest at its lingual surface and tapered into the embrasure. Any undercut in the embrasure would have been blocked out with parallel blockout prior to duplication. Where the minor connector crosses the gingiva, relief should have been placed on the marginal gingiva prior to blockout as well. Minor connector emerges from major connector at a right angle, so that the gingiva crossing is as abrupt as possible and a minimum of marginal gingiva is covered. The junction of the minor and major connectors should be rounded and free flowing to prevent tongue irritation, food entrapment and structural weakness in the metal.
**Minor Connector**

**Ideal**

**Common Errors**

- Joins major connector with sharp angles

- Does not join major connector at 90° angle
Rests: The general shape of the rest is concave, never convex and in the general form of the occlusal surface before the rest preparations were made. Sufficient bulk must exist at the marginal ridge area.

Retentive Clasp Arms

Circumferential Clasp

- **relation to survey** - The clasp arms must be placed with on the terminal 1/3 in the undercut. The tip of the inferior border of the terminal 1/3 is placed at the desired area of undercut.

- **size and taper** - Retentive clasp arms can be formed using 12 gauge half round wax shapes but pre-formed plastic patterns are recommended because the desired taper of the clasp is already established. The taper is necessary because it contributes to the flexibility of the clasp as it must engage the undercut area of the abutment tooth. It is most important that the clasp arm be joined to the minor connector with smooth rounded angles or internal stresses will be present in the metal as the clasp flexes.

Bar clasp

- **relation to survey** - The arm engages the undercut only at its terminus.

- **size and taper** - The approach arm of the clasp should have a taper from the point it emerges out of the resin base to the tooth contact. A finish line can be formed at the point the approach arm and resin meet.
RETENTIVE CLASP ARMS

Ideal

Errors

Joins major connector at sharp angles

No taper

Uneven arc to clasp
Reciprocal Clasp Arms

- **relation to survey** - The entire clasp arm is at or above the height of contour. The ideal position is middle 1/3 of the tooth.

- **size and taper** - Reciprocal clasp arms can be formed by free hand waxing or the use of pre-formed plastic patterns or ready made wax shapes. 12 gauge half round wax or one of the many shapes of the pre-formed plastic patterns is simply laid on the tooth surface and smoothly blended into the minor connector. Since reciprocal arms are not placed into undercuts, there is no need to taper them except to contour them so they are non-irritating to the tongue. The junction of the minor connector and reciprocal clasp arm is rounded.
RECIPROCAL CLASP ARMS

Ideal

Errors

Joins minor connector with sharp angles

Too thin

Placed too high on tooth
Retention Latticework: Proper position:

At the conclusion of the final laboratory session, the student must submit to their instructor one cast that has a completed partial denture wax-up on it.

Finish lines: Sharp, definite, butt-type finish lines are incorporated into the metal because it is here that the acrylic resin meets the metal. An angle no greater than 90° will ensure a neat junction of the two materials and will preclude the formation of a thin feather edge of resin overlapping the metal which is unsightly, unhygienic and prone to fracture. A common error, however, is to place too deep a finish line at the junction of the major connector and the latticework. This causes a thinning of the metal at a point that is vulnerable to breakage in surface.

External finish lines (oral side) should be formed in the wax pattern in a way that provides ample thickness of both metal and resin.

Internal finish lines (tissue side) are also formed by the edge of the saddle relief wax which is placed on the master cast prior to duplication.
Framework off the cast

Condition of the cast

1. Check for any areas of breakage even if they have been repaired; the possibility of distortion is very real.
2. Check for areas of abrasion. These will indicate areas of interference in the mouth.

Examine the framework

1. For porosity - which will indicate areas of weakness and probable fracture
2. For blebs or bubbles - that will prevent the framework from seating if they are in the area of hard tissues or irritation if they are in the area of soft tissue contact.
3. For polish and finish - the framework should be smooth with no scratches.
4. For nicks - check the clasp arms for nicks or weak spots.
LABORATORY STEPS IN FABRICATING A RPD FRAMEWORK:

In the making of an actual partial denture casting, certain steps that will not be done in our laboratory exercises must be understood. The master cast with the final survey, blocked out of guiding planes and critical areas, drawn design and proper work authorization is sent to the laboratory for the casting to be made. The laboratory technician receives, the cast, reproduces the survey and proceeds to place blockout and relief wax on all areas indicated. The master cast with the wax applied is placed in a flask and a duplicating material (reversible hydro-collod) is poured into the flask. After it hardens, the master cast is removed and the negative is poured with a refractory cast material. This material is similar to the investment used for castings in other technique courses. The refractory cast which may be a gypsum investment for gold or a phosphate bonded investment for higher fusing metals is used for the actual wax-up of the partial denture framework. The wax-up must be done on the refractory cast because unlike other wax patterns that may be lifted off the die for investment purposes, the partial denture frame is too complex for this. So the wax-up is done on a cast that is investment material.

After the wax-up is completed, it and the refractory cast is then invested in toto using a large enough casting ring to house the cast and wax-up. Wax burnout and the casting are then made in the standard manner and the casting is retrieved, finished, polished and returned to the original master cast to be sent back to the dentist for try-in, in the mouth.

Preparation of the Master Cast by the Laboratory for Duplication

Block out of the master cast:
After establishing the path of insertion and locating undercut areas on the master cast, any undercut area that will be crossed by rigid parts of the framework need to be blocked out by the addition of wax prior to the duplication procedure. Since all parts of a RPD are rigid except retentive clasp arms, this means that all other parts of the RPD that cross teeth and tissue that are undercut must be blocked out if the interference has not been previously removed. Rigid portions of the framework cannot be constructed in undercut areas because then the partial will not go into place. Blockout on the master cast removes the interference of the undercut in question. When the master cast is duplicated and poured into a refractory cast, the blockout is duplicated as well. Therefore, the refractory cast has no undercuts other than those areas not involved in the framework or dealing with the retentive clasp arm. The wax-up of the RPD then can be freely done on the refractory cast without fear of waxing into an undercut. This type of blockout is called parallel blockout because it parallels all of the surfaces involved. Blockout wax is applied to the cast undercuts at the given path of insertion and trimmed so that it contacts the diagnostic rod or blade trimmer at the same time that the rod or blade contacts the height of contour.

CHAPTER 11 - LABORATORY STEPS IN FABRICATING A RPD FRAMEWORK
In essence, this converts teeth and their undercut areas into parallel cylinders. When this is done, the remaining undercuts or interferences have been circumvented and the partial framework will slide easily to place. The amount of blockout wax used to eliminate an undercut area should be minimal. If the undercut area is large, blocking it out with wax will enable one to make a casting that will go to place, but the undercut may be so large that it creates an unfavorable food trap. The excessive undercut should have been modified in the tooth preparation stage by disking, placement of a restoration or selecting an alternate tilt of the cast, if not to eliminate the undercut then to reduce its magnitude decreasing its food entrapment potential while increasing patient acceptance. Proximal tooth surfaces that are to be used as guide planes and areas beneath all minor connectors receive parallel blockout. The wax is applied to the undercut area remaining gingival to the contact of the diagnostic rod or blade trimmer. Parallel blockout is also used in deep interproximal spaces that are to be crossed by a minor connector or a linguoplate.

Arbitrary blockout:
Refers to areas that are not involved in the casting but are blocked out for convenience. This is done to avoid difficulties in duplication of the master cast. The duplicating material is reversible hydrocolloid, and while this is highly elastic it can tear if drawn over a severe undercut. To prevent this tearing and to make it easier to draw the master cast from the duplicating get, gross undercuts that are not involved with the framework are arbitrarily blocked out. This blockout can be accomplished with the use of hard base plate wax. The special undercut wax need not be used.

Relief of the Master Cast:
This is done for the purpose of providing a space between the partial denture framework and the tissue. A selected thickness of wax is applied to the master cast, the cast is duplicated into a refractory model and the wax-up is done on the duplication of the wax relief on the refractory cast. When the casting is made and returned to the master cast or mouth, it does not contact the tissue in the areas that were relieved.

Areas that require relief include:

1. Gingival crevices and margins that will be crossed by minor connectors or linguoplate. Relief is necessary in these areas to prevent impingement of this delicate tissue so as to avoid and periodontal disturbance. The undercut wax or hard baseplate wax is flowed into these areas with a minimum thickness.

2. Areas in which major connectors will contact thin mucosa such as that over maxillary and mandibular tori and a prominent median palatal raphe. The thickness of wax applied is directly proportional to the amount of displaceability of the tissue covering the residual ridge. The more displaceable the ridge tissue, the more relief needed to cover the torus or suture line. This obviously deals with distal extension bases. In a tooth supported case, the need for relief in these areas is not as critical.

3. Beneath a lingual bar in a distal extension case if the rotation point is more to the anterior or the lingual alveolar mucosa is undercut.
The relief wax is 26 gauge sheet wax and it is applied in the area of the lingual bar. The superior portion is feathered and blended into the tissue, below the height of the contact of the superior edge of the lingual bar so that the top of the lingual bar will contact the tissue where possible. This is necessary to prevent food impaction, and the superior edge does not need relief because it does not move toward the tissue when in function. The inferior edge of the relief wax is extended all the way to the tissue reflection and kept at its full thickness. It is extended the full length to the lingual sulcular depth so to not limit the position of the inferior portion of the lingual bar. If the rotation is farther posterior, the arc of rotation of the lingual bar changes to more of an upward movement and so does not impinge the tissue. If the lingual alveolar mucosa in the area of the lingual bar is undercut, then the undercut must have parallel blockout so the framework will seat without tissue irritation. In addition the area also needs relief because of the upward rotation that will impinge the tissue.

4. The area under the retention latticework needs relief for the attachment of the resin base. One thickness of 26 gauge wax is applied to the ridge beyond the involved area so to not limit the placement of the latticework. The relief wax ends abruptly at a right angle at the finish line to create the internal finish line.

General Principles of Waxing

- Always be sure all parts of the wax-up are firmly secured to the model.
- Avoid sharp angles in the wax-up, except for finish lines.
- All junctions should be smoothly rounded.
- Finish lines should be definite, sharp line angles so resin can be finished to a butt joint.
- Always be sure of enough bulk in major connectors to insure rigidity.
- Occlusal rests should be within the confines of the occlusal rest preparations and never convex in shape.
- Retention arms should have a uniform taper.
- All excess wax independent of the wax-up proper should be carefully removed from the model.
- Slight imperfections, nicks, pits, cracks, etc. are corrected by the careful addition of wax and gentle carving and reshaping. Never attempt to flame out an imperfection.