# CDC 4Y052

# Dental Laboratory Journeyman

## Volume 4. Removable Prostheses


**Air Force Career Development Academy**

**Air University**

**Air Education and Training Command**

**4Y052 04 1912, Edit Code 06**

**AFSC 4Y052**

**Author:** MSgt Emily Jones
381st Training Squadron
Joint Service Dental Laboratory School (AETC)
381 TRS/TXTRR
3038 William Hardee Road, Building 295
JBSA-Fort Sam Houston, Texas 78234
DSN: 420-1950
E-mail address: emily.e.jones.mil@mail.mil

**Instructional Systems Specialist:** Ronnie Hall

**Editor:** Sandra F. Glenn

Air Force Career Development Academy (AFCDA)
Air University (AETC)
Maxwell AFB-Gunter Annex, Alabama

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THE FOURTH volume of Career Development Center (CDC) 4Y052, *Dental Laboratory Journeyman*, includes the survey, design, and construction of removable dental prostheses (RDP). Unit 1 covers the classification, components, and design of removable dental prostheses. Unit 2 is the procedures for waxing and processing the framework of RDP. Unit 3 concludes this volume with information on RDP denture bases and how to repair removable prostheses.

A glossary is included for your use.

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## ACKNOWLEDGMENT

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**NOTE:**

In this volume, the subject matter is divided into self-contained units. A unit menu begins each unit, identifying the lesson headings and numbers. After reading the unit menu page and unit introduction, study the section, answer the self-test questions, and compare your answers with those given at the end of the unit. Then complete the unit review exercises.

*Page*

# Unit 1. Surveying and Designing Removable Dental Prostheses



THE SURVEY AND DESIGN of a removable dental prosthesis (RDP) is the dentist's responsibility. Accomplishing this task requires the dentist to assess the patient's oral health. Specifically, the dentist must determine the stability of the abutment teeth and the condition of the patient's soft tissue. Once the dentist has completed the evaluation, the dentist is prepared to design and prescribe a RDP that meets the patient's needs and preserves oral health.

Your responsibility, as a dental laboratory technician, is to fabricate an RDP that meets the patient's needs according to the provider's prescription. To accomplish this, you must have in-depth knowledge of the RDP classification system and its components, and a thorough understanding of how the survey and design are performed. All of which will be explained later in this unit.

## 1–1. Removable Dental Prostheses Case Classification

The Kennedy classification system, like most classification systems, categorizes information to simplify the RDP design process. The classification system was not intended as a memory exercise designed to frustrate dental students. Dr. Kennedy's intent was to ease the design process by categorizing four types of edentulous arches—Class I, II, II, and IV. Each classification has general design requirements. Understanding this system reduces the time and confusion associated with RDP design.

### 601. Kennedy classification

A simple way to remember Dr. Kennedy's classification system is by using the location and number of the edentulous areas that are present. Large edentulous areas, which do not have teeth at both ends of the area, are called *edentulous extensions.* Class I has two extensions, while Class II has one. Class III has no extensions, and Class IV has one extension in the anterior. Therefore, Class I, II, and IV rely on both tooth and soft tissue support. Remember, these Kennedy classifications categorize information to simplify the RDP design process.

This memory jogger means that a Class I has *two* distal edentulous extensions and is referred to as a bilateral distal extension (fig. 1–1). The reference designators (R, IR, B) in figures 1–1, 1–2, and 1–3 will be explained in a later lesson where they tie into the lesson better. A Class II has *one* distal edentulous extension and is referred to as a unilateral distal extension (fig. 1–2). A Class III has an edentulous area bounded anteriorly and posteriorly by abutment teeth and does not have a distal edentulous extension (fig. 1–3). Class IV has a single bilateral (crosses the midline) edentulous extension anterior to the remaining natural teeth (fig. 1–4).

The most posterior edentulous area of the dental arch is the determining variable in the Kennedy classification system. Sometimes this classification description is too generic and need a more detailed description. This is done by using *modifications*. Modifications are defined as any edentulous space anterior to the most posterior edentulous area. For example, Figure 1–2, item B would be a

Kennedy Class II with one modification. Additionally, if a central incisor were also missing, then Figure 1–2, item B would be Kennedy Class II with two modifications. Kennedy Class IV is the only class that does not have modifications. If there were an edentulous area posterior to an extension, it would become the modification. An arch missing a cuspid and lateral is a Kennedy Class III because the edentulous area does not cross the midline. If both centrals are missing, then the arch is a Kennedy Class IV.

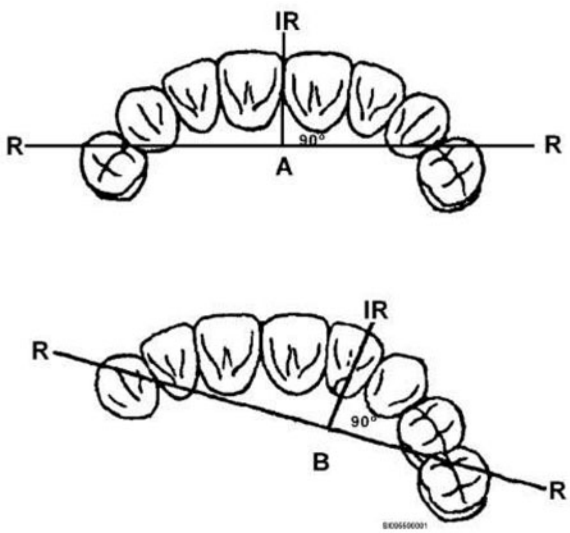


Figure 1–1. Kennedy Class I, bilateral distal extension.

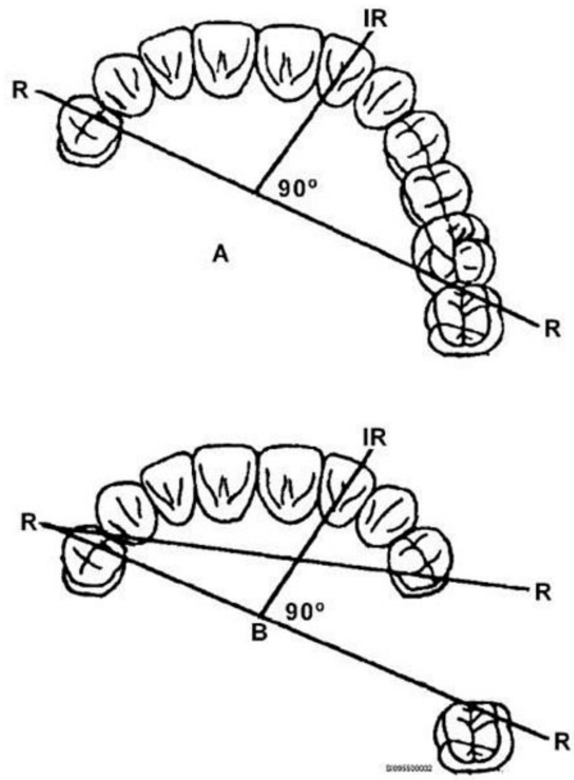


Figure 1–2. Kennedy Class II, unilateral distal extension.

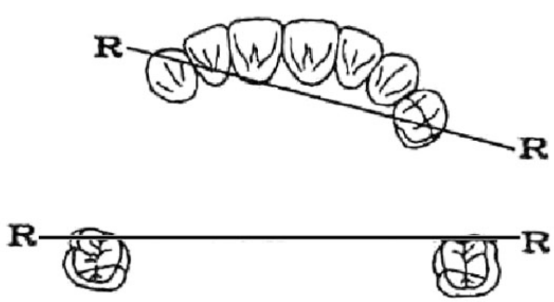


Figure 1–3. Kennedy Class III, tooth-borne.

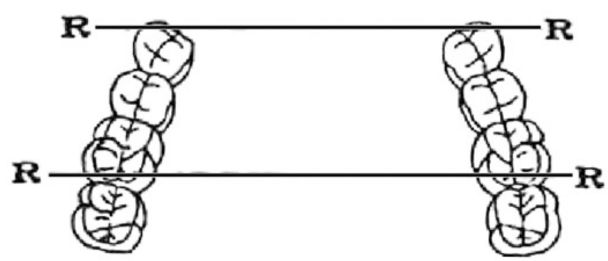


Figure 1–4. Kennedy Class IV, bilateral anterior extension.

## 602. Design concepts based on the Kennedy classification

A RDP must be designed to replace missing teeth and distribute the functional load of mastication throughout the arch. A poorly designed RDP can rock side-to-side or back-to-front, destroying teeth and bone support. The teeth closest to the edentulous area (abutment teeth) are fulcrum points. As you can see in figures 1–1 through 1–4, a line bounded by “Rs” passes through the terminal teeth of the arch and the direct retainers. This is the fulcrum or imaginary line around which a RDP could rotate if the framework fails to equally distribute the occlusal load.

The potential for rotation is noticeably pronounced in Class I and II arches. If not properly supported, a distal extension functions as a lever, with the abutment tooth acting as a fulcrum point. This type of movement occurs when the opposing dentition occludes against the artificial tooth (teeth) of the extension area. This action causes the extension area to move vertically, in a downward direction, toward the edentulous ridge. This vertical movement can be neutralized with occlusal rests, direct retention (clasps), and supporting tissues. As the mouth opens, the extension moves away (upward) from the ridge. Movement away from the ridge is resisted by indirect retainers (plating and rests) placed in the anterior part of the ridge. In figures 1–1 and 1–2, indirect retention (IR) is placed at a 90-degree (°) angle to the fulcrum line. IR may occur on a cingulum or at the incisal rests. Lingual plating may also serve as either a direct or indirect retainer. Remember, Kennedy Class I, II, and IV RDPs require tooth and tissue support for stabilization, while Kennedy Class III requires only tooth support. The following table provides recommended major connector designs for the Kennedy classifications.

| Kennedy Classifications | | | | |
|---|---|---|---|---|
| **Major Connector Design** | **I** | **II** | **III** | **IV** |
| Palatal strap | | | X | |
| Horse shoe | | X | X | X |
| Ant-Post palatal bar | X | X | X | X |
| Closed horse shoe | X | X | X | X |
| Full palate | X | | | |

Each classification has certain unique design requirements. These requirements can be applied differently from case to case and should not be used as the “only” design for each classification. The characteristics of each case will determine which design elements are used.

### Class I, bilateral distal extension

Typically, this design has the posterior abutment teeth clasped. Direct retention for this classification can be any or all of the following:

1. An “I” bar in a buccal undercut.
2. A “T” bar in a distobuccal undercut.
3. An 18-gauge wrought wire clasp in a mesiobuccal undercut. Four occlusal rests are usually used in this last case. Two rests are combined with the clasps, and two are used as indirect retention. Remember, cast cobalt-chromium clasps require 0.010 inch of undercut, while wrought wire clasps require 0.020 inch of undercut.

Most RDP designs that incorporate circumferential clasps require each clasp to encircle the abutment tooth; however, this is not always the case. Cast circumferential clasps used in a Class I design should never engage the mesiobuccal undercut on the abutment tooth. Engaging the mesiobuccal undercut should be avoided because with this design the clasp will act as a lever and actually lift the abutment tooth out of the socket. This occurs because the bilateral extensions are resting on soft tissue. During mastication, the posterior regions of the RDP are compressed towards the alveolar ridge. This causes the framework to “see-saw.” This recurring movement, over time, can actually extrude an abutment tooth from its alveolus.

Sometimes framework designs must be modified because of the patient’s oral health. A patient with significant bone loss will have insufficiently supported teeth. If singularly clasped, these teeth will not be able to support the framework and will eventually be lost. One alternative to avoid further damage is double clasping in the same quadrant (creating a clasp for each of two adjacent teeth). However, double clasping in the same quadrant is only indicated when there is insufficient bone support for the abutment tooth. The decision to double clasp is made by the dentist.

The extent of the Class I edentulous area determines the type of major connector. The anteroposterior (AP) palatal bar, closed horseshoe and full palate major connector may be used. The palatal strap and horseshoe are not used due to their flexibility.

### Class II, unilateral distal extension

Direct retention for a Class II is the same as for a Class I. Two clasps should be used on the dentulous side if there is no modification in that area. Place one clasp as far anteriorly as possible and the other clasp as far posteriorly as possible. The clasps should be a minimum of one tooth apart to ensure stability of the RDP. The choice of undercuts used on these teeth is up to the designer. If there is a modification on the dentulous side, clasp the posterior abutment in the distobuccal undercut and clasp the anterior abutment in the mesiobuccal undercut. A circumferential clasp is usually the best clasp for this situation. Three occlusal rests are used for Class II—two for clasps and one for indirect retention.

### Class III, tooth-borne

Direct retention for a Class III is similar to the retention for a Class II. If there is no modification, the abutment teeth next to the edentulous area should be clasped the same as they would in a Class II case. If there is a modification, clasp all four abutment teeth with the simplest clasp available. Do not clasp posterior abutments that lack bone support. Place an occlusal rest and nonretentive clasps on these unstable abutments. These components will help stabilize the teeth against lateral movement. They can also be used for artificial tooth retention if the abutment is extracted.

### Class IV, bilateral anterior extension

Direct retention for a Class IV case is the two most anterior teeth clasping a mesiobuccal undercut. The two most posterior teeth are clasped in the distobuccal undercut.

## Self-Test Questions

**After you complete these questions, you may check your answers at the end of the unit.**

### 601. Kennedy classification

1. What is the determining variable in the Kennedy classification system?

2. What is considered as a modification to the Kennedy classification system?

3. How does a Class IV arch differ from a Class III arch?

### 602. Design concepts based on the Kennedy classification

1. What effect does a poorly designed RDP have on the mouth?

2. How is rotation around the fulcrum line neutralized?

3. Describe the type of support needed for Class I, II, III, and IV cases.

4. Why should a cast circumferential clasp never engage the mesiobuccal undercut on a Class I case?

5. During RDP design, when is double clasping an acceptable design practice?

6. Why are clasps for a Class II case placed at least one tooth apart?

## 1–2. Removable Dental Prostheses Components

A removable dental prosthesis has several parts or components, each with its specific function. This section discusses the characteristics of framework components and replacement of teeth and tissue.

### 603. Removable dental prostheses framework components

Components of a RDP framework are designed to support and distribute occlusal forces throughout the patient's arch. If any component of a framework is improperly designed or positioned, it can damage the patient's remaining dentition. Extreme care must be taken when fabricating all aspects of a RDP framework.

#### Major connectors

A major connector unites all parts of the RDP; acting as a skeleton, it connects one side of the partial to the other, and also distributes and equalizes stress. As you can see in figure 1–5, there are several types of major connector designs to choose from. The quality that enables the connector to distribute stress throughout its framework is its rigidity and resistance to torque (twisting). The major connector provides rigid support for the RDP. A defective, nonrigid (flexible), major connector has a serious negative effect on a patient's oral health. At best, the connector is uncomfortable; at worst, the connector destroys teeth and the periodontium.

Once the appropriate major connector is selected, it must be designed to blend with the patient's anatomy. The connector should cover as little of the tissue as possible. Minimal coverage allows tissue stimulation. Also, the patient's salivation is closer to normal, and the flavor, texture, and temperature of food are not inhibited.

The location and exact boundaries of the major connector are determined by esthetics, phonetics, and comfort. To keep the connector from interfering with oral function and lessen irritation, it should be contoured to the patient's anatomy. Contouring is done by avoiding convex surfaces. The component is placed, for the most part, in existing depressions and embrasures. The following two types of tissue can interfere with stress distribution of the major connector:

1. Thick or flaccid soft tissue.
2. Bony prominences that cannot withstand the pressure of the stress.

For these two reasons, relief is always used with mandibular connectors and sometimes for maxillary connectors.

The selection of the actual connector is determined by the unique characteristics of the case and the design requirements of the connector. Anatomically, the connector must allow for soft tissue, the amount of room for the connector, any tori that may be present, and the need for indirect retention. The connector should be non-irritating while maintaining rigidity. Irritation is decreased by careful location, as previously discussed. The connector should also cross the median raphe at a 90° angle to be symmetrical. This design feature is important because it provides cross-arch strength and is less distracting to the patient’s tongue.

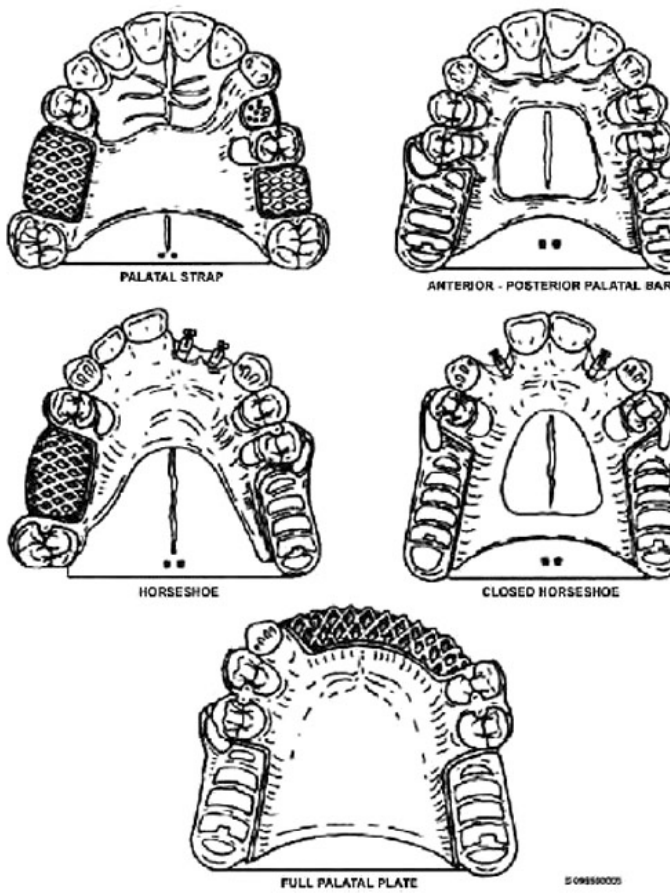


**Figure 1–5. Maxillary major connectors.**

### *Palatal strap*

The anterior border of the palatal strap is an example of a perpendicular crossing of the median raphe. Anatomy also helps the connector’s rigidity. The connector’s rigidity increases by adapting to the oral tissue on several planes. This multiple plane structure prevents flexing. The palatal strap is placed in the center of the palate and can be very irritating to the tongue.

### *Anteroposterior palatal bar*

The AP palatal bar is the most rigid. It allows tissue stimulation and supports long-span edentulous areas. The AP bar is used to bypass palatal tori and may cover the linguals of the teeth for indirect retention. If the linguals are not covered, the anterior border of the connector should be at least 6 millimeters (mm) from the free gingival margin. The minimum anterior width of the palatal bar must be 10 mm and the minimum posterior width of the palatal bar must be 6 mm.

### *Horseshoe connectors*

The horseshoe connector is used as a replacement for the AP bar when tori (bony ridges) are too extensive. However, the horseshoe is flexible and promotes papillary hyperplasia of the rugae by blocking soft tissue stimulation of the rugae. Increase rigidity by using a closed horseshoe.

### *Full palatal plate*

The full palatal connector is the strongest and used when there are few remaining anterior teeth. It is possible to add a posterior seal for extra retention. The full palatal bar splints teeth and withstands heavy mastication.

### *Lingual bar*

The lingual bar is a 5 mm high, half-pear shape in the cross-section. The half-pear shape provides this connector's rigidity. The superior border should be 3 mm from the free gingival margin and from the inferior border at the height of the floor of the mouth. Three of the following mandibular major connectors are basic variations of the lingual bar (fig. 1–6).

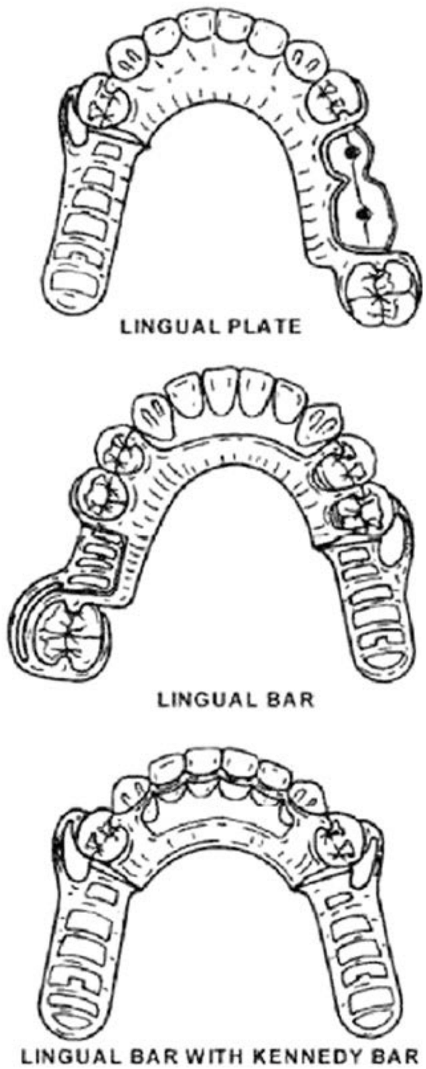


**Figure 1–6. Mandibular major connectors.**

### *Kennedy bar*

A Kennedy bar may be added to a lingual bar to provide indirect retention while allowing a natural cleansing action.

### *Lingual plate*

Lingual plate is used for indirect retention and splinting periodontally involved teeth, if necessary. An artificial tooth may easily be added to a lingual plate if required. Lingual plating's superior border stops at the mid-third of the teeth and closely adapts to them. It is used when there is little room for a lingual bar.

### *Labial bar connectors*

Lingual bar connectors cannot be used on patients with lingually inclined mandibular teeth. Mandibular teeth, with a lingual inclination, create an obstruction for the lingual bar, making it difficult, if not impossible to seat a RDP. This anatomical occurrence can be overcome by using one of two major connectors that can be positioned on the labial aspect of the alveolar ridge-labial and sublingual bar connectors.

#### *Labial bar*

The first type of connector is called a labial bar (fig. 1–7). The labial bar may be rigid or hinged. The hinged version is used to splint periodontally involved teeth.

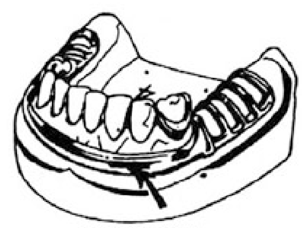


**Figure 1–7. Rigid labial bar major connector.**

#### *Sublingual bar*

The second type of connector is the sublingual bar. It lays low (sublingual) in the mandibular lingual vestibule of the mouth. It may also be used when there is insufficient alveolar height for a lingual bar.

## Minor connectors

Minor connectors are the connecting links between the major connector and other parts of the RDP. These connectors should be rigid to resist breakage and distortion during function, must not lock into undercuts of the teeth and soft tissue, and must be adapted and contoured to minimize patient discomfort. Placing the minor connector in an interproximal area and having the connector project from the major connector at a 90° angle are two ways to prevent discomfort. They must also be constructed and positioned so they do not interfere with the artificial tooth placement. Minor connectors may also serve as proximal plates. The proximal plate supports the tooth by increasing the encirclement around it. In some cases, it may act reciprocally as it guides the partial to rest properly in the mouth.

## Framework support

The major and minor connectors distribute functional stress to different parts of the RDP. The other links in this chain are *rests* and the *denture base*. The stress must be transmitted to the oral structures in a nondestructive form to adequately support the RDP. Let's look at these two critical components.

### *Rests*

Rests support the partial against downward forces and prevent the RDP from placing pressure on the soft tissue of the mouth. Rests can be in two possible forms:

1. As part of a clasp-assembly.
2. As auxiliary rests that are not part of a clasp.

Rests can be placed in three different tooth locations: occlusal, incisal, and lingual. Rests transmit functional stress along the long axis of the abutment tooth. Figure 1–8 depicts a typical occlusal rest. Notice the location of the deepest part of the preparation. This point is in line with the long axis of the tooth. The thinnest part of the rest must be strong enough to resist fracture during mastication.

The rest prevents the RDP from moving toward the tissue. This prevents tissue impingement, maintains optimal clasp position, and keeps the artificial teeth in place during mastication. To perform as intended, the dentist must prepare the teeth for the rest. The rest preparation directs the force and prevents the rest from slipping. Rests also provide indirect retention for Kennedy Class I and II edentulous arch cases.

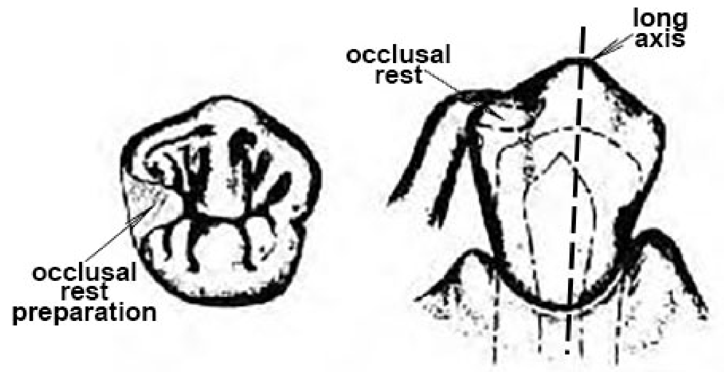


**Figure 1–8. Occlusal rest contour and relation to the long axis of the tooth.**

### *Denture base*

The denture base assists stress distribution and framework support. The denture base is connected to the framework by what is technically a minor connector. This connector should have internal and external finish lines to strengthen the edge of the acrylic. There are two types of connectors—*mesh* and *open retention* (OR). OR is used most often since it allows more vertical space for setting teeth. Cast metal denture bases with retention beads are also used to a limited extent.

### *Retention*

The RDP must resist dislodgement to function properly. Gravity and sticky food are two factors that dislodge the RDP. Direct and indirect retention both act to keep the RDP in position. The retentive tip of the clasp engages a small amount of undercut just below the height of contour of the tooth. The height of contour is indicated by the survey line. Clasp parts that retain the RDP are labeled in figure 1–9.

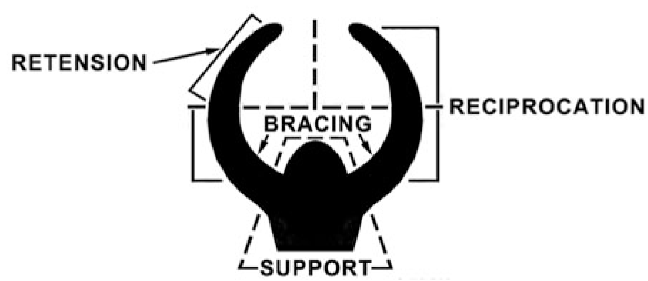


**Figure 1–9. Function of the different parts of a clasp.**

### *Reciprocation*

Reciprocation is the counterpart to retention. Reciprocation opposes the effect, or force, created by another part of the RDP. This opposition prevents movement of the tooth as the retentive clasp slips into position. Several forms of reciprocation are available—reciprocal arms, plating, and minor connectors, and even proximal teeth provide reciprocation. Reciprocation opposes a retentive force either on the opposite side of the tooth, or on the opposite side of the arch. An example of cross-tooth reciprocation is seen in figure 1–10. A reciprocal arm lies above the survey line while reciprocal plating extends from below the line to 0.5 mm above the survey line.

Reciprocation also is done by the action of one clasp opposing the action of another clasp on the opposite side of the arch, as illustrated in Figure 1–11. The identification and use of this concept is a critical step in the design of a RDP.

Unilateral undercuts also provide reciprocation. For example, in figure 1–12, undercut area A opposes undercut area B on the same side—unilateral. Undercut area A also opposes undercut area C on the opposite side of the cross arch. When the retentive clasp and reciprocal element are used correctly, the abutment tooth is encircled. Encirclement prevents teeth from drifting. Drifting or tooth movement will reduce the effectiveness of the clasp.

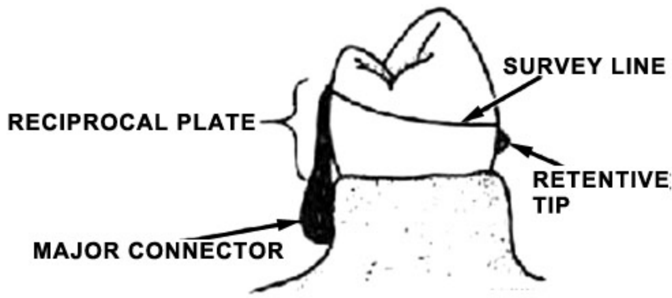


**Figure 1–10. Reciprocation provided by reciprocal plating.**

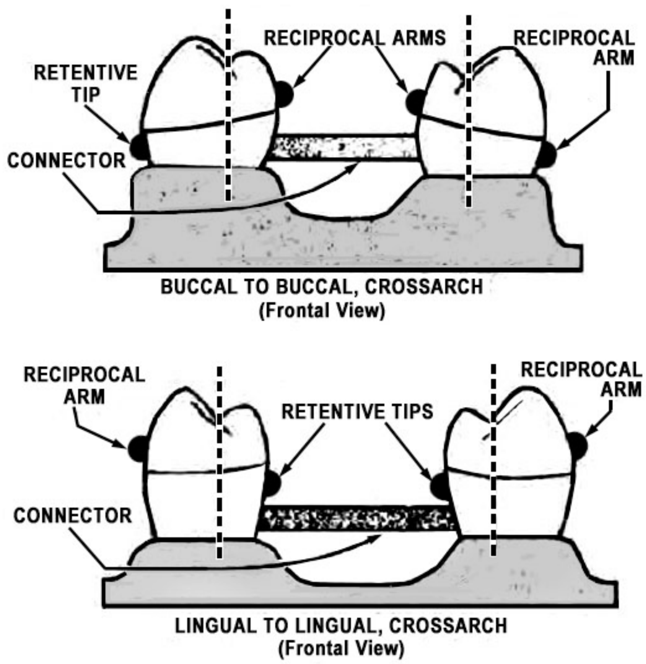


**Figure 1–11. Cross-arch reciprocation.**

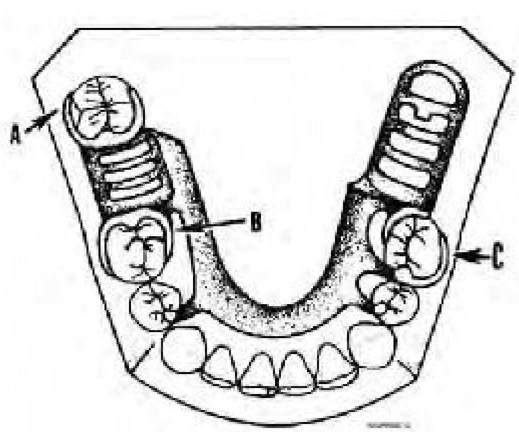


**Figure 1–12. Unilateral and cross-arch reciprocation.**

### Bracing

Bracing is another concept involved with retention. Bracing resists the horizontal movement of the RDP in the mouth. It is also useful for stabilizing periodontally weak teeth. Clasping teeth with poor periodontal support should be avoided if possible. Bracing elements, like plating and a nonretentive arm, can act like a splint for the weak tooth. These elements also provide retention for an artificial tooth if the natural tooth is extracted later.

### Direct retention

The direct retainer should be passive (at rest) until activated by a dislodging force. When this force occurs (for example, when the patient chews sticky food), the retainer should hold the RDP in place. To accomplish this, the retainer must engage the undercut of the abutment tooth. The amount of undercut needed depends on the composition and design of the clasp. An undercut of .010 inch is adequate for a half-round cast chrome-cobalt clasp. An undercut of .020 inch is needed for a round wrought wire clasp. Regardless of the depth of undercut, clasp design, half-round or round, determines the direction of movement. The half-round clasp only moves in an outward direction, while the round clasp is more flexible because it may move in any direction.

Flexibility depends on the following factors used to make up the clasp:

- Taper.
- Width.
- Length.
- Thickness.
- Cross section.
- Type of metal.

For example, the retentive arm will taper while the reciprocal arm does not. The taper allows the retentive arm to flex over the height of contour. There must also be a planned path of insertion. This allows the direct retainers to work together to provide adequate stability.

There are two types of direct retainers—suprabulge (fig. 1–13), and infrabulge (fig. 1–14). The suprabulge retainer approaches the retentive undercut from above the survey line. The infrabulge retainer approaches the retentive undercut from below the survey line. Figure 1–15 gives a comparison of the two retainers. Notice that the suprabulge retainer is also known as a circumferential clasp and the infrabulge retainer as a bar clasp.

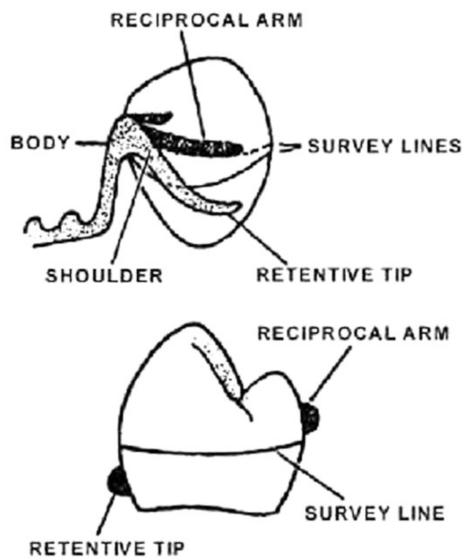


**Figure 1–13. Suprabulge retainer.**

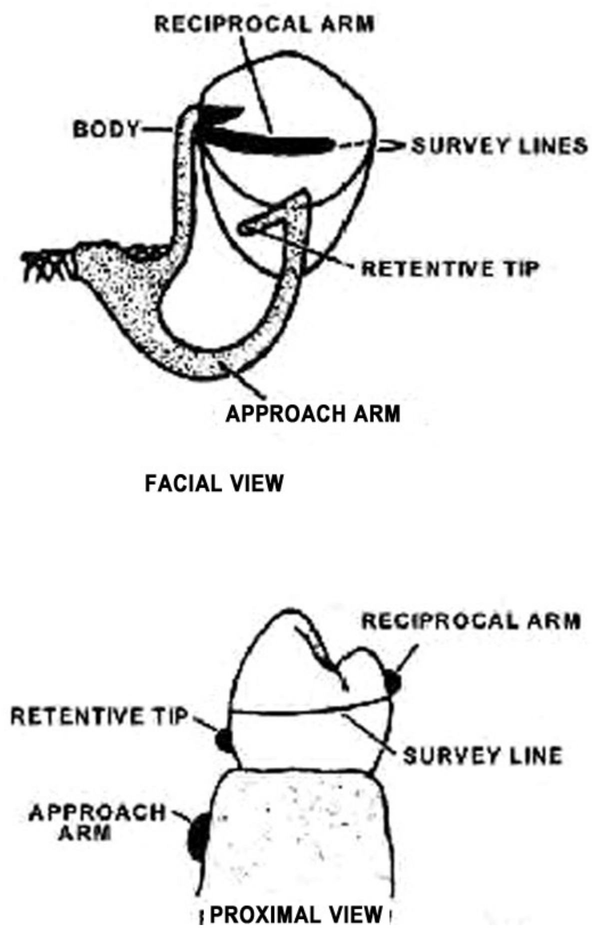


**Figure 1–14. Infrabulge retainer.**

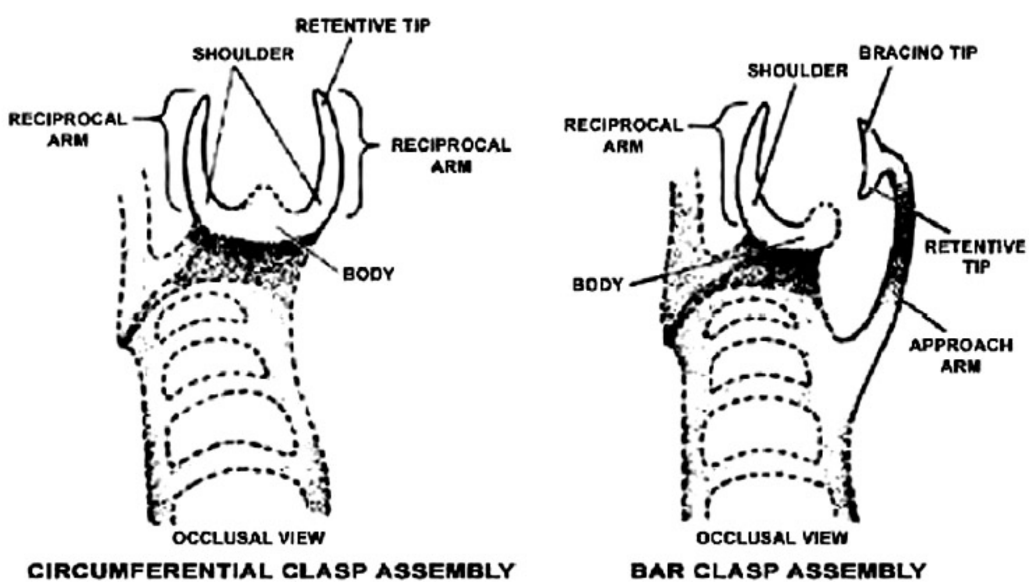


**Figure 1–15. Occlusal view of the suprabulge retainer and infrabulge retainer.**

Now, let's cover the advantages and disadvantages of the two types of direct retainers. The commonly used suprabulge retainers are shown in figure 1–16. The circumferential clasp is easy to make and repair. It is very retentive when used correctly; however, the circumferential clasp covers a lot of tooth and may damage the tooth if distorted. The embrasure (crib) clasp can replace a bar clasp on a Class I or II case when a bar clasp is contraindicated.

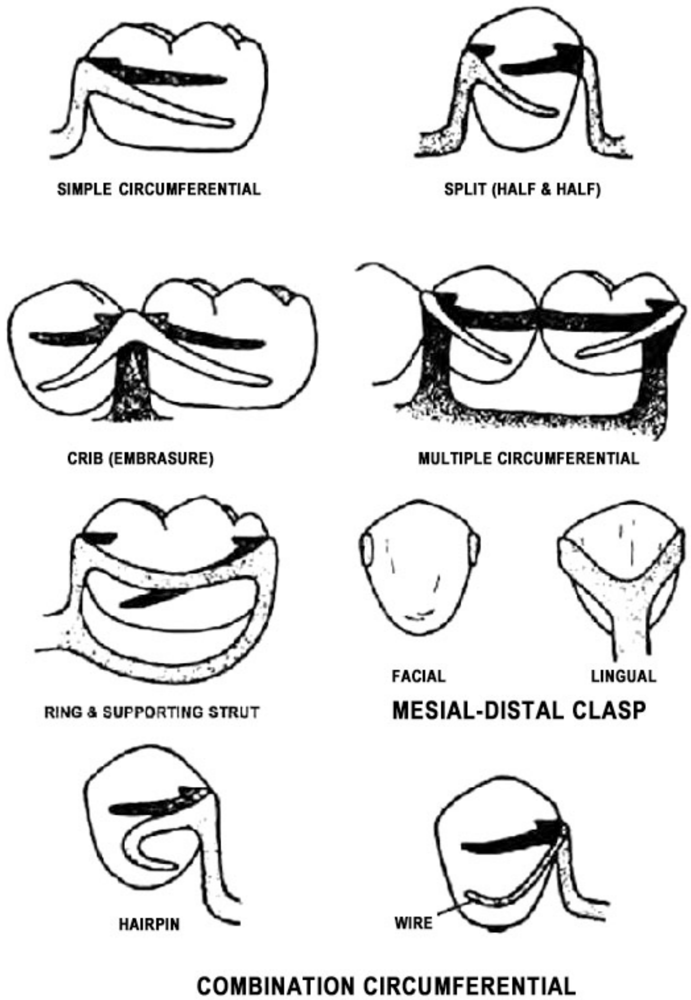


**Figure 1–16. Suprabulge retainers.**

However, the wrought wire clasp like the multiple circumferential clasp is difficult for the dentist and dental laboratory technician to make. The wrought wire clasp is used on weak abutments and may be cast into the framework, soldered to the framework, or processed into the denture base.

The infrabulge clasps (fig. 1–17) are most often used in Class I and II cases. All infrabulge retainers share the same disadvantage: deep, soft tissue undercuts inhibit their use. The T bar's retentive distal arm releases the undercut when the distal extension moves gingivally. This relieves the stress on the abutment tooth. The mesial arm stabilizes the tooth. The modified T bar is used on maxillary arches due to its more esthetic appearance. The I bar remains below the survey line and covers a very small amount of tooth structure. Consequently, the I bar does not provide the same amount of bracing as the other infrabulge retainers.

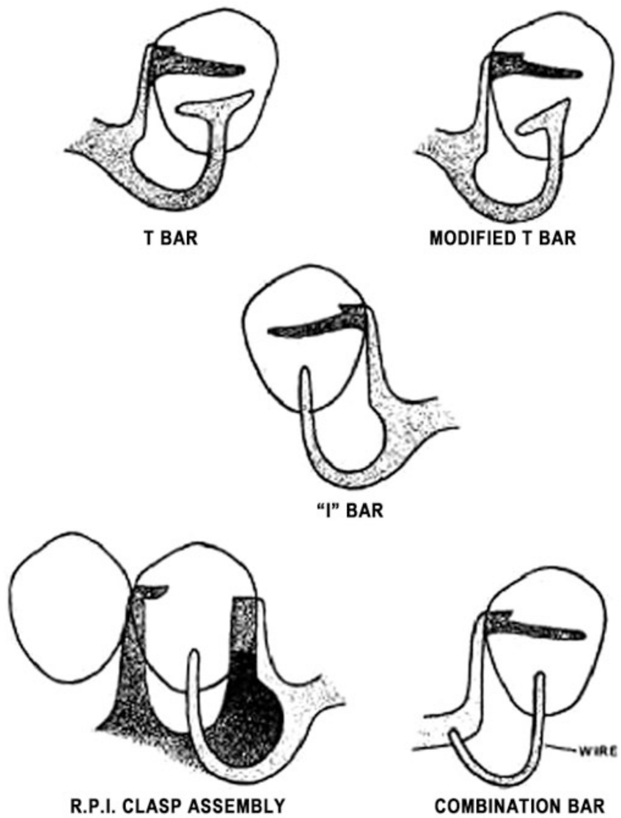


**Figure 1–17. Infrabulge retainers.**

The rest, plate, I bar (RPI) clasp assembly (fig. 1–18) is a particularly nondestructive infrabulge retainer. When the distal extension moves gingivally, the mesial occlusal rest acts as the fulcrum point preventing excessive movement. The distal proximal plate disengages from the tooth, as well as the I bar, preventing lateral stress transmission to the tooth. The distal guide plane is approximately 2 to 3 mm high with the plate contacting approximately 1 mm of the abutment tooth above the survey line as shown in the facial view in figure 1–18. The proximal plate guides the RDP in place and provides bracing for the abutment tooth.

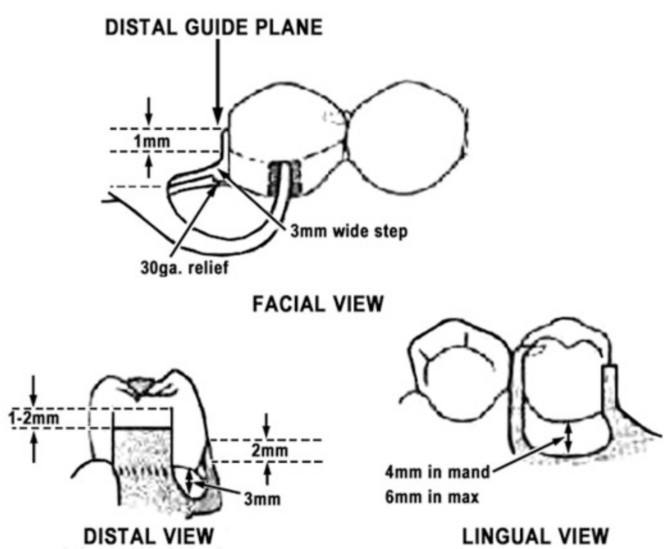


**Figure 1–18. The RPI clasp assembly.**

#### *Indirect retention*

We have already covered some of indirect retention's relationship to the Kennedy classifications. This lesson will further your understanding of the relationship. Indirect retention is needed in Class I and II cases where occlusal movement of the distal extension is possible. Direct retention in Class III and IV cases prevents occlusal movement due to two axes of rotation. Class I and II cases have one axis that passes through the direct retainers. Auxiliary rests, lingual plate, direct retainer, and a modification to the anterior of the denture base could provide indirect retention. However, do not confuse a rest that supports the framework with an auxiliary rest that furnishes indirect retention. For the best result, the RDP should be very stable, rigid, and well supported by abutment teeth, with definite rest preparations.

#### *Precision attachments*

Precision attachments are retentive without any visible clasps. Their precise, interconnecting fit greatly improves the RDP's stability; however, the abutment teeth must have good periodontal support. Also, the attachments wear out and are difficult to repair or replace. The dentist and the laboratory technician must take extra care in making these appliances. The patient also needs to have dexterity to install the appliance. As for Class I and II cases, an attachment incorporating stress relief is always necessary.

## 604. Tissue and teeth replacement

Restoring a patient's teeth and supporting tissue are the reasons for making a removable dental prosthesis. This is a simple fact that must be remembered by the technician making the framework. Conversely, the technician replacing the missing teeth must remember that the framework was made to be retained in the patient's mouth. Neither technician should compromise the other's efforts unless authorized by the dentist. The framework technician should provide room for artificial teeth and the denture technician should not alter the framework unless directed by the dentist. Remember, this is a team effort.

### Removable dental prosthesis base

The denture base of a RDP supports artificial teeth, improves the patient's appearance by replacing the missing tissue, distributes occlusal stress, and stimulates supporting tissue. Occlusal load distribution depends on the case's classification. Occlusal stress is transmitted to the abutment teeth in a tooth-supported RDP, while the denture base of a distal extension RDP distributes the load to the ridge. The distal extension denture base must cover as much of the edentulous ridge as possible to distribute the load over as wide an area as possible. Ridge coverage also braces the RDP, preventing horizontal movement of the RDP.

An edentulous distal extension is exposed to considerable stress during mastication. The denture base must distribute this stress over a wide area of the ridge to reduce bone resorption and tissue trauma. The denture base must cover the tuberosities, retromolar pads, and the buccal shelves. The base should extend into the buccal and lingual vestibules without hindering lining mucosa movement.

The denture base can be either metal or acrylic resin. The resin base is usually attached to the RDP by OR. The OR is preferred over mesh retention since it allows more vertical space for teeth. Mesh retention weakens the resin base in comparison to OR. A metal base will have beads to retain the denture base.

The acrylic resin base is preferred when resorption is expected for both distal extensions and for post-surgery patients. An acrylic resin base provides the option to reline the prosthesis. The metal base is favored for tooth-supported RDPs and for patients with healthy, stable ridges. Metal bases have the advantages of thinness coupled with rigidity, cleanliness, and the ability to transmit temperature to tissue well. Regardless of which type is used, the base should be well adapted to the tissue.

### Artificial teeth

Some of the more esthetic tooth replacements are acrylic resin embedded in a resin denture base. The materials used to make the teeth are available in a wide selection of shades and molds and the denture base is very effective for restoring resorbed tissue. However, this method is not advised when there is insufficient space to place an artificial tooth.

A very natural-appearing, anterior replacement is the reinforced acrylic pontic (RAP). When making a RAP, acrylic resin denture teeth are butted to the ridge, a lingual box preparation is made in a denture tooth, and the framework waxup is waxed into the box preparation. This results in a metal base between the denture tooth and the ridge. Angled slots may be ground into the resulting metal backing to improve retention. The teeth are fixed to the framework with tooth shade acrylic resin.

RAPs should not be used on a patient with a severely resorbed anterior ridge. Also, like other metal-based replacements, a RAP cannot be relined.

Tube teeth (customized denture teeth) are sometimes used for posterior tooth replacements in RDPs. A denture tooth is customized into a tube tooth by first cutting a ledge into the proximal and lingual ridge lap. Then a tube-shaped hole or diatoric is drilled into the tissue side of the denture tooth. The framework is then waxed to the tooth. Later, the tube tooth is processed to the framework with tooth shade acrylic. Tube teeth share the same drawbacks as RAPs.

Metal pontics are another type of posterior tooth replacement. They are normally used when there is limited space for resin teeth. Due to its hardness, chrome-cobalt alloy pontics should have minimal occlusal contact with the opposing teeth. The buccal of the pontic may be filled with tooth shade acrylic to improve esthetics. Gold occlusals, combined with resin buccals, may be used for long-span edentulous areas.

Acrylic resin facings may be used in the anterior when the horizontal overlap is severely restricted. However, keep in mind, these replacements do not appear natural in the mouth and have the same restrictions as RAPs. Currently, facings are replaced when repair is necessary and new RDPs are seldom designed to use facings for tooth replacement.

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## Self-Test Questions

**After you complete these questions, you may check your answers at the end of the unit.**

### 603. Removable dental prostheses framework components

1. What is the purpose of the major connector in a RDP?

2. What structural quality allows a major connector to distribute and equalize stress?

3. How could a defective major connector affect a patient’s oral health?

4. Why should the major connector cover as little of the patient’s tissue as possible?

5. Why should the major connector cross the median raphe at a 90° angle?

6. What is the purpose of direct and indirect retention?

7. What is the benefit of using bracing for retention purposes?

8. What is the desired state of the direct retainer when the RDP is seated?

### 604. Tissue and teeth replacement

1. What is the purpose of the denture base of a RDP?

2. How is occlusal stress distributed in a tooth-supported RDP?

3. How is occlusal stress distribution in a distal extension RDP?

4. What are the advantages of metal bases?

5. When are artificial teeth embedded in an acrylic resin denture base not advised?

6. When is a reinforced acrylic pontic not recommended as an artificial tooth replacement?

## 1–3. Removable Dental Prosthesis Cast Survey and Design

This section brings together the information from the two previous sections. At this time, you should have a good idea of what design is appropriate for each Kennedy classification and which component is appropriate for the design. Now, you must learn how to survey the cast to determine the components' placement and then design the prosthesis on the cast.

### 605. Dental surveyor

The dental surveyor is used in many aspects of dentistry. When used correctly, processing time is reduced, as well as insertion time for the dentist. This lesson will help you become familiar with the dental surveyor.

#### Purpose

The surveyor determines parallelism between anatomical surfaces and the path of insertion, location of clasps and clasp tips, amounts of undercut, and path of insertion. It is also used for shaping blockout wax, carving wax crown patterns, placing precision attachments, and milling rests and guide plans into cast restorations.

### Surveyor components

A typical dental surveyor is illustrated in figure 1–19. The most critical components of the surveyor are the vertical spindle and survey table (also called a tilt top). The vertical spindle must be perpendicular to the horizontal base of the surveyor for an accurate survey. Any deviation from a 90° angle will alter the desired path of insertion and the blockout. The survey table securely holds the cast and orients the cast to the desired path of insertion. The table locks into position, maintaining the cast's position throughout the survey. An accurate survey depends on the fixed position of the cast.

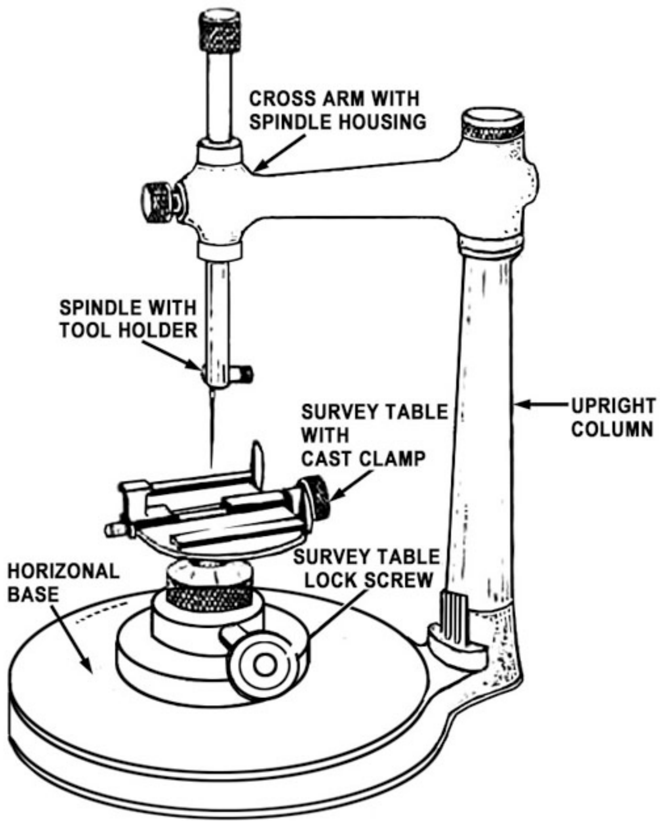


Figure 1–19. Dental surveyor components.

### Surveyor attachments

Also known as surveyor tools or instruments, some attachments are shown in figure 1–20. The analyzing rod locates undercuts and determines the path of insertion. The carbon marker indicates the survey line. Undercut gauges are available in .010, .015, .020, and .030 inch sizes and are used to measure the amount of undercut. The parallel blockout tool creates a blockout that is parallel to the path of insertion. Tapered blockout tools are used to incorporate a 2° or 6° taper to the blockout wax.

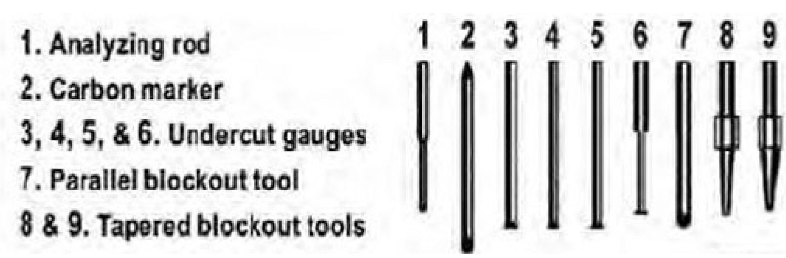


Figure 1–20. Surveying attachments.

## 606. Surveying

Surveying the RDP cast is more than placing survey lines on a cast; it is the application of the dentist's training and experience to the task of planning a RDP. As you gain experience as a technician, you may perform some of these surveying procedures. The following are the four major steps to surveying:

1. Evaluating the cast.
2. Determining the path of insertion.
3. Surveying the cast.
4. Drawing the design.

### Evaluate cast

As in any task requiring fabrication of a product, an evaluation of the product is necessary. First, classify the cast using the Kennedy system. This will provide a general idea of what the design should look like. Then, check the cast for anatomic problems. Gross tori, excessive tilting of natural teeth, or evidence of flabby soft tissue are all problems to be considered during the evaluation.

The casts should then be hand-articulated (occluded) to evaluate the occlusion. The amount of vertical overlap is recorded on the linguals of the maxillary teeth. The amount of vertical overlap determines the placement of indirect retainers, such as lingual plating and rests. Ridge relationships are checked for cross-bite. The patient's centric occlusion is evaluated for adequate space for rests and retainers.

The cast is tilted in various directions in relation to the analyzing rod to increase desirable undercuts and decrease undesirable undercuts. Tilting the cast to the posterior increases distal undercuts and decreases mesial undercuts. Tilt the cast anteriorly and the opposite occurs. Abutment teeth and edentulous areas receive extra attention during the complete cast analysis. Tilting the cast also determines the path of insertion for the RDP.

### Determining the path of insertion

The AP tilt and the lateral tilt combine to form the path of insertion. Factors that influence the path of insertion include desirable undercut, angulation of teeth, preexisting guide planes, type of artificial tooth replacement, and the patient's anatomy. The degree of AP tilt is determined by the tilt that creates the least amount of undesirable undercut. Reverse the tilt too far to the anterior and it would be impossible to insert the RDP.

Normally, there is only one path of insertion for a RDP. However, there is a rotational or dual path of insertion method used when proximal retention is needed. The rotational path is usually used when replacing maxillary incisors. The mesial undercuts of the anterior teeth are used for retention. The rotational path has two paths of insertion. The first is a posterior tilt that allows the placement of the anterior retainers and denture base. The second path is closer to a horizontal tilt that places the posterior retainer (clasp) on a molar.

Confirm the tilt by using the "tripod marks"; these tripod marks must be registered (recorded) so the cast orientation can be reproduced at the area dental laboratory (ADL) for design transfer and blockout.

In the Air Force, we use tripod marks. To make tripod marks, lock the survey table at the desired tilt and adjust the spindle to a position that allows you to place three marks on the cast at the same vertical height in a wide triangle. Select immobile parts of the cast, like cingula and bony prominences, for the marks. The carbon rod makes *black* horizontal lines. A *red* vertical line is drawn through the black line and the cross is circled in *blue*.

### Surveying the cast

The RDP cast is then marked with the carbon rod on all accessible heights of contour. This mark is known as a survey line (fig. 1–21). A survey line is placed on all teeth as well as soft tissue areas. A high survey line is placed on the alveolar ridge and teeth, while the tip of the rod places a low line in the sulcus area. High and low survey lines on the cast's soft tissue identify desirable areas for approach arms and undesirable undercuts for blockout. Surveying the soft tissue area of an abutment tooth is necessary when using infrabulge retainers.

As shown in figures 1–22 and 1–23, the approach arm of the retainer must not be placed in an undercut.

With the survey lines marked, it is time to find the desirable undercuts for the clasp tips. The shaft of the appropriate undercut gauge is placed against the survey line and the lip of the gauge itself touches the exact location point of the bottom of the clasp tip (fig. 1–24). The location for the bottom of the clasp tip is indicated with a red pencil by drawing short horizontal and vertical lines backwards and upwards from the tip. When positioning clasps on the abutments of an edentulous area, converge or diverge the clasps for better retention. Clasps going in the same direction are less effective. These three clasps are shown in figure 1–25.

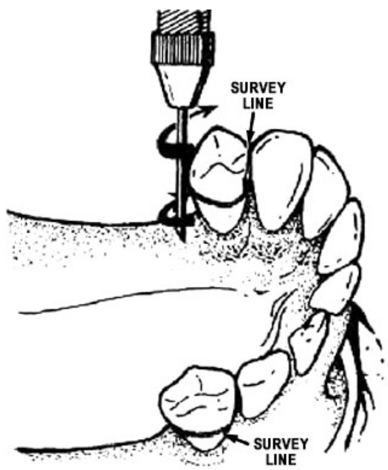


Figure 1–21. Marking a survey line.

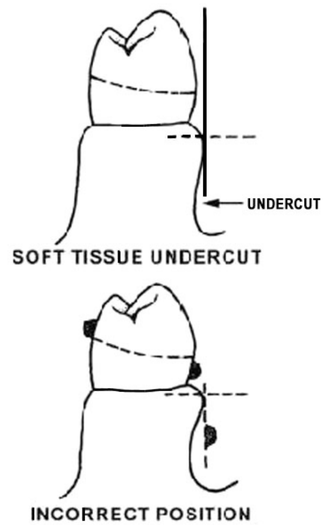


Figure 1–22. Unacceptable approach arm position.

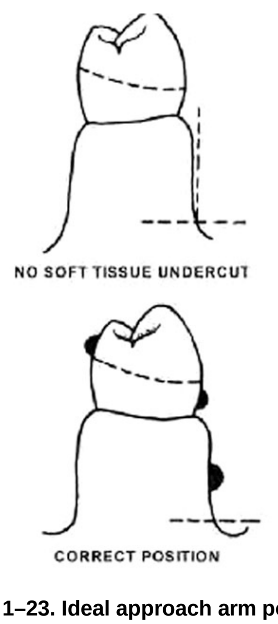


Figure 1–23. Ideal approach arm position.

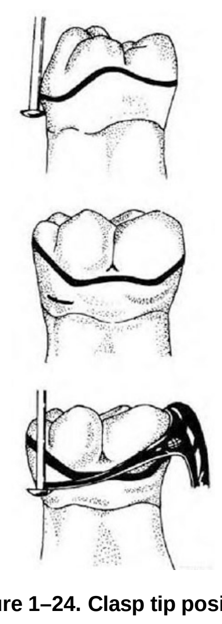

Figure 1–24. Clasp tip position.

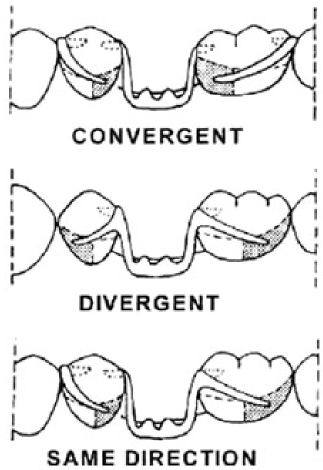


**Figure 1–25. Improving retention using convergence and divergence.**

There will be times when suitable undercuts are not present. Usually, the dentist can modify (recontour) the patient's teeth slightly to provide undercuts. In extreme cases, the tilt may even have to be changed. Other modifications to the patient's teeth include preparing rests, occlusal space for retainers, and guide planes. The planned modification is marked in red on the RDP cast.

### Drawing the design

Designing the cast requires the following four colored pencils:

1. *Black* indicates survey lines.
2. *Brown* indicates the metal framework.
3. *Blue* identifies the acrylic boundary.
4. *Red* identifies relief areas (areas to be reduced).

The first step of the design is to mark the rest areas in red. The clasps and reciprocal elements are then drawn in brown. The major connector is drawn next. Then the minor connectors are drawn.

It is important to remember that the design must be precise and easily understood. Each component must be drawn exactly where it is supposed to be. The principles learned in previous lessons must be applied in the design phase.

For example, circumferential clasps must encircle more than 180° of the tooth. Approach arms should not enter soft tissue undercuts. In addition, the gingival edge of the arm should be at least 3 mm away from the gingival crest of the abutment tooth. Major connectors should be drawn to allow maximum use of anatomical depressions. An understanding of component characteristics makes the design process easier.

## Self-Test Questions

**After you complete these questions, you may check your answers at the end of the unit.**

### 605. Dental surveyor

1. What are the uses of a dental surveyor?

2. What characteristic of the vertical spindle is necessary for an accurate survey?

3. How is the survey table used?

4. What tool determines the path of insertion?

5. What surveyor attachment measures the amount of undercut?

### 606. Surveying

1. Why should you occlude RDP diagnostic casts prior to performing the surveying?

2. What two basic tilts of the cast make up the path of insertion?

3. When surveying, what determines the AP tilt?

4. When is a rotational path of insertion recommended?

5. What is the purpose of making tripod marks?

6. How are tripod marks placed?

7. Why should you mark high- and low-survey lines on the cast's soft tissue?

8. In addition to modifications made to provide suitable undercuts, what other modifications to a patient's teeth can a dentist make when surveying a cast?

9. What color identifies the acrylic boundary?

# Answers to Self-Test Questions

### 601

1. The most posterior edentulous area of the dental arch.
2. Any edentulous area anterior to the most posterior edentulous area.
3. The anterior edentulous area must cross the midline to be classified as a Class IV.

### 602

1. It can rock side-to-side or back-to-front, destroying teeth and bone support.
2. By using occlusal rests, direct retention, and supporting tissues.
3. Kennedy Class I, II, and IV RDPs require tooth and tissue support for stabilization, while Class III requires only tooth support.
4. Because with this design, the clasp will act as a lever and actually lift the abutment tooth out of the socket.
5. Only when there is insufficient bone support for the abutment tooth.
6. To ensure stability of the RDP.

### 603

1. It unites all parts of the RDP, acting as a skeleton connecting one side of the partial to the other.
2. Its rigidity and resistance to torque.
3. At best, the connector is uncomfortable; at worst, the connector destroys teeth and the periodontium.
4. It allows tissue stimulation, patient’s salivation to be closer to normal, and the flavor, texture, and temperature of food are not inhibited.
5. It provides cross-arch strength and is less distracting to the patient’s tongue.
6. Both act to keep the RDP in position.
7. Bracing resists the horizontal movement of the RDP in the mouth. It is also useful for stabilizing periodontally weak teeth.
8. It should be passive until activated by a dislodging force.

### 604

1. It supports artificial teeth, improves the patient’s appearance by replacing the missing tissue, distributes occlusal stress, and stimulates supporting tissue.
2. It is transmitted to the abutment teeth.
3. The denture base covers as much of the edentulous ridge as possible to reduce and distribute the load over as wide an area as possible.
4. Thinness coupled with rigidity, cleanliness, and the ability to transmit temperature to tissue.
5. When there is insufficient space to place an artificial tooth.
6. A RDP patient with a severely resorbed ridge is not a good candidate for metal-based replacements.

### 605

1. Determines parallelism, location, amounts of undercut, and path of insertion. Is used for shaping blockout wax, carving wax crown patterns, placing precision perpendicular to the base attachments, and milling cast restorations.
2. It must be perpendicular to the horizontal base of the surveyor.
3. It orients the cast to the desired path of insertion and maintains the cast’s position throughout the survey.
4. An analyzing rod.
5. An undercut gauge.

### 606

1. To evaluate the vertical overlap, occlusion, ridge relationships, and space for rests and retainers.
2. AP tilt and the lateral tilt.
3. The tilt that creates the least amount of undesirable undercut.

4. When proximal retention is needed.
5. It registers the tilt so the cast orientation can be reproduced for design transfer and blockout procedures.
6. Place three marks on the cast at the same vertical height in a wide triangle. Select immobile parts of the cast, like cingula and bony prominences, for the marks.
7. To identify desirable areas for approach arms and undesirable undercuts for blockout.
8. These include preparing rests, occlusal space for retainers, desirable undercuts, and guide planes.
9. Blue.

**Complete the unit review exercises before going to the next unit.**

## Unit Review Exercises

**Note to Student:** Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

**Do not return your answer sheet to the Air Force Career Development Academy (AFCDA).**

1. (601) Identify the name of the classification system that categorizes information, which simplifies the removable dental prosthesis (RDP) design process.
   a. Shakespeare.
   b. Middleton.
   c. Kennedy.
   d. Culver.

2. (601) Select the classification class that has an edentulous area bounded anteriorly and posteriorly by abutment teeth and does not have a distal edentulous extension.
   a. I.
   b. II.
   c. III.
   d. IV.

3. (602) The type of major connector used for a Class I removable dental prosthesis (RDP) is determined by the
   a. amount of lingual undercut.
   b. shape of the patient’s palate.
   c. extent of the edentulous area.
   d. ridge resorption.

4. (603) Identify the framework component that unites all parts of the removable dental prosthesis (RDP).
   a. Major connector.
   b. Minor connector.
   c. Palatal strap.
   d. Lingual bar.

5. (603) Which major connector characteristic of a removable dental prosthesis (RDP) is designed to distribute stress throughout its framework?
   a. Rigidity.
   b. Flexibility.
   c. Ability to rotate about its axis.
   d. Ability to translate along its axis.

6. (603) Select the major connector that is used as a replacement for the anteroposterior (AP) palatal bar when tori are too extensive.
   a. Horseshoe.
   b. Full palatal.
   c. Lingual.
   d. Labial.

7. (603) Which major connector is 5 millimeters (mm) high and half pear shaped in the cross section?
   a. Anteroposterior palatal bar.
   b. Horseshoe connector.
   c. Full palatal plate.
   d. Lingual bar.

8. (603) Identify the framework components that are the connecting links between the major connector and other parts of the removable dental prosthesis (RDP).
   a. Sublingual bars.
   b. Minor connectors.
   c. Full palatal plates.
   d. Horseshoe connectors.

9. (603) What prevents the removable dental prosthesis (RDP) from moving toward the tissue?
   a. Bars.
   b. Rests.
   c. Connectors.
   d. Denture bases.

10. (603) Besides resisting the horizontal movement of the removable dental prosthesis (RDP), how else is bracing useful?
    a. As indirect retention.
    b. When reciprocation is not needed.
    c. For stabilizing periodontally weak teeth.
    d. To neutralize lateral RDP movement.

11. (603) What makes a round clasp more flexible than a half-round clasp?
    a. Moves in any direction.
    b. Can be used in deeper undercuts.
    c. Made of strong, but flexible polymer.
    d. Only requires an undercut of .001 inch.

12. (603) When using precision attachments, what must the abutment teeth have in order to improve the removable dental prosthesis (RDP) stability?
    a. Occlusal support.
    b. Periodontal support.
    c. Direct retention.
    d. Indirect retention.

13. (604) The denture base of a removable dental prosthesis (RDP) supports artificial teeth, replaces missing tissue, distributes occlusal stress, and
    a. cancels occlusal force.
    b. requires additional bracing.
    c. stimulates supporting tissue.
    d. restores the alveolar process.

14. (604) A denture base can be either metal or
    a. acrylic resin.
    b. plastic.
    c. triad.
    d. mesh.

15. (605) Aside from the survey table, what is another critical component of the dental surveyor?
    a. Analyzing rod.
    b. Carbon marker.
    c. Vertical spindle.
    d. Undercut gauge.

16. (605) What holds the cast and orients it to the desired path of insertion?
    a. Vertical spindle.
    b. Carbon marker.
    c. Survey table.
    d. Undercut gauge.

17. (605) What is the accuracy of the dental surveyor dependent upon?
    a. Path of insertion.
    b. Amount of undercut.
    c. Fixed position of the cast.
    d. Vertical spindle maintaining a two-degree tilt.

18. (605) The surveyor undercut gauges come in which sizes?
    a. 0.10, 0.15, 0.20, 0.30 inch.
    b. .010, .015, .020, .030 inch.
    c. 0.10, 0.15, 0.20, 0.30 millimeter (mm).
    d. .010, .015, .020, .030 mm.

19. (606) When evaluating a cast, what is the first step prior to fabrication of a removable dental prosthesis (RDP)?
    a. Draw the design.
    b. Articulate the casts.
    c. Classify the cast using the Kennedy system.
    d. Check the cast for anatomical problems.

20. (606) A rotational path of insertion is used when
    a. the appearance of the final removable dental prosthesis (RDP) is not important.
    b. a modified T-clasp is placed on a cuspid.
    c. intracoronal retainers are used.
    d. proximal retention is needed.

21. (606) Surveying the soft tissue area of an abutment tooth is necessary when
    a. using infrabulge retainers.
    b. using suprabulge retainers.
    c. determining the lingual border of the denture base retention.
    d. a reinforced acrylic pontic is to be placed next to the abutment.

22. (606) Identify the color that indicates the *acrylic boundary* when designing a cast.
    a. Black.
    b. Brown.
    c. Blue.
    d. Red.

23. (606) Select the color that identifies a *relief area* when designing a cast.
    a. Black.
    b. Brown.
    c. Blue.
    d. Red.

**Please read the unit menu for unit 2 and continue ➔**

# Student Notes

# Unit 2. Partial Removable Dental Prosthesis Construction



ONCE THE PRELIMINARY CAST is designed and the master cast is made, it is time to make the framework. Most bases will need to ship the master cast to the ADL to make the framework. Upon arrival at the ADL, the case will be assigned a case number and sent to the removable department for fabrication. Several technicians take part in this process. The manufacturing of the framework requires precise attention to detail.

## 2–1. Fabricating the Wax Pattern

The first part of making a framework requires extensive preparation. The casts must be duplicated and prepared for waxing. Then, the wax and plastic components must be adapted precisely according to the design.

### 607. Cast preparation for wax-up

Cast preparation involves several steps. The first thing you must do is determine the acceptability of the cast. The master and preliminary casts should be checked for voids, nodules, distortion, an undercut base, and whether or not the cast is identified. Framework-bearing areas should be free of voids and nodules. Comparing the preliminary and master casts for distortion must be accomplished. A caliper and ruler should be used to measure arch width, tooth width, and other easily distorted areas. The master cast base should be trimmed at a 90° angle, or taper slightly toward the top to avoid creating undercuts and better facilitate duplication. The casts should also be identified in some way to prevent confusion.

#### Master cast design transfer

When satisfied with the cast's acceptability, transfer the design from the preliminary cast to the master cast. Start by transferring the tripod marks from the preliminary cast to the master cast using a ruler and caliper to find the exact location. This allows you to establish the correct tilt and prepare the master cast for survey. The master cast should be surveyed *before* transferring the design.

After surveying the master cast, including the areas of soft tissue undercut, locate the retentive undercuts using the design (preliminary) cast. Measure the exact undercut needed and mark the tip area in red. Then, mark the rests in red and outline it in brown. Draw the rest of the framework outline in brown. If you question the design based on the survey of the master cast, bring it to the attention of the prescribing doctor.

#### Master cast blockout

Now that the master cast design matches the preliminary cast design, it is time to prepare the master cast for duplication. The blockout of undesirable undercuts as well as ledging and relieving the cast requires the preparation of the master cast for duplication. As you know, there are 0, 2, and 6° blockout tools for use with the dental surveyor. Special blockout wax is adapted to the master cast and carved to the desired angle, if any. It is important not to scrape the cast during this procedure. A slight scrape on an abutment may slow the framework try-in for the receiving dentist.

### *Ledging*

Once the master cast is blocked out, it is time to expose the red marks that locate areas for the retentive clasp tips (fig. 2–1). This is called ledging the cast. Ledging provides for proper placement of clasp tips. Carefully remove wax in this area, creating a 90° angle of wax to the tooth.

### *Relief*

The dentist should provide information on the tissue condition of the patient to perform the next step of the preparation. Relief wax is applied to specific areas of the master cast. This creates space between the ridge and the frame to protect the ridge and to allow for the acrylic to surround the metal when processing. The amount of relief depends on the extent of the rotation possible for an edentulous distal extension RDP. A tooth-borne RDP does not need relief. On the other hand, an RDP with a long distal extension area needs more relief under the major connector. A sloping ridge (fig. 2–2, B) will also need more relief than a steep ridge (fig. 2–2, A). The final factor is tissue mobility. The more mobile tissue there is the great the need for more relief. The minimum amount of relief is a flash of wax on the cast, or a thicker relief of 28- or 30-gauge sheet wax may be used.

Relief wax is also applied to the denture base area. A tissue stop is cut into the relief wax of distal extensions. The resulting metal tissue stop prevents framework movement during packing. The final step is to carve a beadline on the borders of the major connector of maxillary RDP casts. The bead is a maximum of 1 mm deep. The beadline prevents debris from lodging between the RDP and soft tissue.

Sprue cones are added prior to duplication of the master cast. The A cone shown in figure 2–3 is used on flat surfaces. The D cone is used on slanted surfaces. The B and C cones are used when duplicating and spruing.

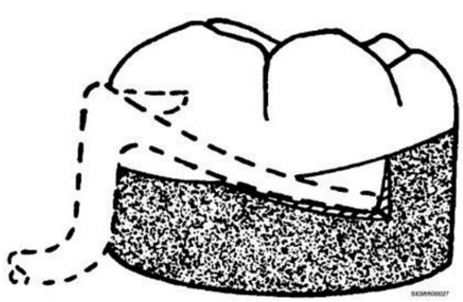

**Figure 2–1. Ledged abutment tooth in relation to a retentive tip.**

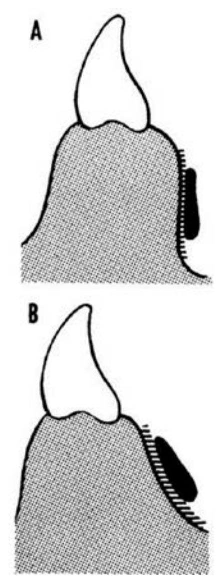


**Figure 2–2. Comparison of relief amount of a steep ridge and a sloping ridge.**

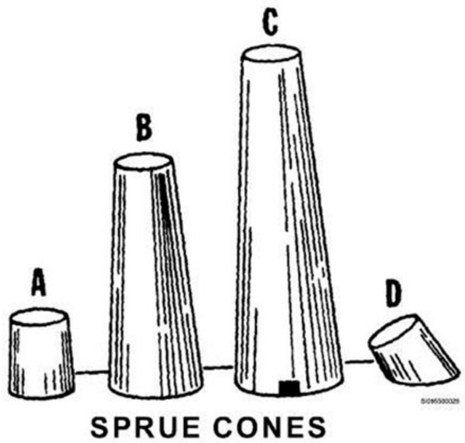


**Figure 2–3. Sprue cones.**

Some problems, probable causes, and solutions usually found in these procedures are shown table 2–1.

| Problem-Solving Chart for Design Transfer, Blockout, Relief, and Ledging | | |
|---|---|---|
| **Problem** | **Probable Cause** | **Solution** |
| Framework fits too tightly or will not seat completely. | Blockout incomplete, framework component engaged a hard tissue undercut. | Completely blockout all undesirable undercuts. |
| Frame is too retentive. | Clasp tip placed too deeply into undercut—usually caused by incorrect ledging. | Use undercut gauge to accurately measure depth of undercut; trim ledging to proper place and level. |
| Duplicating material torn when master cast is removed. | Undesirable undercuts not eliminated on master cast. | Completely blockout all undesirable undercuts. |
| Lingual bar impinges on soft tissue. | Relief wax not placed on cast under lingual bar design. | Place appropriate gauge relief wax on master cast—distal extension RDP may require more relief. |
| Framework beading impinges on soft tissue-causes blanching. | Cast beading too deep. | Beading depth should not exceed 1.0 mm in depth. |

**Table 2–1. Problem-Solving Chart for Design Transfer, Blockout, Relief, and Ledging. (Reproduced with permission from C.V. Mosby Company.)**

## Master cast duplication

To duplicate the master cast, an impression must first be created. Soak the master cast using the capillary method in 90° Fahrenheit (F) saturated calcium sulfate dihydrate solution (SDS) water for at least two hours. Then, secure the cast to the base of the duplicating flask with modeling clay or use a vacuum soak. Next, assemble the flask and ensure that the seal is tight. Then, pour the duplicating medium, reversible hydrocolloid, slowly into the flask. After cooling the base of the flask in circulating water, disassemble the flask and remove the cast straight up to prevent tearing. Check the impression for torn areas, and remove any debris that may have fallen into the impression.

## Refractory cast

The refractory cast is made from a high heat investment. Remember, “investment” is the gypsum material used to enclose a denture wax pattern in the flask, forming a mold. Follow the manufacturer’s directions when making the refractory cast. Place the B sprue cone in the impression and pour the investment into the impression. Do not pour a wash of investment or over vibrate the mold because this may distort the hydrocolloid.

Remove the refractory cast from the hydrocolloid. Trim the cast at an angle so it is at least one-fourth inch from the proposed pattern. You can trim the cast with a knife, or a wet or dry model trimmer. Be sure not to touch the pattern-bearing area of the cast. Remove any debris prior to sealing the cast. The refractory cast may be sealed with either a commercial model spray or dipped in beeswax. The refractory cast must be dehydrated before immersing it in heated beeswax.

### Duplicate master cast

While the refractory is being made, a duplicate master cast needs to be constructed. Duplicate master casts are used to test fit the metal framework. Touch up the blockout and relief wax, remove the sprue cone and repeat the duplication procedure. Pour the duplicate master cast with a dental stone. Problems, causes, and solutions encountered in these procedures are shown in table 2–2.

| Problem-solving Chart for Duplication and Investment Cast | | |
|---|---|---|
| **Problem** | **Probable Cause** | **Solution** |
| Cast surface detail is poor. | Cast surface was too cool when colloid contacted surface causing colloid to prematurely gel.<br>Pouring temperature of colloid below recommended level. | Soak casts in a SDS maintained at 90°F. |
| Cast surface shows relief and blockout wax was distorted. | Pouring temperature of colloid is too hot. | Set colloid to manufacturer's temperature usually 135-140°F. |
| Mold damaged when master cast is removed. | Blockout on master cast inadequate. | Inspect blockout to ensure all undesirable undercuts are eliminated. |
| Framework does not fit master cast. | Refractory cast abraded by improper handling. | Avoid touching design areas. |
| | Model cooled too quickly. | Regulate water level (to contact the flask base only) and temperature (55°F) in cooling tank. |
| | Incorrect water-powder ratio used for investment cast. | Use 29 cubic centimeters (cc) distilled water (room temperature) per 100 grain (gr) of powder. |
| | Colloid contaminated. | Evaluate colloid for contaminates or over-use; replace as necessary. |
| Components are misplaced on master cast. | Design transferred improperly. | Carefully follow master cast design, pay close attention to anatomical landmarks. |

**Table 2–2. Problem-solving Chart for Duplication and Investment Cast.**
**(Reproduced with permission from C.V. Mosby Company.)**

## 608. Waxing the framework pattern

Waxing the framework pattern is a critical procedure. What you do or do not do in the wax will be reproduced in metal. A properly waxed framework will reduce subsequent processing time.

### Design transfer

Usually, the refractory cast does not need to be surveyed when transferring the design from the master cast. The metal framework (brown) portion of the design is outlined on the refractory cast with a wax pencil. Never use a graphite pencil on the refractory. An ordinary graphite pencil leaves particles that cause pits in the casting. Follow landmarks like blockout and ledging to guide the outline. Ensure the upper border of the lingual plate, if any, is drawn above the survey line. If the line is drawn below the survey line and on the blockout, then a space will exist between the plating and cast.

### Waxing sequence

Freehand waxing combined with the use of plastic patterns is the most often used method of fabrication. Tacky liquid, made from plastic patterns dissolved in acetone, is painted on the pattern and placed carefully on the cast. Extra care is needed to prevent distorting the patterns. Also, tacky liquid application is critical since sloppy application of tacky liquid causes fins on the casting. The patterns are trimmed and waxed in freehand to provide the desired contour.

Wax is applied freehand to the borders and beadline of the major connector. A flash of wax is added to the major connector area to reinforce the connector. The major connector sheet is then applied to the cast. The sheet should not trap air and should be sealed at edges to prevent investment from entering under the pattern. The denture base retention areas and finish lines are then constructed, followed by the clasps, rests, and minor connectors. It is wise to use a minute drop of wax to seal the clasp tip in place.

### Reinforced acrylic pontics

If the design requires RAP or tube teeth, they are placed during the construction of the framework pattern. Appropriate teeth are selected and carefully adapted to the master cast. When possible, use square teeth for RAPs since they fill the gingival embrasures better than other tooth contours. Create a stone matrix of the incisal edges of the denture tooth and adjacent teeth so the pontic (denture tooth) can be repositioned on the refractory cast. A box preparation is made in the lingual of anterior teeth. The proximal portions are left intact. Figure 2–4 gives a proximal view of a RAP. Notice the placement, height, and configuration of the backing. Also, notice the location of the finish line approximates the natural lingual anatomy of a tooth.

#### *Tube teeth*

Select a posterior denture tooth and adapt it to the ridge. Create a ledge around the base of the denture tooth that will form a butt joint and finish line with the metal base (fig. 2–5). Drill a “tube” into the tooth to receive the post.

Lubricate the tube tooth; position it using the matrix; and flow wax into the preparation. Remove the tooth when the wax cools.

#### *Braided post*

A simpler posterior tooth replacement is the braided post retention. A 20-gauge rope wax is twisted together and placed in the center of the edentulous area. The tooth is adapted to the framework at the receiving lab (fig. 2–6).

#### *Wrought wire clasps*

Other modifications are also made to the framework pattern besides adapting teeth. A wrought wire clasp may be added to the framework by either the cast-to or the solder method. For the cast-to method, the wire is bent and waxed into the framework (fig. 2–7). The bends in the wire provide mechanical retention within the cast framework. For the solder method, the wire can be soldered to the minor connector or retention area after casting the framework. To prepare the wax-up minor connector for soldering, wax the wire in position, then remove it. This leaves a slot below the occlusal rest.

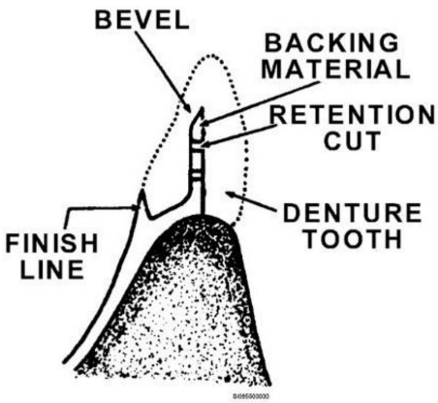


Figure 2–4. Proximal view of a RAP.

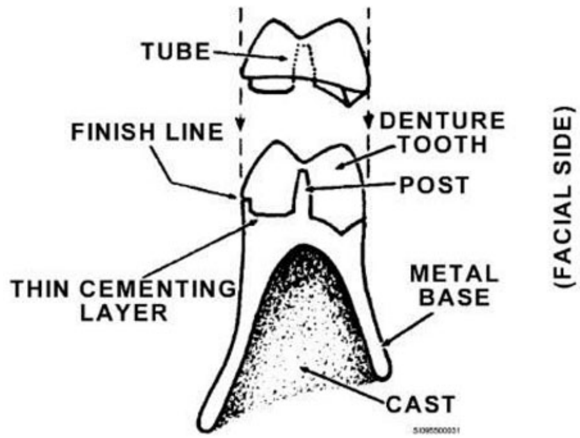


Figure 2–5. Proximal view of a tube tooth.

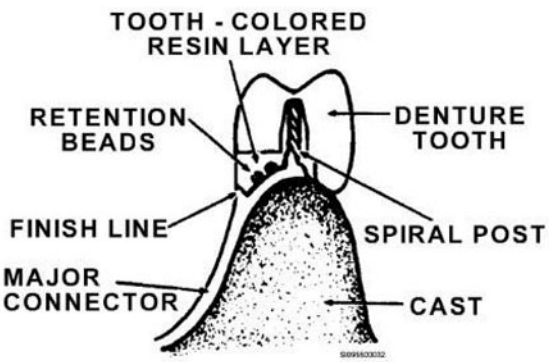


Figure 2–6. Proximal view of a spiral retention post.

Figure 2–7. Wrought wire placement for the cast-to method.

## Waxing principles

The dentist's design must be followed to make a RDP framework. Not every detail is provided in the design; however, careful waxing and adherence to the following principles will help ensure a successful framework.

### *Finish lines*

Finish lines have two requirements:

1. Have a defined leading edge.
2. Be properly positioned.

The finish line should not obstruct tooth placement or be too lingual. The external finish line cannot, under any circumstances, be placed directly over the internal finish line as shown in figure 2–8, A.

As illustrated, placing the external finish line directly over the internal finish line will probably result in the retention area breaking away from the framework. Correct placement of the external finish line is illustrated in figure 2–8, B and C.

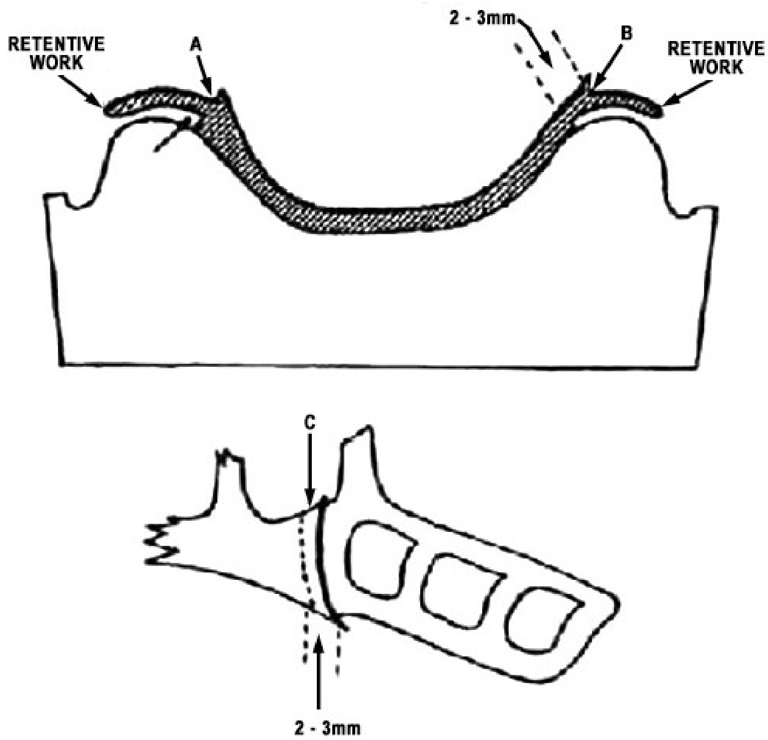


**Figure 2–8. Placement of an external line in relation to the internal finish line: incorrect placement (A); correct placement (B) and (C).**

### *Denture base retention*

Usually, the simpler the denture base retention is, the better the finished framework. The retentive network design in figure 2–9, A is better than the network in 2–9, B. Open grid retention shown in A allows acrylic to flow around the metal. Teeth may also be set between the grids if there is lack of space. When waxing, flare and round the areas of the open retention. Figure 2–9, C is an example of sharp corners in open retention that could cause denture base fractures. Since the framework is made of delicate wax and plastic patterns, distortion is a serious problem. Excessive heat or pressure could result in distortion.

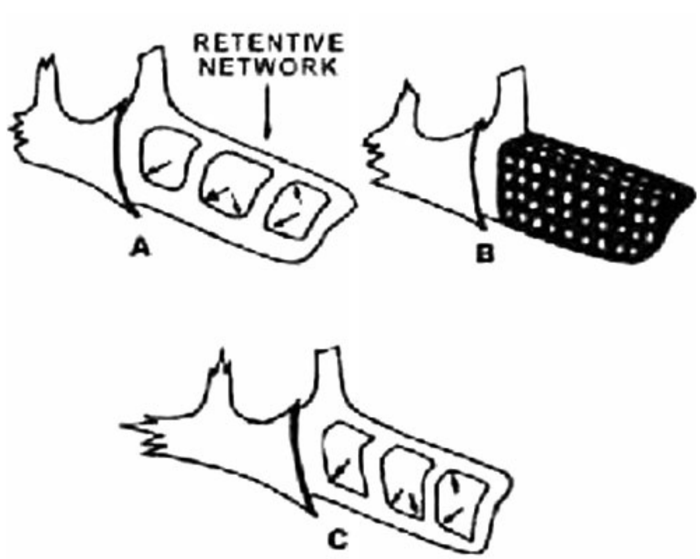


**Figure 2–9. Comparison of open retention (A) to mesh retention (B) (C) is an example of sharp angles in the open retention.**

Figure 2–10, A illustrates undesirable thinning over the eminence and rugae. Figure 2–10, B illustrates the proper contour for these areas.

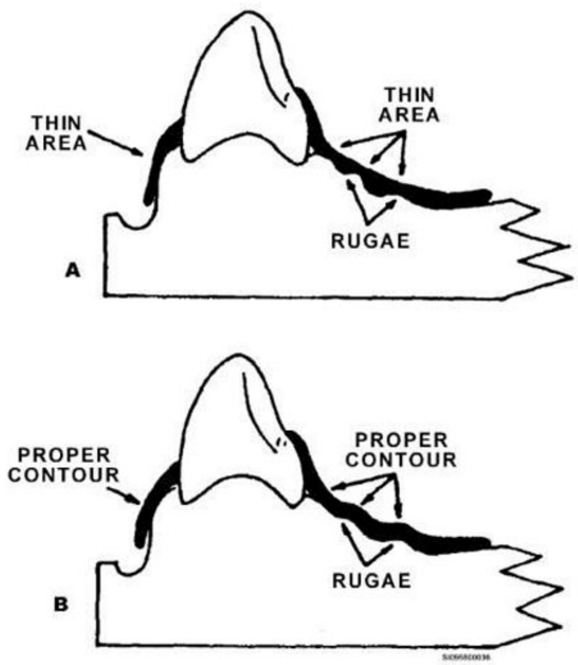


**Figure 2–10. Improper contour (A) and proper contour (B).**

Some problems, probable causes, and solutions usually found in these waxing procedures are shown in table 2–3.

| Problem-solving Chart for Waxing | | |
|---|---|---|
| **Problem** | **Probable Cause** | **Solution** |
| Major connector thin in some areas. | Stipple sheet or casting wax thinned by excessive finger pressure.<br>Thickness of pattern reduced when smoothing wax. | Avoid excessive pressure when applying stipple or sheet casting wax.<br>Take care when smoothing—maintain original detail. |
| Space exists between upper border of lingual plate and teeth. | Pattern not extended beyond blockout area (above survey line) on refractory cast.<br>Blockout wax placed too high. | Transfer design and verify pattern extends 0.5 mm above survey line.<br>Carefully trim blockout wax to survey line. |
| Lingual of denture base overbulked or under contoured. | External finish lines improperly placed. | Allow enough room for contouring acrylic resin and denture teeth. |
| Interproximal display of metal on either side of a RAP. | Proximal reduction of facing carried too far labially. | Carefully adapt the proximal and ridgelap areas of the acrylic teeth to the space. |
| Inability to remove stone matrix from master cast. | Stone locked in undercut(s) and/or lack of adequate separator. | Apply proper type and amount of separator. Avoid undercuts when constructing matrix. |

| Problem-solving Chart for Waxing | | |
|---|---|---|
| **Problem** | **Probable Cause** | **Solution** |
| Matrix does not fit refractory cast. | Matrix extends into blocked out area. | Trim contact areas until matrix seats completely. |
| Components are misplaced. | Design not transferred correctly. | Carefully follow brown pencil line. |
| Flash of metal on clasp arms or components. | Wax not trimmed or too much tacky liquid used. | Refine wax pattern; use tacky liquid sparingly. |
| Tissue side of casting has irregular surface. | Preformed patterns not completely adapted to cast surface-allowed investment to seep between pattern and refractory cast. | Carefully apply each component, securing it to the refractory cast. |

**Table 2–3. Problem-solving Chart for Waxing.**
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## Self-Test Questions

**After you complete these questions, you may check your answers at the end of the unit.**

### 607. Cast preparation for wax-up

1. What are some problems you should look for when evaluating the master cast?

2. Why should the master cast be trimmed to a 90° angle or tapered slightly toward the top?

3. Why are the tripod marks transferred first?

4. What purpose does ledging serve?

5. What material is normally used to duplicate a master cast?

6. What are two methods of sealing a refractory cast?

7. What is the purpose of making a duplicate master cast?

8. What issue results when the RDP design is transferred improperly?

### 608. Waxing the framework pattern

1. Why is it necessary to use a wax pencil instead of a lead pencil to transfer the design from the master cast to the refractory cast?

2. What could cause a space between the upper border of a lingual plate and the cast?

3. Why should you be especially cautious when using tacky liquid?

4. Why are square teeth, when possible, selected for RAPs?

5. How is a spiral post retention post fabricated?

6. What preparation of the minor connector is needed prior to soldering a wrought wire clasp?

7. What are the two requirements of a finish line?

## 2–2. Processing the Framework Pattern

After completing the wax pattern, it is time to process it. Processing involves spruing, investing, burnout, casting, and finishing the framework. How well you waxed the framework will directly affect the success of the processing. This section explains how to cast and finish the framework.

### 609. Casting the framework

To arrive at a functional metal framework, you must proceed with the steps leading to the actual casting process. This lesson will help you understand why these procedures are done to such an exact degree.

#### Spruing

Always sprue to the bulky section of the pattern. The ideal partial denture wax-up gets progressively smaller in volume from the point of attachment. The ideal partial denture is not always possible. Sometimes there may be a bulky pontic or large clasp arms isolated by a thin section. This requires an auxiliary sprue to feed the molten metal to this section.

The main sprue is the reservoir and the bulkiest section of the casting. Metal in this area stays molten longer than the thinner sections. The sprue supplies molten metal to offset the shrinkage during solidification. The area, where the sprue lead is attached, is always the least dimensionally accurate section of the casting. This is due to the metal shrinkage in this area.

Sprues should be thinned and flattened out at the point of attachment to force the metal into the mold under pressure. Check the attachment site for sharp angles and eliminate them when present.

Investment will fill the angle, creating a sharp-angled corner. Later, the flow of molten metal will break off the corner and carry it into the casting. Take the extra time to seal completely around the sprue attachment. Both sides of the sprue cone should also be sealed with wax. This prevents investment particles from breaking off and causing pits in the casting.

Most RDPs are sprued using the overjet principle. The overjet method of spruing differs from other methods by attaching the sprue leads 4.5 mm below the top of the sprue cone. Figure 2–11 is a cross-section of a cast with an overjet sprue. The initial thrust of the molten metal is directed against the tip of the main sprue reservoir. This creates turbulence at the top of the sprue rather than at the entrance to the pattern.

Overjet spruing has the following advantages:

- The casting is denser.
- The tip of the main sprue collects loose particles, preventing them from entering the mold.
- The main sprue remains molten longer allowing access to more molten metal during solidification.
- The scuffing effect of the molten metal is moved away from the mold entrance and occurs instead at the tip of the sprue reservoir.

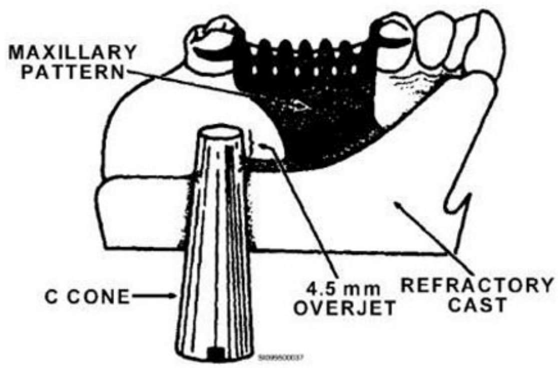


**Figure 2–11. Overjet spruing.**

Figure 2–12, A, B, and C, illustrates three types of overjet spruing. Notice the main sprues do not feed directly into a large component. This reduces the chance of turbulence within the mold. Figure 2–12, C also shows the use of auxiliary sprues with bulky clasp assemblies that are isolated by a thin section.

Another spruing technique is used for RDPs with full palates and metal denture bases. As you can see in Figure 2–13, it is not possible to place a sprue cone in the center of the cast. A wedge-shaped sprue is attached to either the anterior or posterior border of the pattern.

The sprue must be attached to the bulkiest section and fanned out. Notice the 8-gauge round wax exiting the sprue and attaching to the bottom of the cast. This is used to prevent the wedge sprue from breaking off during investing.

Once the pattern is sprued, select the size of the metal ingot. The following factors are evaluated to determine the ingot size:

- Number of sprue leads.
- The size of the framework.
- Number of metal teeth or backings.
- The thickness and width of the components.

This information is then compared to the manufacturer’s conversion chart (provided with your casting system) to discern the correct ingot size.

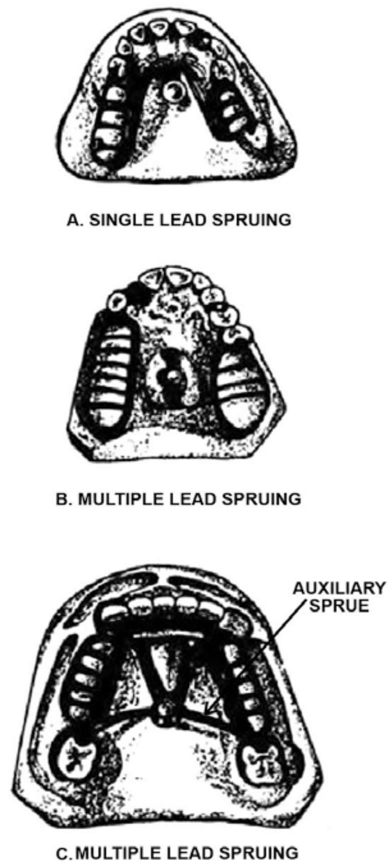


**Figure 2–12. Three types of overjet spruing.**


**Figure 2–13. Wedge spruing.**

## Investing

There are three stages to investing a RDP pattern. The first stage is the "paint-on" of the initial layer of investment. The second stage is placing the RDP pattern into the outer investment. The third stage is facing off the mold surface and removing the flask former. Let's look at three stages of investing.

### *Paint-on*

The ingot size is marked on a wet paper towel placed under the flask. This identifies the ingot requirement and seals the investment in the flask. A surface tension reducer, or wetting agent, is applied to the pattern with the excess blown off. The initial paint-on layer is hand mixed or mechanically spatulated with vacuum. While gently vibrating the brush hand, paint a 2-3 mm uniform layer of investment all over the pattern. Uniformity is necessary for even expansion of the investment. More important, a thin layer allows gases to escape during burnout. A thick paint-on layer creates casting voids or short clasp arms.

### *Outer investment*

Once the paint-on reaches its final set, about 15 minutes, you must select a flask. A 6 to 12 mm clearance between the flask and cast is required. The outer investment is mixed with a straight-bladed mixer to ensure the mix is porous. Porosity ensures gases will escape. Fill the flask three-quarters full with the outer investment. Wet the cast, remove the excess water, and slowly place the cast to within 6 mm of the bottom of the investment. Position the sprues toward the seam. This ensures the thinnest, lightest parts of the casting are farthest from the seam and that the centrifugal force of the casting machine will aid the flow of metal. Main sprues are placed toward the seam. If there are more than two main sprues, then they are placed at equal spacing toward the seam. Orienting the sprue toward the seam also ensures all of the castings are made in the same relative position.

### *Facing-off*

The sprue cone is removed following the final set of the outer investment. The mold is then faced off against a screen or model trimmer wheel until reaching the flask former. Remove the flask former and rinse any loose investment particles from the sprue hole. Then, mark the ingot size in rouge on the bottom of the flask. Spruing and investing are relatively simple but can have some problem areas, like nodules and fins on a casting. Fins and nodules can be caused by air trapped during paint-on and by not using a surface tension reducer on the pattern. Other possible problems, probable causes, and solutions are shown in table 2–4.

| **Problem-solving Chart for Spruing and Investing** | | |
|---|---|---|
| **Problem** | **Probable Cause** | **Solution** |
| Incomplete casting. | Some cases require multiple or auxiliary sprues. | Use double main sprues for anterior-posterior palatal bar, lingual bar with Kennedy bar.<br>Auxiliary sprues used on large pontics or isolated components. |
| | Paint-on investment too thick or outer investment was vacuum mixed. | Apply investment uniformly; do not exceed 3 mm thickness.<br>Hand spatulate outer investment to maintain porosity. |
| Porosity incasting. | Improper spruing techniques. | Sprue to bulky part of pattern. |
| Investment particles incasting. | Sprue leads not properly joined to sprue cones or pattern. | Sprue attachment should be smooth, rounded, and without sharp edges. |
| | Particles of investment left in sprue hole after investing. | Rinse loose investment out of sprue hole after trimming. |

| Problem-solving Chart for Spruing and Investing | | |
|---|---|---|
| **Problem** | **Probable Cause** | **Solution** |
| Nodules and fins on casting. | Air trapped during paint-on of investment.<br>Surface tension reducer was not used on pattern. | Allow investment to flow ahead of brush; do not push the investment into place.<br>Dip waxed refractory in Ti-Sol and blow off excess. |
| Casting will not seat on master casts. | Improper water-investment ratio<br>Improper blockout technique. | Use 29 cc distilled water at room temperature with 100 gr of investment.<br>Use surveyor to trim blockout wax to prescribed angle. |

**Table 2–4. Problem-solving Chart for Spruing and Investing.**
**(Reproduced with permission from C.V. Mosby Company.)**

## Casting

All metals shrink during solidification. Ticonium alloy shrinks 1.7 percent by volume when cooling. This shrinkage is compensated for by the setting and thermal expansion of the investment. Whether or not proper expansion takes place depends on how the investment is handled. Follow the manufacturer's directions explicitly. The burnout procedure provides the thermal expansion. There are three objectives of the burnout:

1. Eliminate the wax and plastic patterns.
2. Provide thermal expansion of the mold.
3. Heat the mold to prepare it to receive the molten metal.

Molds should be soaked prior to being loaded in the oven to create steam during burnout and to have uniform expansion. A dry mold will crack when heated. Load the mold's sprue hole down to ensure that wax is quickly eliminated from the mold. If two layers of molds are needed, stagger the molds so they heat uniformly. Place the molds with the seams all in one direction to speed loading the casting machine.

Recommended burnout procedure is to raise the oven temperature to 1,350°F in two to three hours from room temperature. After the oven reaches 1,350°F, a mold containing all wax components heat soaks for one hour. Molds containing plastic patterns heat soak for two hours. Most burnout procedures are performed overnight to save time.

The casting is done with an automatic casting machine. This machine uniformly melts the alloy and reduces the chance for human error. The machine is balanced with a dummy flask of the same size of the mold to be cast. The machine is started and the correct size ingot for the mold is placed in the crucible. The mold is loaded in the casting machine with the sprue hole at the two o'clock position. This eliminates the need to exactly center the sprue when investing. The correct procedures for operating the casting machine must be followed to ensure safety and a complete casting. Some problems, probable causes, and their solutions are shown in table 2–5.

| Problem-solving Chart for Burnout and Casting | | |
|---|---|---|
| **Problem** | **Probable Cause** | **Solution** |
| Cracks in mold during burnout. | Investment mold too dry when placed in oven.<br>Burnout temperature increased too rapidly. | Place each mold in plastic bag containing moisture to prevent investment from drying out.<br>Allow a 2–3 hour "warm-up" for the burnout oven. |

| | | |
|---|---|---|
| Portions of framework did not cast. | Metal too cold when cast.<br>Paint-on too thick. | Conduct practice casting to check for adequate heating. Make adjustments if possible.<br>Ensure paint-on is applied uniformly at 2-3 mm thick. |
| Pitted and discolored casting. | Investment overheated Metal too hot. | Begin burnout cycle in cold oven and increase temperature gradually to 1,350°F.<br>Conduct practice casting to check for adequate heating. Make adjustments if possible. |
| Pits. | Dirty wax used that contains debris.<br>Sprue hole not rinsed out (debris left inside). | Remove debris from wax-up Thoroughly rinse out sprue hole. |
| Miscast. | Sprue hole placed in wrong position. | Adjust the height of the flask until the sprue hole is just above the centerline at the 2 o'clock position. |
| Short clasps or rests. | Paint-on too thick. | Ensure paint-on is applied 2-3 mm thick. |

**Table 2–5. Problem-solving Chart for Burnout and Casting.**
**(Reproduced with permission from C.V. Mosby Company.)**

## 610. Finishing the framework

It is amazing how an experienced finisher can transform a dull, rough looking piece of metal into a sparkling smooth work of art.

It is equally amazing how a careless technician can damage a framework. A systematic approach that allows for delicate finishing procedures produces a quality framework.

Before you can finish the framework, you must remove it from the investment. Allow the mold to bench cool 30 minutes and then remove the outer investment by tapping it with a hammer or knife. Grasp the main sprue with pliers and gently tap the pliers until the paint-on layer is removed. Tapping the pliers, rather than the sprue, reduces the risk of the framework breaking away from the sprue and distorting when the framework hits the bench.

Next, sandblast the framework to remove investment residue and surface oxides. Be sure to sandblast the inside of the clasps and rests, as well as the tissue side of the major connector. Inspect the casting for residue and dark oxide spots. Failure to remove these flaws will interfere with polishing.

### Finishing

Finishing chrome alloys requires a high-speed lathe, 24,000 rotations per minute (rpm). However, a precaution before using the high-speed lathe, you need to review all technical and safety procedures. The following are just some of the safety precautions you should practice:

- Make sure the mandrels run true.
- Use a truing stone on points and wheels.
- Let the finishing abrasive and speed of the lathe do the cutting.
- *Always* work with the guard down and with a functioning exhaust hookup.
- Be sure each finishing operation removes all scratches caused by the preceding abrasive.

- Ensure mandrels are seated deep within the collet. An overextended mandrel could bend or break, damaging not only the framework but also harm you.
- Avoid heavy pressure. Heavy pressure will heat the work, warp the casting, cause slow cutting by crushing the abrasive particles, and cause the abrasive to clog and glaze.

Begin by removing the sprue with a separating disc (fig. 2–14). A small disc can be used to cut auxiliary sprues and refine external finish lines. Figure 2–15 shows shaping the attachment site and rough finishing with a heatless stone bur. The rest of the finishing is done with color-coded stone burs. Each shape has a coarse and fine abrasive for use by the technician.

Begin with a Number (No.) 205 barrel stone bur and progress to smaller stones to grind "hard-to-reach" spots (fig. 2–16). Training and experience dictate which stones to use. Stone burs can be shaped with a truing stone to meet individual needs. Never rough-finish metal that contacts soft tissue. Also, finish the clasps separately since they require extra attention.

Clasp assemblies are made to fit precisely in an undercut with a predetermined amount of flexibility. Over finishing will reduce clasp strength and retention. Using a No. 203 with tapered stone bur (fig. 2–17), gently clean the clasp interior. Do not remove a large amount of metal. The objective is to diminish the amount of "rubbering" to be done later.

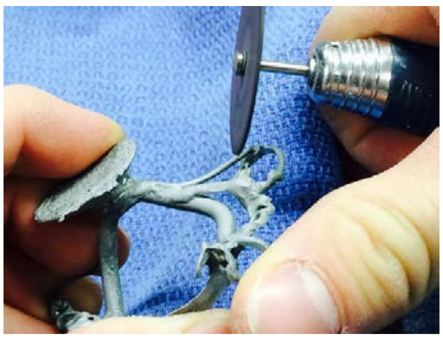

**Figure 2–14. Sprue removal with disc.**

**Figure 2–15. Shaping the attachment site with heatless stone.**

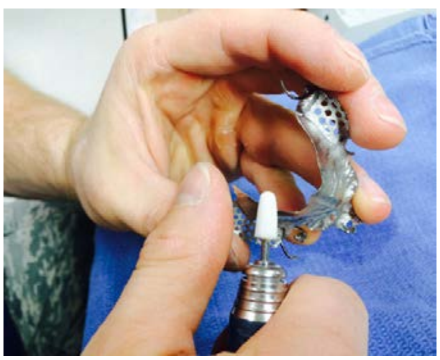

**Figure 2–16. Rough finishing the framework with barrel stone.**

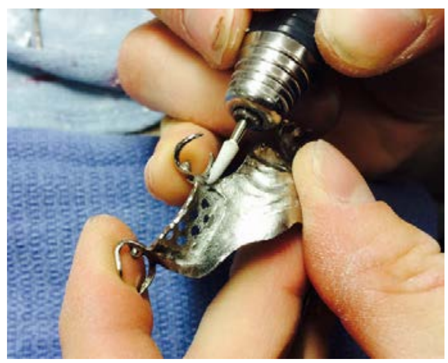

**Figure 2–17. Finishing with tapered stone.**

## Polishing

After you have shaped the casting and completed the rough finishing, you are ready to polish the casting. Normally, polishing is divided into three areas:

1. Electropolishing.
2. Rubbering.
3. Buffing.

### *Electropolishing*

Electropolishing is the opposite of electroplating. A layer of metal is removed from the framework by an electric current carried by an electrolyte solution. Only the rugae and tissue bearing areas need electropolishing, but some technicians prefer to treat the entire casting. This ensures the entire casting is equally bright.

Prepare the casting by first sandblasting the entire casting. Pay extra attention to the inside of clasps and underneath rests. Then, rinse the casting in water to remove any sand that could contaminate the electrolyte solution. Finally, dry the casting to prevent water from contaminating the solution and depositing a brown film on the casting.

To electropolish, select the correct solution and heat it to 120 to 140°F. Use a pan of warm water or the electropolisher heater. Stir the solution and monitor the temperature at the same depth the casting will be placed. Large cases, such as full palates, large horseshoes, and deep-vaulted palates will polish better in a cooler (120°F) solution.

Remove the solution from the heater and attach the cathode clip to the terminal tab of the cathode ring (fig. 2–18). Attach the anode to the casting and place in the solution. Prevent clip erosion by only submerging the casting to cover the tip of the clip. Center the casting and do not let it touch the cathode ring. Start the electropolisher and adjust the amperage. Usually two amperes per square inch of RDP framework is sufficient. Electropolish the casting for six minutes. Reverse the position of large castings in the solution after three minutes.

After electropolishing, release the casting from the anode clip into a bowl of water and sodium bicarbonate to neutralize the acid. Rinse the anode clip with water and allow the assembly to dry. Inspect the casting to be sure the process was complete.

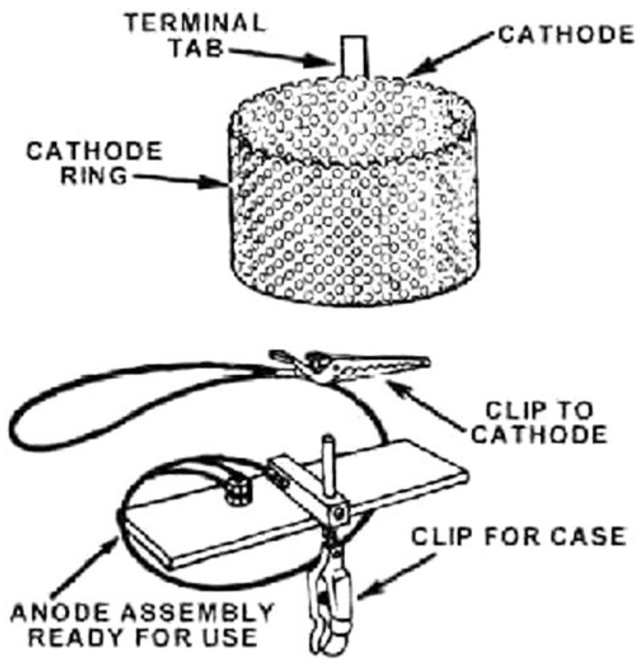


**Figure 2–18. Anode assembly and cathode ring.**

Some problems, probable causes, and solutions are shown in table 2–6.

| Problem-solving Chart for Electropolishing | | |
|---|---|---|
| **Problem** | **Probable Cause** | **Solution** |
| Framework whitens but does not shine. | Solution too cold.<br>Solution contaminated with residue Polishing time too short.<br>Amperage too low. | Warm the solution.<br>Change the solution.<br>Increase electropolishing time or increase amperage. |
| Framework etched. | Solution too hot.<br>Electropolishing time too long.<br>Amperage too high. | Stir solution to help cool.<br>Decrease electropolishing time.<br>Decrease amperage. |
| Uneven polish. | Framework not centered in ring.<br>Incomplete sandblasting.<br>Frame contaminate with residue from sandblaster or oil from compressor or fingers.<br>Clamp teeth worn. | Center framework.<br>Completely sandblast.<br>Do not touch frame with uncovered fingers<br>Replace worn parts. |
| Framework is dark yellow or brown. | Water in solution. | Change solution and ensure frame is dry before electropolishing. |
| Framework is black. | Solution too hot. | Use cooler solution. |

**Table 2–6. Problem-solving Chart for Electropolishing.**
**(Reproduced with permission from C.V. Mosby Company.)**

### *Rubbering*

The next step is "rubbering" the framework to remove scratches caused by the rough finishing. Begin on the connectors with a rubber wheel to smooth all accessible areas. Then, use a knife-edge rubber wheel or a rubber point to smooth hard-to-reach areas (fig. 2–19 and fig. 2–20). Rubber the tissue areas and rugae only enough to smooth any roughness. Use long smooth strokes when rubbering. Short strokes or "jumping" creates ripples that ruin the final polish. Long strokes make a smooth ripple free surface that is easily polished. Ripples may cause discomfort to the patient. Keep a point on the rubber point when rubbering lingual plating. This will maintain the plating's lingual anatomy.

While rubbering the framework, you may find a rough area that is difficult to remove with a rubber point. Remove the roughness by stoning the rough area. Going back to stoning the area will save time in the long run. Attempting to rubber out the rough area could create a flat spot or ripple.

Rests are relatively simple to smooth. Each one should completely fill the rest seat, but it should not overflow the prepared area. The junction should be smooth without ledges or depressions. The area underneath the occlusal rest and guide plane can be smoothed out with the hollowed-out end of a rubber point. Figure 2–21 shows how the end of a rubber point can be hollowed out by holding a knife tip against the end while it is turning.

Clasps, however, are a different story. Be very careful when rubbering a clasp. Too much rubbering can ruin the taper of a clasp and weaken it. The decision to rubber the clasp interior depends on the roughness of the clasp, whether nodules were removed by stoning, and the dentist's preferences. The clasp interior should be smooth to prevent scratching tooth enamel. If smoothing is needed, use a rubber point.

After rubbering is complete, test fit the framework on a duplicate cast. This prevents damage to the master cast while adjusting the framework. Closely inspect the tissue side of the framework for nodules and other defects. Carefully remove any defects with a fine abrasive stone and rubber the area. Then gently try to seat the framework on the duplicate cast. If it does not seat, apply a disclosing medium and reseat the framework. Do not press the frame so hard that stone is left on the frame. The residual stone prevents complete seating on the master cast. The frame is fully seated when the rests completely fill their rest preparations.

After the framework seats on the duplicate cast, adjust the occlusion on the master cast. Remove the framework and articulate the casts with bite registrations (if provided) or hand articulate the casts and mount. Framework rests that oppose edentulous spaces and artificial teeth usually do not need their occlusion adjusted.

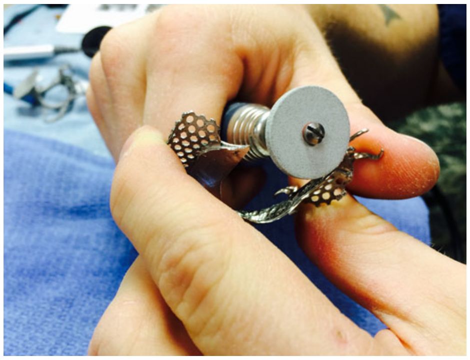

**Figure 2–19. Rubbering the framework with rubber wheel.**

**Figure 2–20. Rubbering the framework with rubber point.**

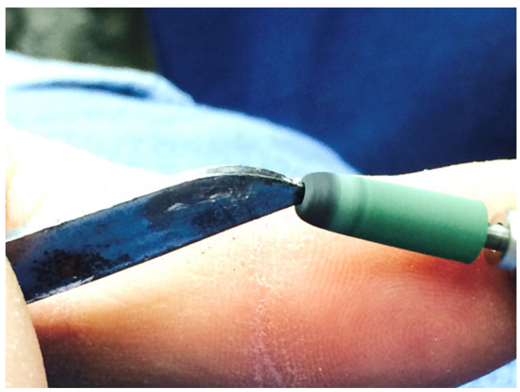

**Figure 2–21. Using a knife to hollow the end of a rubber point.**

Adjust the vertical dimension until the pin firmly contacts the incisal table. Rests and maxillary linguoplate are the most likely components you will adjust. Minimum thickness for a rest is 1 mm. Linguoplate may be ground thinner (0.5 mm) but should not be perforated. Use a metal thickness gauge routinely during this step. If it appears you will exceed the minimum thickness, mark the opposing area in red and notify the dentist. It is the dentist's decision whether to reduce the framework or opposing tooth. Eliminate anterior and posterior working, balancing (non-working), and protrusive contacts between the framework and opposing teeth. If this is not possible, reduce the contact as much as possible and rubber the ground areas.

### *Buffing*

Finally, polish the framework on either a high- or low-speed lathe. The following are important points of polishing:

- Use light pressure.
- Do not miss any part of the framework.
- Use plenty of polishing compound on the wheel.

Even more important is to not catch a clasp in the spinning wheel. This could throw the framework at you or at the ceiling. Some technicians cover the clasp tips with their fingers when polishing near the clasps, as illustrated in figure 2–22. You will also notice the position of the frame against the wheel. Polishing any lower or higher than this could cause the frame to catch in the wheel.

**Figure 2–22. Final polishing of the framework.**

Begin to polish by applying a polishing agent to a rag, brush, or felt wheel. Felt points and brush wheels are good for hard-to-reach areas. Polish the entire framework to a high luster. Polish the tissue side with a brush wheel and clasp interiors with a felt point. There is no need to polish the retention areas since they will be covered with acrylic. Completely remove the polishing compound with an ammoniated cleaning solution in an ultrasonic cleaner.

When the frame is clean and dry, repeat the polishing process with a polishing agent to achieve a high shine. Use separate polishing attachments for each type of polishing compound. Clean and dry the framework when you are satisfied with its shine. Inspect the framework for a smooth, high-shine appearance. Remove the blockout wax from the cast and prepare the case for shipment. Problems, probable causes, and solutions associated with framework finishing and polishing are shown below in table 2–7.

| Problem-solving Chart for Finishing and Polishing | | |
|---|---|---|
| **Problem** | **Probable Cause** | **Solution** |
| Framework warped. | Quenching mold in water.<br>Framework overheated by friction and pressure. | Allow mold to air cool to the touch.<br>Do not hold casting directly under sandblaster; keep framework moving. |
| Polished surface is dull. | Finishing sequence not followed. | Complete each step before moving to next abrasive. |
| Clasp nicked or bent. | Clasp caught in lathe or hit by stone or bur. | Exercise care when finishing. |
| Major connector flexes. | Framework thinned during finishing procedures. | Frequently check thickness during finishing procedures. |
| Framework occlusion is high. | Cast incorrectly mounted.<br>Inadequate space allowed in original design. | Carefully orient cast to maximum intercuspation (centric occlusion).<br>Do not thin metal surface to less than 0.5 mm. Mark opposing cast surface in red and inform dentist. |

**Table 2–7. Problem-solving Chart for Finishing and Polishing. (Reproduced with permission from C.V. Mosby Company.)**

## Self-Test Questions

**After you complete these questions, you may check your answers at the end of the unit.**

### 609. Casting the framework

1. When should auxiliary sprues be used?

2. What is the least dimensionally accurate area of a RDP casting? Why?

3. Why are both sides of the sprue cone sealed to the cast with wax?

4. What factors determine the ingot size?

5. What is the cause of casting voids?

6. Why must the outer investment be porous?

7. What are two probable causes for nodules and fins on a casting?

8. What are the three objectives of the burnout?

9. What could cause parts of the framework to fail to cast?

### 610. Finishing the framework

1. What is the purpose of sandblasting the framework?

2. How much rough finishing is done on the inside of clasps?

3. What is the electropolishing process?

4. When electropolishing the framework, what is the ideal temperature of the solution for large cases?

5. What is the advantage of using long strokes when rubbering a case?

6. During the rubbering stage you discover a scratch that is difficult to remove with a rubber point. What should you do?

7. Why should the clasp interior be smooth?

8. Why is the framework seated first on a duplicate cast?

9. What could cause a dull surface on a framework after the final polish?

## Answers to Self-Test Questions

**607**

1. Voids, nodules, distortion, an undercut base, and whether or not the cast is identified.
2. To avoid creating undercuts and better facilitate duplication.
3. To establish the correct tilt and prepare the master cast for survey.
4. Ledging allows proper placement of the clasp tips.
5. Reversible hydrocolloid.
6. Either a commercial model spray or it can be dipped in beeswax.
7. To test fit the metal framework.
8. Components are misplaced on the master cast.

**608**

1. An ordinary graphite pencil leaves particles that cause pits in the casting.
2. The design was drawn below the survey line on the refractory.
3. Sloppy application of tacky liquid causes fins on the casting.
4. Square teeth fill gingival embrasures better than other tooth contours.
5. Rope wax is twisted together and placed in the center of the edentulous area.
6. The connector is waxed with the wire in position. The wire is removed leaving a slot below the occlusal rest.
7. The finish line must have a defined leading edge and be properly positioned.

**609**

1. In cases that have a bulky pontic or isolated areas, such as large clasp arms on a molar.
2. The sprue attachment area, since this is where most of the shrinkage of metal takes place.
3. To prevent investment particles from breaking off and causing pits in the casting.

4. The size of the framework, thickness, and width of the components, number of metal teeth or backings, and number of sprue leads.
5. Excessively thick paint-on.
6. To allow gases to escape.
7. Air trapped during paint-on and surface tension reducer was not used on the pattern.
8. (1) Eliminates the wax and plastic patterns.
   (2) Provides thermal expansion of the mold.
   (3) Heats the mold to prepare it to receive the molten metal.
9. The metal being too cold when cast and paint-on too thick.

**610**

1. To remove investment residue and surface oxides.
2. Only enough to gently clean the clasp interior.
3. A layer of metal is removed from the framework by an electric current carried by an electrolyte solution.
4. 120°F.
5. The surface is ripple-free, leaving a smooth and easily polished framework.
6. Remove the scratch with a stone and then rubber the area.
7. To prevent scratching tooth enamel.
8. To prevent damage to the master cast while adjusting the framework.
9. Finishing sequence was not followed.

**Complete the unit review exercises before going to the next unit.**

## Unit Review Exercises

**Note to Student:** Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

**Do not return your answer sheet to the Air Force Career Development Academy (AFCDA).**

24. (607) With prosthodontics, ledging provides for the proper placement of
    a. rests.
    b. clasp tips.
    c. minor connectors.
    d. major connectors.

25. (607) A refractory cast is made from
    a. low heat investment.
    b. high heat investment.
    c. medium heat investment.
    d. zero degree heat investment.

26. (607) The refractory cast must be dehydrated
    a. before immersing it in heated beeswax.
    b. after immersing it in heated beeswax.
    c. to prevent wax from sealing the cast.
    d. overnight.

27. (607) Duplicate master casts are used for
    a. waxing the removable dental prosthesis (RDP) framework.
    b. adapting reinforced acrylic pontics (RAP).
    c. testing the metal framework fit.
    d. applying relief material.

28. (607) Select the probable cause of the removable dental prosthesis (RDP) framework not fitting the master cast.
    a. Design transferred improperly.
    b. Block out on master cast inadequate.
    c. Pouring temperature of colloid is too hot.
    d. Refractory cast abraded by improper handling.

29. (608) What can particles of a graphite pencil left in the design on a refractory cast cause?
    a. Pits in the casting.
    b. A discolored casting.
    c. Weakened direct retainers.
    d. A change in the properties of the alloy.

30. (608) What could result from placing an external finish line directly over the internal finish line?
    a. A well-defined finish line.
    b. Quicker production of the framework.
    c. The retention area breaking away from the framework.
    d. Better retention of the denture base due to the extra acrylic.

31. (608) What could an open denture base retention with sharp corners cause?
    a. Denture base fractures.
    b. Difficulty during finishing.
    c. Incorrect placement of artificial teeth.
    d. The investment to crack during burnout.

32. (609) Where is a wedge-shaped sprue attached to the pattern?
    a. Either the posterior border or the retention grid area.
    b. Either the anterior or posterior border.
    c. The posterior border.
    d. The anterior border.

33. (609) Which would be the result of an overly thick paint-on during the *first stage* of investing a removable dental prosthesis (RDP) pattern?
    a. Excessive rigidity.
    b. Porosity or nodules.
    c. Gassing or discoloration.
    d. Casting voids or short clasp arms.

34. (609) During the *investment stage*, how many minutes does it take for the paint-on to reach its final set?
    a. 5.
    b. 10.
    c. 15.
    d. 20.

35. (609) When doing a burnout procedure, why should a mold be loaded with the mold's sprue hole down?
    a. Water needs to drain from the mold.
    b. Prevent steam from being trapped in the mold.
    c. Allow wax to be quickly eliminated from the mold.
    d. Allow for uniform heating to begin at the bottom of the mold.

36. (610) When finishing a chrome alloy framework, avoid heavy pressure because it will
    a. scratch the casting.
    b. break the framework.
    c. heat the framework and warp the casting.
    d. cause fast cutting by crushing the abrasive particles.

37. (610) Polishing the framework is normally divided into rubbering, buffing, and
    a. dielectric polishing.
    b. magnetic polishing.
    c. electropolarizing.
    d. electropolishing.

38. (610) When finishing the framework, what is used to smooth a clasp interior?
    a. Felt point.
    b. Rag wheel.
    c. Rubber point.
    d. Rubber wheel.

39. (610) What is the solution to a warped framework?
    a. Exercise care when finishing.
    b. Allow mold to air cool to the touch.
    c. Carefully orient cast to maximum intercuspation.
    d. Do not thin metal surface to less than 0.5 millimeters (mm).

**Please read the unit menu for unit 3 and continue ➔**

# Student Notes

# Unit 3. Removable Appliance Applications



IN THE PREVIOUS UNIT, we covered how to fabricate RDP framework. This unit will cover how to fabricate partial denture bases and cover techniques to improve and repair existing removable appliances.

## 611. Removable dental prosthesis base

These techniques and principles can apply to both complete and partial removable dentures. Complete dentures are used when all the teeth are missing, while partial dentures are used when some natural teeth still exist. Partial dentures usually consist of replacement teeth attached to pink or gum colored plastic bases. Depending on the patient's needs, the dentist will design a partial denture.

Producing an RDP base is similar to complete denture base fabrication; however, the metal framework does incur some unique procedural considerations. In this lesson, artificial teeth arrangement, and denture base fabrication will be covered.

The dentist will try-in the RDP framework, adjust it, and then take an occlusal registration. If there are extensive edentulous areas, you will have to make occlusal rims; refer to Volume 3 for fabrication steps.

Occlusal rims can be attached directly to the frame with wax or sealed to resin record bases. If using the wax method, apply a tinfoil substitute to the edentulous area and then apply a thin layer of molten wax. Quickly seat the frame completely. Then, apply the occlusal rim. A resin record base should be sprinkled directly onto the frame. To remove the record base, flame the base to soften it. Do not burn it because it will cause carbon markings on the framework.

### Artificial teeth arrangement

Apply tinfoil substitute to the edentulous areas of the cast if the dentist requests a try-in. Be careful not to flow wax into undercut areas around the stone teeth because it will hinder removal of the RDP from the cast. You may not want to wax an extensive flange for the try-in because it could break off in the mouth.

With anterior teeth, you are primarily concerned with esthetics. The patient must be able to open and close their mouth and speak well, but anterior esthetics will usually win out over function and phonetics as a compromise. Try to match the natural teeth's position, mold, and overall arrangement. For example, do not make a "perfect" anterior arrangement on one side of the midline when the natural teeth on the opposite side are rotated and overlapping.

Use the natural anteriors as guides for tooth selection. Feel free to mix and match different molds and shades to complement the natural teeth. Be flexible and imaginative when arranging the anteriors to avoid the "ideal or perfect tooth arrangement."

The ideal type of arrangement can lead to an occlusal scheme that will have eccentric interferences between the teeth. Try to avoid these contacts to prevent tooth wear or breakage but not at the expense of esthetics. If eccentric contacts are unavoidable, distribute the contacts among as many of the artificial teeth as possible, such as in replacing a lateral incisor, cuspid, and bicuspid of a patient with anterior guidance.

When arranging posterior teeth, function is very important. Acrylic resin posterior teeth are used because they are easy to adjust. The teeth are arranged from the anterior to the posterior. To achieve maximum intercuspation with the opposing teeth, you may have to grind the mesials and distals of the teeth to fit the framework. Figures 3–1a and 3–1b illustrate adjusting the teeth to fit the minor connector.

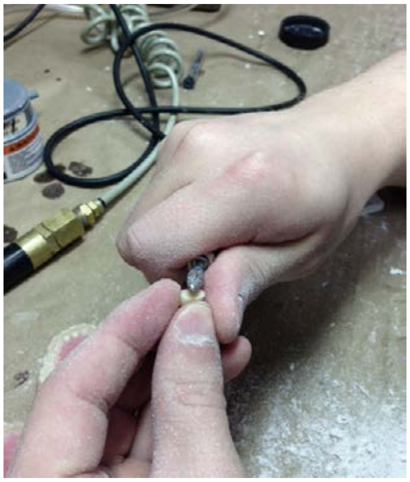

**Figure 3–1a. Adjusting a tooth to fit against a minor connector.**

**Figure 3–1b. Positioning the tooth to fit against a minor connector.**

Before arranging the posterior teeth against natural dentition, open the vertical dimension of occlusion (VDO) 1 mm; arrange the teeth and put the pin back in its original position. Then, using articulating paper, grind the teeth into a tight centric occlusion. Centric occlusal contacts are the only contacts necessary in the majority of RDPs. The RDP is stabilized by its framework and does not need working and balancing (non-working) contacts. The exception would be a Class I (bilateral distal extension) RDP opposing a complete denture; then, a bilateral balanced occlusion may be needed to stabilize the complete denture.

### Denture base

The patient's mouth determines the denture base appearance. The denture's gingival margin shape, height, festooning, and stippling should match the natural tissue. The mesial and distal edges of the denture base should be flush with the natural tissue rather than have a noticeable roll. The edges should be almost knife-edged in the area of the attached gingiva. The edge should thicken towards the sulcus because it will contact movable mucosa.

The labial flange in the anterior should extend into the sulcus to prevent exposure when smiling. The flange will also replace lost muscle support and affect function as well as esthetics. Class I, II, and IV RDPs are partially supported by the denture base so these flanges must extend into the sulcus. A Class III RDP, however, is tooth supported and requires only enough flange to appear natural in the mouth. The final wax-up should be neat with definite boundaries. Careful attention to procedural detail is critical during this stage of denture processing. The acrylic must be carefully mixed, packed, and cured. If an error occurs during any of these procedures, the final prosthesis could be ruined.

### Preparation for flasking

Flasking is the process of pouring the cast and waxed denture in a flask in order to create the denture mold. Before flasking, verify that all functional and esthetic requirements are met. This includes checking the occlusal arrangement and function, and the contours of the denture base. There may also be some changes requested by the dentist. Check for damage to the wax-up and for loose teeth. Once you and your trainer or dentist are satisfied with the final product, you are ready to begin flasking.

### Flasking

Once you are certain the wax-up is ready, separate the cast from the mounting. Soaking the mounting and cast will make separation easier. Clean all debris from the casts and write the patient's identification on the heel of the cast if not already done. Place the cast in the flask. The cast should be 6 mm from the sides of the flask. There should also be 6 mm between the teeth and the top edge of the flask. Apply a thin coat of petrolatum to all cast areas. Clean the flasks, making sure all of the numbers on the components match. Then, apply petrolatum to the flask.

When flasking the lower half of an RDP, fill it with investment material and ensure the stone teeth of the cast are covered with the investment material. The framework and cast are then pressed into the lower half and carefully smoothed out to eliminate undercuts out to the land area of the flask.

### Boilout

Start the boilout tanks before you begin flasking. This ensures the water is boiling when the investment material reaches its final set. For your own safety, remember you are working with an open flame, boiling water, hot surfaces, steam, noxious fumes, and a high temperature environment. Always work safely! Limit your exposure to safety hazards by using an exhaust vent and heat-resistant gloves, and always be aware of the possibility of fire and burns.

Immerse the flasks in boiling water for five minutes to soften the wax. Carefully separate the two halves by prying on both sides. The record base should remain in the lower half and the teeth in the upper half. Do not try to pry the record base away from the teeth if it remains in the upper half. Flush the upper half with boiling water to loosen the record base then remove it. Trim away any stone flash and flush both halves until all wax and debris are removed. Treat both halves with a detergent and rinse with clean boiling water. Sometimes scrubbing is the only way to remove separator residue from the cast. Rinse the halves several times to clean both halves.

During the rinse, some of the teeth may float loose. Put them aside until you finish rinsing the mold. Then, carefully clean the teeth in boiling water. Once cleaned, replace the teeth in the upper half. Drain the mold halves of water and remove any debris that did not flush out. Apply the first coat of separator while the molds are hot, but not steaming. Set them on their heels to drain. After applying the separator, check the casts for brush hairs or other contaminants. Be careful not to contaminate the separator.

### Packaging the RDP

Packing the RDP is the same as other appliances. However, you have the option to split pack the RDP. During the split pack, resin is applied to both halves of the flask and trial packed. Before final closing, dampen the resin with monomer to ensure the two halves of resin unite completely.

### Curing

There are two methods to cure the acrylic resin. One is the long-cure method where the flask is immersed in 160°F water for eight hours. The second is the short-cure method where the flask stays in 160°F water for 90 minutes. Then, the water is boiled for 30 minutes.

### Deflasking

After curing, you are ready to deflask or recover the RDP. After deflasking, clean the investment material and acrylic flash off the occlusal surfaces of the stone teeth. Remount, correct the processing error, and remove the RDP from the cast. Trim the flash from the denture base and do any shaping required. You may find acrylic resin flash on the framework at the internal and external finish lines. This can be removed by lightly rubbering the area. Be careful not to flatten the finish lines when rubbering.

Proceed with pumicing and polishing. Remember, polishing RDPs is more dangerous than polishing complete dentures because the RDP framework has clasps and other extensions. Protect these extensions when polishing. Most technicians cover the extensions with their fingers, which works well. However, be aware that if the RDP is caught in the wheel, that extension may end up in your finger! Covering the extension with tape is probably the safest alternative to pierced fingers.

## 612. Repairing removable prostheses

Intra-oral prostheses are subjected to a barrage of masticatory forces. Over time, these forces can cause the prosthesis to weaken and break. Additionally, these forces can cause the onset of ridge resorption, which can compromise the “fit” of the prosthesis. When these events occur, the patient will usually return to the clinic to have their appliance repaired. In this lesson, we will cover repairing RDP frameworks and improving denture retention.

Acrylic repair is one of the tasks that you frequently encounter in a dental laboratory. It may be a one-tooth repair, a cracked denture repair, or the repair of a denture broken into a number of pieces.

### Keys to success

If you are to succeed in repairing broken removable prostheses, the following conditions must be met:

1. The parts being repaired must be perfectly clean.
2. The parts must be assembled with total accuracy.
3. The parts must be kept absolutely immobile while the repair resin is curing.

### Single-tooth repair

Because this is such a frequent and simple task, it has become a routine dental laboratory procedure. If the tooth has loosened, you can reattach it in its original position by using self-curing acrylic resin. If the tooth is broken, cracked, or missing, it must be replaced with another tooth of the same mold and shade. Select the replacement based on the apparent mold of the remaining teeth.

To replace one tooth, select a bur and cut a box preparation on the lingual surface of the denture base. Be careful not to cut any base material on the labial surface. Make the margins of the preparation straight and even, as shown is figure 3–2. Roughen the ridgelap of acrylic teeth to guarantee good chemical bonding with the repair material. Cut a small diatoric into the plastic tooth for additional retention. Position a tooth of the correct mold and shade in the prepared area. Check the labial surface (neck) of the tooth to be sure it is tight against the denture base. Hold the tooth in position with sticky wax (fig. 3–3). Construct a stone matrix (fig. 3–4). If a posterior tooth is to be replaced, an occlusal matrix or opposing cast will be needed.

Remove the sticky wax after the stone is set. Paint the matrix with a tinfoil substitute. Reassemble the denture, tooth, and matrix in correct alignment. Sticky wax the tooth to the matrix and the matrix to the denture; this will hold everything in place. Sprinkle self-curing acrylic into the preparation and moisten it with monomer. The resin should be overbuilt slightly and kept moist to avoid porosity. Place the repaired denture in a pressure pot filled with warm water and cure at 115°F at 20 pounds per square inch (psi) for 30 minutes. After the acrylic has cured, finish the repaired area and polish the entire denture.

**Figure 3–2. Box preparation.**

**Figure 3–3. Sticky wax replacement tooth.**

**Figure 3–4. Stone matrix.**

### Cracked denture repair

A cracked denture will be in one piece but will have a crack that may run well into the middle of the palate. You need to create a cast to accomplish this repair. Begin by blocking out all tissue surface areas outside the repair area with wet tissue or other suitable material. Pour a cast of the denture to include generous areas on either side of the fracture line and on all denture borders. After the stone sets, remove the denture from the cast.

Soak the cast in saturated calcium SDS to remove any air. Blow off the excess moisture. Apply a tinfoil substitute to the cast at least 8 mm beyond the denture fracture line in all directions. Allow the tinfoil substitute to dry. Use a bur and enlarge the crack so that it is approximately 2 or 3 mm wide. Continue this preparation approximately 2 mm past the visible ends of the crack. Create a rabbet joint to accommodate the repair material and to increase the amount of bonding surface between the old and new acrylic resin (fig. 3–5).

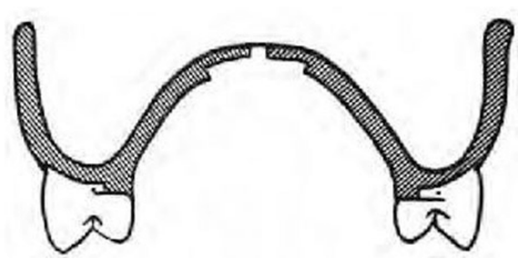

**Figure 3–5. Rabbet joint.**

Replace the denture on the cast and make sure that it seats completely. You may use the sprinkle method to repair the crack and cure the denture as you did for the single-tooth repair or you may use the dough method.

When using the dough method, first soak tissue paper in warm water to form a soft pulp. Pack the pulp into the preparation and contour it to the desired shape. Prepare matrices that cover the prepared area.

**NOTE:** Before making the matrices, paint a separating medium onto any cast surfaces that come in contact with fluid stone.

Remove the hardened matrices and wet tissue from the cast. Paint each matrix with tinfoil substitute. Mix self-curing resin according to the manufacturer’s directions and let it reach packing consistency. Lightly moisten the repair area with monomer and press the doughy acrylic resin into the repair area. Put the matrices in place and hold it together with a rubber band. Place the assembly in a pressure pot and cure according to manufacturer’s directions.

### Complete fracture repair

In the cracked denture repair described above, the denture was not in two or more pieces. Although cracked, each side of the crack maintained a proper relationship to the other side. In this lesson, we cover how to repair dentures that have a complete fracture resulting in two or more pieces. These repairs are classified as simple or complex denture base fractures.

#### *Simple*

In this type of fracture, the denture has been broken into pieces, and there is absolutely no doubt about how the pieces fit together. The patient’s presence and clinical cooperation are not necessary. Procedures to accomplish a simple complete fracture repair are as follows:

1. Assemble the parts of the denture.
2. Apply sticky wax to the fracture line to maintain the pieces in correct position. It is a definite advantage to have a helper when joining the pieces.

3. Attach two or more old burs or pieces of coat hanger wire across the fracture line of the denture to reinforce the denture until the matrix is made. **NOTE:** Do not use wooden sticks, as wood tends to warp.
4. Examine the tissue side of the denture to make sure all parts are in perfect alignment.
5. Blockout all tissue surface areas outside the repair area with wet tissue or other suitable material.
6. Pour a cast of the denture to include generous areas on either side of the fracture line and on all denture borders.
7. After the stone sets, remove the denture from the cast.
8. Soak the cast in SDS to remove the air.
9. Blow off the excess moisture. Apply a tinfoil substitute to the cast at least 8 mm beyond the denture fracture line in all directions. Allow the tinfoil substitute to dry.
10. Prepare a rabbet joint.
11. Apply self-curing resin by sprinkle or dough method.
12. Finish and polish the denture.

### *Complex*

In this type of fracture, the pieces cannot be made to fit against one another in precise relationships and sometimes one or more fragments have been lost (for example, loss of a flange). The pieces can be realigned or new resin added only if the dentist assists in the reconstruction and the patient is present.

In complex fracture repair, the most likely problem is that a piece of the denture is missing and must be replaced. Patients routinely fracture a denture flange and lose the fragment. The dentist will use a material like modeling plastic to make the repair. Add it to the denture's fracture line, place the denture in the patient's mouth, and shape a new section for the lost piece of the denture. The technician will receive a denture with a replacement area made from modeling plastic. The modeling plastic will be converted into resin, using the following sequence:

1. Use wet paper towels or wet tissue to pack undercut areas not involved in the repair.
2. Pour a cast that includes all denture borders and the tissue surface of the modeling plastic section, plus an additional 8 mm of denture tissue surface.
3. After the stone is set, remove the denture from the cast. Cut the modeling plastic away from the denture and bevel the denture's broken margin.
4. Paint tinfoil substitute onto the cast to take in all of the repair area and 8 mm beyond.
5. Replace the denture on the cast and tack it down with sticky wax.
6. Repair the denture by the dough or sprinkle method.
7. Finish and polish the denture.

Some problems you may encounter, their probable cause, and their solutions can be found in the following table 3–1.

| Problem-solving Chart for Acrylic Removable Prostheses | | |
|---|---|---|
| **Problem** | **Probable Cause** | **Solution** |
| Replacement tooth too long, too short, or incorrectly positioned buccolingually. | Ridge lap of denture teeth not modified properly.<br>No opposing occlusion was used to adjust occlusal contact. | Prepare ridge lap to assure correct positioning; check position carefully before making index.<br>Dentures requiring posterior replacements should be mounted in articulator and occlusion adjusted. |
| Replacement tooth wrong shade. | Shade selection in error. | Check shade under variety of lighting conditions to assure proper shade. |
| Porous repair resin. | Monomer evaporated from resin or repair not cured in pressure pot. | Keep resin moistened with monomer and place repair in pressure pot with 115°F water at 20 psi for 30 minutes. |
| Repaired denture base does not fit properly. | Pieces not aligned properly.<br>Denture not allowed enough curing time. | Align parts accurately and sot lute with sticky was; use metal burs across the arch for reinforcement.<br>Cure properly in 115°F water at 20 psi for 30 minutes. |
| Denture base repair not rigid. | Monomer contaminated or wrong monomer used (heat-cured). | Use uncontaminated self-curing monomer or use monomer from dappen dish, but do not use monomer from the bottle. |
| Denture base repair fails. | Preparation in acrylic contaminated with tinfoil substitute.<br>Denture fits poorly; occlusion errors cause stress on repaired area. | Avoid getting tinfoil substitute on prepared edges next to repair.<br>Reline denture base; remount appliance to adjust occlusion. |

**Table 3–1. Problem-solving Chart for Acrylic Removable Prostheses. (Reproduced with permission of C.V. Mosby Company.)**

### *Reline denture base*

The patient's denture oral tissues undergo constant change. These changes are caused by aging and diseases like diabetes and osteoporosis. Bone resorbs and soft tissue changes its tone and thickness. The physical changes can cause removable prostheses to lose their original fit. Not only is retention compromised, but the facial muscles recess and the patient has difficulty functioning.

Denture bases for RDPs must also be relined occasionally because of tissue changes. This is particularly critical since the denture base helps prevent framework rotation of Class I and II RDPs. In this lesson, we will cover how to reline a complete denture and an RDP and how to rebase a denture. If the denture teeth are not badly worn, and the denture base is in good condition, the dentist may elect to reline a complete denture. To prepare a denture for a reline, remove all tissue surface undercuts. This prevents breaking the cast ridge when removing the denture from the cast. Then, reduce the denture border approximately 1 mm to allow space for border molding. The modified denture will actually be used as a tray for the impression. The dentist will use a soft reline material as an impression material.

Before pouring the cast, estimate the thickness of the impression material. Extremely thick areas, in excess of 3 mm, are prone to trap air within the cold-cure acrylic. If a reline is very thick throughout, you may want to flask and heat-cure the denture overnight. This will prevent voids in the acrylic, but unless done carefully, may cause the denture to warp by releasing processing stresses during the curing cycle.

Most relines are done on a reline jig (fig. 3–6) with repair acrylic. Clean and disinfect the impression and pour a cast. Be careful not to bury the flanges, particularly the lingual flanges of the mandibular denture. When the cast sets, make the lower index.

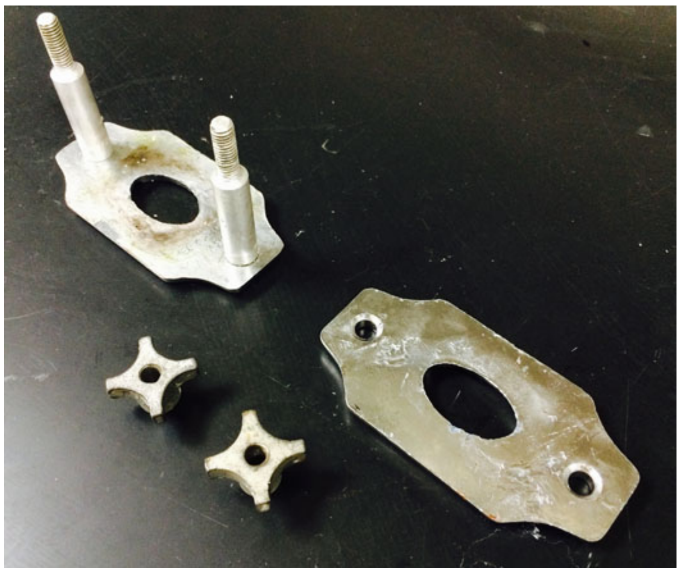

**Figure 3–6. A reline jig.**

Blockout any undercuts in the palate, fill them with plaster, and invert the denture into a plaster patty. Cover the teeth enough to ensure a definite occlusal index. Be sure you do not bury the lingual part of the mandibular denture. This area must stay open to remove excess resin when closing the jig for processing. When the lower index sets, use plaster to attach the upper half of the jig to the cast. Do not let the plaster cover the posts.

Disassemble the jig and remove the denture from the cast. If a ridge breaks off, glue it back in place. If the mandibular denture will not come off the cast, it is probably caught in the retromylohyoid area. Cut this part of the flange off to prevent an uncontrolled break of the cast or denture. Clean the cast and have the dentist prepare the posterior palatal seal. Paint tinfoil substitute on the cast and set it aside to drain off the excess.

Remove the impression material from the denture. Relieve any remaining undercuts, make a butt joint on the peripheral roll, and open the frenum spaces. The entire surface should be ground and then cleaned of contaminants with monomer. This improves the bond between the old denture base and the new acrylic.

Mix a 2:1 ratio of polymer to monomer repair resin. This ratio is used because it traps less air and bonds well with the denture base. Dampen the denture with monomer and cover it with the resin. Also, apply resin to the cast to prevent voids on the denture surface. Take care not to trap air when applying the resin. Slowly close the halves of the jig short of metal-to-metal contact. Push the escaping resin back between denture and cast. Tighten the two halves together when the acrylic resin reaches a doughy and firm state. Make sure you have metal-to-metal contact when tightening the thumbnuts. If not, the VDO will be increased. Place the reline jig with the denture in a pressure pot for curing. Cure the reline in 115°F water at 20 psi for 30 minutes. Remove the cast, and finish and polish the denture.

Check with the dentist before reducing what appears to be a bulky labial flange. It may be needed to support the lip. Otherwise, remove the flash and smooth the denture by pumicing. Use a brush wheel to remove plaque accumulation and try to reduce any plaque traps. Check the palate for thickness. You may have to thin it somewhat when finishing. The polishing procedures are the same as for new dentures. Some problems, probable causes, and solutions appear in the following table 3–2.

| Problem-solving Chart for Denture Relines | | |
|---|---|---|
| **Problem** | **Probable Cause** | **Solution** |
| Voids in resin on tissue side. | Self-curing resin not applied evenly to inside of denture base or into sulcus of the cast. | Coat entire tissue surface of denture and cast with resin; slowly expel air and use adequate volume of material. |
| Line of demarcation visible between reline and denture base. | Tissue surface contaminated.<br>Self-curing resin too dry before closing reline jig. | Clean denture base after grinding surface and use uncontaminated monomer to clean tissue surface.<br>Place reline mixture into denture and opposing cast immediately after mixing; close thumbnuts on jig after acrylic resin is doughy. |
| Denture difficult to remove from master cast. | Denture base undercuts not removed prior to taking impression. | Grind and eliminate all potential undercut areas—unless otherwise directed by dentist. |
| Porous reline. | Not cured properly in pneumatic curing unit. | Submerse reline in 115°F water with 20 psi for 30 min. |
| Maxillary palate distorted. | Palatal cross-section too thin and not supported by index. | Occlusal index must contact palatal vault of maxillary reline. |
| Incorrect denture occlusion. | Denture not accurately seated in occlusal index.<br>Denture moved during processing. | Gently press occlusal surface into stone<br>Replace denture into occlusal indentations and lute to occlusal index. |

**Table 3–2. Problem-solving Chart for Denture Relines.**
**(Reproduced with permission of C.V. Mosby Company.)**

### *RDP reline*

Relining an RDP is basically the same as relining a complete denture in a reline jig. The dentist will take an impression of the saddle base area and trim the impression material from the framework. Only the denture base should be covered with impression material. Pour the impression sites and place the RDP in a stone patty. The RDP framework should contact the stone to create a positive index without locking the RDP to the cast.

When the cast has set, invert the RDP into an occlusal index in the lower half of the reline jig. Be very careful not to bury the delicate parts of the framework in stone, yet still provide an adequate index and support for the RDP. Some fragile components must be in the index to orient the RDP. You may tape off RDP components that are not to be included in the index.

Attach the cast to the upper half of the jig after the index sets. Once the plaster has set, separate the components, prepare the denture base, and cast as you would for a complete denture reline. Process and finish the RDP.

Some problems you may encounter, their probable causes, and their solutions can be found in the following table 3–3.

| Problem-solving Chart for Removable Dental Prosthesis Relines | | |
|---|---|---|
| **Problem** | **Probable Cause** | **Solution** |
| Voids in borders areas. | Acrylic resin not compressed into peripheral roll.<br>Not enough acrylic resin used. | Use spatula to place acrylic mixture into border area before and after closure of the reline jig.<br>Use more acrylic resin. |
| Rest of RDP did not seat into preparations. | Reline jig not completely closed.<br>Impression made with excess pressure over denture base area. | Confirm that thumbscrews of reline jig are completely tightened before processing.<br>Remake impression; avoid isolated pressure. |
| Relined RDP rocks in patient's mouth. | Impression made with teeth in occlusion.<br>Impression made with excess pressure over denture base area.<br>Poor framework design. | Remake impression; take open mouth impression.<br>Remake impression; avoid isolated pressure.<br>Framework should be supported by at least three rests. |

**Table 3–3. Problem-solving Chart for Denture Relines.**
**(Reproduced with permission of C.V. Mosby Company.)**

## Self-Test Questions

**After you complete these questions, you may check your answers at the end of the unit.**

### 611. Removable dental prosthesis base

1. To remove the record base, flame the base to soften it. What will happen if you burn the base?

2. Why is it *not* a good idea to wax an extensive flange for the try-in?

3. When selecting anterior teeth, what will usually win out over function and phonetics as a compromise?

4. What is prevented when you avoid eccentric contacts when arranging teeth?

5. What are the only contacts necessary in the majority of RDPs?

6. What determines the denture base appearance?

7. What should the denture's gingival margin shape, height, festooning, and stippling match?

8. Why is polishing RDPs more dangerous than polishing complete dentures?

**612. Repairing removable prostheses**

1. If you are to succeed in repairing broken removable prostheses, what conditions must be met?

2. How can you guarantee a good chemical bond between the replacement denture tooth and the repair material?

3. What two methods could you use to repair and cure a cracked denture?

4. What are the two classifications for dentures that are in two or more pieces?

5. What is lost in removable prostheses when a patient experiences physical change?

6. What must be removed to prepare a denture for a reline?

7. In excess of how many mm thick are prone to trap air within the cold-cure acrylic when pouring the cast?

8. What is the probable cause if there are voids in the resin on the tissue side of a denture reline?

## Answers to Self-Test Questions

**611**

1. It will cause carbon markings on the framework.
2. It could break off in the mouth.
3. Anterior esthetics.
4. Tooth wear or breakage.
5. Centric occlusal contacts.

6. The patient's mouth.
7. The natural tissue.
8. The RDP framework has clasps and other extensions.

**612**

1. The parts being repaired must be perfectly clean. The parts must be assembled with total accuracy. The parts must be kept absolutely immobile while the repair resin is curing.
2. Roughen the ridgelap of acrylic teeth.
3. Sprinkle method or the dough method.
4. Simple or complex.
5. Their original fit.
6. All tissue surface undercuts.
7. mm.
8. Self-curing resin not applied evenly to inside of denture base or into sulcus of the cast.

## Unit Review Exercises

**Note to Student:** Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

**Do not return your answer sheet to the Air Force Career Development Academy (AFCDA).**

40. (611) Identify the denture appliance that is used when some of the patient's natural teeth still exist.
    a. Complete.
    b. Partial.
    c. Half.
    d. Full.

41. (611) Occlusal rims can be attached directly to the frame with wax or they can be sealed to
    a. resin record bases.
    b. resin retainers.
    c. denture bases.
    d. natural teeth.

42. (611) What is very important when arranging posterior teeth?
    a. Esthetics.
    b. Function.
    c. Phonetics.
    d. Overlapping.

43. (611) Before arranging posterior teeth against natural dentition, how many millimeters (mm) do you open the vertical dimension of occlusion (VDO)?
    a. 4.
    b. 3.
    c. 2.
    d. 1.

44. (612) Select the kind of forces that can cause an intra-oral prosthesis to weaken and break over time.
    a. Masticatory.
    b. Segmented.
    c. Residual.
    d. Joint.

45. (612) Identify the type of acrylic resin that can be used to repair a loosened tooth by reattaching it in its original position.
    a. Quick-dry.
    b. Self-curing.
    c. Heat-curing.
    d. Double-sided adhesive.

46. (612) Use a bur to create which type of cut on the lingual surface of the denture base when accomplishing a single-tooth acrylic repair?
    a. Rabbet joint.
    b. Labial joint.
    c. Box preparation.
    d. Open preparation.

47. (612) What must be done to increase the amount of bonding between the old and new acrylic resin during a repair?
    a. Create a rabbet joint.
    b. Create a box preparation.
    c. Coat repair area with monomer.
    d. Soak the repair in saturated calcium sulfate dihydrate solution (SDS).

48. (612) Identify the type of denture fracture where there is no doubt about how the pieces fit together.
    a. Complex.
    b. Simple.
    c. Hard.
    d. Easy.

49. (612) Select the type of denture fracture where the pieces do *not* fit against one another in a precise relationship.
    a. Complex.
    b. Simple.
    c. Hard.
    d. Easy.

50. (612) What is the probable cause if the denture base repair is *not* rigid?
    a. Error in shade selection.
    b. Contaminated monomer.
    c. Pieces not aligned properly.
    d. Ridgelap of denture tooth not modified properly.

51. (612) What does a denture patient's oral tissue constantly undergo?
    a. Change.
    b. Fracture.
    c. Manipulation.
    d. Color correction.

52. (612) Whom should you check with before reducing what appears to be a bulky labial flange?
    a. Dental officer in charge.
    b. Flight chief.
    c. Commander.
    d. Dentist.

53. (612) What is the probable cause if a denture is difficult to remove from the master cast after a reline?
    a. Undercuts.
    b. Reline jig shifted.
    c. Surface contamination.
    d. Acrylic not compressed.

# Glossary

## Terms

**abutment—**On removable partial dentures, it is the tooth on which a clasp is placed to support and retain the removable partial denture. On fixed partial dentures, it is the tooth to which the retainer is cemented. On implants, the part that supports and/or retains the prosthesis.

**acrylic resin—**A plastic widely used in dentistry for making denture bases, provisional crowns, custom trays, etc.

**align—**To properly position in relation to another object or objects.

**alloy—**A substance consisting of a mixture of two or more pure metals.

**alveolar—**Part of the mandible and maxilla that surrounds and supports the roots of natural teeth.

**alveolus—**The bony socket holding the root of a tooth by the periodontal ligament.

**anterior teeth—**The central and lateral incisors and the cuspids of either arch.

**anteroposterior—**Extending from the front, backward.

**approach arm—**The part of a bar clasp connecting the retentive portion to a removable partial denture framework.

**articulator—**A mechanical device representing the temporomandibular joints and jaws to which maxillary and mandibular casts can be attached for performing prosthodontic procedures.

**axis—**An imaginary line passing through a body, around which the body may rotate, for example, transverse horizontal axis.

**bar—**A major connector used in removable partial denture construction to connect the right and left sides of the framework.

**bar clasp—**A type of clasp in which the retentive tip approaches the undercut from below the survey line. Also called *infrabulge clasp*.

**base—**The part of a removable prosthesis that retains artificial teeth and replaces the alveolar process and gingival tissues. The base of a removable prosthesis is made of metal or denture resin.

**base metal—**Any metal element that does not resist tarnish and corrosion. Any metal which is not noble.

**baseplate wax—**A hard, pink wax used for making occlusion rims, waxing dentures, and many other dental procedures.

**beading—**As in "beading a cast": to score a cast in any desired area to provide a seal between the finished prosthesis and the soft tissue. As in "beading an impression": to rim an impression with a wax strip before pouring so that all critical impression landmarks show up in the cast.

**beadline—**The indentation resulting from beading the cast.

**blockout—**The process of eliminating undesirable undercut areas of a cast or denture. This procedure is most frequently used in preparing a cast for removable partial denture construction. The undercut areas below the survey line on the teeth are blocked out with wax.

**border molding—**Shaping of an impression material by the manipulation of the tissues to determine the denture border position.

**bracing—**The resistance to displacement in a lateral direction from masticatory forces.

**buccal—**Pertaining to the cheek. The surface of the tooth toward the cheek.

**bur—**A small rotating instrument used in the dental handpiece for cutting acrylic resin or metal. Also used by the dentist to cut enamel or dentin.

**burnout—**The elimination by heat of wax or resin from a mold designed to receive molten alloys.

**butt joint—**A type of joint in which the two pieces to be joined touch each other but do not overlap.

**cast—**The positive reproduction of the mouth in stone or similar material upon which a prosthetic appliance can be constructed. To produce a shape by thrusting a molten liquid into a mold possessing the desired shape.

**cast base—**The portion of the removable prosthesis covering the edentulous ridges and supporting artificial teeth, made of metal. Also called *metal base denture*.

**centimeter—**A hundredth of a meter; 2.54 centimeters equals 1 inch.

**centric occlusion—**The occlusion of teeth when the mandible is in maximum intercuspation, may or may not coincide with centric relation.

**circumferential clasp—**Clasps that approach the undercut portion of a tooth from above the survey line.

**clasp—**The part of a removable partial denture partly encircling the abutment tooth, helping retain, support, and stabilize the appliance.

**clasp arms—**The shoulders and tips of a clasp; the part of the clasp which extends from the body out to the tip.

**complete denture—**A dental prosthesis replacing all natural dentition and the associated structures of the maxilla or the mandible.

**contour—**(noun) The shape of a surface**.** (verb) To shape into a desired form.

**convex—**A surface curved outward toward the viewer.

**cross-section—**A cut section of an object, made so the cut is perpendicular to the object's long axis.

**crown—**In anatomy, the part of the tooth covered by enamel. In the laboratory, an artificial replacement that restores missing tooth structure with a metal or ceramic restoration.

**cusp—**A cone-shaped elevation on the occlusal surface of a molar or bicuspid and on the incisal edge of the cuspid.

**cuspid—**A tooth having one cusp or point; the third tooth from the midline. So named because they correspond to the long teeth of a dog. Also called *canine.*

**cuspid or canine eminence—**The prominence of labial bone which overlies the root of the upper canine.

**deflasking—**The removal of the denture from the mold in the flask.

**dental stone—**A special calcined gypsum physically different from dental plaster in that the grains are nonporous and the product is stronger.

**dentition—**The natural teeth as a unit.

**dentulous—**With teeth; as opposed to edentulous (without teeth).

**denture border—**The margin of the denture base at the junction of the polished surface and the impression surface. The peripheral border of a denture base at the facial, lingual, and posterior limits. Also called *peripheral roll*.

**diastema—**A space between the teeth.

**diatoric—**A channel placed in the denture tooth as a mechanical means of retaining it in the denture base.

**direct retainer—**The part of a removable partial denture appliance designed to directly resist dislodgement; for example, the clasp.

**disc—**A flat circular plate usually impregnated with an abrasive agent, used in the laboratory to smooth and polish. The abrasive agent may be silica, garnet, emery, or some other agent.

**distal—**A surface facing away from the midline of the mouth; the distal surface of a tooth.

**dough—**The moldable mixture formed by combining acrylic resin powder and liquid.

**duplicate cast—**A cast produced from an impression of another cast.

**duplicating material—**A substance such as hydrocolloid used to make an impression so an accurate copy of the cast can be produced.

**eccentric—**Any position of the mandible other than its normal position.

**edentulous—**Without teeth; may be an area, an arch, or an entire mouth.

**embrasure—**The space defined by surfaces of two adjacent teeth. The space is divided into occlusal/incisal, facial, lingual, and gingival areas.

**enamel—**The white, compact, very hard substance covering and protecting the dentin of the crown of teeth.

**esthetics—**Harmony of form, color, and arrangement. The quality of a pleasing appearance.

**external or lateral—**Surfaces farther from the medial plane.

**facial—**The surface of the tooth or appliance nearest the lips or cheeks. Used synonymously for the words *buccal* and *labial.*

**festooning—**Shaping and contouring a denture wax-up or the cured denture base to simulate natural tissue.

**finishing—**The process of smoothing and trimming a prosthesis before its final polish. The entire procedure of smoothing and polishing.

**flange—**The part of the denture base which extends on the facial or lingual surface from the finish lines of the teeth to the periphery.

**flash—**The overflow of denture base material which results from over-packing a denture mold. The thin metal fins which sometimes occur on castings.

**flask—**A metal case or tube used in investing procedures. Holds the casts and the investment during the packing and curing phases of denture construction; or the metal ring used to invest a wax pattern. To flask or surround; to invest.

**flasking—**The process of investing a waxed pattern to create a mold.

**flexible—**Capable of being bent without breaking.

**foil—**An extremely thin, pliable sheet of metal, usually of variable thickness.

**framework—**The metal skeleton of a removable partial denture or metal-ceramic fixed partial denture.

**freehand waxing—**A method of waxing in which the wax flows from an instrument directly onto the refractory cast to form the removable partial denture framework.

**fulcrum—**The support upon which a lever rests when a force is applied. In removable partial dentures, an abutment tooth may act as a fulcrum for the appliance.

**gauge—**A measure of the thickness or diameter of an object.

**gingiva—**The gum tissue.

**horizontal overlap—**The projection of teeth beyond their antagonists in a horizontal direction. Also called *overjet*.

**hydrocolloid—**An impression material used extensively in dentistry. It may be reversible agar type or irreversible alginate type.

**impression—**A negative reproduction of a given area.

**incisal—**Pertains to the cutting edge of the anterior teeth.

**incisal edge—**The biting edge of an anterior tooth.

**incisor**—A tooth with a cutting edge; the centrals and laterals.

**index—**A guide, usually of a rigid material, used to reposition teeth or other parts in some original position.

**infrabulge—**The area on a tooth below the survey line.

**ingot—**Gold supplied in the form of one or two pennyweight (1.55 or 3.1 grams) pieces. Some of the base metal alloys are supplied in small cylinders and are also called ingots.

**insertion—**A structure where a muscle attaches that has the greater movement during contraction.

**intercuspation—**The cusp-to-fossa relationship of the upper and lower posterior teeth to each other.

**internal—**Surfaces closer to the medial plane.

**interproximal—**Between adjoining tooth surfaces.

**investment—**The gypsum material used to enclose a denture wax pattern in the flask, forming a mold. In fixed or removable prosthetics, a heat resistant material is used to enclose a wax pattern before wax elimination.

**labial—**Pertaining to the lips. The surface of an anterior tooth opposite the lips.

**labial bar—**The metal piece or major connector connecting the right and the left sides of a lower removable partial denture. It is contoured to the labial tissue anterior to the lower teeth.

**lingual—**Pertaining to the tongue. The surface of a tooth or prosthesis next to the tongue is the lingual surface.

**long axis—**An imaginary line passing lengthwise through the center of a tooth.

**mandibular—**Referring to the mandible or lower jaw.

**margin—**The border or boundary, as between a tooth and a restoration. The outer edge of a crown, inlay, or onlay.

**master cast—**The positive reproduction in stone made from the final impression.

**mastication—**The chewing of food.

**matrix—**The mold in which something is formed to use as a relationship record. The portion of a dental attachment system that receives the matrix. Also called *female attachment*.

**maxilla—**The upper jaw.

**maxillary—**To refer to the maxilla or upper jaw.

**maxillary tuberosity—**An area in the form of a bulge, at the posterior end of the maxillary alveolar ridge.

**maxillomandibular relationship—**Any spatial relationship of the maxilla to the mandible. Also called *jaw relation*.

**maxillomandibular relationship record or registration—**A record of the relationship of the mandible to the maxillae.

**median raphe—**The fibrous tissue extending along the middle of the hard palate.

**mesial—**The surface of a tooth nearest the midline in a normal occlusion.

**metal**—A substance which is to some degree malleable and ductile and which conducts heat and electricity.

**midline—**The imaginary line through the middle of an object, dividing the object into equal parts.

**millimeter—**A unit of length in the metric system equal to 1000 microns or one thousandth part of a meter.

**minor connector—**The part of a removable partial denture frame uniting clasps and rests to the remainder of the framework.

**molars—**The teeth situated in the posterior region of the mouth. The teeth behind the premolars.

**monomer—**A chemical compound that can undergo polymerization. Most common is *methyl methacrylate* liquid.

**mucosa** (mucous membrane)—The soft tissue lining the oral cavity.

**occlude**—To bring together; to bring the upper and lower teeth together.

**occlusion—**The act or process of closure or of being closed or shut off. The static relationship between the incising or masticating surfaces of the maxillary or mandibular teeth.

**occlusal rim—**The wax occlusal extension of a denture base used to establish jaw and tooth relationship during the construction of a partial or complete denture.

**palate—**The roof of the mouth; classified into both hard and soft palate areas.

**periodontics—**The branch of dentistry dealing with the science and treatment of the tissues and bone surrounding the teeth.

**periodontium—**Collectively**,** the tissues which surround and support the tooth.

**placement—**The process of directing a prosthesis to a desired location; the introduction of prosthesis into the patient's mouth. Also called *insertion*.

**plastic—**Capable of being shaped or formed**.** Pertaining to the alteration of living tissues**.** Any of numerous organic synthetic or processed materials that generally are thermoplastic or thermosetting polymers. They can be cast, extruded, molded, drawn, or laminated into films, filaments, and objects.

**pit—**In dentistry, a depression usually found where several developmental lines intersect.

**polishing agent—**Any material used to impart a luster to a surface.

**polymer—**Compound (powder) composed of smaller organic units. Most common in dentistry is methyl methacrylate powder.

**pontic—**A suspended artificial tooth on an isolated tooth on an RPD.

**porous—**Pitted; not dense; containing voids and bubbles.

**porosity—**The presence of voids or pores within a structure.

**posterior—**Situated in back of or behind.

**posterior tooth—**All premolar and molars.

**process**—In anatomy, a prominence or projection of bone. In dentistry, any technical procedure that incorporates a number of steps; the procedure of polymerization of dental resins for prostheses or bases.

**prosthesis—**An artificial replacement for a lost part of the body. In dentistry, it is used in the more limited sense of a strictly dental replacement. Plural is *prostheses.*

**proximal—**Situated close to. Next to or nearest the point of attachment or origin, a central point.

**Pulp—**The connective tissue found in the pulp chamber and canals, made up of arteries, veins, nerves, and lymph tissue.

**quadrant—**In dentistry, one of the four sections of the dental arches, divided at the midline.

**reciprocal arm—**The rigid arm of the clasp located opposite the retentive arm, designed to oppose pressure exerted by the retentive arm.

**reciprocation—**The means by which one part of a removable dental prosthesis (RDP) counters the forces of an opposing part.

**record base—**An interim denture base used to support the record rim material for recording maxillomandibular records.

**refractory cast—**A heat-resistant duplicate of a blocked out and relieved master cast.

**relief—**The reduction or elimination of undesirable pressure or force from a specific region; e.g., The scraping of a working cast to better fit a facing to the ridge**.** Material added to a cast to relieve the pressure over specific areas in the mouth. Also added to the master cast before duplicating it to create a raised area on the refractory cast.

**reline—**The replacement of the tissue surface of the denture to make it fit more accurately.

**removable partial denture—**A dental prosthesis which artificially replaces teeth and associated structures in a partially edentulous dental arch and can be removed and replaced by the patient.

**resin—**A gummy substance obtained from various trees. It is used to make many dental materials. A broad term used to describe natural or synthetic materials that form plastic materials after polymerization.

**resorption—**The loss of tissue substance by physiologic or pathologic processes. The roots of the primary teeth are resorbed naturally.

**retromolar pad—**The soft tissue pad at the posterior extremity of the mandibular ridge.

**ridge—**An elevated body part; a long, narrow, raised crest. A linear elevation of enamel on the surface of a tooth; for example, a marginal ridge. The alveolar ridge: the area of the upper and lower jaws formerly occupied by the natural teeth.

**ridge lap—**The area of an artificial tooth which normally overlaps the alveolar ridge. It corresponds, on the inner surface of the denture tooth, approximately to the location of the collar on the facial surface.

**ridge relationship—**The position of the upper and lower ridges relative to each other.

**ridge resorption—**The resorption of the alveolar bone, once teeth are no longer present, resulting in a progressively flatter ridge.

**root—**The portion of the tooth covered with cementum.

**rugae—**The elevated folds or wrinkles of soft tissue situated in the anterior part of the palate.

**saturated calcium sulfate dihydrate solution—**A clear, true solution of water and a maximum amount of dissolved, dihydrate (set) gypsum product.

**separating medium—**An agent used between two surfaces to prevent them from sticking together.

**shade—**A term used to describe a particular hue, or variation of a primary hue, such as a greenish shade of yellow.

**solder—**A fusible metal alloy used to unite the edges or surfaces of two pieces of metal. The act of uniting two pieces of metal by the proper alloy of metals.

**solute—**In a solution, the dissolved solution is called the solute. In salt water, the water is the solvent, and the salt is the solute.

**stability—**The property of resistance to tipping and rocking of a prosthesis.

**sulcus—**A furrow, fissure, or groove. In dentistry, a linear depression in the surface of a tooth, the surfaces meet at an angle. A sulcus is always found along the surface of a developmental line. Sulci is the plural form.

**superior—**Above.

**tooth arrangement—**The placement of teeth on a denture with definite objectives in mind.

**torque—**A twisting force.

**try-in—**A preliminary insertion of trial dentures, a partial denture casting, or a finished restoration to evaluate fit, appearance, maxillomandibular relations, and so forth.

**vault—**The palate or roof of the mouth.

**vertical dimension of occlusion—**The distance measured between two points when the occluding members are in contact.

**vertical overlap—**The distance teeth lap over their antagonists as measured vertically. It may also be used to describe the vertical relations of opposing cusps. The vertical relationship of the incisal edges of the maxillary incisors to the mandibular incisors when the teeth are in maximum intercuspation.

**wax—**There are many different types of waxes used in dentistry; each is compounded to produce certain physical properties for a specific purpose. They are manufactured in various forms, such as baseplate, boxing, inlay, and sticky.

**wax pattern—**Wax which has been formed into the size and shape desired in the finished prosthesis and used to form the mold in the investment.

**wax-up—**(noun) The finished wax pattern for any dental prosthesis. (verb) To smooth and finish the wax on a complete denture. To flow and carve a wax pattern for a fixed restoration. To contour the wax for any dental prosthesis.

## Abbreviations and Acronyms

| | |
|---|---|
| **°** | degree |
| **ADL** | area dental laboratory |
| **AP** | anteroposterior |
| **cc** | cubic centimeter |
| **F** | Fahrenheit |
| **gr** | grain |
| **IR** | indirect retention |
| **mm** | millimeter |
| **No.** | number |
| **OR** | open retention |
| **psi** | pounds per square inch |
| **RAP** | reinforced acrylic pontic |
| **RDP** | removable dental prosthesis |
| **RPI** | rest, plate, I bar |
| **rpm** | rotations per minute |
| **SDS** | saturated calcium sulfate dihydrate solution |
| **VDO** | vertical dimension of occlusion |

# Student Notes

**AFSC 4Y052**
**4Y052 04 1912**
**Edit Code 06**