R.P.D. Syllabus

"Simplifying the Challenge of R.P.D. Design"

2nd Edition

Provided by

Johns Dental Laboritories, Inc.
423 So 13th Street
Terre Haute, IN, 47807
800: (800)457-0504
Phn: (812)232-6026
Fax: (812)234-4464
Web: www.johnsdental.com
Email: labinfo@johnsdental.com

R.P.D. Syllabus

"Simplifying the Challenge of R.P.D. Design."

2nd Edition

L.T. Armstrong, D.M.D.

The purposes of this Syllabus are as follows:

1. Discuss considerations for standard R.P.D. designs.
2. Describe the various types of esthetic clasps available.
3. Show the tooth preparation required for their successful use.
4. Illustrate the situations where each can be used to its best advantage.

Acknowledgments

Portions of this syllabus, particularly the sections describing the Rotational Path designs and the “pump handle effect”, are abstracted from “Removable Partial Denture Designs”, outline syllabus, third edition, Arthur J. Krol, D.D.S., Theodore E. Jacobson, D.D.S., and Frederick C. Finzen, D.D.S.

EsthetiClasp™ is a trademark of Vitallium/Austenal. Most of the information for this design comes from Austenal research and their technique manuals.

Counterpoise™ is a trademark of Armstrong Laboratory, Inc.

Saddle-Lock™ is a trademark of Saddle-Lock Inc. and restorations are constructed through a license agreement.

Equipoise™ is a trademark of Dr. Gerome Goodman, D.D.S.

Table of Contents

Introduction: Simplifying the Challenge of R.P.D. Design

Dr. L.T. Armstrong

The purpose of this Syllabus is to clarify the many different clasp designs available. Further to simplify the selection process in order to provide your patient with the best possible removable appliance. There is no perfect removable appliance, so "best possible" is defined as meeting, as closely as we can, the following criteria:

a) It restores the lost occlusal function caused by the patient's missing teeth,
b) it minimizes the stress placed on abutment teeth to ensure their longevity,
c) it minimizes the trauma to the supporting and surrounding tissue and bone,
d) it's self-cleaning and does not produce food entrapment areas,
e) it's comfortable for the patient to use and wear, and
f) it meets the particular esthetic needs of your patient.

The first part of the syllabus describes the most commonly used clasp designs. These three designs and their variations have been used for as long as dentistry has been able to make castings. They are:

a) The Akers or "C" clasp,
b) The Roach or "T" clasp, and
c) The Ring or back action clasp.
d) The "H" or "Double C" clasp is a variation of the Akers clasp.
e) The "I-bar" clasp is a variation of the Roach or "T" clasp.

However, in the late 50's or early 60's, Dr. Arthur Krol, using the "I-bar" and two proximal plates, developed the "R.P.I." design concept. His design was a great improvement in clasping. It better met the entire criteria list above.

With increased patient awareness of the esthetic potential of dentistry, there is more interest in esthetically designed clasps. Clasps that would eliminate the facial display of metal without the expense and maintenance requirements of precision attachments. Currently, there are five designs with seven variations to meet these esthetic requirements.

a) Equipoise®,
b) Saddle-Lock®,
c) Estheti-Clasp®,
d) Counterpoise®, and
e) Rotational Path®

The syllabus' second, third, and fourth parts describe these designs, the indications and advantages of each, and their preparation requirements.

The appendix of this syllabus discusses recommended clinical procedures for using crowned abutments, taking impressions, and pouring up models.

The primary problem with R.P.D.s comes from requiring two to four abutment teeth to carry, not only their own occlusal load, but also the load of four to eight other missing teeth. It is difficult to design an appliance that does not cause irreparable damage to these abutments. Example, a common R.P.D. repair is, *"extract abutment, add to partial and move the clasp to the next tooth."*

The cause of the problem is the "crowbar" stress that many clasp designs place on abutment teeth. Dr. Krol refers to this as the "pump-handle" effect.[1] And Dr. Goodman calls it the "class I lever" effect.[2] By any name it can result in tooth extraction (see figures 1, 2, and 3 on the following page). In a class I lever or a crowbar, the force (occlusal load) is one side of the fulcrum (rest) and the resistance (the clasp on the abutment tooth) is on the other. The strength of the force is greatly magnified by the length of the lever arm (increased distance from the fulcrum) and the closeness of the resistance to the fulcrum. An easy step to reduce abutment stress in a free end saddle is to move the rest from the distal fossa to the mesial fossa. This creates a class II lever[3] (resistance and force on the same side as the fulcrum) and greatly reduces the stress on the abutment.

Another factor in the success of an R.P.D. is the utilization of tissue/bone bearing areas. The broader the bearing area, the better. On the upper, covering as much of the palate as possible improves both stability and support. A broad horseshoe design provides more support than a palatal bar. Carried to the extreme, a full cast palate provides the most support, but it sharply reduces your patient's comfort and ability to tolerate the appliance. Therefore, it is rarely used. On lower free end R.P.D.'s, covering the anterior half of the retromolar pad provides distal support for the appliance and **greatly** reduces the stress on the abutment teeth. The mesial half of the pad is stable and does not resorb, as does the alveolar bone. Coverage is best done by using a cast, "golf cap" extension from the mesh retention areas. The term "golf cap" means a small cast extension covering **only** the pad's mesial half and does not overlap the tissue lateral to it. The coverage of the pad taught by Dr. Thomas Shipmon Sr. is ideal support for a mandibular free end saddle. However, the chrome base can be difficult to adjust if over extended and it can't be relined.

An important consideration not covered in this Syllabus is the hygienic factors of an R.P.D. Dr. Arthur J. Krol did a great deal of research in this area. These factors are covered extensively in his book titled "Removable Partial Denture Design" (see bibliography).

A valuable tool in partial denture design is the Retentoscope. This instrument was developed a number of years ago as part of the Saddle-Lock technique. Normal surveying procedures determine the crest or height of contour but only vertically. The procedure does not accurately measure the horizontal depth of the undercut gingival to the crest of contour. The gauge on the left side of the Retentoscope (figure 4) accurately measures the depth of the undercut. This allows the clasp tip to be place in the optimum undercut.

This syllabus does not cover all of the variations that you will face. To assist you in your diagnosis, all Terec Laboratories offer a free survey and design service. If you send in your patient's study cast, we will survey the model(s), suggest a design and prepare the abutment teeth approximately as you would need to prepare the patient's teeth. The models are then returned to you with a written outline for your approval.

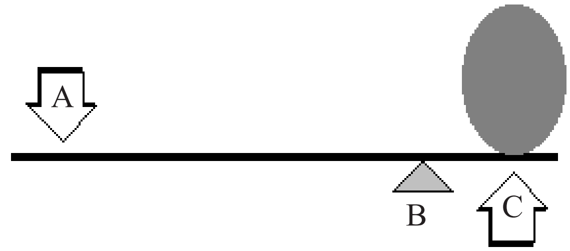

Fig #1: This is a simple representation of a lever. By pressing on area (A), braced against the fulcrum (B), it's possible to lift the rock (C).

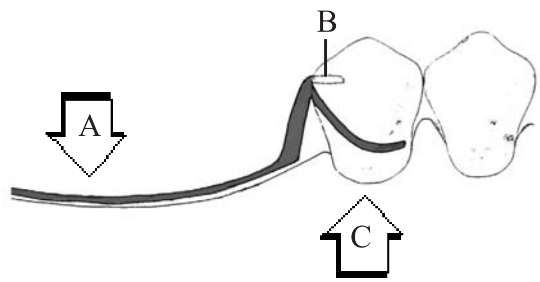

Fig #2: This "lever" (frame) works in a similar way except that the fulcrum is the distal rest.

Fig #3: The lever in figure 2 results in gradual tooth extraction.

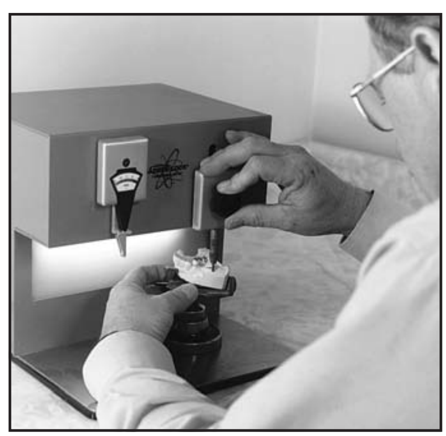

Fig #4: The Retentoscope accurately measures the depth of the abutment's undercut.

Part I: Standard Designs

There are a number of standard clasp designs that have been used for years to construct removable partial dentures. Some of them date back to the pre-casting period of dentistry. These clasps were constructed by bending gold wire around the tooth, adapting platinum foil over the distal marginal ridge and soldering a rest and tang (or loop) to the adapted gold wire. Today's most commonly used cast clasp, the Akers or “C” clasp, is an example of this old wrought wire technique.

This syllabus will cover only the most commonly used designs. These are:

1. Akers or “C” Clasp
2. Roach or “T” Clasp
3. “H” or “Double C” Clasp
4. Ring or Back Action Clasp
5. “I-Bar” Clasp

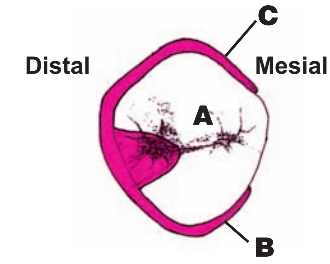

Fig #5: “C” Clasp, Occlusal View

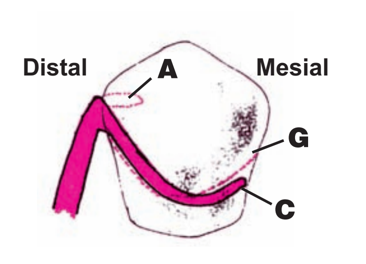

Fig #6: “C” Clasp, Buccal View

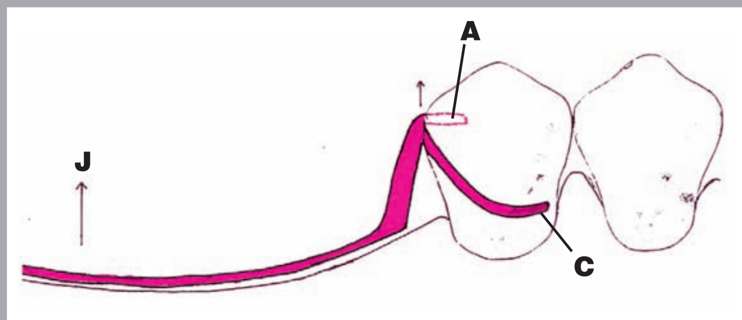

Figure #7: (Disadvantage to “C” Clasp #2)
The free-end saddle lifts easily during mastication.

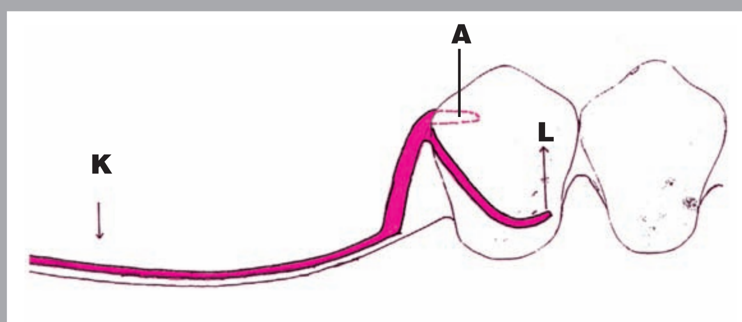

Figure #8: (Disadvantage of “C” clasp #3)
The lever effect can damage the abutment tooth.

Section 1: Akers or “C” Clasp

The components of this clasp are illustrated in figure 5 and 6. They consist of the rest (A), the reciprocal or bracing arm (B), the retentive arm (C), and its relation to survey line (G). It's used primarily on the distal abutment of free-end saddles and on both anterior and posterior abutments of the tooth borne saddles. The design has three disadvantages when used with a free-end configuration. These are:

1. Both the retentive and reciprocal clasp arms cover the entire buccal and lingual surfaces, eliminating the tooth's self-cleansing action. This disadvantage also exists when used in a tooth-borne configuration.

2. Because the area of retention (C) is the mesial portion of the buccal surface (figure 7), there is no resistance to the saddle lifting (J) during mastication. The lift caused by tacky food results in the patient's complaint, “food gets under my partial.”

3. Because the clasp is usually configured with a distal rest, excess stress is transmitted to the abutment. This is described in the literature as the “pump handle effect[1]” (Dr. Krol's term) or the “class I lever effect[2]” (Dr. Goodman). In figure 8, the rest (A) is the fulcrum and the saddle and the clasp are the lever

arms. When force is applied to the longer saddle lever arm (K), it is magnified on the shorter clasp lever arm (L). The result is either damage to the abutment's P.D.M. or clasp breakage. One of the most common partial repairs is, "add abutment to the partial and move clasp forward to the next tooth."

Using a mesial rather than a distal rest (fig. 9) can eliminate the third disadvantage. By using a mesial rest, the class I lever is converted to a less damaging class II lever.[3]

Section 2: Roach or "T" Clasp

The components of this clasp are illustrated in figures 10 and 11. They consist of the rest (A), the reciprocal or bracing arm (B), the retentive arm (C), and its relationship to the survey line (G).

It is used primarily on the distal abutment of free-end saddles and on the anterior abutment of tooth-borne saddles. Since the buccal approach arm of the clasp should have a 3 mm drop from the gingival margin (H, figure 11), there is usually inadequate space on the buccal side of molars for this design. The Roach or T clasp has a "L" modification. The mesial portion of the retentive arm is not waxed on the clasp, making an upside down "L" clasp.

The Roach clasp has the same disadvantages associated with an Akers clasp discussed in section 1: It denies a tooth's self-cleansing, there's no resistance to lift, and there's excess stress on the abutment. As with the Akers clasp, the last disadvantage can be reduced by moving the rest from the distal to the mesial fossa (figure 9).

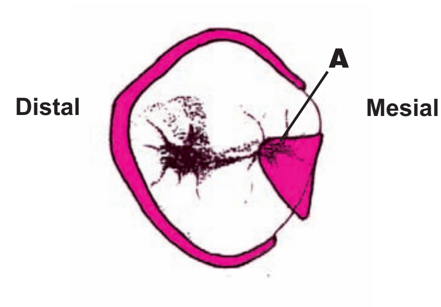

Figure: #9: Using a mesial rest even with non-esthetic partials is recommended.

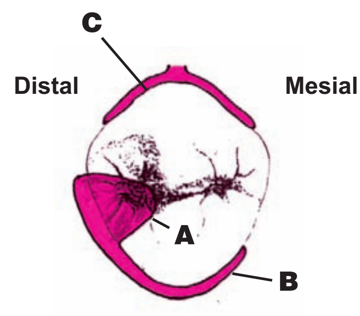

Fig #10: Roach Clasp, Occlusal View

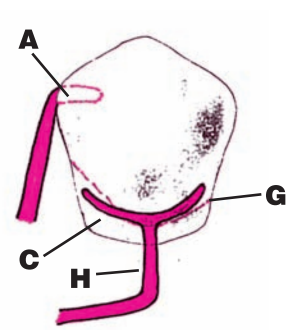

Fig #11: Roach Clasp, Buccal View

Reason to use Armstrong #2: Armstrong Laboratory "wrote the book" on R.P.D. design.

Section 3: "H" or "Double C" Clasp

The components of this clasp are illustrated in figure 12, 13, and 14. They consist of two rests (A), two reciprocal arms (B), two retentive arms (C), and their relationship to the survey line (G). It is used primarily either on the opposite side of the arch from a saddle area (where that arch section has no missing teeth) (figure 12) or on the two teeth immediate anterior to a free-end saddle (figure 13).

The problems associated with this design are:

1. the full coverage of the buccal and lingual arms eliminates the tooth's self-cleansing action, and

2. when used on an intact arch section opposite a free-end saddle, torque is a problem. The normal movement associated with a free-end saddle causes the opposite H clasp to flex during mastication. Because of the flexing, the H clasp will work-harden, become brittle, and break.

When this design is used for cross arch stabilization and retention, a trans-occlusal groove should be prepared as described in Part IV, section 5, figures 44, 45, and 46.

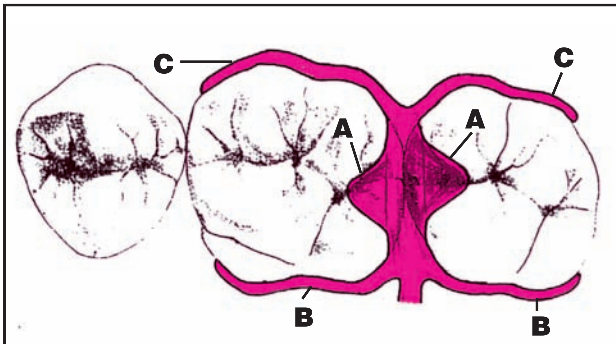

Figure #12: "H" Clasp, Occlusal View

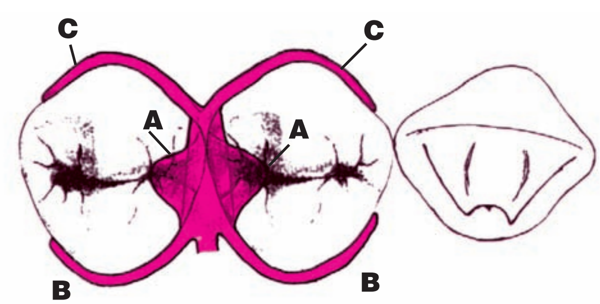

Figure: #13: "H" Clasp, Occlusal View

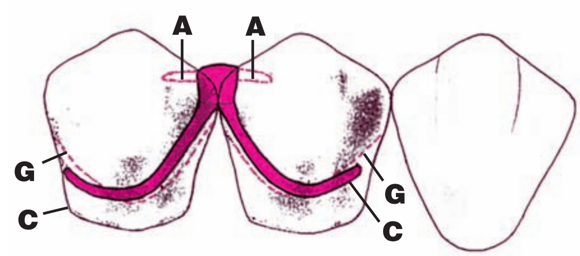

Figure #14: "H" Clasp, Buccal View

Section 4: The Ring or Back-Action Clasp

The components of this clasp are illustrated in figures 15 and 16. They consist of the rest (A), the reciprocal arm (B), the retentive arm (C), and its relationship to the survey line (G). Note that the reciprocal or bracing arm and the retentive arm are contained on the same arm, its function changing as it wraps around the abutment. It is used primarily on the molar abutment of a tooth-borne saddle. It is the clasp of choice when the molar is tilted mesially.

There are two disadvantages of this design. First, the clasp arm blocks the normal self-cleansing action of the tooth. Second, the long arm with both bracing and retention on the same component increases flex. Consequently, there's a greater potential for fracture due to work hardening.

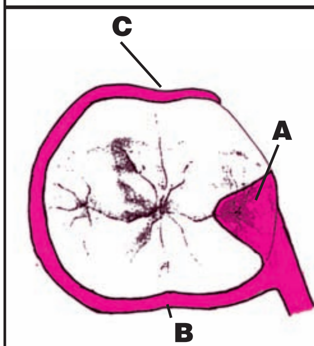

Fig #15: Back-Action Clasp, Occlusal View

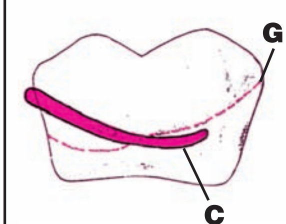

Fig #16: Back-Action Clasp, Buccal View

Reason to use Armstrong #3: Armstrong Laboratory does not "farm out" its frames like other labs.

Section 5: "I-Bar" Clasps

The components of this clasp are illustrated in figures 17, 18, and 19. Note that the clasps can be configured using a lingual arm as in figure 17 or no lingual arm but a distal proximal plate (as in figure 18). When used with a distal plate, the portion of the rest's minor connector just gingival to the rest (A) and the distal plate combine to provide reciprocation (B) to the retentive I-bar arm (C). When used with a proximal plate, a distal guide plane should be prepared as described in part IV, section 2C, figure 43, except that the guide plane should only be 2 mm wide occluso-gingivally.

Primary indications for this design are the abutment for the posterior free-end saddle and the anterior abutment for the tooth-borne saddles. Because of the 3mm clasp drop from the gingival margin (H, figure 19), there is usually insufficient room for its use on molars. Also, the position of the buccal frenula in the bicuspid region may contra-indicate its use, again because of the 3mm drop required.

Mesial rests are always indicated with the I-bar design. This is particularly necessary when used with free-end saddle configurations.

Using a distal rest produces damage to the P.D.M. of the abutment. The retentive area is focused to a single point on the buccal surface and the lever arm action, described in section A, figure 8, is destructive.

The I-bar design shown in figure 18 is almost identical to the R.P.I. design developed by Arthur Krol.[3] In a distal free-end configuration, the rest is always placed in the mesial fossa. Note that the undercut used for the I-bar retention is always mesial to the greatest mesio-distal convexity of the abutment. An R.P.I. appliance also uses two guide planes. The most obvious is on the distal (as explained in the first paragraph describing I-bar clasps). The second plane is gingival to the lingualized mesial rest. This guide plane does not break or damage the natural contact between the abutment and adjacent tooth. However, it is as tall gingivo-occlusally and as wide bucco-lingually as the space will permit.

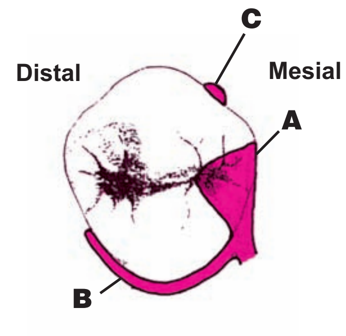

Figure #17: "I-bar", Occlusal View

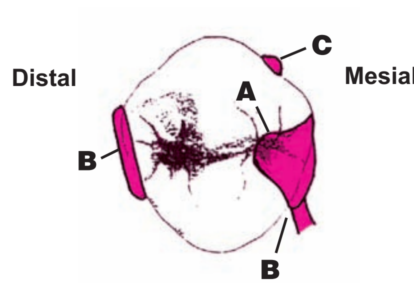

Figure #18: "I-bar", Occlusal View

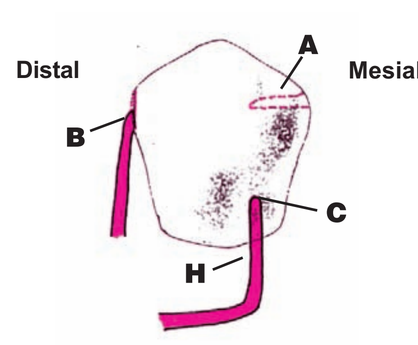

Figure #19: "I-bar", Buccal View

Reason to use Armstrong #4: Armstrong Laboratory offers complimentary survey, design, and consultation.

Part II: Overview of Esthetic Partial Designs

Types of Esthetic Clasps

When the dental profession first became aware of esthetic clasps, there were only one or two designs available. Obviously, this limited selection could not fit every situation and working within these limitations was difficult.

Currently, there are four basic types of esthetic clasps. Three of them have standard modifications resulting in eight designs available to meet your case requirements. Consequently, it is no longer necessary to force a design on a case. With this wide choice, you can select the one that fits the individual case requirements. **Therefore, it is beneficial to you that your laboratory has a thorough working knowledge of all of these designs.**

These designs (with modifications) are:

1. Saddle-Lock
   A. Free-end modification
   B. All tooth-borne modification
2. EsthetiClasp
   A. “C” modification
   B. “L” modification
   C. “J” modification
3. Counterpoise
4. Rotational Path
   A. Anterior modification
   B. Posterior modification

There is a fifth design. However, it requires cutting through and permanently opening the contact between the abutment and it’s adjacent tooth. Currently it is little used and, therefore, not listed here.

All of these designs adhere to the original basic requirements of clasp physiology, which are:

(a) encompassing the abutment tooth at least 181 degrees (see figure 20),
(b) tripod three point contact of the abutment (see figure 21), and
(c) a reciprocal area approximately opposite the retentive area on the abutment.

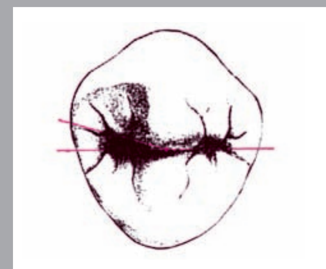

Figure #20: In order to provide retention, a clasp must encompase the tooth by more than 180 degrees.

Figure #21: In order to provide retention, a clasp must have three point contact.

Benefits of Esthetic Designs

There are numerous advantages to you in all of these designs:

- **Esthetics:** They do not show facial display of the metal retentive clasp arms.
- **Superior Retention:** Normal tooth contour provides a more dependable and useable undercut on the proximal surfaces than on the facial or lingual surfaces.
- **Gentler to Abutments:** Both the rest placement and retentive area used, reduce stress on the abutment tooth during normal functions by eliminating the "pump handle" effect.
- **Superior Function:** The retentive clasp is activated to resist lift of the appliance due to tacky food during function. It is passive during chewing compression and does not transmit stress to the tooth as, for example, an Akers clasp.
- **Durability:** It does not bend or torque during function. This reduces work hardening and the resulting clasp breakage. Esthetic designs function longer without problems.

Contra-Indications of Esthetic Designs

Esthetic designs are difficult when the patient has all six anteriors (cuspid abutments) with no posterior teeth, either bilateral or unilateral. The problem stems from the natural shape of cuspids. When viewed from the occlusal and from the proximal, cuspids are triangular in shape (figure #22). This shape makes it difficult to obtain the mesial height on the guide plane necessary for adequate reciprocation. Also the triangular shape places the point of retention (181 degrees from the reciprocal plate) too far around on the labial surface for esthetics. These problems are solvable with the use of a crown on the cuspid abutment (see part V of this syllabus).

One exception: If the patient has abnormally twisted cuspids where their buccal surface is parallel to the labial surface of the centrals, retention may be possible without facial clasps or crowning.

Any design, esthetic or standard, can be difficult when the patient has an extremely deep overbite. If the lower teeth touch the upper lingual gingival tissue, there is no room for minor connectors. This problem must be corrected by crowning or selective grinding the lowers for any type R.P.D. to be successful.

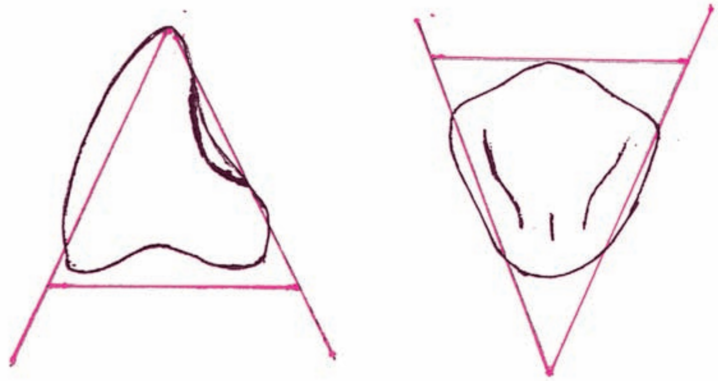

Figure #22: The triangular shape of cuspids makes it difficult or impossible to clasp without using the labial surface.

Reason to use Armstrong #6: Armstrong Laboratory uses Vitallium 2000 Plus in all its non-economy frames.

Part III: Esthetic Design Descriptions

Section 1A: Saddle-Lock (Free-End Modification)

The placement of the components of a Saddle-Lock clasp is illustrated by the line drawings in figures 23, 24, and 25. They consist of the rest (A), the reciprocal plate (B), the retentive clasp (C) and the protective plate (D). The retentive clasp is a round, light arm (18 ga. in thickness) and is suited for deep undercuts (0.02-0.025mm). It is connected to the partial frame in the area of the finish line of the saddle. It threads through a slot formed in the protective plate (D) but does not contact it. The protective plate functions to keep the light clasp in proper relationship to the surveyed tooth undercut. The reciprocal plate (B) acts like the lingual arm on a standard clasp, providing bracing action for the retentive arm. It is placed approximately 181 degrees opposite the retentive point. It is directly connected to the horseshoe or palatal bar leaving the lingual surface of the tooth open for normal self-cleansing action. By placing the rest (A) in the mesial fossa, the "pump handle[1]" effect is eliminated, reducing stress on the abutment. On all free-end designs, the rest is the fulcrum. It's mesial placement allows the retentive clasp to move gingivally when the saddle is compressed by chewing action, reducing torque on the abutment.

Indications: This design is best used for free-end saddles with bicuspid or molar abutment (not cuspids, see contra-indications). The abutments must be tall interproximally (4-5mm from the marginal ridge to the gingival crest). The height provides the space required for the clasp and the protective plate. The thin, flexible clasp adapts well to a normal to deep undercut on the distal surface (0.02-0.025mm).

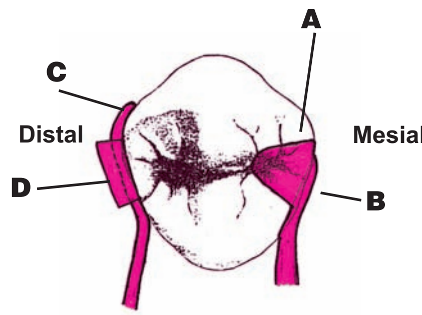

Figure #23: Saddle-Lock, Free End, Occlusal View

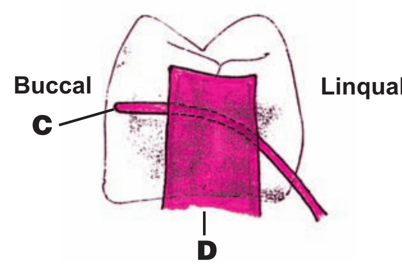

Figure #24: Saddle-Lock, Free End, Distal View

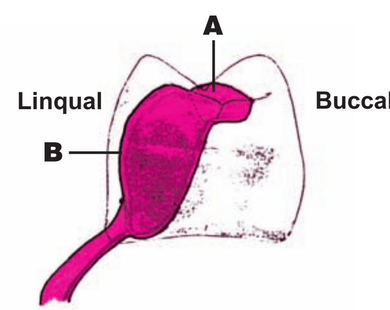

Figure #25: Saddle-Lock, Free End, Mesial View

Section 1B: Saddle-Lock (Tooth-Borne Modification)

The placement of the components of this clasp is illustrated by the line drawings in figures 26, 27, and 28. Since the appliance is all tooth

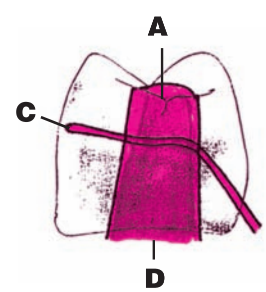

Figure #26: Saddle-Lock, Tooth-Borne, Distal View

Reason to use Armstrong #7: Armstrong Laboratory checks all cases under magnification to ensure quality fit.

borne, there is no "pump handle[1]" problem. This permits the rest to be placed in the fossa adjacent to the saddle areas. The components are the rest (A), the retentive clasp (C), the protective plate (D) and the reciprocating or bracing area (B). The retentive clasp arm and it's relationship to the protective plate is the same as described in section 1A. The only difference is that the protective plate (D) is connected to the rest (A), figures 27 and 28.

Note that the solid contact areas of the teeth anterior to the clasp provide the bracing for the anterior retentive clasp, (B) fig. 28. If there are spaces in these areas, the free-end modification described in 1A must be used. The bracing function for the posterior abutment, fig.27, is provided by the lingual clasp arm that wraps around the distal of the abutment (B).

If the dentist diagnoses a weakness in the posterior abutment that would indicate it's possible early loss, the Saddle-Lock Free-end clasp design should be used on the anterior abutment. This would allow for the later addition of the posterior tooth to the appliance without having to remake it.

Indications: This design is best used for fully tooth-supported saddles. Since there is a molar abutment present, a cuspid can be used as the anterior abutment. The abutments must be tall interproximally (4-5mm from the marginal ridge to the gingival crest). The height provides the space required for the clasp and the protective plate. The thin, flexible clasp adapts well to a normal to deep undercut on the distal surface (0.02-0.025mm).

Section 2A: EsthetiClasp ("C" Modification)

The placement of the components of this clasp is illustrated by the line drawings in figures 29 and 30. They consist of the rest (A), the retentive arm (C) and the reciprocal or bracing plate (B). In this design the retentive arm is connected to the bracing plate/rest assembly. The thickness of the clasp can be varied to match the depth of the undercut used. It's only disadvantage is that the retentive arm crosses the lingual surface, eliminating the tooth's self-cleansing action in this area.

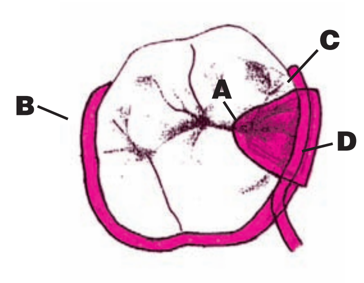

Figure #27: Saddle-Lock, Tooth-Borne, Occlusal View

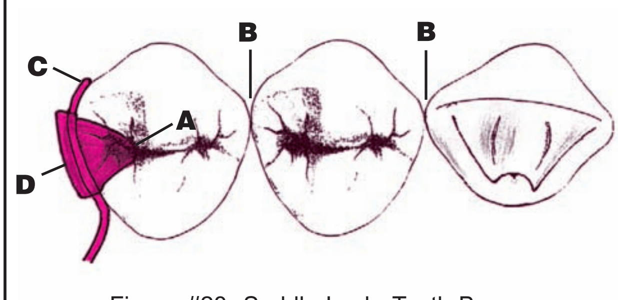

Figure #28: Saddle-Lock, Tooth-Borne, Occlusal View

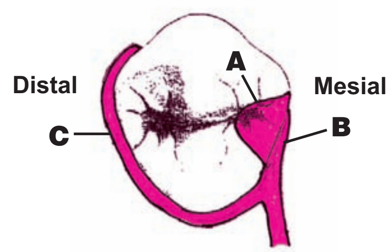

Figure #29: EsthetiClasp "C", Occlusal View

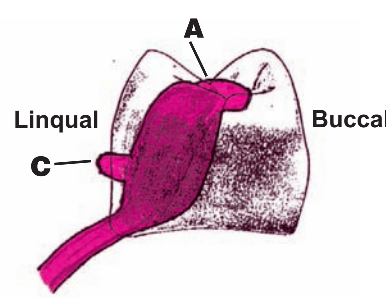

Figure #30: EsthitiClasp "C", Mesial View

Reason to use Armstrong #8: Armstrong Lab's turnaround time for a frame (usually four working days).

Indications: The design is used primarily in long saddle areas (replacing 4-6 large teeth). The clasp thickness can be varied depending on the undercut present (0.005 - 0.02 mm).

Section 2B. EsthetiClasp ("L" Modification)

The placement of the components of this clasp is illustrated by the line drawings in figure 31 and 32. They consist of the rest (A), the retentive clasp arm (C), the reciprocal or bracing plate (B) and the trans-occlusal connector (E). Note: the bracing plate (B) is a very small, flat extension on the facial surface of the molar. It covers only the occlusal 1/5 of the distal slope of the distal buccal cusp. Its small size on the distal of the 1st molar does not cause an esthetic problem. It is a better alternative than the more standard buccal clasp arm. Normally, no preparation required for this bracing plate. The EsthetiClasp "L" modification is a single unit clasp assembly connected to the major connector, horseshoe or palatal bar (F). It's only disadvantage is that the retentive arm crosses the lingual surface, eliminating the tooth's self-cleansing action in this area.

Indications: This design is used primarily across the arch from unilateral saddle where the dentition is intact.

Section 2C. EsthetiClasp ("J" modification)

The components of this clasp and their tooth position are illustrated in the line drawings, figure 33 and 34. They consist of the rest (A), the retentive arm (C), the reciprocal or bracing plate (B) and the trans-occlusal connector (E). The placement of the bracing plate (B) is exactly the same as described in 2B, (EsthetiClasp "L" modification). The retentive arm (C) used for this design is an "I-Bar" attached directly to the major connector (F). This split or two-part clasp assembly has the advantage of leaving most of the lingual surface clear for the tooth's normal self-cleansing action.

Indications: This design is used primarily across the arch from unilateral saddle where the dentition is intact.

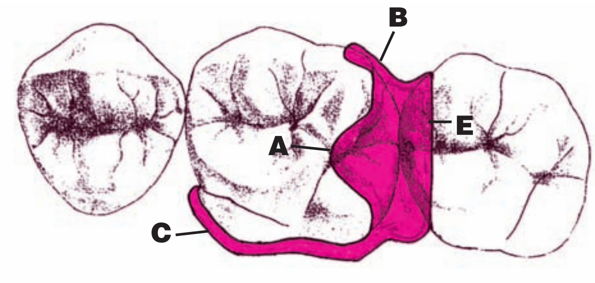

Figure #31: EsthetiClasp "L", Occlusal View

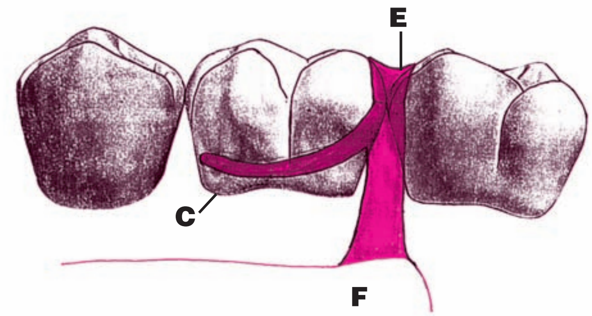

Figure #32: EsthetiClasp "L", Lingual View

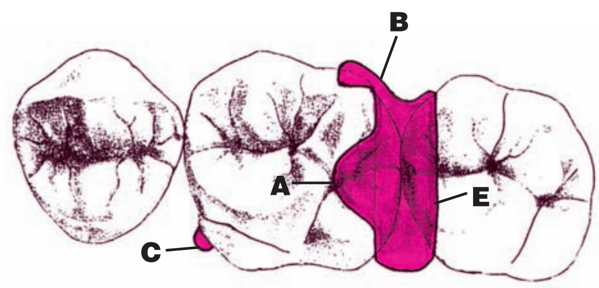

Figure #33: EsthetiClasp "J", Occlusal View

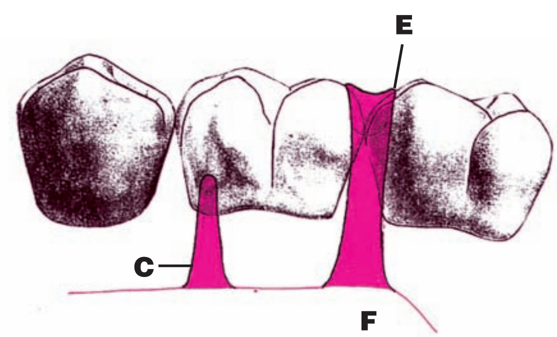

Figure #34: EsthetiClasp "J", Lingual View

Reason to use Armstrong #9: "The five-minute frame."

Section 3A. Counterpoise

The components and their placement are illustrated in the line drawings, figures 35, 36, and 37. They consist of the rest (A), the reciprocal or bracing plate (B) and the separate retentive arm (C). The retentive arm (C) can be varied in thickness to suit the amount of undercut present, i.e. made thicker for less undercut and thinner for deeper undercut. Because there is no clasp housing or protective plate as in Saddle-Lock, the assembly does not require as much occluso-gingival tooth height. It is ideally suited for saddles where the teeth are short (less than 3 mm to marginal ridge). It does not interfere with self-cleansing ability of the tooth.

Indications: The distal design clasp thickness can be varied to match degree of undercut (.005 to .025). It's primarily used in free-end and tooth-borne saddles where the teeth are short (less than 3 mm to marginal ridge).

Section 4A. Rotational Path (Anterior Modification): This restoration is described Part IV, preparation requirements.

Indications: This design is used in cases that are missing only anterior teeth with full compliment of the posterior teeth.

Section 4B. Rotational Path (Posterior Modification): This restoration is described in Part IV, preparation requirements.

Indications: This design is best used with posterior tooth-borne saddles with severely tilted molars.

Figure #35: Counterpoise, Mesial View

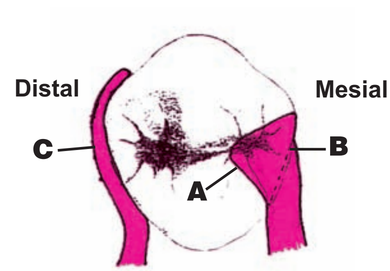

Figure #36: Counterpoise, Occlusal View

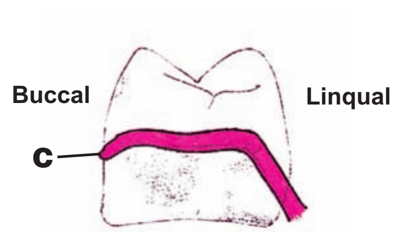

Figure #37: Counterpoise, Distal View

Reason to use Armstrong #10: Try us any you'll agree that no one makes a better frame.

Part IV: Preparation Requirements of Esthetic Designs

All tooth modifications and preparations suggested in these sections are done by enameloplasty. In no case should any of the preparations penetrate through the enamel into dentin. While the preparations are critical to the success of the appliance, any which would penetrate the enamel will indicate the need for crowns on the abutment teeth.

Section 1: Rest Preparations (General)

A. Rest preparations should be deep enough to allow a rest thickness of at least 1.5mm.

B. Rest seats should be prepared with relatively parallel walls (not spoon shape) so the rest provides bracing for the appliance (see figure 39-arrows).

C. Rest should be broad - at least ˚ the width of the occlusal table and 1/4 to 1/3 of the mesial distal length of the table, 1/4 for molars and 1/3 for bicuspids (fig. 38).

D. The proximal occlusal line angle of the rest should be rounded, not a sharp right angle.

E. Brassler makes two F.G. diamond burs that are good for preparing rests: #845.KR.018 for bicuspids and #845.KR.025 for molars.

Section 2: Tooth Preparation Necessary for Esthetic Clasping of a Distal Free-End Saddle.

Clasp of choice: Counterpoise, Saddle-Lock Free-end Modification, and EsthetiClasp "C" Modification.

Preparation:

A. Prepare a rest (A on figures 40-42) as described above in the mesial fossa of the abutment tooth.

B. On the lingual half of the mesial surface of the abutment, prepare a flat guide plane (B on figures 40-42). This plane should be as tall as possible from gingival to occlusal and as wide as possible from lingual toward the buccal without destroying the contact area. **Note**: All flat guide planes used for the appliance should be as parallel to one another as clinically possible. These guide planes are fit-

Figure #38: General Preparation Requirements, Occlusal View

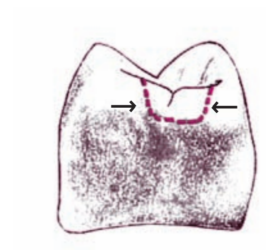

Figure #39: General Preparation Requirements, Mesial View

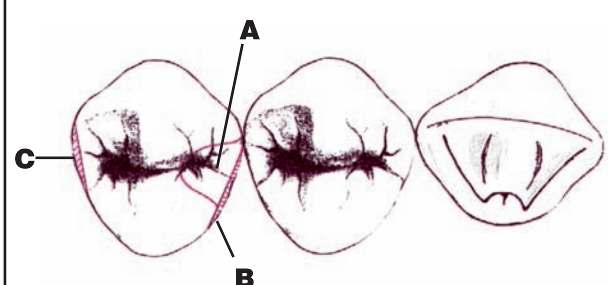

Figure #40: Preparation Requirements for Distal Free-End Saddle, Occlusal View

Reason to use Armstrong #11: Patient education materials on esthetic partials are available to our customers.

ted with proximal plates on the casting. These plates act as reciprocation for the retentive arms. **Preparing the guide planes is critical to the success of the restoration.**

C. On the distal surface, prepare a very narrow, flat, "positioning guide plane" in the occlusal 1/4 of the distal surface (C, fig. 40, 41, and 43). This guide plane is wide from buccal to lingual, but only 1 to 2 mm tall from occlusal toward gingival. This guide plane moves the undercut gingivally and provides room for the artificial tooth to contact the abutment occlusal to the clasp arm. A common error is making this plane too tall. It should never extend to the gingival crest.

Section 3: Tooth Preparation Necessary for Esthetic Clasping of a Mesial Free-End Saddle

Clasp of choice: Counterpoise, EsthetiClasp "C" or "L" Modification.

Preparation: Exactly the reverse of a distal free-end saddle. Proper preparation includes:

A. A rest in the distal fossa,

B. A guide plane for reciprocal plate prepared on the lingual half of the distal surface as described in Section 2B, and

C. A narrow positioning guide plane prepared in the occlusal 1/4 of the mesial surface as described in Section 2C.

Section 4: Preparation for Tooth-Borne Saddle

Clasp of choice: Saddle-Lock or Counterpoise.

Preparation: There is no variation from standard partial preparations (i.e. a mesial rest in the posterior abutment and a distal rest in the anterior abutment). If the posterior abutment is periodontally weak, prepare the anterior abutment as if it were a free end saddle abutment. (Mesial rest and mesial guide plane, see Section 2). If the posterior abutment is subsequently lost, it can be added to the appliance without having to redesign and remake the partial.

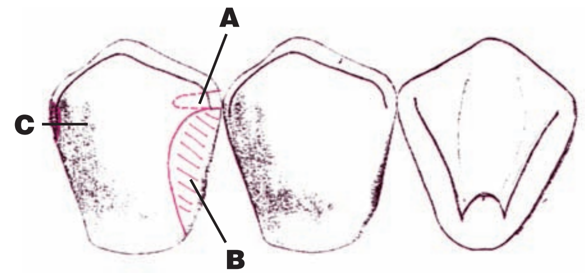

Figure #41: Preparation Requirements for Distal Free-End Saddle, Lingual View

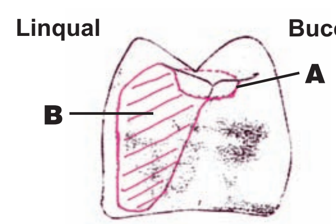

Figure #42: Preparation Requirement for Mesial Free-End Saddle, Mesial View

Figure #43: Preparation Requirement for Mesial Free-End Saddle, Distal View

Reason to use Armstrong #12: Armstrong Laboratory is full-service and can handle "combination cases."

Section 5: Unilateral Saddle (Either Free-End or Tooth-Borne Saddle)

Clasp of choice (next to the saddle area)- Saddle-Lock, Counterpoise or EsthetiClasp "C" modification. Across the arch, use EsthetiClasp, either "L" or "J" modification.

Preparation:

On the abutment or abutments (tooth-borne) next to the edentulous area, prepare the teeth as describe previously sections #2 or #4, depending on clasp selection.

On the other side of the arch, where there are no missing teeth or naturally occurring spaces, the "L" or "J" design should be used. The preparation is as follows:

On the occlusal surfaces between either the first and second molars or the first molar and 2nd bicuspid, prepare a groove (E) for the clasp to cross the occlusal surface (see fig. 45 and 46). It should be at least 2 mm wide and 1.5 mm deep.

The groove will allow the clasp to be within the occlusal plane rather than sitting on top of it and be much more comfortable for your patient. **The groove cannot break through the contact occlusally.** In some cases it may be necessary to relieve the opposing cusp tip slightly. **Note**: After the groove is prepared, be sure to round the sharp line angles at the buccal occlusal and lingual occlusal ends of the groove (M, fig. 44). If this is not done, the sharp edge will be a cleavage point and contribute to clasp breakage.

Next, prepare a rest (A) as described in Section 1. Place the rest in the mesial fossa of the 1st molar (if the groove is between the molar and bicuspid), or in the distal fossa of the 1st molar (if groove is between the molars).

The last step is to enhance the undercut with a dimple (C) on the lingual surface of the molar at the retentive point (tip of the clasp arm) of either the "L" or "J" clasp arm (see fig. 46).

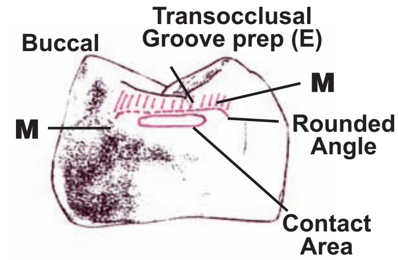

Figure #44: (Mesial View) After the trans-occlusal groove is prepared, be sure to round the sharp line angles at the buccal occlusal and lingual occlusal ends of the groove. Be careful not to break the contact area.

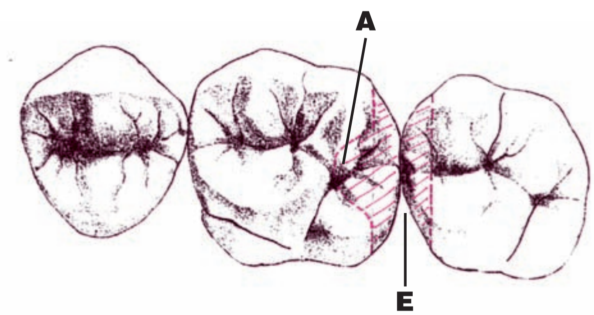

Figure #45: Trans-Occlusal Groove, Occlusal View

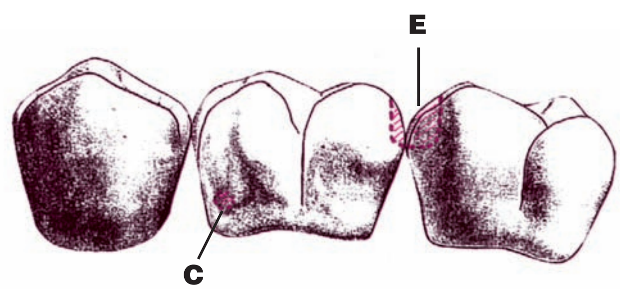

Figure #46: Trans-Occlusal Groove, Lingual View

Reason to use Armstrong #13: No hidden-costs. Models, design, sanitation, etc. are included with a frame.

Section 6: Rotational Path, Anterior Modification

The information in this and in the following section 7 comes from Dr. Krol's Syllabus as indicated in the acknowledgments.[4] This appliance is indicated when the patient is missing either the four incisors or all six anterior teeth, but has a complete posterior dentition. As in the diagrammatic illustration by Dr. Krol, the undercuts used for retention are on the mesial of the cuspids and the distal buccal of the 2nd molars. The appliance is inserted with a rotational movement.

Proximal plates are used to engage the undercuts on the mesial of the cuspids. This area is seated first and then rotated on a surveyed arch to seat the molar clasps. Since the partial is seated in the anterior area first and then rotated into place, no labial flange can be used. The anterior artificial teeth must be butted against the ridge.

The laboratory uses a two-stage survey procedure to ensure proper rotational path.

Preparation:

A. Standard rest preparations are made in the mesial fossa of either 1st or 2nd molars to be clasped,

B. Mesial lingual step rests (see fig. 48 and 49) are prepared in the cingulum area of both cuspids or standard mesial rests on 1st bicuspids (if all anterior teeth are missing). The cuspid step rest is necessary so that there is no interference to the rotation path at the incisal edge of the rest.

Generally, the case is designed with a buccal arm on either the 1st or 2nd molars, but this is far enough posterior to be acceptable esthetically. In some cases it is possible to use an EsthetiClasp "L" or "J" modification and eliminate the buccal clasp arm. To be sure of which clasp design can be used posteriorly, it is necessary for your local Terec lab to survey a study model prior to tooth preparation.

Figure #29: Rotational Path Insertion

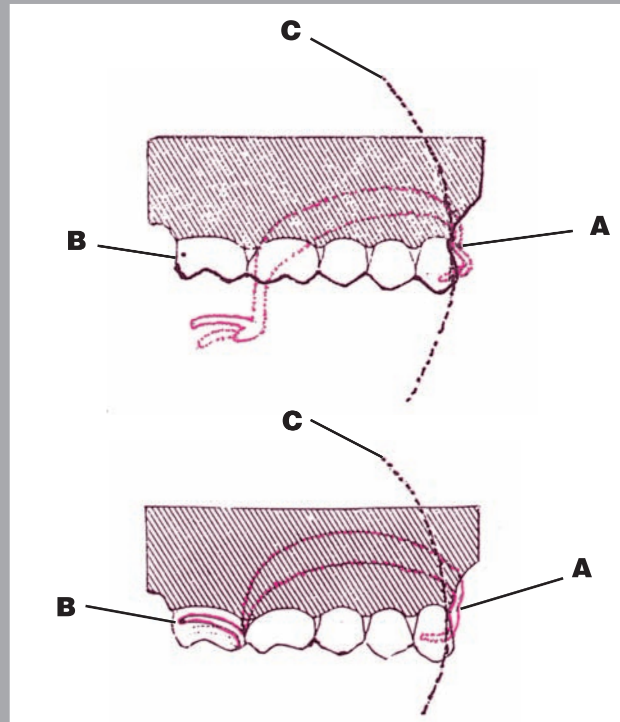

Figure 47 diagrammatic illustration[5] of the insertion of a maxillary partial denture framework unitizing the undercuts on the mesial surface of the cuspids and the distal buccal of the second molar. (A) indicates the point of rotation, (B) indicates area of retention on molar, (C) indicates the arch the cuspid minor connector would have to follow to be displaced. It is apparent that the anterior segment can not be dislodged without first releasing the clasp on the molar.

Figure #48: Rotational Path, Mesial View

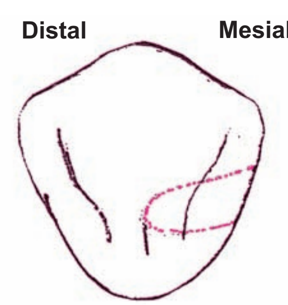

Figure #49: Rotational Path, Lingual View

Reason to use Armstrong #14: $3.95 covers shipping by Airborne both ways.

Section 7: Rotational Path, Posterior Modification[4]

This tooth-borne appliance is indicated when 2nd molars are severely tipped and clasping them would be difficult (see figure 50). It is designed in a two stage survey to be seated in a posterior to anterior rotational arch, utilizing the mesial undercut of the tipped molars for posterior retention. A Counterpoise, Saddle-Lock or I-Bar clasp provides anterior retention.

Preparation:

A. Prepare a long occlusal rest extending ˚ to 2/3 the mesial distal length of the 2nd molar. The length of the rest is critical (see figure 52).

B. On the anterior abutment, prepare a distal guide plane (see figures 50 and 51) in the occlusal 1/3 of the distal surface. This guide plane should be approximately parallel to the mesial surface of the tipped 2nd molar.

C. Prepare a distal rest in the anterior abutment.

This concludes the discussion of R.P.D. designs. On behalf of TEREC, I hope you've found the information presented in this syllabus helpful for both your patients and your practice.

If you have any further questions or need additional assistance, please feel free to contact your nearest TEREC laboratory using the toll-free number on the cover.

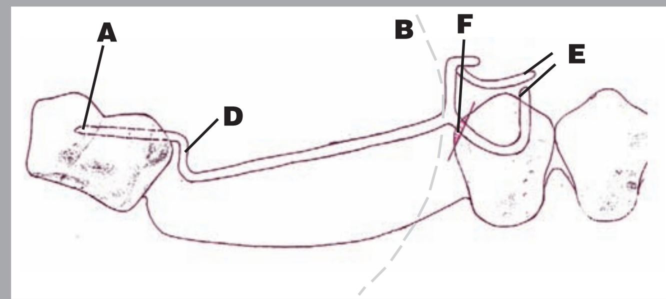

Figure #50: Pre-Insertion

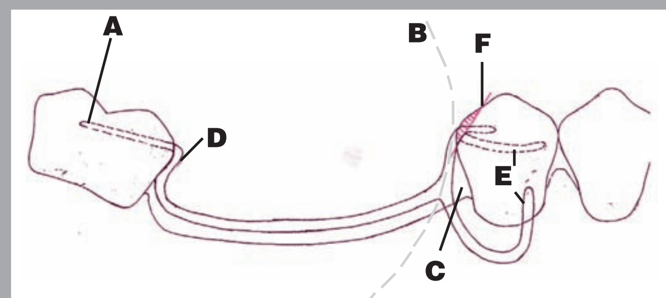

Figure #51: Post-Insertion

Diagrammatic illustration[5] (figures 32 and 33) of Posterior/Anterior path of insertion. Upon insertion the distal portion of the molar rest (A) is positioned first. The reminder of the partial is rotated into position. (A) Center rotation; (B) arch of rotation upon insertion; (C) space indicating block out necessary for minor connector to permit bicuspid clasp to seat (E); (D) minor connector moves into intimate contact with mesial surface of molar providing posterior retention. Prepared guide plane (F) reduces the block out necessary (C) and reduces open space for food collection.

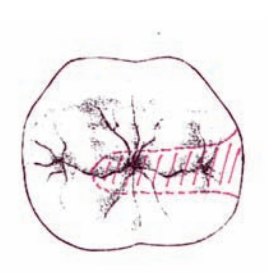

Figure #52: Tooth-Borne Preparation for Rotational Path

Appendix A: Abutments Requiring Full Crowns

Designing any R.P.D. when the patient has only six anteriors remaining is a problem. The triangular shape of the cuspids (described earlier) generally require them to be crowned both for adequate retention and for patient satisfaction. When full crowns are used on the abutments, the following procedure is recommended.

1. No changes in standard crown preparation are required for esthetic designs,

2. When the crowns are returned from the laboratory **do not** cement them (try in the crowns, verify the occlusion, margins, etc.),

3. Place a small amount of temporary cement, about a pin head size on one area of the crown margin and seat the restoration,

4. Take a full arch R.P.D. impression in elastic material (Impregum, VPS, etc.). **Note**: This is the only time an elastic impression is recommended for partial denture construction, and

5. Remove the impression and the crowns. If the crowns do not come off in the impression, remove them but do not place them back in the impression, allow us to do that. Return both the impression and the crowns to the laboratory. **DO NOT POUR THE MODEL.**

We will place the crowns in the impression, make an acrylic die and pour the master model. This technique allows us to do any final precision milling on the crowns necessary to give you a very accurate esthetic partial.

Since the patient will be wearing temporaries longer, you will need a durable temporary crown. Consider using a Duratemp or other lab-prepared temporary crown for this purpose.

Appendix B: Recommended Impression Technique

For removable partial denture impressions, other than the “pick-up” impressions for full crowns described in the previous section, alginate used in a particular manner is recommended. Elastic impressions (Impregum, VPS, etc) are very expensive and can be difficult to use. A full arch elastic impression always seems to have at least one “pulled” area, resulting in a “retake” impression. They are also more uncomfortable for your patient due to the four to six minutes setting time. Alginate can provide an excellent impression with sufficient accuracy. It’s cheaper and is much easier on your patient. The only material required, other than good stock trays, mixing bowls and alginate, is an alginate syringe.

Procedure:

A. Shake the alginate can thoroughly, mix alginate using the manufacturer’s suggested water/powder ratio.

B. Load both the syringe and tray. Using the syringe, inject alginate thoroughly around all natural teeth, being sure that the rests and guide planes are full and bubble-free.

C. Seat tray and allow alginate to set. Remove the tray, rinse out the saliva and pour immediately.

D. Pour the model using a very thick, smooth mix of regular lab stone.

Using die stone is not required and also not recommended. Die stone is hard but also very brittle. It flakes easily. Use regular lab stone but in a very thick, smooth mix. A thick mix will flow smoothly under vibration but does not run like a thin mix. Thickly mixed, the model is harder with less chance of air bubbles.

An indication of correct thickness of mixed stone is as follows: the mix does not drip or fall off when the spatula is inverted (turned upside down).

IMPORTANT—After the impression is poured, **DO NOT** invert the tray onto a stone paddy. Inverting can cause error. The unset stone will try to sag away from the impression. The degree of sag (if it occurs) will not be visible to the eye, but is sufficient to cause poor fit of the framework. Instead mound the thick stone on top of the tray and allow it to set. Before pouring the model, place Playdoh or children’s modeling clay in tongue area of lower tray to keep the stone from locking over the lingual flange of the tray.

Footnotes

1. Arthur J. Krol, et al. *Removable Partial Denture Design*. (San Rafael: 1990) pp. 94-97
2. Gerome Goodman, Equipoise. (Highland Beach: 1989) pp. 9-11
3. Gerome Goodman, Equipoise. (Highland Beach: 1989) pp. 11-13
4. Arthur J. Krol, et al. *Removable Partial Denture Design*. (San Rafael: 1990) pp. 69-88
5. Arthur J. Krol, et al. *Removable Partial Denture Design*. (San Rafael: 1990) These illustrations are hand drawn copies of the illustrations on the cover of this book.

Bibliography

Goodman, Gerome, *Equipoise*. Highland Beach: Equipoise Dental Prosthetics, Inc, 1989

Krol, Arthur J., Theodore E. Jacobson, and Fredrick C. Finzen, *Removable Partial Denture Design*. San Rafael: Indent, 1990.

Stratton, Russell J. and Frank J. Wiebelt, *An Atlas of Removable Partial Denture Design*. Chicago: Quintessence Publishing Co. Inc., 1988

Swenson, Merrill G. and Louis G. Terkla, *Partial Dentures*. St. Louis: The C.V. Mosby Company, 1955.

• Atlanta • Cedar Rapids • Green Bay • Louisville • Long Island • Minneapolis •

Creating the Future of Dentistry!

Saddle-Lock is a registered trademark of the Saddle-Lock Company

TEREC is a strategic alliance of regional laboratories whose primary mission is to research, develop and bring innovative world-class technology to your practice.

TEREC
Member Dental Laboratories

Visit our Website at: **http://www.terec.org**

New Image Dental Laboratory Inc.
Atlanta, **Georgia**
800-233-6785

Johns Dental Laboratories
Terre Haute, **Indiana**
800-457-0504

Dental Prosthetic Services, Inc.
Cedar Rapids, **Iowa**
800-332-3341

Prodenco Group Inc. (Main Office)
Sioux City, **Iowa**
800-831-0936

Armstrong Dental Laboratory, Inc.
Louisville, **Kentucky**
800-626-6276

Excel Dental Studios, Inc.
Minneapolis, **Minnesota**
800-328-2568

Edmonds Dental Prosthetics, Inc.
Springfield, **Missouri**
800-462-3569

Town & Country Dental Studios
Long Island, **New York**
800-925-8696

Lord's Dental Studio, Inc.
Green Bay, **Wisconsin**
800-821-0859

Shaw Group
Pennsylvania - 888-SHAW LAB
Michigan - 800-523-5462
Canada - 800-387-2969

• Green Bay • Cedar Rapids • Atlanta • Terre Haute • Springfield • Sioux City •