

DESIGNING RPDs

As strange as it may seem, surveys show that many practicing dentists do not design RPDs. In many cases, preliminary models are forwarded to laboratory technicians for design, and the dentist follows the instructions prescribed by the lab tech. This is inappropriate because an RPD is not fabricated solely according to information derived from stone models. Many other clinical factors are of critical importance in designing the prosthesis. Oral structures and diagnostic information along with patient's desires are an integral part of the RPD's ultimate success. This information is not available to the laboratory technician, and more significantly, the laboratory technician is not responsible for its comprehensive assessment and interpretation. Laboratory technicians are knowledgeable in technical aspects of RPD fabrication and their advice and guidance can be an invaluable resource when questions of a procedural nature arise.

However, there is no equivocation on this point-the responsibility of the RPD design, and the ultimate success of the dental treatment provided, rests solely with the dentist. The first requirement of any dental treatment is to protect the oral structures that remain, and this imperative can only be realized when all aspects of the dental treatment, especially the RPD design, is under the complete control of the dentist.

That being said, many dentists find it difficult to solve the puzzle of RPD design. It is a complicated procedure, and often dentists feel overwhelmed by the demands inherent its accomplishment. This need not be the case however. When tackling this task with a systematic approach, any general dentist should be capable of designing most RPDs. Complex cases should be referred to a provider with appropriate expertise, experience, and training.

This instruction is intended to guide you through the design process. It will help you assess the patient's dental condition, select design features, complete the treatment plan form, and clearly communicate the RPD design by drawing it on the preliminary model.

Gather information:

Consider all other treatment needs.

The final RPD design should include only teeth viable after all other treatment needs are addressed. Periodontal and endodontic issues, questionable restorability, surgical needs, caries risk, and occlusal discrepancies must be assessed before a definitive design is accepted.

If a patient has emergent needs and is in pain, treatment such as extractions, caries control, and fabrication of IRPDs can be accomplished before planning of definitive treatment.

However, when such needs are taken care of, a preliminary design must be prepared before any other treatment is planned. The RPD design will most certainly impact treatment planning decisions, so a rational plan for the final restoration is necessary. Prognosis of teeth should be evaluated with consideration of their function in the RPD design. Is the tooth predictably restorable? If not can the design of the partial allow for easy replacement if lost? Will it serve as a distal extension abutment? Will its retention avoid a distal extension configuration?

During the course of treatment, the initial RPD design may require alteration. Time, money, and patient discomfort should not be expended on teeth that ultimately have a poor prognosis or are strategically unessential to the final design.

A preliminary design includes surveyed and mounted casts with drawn RPD designs, and a completed RPD Design Treatment Plan Form. In the teaching clinic, a faculty member will sign the RPD Design Treatment Plan Form when the treatment plan is deemed a reasonable starting design. As treatment progresses, changes may have to be made and alterations to the design made.

What clinical features are present that influence the design?

- Adequate, mounted study models are imperative. CLINICAL PHOTOS.
- Existing restorations and caries
 - All caries must be eliminated.
 - Rest seats:
 - can be placed in amalgam restorations if edges can be placed in enamel.
 - can be placed in metal crowns, but may run risk of perforation.
 - should not be placed in composite restorations.
 - should not be placed in porcelain, but many times are after cautioning patient.
 - Infrabulge retainers should not be used if abutment has a CI V restoration.

-Abutment teeth with large restorations, especially DE abutments, should have surveyed crowns.

- Esthetics
 - Circlet clasps, especially clasps with mesial shoulders and retention to the DB are usually visible and therefore unesthetic.
 - WW clasps rest more gingivally on the tooth surface than cast circlets because they engage twice as large an undercut.
 - A short anterior edentulous span may not need clasp retainer. Frictional retention alone may be adequate when the taller proximal surfaces of anterior teeth are prepped with precise parallelism.
- Tooth contours
 - Modifications to tooth contours can be made to enhance undercuts. This should not be considered on a regular basis, only used when no other possibility exists and there is not a compelling reason to do a surveyed crown.
 - Maxillary posterior teeth tilt toward the buccal. This means that there are usually available undercuts for retention available, but also that the survey lines for surrabulge retainer shoulders must be lowered. Usually the lingual survey lines are low and do not interfere with lingual clasps or plating.
 - Mandibular posterior teeth tilt toward the lingual. This means that often it is hard to find buccal undercuts. DL undercuts may be used for retention on Md molars bilaterally, but not premolars. Retainers such as C clasps and ring clasps may be considered. Often lingual survey lines must be lowered to accommodate lingual reciprocating clasps and plating.
- Cingulum anatomy
 - Usually, maxillary canines have sufficient cingulum enamel bulk to support a cingulum (chevron) rest seat; maxillary central incisors and mandibular canines sufficient cingulum enamel to support alternate cingulum (reverse chevron) rest seat. However, each case must be evaluated and judged independently.
 - Additionally, care should be taken to place rest seats on maxillary anterior teeth gingivally to centric contacts.
- Reduced interarch space
 - May affect choice of tooth replacement and denture base retention.
 - Compromised anterior interarch space may affect esthetics.
- Mesially tilted teeth
 - Should not use mesial occlusal rest as abutment for distal extension.
- Periodontal status of teeth
 - Poor crown root ratio, mobility, pocket depth, and any other negative perio indicator should be considered carefully when selecting tooth as

abutment, particularly for distal extension cases. If tooth fails, entire RPD will have to be remade.

-Infrabulge retainers should not be used for abutments with mucogingival defects or recession.

- Bony undercuts of soft tissue
 - No infrabulge retainers.
- Frenal attachments
 - No infrabulge retainers without preprosthetic frenectomy for buccal frena.
 - Assess anterior lingual space for Md RPDs and need for lingual frenectomy if absolutely necessary.
- Tori
 - Mx midline torus will affect choice of major connector.
 - Md bilateral tori may affect choice of major connector, and may necessitate surgical removal before treatment.
- Soft tissue loss
 - Present or future resorption may require denture base retention and denture base.
- Teeth with guarded prognosis-plan for loss
 - Use lingual plate to allow addition to partial in case tooth is lost.
 - Use distal extension appropriate RCA for anterior abutment in case posterior tooth is lost.
- Occlusion
 - Placement of rests away from heavy occlusal contacts.
 - Low survey lines for reciprocal elements and suprabulge shoulders.
 - Caution with reverse circlet clasps.
- Ridge anatomy need to do altered cast impression, choose rca to favor tooth or ridge
- Concept of strategic teeth.
 - Consider importance of questionable teeth to overall RPD design.
 - Retention of tooth that prevents distal extension configuration may warrant efforts to save it when otherwise expendable.

Begin Design Process:

Orientation and survey:

After clinical data is gathered, formulation of the RPD design can begin. First, a preliminary survey at a neutral position is made. Select orientation perpendicular to the occlusal plane. *(Why should occlusal plane be “flat with the floor”? Because this will be the path of insertion and removal of the RPD. It isn't practical to expect the patient to insert a prosthesis from an eccentric lateral or AP direction, and dislodgement occurs at a path perpendicular to the occlusal plane.)*

Small adjustments to the neutral orientation are made to align abutment proximal surfaces that will be used as parallel guiding planes, usually by slightly tilting in AP direction. *(Why? Because guiding planes can only be prepared to the extent that no dentin is exposed. The path selected should accommodate all abutment proximal surfaces.)* Adjustments to the tilt are also made to find retentive undercuts by tilting BL, from side to side. The tilt can deviate slightly ($<10^\circ$) from the existing occlusal plane.

Ultimately, if contours of abutment teeth cannot provide these features, surveyed crowns may be considered.

Make preliminary survey of study model

- *Check analyzing rod to ensure it is straight.
- *At neutral position, occlusal plane “flat with floor”.
- *Slightly adjust to balance proximal guide planes between abutment teeth.
- *Lightly survey teeth to locate undercuts.

Sequence of design process:

These steps are listed on the design worksheet. You may find it helpful to use the diagrams on the sheet to work out the design. Or you may prefer to use the other practice forms that are available. You can use these at your discretion. You will fill out the RPD Design Treatment Plan form (used in clinic) as your final design.

Unless specifically mentioned, assume 3rd molars are not included in design.

1. Modification spaces:

- * All abutments require guiding planes and proximal plates. (except when diastema is present)
- * Almost all abutments require rests seats and rests (exception smaller incisors).
- * Most abutments have a retentive clasp assembly (RCA) comprised of a retentive clasp, a rest, reciprocation, and a proximal plate. (RCA not abutting an edentulous space will not have a proximal plate.)

Some anterior abutments use tall guiding planes as frictional retention.

2. What is the Kennedy classification? This will tell you:

- Number of modification spaces. More spaces mean more abutments and guiding planes.
- Axis of rotation during dislodgement.
- Location of indirect retention.
- Distal extensions which require specific retainer clasp assemblies.
- Clasp configuration, ie bilateral, quadrilateral, tripodal. (May need more RCAs if there are large modification spaces.)

3. Retentive clasp assemblies (RCA):

- If modification space is a short span, as in a single missing premolar, often there is insufficient room to place an infrabulge or WW retainer.
- Tall guide planes can be used for retention in anterior modification spaces, instead of retentive clasps. Proximal plates and rests are still required.
- WW clasps are kinder to weak abutment teeth, cast clasps are kinder to fragile, less robust residual ridges in distal extensions.
- When considering premolars and molars as abutments for distal extensions, there are four acceptable RCAs:

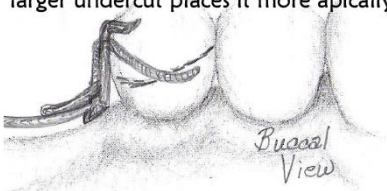
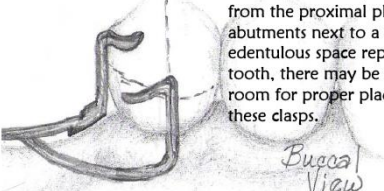
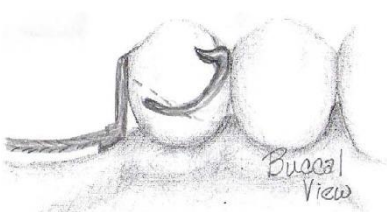
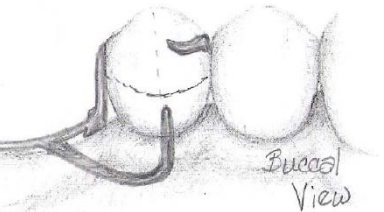
WW w/ DO rest

Reverse circlet w/ MO rest

I Bar w/ MO rest

T bar w/ DO rest

Contraindications and requirements are given in chart.

Clasp assemblies by:		SUPRABULGE	INFRABULGE
Retentive clasp	Rest location	May need to adjust survey line for shoulder. Unesthetic	Esthetic... But, cannot be used if: High frena attachment Bony buccal undercut Mucogingival defect CI V restoration
DISTAL REST	Less vertical movement. Clasps move opposite occlusal load.	<p>WW</p> <p>More stress to tissue, less stress to tooth. More esthetic than cast circlet because larger undercut places it more apically.</p>  <p>Buccal View</p>	<p>MOD T BAR</p> <p>WW and infrabulge retainers originate from the denture base retention element, remotely from the proximal plate. For abutments next to a small edentulous space replacing one tooth, there may be too little room for proper placement of these clasps.</p>  <p>Buccal View</p>
	More vertical movement. Distal plate and clasps move same direction as occlusal load. Cannot use on mesially tipped tooth.	<p>REVERSE CIRCLET</p> <p>May have difficulty with occlusal clearance.</p>  <p>Buccal View</p>	<p>I BAR</p> <p>Special requirements for reciprocation elements and distal guiding plane. Physiologic adjustment.</p>  <p>Buccal View</p>
MESIAL REST			

As you work through the design, you may find there are insufficient undercuts for proposed clasp designs. If not, can cast be reoriented to gain favorable undercut while maintaining same general relationship to occlusal plane? If not, you should consider another approach such as alternate clasp choice, alteration of tooth surface, or surveyed crown.

4. What major connector is indicated?

Mandibular major connectors

Lingual bar

‘default choice’.

Lingual plate

Greater strength when greater number of teeth are missing.

Limited sublingual space, < 8mm.

Questionable prognosis of anterior teeth.

Mandibular tori.

Maxillary major connectors

Palatal strap

Limited number of posterior replacement teeth

Generally not used with distal extensions

Horseshoe

Replacement of anterior teeth

Cannot be used for distal extensions

Full palate

Maximum strength

Can be used for distal extensions

AP strap

Midline tori

Can be used for distal extensions

Note: Do not plate anterior teeth unless specific reason calls for it. The anterior palate is an important area for phonetics.

5. Complete framework

Draw outline of complete framework. This means brown is a continuous line connecting for form the outline. Single lines ending nowhere do not define the framework.

MD Distal extensions- stops at posterior abutments with sharp angle, connects to blue denture base.

MX Distal extensions- extends back to distal of RPD, sharp angle that connects to blue denture base.

6. Teeth replacement

Denture base with connector - use if:

Long edentulous span, loss of bone and soft tissue, may be a need to reline, distal extension.

No denture base (tube teeth, slot teeth, RAP)

More esthetic
One or two missing teeth, minimal soft tissue loss.

When you have noted your ideas on an arch diagram, draw a proper RPD design on a second to work out correct drawing.

Start design on second arch diagram

Lightly pencil out missing teeth

- Proximal plates
- Clasp assemblies
- Major connector
- Denture base retention
- Denture base
- Mark areas of tooth preparation needed in red.

When you have perfected the design you wish to submit, complete the design process.

- **Copy onto on “Treatment Plan Form” and fill in all tabular information.**
- **Design study model:**
 - Tripod and survey all teeth.
 - Framework outline from treatment plan form
 - Modifications in red

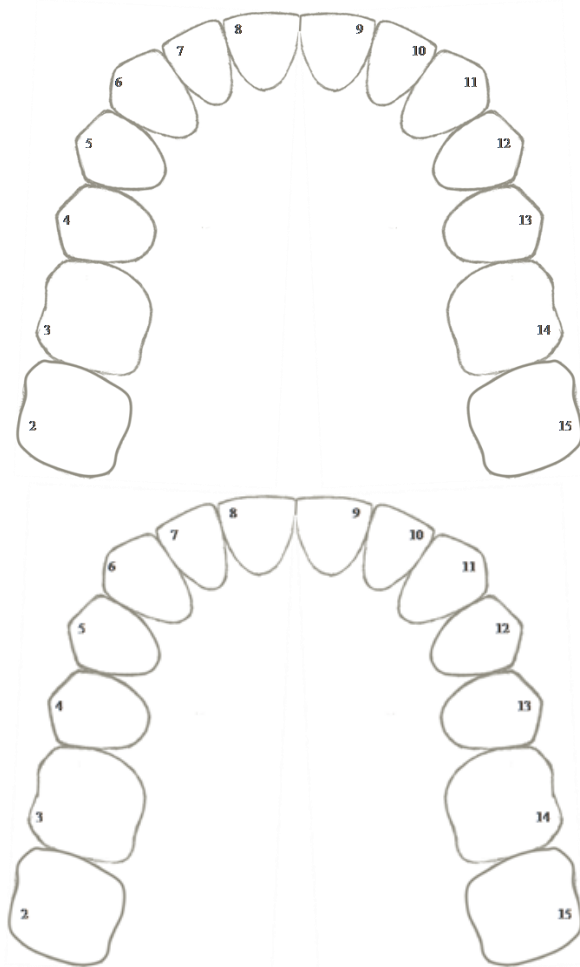
Work through steps in order suggested.

Refer to accompanying instruction for treatment of each topic.

Use first diagram to sketch, second diagram to organize design for cast and TP.

* refers to retentive clasp assembly.

MX RPD Design Worksheet



Distal Extension RCA choices for posterior teeth

Clasp assemblies by:

	<u>SUPRABULGE</u>	<u>INFRABULGE</u>
Retentive clasp	May need to adjust survey line for shoulder. Unesthetic	Esthetic... But, cannot be used if: High frena attachment Bony buccal undercut Mucogingival defect CI V restoration
Rest location		
DISTAL REST	<p>WW</p> <p>More stress to tissue, less stress to tooth. More esthetic than cast circlet because larger undercut places it more apically.</p>	<p>MOD T BAR</p> <p>WW and infrabulge retainers originate from the denture base retention element, away from the proximal plate. May not be enough room in short edentulous spaces.</p>
MESIAL REST	<p>REVERSE CIRCLET</p> <p>May have difficulty with occlusal clearance.</p>	<p>I BAR</p> <p>Special requirements for reciprocation elements and distal guiding plane. Requires physiologic adjustment.</p>

Clinical information:

Survey:

>Flat with floor.

>Adjust tilt to best position for proximal surfaces of abutments.

>Lightly mark survey lines.

Plan Design:

1.

>Lightly block out missing teeth.

>Proximal plates.

2.

Classification:

>III or IV: quadrilateral RCA* distribution.

>I: bilateral RCA distribution } *rotational axis &*

>II: tripodal RCA distribution } *indirect retention rest*

3.

Clasp selection (with survey & cast):

>Existing restorations.

>Esthetics.

>Undercut location.

>Mechanics of DE.

4.

Major connector:

>MX: Strap, AP strap, full palate, horseshoe

5.

Complete framework.

6.

Tooth and soft tissue replacement:

>Denture base retention

>Tube tooth, RAP

>Denture base outline

Preliminary Design:

>Tripod study model.

>Resurvey.

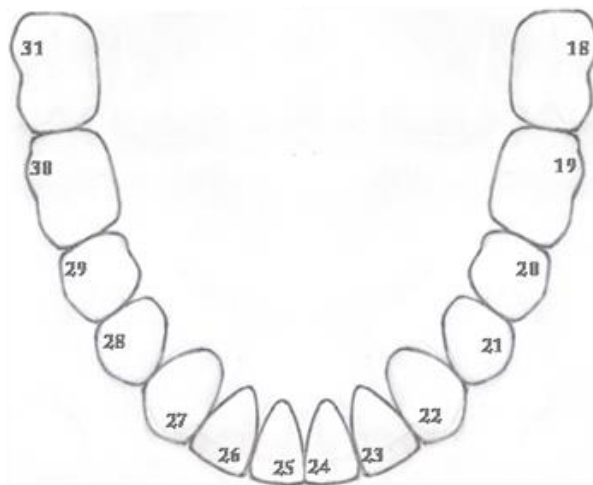
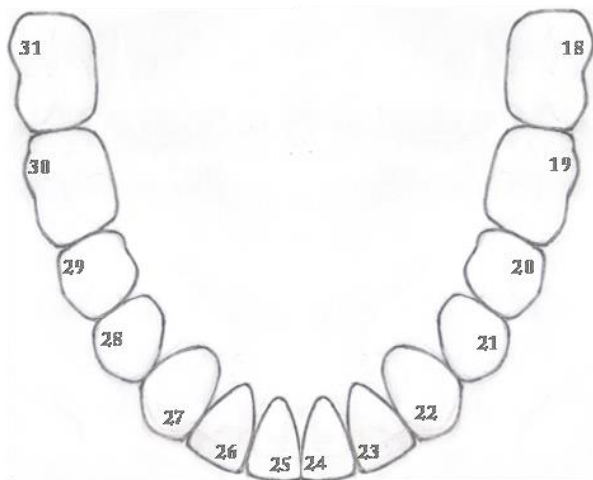
>Design in brown on study model.

>Mark adjustment areas in red on study model.

>Complete TP form.

Work through steps in order suggested.
 Refer to accompanying instruction for treatment of each topic.
 Use first diagram to sketch, second diagram to organize design for cast and TP.
 * refers to retentive clasp assembly.

MD RPD Design Worksheet

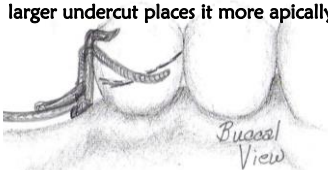
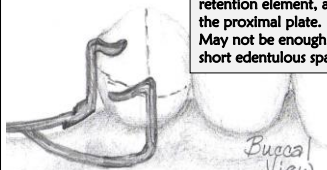

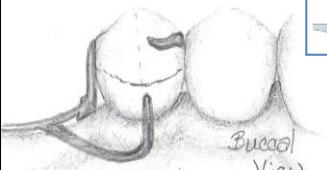


Distal Extension RCA choices for posterior teeth

Clasp assemblies by:

SUPRABULGE

INFRABULGE

	Retentive clasp Rest location	Distal Rest	Mesiial Rest	Suprabulge	InfraBulge
				May need to adjust survey line for shoulder. Unesthetic	Esthetic... But, cannot be used if: High frena attachment Bony buccal undercut Mucogingival defect CI V restoration
Less vertical movement of distal extension under occlusal load. Clasps move opposite direction of occlusal load.				WW More stress to tissue, less stress to tooth. More esthetic than cast circlet because larger undercut places it more apically. 	MOD T BAR WW and infraBulge retainers originate from the denture base retention element, away from the proximal plate. May not be enough room in short edentulous spaces. 
				REVERSE CIRCLET May have difficulty with occlusal clearance. 	I BAR Special requirements for reciprocation elements and distal guiding plane. Requires physiologic adjustment. 

Clinical information:

Survey:

- >Flat with floor.
- >Adjust tilt to best position for proximal surfaces of abutments.
- >Lightly mark survey lines.

Plan Design:

1.
 - >Lightly block out missing teeth.
 - >Proximal plates.

2.

Classification:

- >III or IV: quadrilateral RCA* distribution.
- >I: bilateral RCA distribution. } *rotational axis &*
- >II: tripodal RCA distribution. } *indirect retention rest*

3.

Clasp selection (with survey & cast):

- >Existing restorations.
- >Esthetics.
- >Undercut location.
- >Mechanics of DE.

4.

Major connector:

- >MD: Bar or plate

5.

Complete framework.

6.

Tooth and soft tissue replacement:

- >Denture base retention
- >Tube tooth, RAP
- >Denture base outline

Preliminary Design:

- >Tripod study model.
- >Resurvey.
- >Design in brown on study model.
- >Mark adjustment areas in red on study model.
- >Complete TP form.