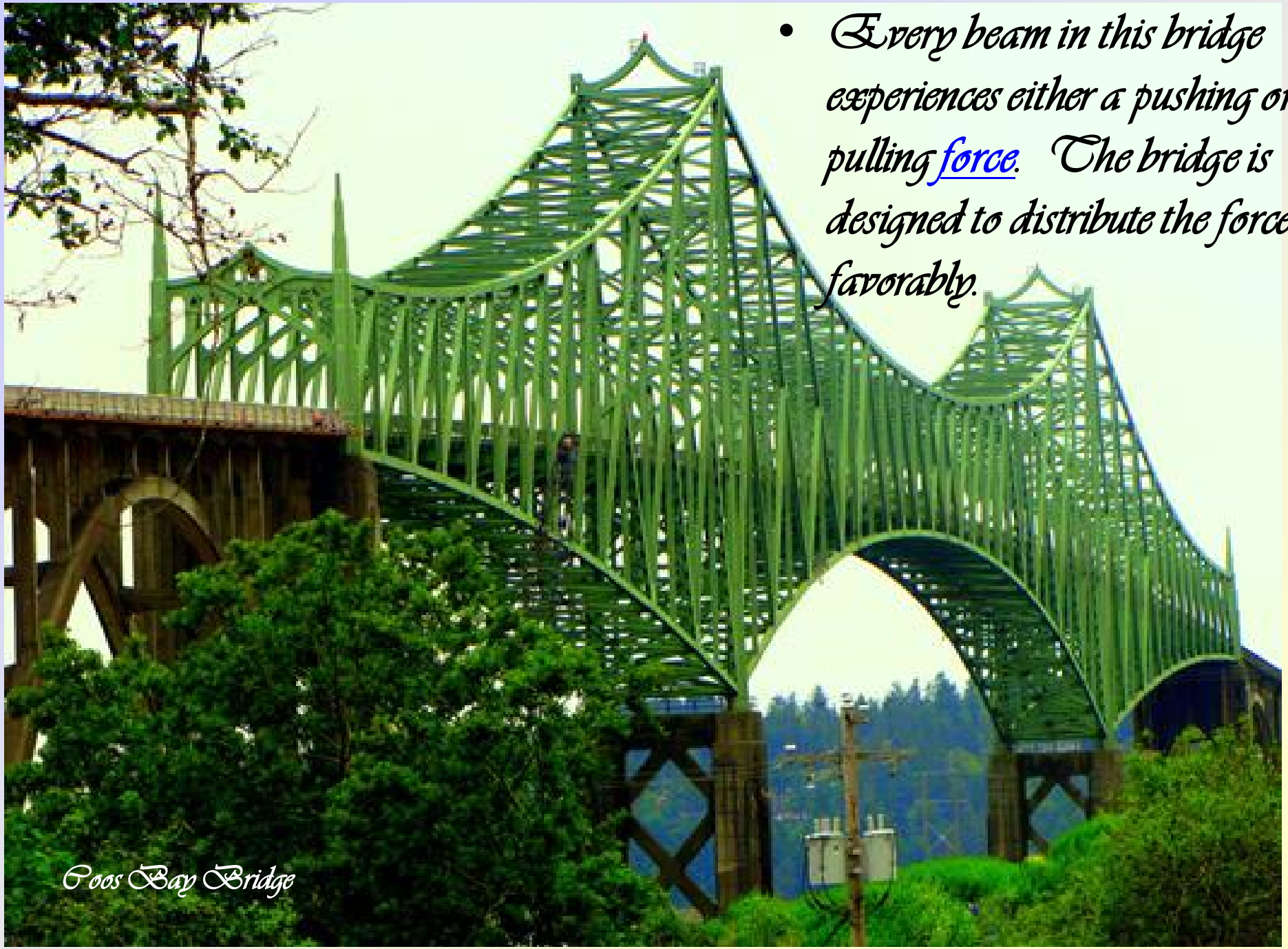
Mechanics of Distal Extensions

Yaquina Bay Bridge
Designer: Conde McCullough



- Every beam in this bridge experiences either a pushing or pulling force. The bridge is designed to distribute the force favorably.

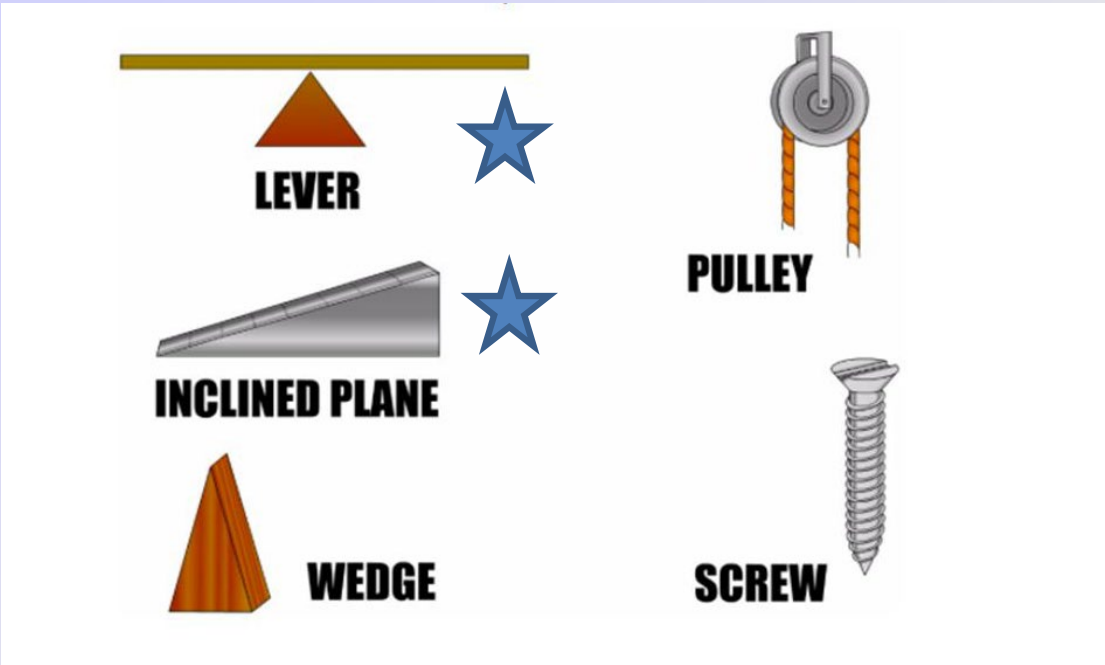
Coos Bay Bridge

Properties of Force: Prosthodontic Considerations

- Has magnitude
  - For instance, variable masticatory force.
- Has direction
  - Favorable, along long axis of tooth or compressive stress to bone.
  - Unfavorable, shear or lateral forces.
- Has area of application
  - Distribution of occlusal forces.
  - Broad distribution reduces stress,

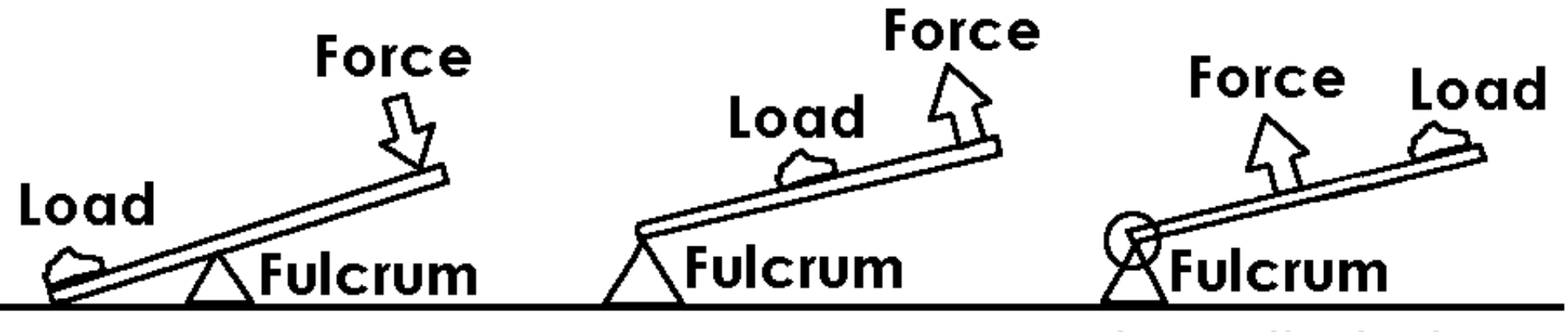
    Stress = force/area.

5 Simple Machines



Machines increase mechanical advantage—
more work output with less effort input (force).

LEVERS



Class 1 **Class 2** **Class 3**

most efficient → **least efficient**

Mechanical Advantage

Do we want mechanical advantage?

- For oral surgery
  - Yes

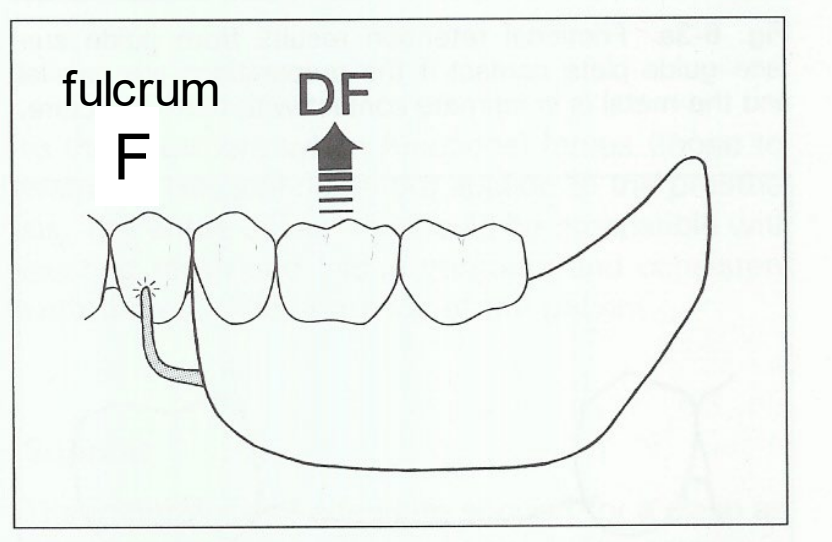
Mechanical Advantage

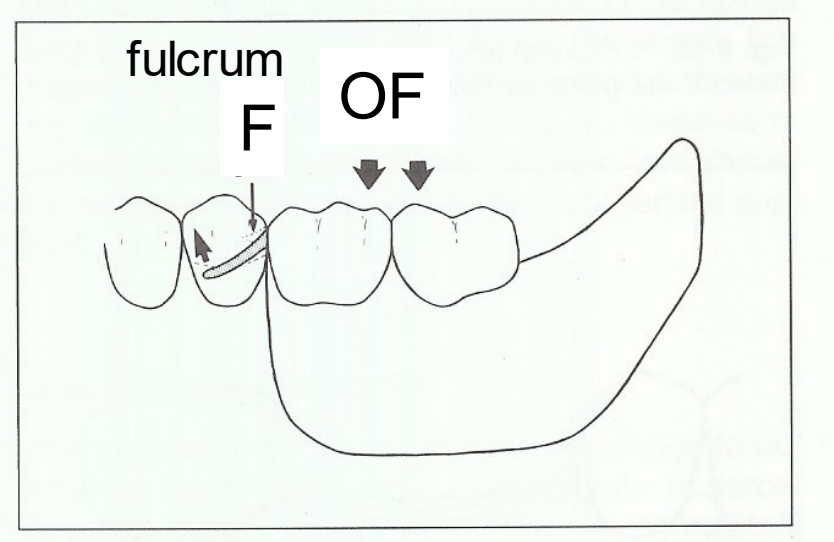
Do we want mechanical advantage?

- For oral surgery
  - Yes
- For RPD frameworks
  - NO
  - Increased mechanical advantage means it takes less force to increase stress to teeth.

The rationale for any distal extension clasp design is ***first*** to protect the abutment tooth, not to retain prosthesis.

There are two vertical forces acting on framework.



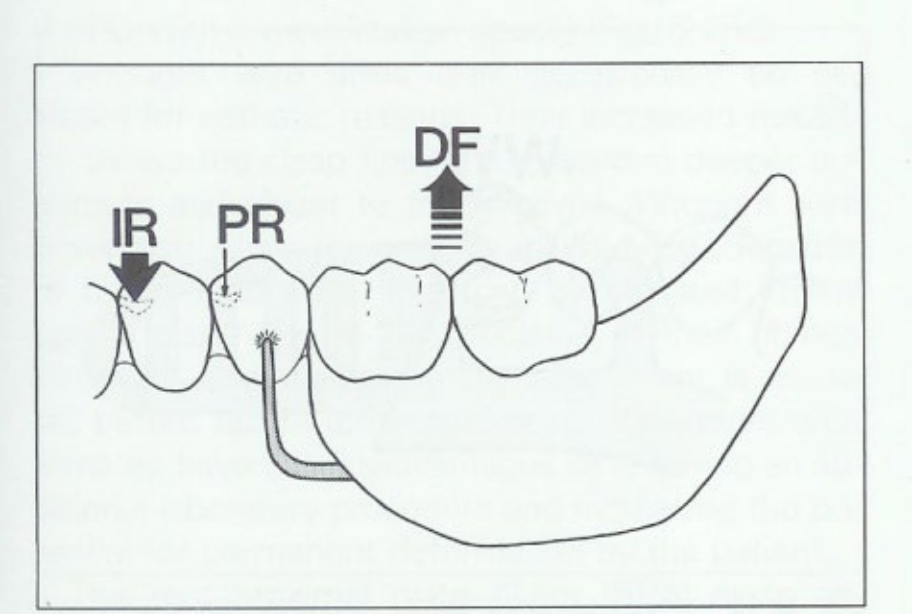


Dislodging force is resisted by retention.

Occlusal force is resisted by support.

Both movements cause the DE framework to behave as lever and rotate.

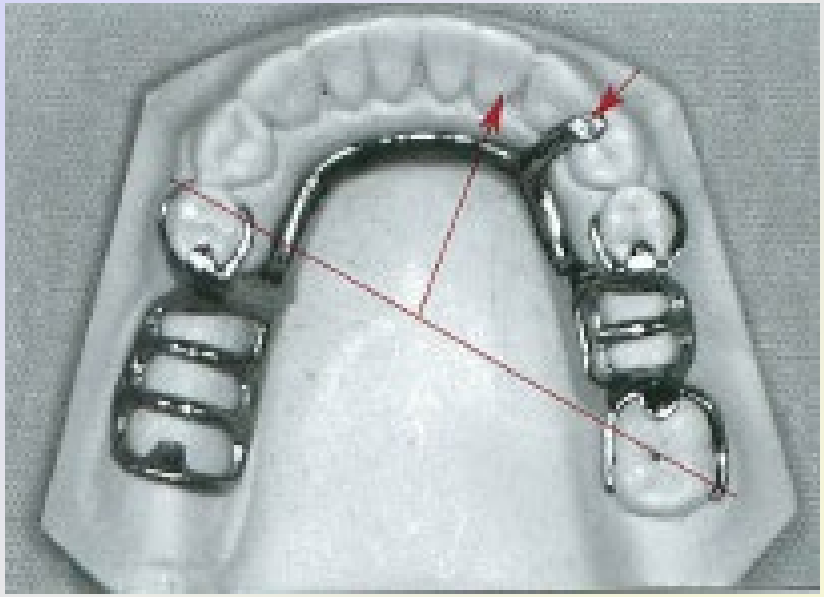
Dislodging Force:
Opposite movement of Occlusal Loading

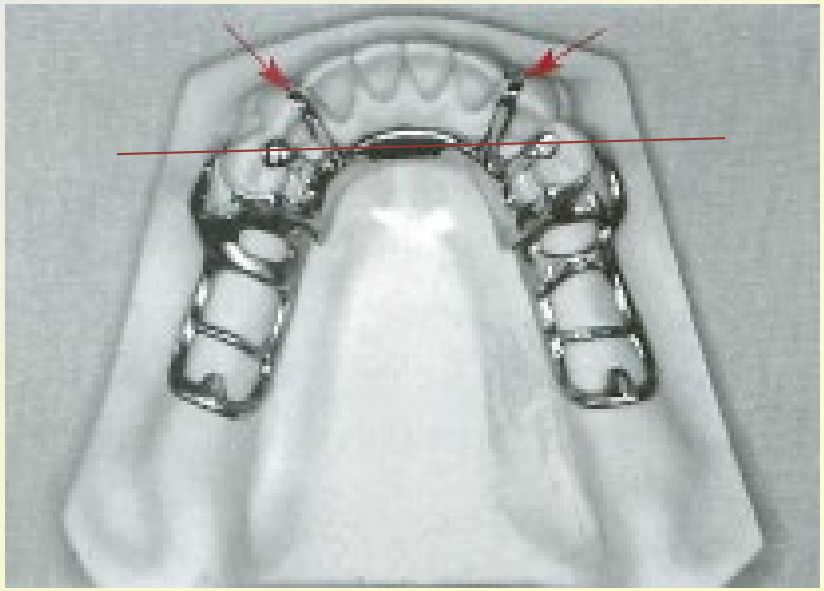


- **Framework components anterior to retentive tip act as Cl I lever arm, moving tissueward when DE is dislodged.**
- ***Indirect retention*** **consists of support component – RESTS.**
- **Placed as far anteriorly, away from the axis of rotation as possible.**

Identify the axis of rotation during dislodgement and place IR to counteract movement.

- To locate rest for indirect retention:
  1. Identify axis of rotation- abutment teeth with the most posterior retentive tips.
  2. Place indirect retention rest perpendicularly, as far away from axis as possible.





Indirect retention only applies to resistance of movement during dislodgement.

All indirect retention is in the form of rests.

Occlusal Force:

A special problem for DE RPDs

- **Fact:**

Distal extension RPDs move under function because of the different displacement of PDL and soft mucosa. Stewart says mucosa displaces 250x more than PDL.

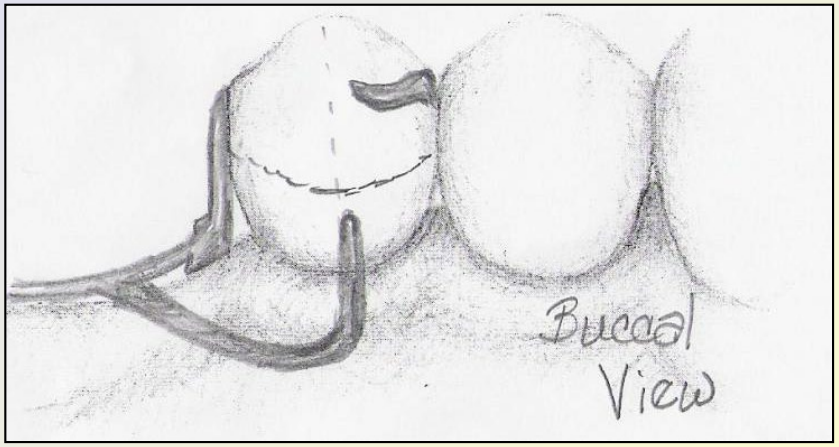
- **Problem:**

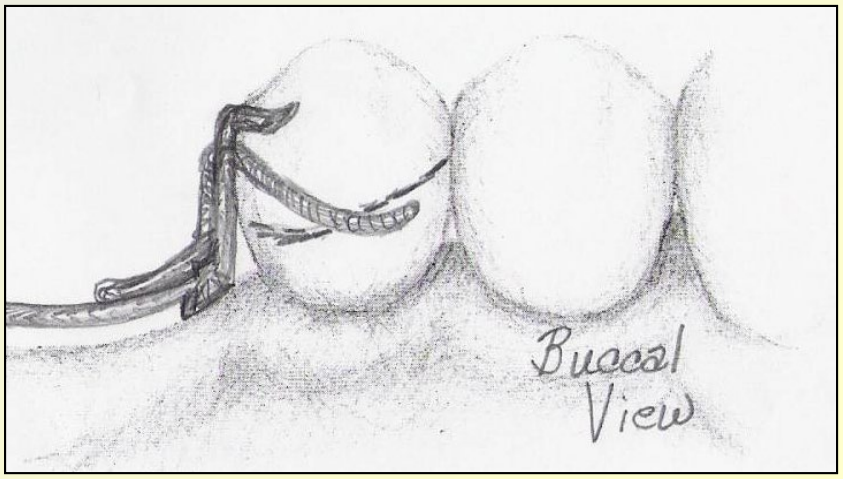
How can we control the movement of extension base RPDs so we achieve a favorable biomechanical outcome and protect abutment teeth?

By specific design guidelines governing distal extensions.

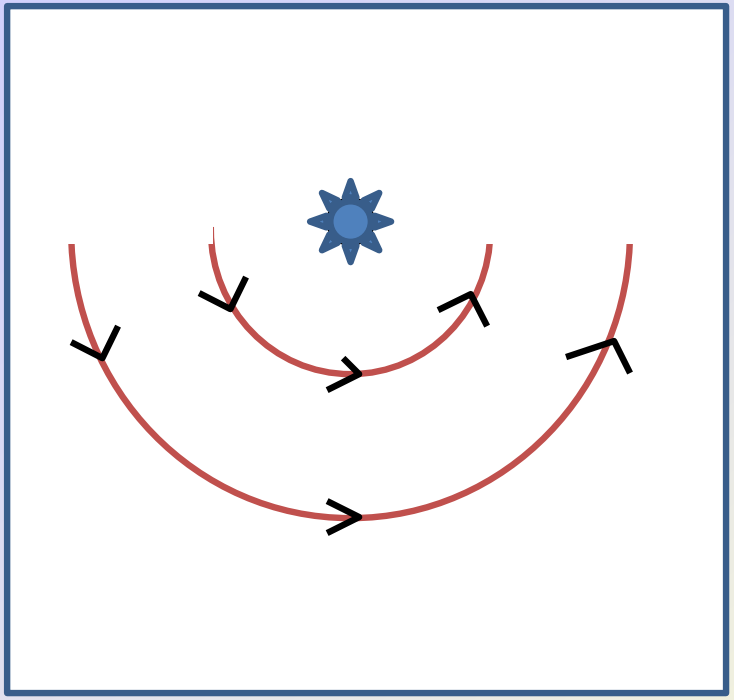
Occlusal Force:
Factors that control DE mechanics
HINT: ITS ALL ABOUT LEVERS

- Rest positions (the fulcrum of the lever):
  - Mesial vs distal
- Retentive clasps:
  - Infrabulge vs. suprabulge
  - Material –cast metal vs. wrought wire
- Retention location:
  - Mesial vs. distal



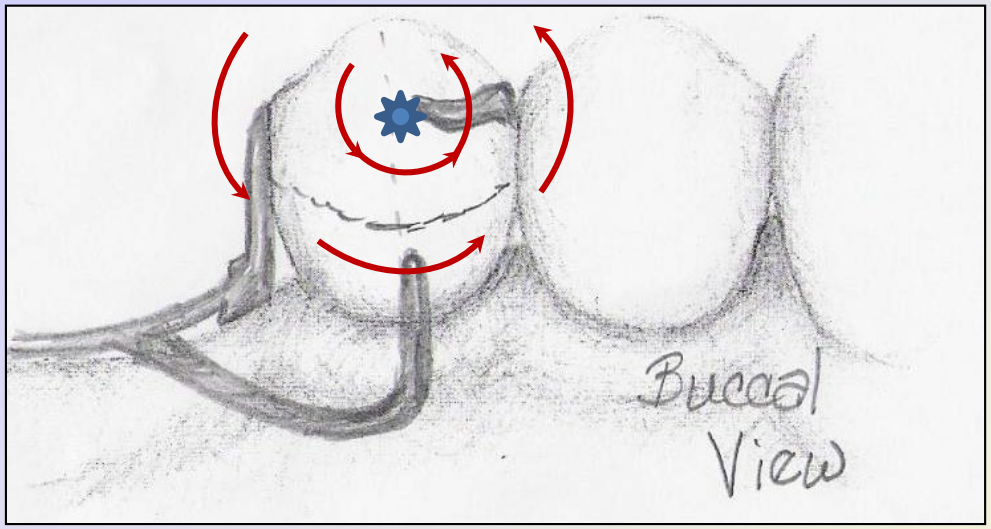


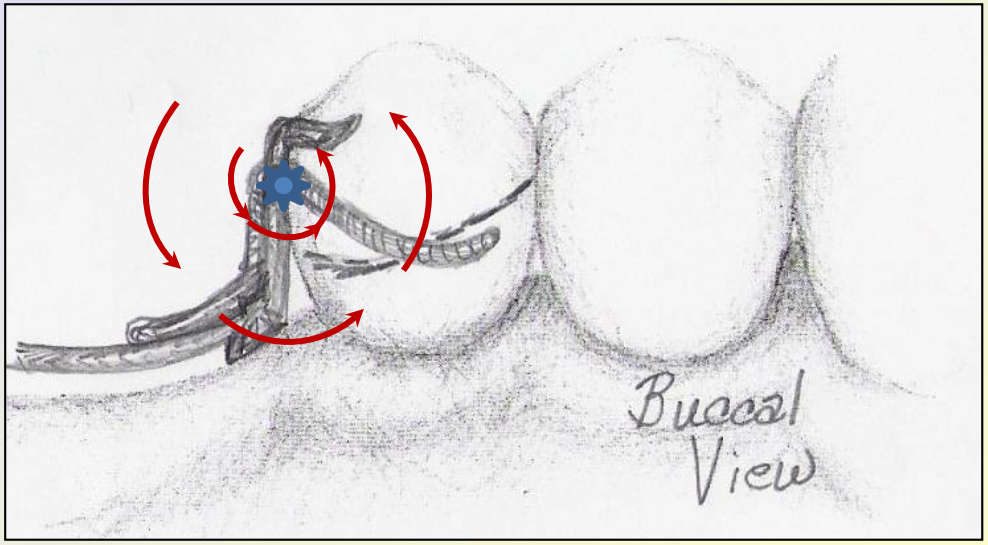
Rotational Center (during occlusal loading)



- **Through fulcrum pivot points (rests).**

The most distal rest acts as a fulcrum and is the center of rotation.

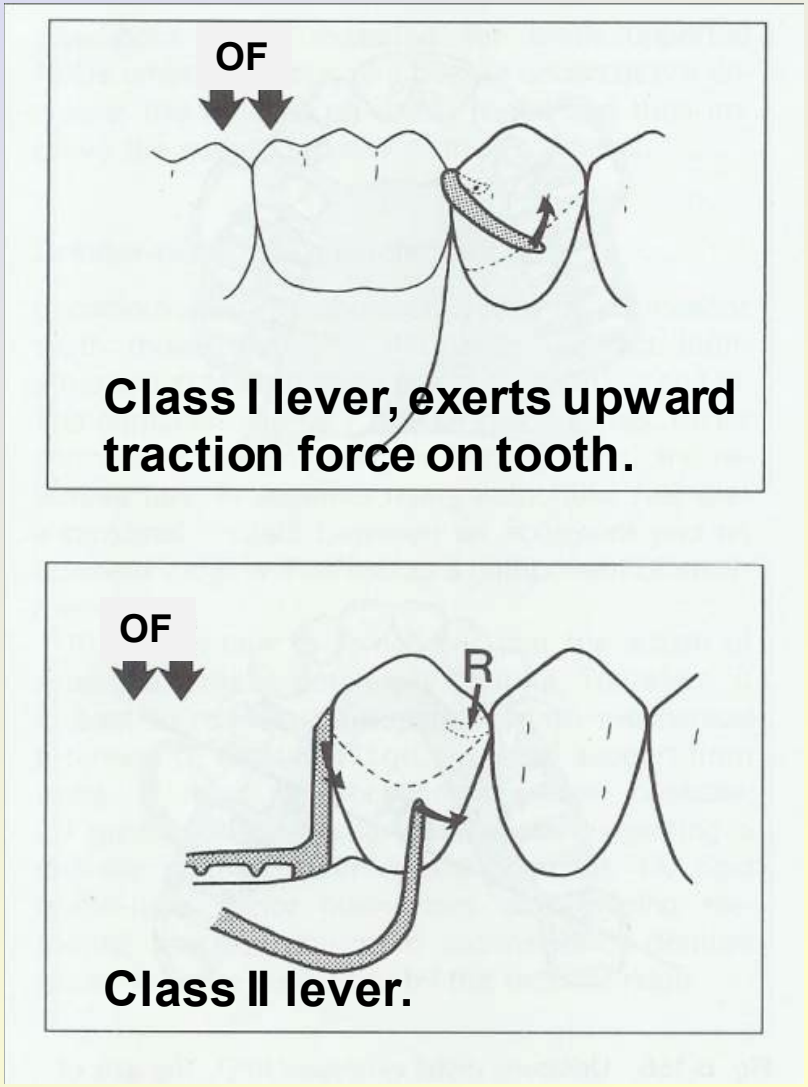




Location of rotational center changes with location of <u>most terminal rest.</u>

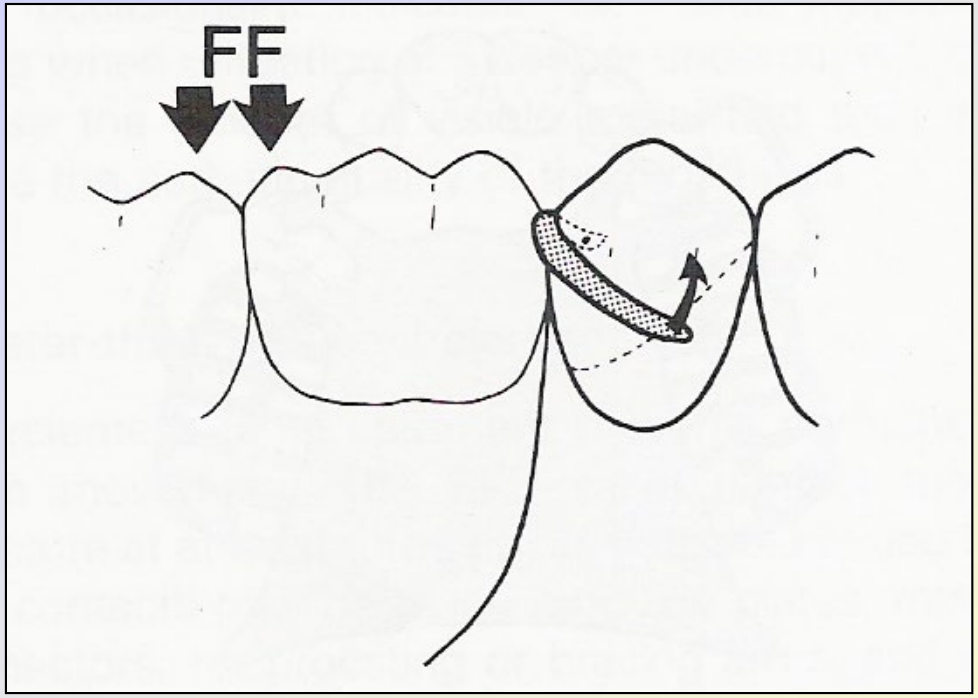
Mesial and Distal Rests: Different location of lever fulcrum

- All framework components on same side of fulcrum as occlusal loading move tissueward with occlusal loading
- All framework components on opposite side of fulcrum as occlusal loading move upward



Protection of abutment tooth during occlusal loading

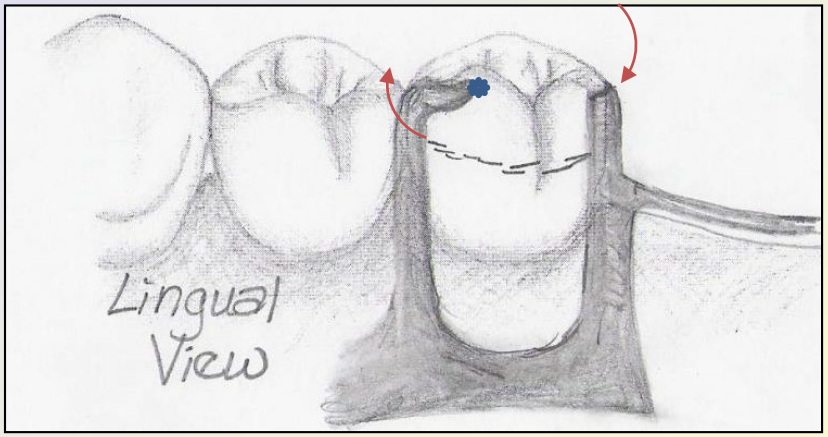
"Lifting" stresses should be eliminated/reduced.

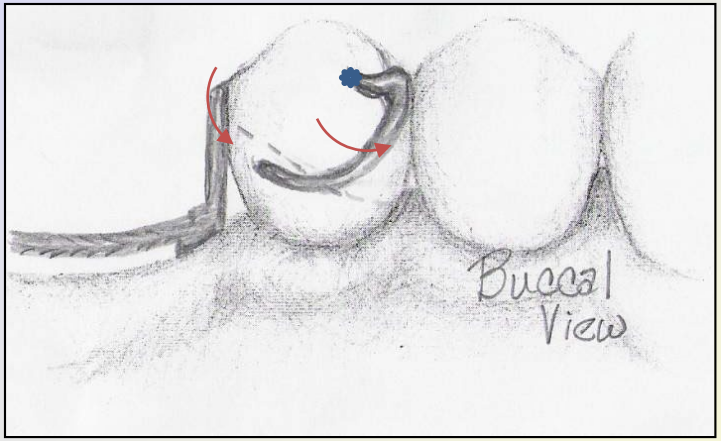


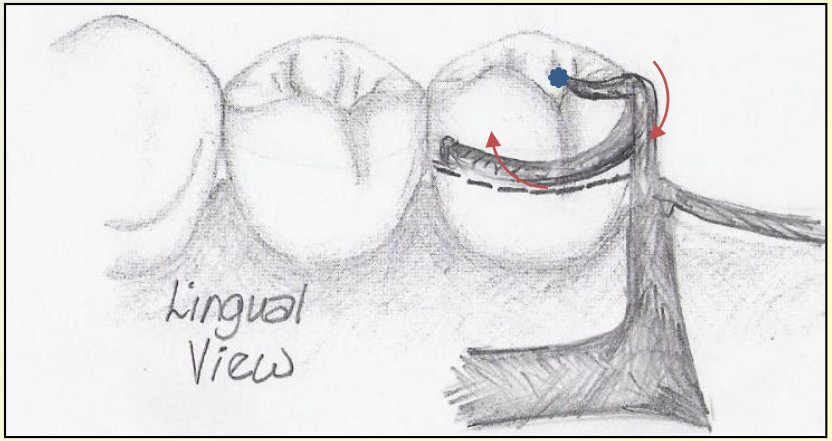
- This is the classic example of destructive clasp assembly design:
  - Distal rest with cast circlet retentive clasp to MB undercut.
- A class I lever lifts against the survey line exerting traction forces on the abutment tooth.

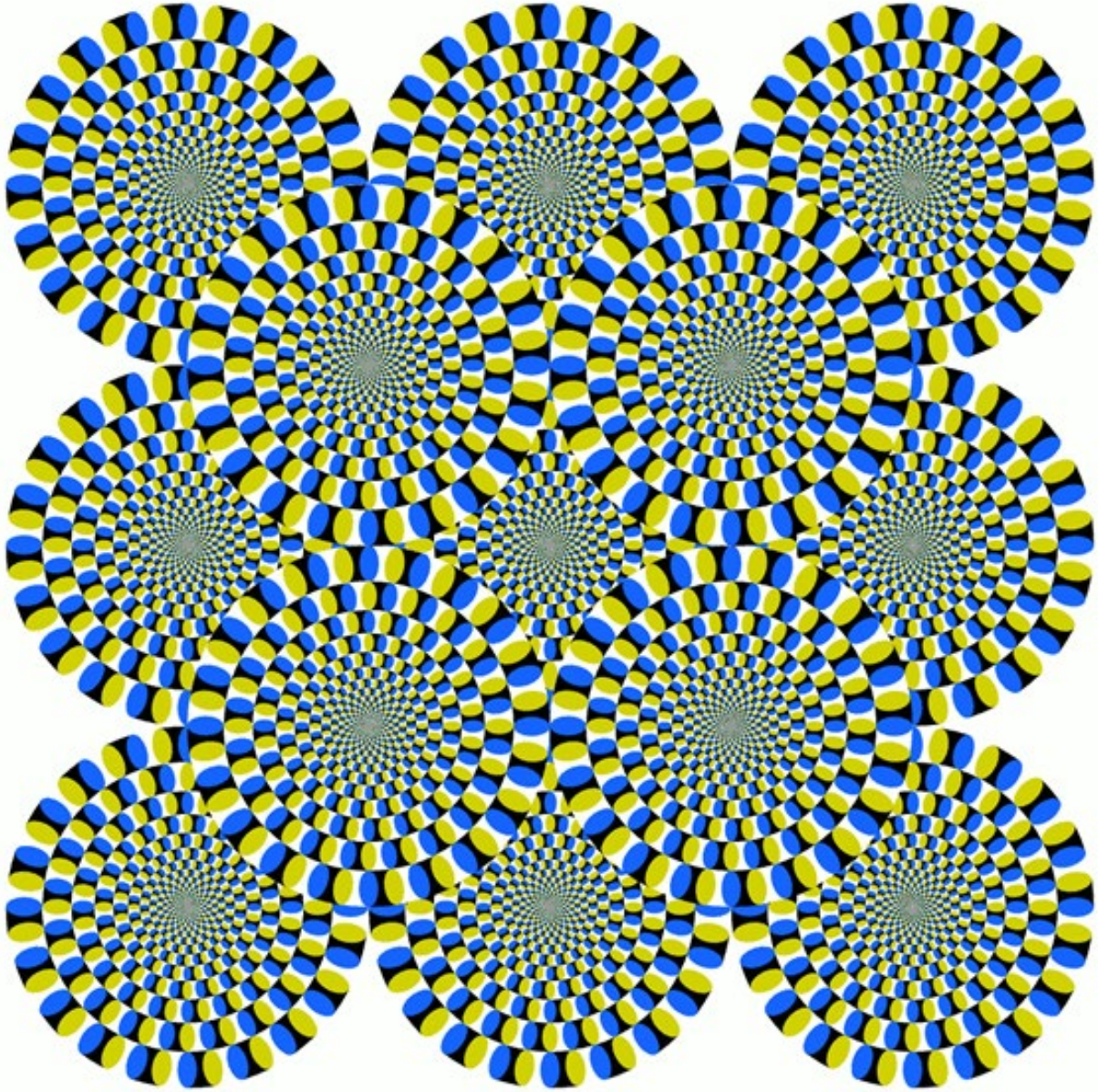
Besides movement of retentive tip, you must also consider movement of <u>all</u> components of clasp assembly during occlusal loading.

- Minor connectors
- Proximal plates
- Reciprocation
- Shoulders of retentive clasps

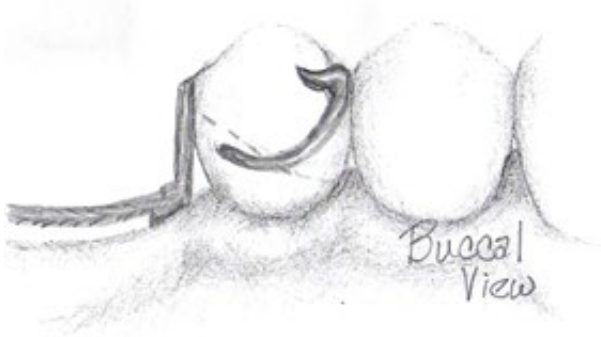
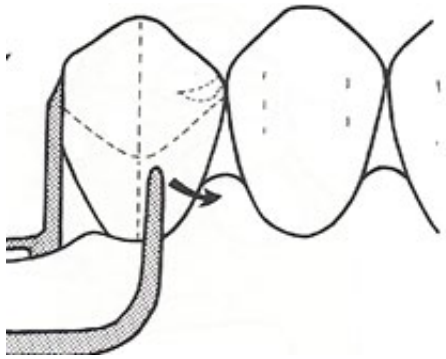
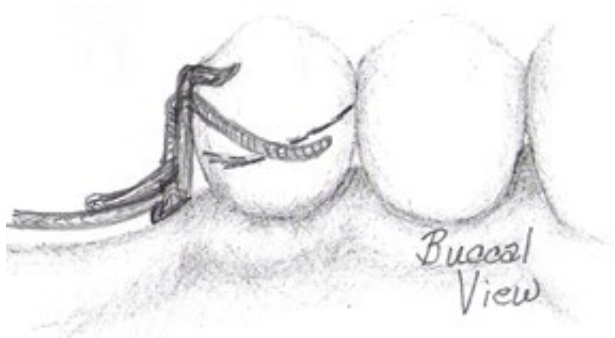
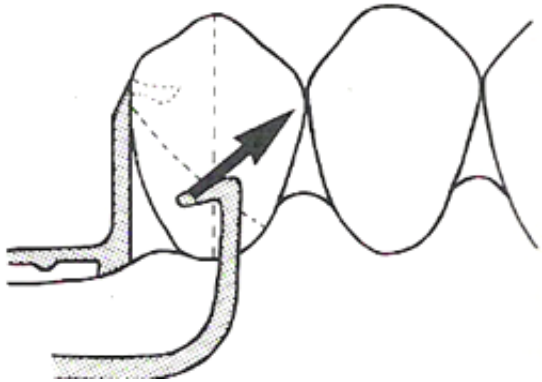




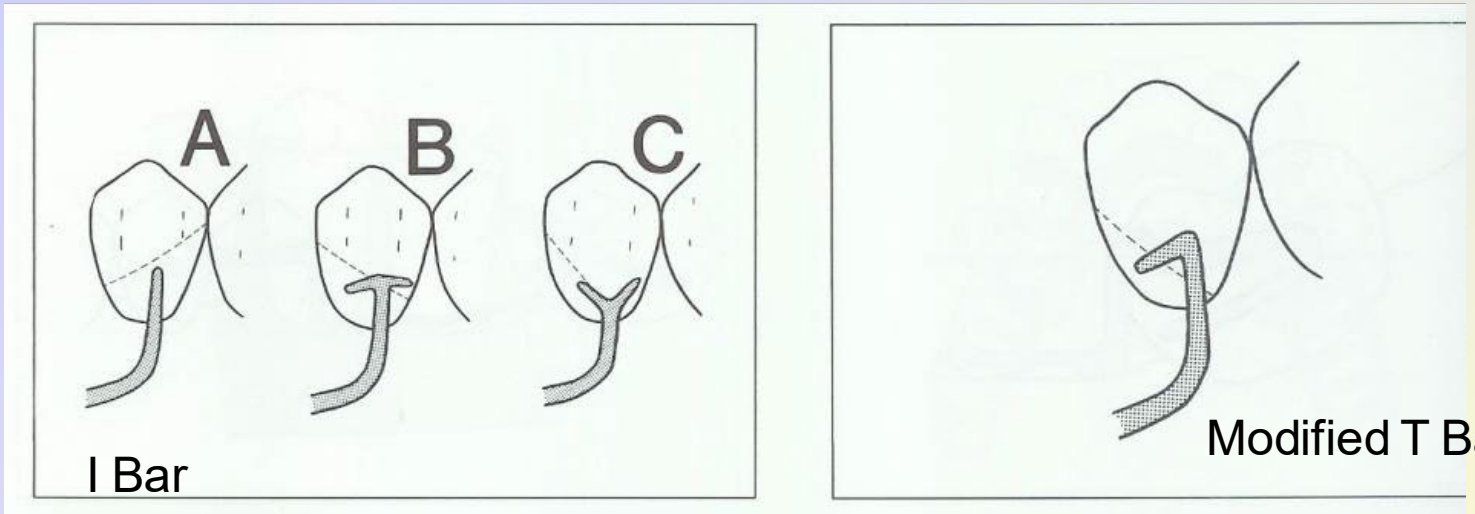




Options for DE clasp assemblies

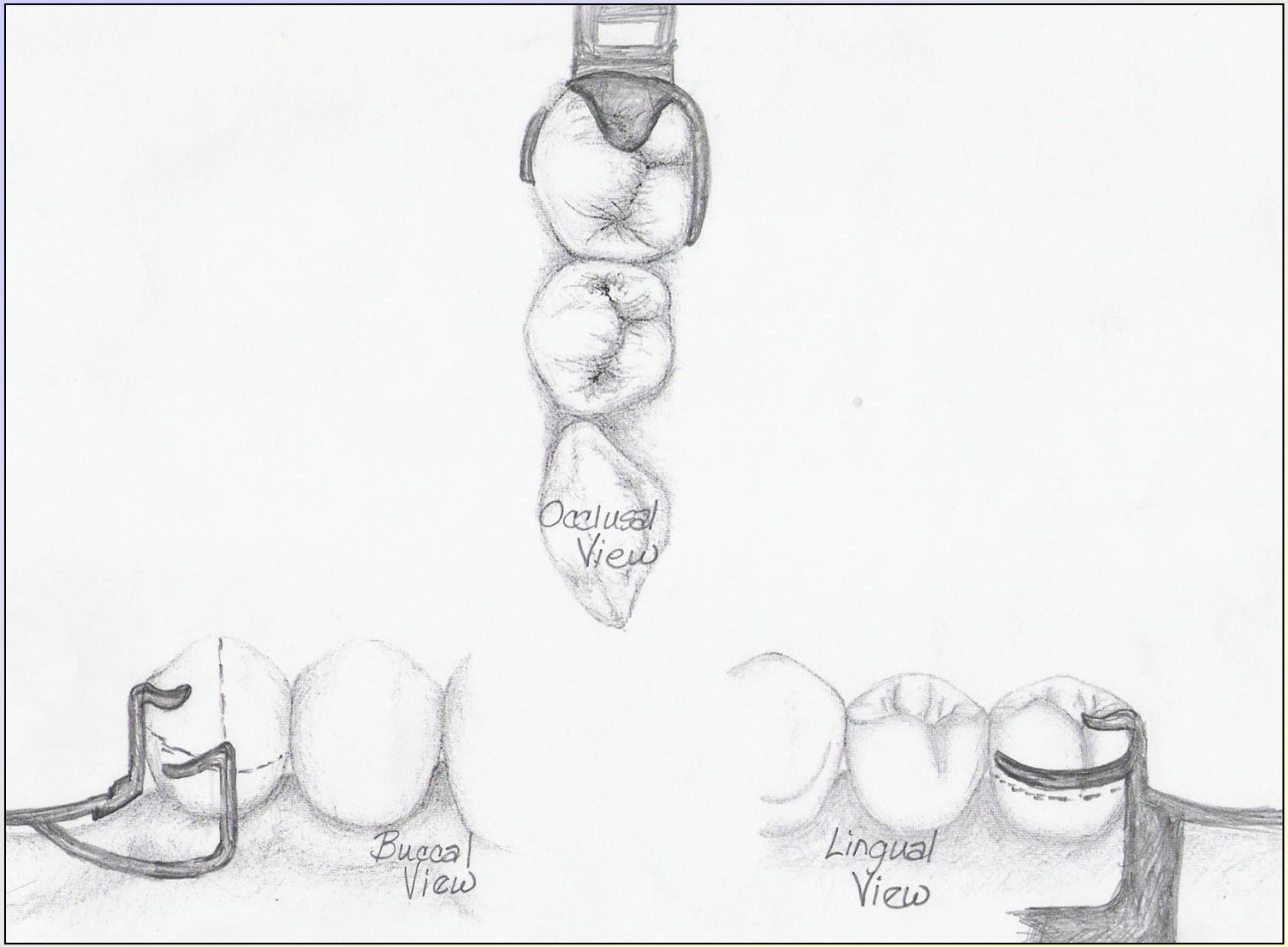
Clasp type / Rest location	Suprabulge	Infrabulge
Mesial	Reverse circlet 	I Bar 
Distal	Wrought wire 	Modified T bar 

Infrabulge retainers: I Bar and Modified T Bar



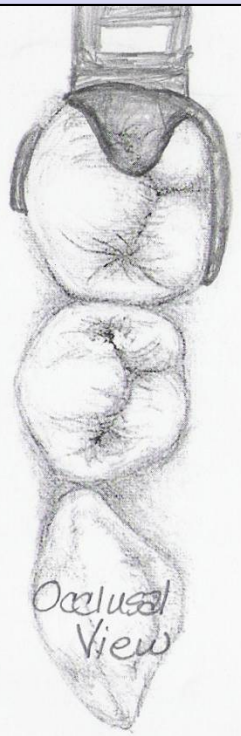
- **Approach retention from below rather from above survey line.**
- **Less tooth contact, some feel it is superior clasp to suprabulge.**
- **Contraindications:**
  - **Bony undercuts**
  - **Mucogingival defects**
  - **Cl V restorations**
  - **Interference of buccal frena**

Modified T Bar

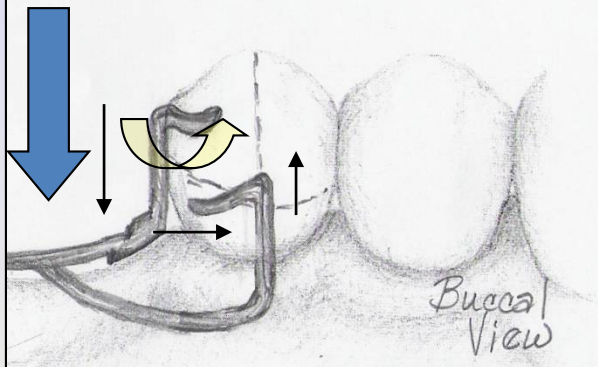


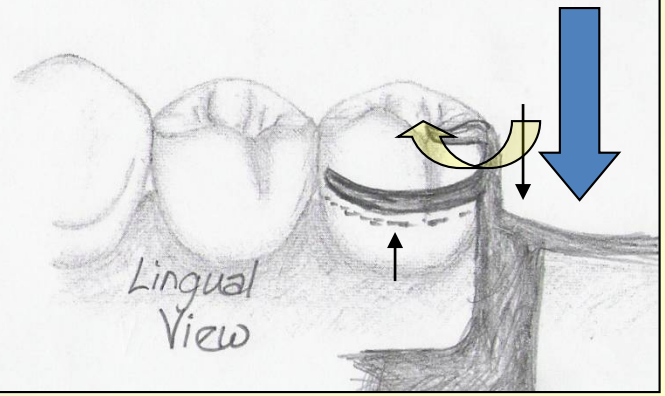
Modified T Bar

- Retentive tip moves forward and shoulder moves forward

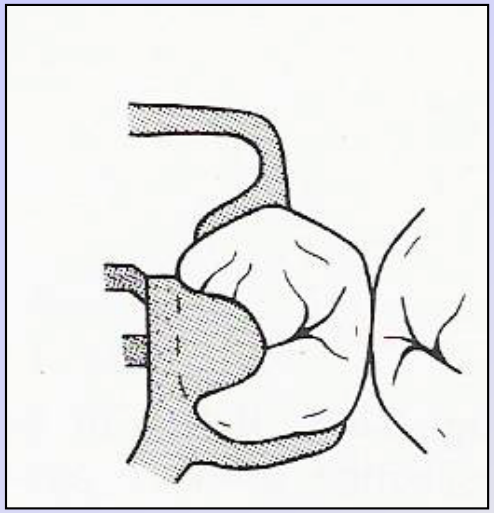


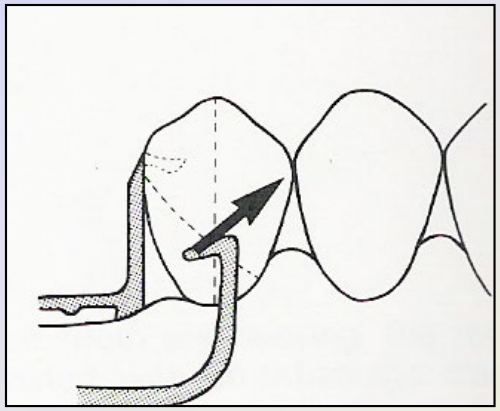
- Reciprocation moves opposite occlusal force
- Away from HOC
- Distal rest stabilizes proximal plate

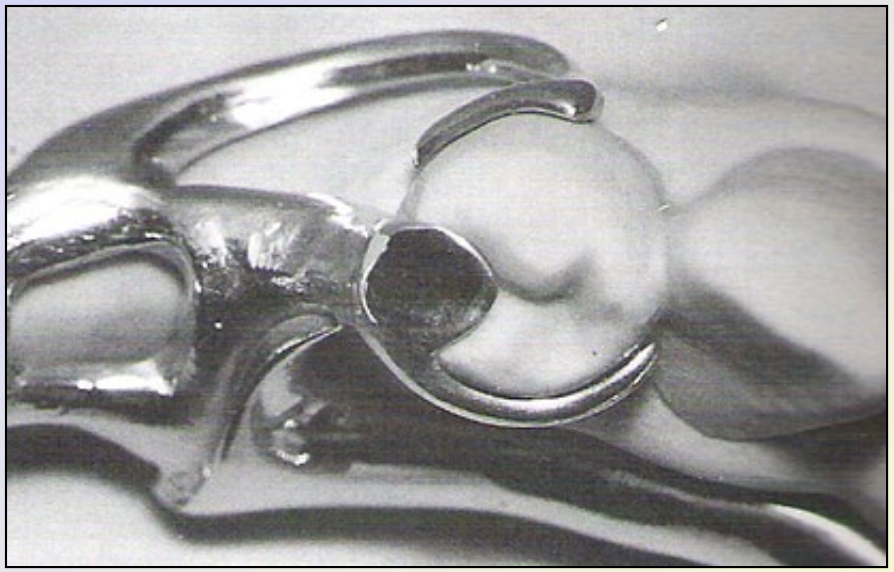


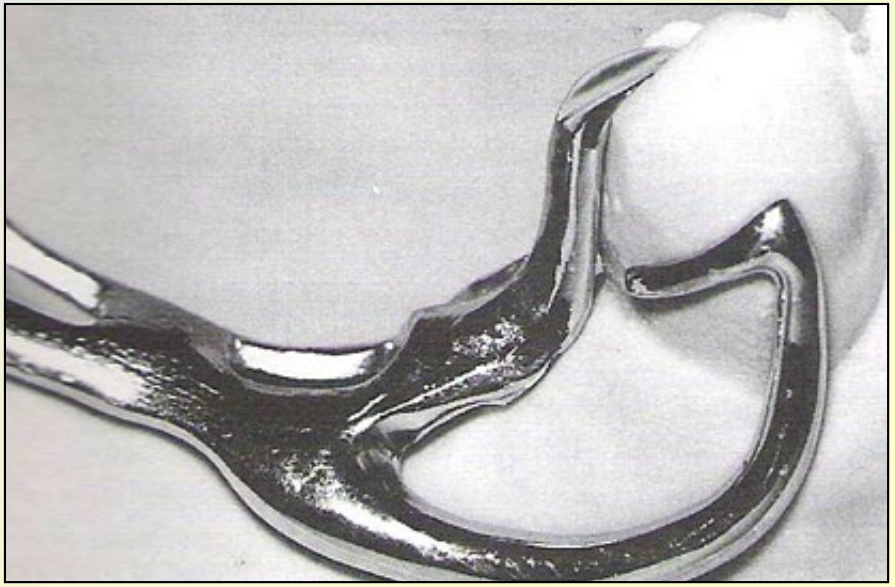


Modified T Bar









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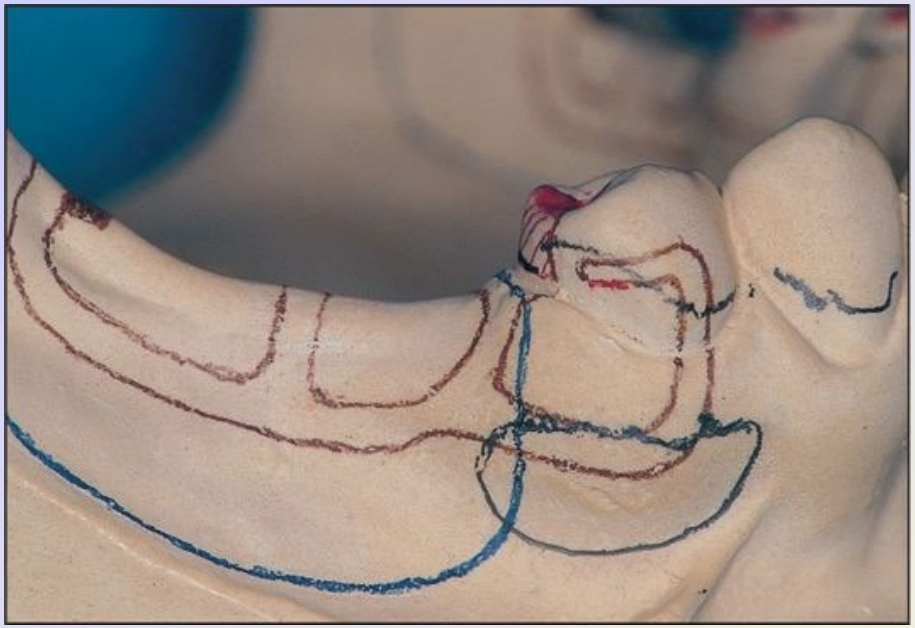
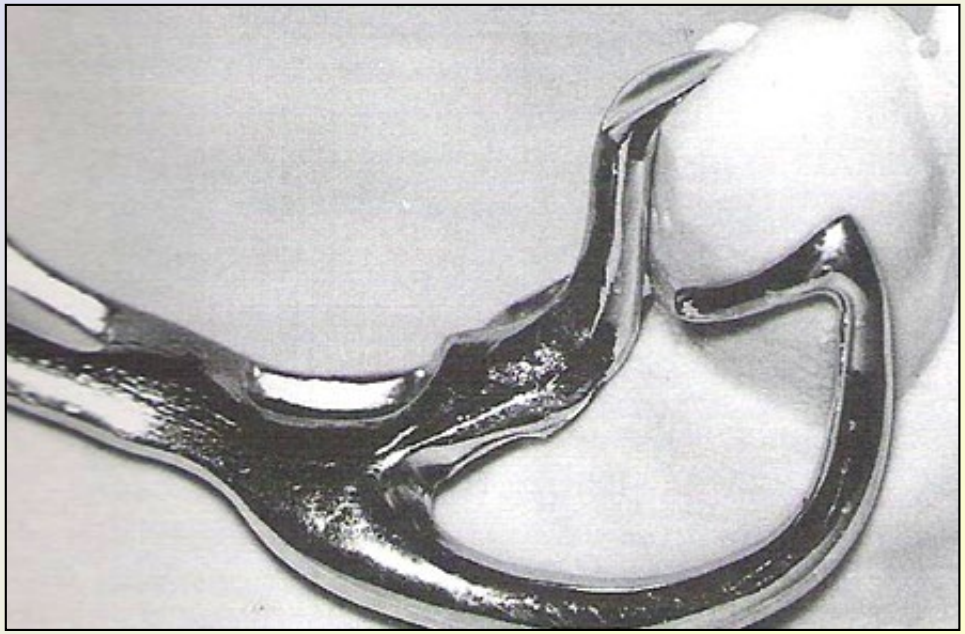
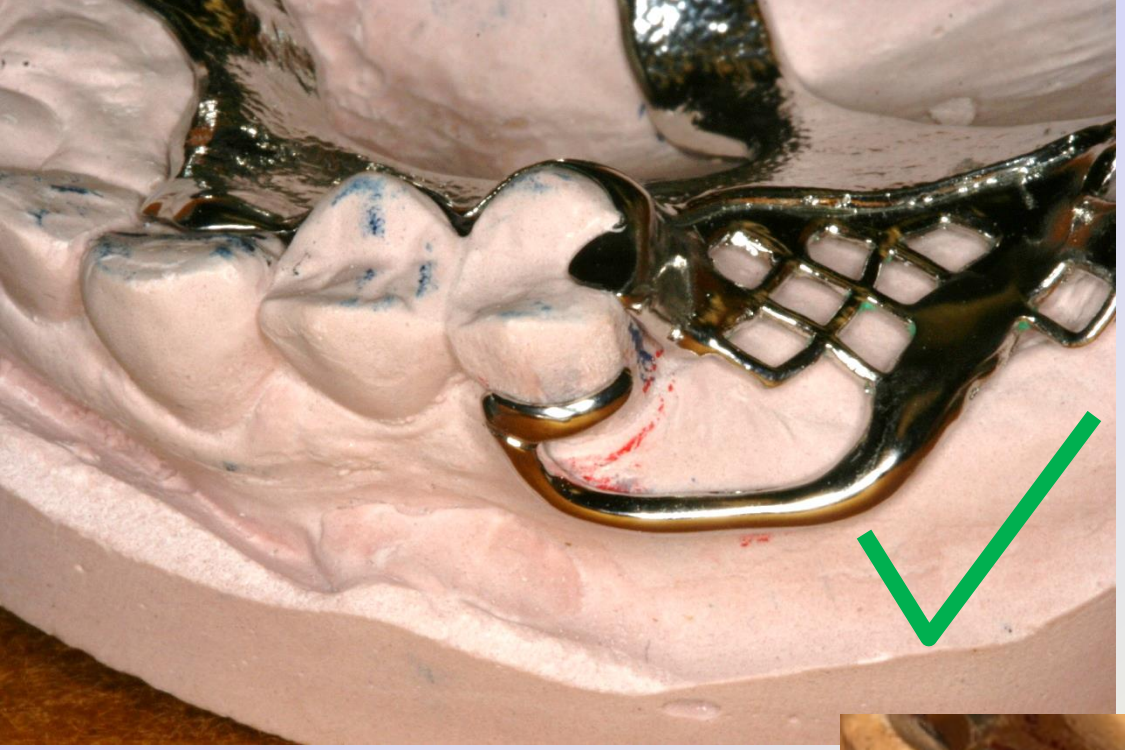






T bar with DO vs. MO rest

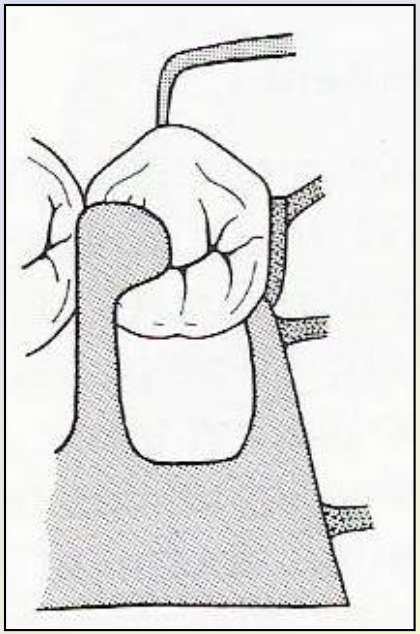
With MO rest…

Reciprocation moves downward toward HOC,

while retentive clasp disengages from tooth.

Could this cause buccal force?

I Bar



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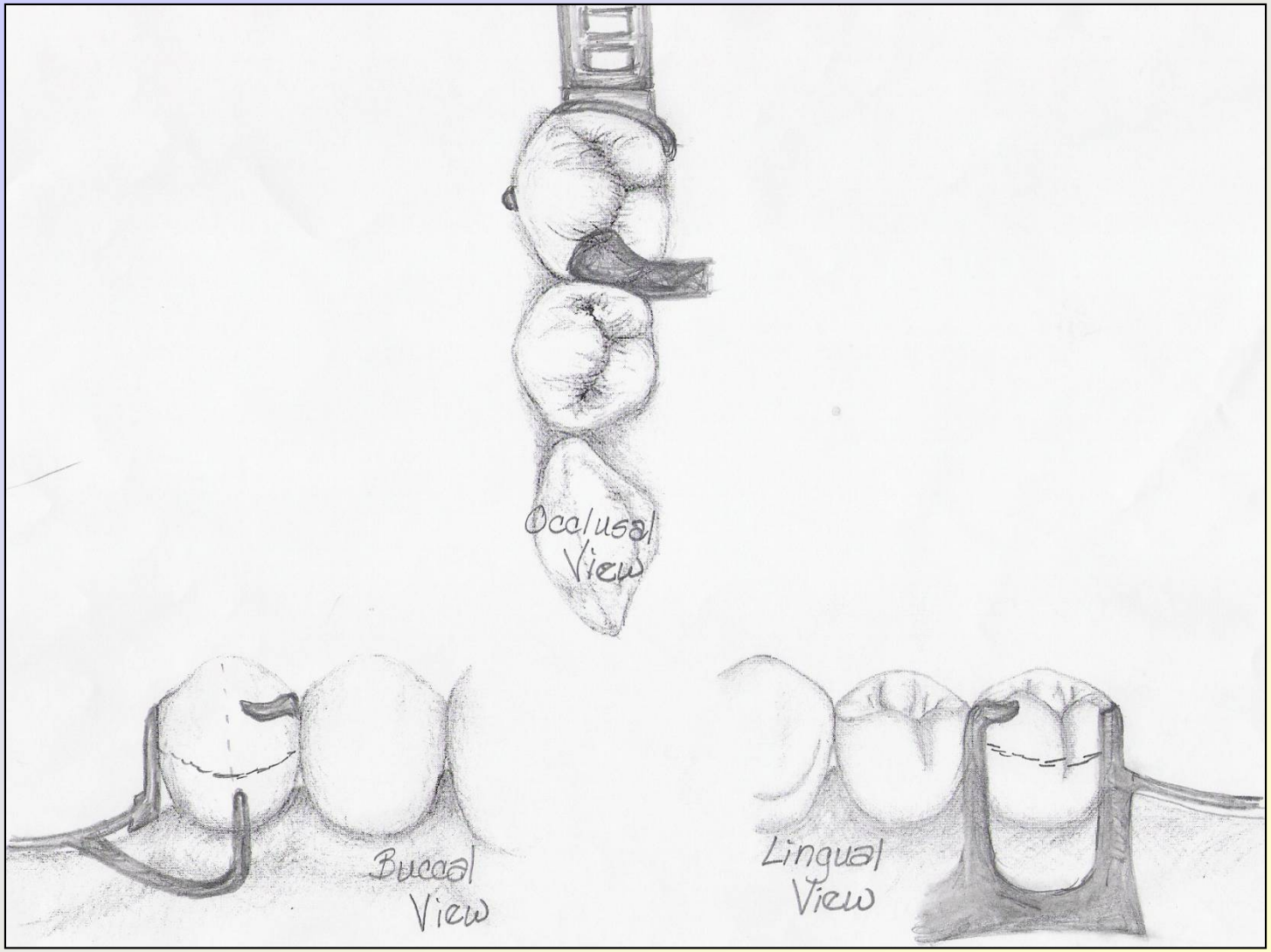
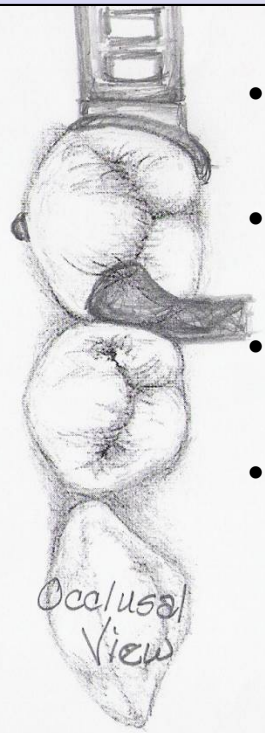
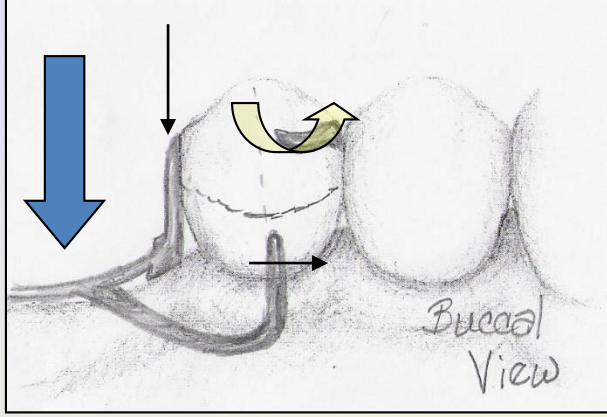


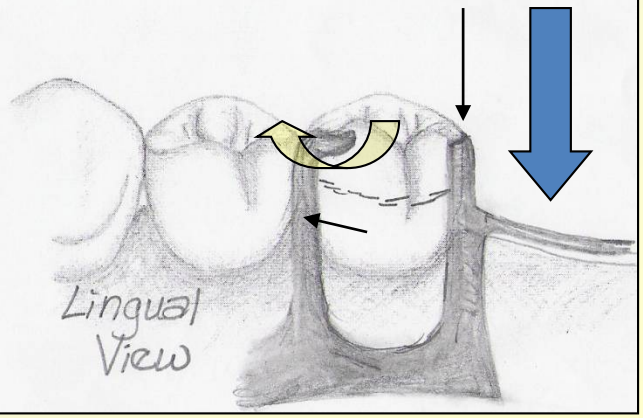
I Bar

- Retentive tip disengages from tooth
- Moves forward

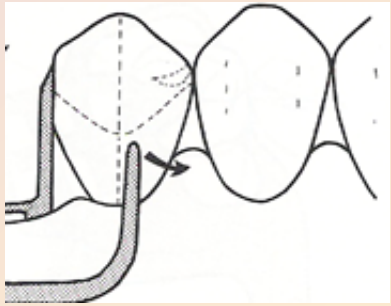
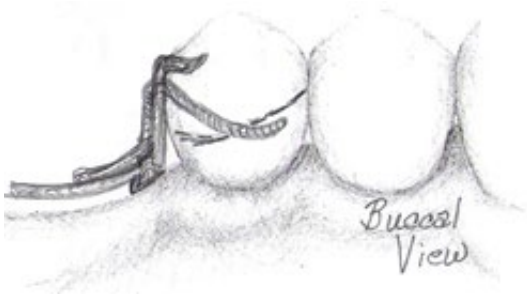
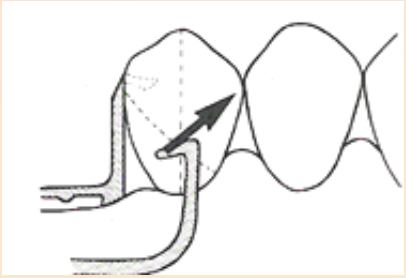


- No lingual reciprocation clasp or plate
- Does not push down against HOC
- Does push against anterior tooth
- Physiologic adjustment



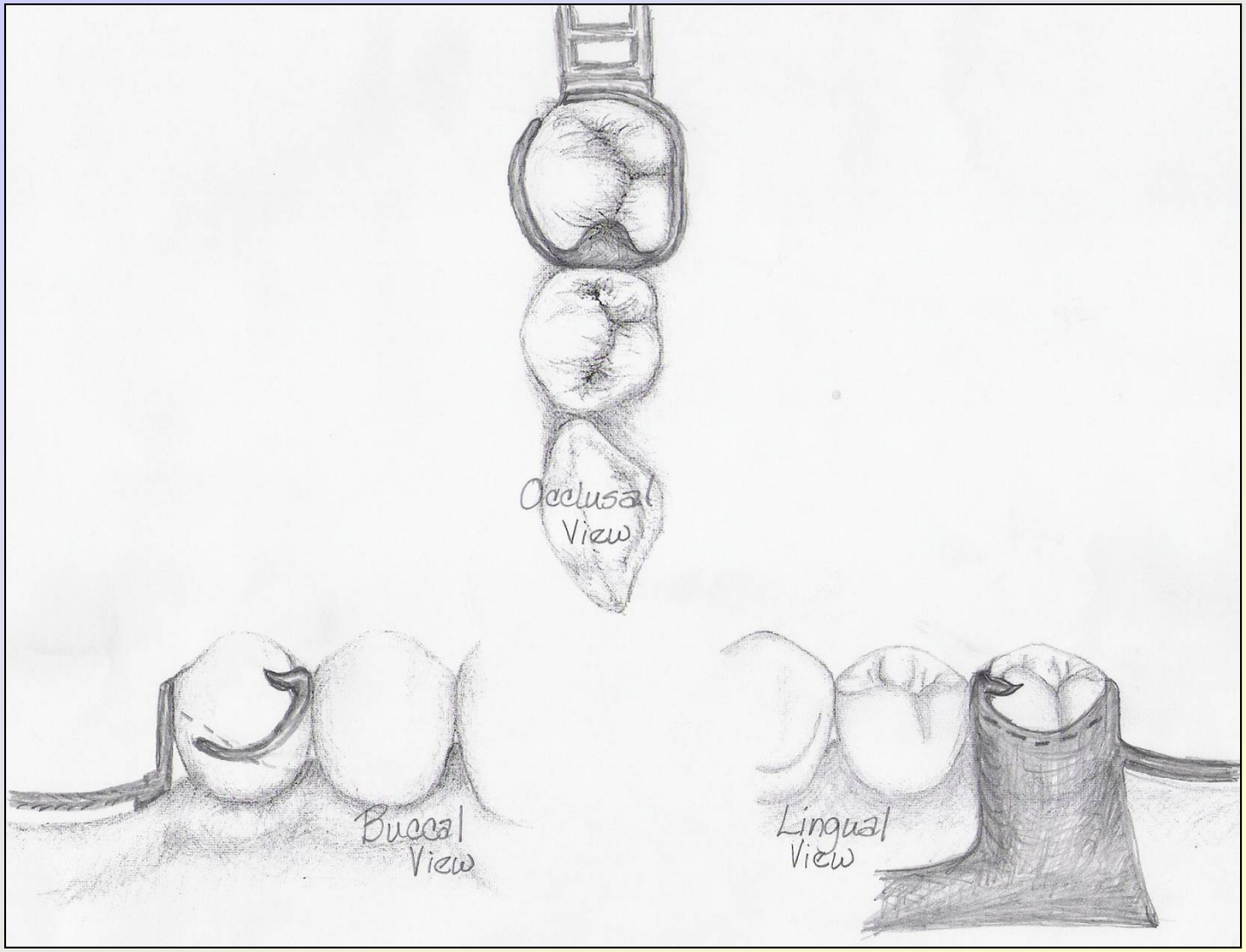


Choosing DE clasp assemblies

Clasp type / Rest location	Suprabulge	Infrabulge
		Mucogingival issues **Class V restorations** **High frena** **Bony undercuts**
Mesial	Reverse circlet 	I Bar 
Distal	Wrought wire 	Modified T bar 

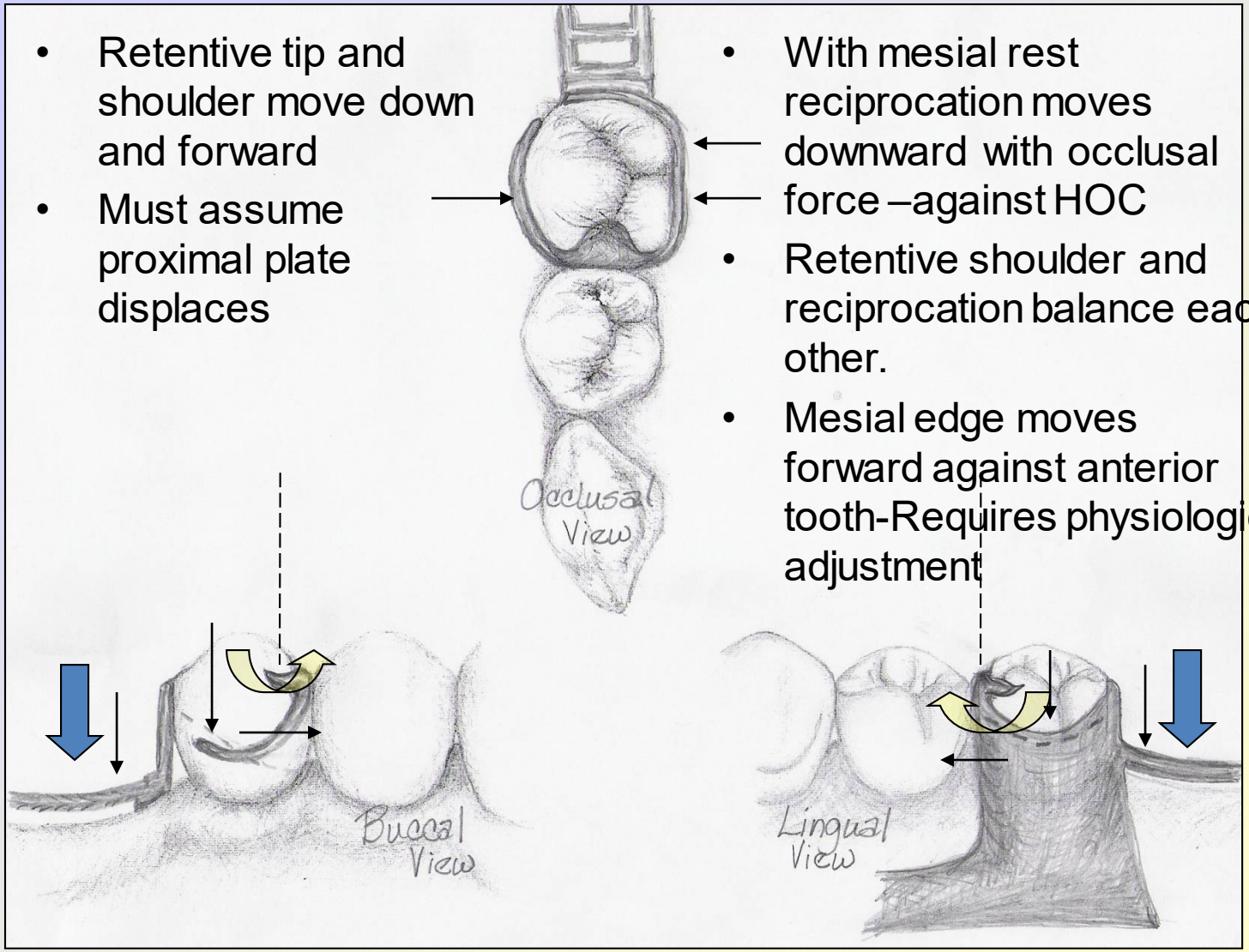
Suprabulge Retainers

Reverse Circlet



Reverse Circlet

- Retentive tip and shoulder move down and forward
- Must assume proximal plate displaces

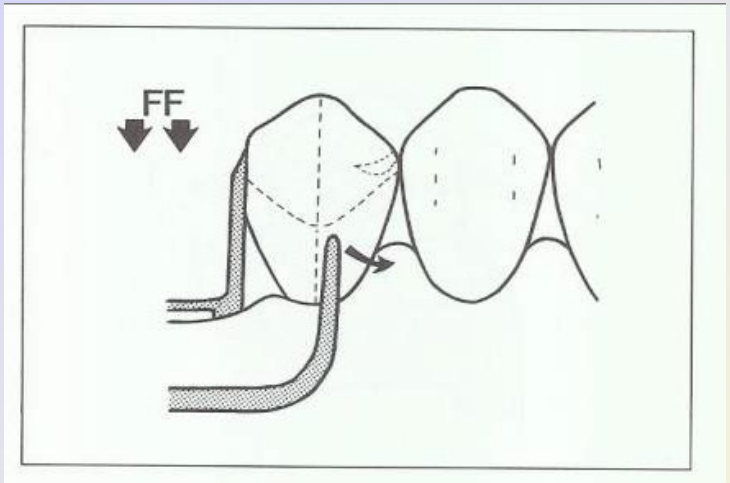


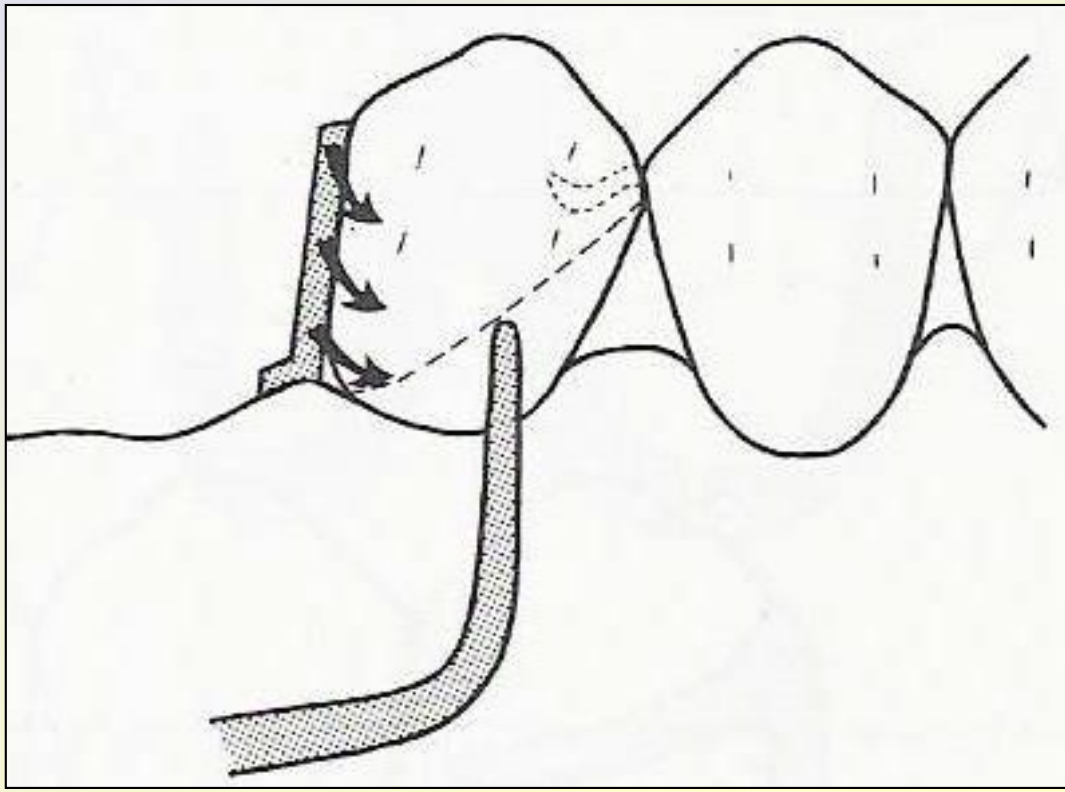
- With mesial rest reciprocation moves downward with occlusal force –against HOC
- Retentive shoulder and reciprocation balance each other.
- Mesial edge moves forward against anterior tooth-Requires physiologic adjustment

Reverse circlet as part of embrasure clasp assembly

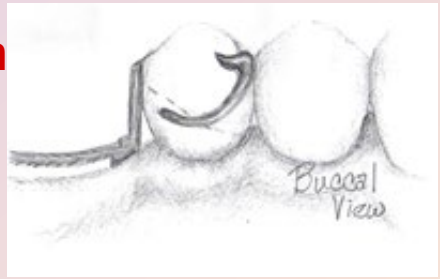
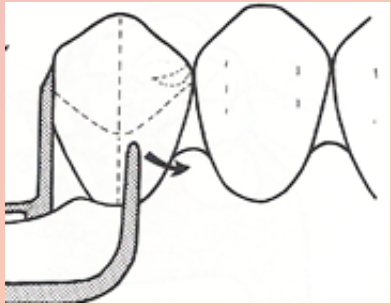
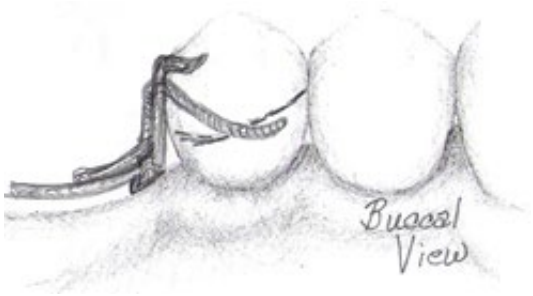
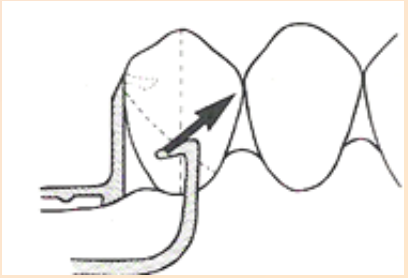
Mesial tilt:

- **A mesial rest allows more vertical movement during occlusal loading.**
- **There must be space for the proximal plate to have play during loading.**
- **A mesially tipped tooth provides no such space and causes destructive torquing stress to theabutment tooth.**
- **Therefore, mesial rests should not be used for distal extension RCAs on mesially tipped teeth.**

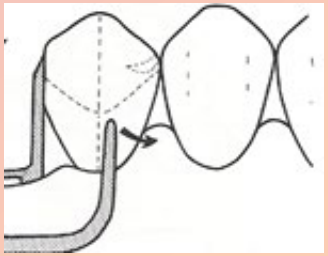
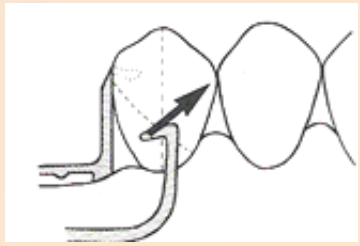




Choosing DE clasp assemblies

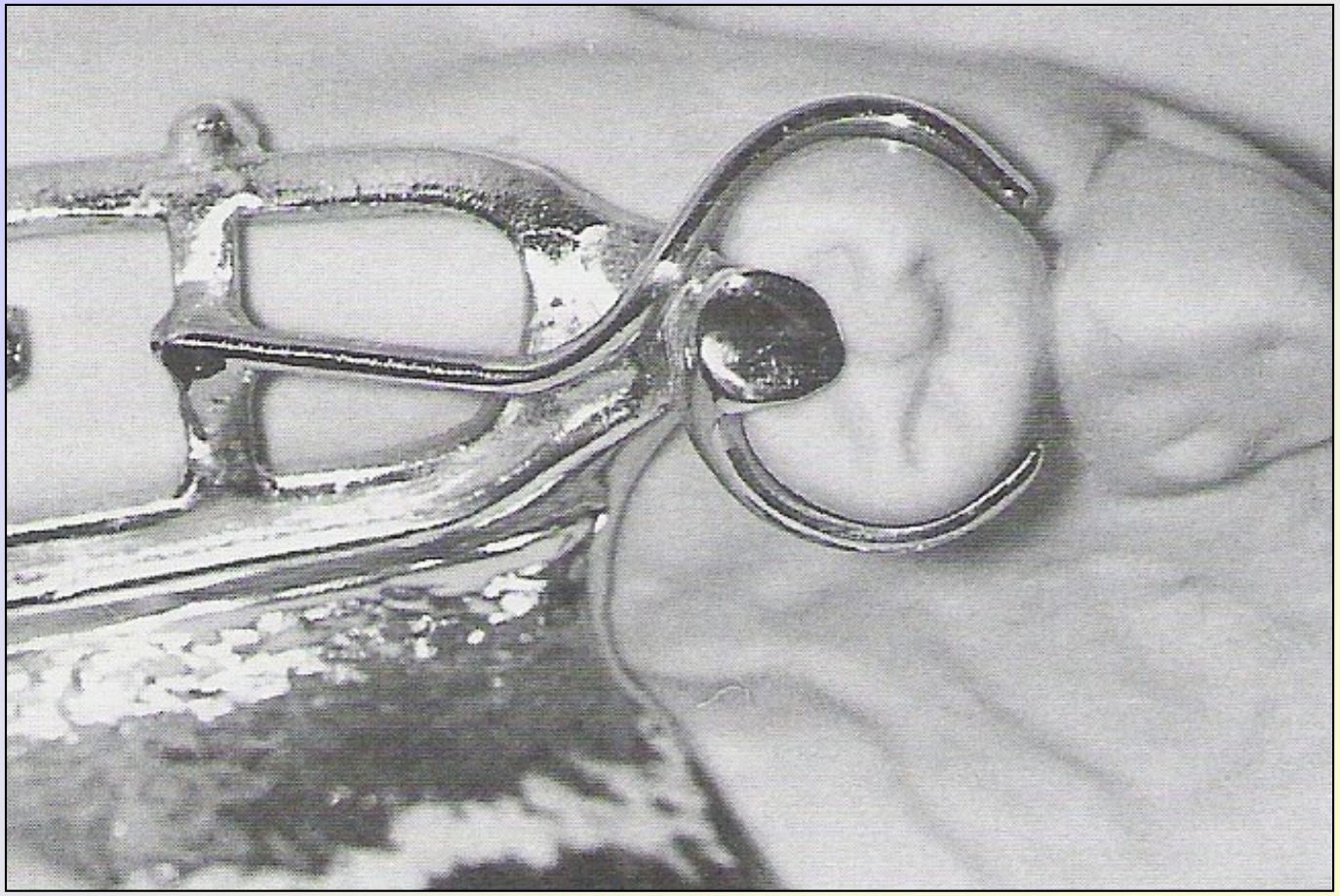
Clasp type / Rest location	Suprabulge	Infrabulge
		Mucogingival **Class V restorations** **High frena** **Bony undercuts**
Mesial **Mesial tilt**	Reverse circlet **Occlusion** 	I Bar 
Distal	Wrought wire 	Modified T bar 

Choosing DE clasp assemblies

Clasp type / Rest location	Suprabulge	Infrabulge
Mesial **Mesial tilt**	Reverse circlet **Occlusion** 	I Bar 
Distal	Wrought wire 	Modified T bar 

Mucogingival
Class V restorations
High frena
Bony undercuts

Wrought Wire

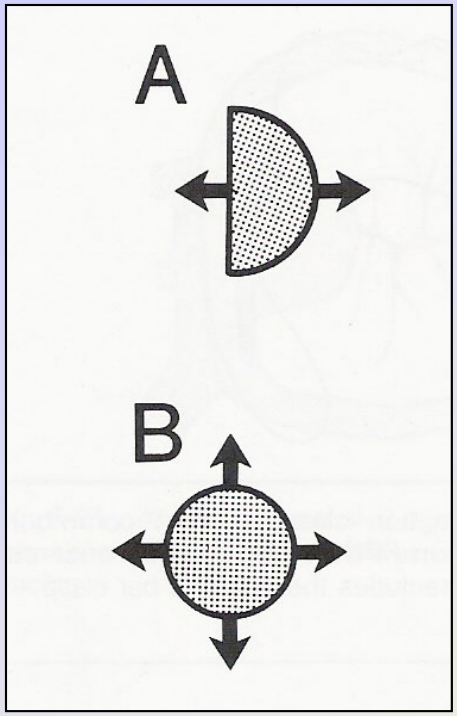


This is a class 1 lever!

However, the unique flexibility of WW clasps means they can be used in Class I lever situations.

- **Wrought wire clasps are flexible due to:**
  - **Cross-sectional geometry**
    - **ROUND**
  - **The wire's material property**
    - **NOT AT STIFF AS CAST CLASP MATERIAL**

Difference in flexibility of cast clasps vs. wrought wire clasps

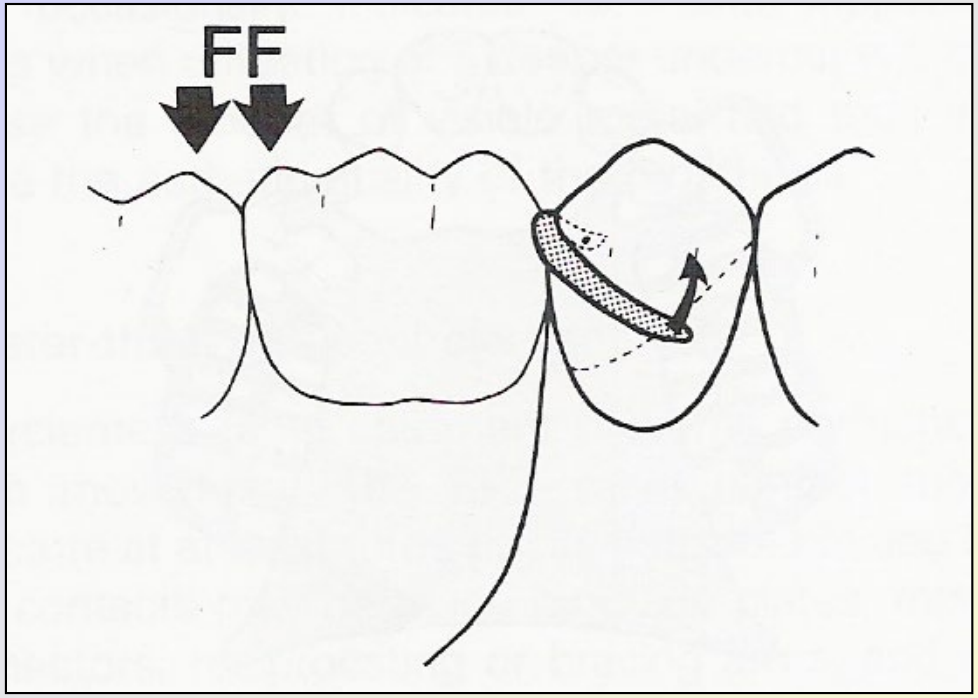


Cast clasps are made of less flexible material and can only allow deflection in lateral direction because of cross sectional geometry.

Wrought wire is more flexible material and deflect laterally and vertically. When it pushes up against HOC, it flexes and does not cause stress.

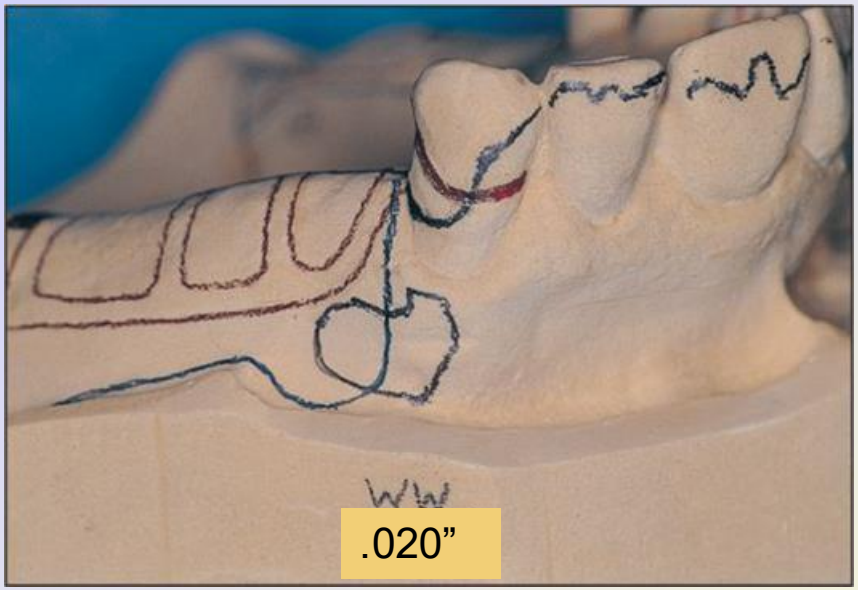
Protection of abutment tooth during occlusal loading

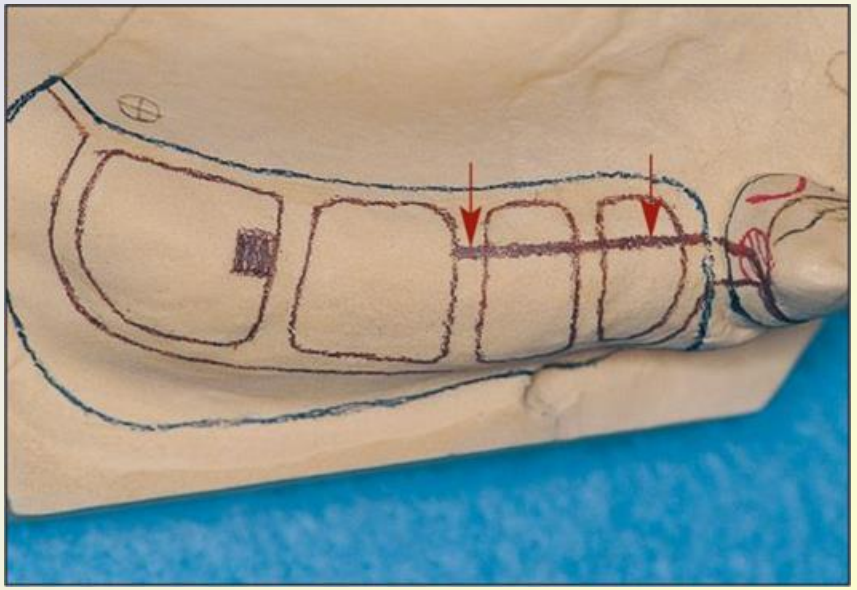
"Lifting" stresses should be eliminated/reduced.



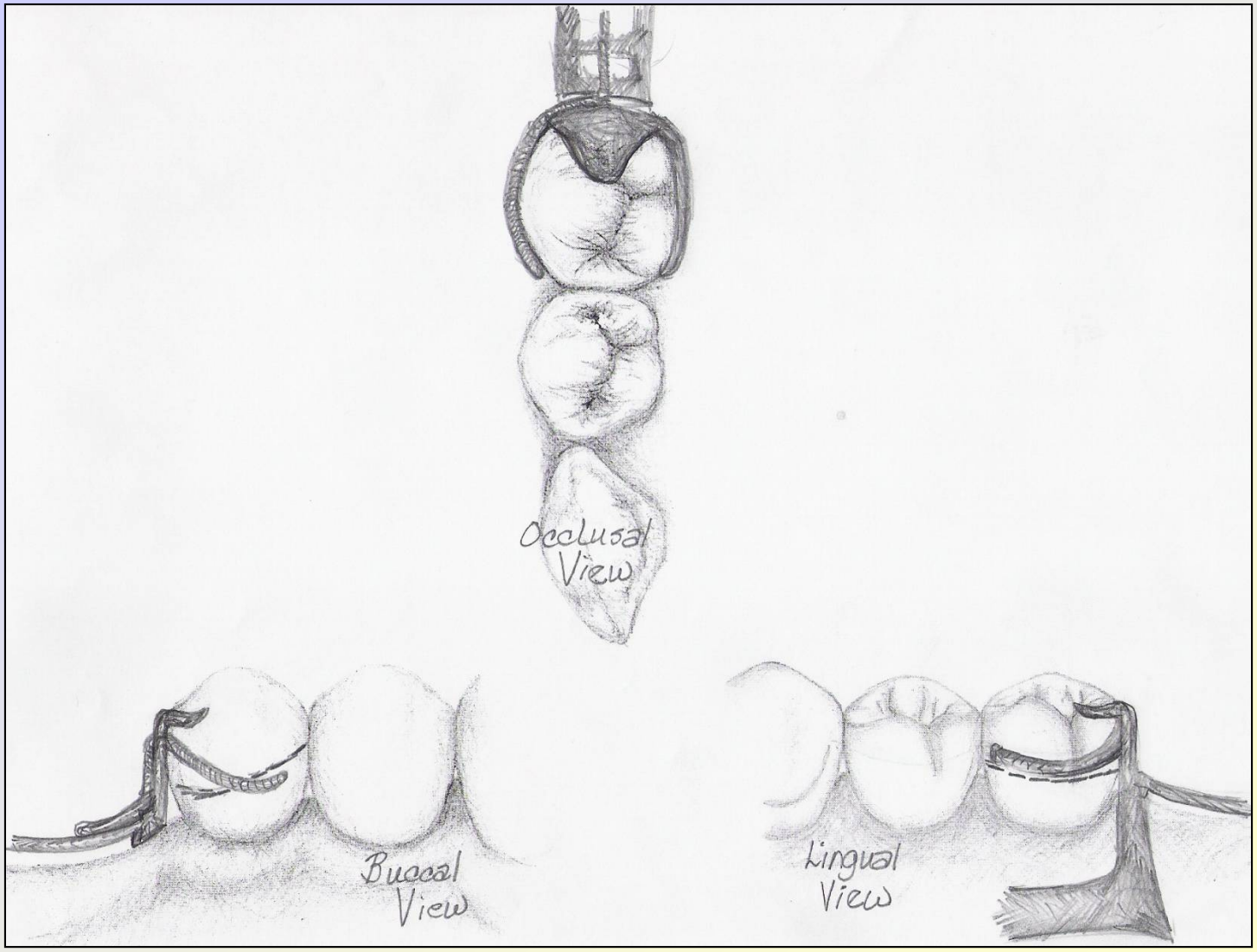
- This is the classic example of destructive clasp assembly design:
  - Distal rest with cast circlet retentive clasp to MB undercut.
- A class I lever lifts against the survey line exerting traction forces on the abutment tooth.

Wrought Wire Clasp

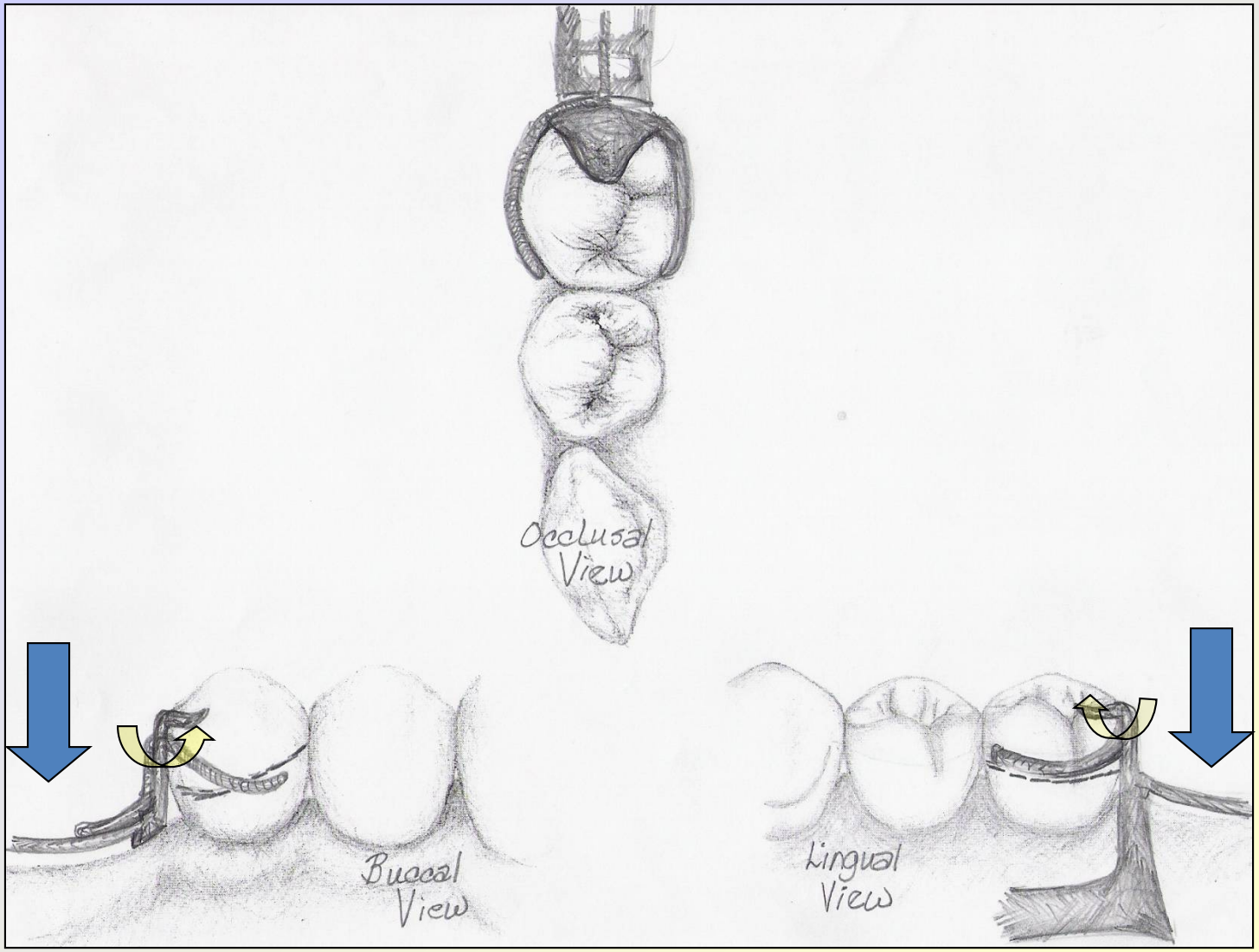




Wrought Wire



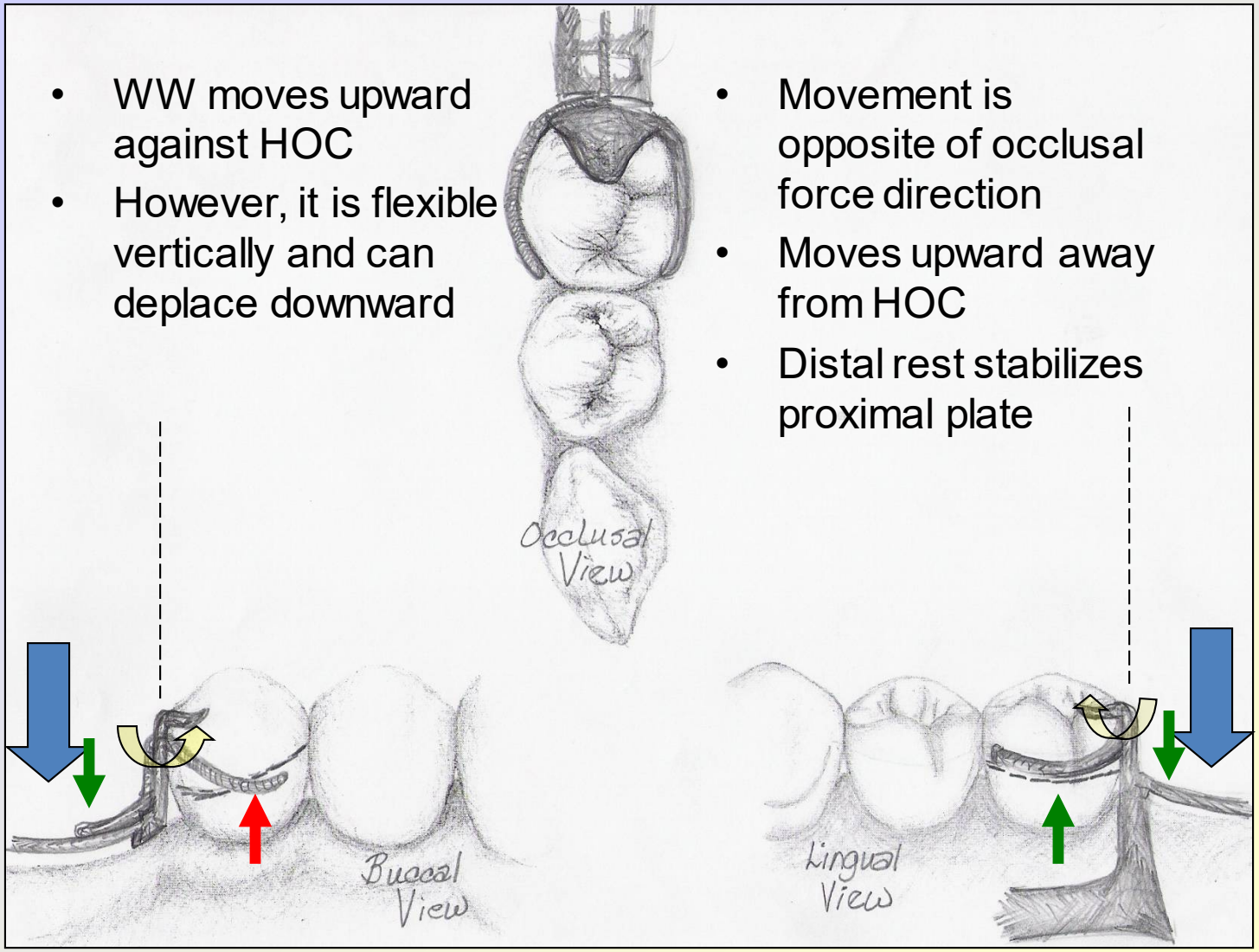
Wrought Wire



Wrought Wire

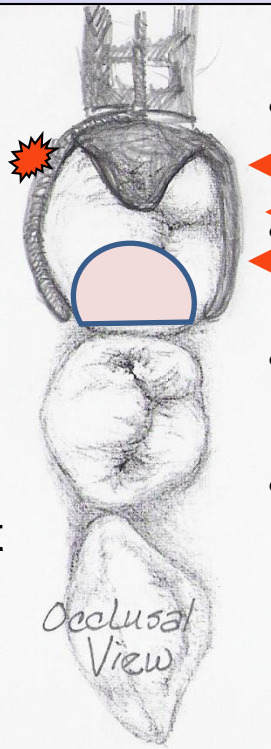
- WW moves upward against HOC
- However, it is flexible vertically and can deplace downward

- Movement is opposite of occlusal force direction
- Moves upward away from HOC
- Distal rest stabilizes proximal plate

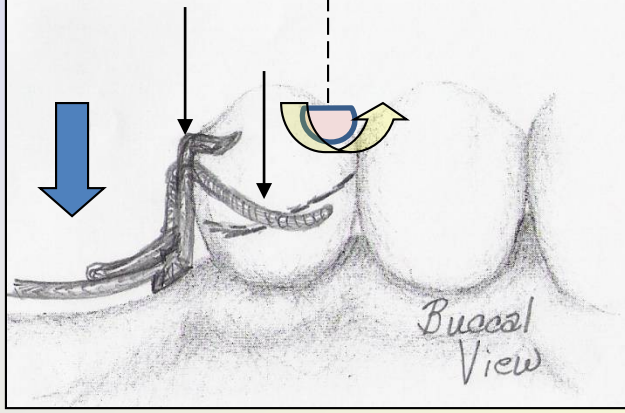


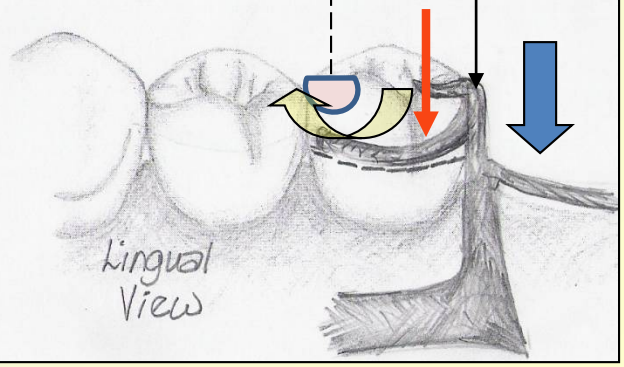
Wrought Wire with <u>INCORRECT</u> MO rest

- Retentive tip does move forward instead of upward
- More movement downward of proximal plate
- Flexible shoulder of WW pushed against HOC



- Reciprocation moves downward against HOC
- Exerts buccal pressure on tooth
- No strong cast element on buccal to conteract
- Over time weakens/deforms WW





Wrought wire with DO (right) vs MO (wrong) rest

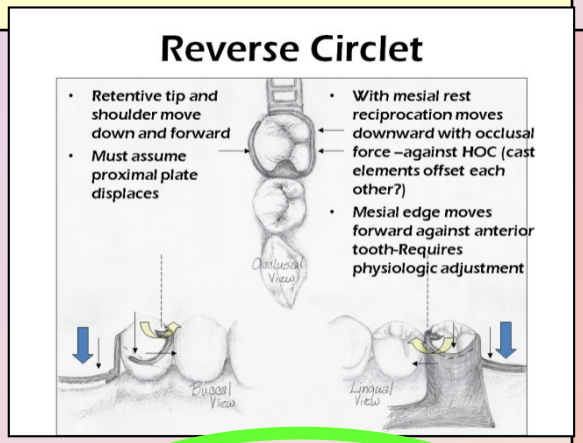
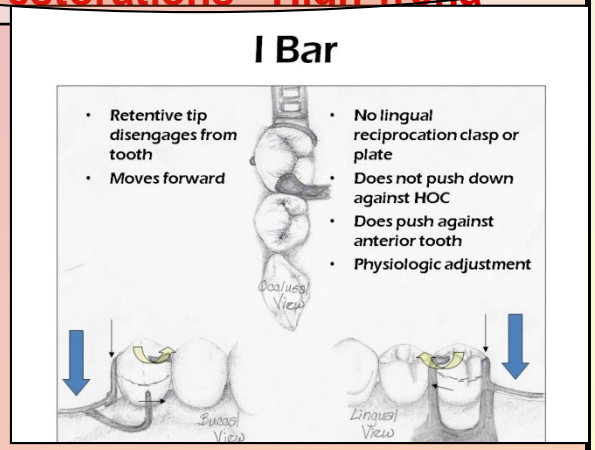
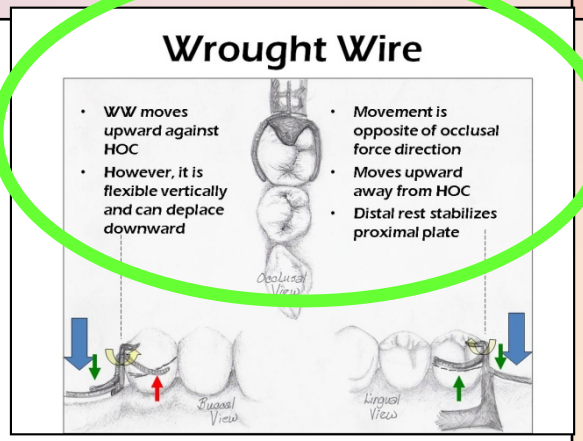
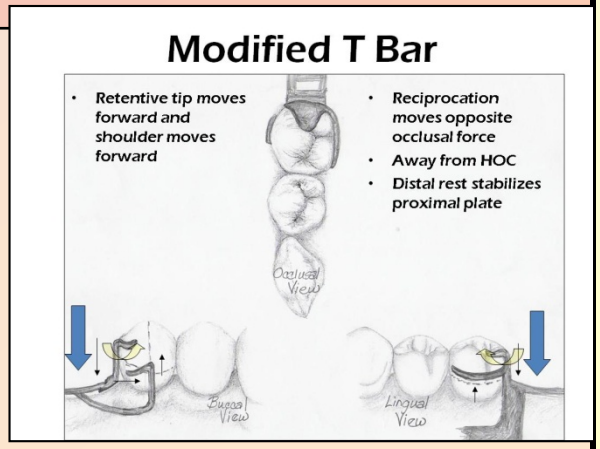
Rigid reciprocation moves downward toward HOC,

while shoulder of flexible WW also moves down toward HOC.

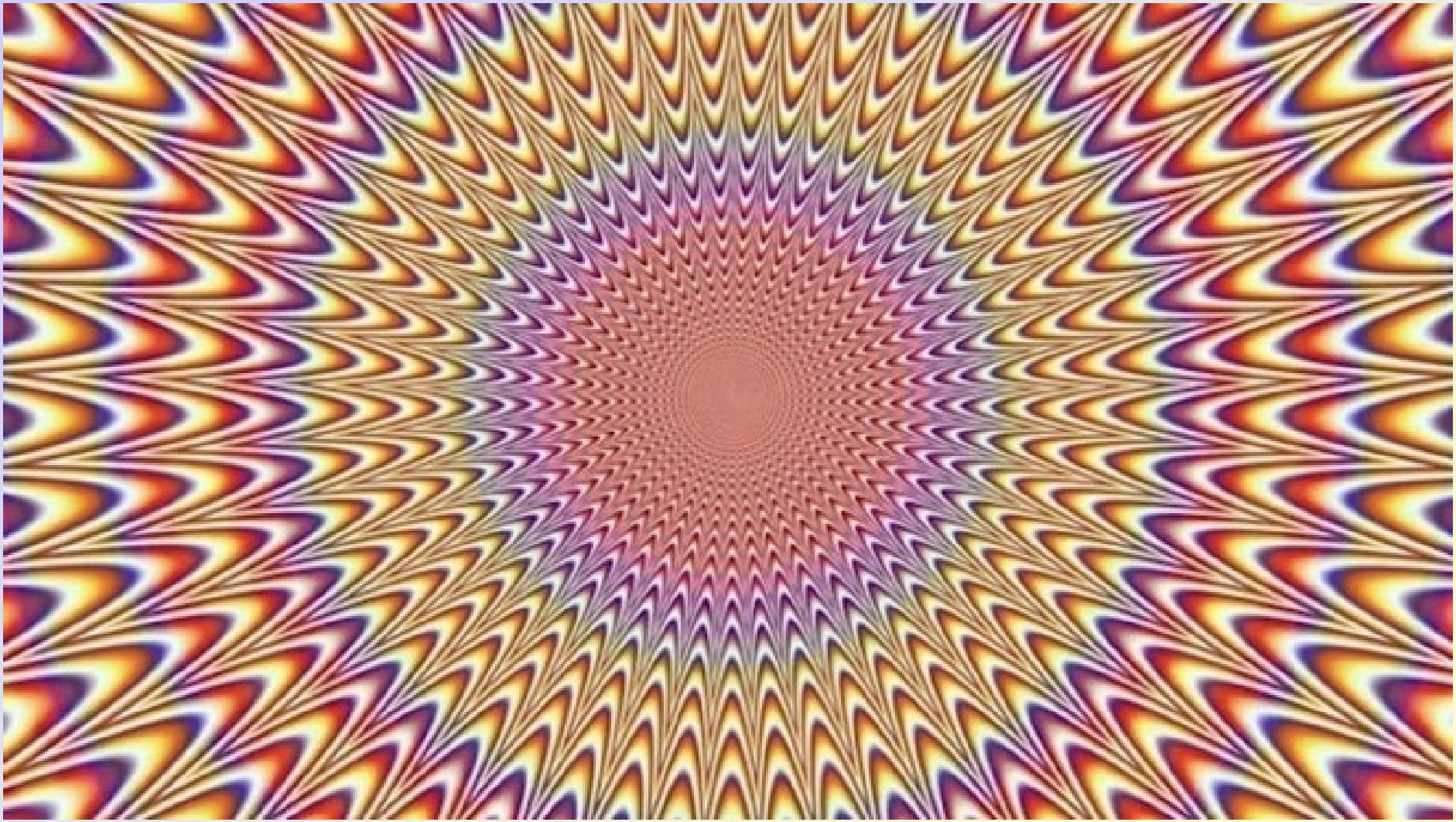
Could this result in buccal movement and deformation of WW?

What an MO rest w/ WW allows to happen biomechanically.

Choosing DE clasp assemblies

Clasp type / Rest location*	Suprabulge	Infrabulge
Mesial ~~Mesial tilt~~	Can be unacceptable due to occlusal interference 	Mucogingival undercuts Bony Class V restorations High frena 
Distal	Often becomes only remaining option 	

*Rotational center location



Cape Creek Bridge

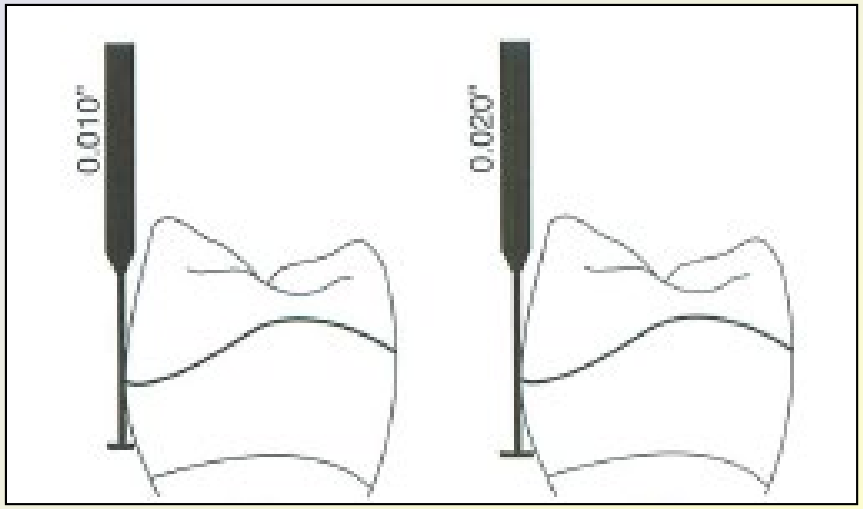
Design Notes

- **Symmetry is desirable whenever possible.**
- **Know bilateral, tripodal, or quadralateral RCA configurations for Kennedy classes(p. 107)**

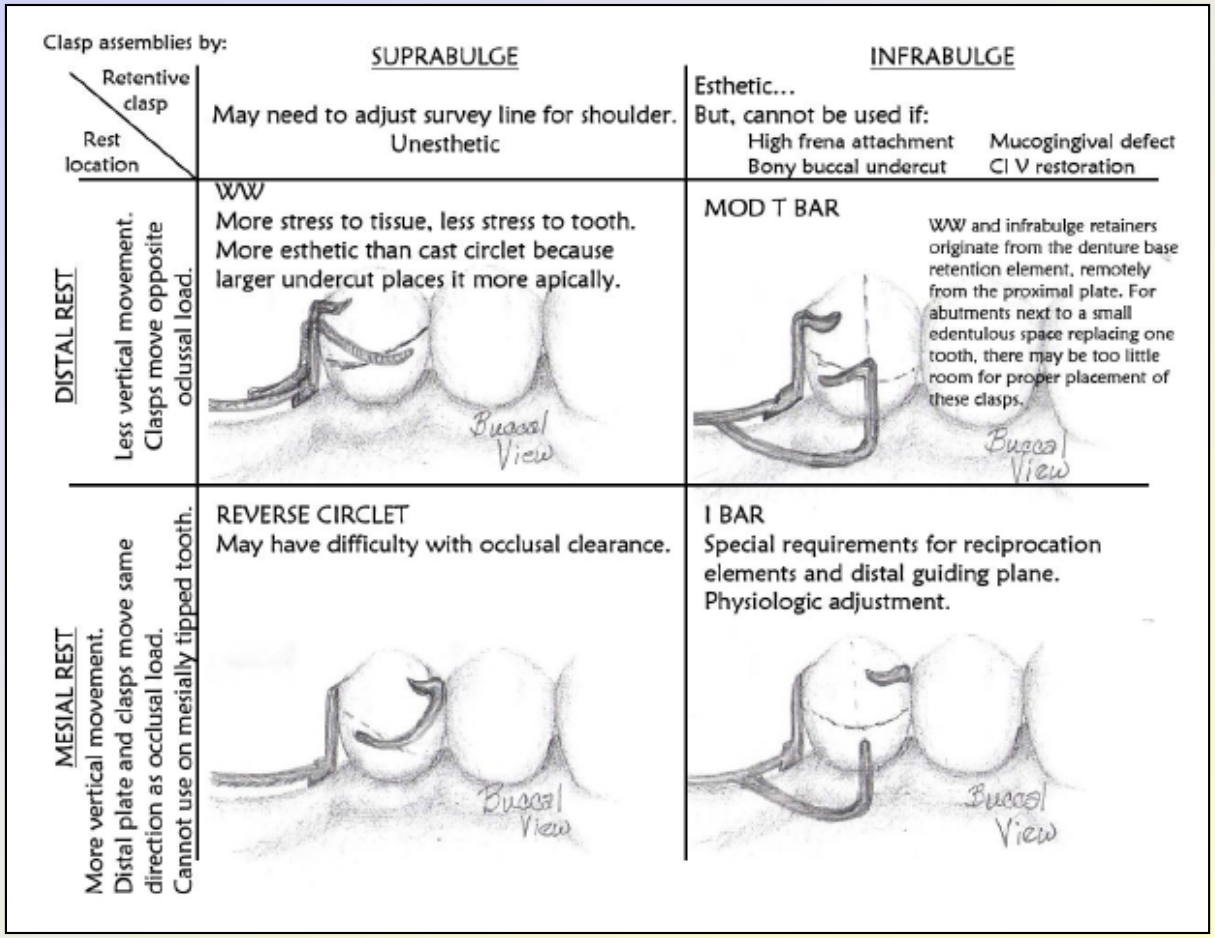
Thousandths of an inch= a “mil”

- **Engineering and manufacturing terminology.**
- **Describes thickness of thin items such as paper, wires, fibers.**
- **A plastic ID card is 30 mils, or 0.030”.**

- 0.010” = ~ ¼ mm.



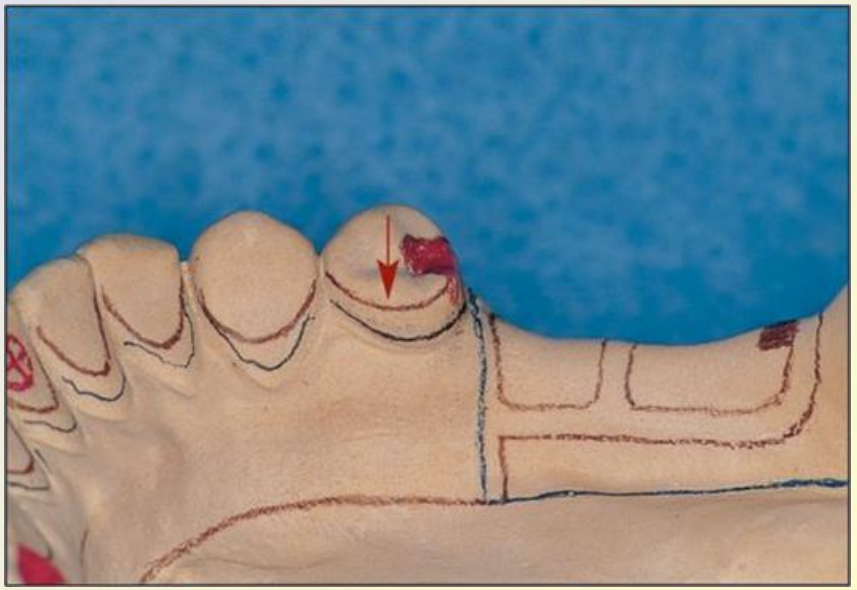
Rules are for posterior abutment what happens with anterior abutments



Lingual surfaces

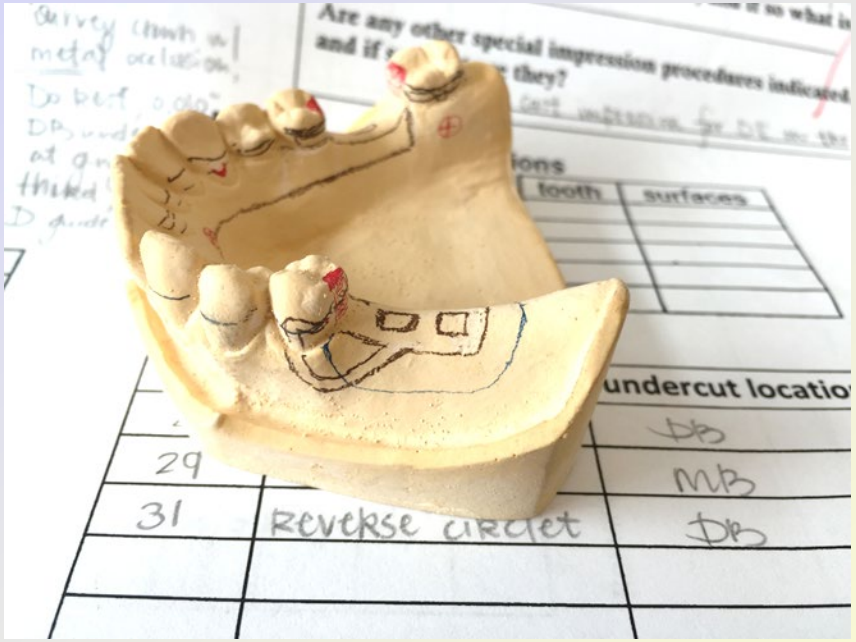
- **Either have plate or clasp- not both.**

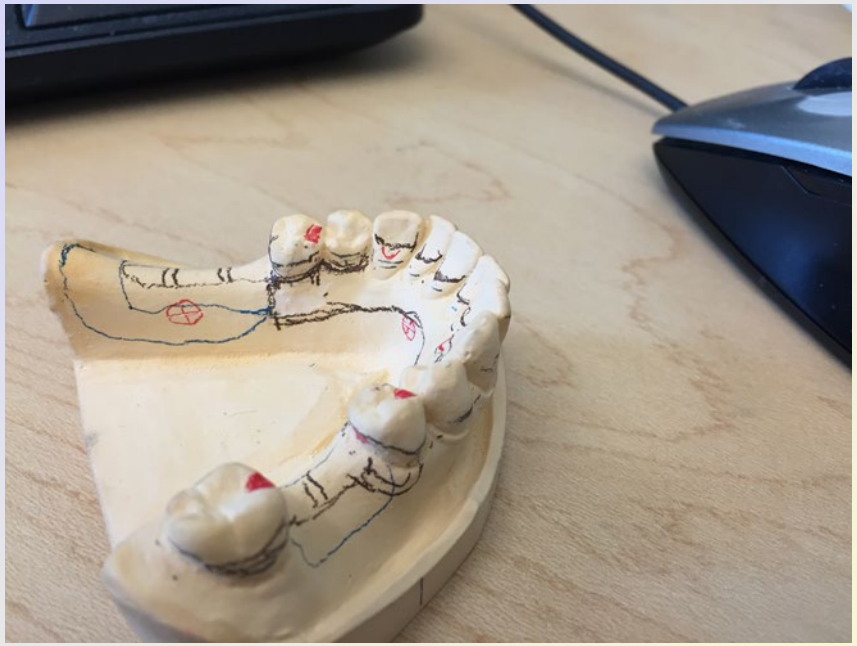
Lingual Clasp and Lingual Plate

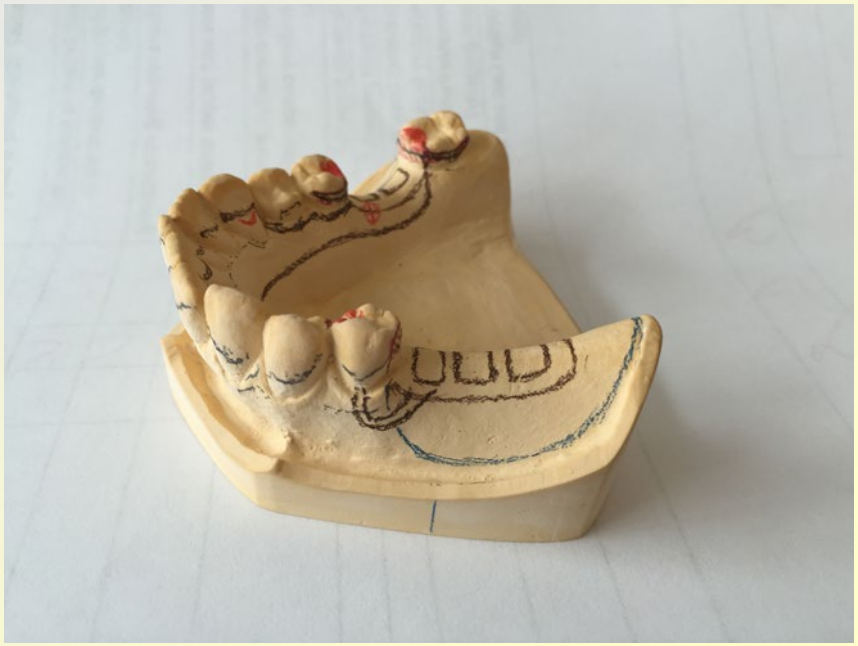


ERRORS

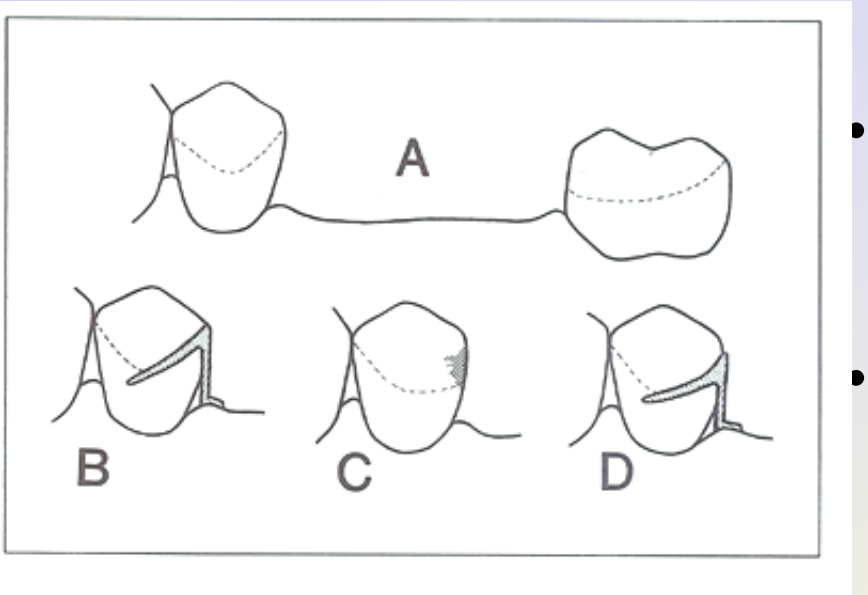

and if so what are they?
tooth
surfaces
undercut loc
DB
MB
DB


tooth
surfaces
29
31
Reverse circlet
undercut locatio
DB
MB
DB

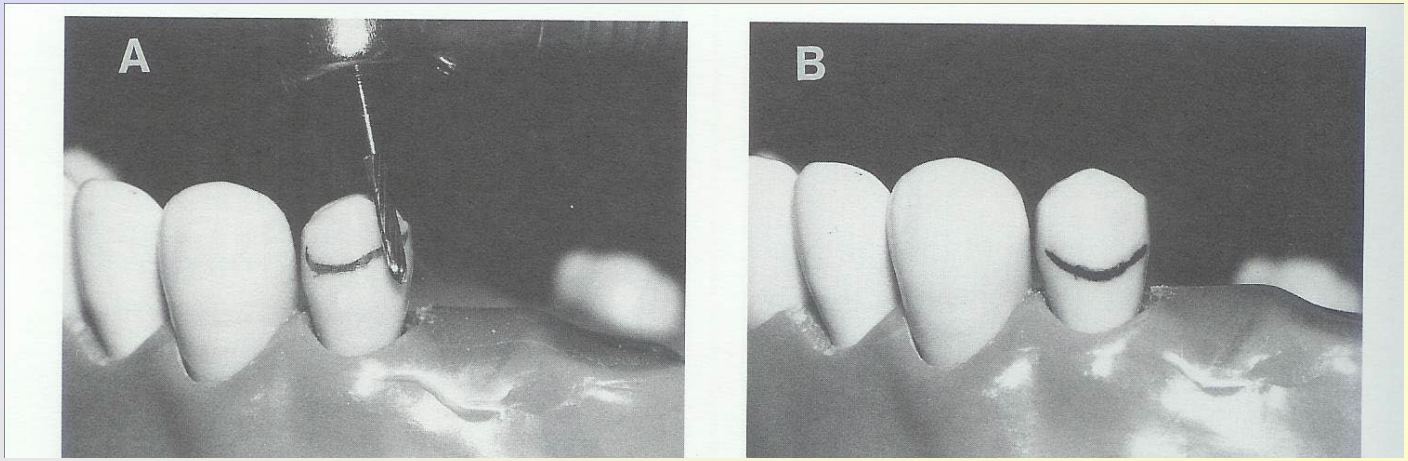




Modify Survey Lines: Direct Retainers



- Shoulder of circlet clasp must stay above survey line.
- This can put the clasp shoulder very high on tooth is survey is also high.
- Recontour to lower survey line so non flexible shoulder can lay lower on tooth.



“Enhancing retentive undercuts”

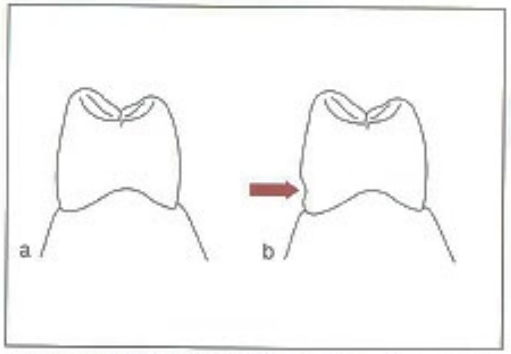


Fig 10-34 *(a)* The facial and lingual surfaces of the tooth are relatively vertical. *(b)* As a result, a gentle depression *(arrow)* may be created. In this instance, the depression has been created on the facial surface.

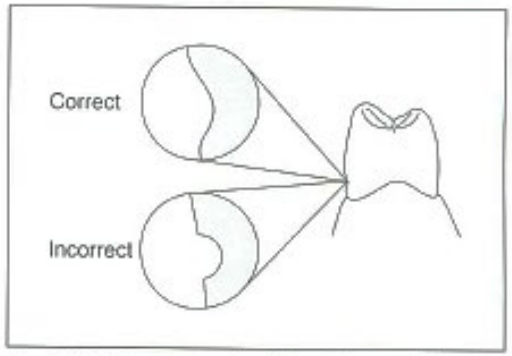


Fig 10-35 A depression should exhibit smooth, flowing contours. Sharply defined dimples and pits should be avoided since retentive clasps cannot flex into and out of these indentations.

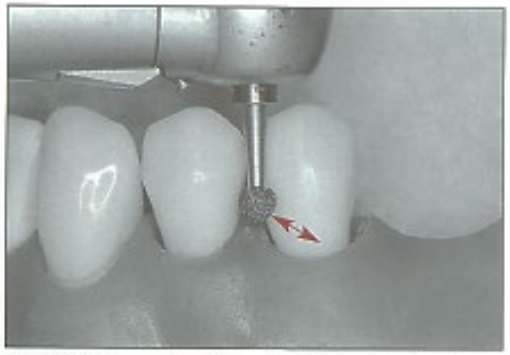


Fig 10-36 A gentle depression is prepared using a round diamond bur in a high-speed handpiece. The bur is moved in an anteroposterior direction *(arrow)*.

Fig 10-37 The preparation is smoothed using a carborundum-impregnated rubber point in a low-speed handpiece. Care must be taken not to obliterate the depression.

North Bend, Oregon