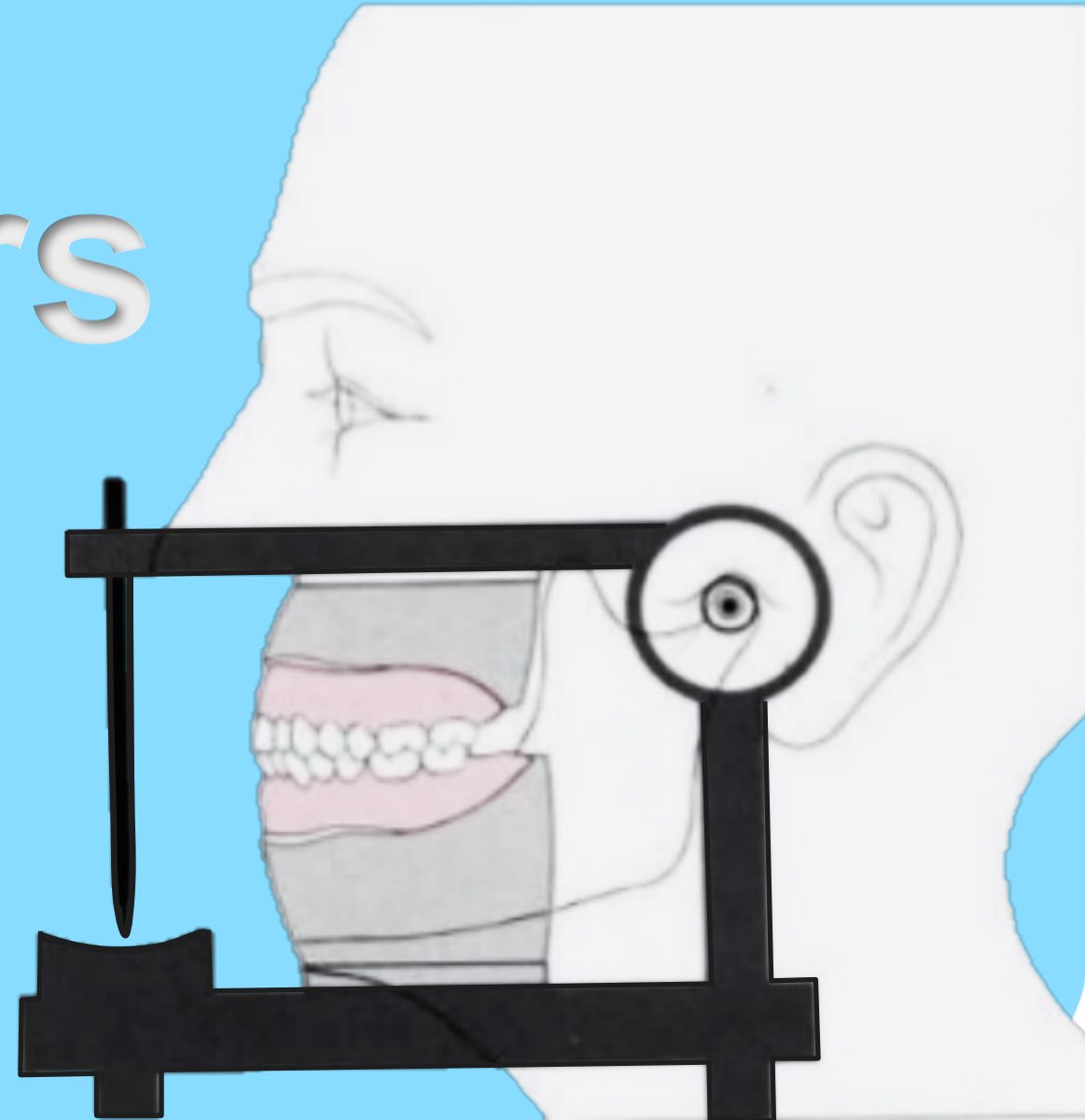




# Articulators



Dr Matsubara



## LEARNING OUTCOMES:

- 1) Explain the importance of the articulator for oral rehabilitation
- 2) Describe the classification of articulators
- 3) Understand the difference between ARCON and NON-ARCON articulators
- 4) Describe the Facebow recording and its clinical importance
- 5) Describe bite registration in CR and when to mount in CR or MIP
- 6) Describe the programming of a semi-adjustable articulator

- Bennet angle: Adjustability in the angle formed between the sagittal plane and the condylar track in the nonworking side.
- Bennett movement: lateral shift of the mandible resulting from the movements of the condyles along the lateral inclines of the mandibular fossae during lateral jaw movement
- Intercondylar distance: Refers to the distance between the vertical axes of rotation
- Horizontal axis of rotation: Mandibular movement around the horizontal axis is an opening and closing motion.
- Incisal guidance: The simulation of anterior guidance in the natural dentition.
- Condylar & glenoid fossa components: Variability in the angle of the eminentia; the directional condylar guidance provided by the medial, superior and posterior walls of the glenoid fossa; and the ability to simulate laterotrusive and protusive movements.

# Articulators



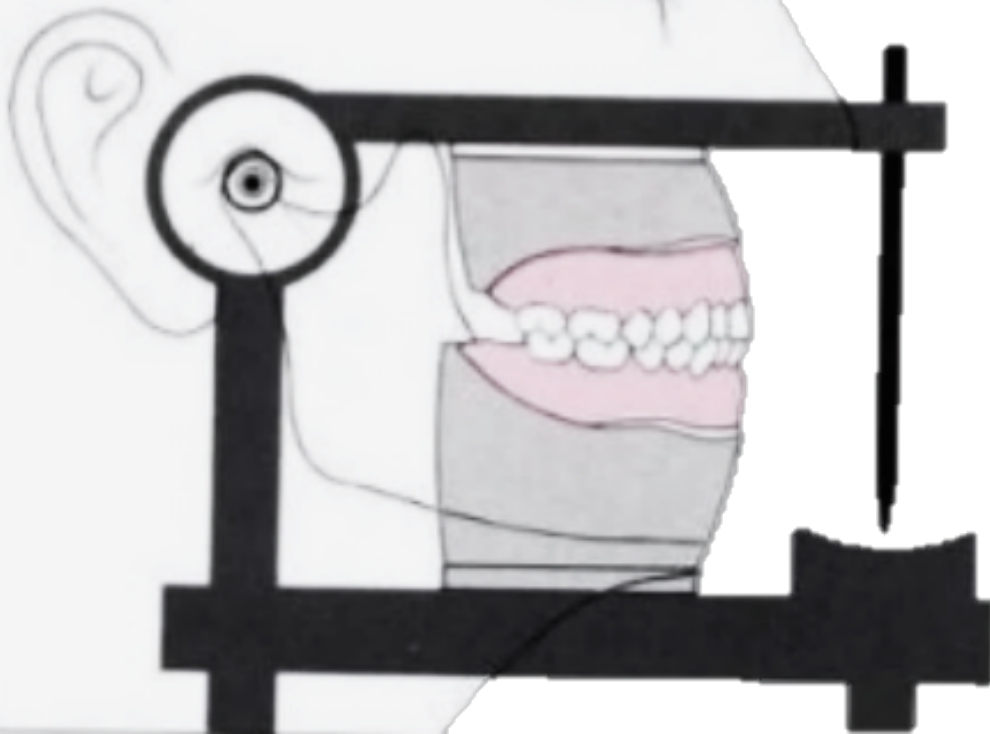
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Oral Health Centre  
of Western Australia

”A mechanical instrument that represents the TMJs and jaws, to which maxillary and mandibular casts may be attached to simulate some or all mandibular movements”

Glossary of Prosthodontic Terms 9<sup>th</sup> ed.



## FUNCTION

- To evaluate the patient's occlusion (**simulate mandibular movements** and hold casts in a determined fixed relationship)
- To allow most of the prosthetic work to be done **without the presence** of the patient
- Dental laboratory can then **design the prosthesis** (occlusal surfaces) to be in functional harmony with the patient's movements
- To **reduce clinical time** needed for adjustments of restorations

ASSIST IN: Diagnosis & treatment planning, and fabrication of restorations

## LIMITATIONS

- Due to their inflexible mechanical nature, articulators cannot simulate the **complex tissues, joints; and neuromuscular control** that influence mandibular movements.
- Even the most advanced and expensive articulator, can only be customised to simulate, but still not fully replicate, all possible combinations of movements in the patient

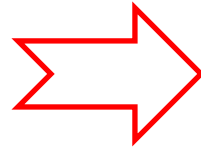
Human masticatory system is the ultimate articulator

When should you mount the models on articulators?

- To assess occlusion (Diagnostic Articulation)
- Diagnostic wax up
- More than two single crowns / Bridge
- Removable partial dentures
- Complete dentures
- Immediate dentures (partial or complete)
- Cases where increase of VD is necessary (wax up)
- Occlusal splints (if not using CAD-CAM)
- Single crowns ??

## During treatment planning: Diagnostic Articulation

- Tooth alignment
- Prosthetic/interocclusal space
- Occlusal contacts
- Occlusal plane



- Enough space for restorations,
- Shape, morphology and size of artificial teeth (Partial dentures and immediate dentures)
- **Occlusal rest** (guide planes, adequate height of contour, undercuts – surveyor)

## During treatment planning: Diagnostic Articulation

**Do you need to mount study models on articulator for Complete Denture treatment plan?**

No, we can change all those parameters in a complete denture.

Note: Edentulous patient with severe class II or III, you may need to mount the models to assess ridge relationship.

## CLASSIFICATION

Based on:

- Instrument function
- Adjustability

## CLASSIFICATION BASED ON INSTRUMENT FUNCTION

- Capacity to simulate mandibular movements

Class I: Hinge type

Class II: Arbitrary

Class III: Average

Class IV: Special

## CLASSIFICATION BASED ON INSTRUMENT FUNCTION

### Class I: Hinge type

- Simplest instrument
- Accept a single static registration
- Only vertical motion is passible
- Cannot accept a facebow
- Limited use: very simple restorations



## CLASSIFICATION BASED ON INSTRUMENT FUNCTION

### Class II: Arbitrary

- Articulator that allow horizontal and vertical movements but it does not orient the motion of TMJs



## CLASSIFICATION BASED ON INSTRUMENT FUNCTION

### Class III: Average

- Simulates condylar pathways by using averages or mechanical equivalents for all or part of the motion
- Allows vertical and horizontal motion
- Use of face-bow transfer
- Does not allow total customization of condylar pathways



## CLASSIFICATION BASED ON INSTRUMENT FUNCTION

### Class IV: Special

- Accept three dimensions dynamic registrations
- Use of facebow transfer
- Capable of accurately reproduce the condylar pathway
- Able to adjust multiple angles



## CLASSIFICATION BASED ON ADJUSTABILITY

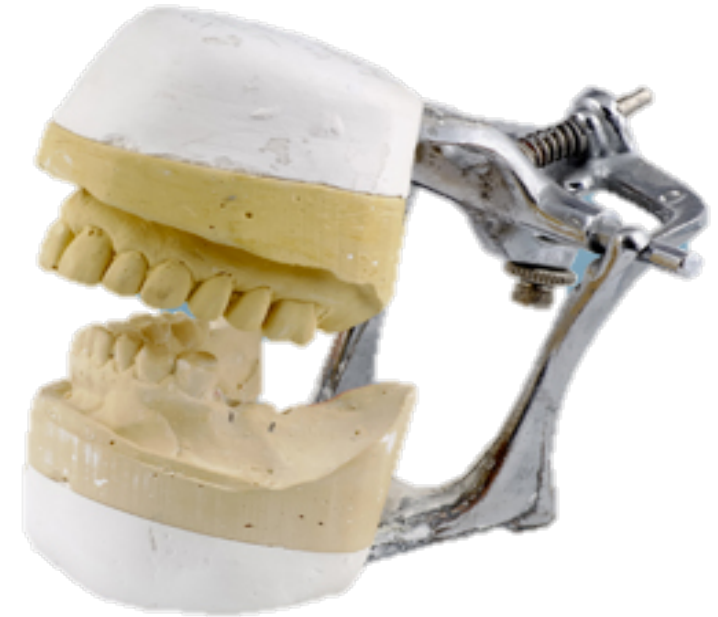
- Nonadjustable articulator
- Semi-adjustable articulator
- Fully-adjustable articulator

## CLASSIFICATION BASED ON ADJUSTABILITY

### **Nonadjustable articulator:**

- Class I articulator
- Open and close in a fixed horizontal axis

Indication: simple cases (e.g. single crown)



## CLASSIFICATION BASED ON ADJUSTABILITY

### **Semi-adjustable articulator:**

- Class III articulator
- Condylar guidance incline, Bennet angle, incisal guidance, inter condylar distance\*
- Two types:
  - Arcon articulator
  - Non-arcon articulator

## CLASSIFICATION BASED ON ADJUSTABILITY

Semi-adjustable articulator

### ARCON Type

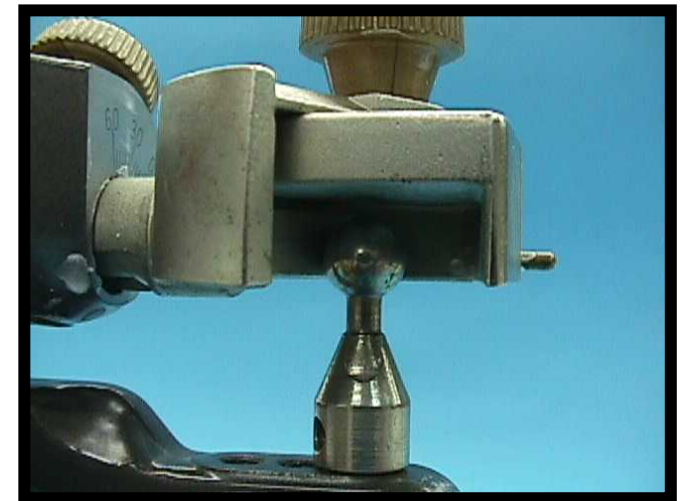
Ar – articulator  
Con – condyle

This type resemble the TMJ:

- Condylar element (sphere) is attached to the lower member of the articulator
- Mechanical fossae is attached to the upper member

Simulated the correct anatomical position of the TMJ elements

Example: Kavo Protar, Whip Mix



## CLASSIFICATION BASED ON ADJUSTABILITY

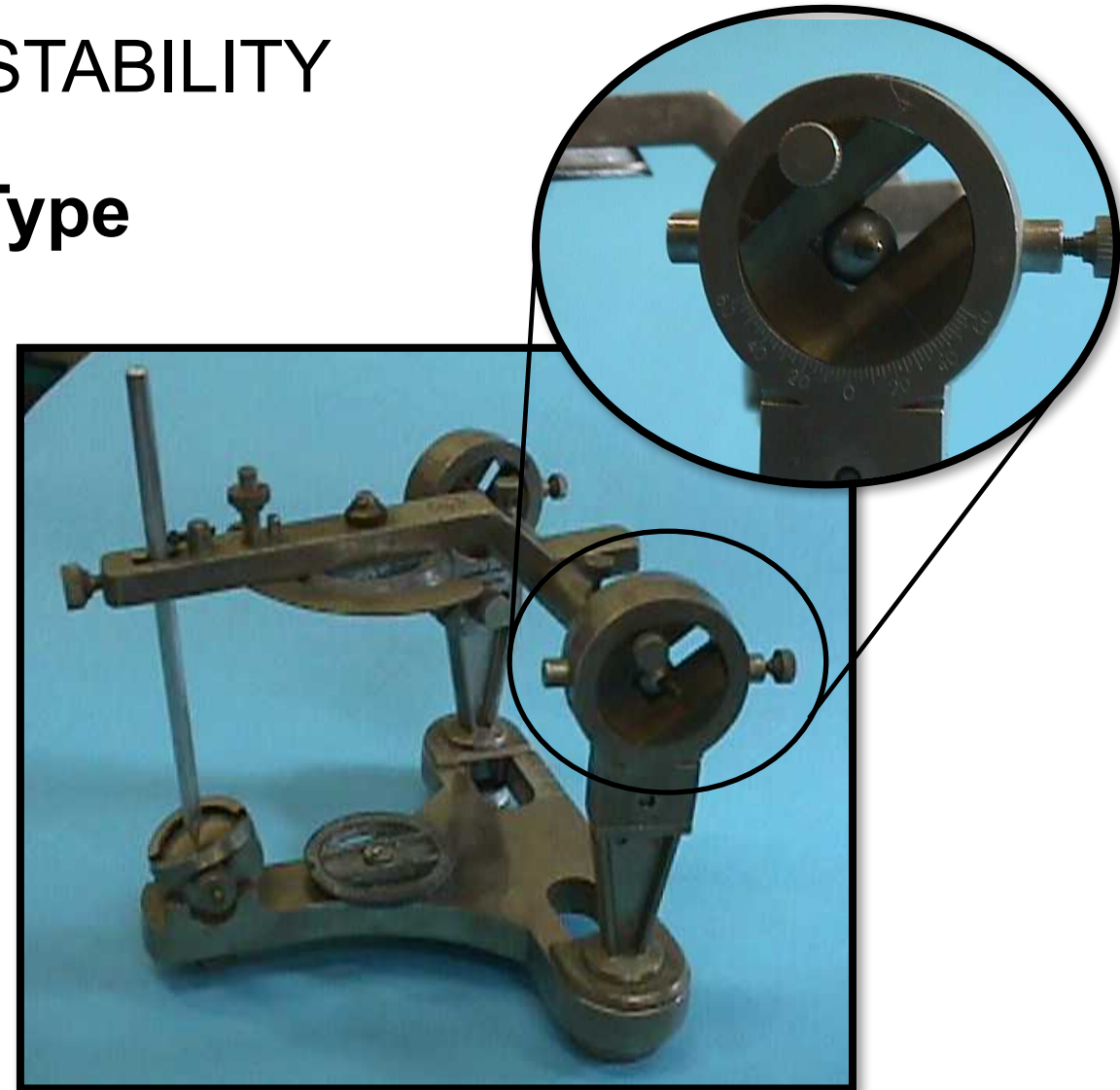
Semi-adjustable articulator

### **NONARCON Type**

- Condylar element (sphere) is attached to the upper member of the articulator
- Mechanical fossae is attached to the lower member

Upper and lower components are rigidly attached – easier to handle

Example: Hanau, Dentatus articulator

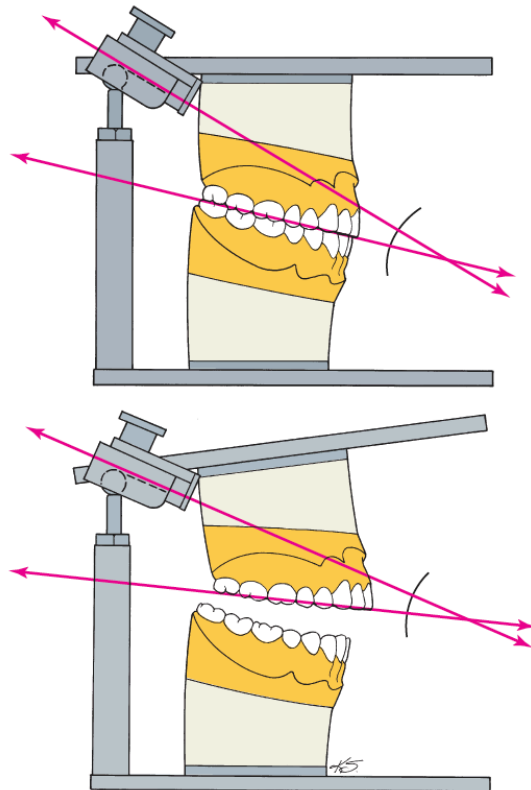


## CLASSIFICATION BASED ON ADJUSTABILITY

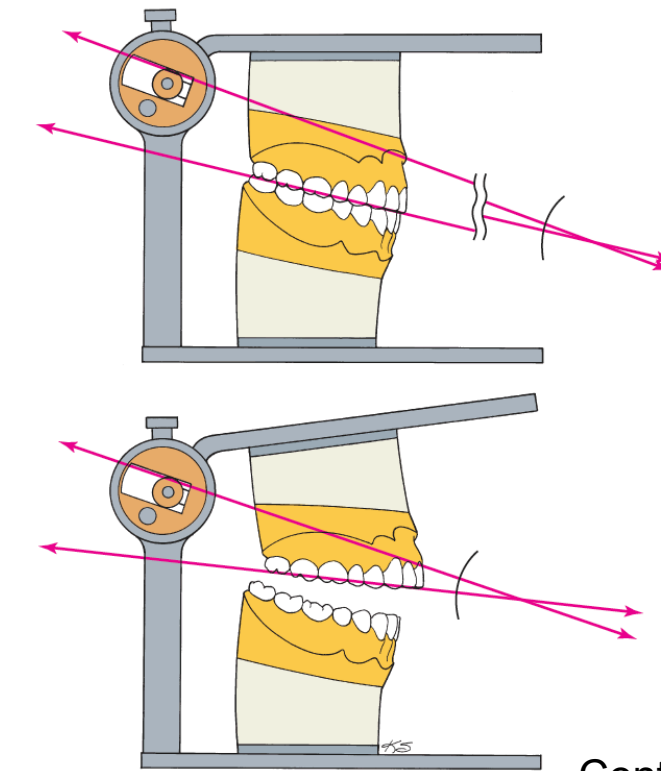
Semi-adjustable articulator

### ARCON vs NONARCON

ARCON  
Articulator



- Condylar inclination is at a fixed angle to the maxillary occlusal plane



NONARCON  
Articulator

- the angle changes as the articulator is opened



Errors to program the articulator (protrusive record)

## SEMI-ADJUSTABLE

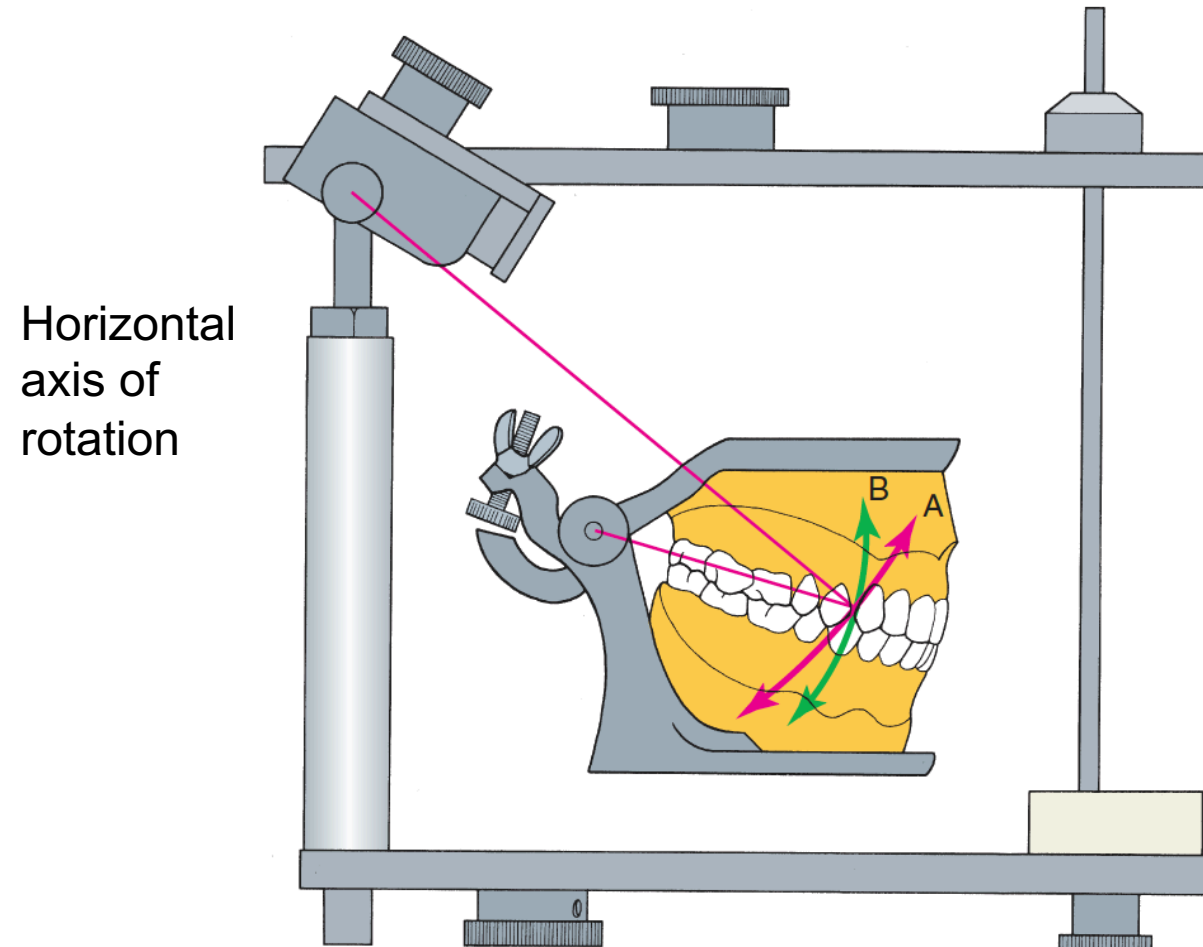
ARCON



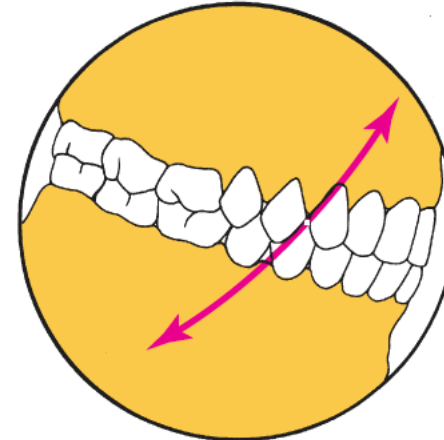
NONARCON



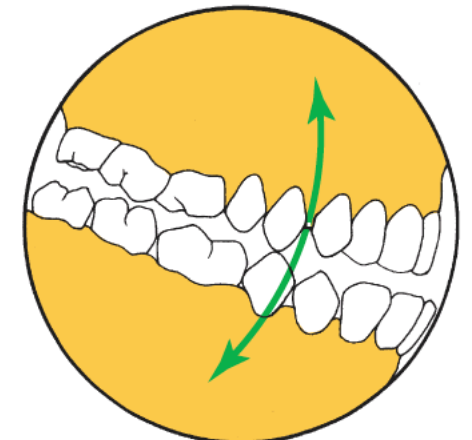
## CLASSIFICATION BASED ON ADJUSTABILITY



A) Semi-adjustable articulator



B) Nonadjustable Articulator Type I

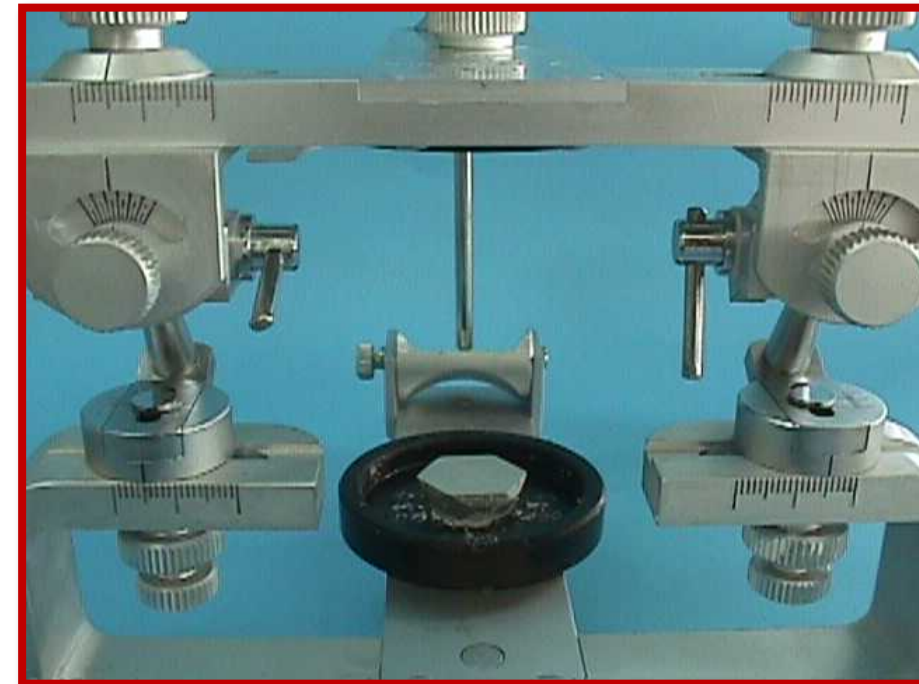


Premature contact, interference

## CLASSIFICATION BASED ON ADJUSTABILITY

### Fully adjustable articulator:

- Class IV articulator
- Capable of being adjusted to follow the mandibular movement in all direction
- Condylar guidance, Bennet angle, Fisher angle, intercondylar distance, anterior guide
- Not commonly used due to its complexity



- The articulator is an essential tool in successful **denture** manufacturing that allows for the correct positioning of artificial teeth, which in turn result in balanced articulation and a successful prosthodontic appliance.

## Facebow

Aim: to record the **anteroposterior** and **mediolateral** spatial position of the maxillary occlusal plane in relation to horizontal **axis of rotation of the mandible** during opening and closing, and to the cranial base.



Whipmix facebow



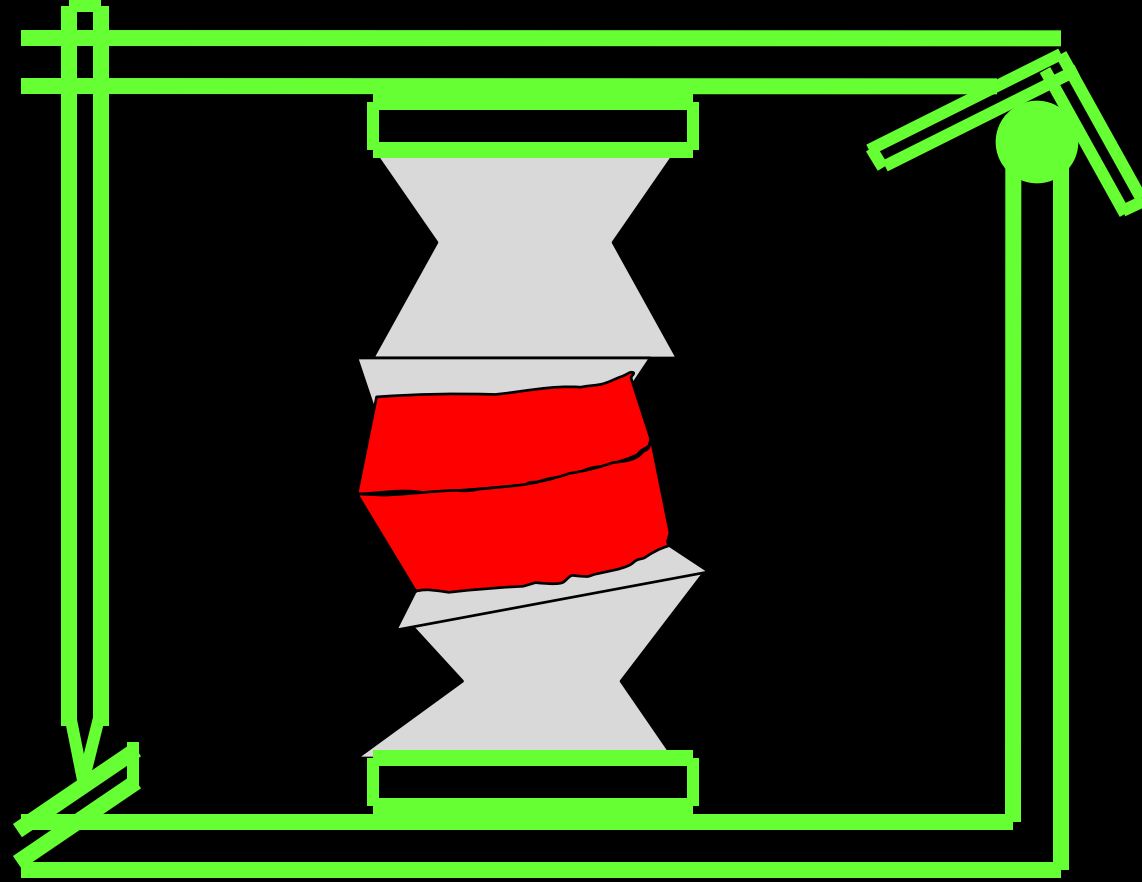
Dentatus facebow

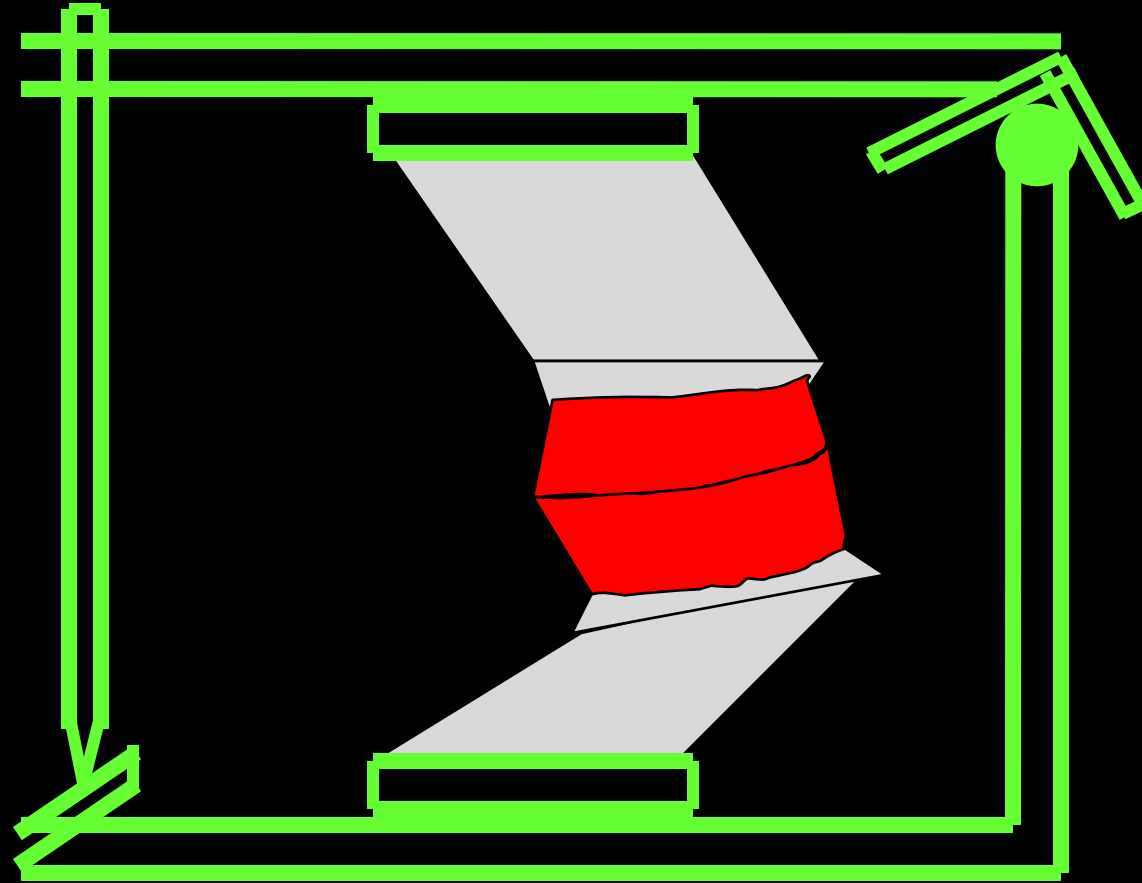
## Facebow

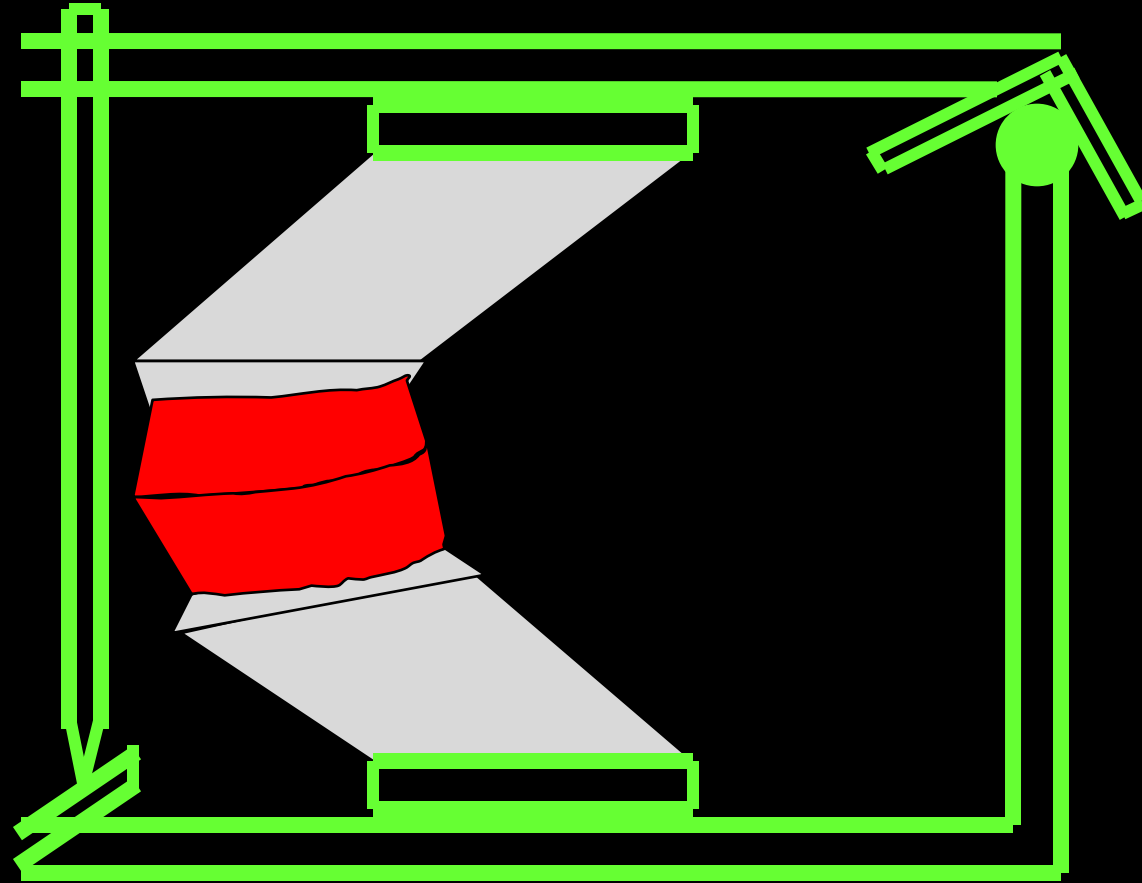
Aim: to record the **anteroposterior** and **mediolateral** spatial position of the maxillary occlusal plane in relation to horizontal **axis of rotation of the mandible** during opening and closing, and to the cranial base.

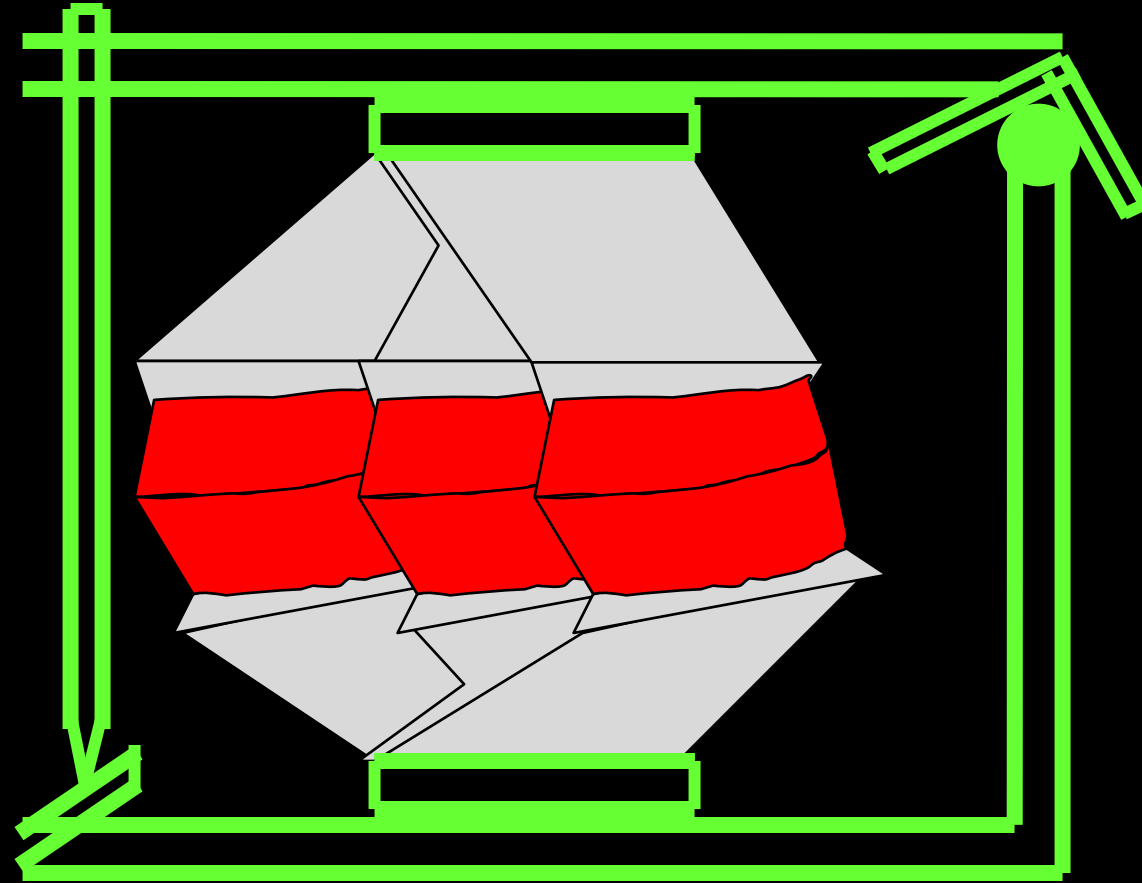
Kavo Protar facebow

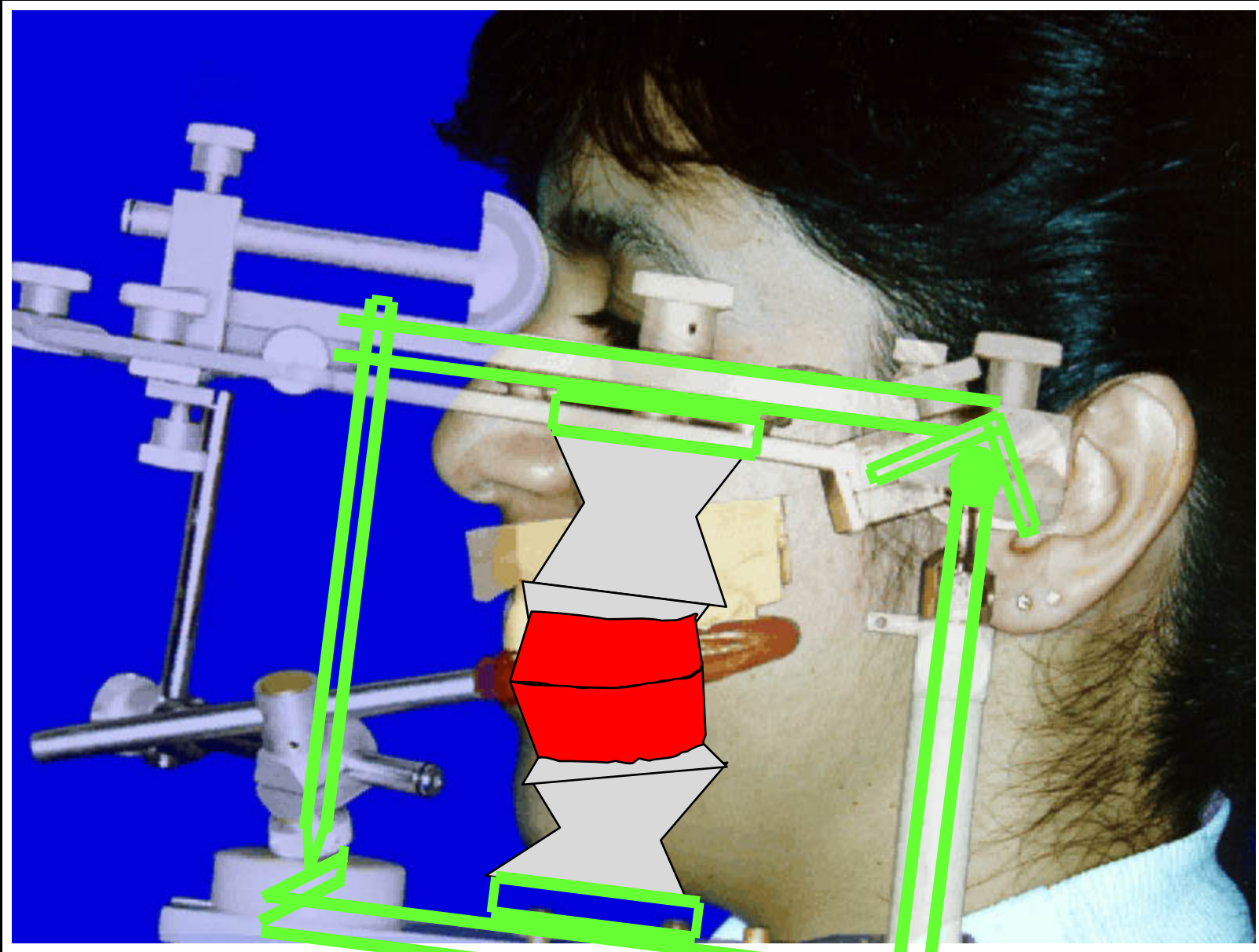




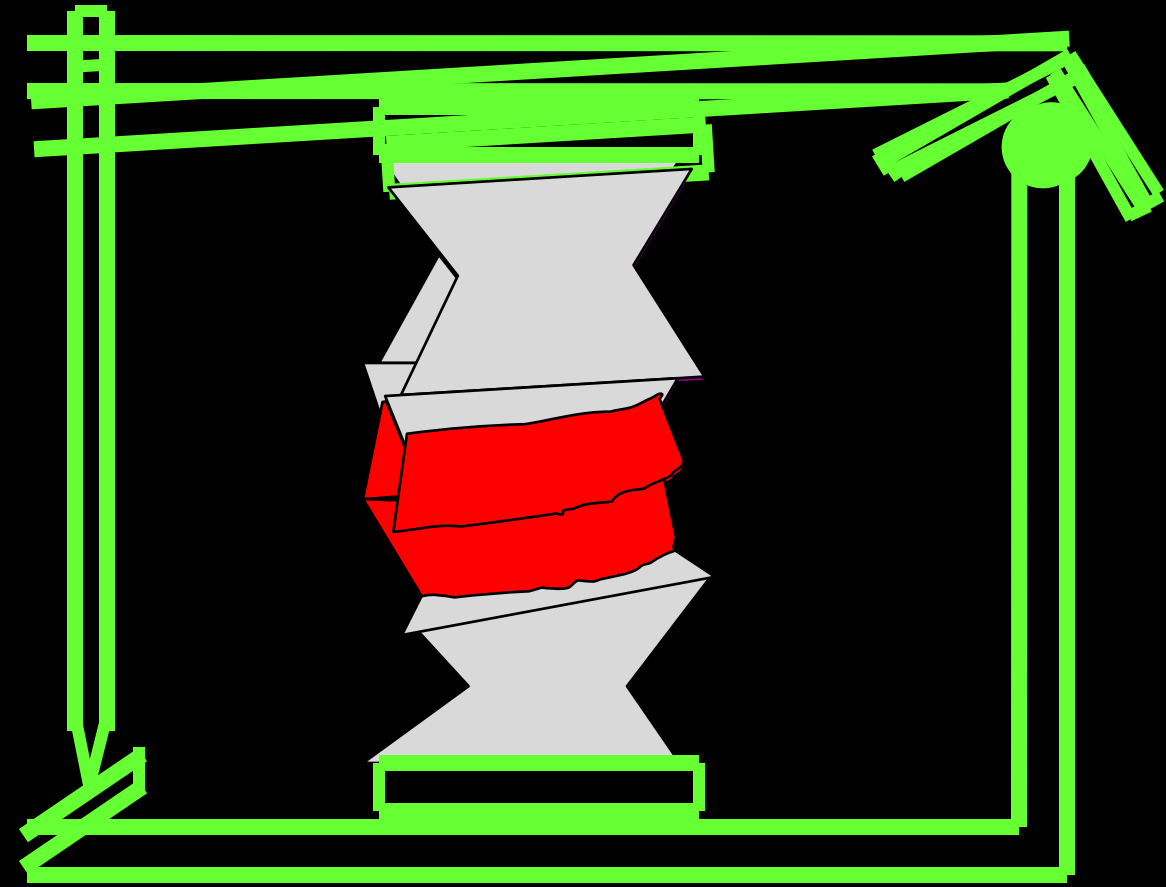






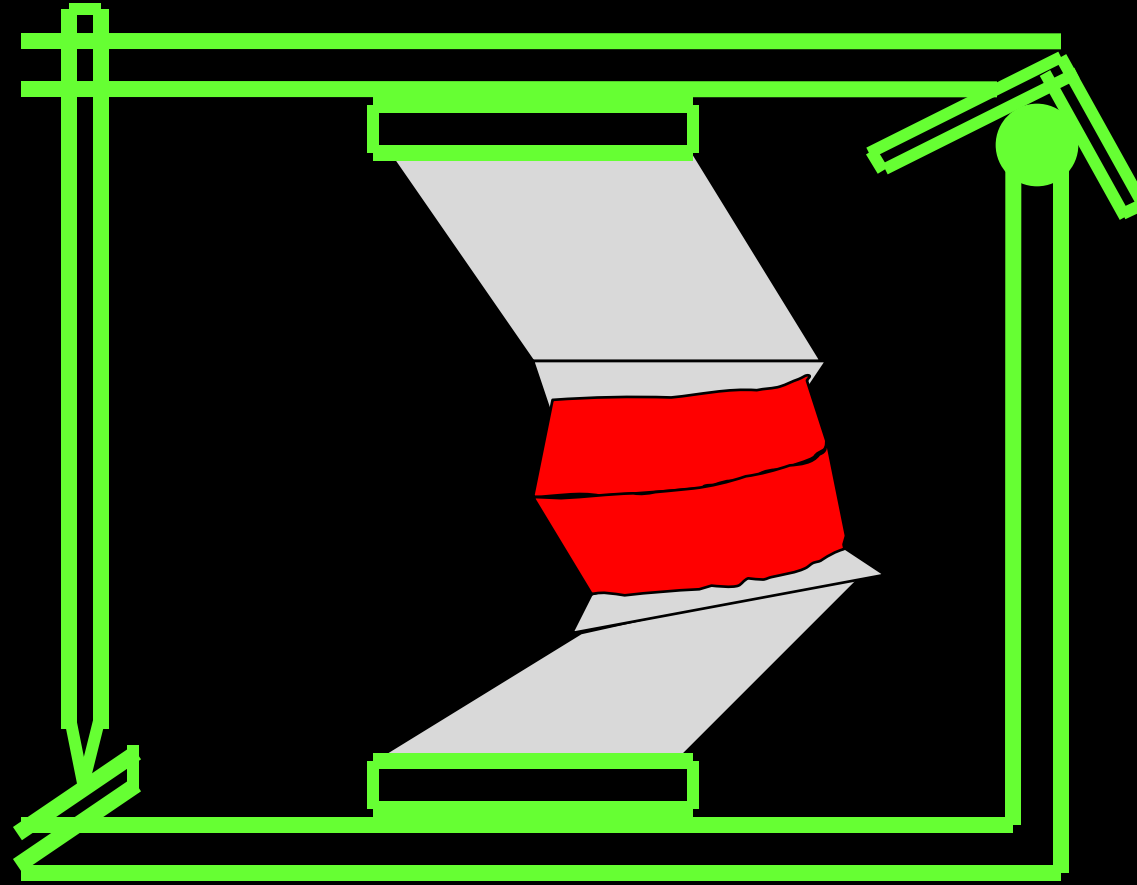


Model  
mounted  
**with**  
facebow

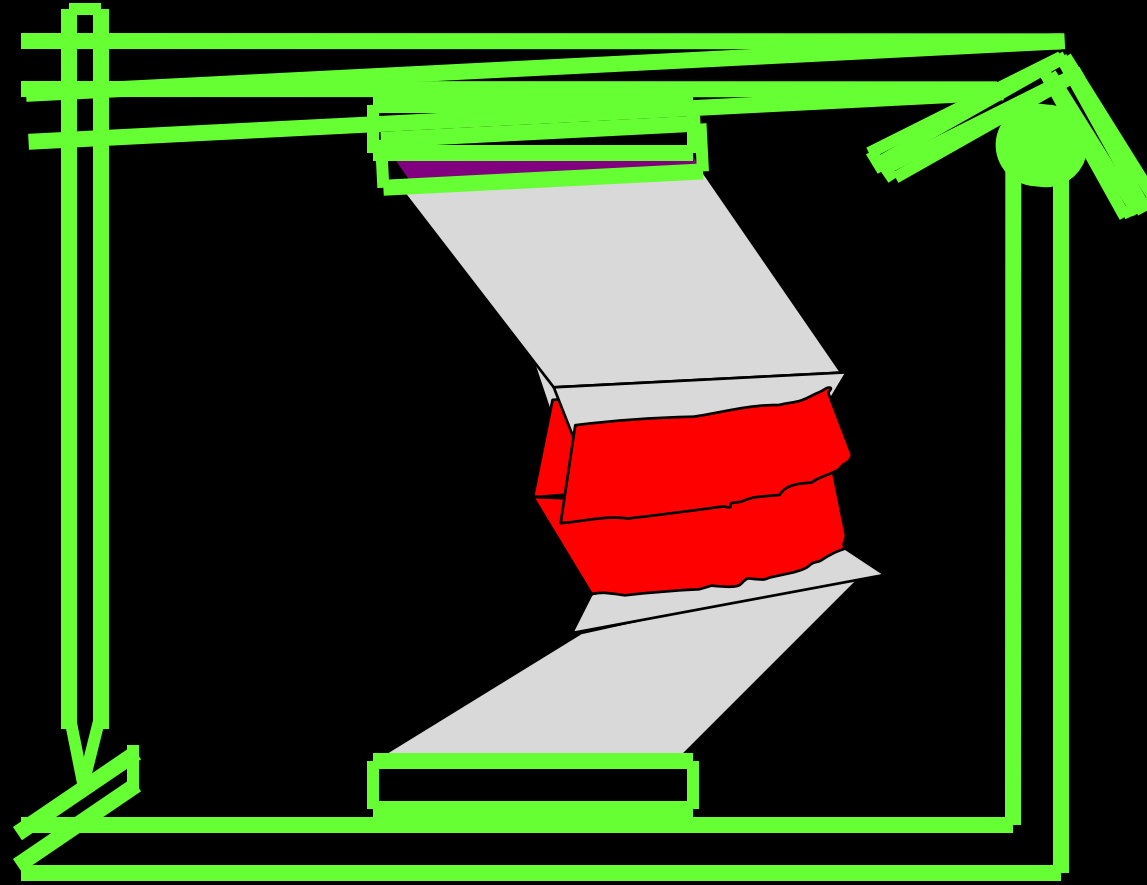


**OVD Reduction**

Model  
mounted  
**without**  
facebow



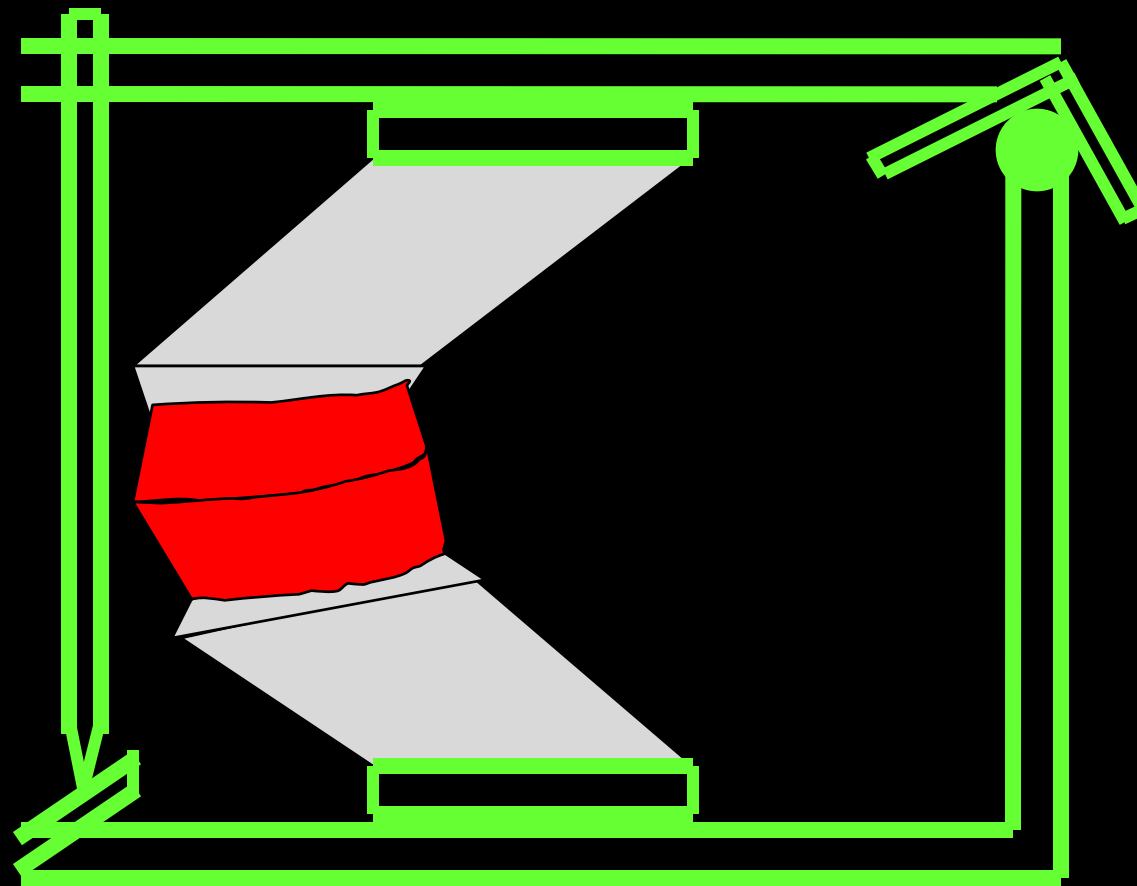
Model  
mounted  
**without**  
facebow



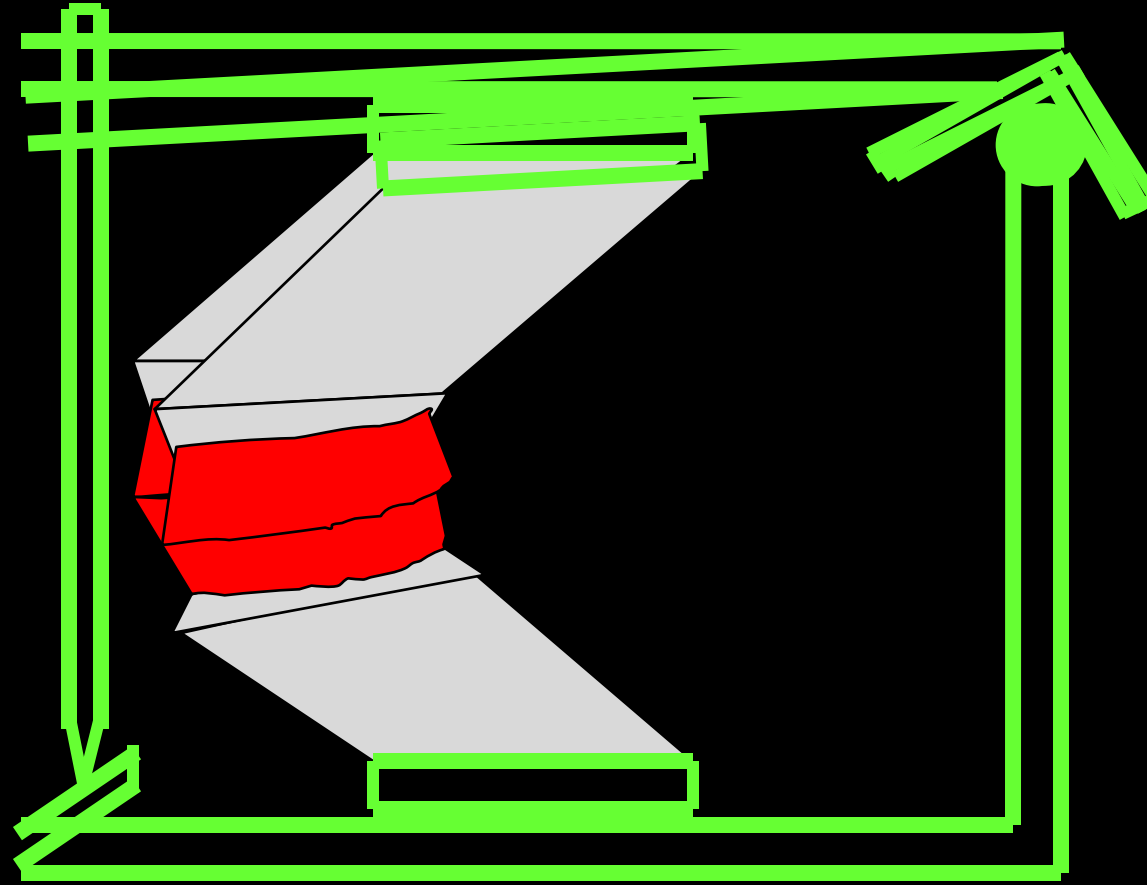
**OVD Reduction**

**Reduce less than you necessary**

Model  
mounted  
**without**  
facebow

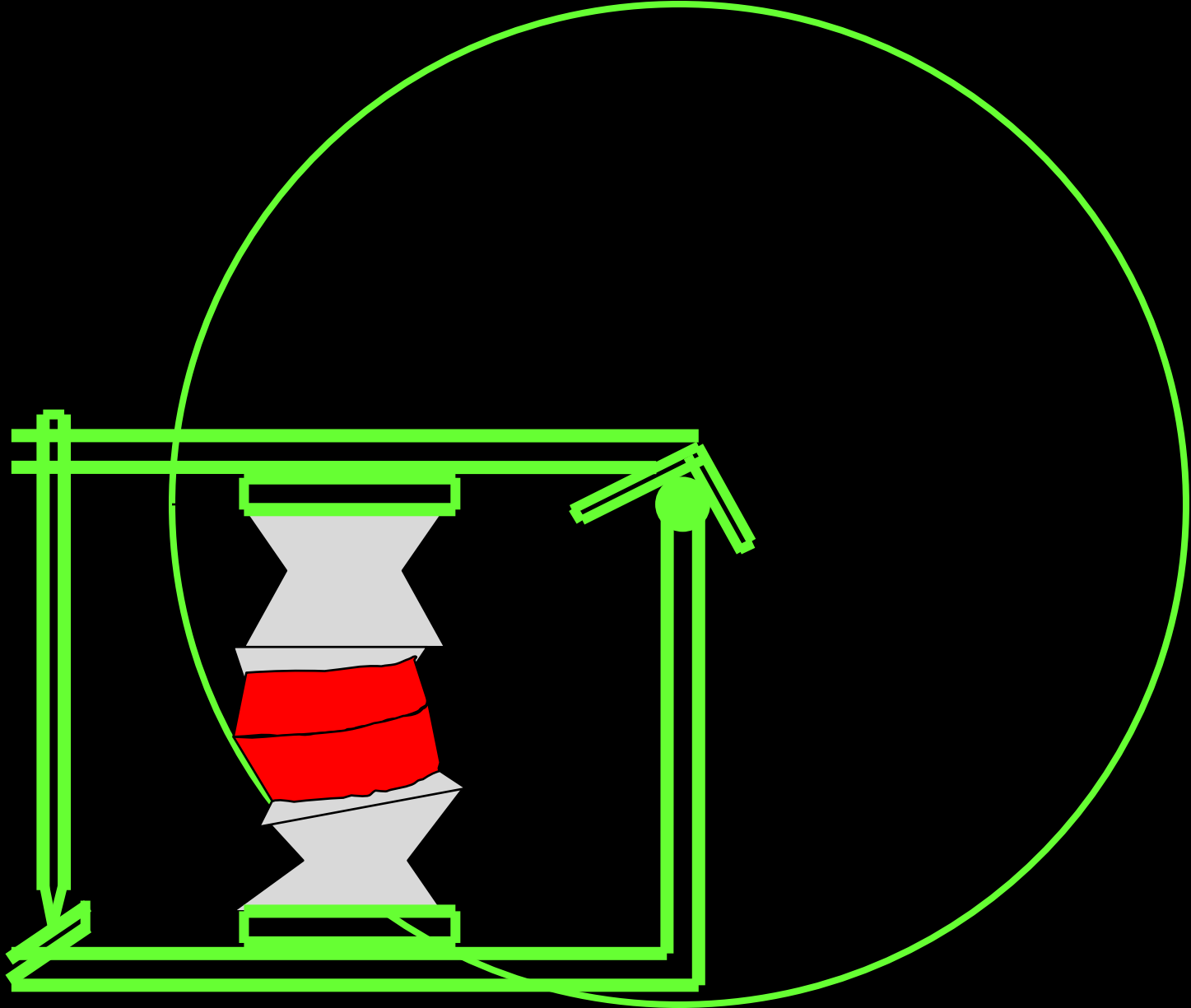


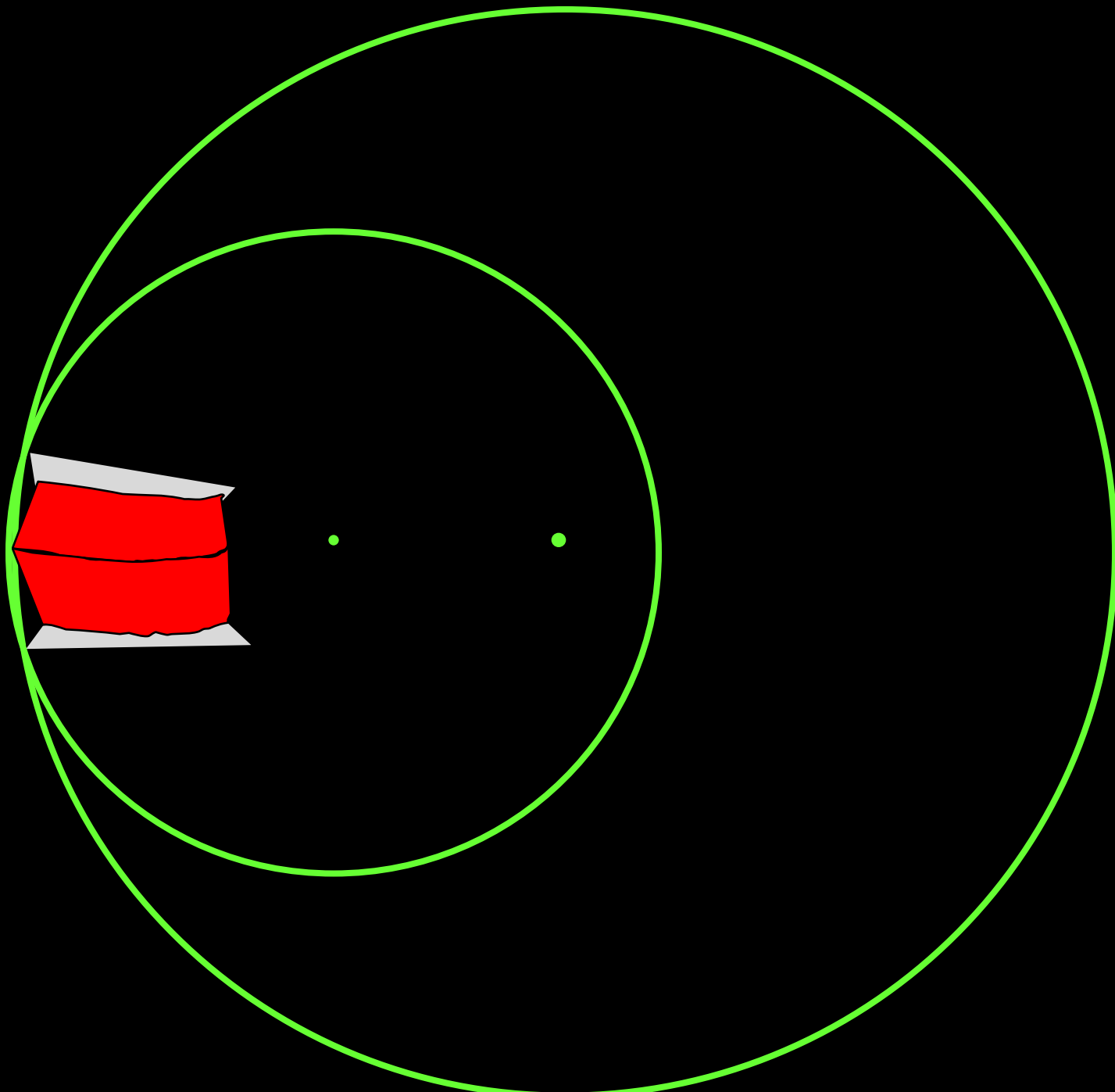
Model  
mounted  
**without**  
facebow

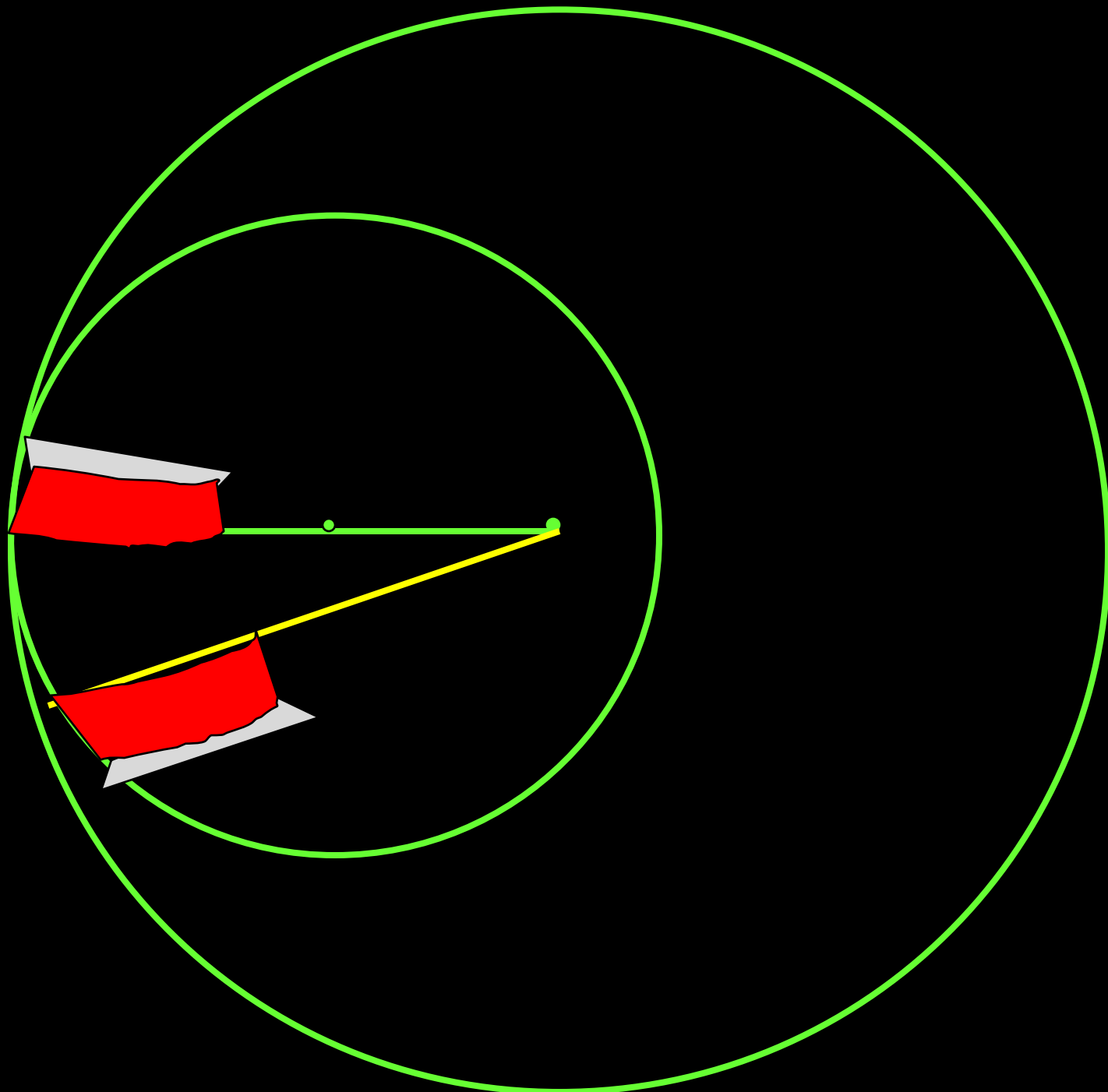


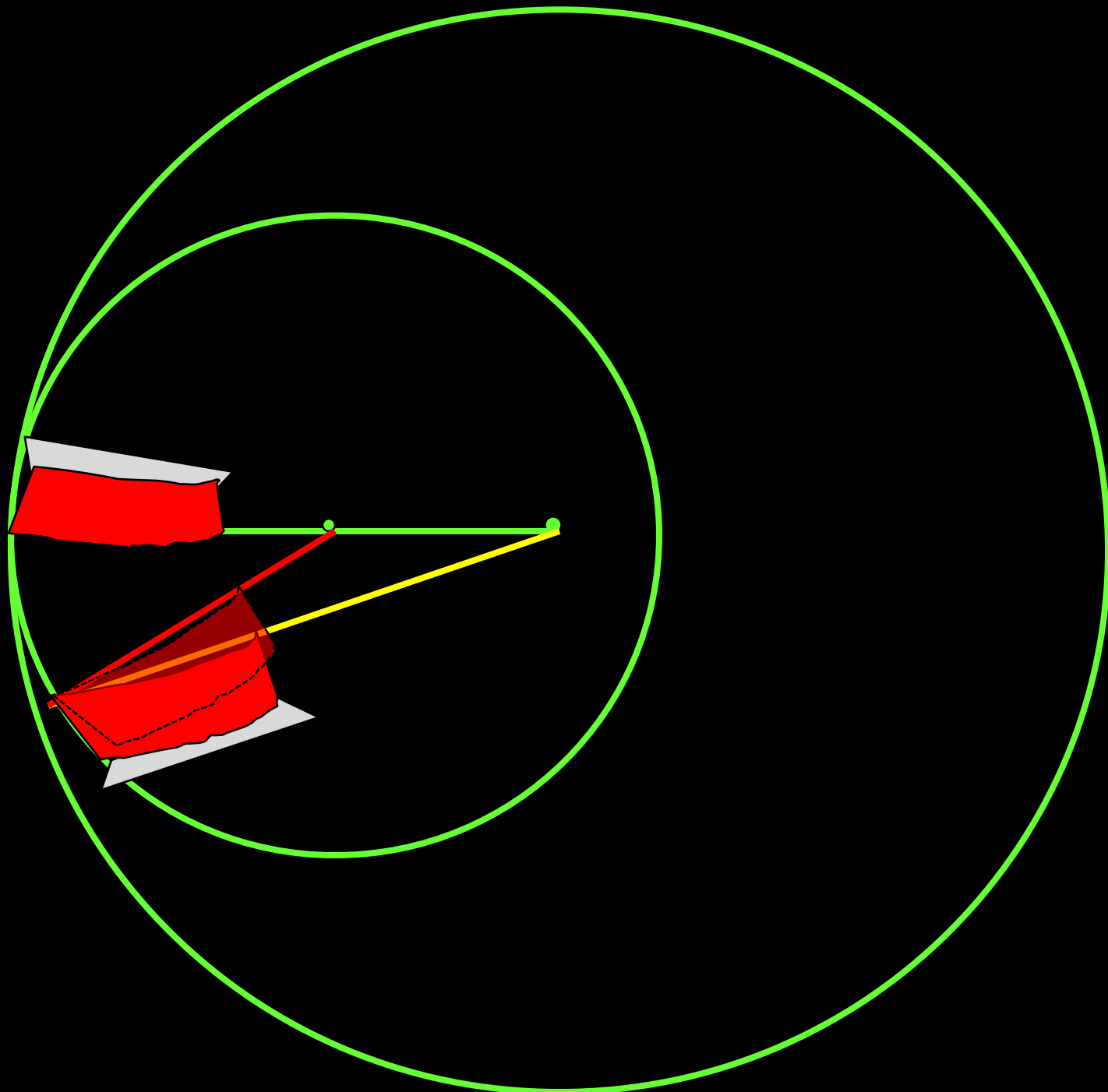
**OVD Reduction**

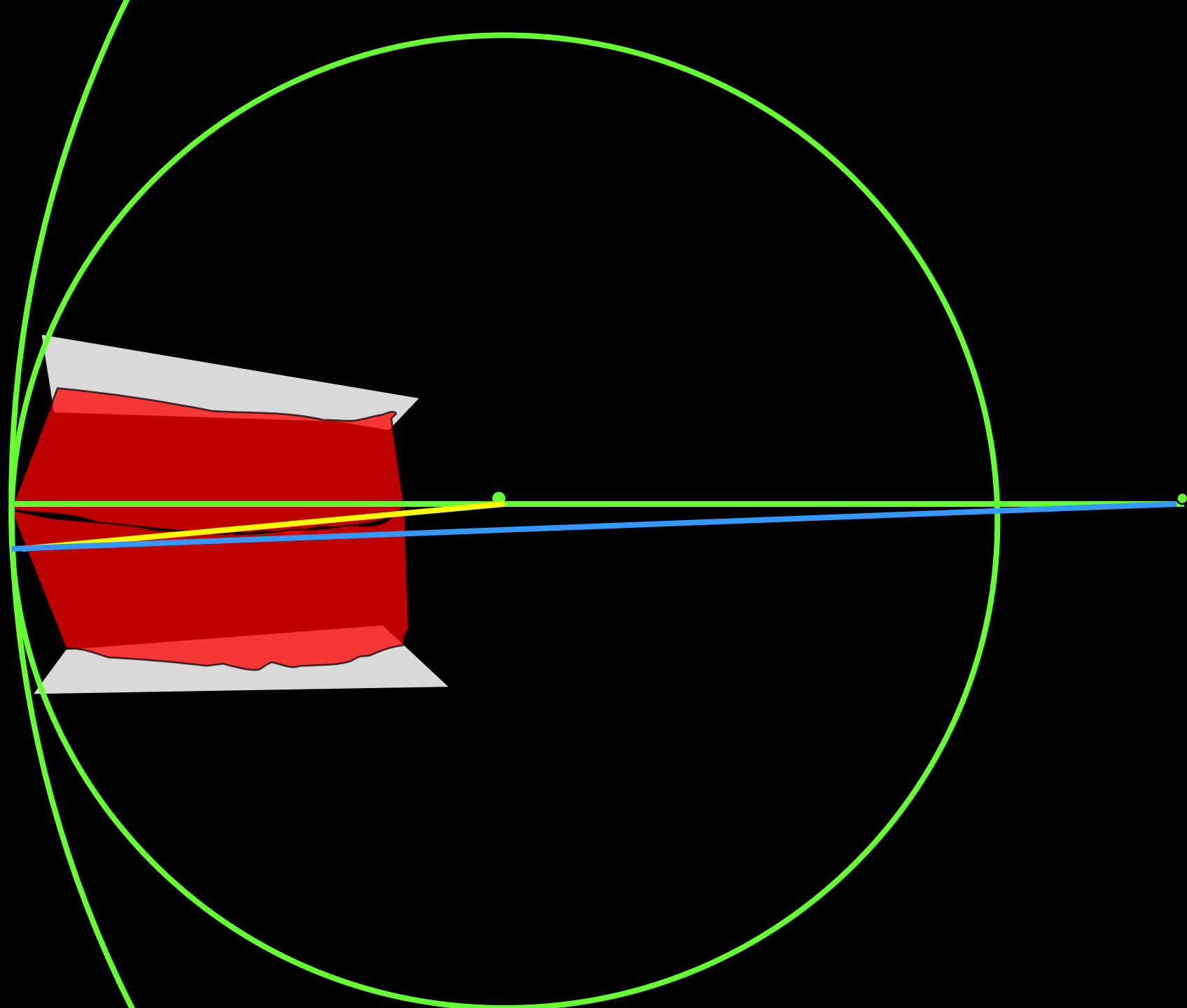
**Reduce more than necessary**



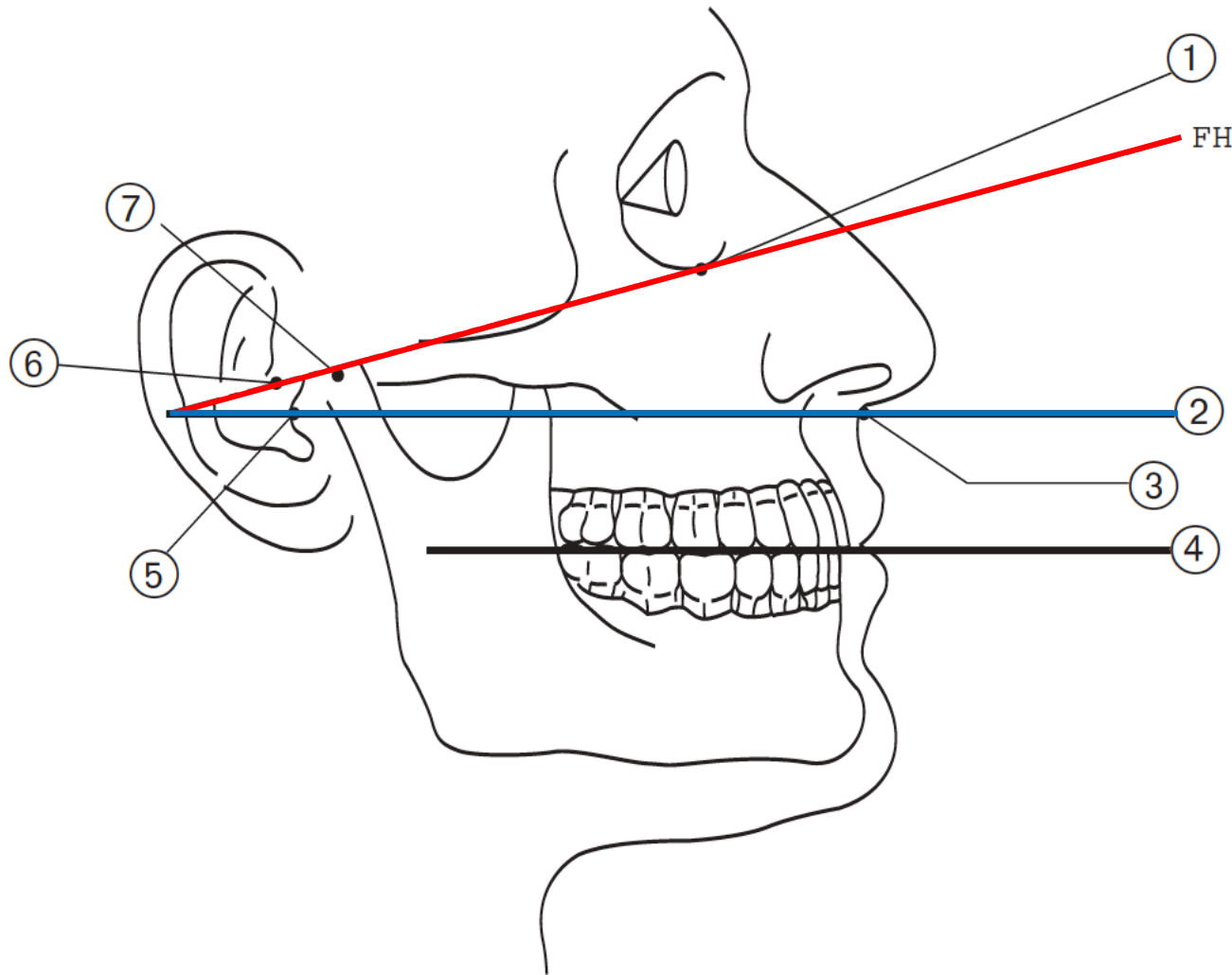








# Articulators



1- Infra-orbital point

6 - Porion

**Frankfurt  
Horizontal  
plane**

3 – Subnasal point

5 - Tragus

**2 Camper's  
plane**

7 – Hinge axis

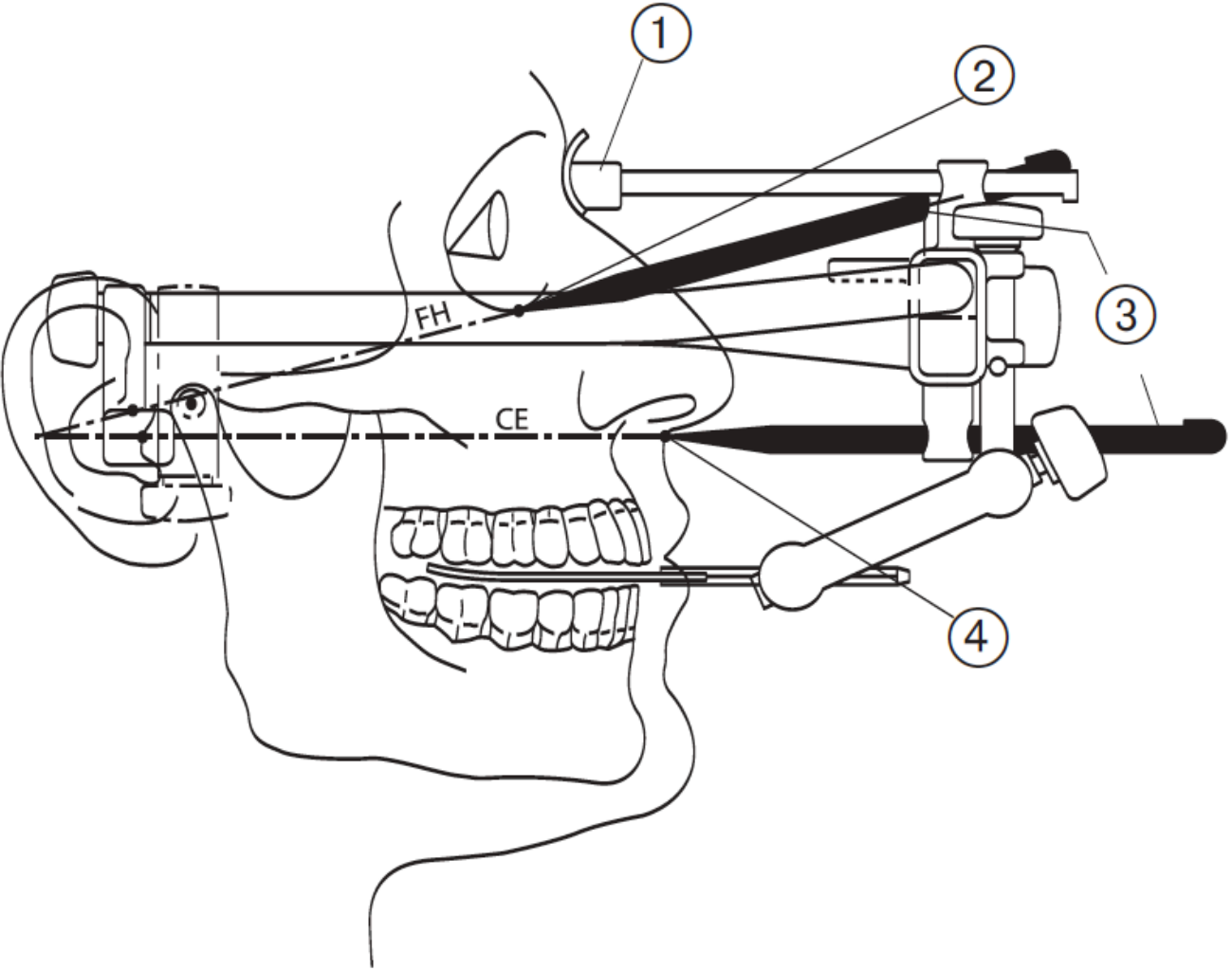
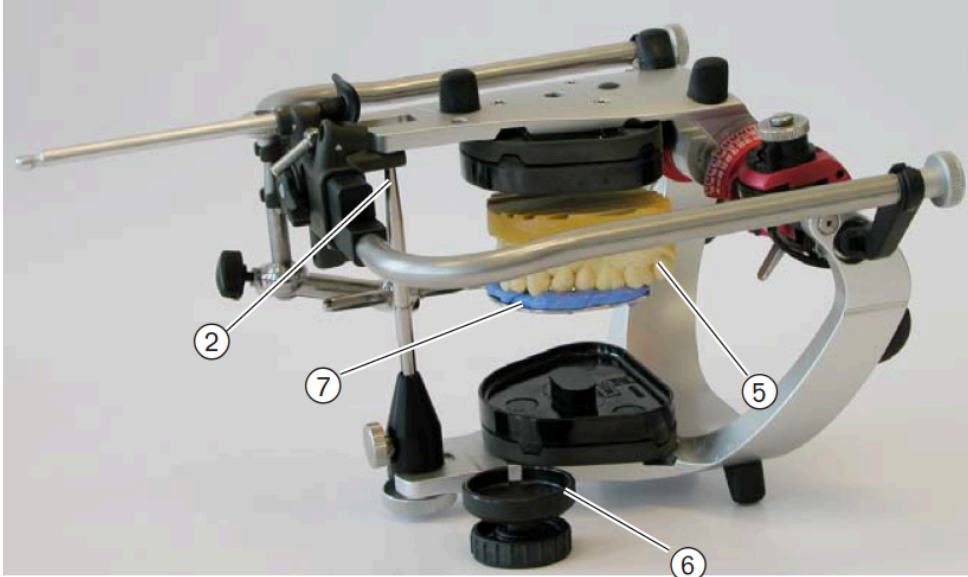
**4 Occlusal plane**

2 // 4

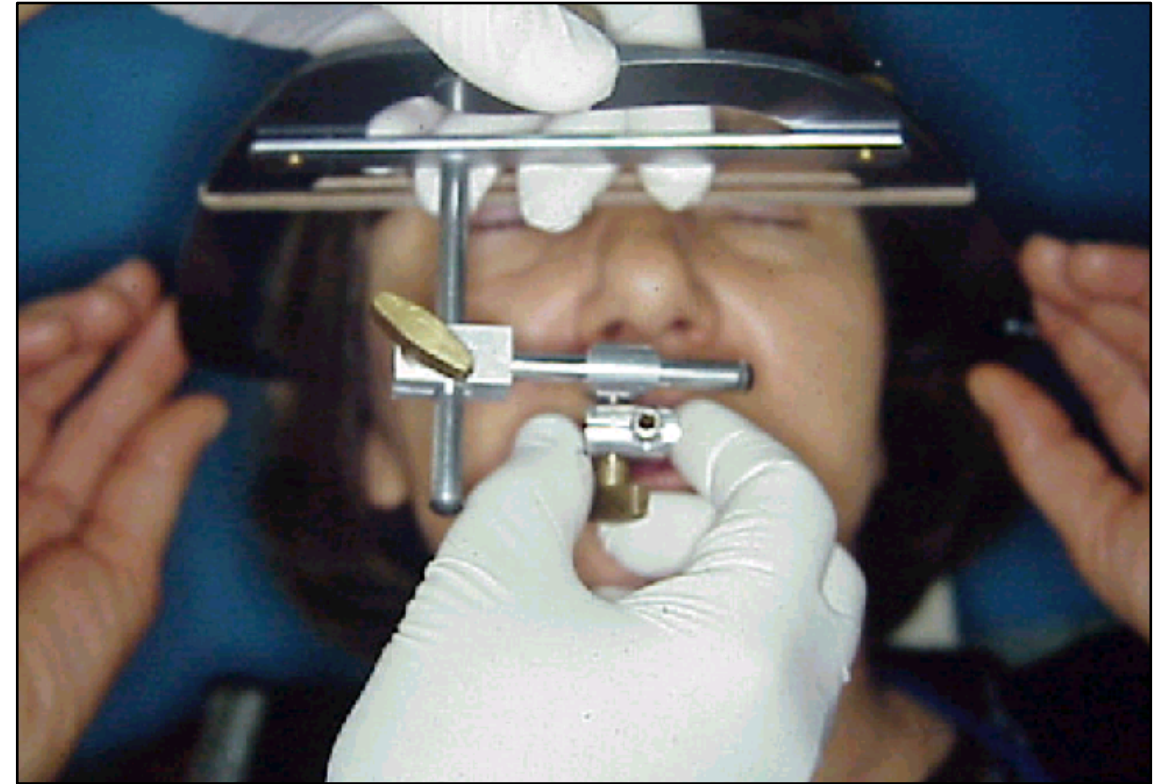
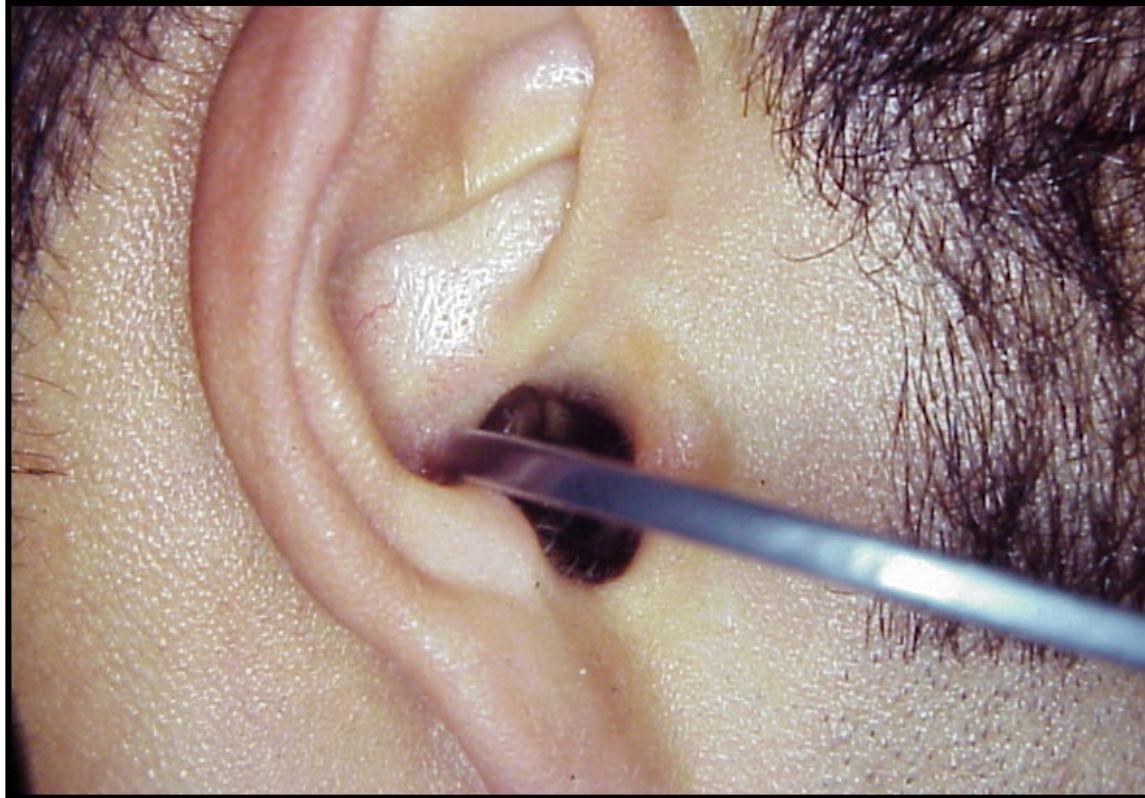
## Kavo Protar facebow

Can use either Frankfurt or Camper's plane

1. Nasal support



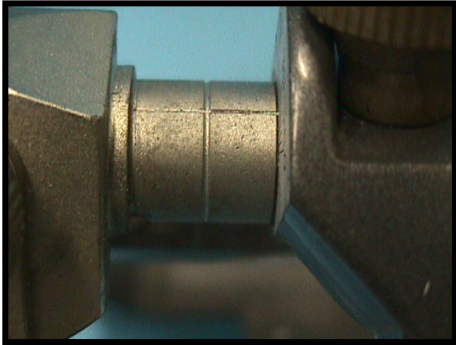
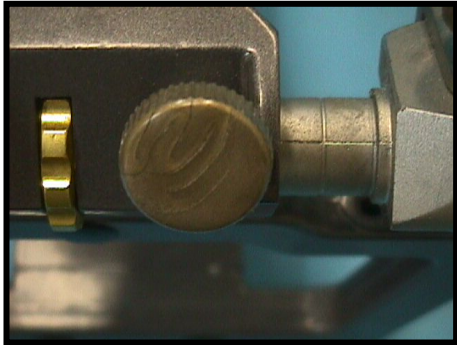
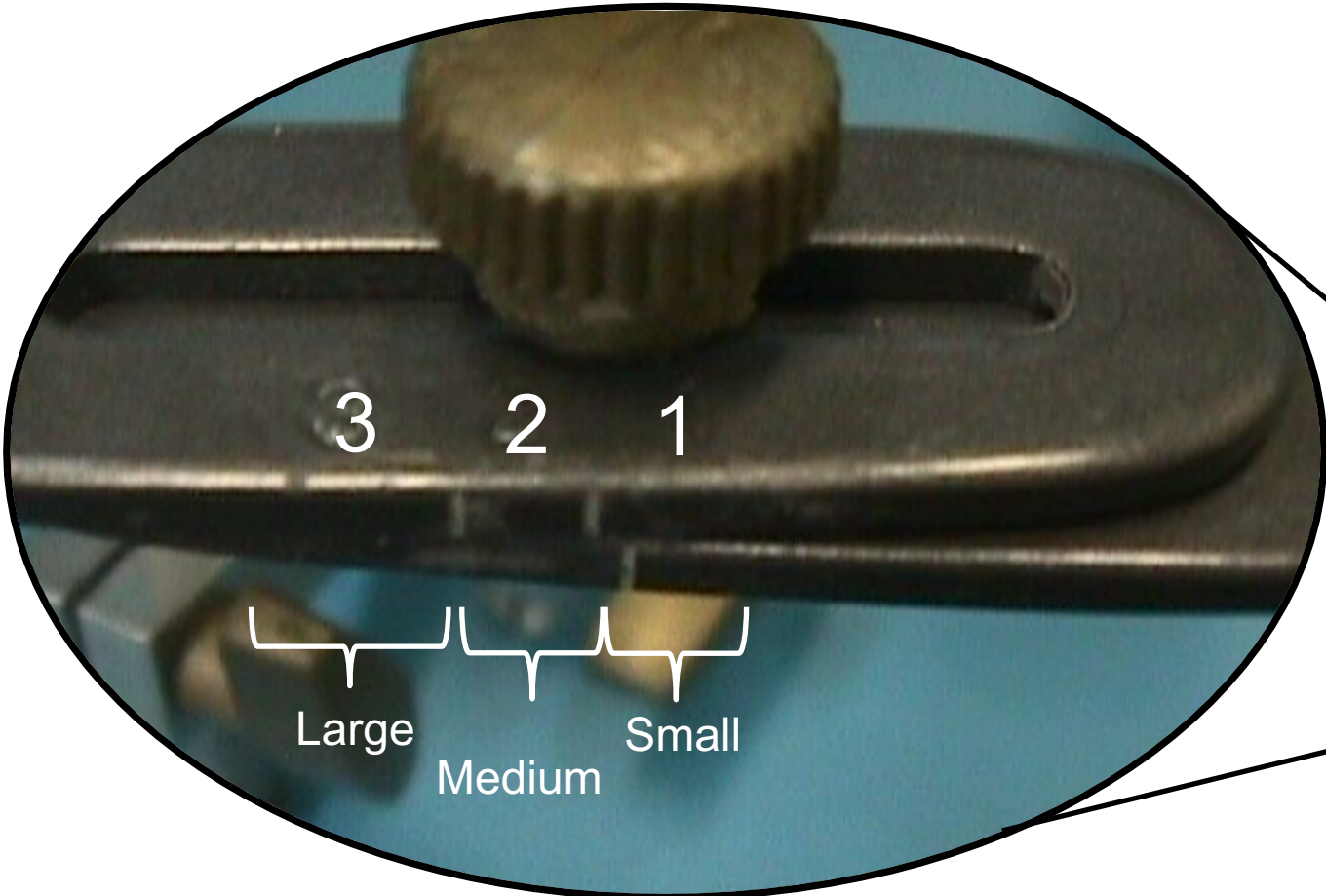
## INTERCONDILAR ADJUSTMENT (Not available on Kavo PROTAR)



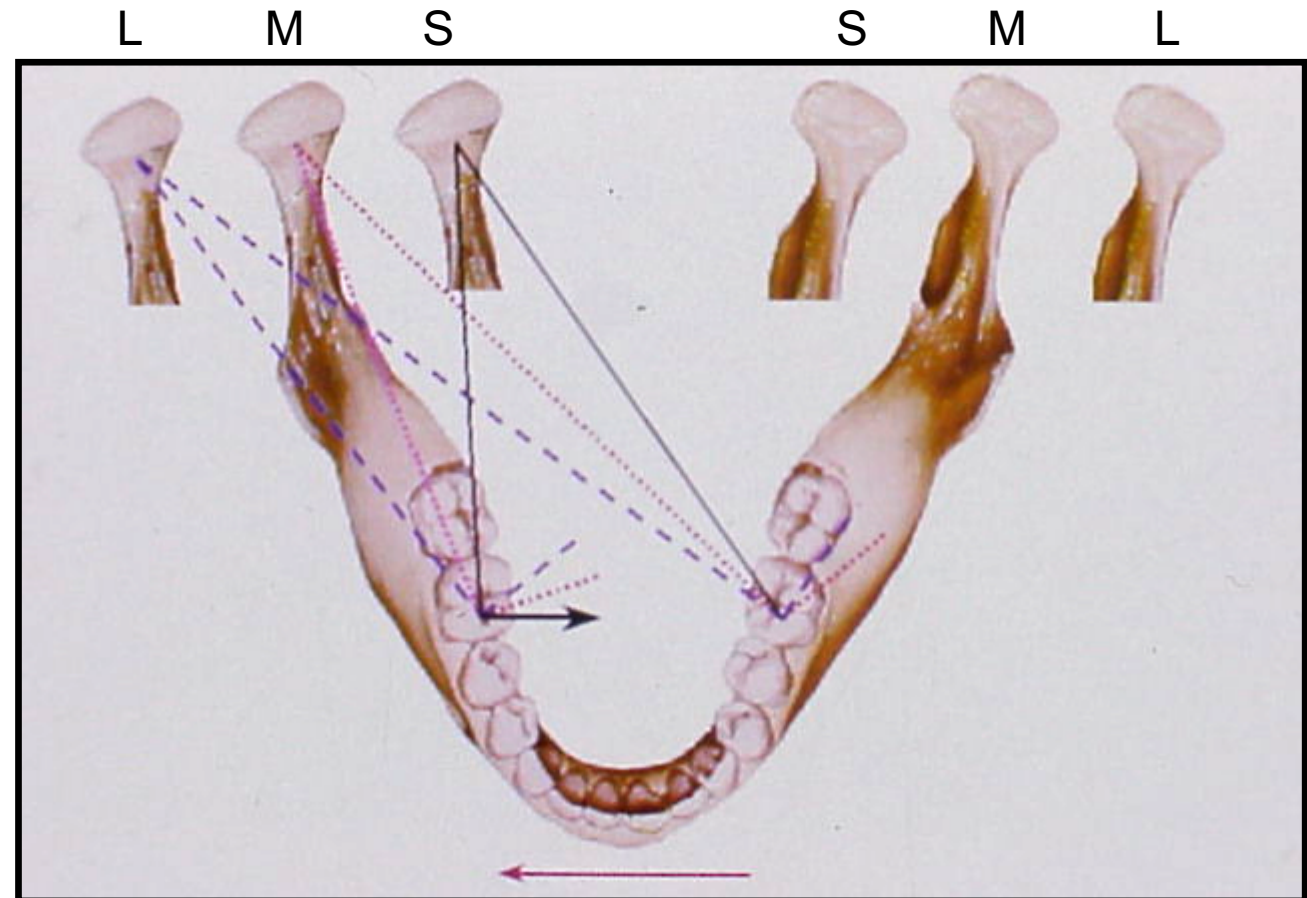
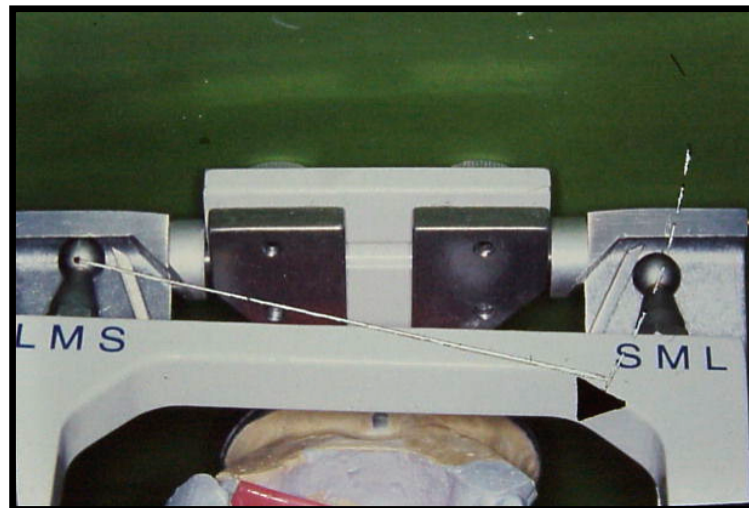
# Articulators



## INTERCONDILAR ADJUSTMENT (Not available on Kavo PROTAR)



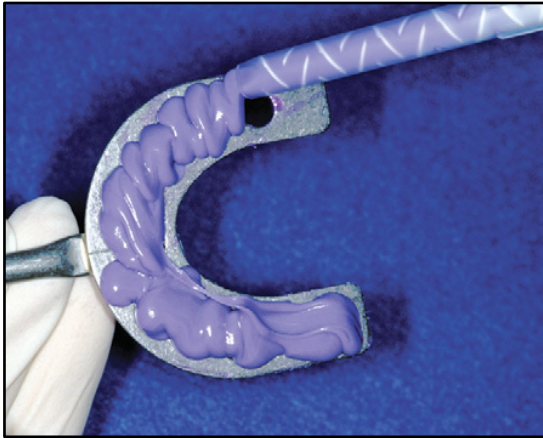
## Intercondylar Distance



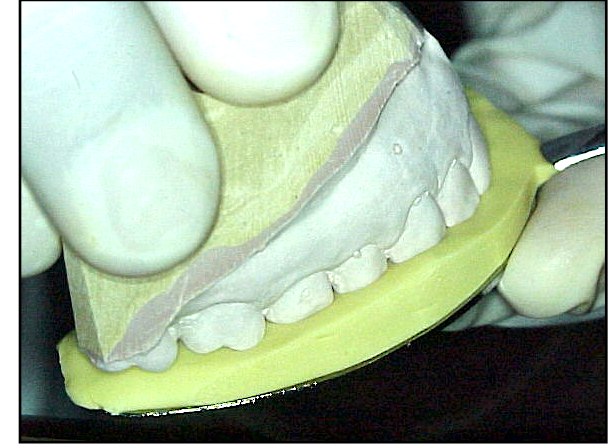
## FACEBOW RECORD

1<sup>st</sup> Impression of maxillary cusp tips on the fork

Automixed elastomer



Addition or condensation silicone putty



Impression  
Compound  
(not available in the clinic)



## FACEBOW RECORD

2<sup>nd</sup> Place the prepared bite fork in the patient's mouth: patient can hold it against the upper teeth



Partial or complete edentulous cases



Need **base and wax rim** to provide posterior support

## FACEBOW RECORD

3<sup>rd</sup> Adapt the bow to the width of the patient's face.

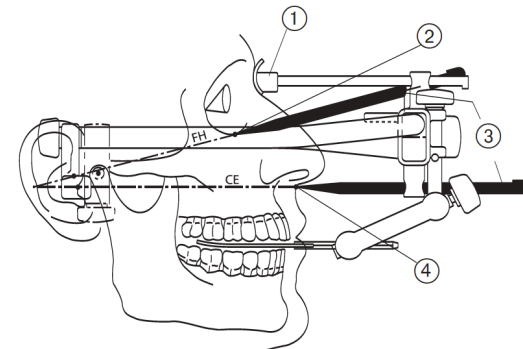


4<sup>th</sup> Adjust the nasal support on the nasion and fix it with the lock lever

### NOTE:

If the Frankfurter horizontal is used, the reference pointer must be inserted above the bow.

If the Camper plane is used, the reference pointer must be positioned below the bow.



## FACEBOW RECORD

5<sup>th</sup> Shove the bite fork support onto the bite fork ④

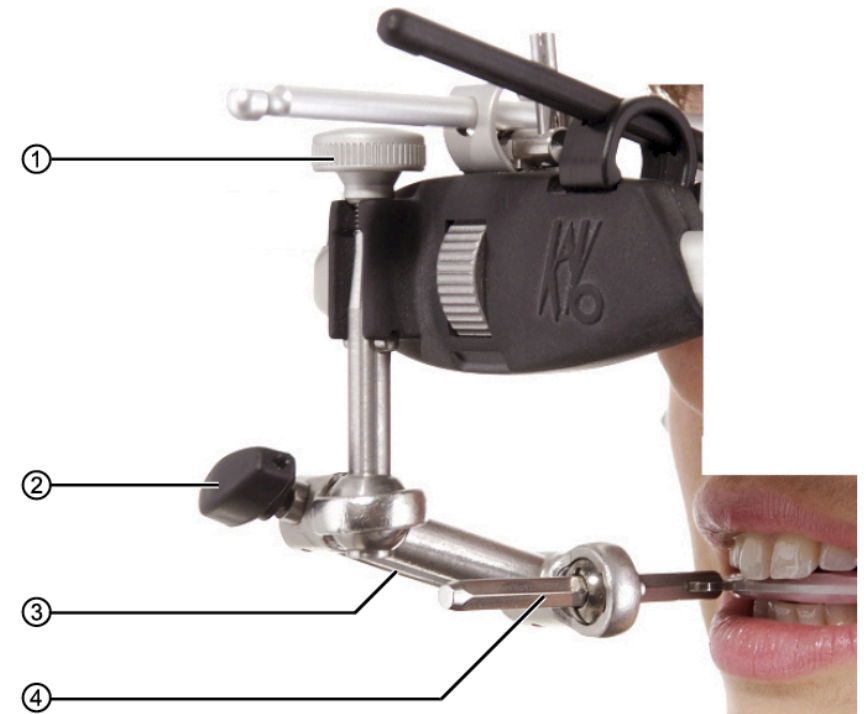
6<sup>th</sup> Adapt the bite fork support on the facial bow and tighten the the finger screw ①

Make sure that the guide pins of the bite fork support engage in the guide groove of the facial bow.

7<sup>th</sup> Tighten the knurled screw ②



Bite fork support





# Bite Registration

## Should I use CR or MIP (habitual bite position)?

**Confirmative approach:** patient has stable bite, no symptoms of TMD

- Prosthetic treatment in **MIP**, habitual bite position.

**Reorganized approach:** patient with no stable bite, loss of VD, signs and symptoms of TMD

- Prosthetic treatment in **CR**

**A second option for Reorganized approach:**

**Freedom in centric:** Reestablish the bite in **CR** and leave area of freedom in the restoration so that the patient can function anywhere between CR and old habitual position (MIP) if necessary.

## MIP (habitual bite position)

- Respect working time of bite registration material
- Do not use a lot of material
- Check if the patient is contacting upper and lower teeth

## MOUNTING OF MANDIBULAR MODEL

### BITE REGISTRATION IN CR

RC = Most posterior position of the mandible in which the condyle is in the most anterior and superior position within the fossa.

### Manipulating a patient's mandible



## BITE REGISTRATION IN CR

Tongue tip to soft palate



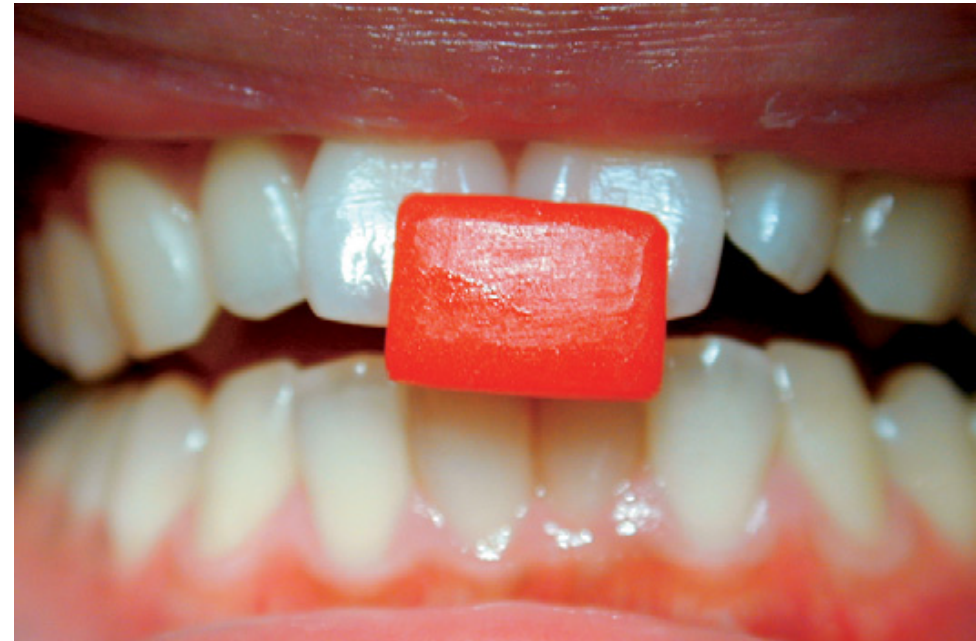
## BITE REGISTRATION IN CR



## BITE REGISTRATION IN CR

### ”Lucia Jig”

- Small anterior programming device made of acrylic resin
- Prevent posterior contact points
- Help mandible manipulation



## BITE REGISTRATION IN CR

”Lucia Jig”



## BITE REGISTRATION IN CR

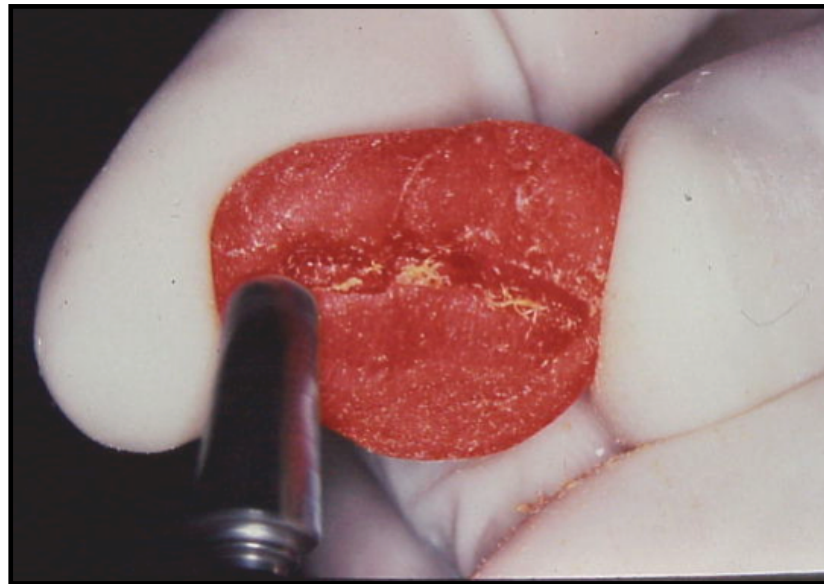
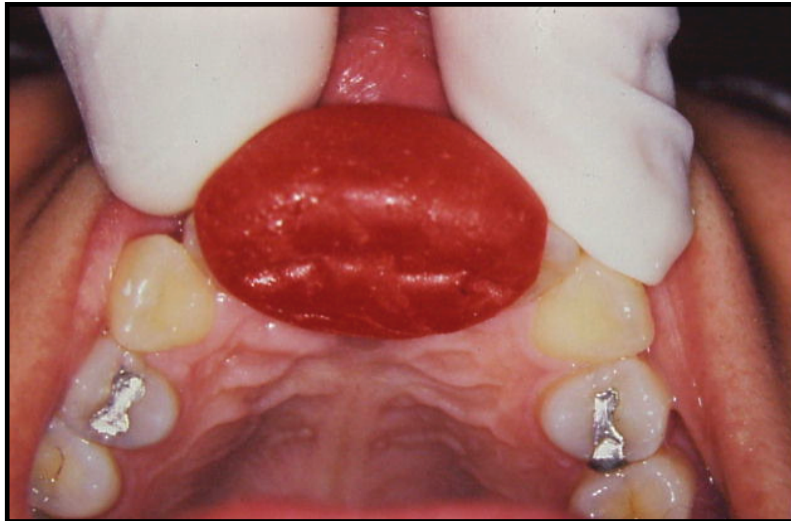
”Lucia Jig”



1 mm apart

## BITE REGISTRATION IN CR

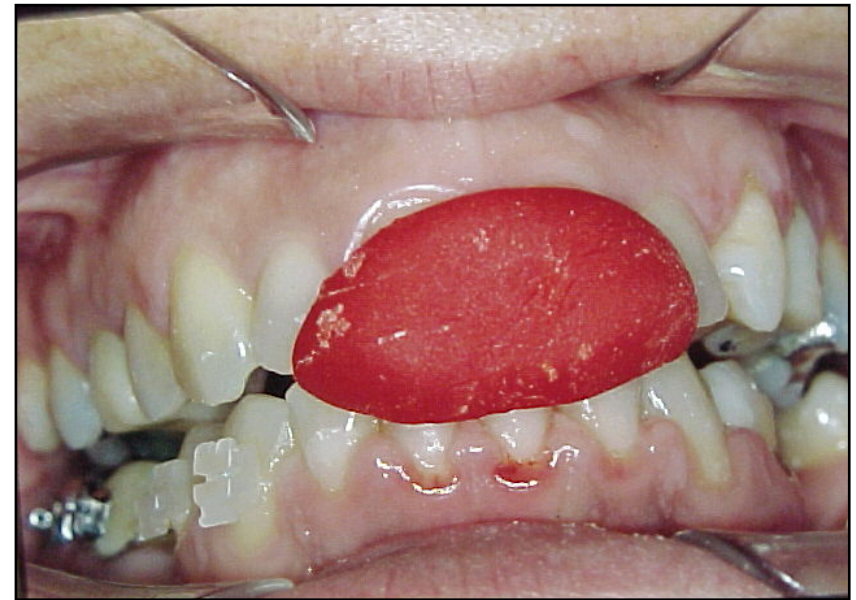
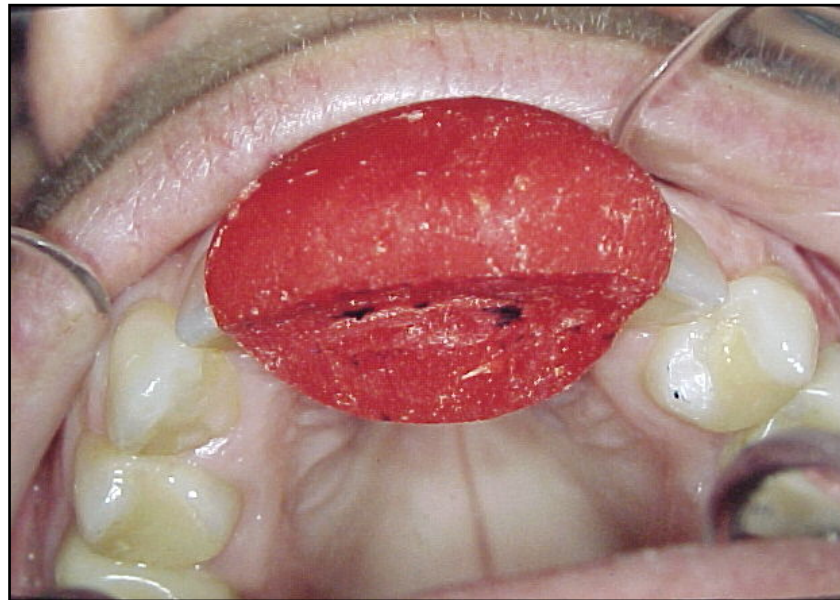
### "Lucia Jig"



Create a platform

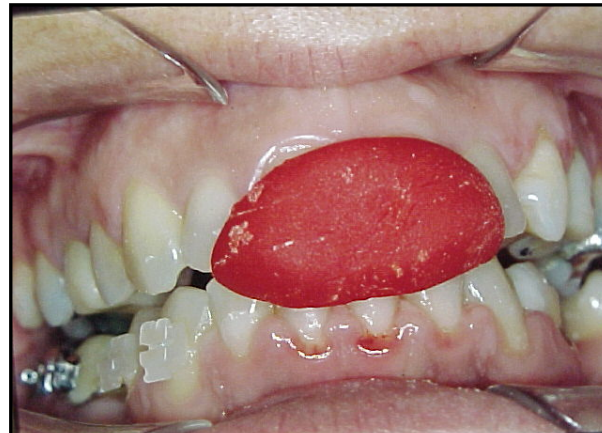
## BITE REGISTRATION IN CR

### "Lucia Jig"



## BITE REGISTRATION IN CR

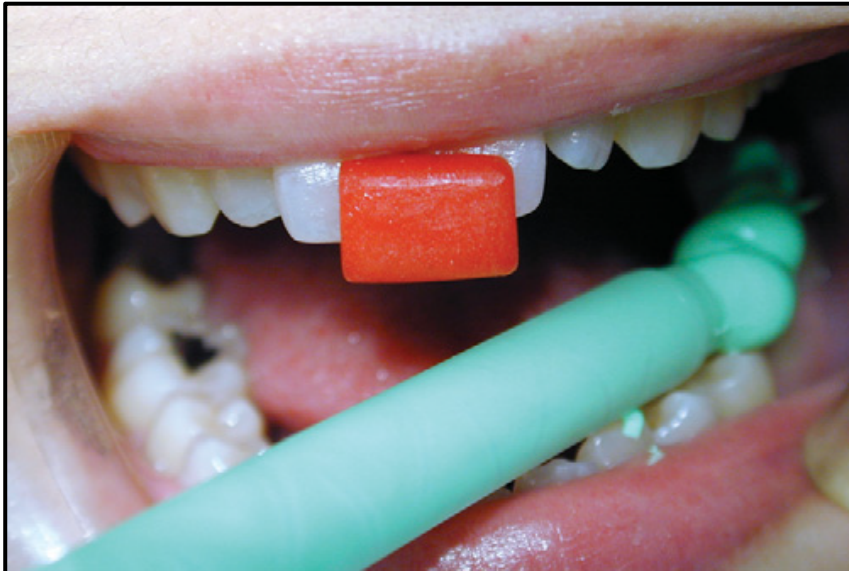
### "Lucia Jig"



RC record

## BITE REGISTRATION IN CR

### ”Lucia Jig”

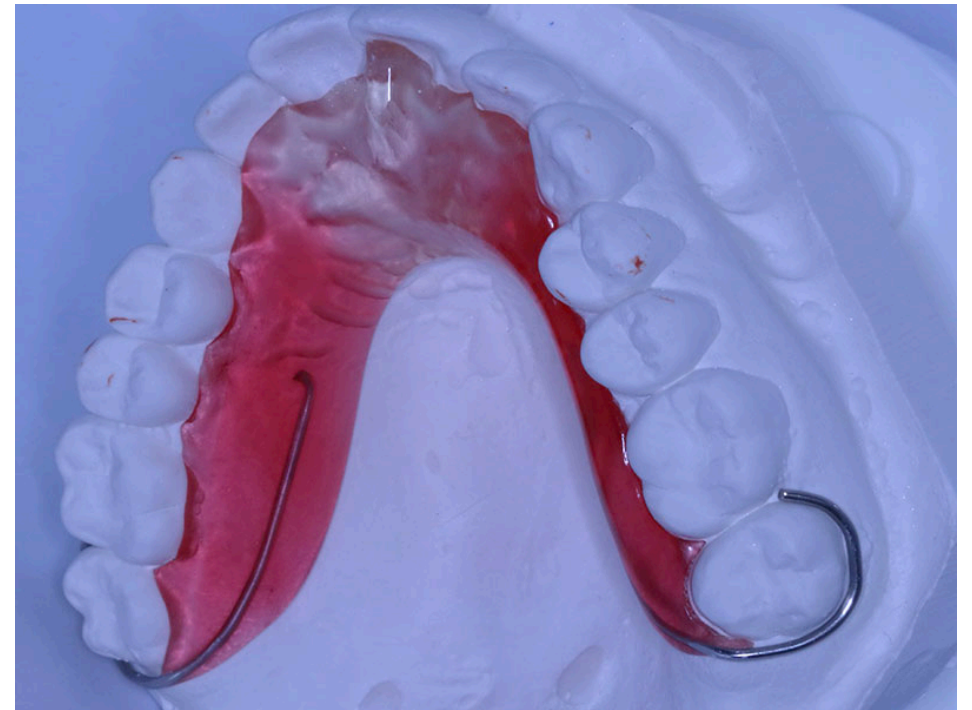


## BITE REGISTRATION IN CR

Occlusal splint



Kois deprogrammer

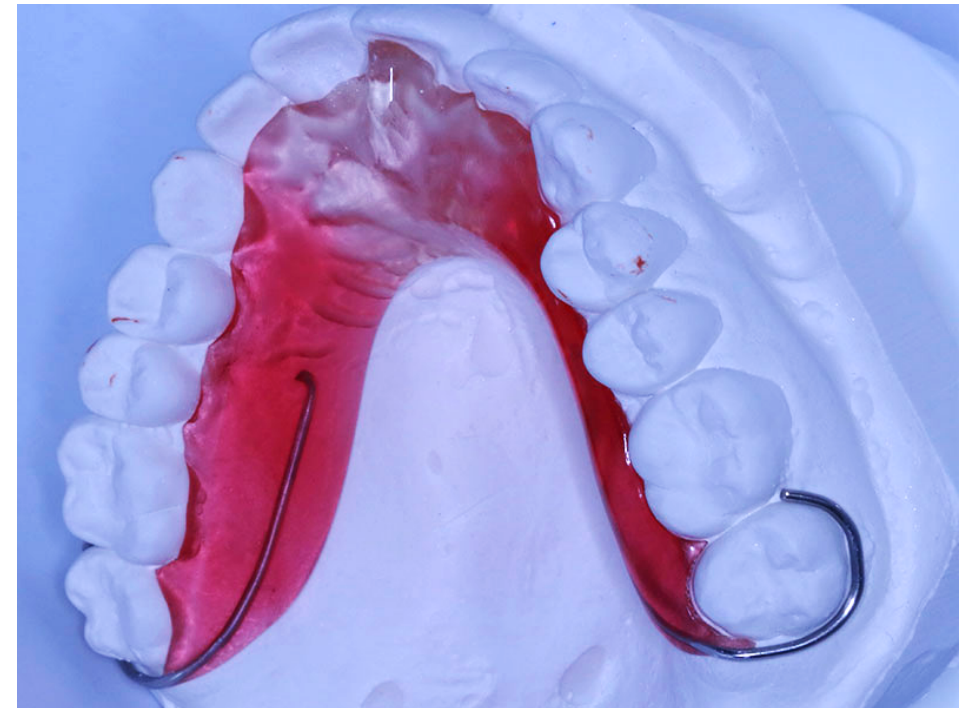


## BITE REGISTRATION IN CR

Anterior jig



Kois deprogrammer



## Jaw Relation Record

### ➤ Requirements:

- Durability
- Rigidity
- Ease of application
- Ease of transfer

➤ For edentulous areas:  
stabilizing base and  
occlusal rim

Consider multiple records  
to ensure repeatability

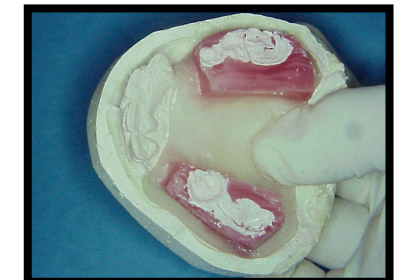
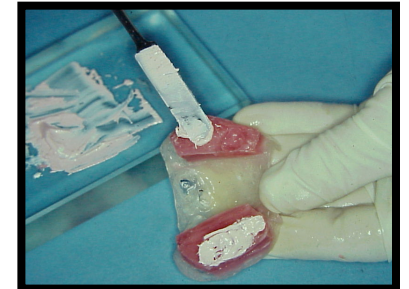
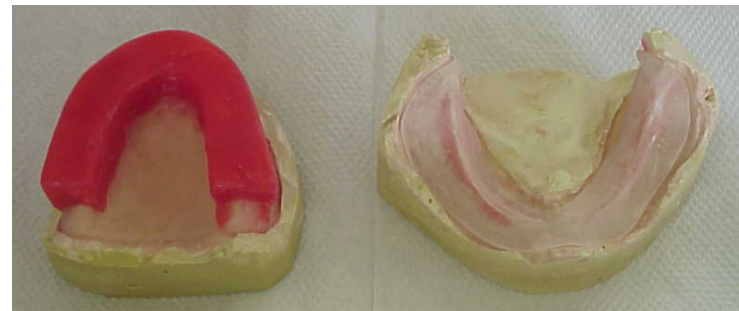
## Suitable materials

Wax

Silicone

ZnO-eugenol

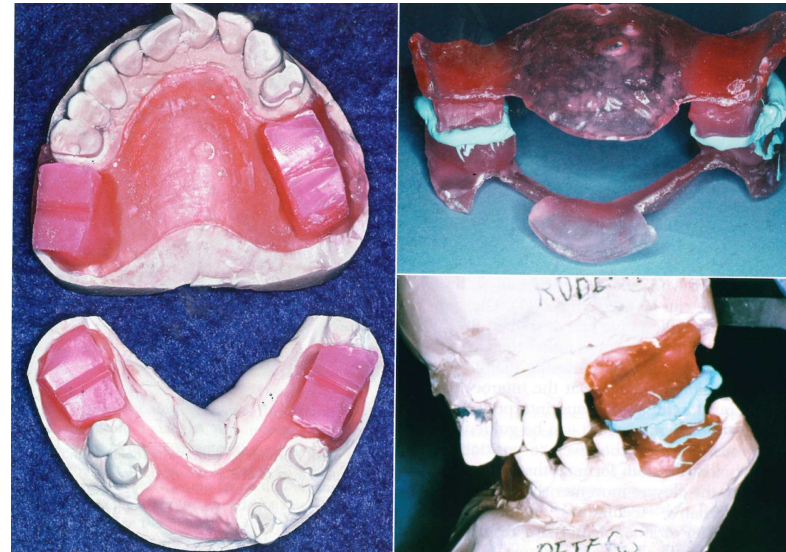
Resin



## Jaw Relation Record



Elastomeric material



# Articulators



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AUSTRALIA**



Oral Health Centre  
of Western Australia



## PROGRAMMING THE ARTICULATOR

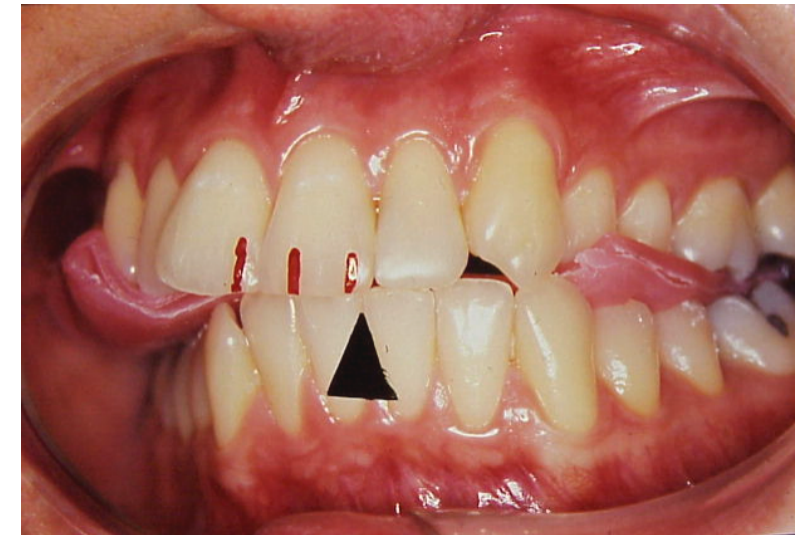
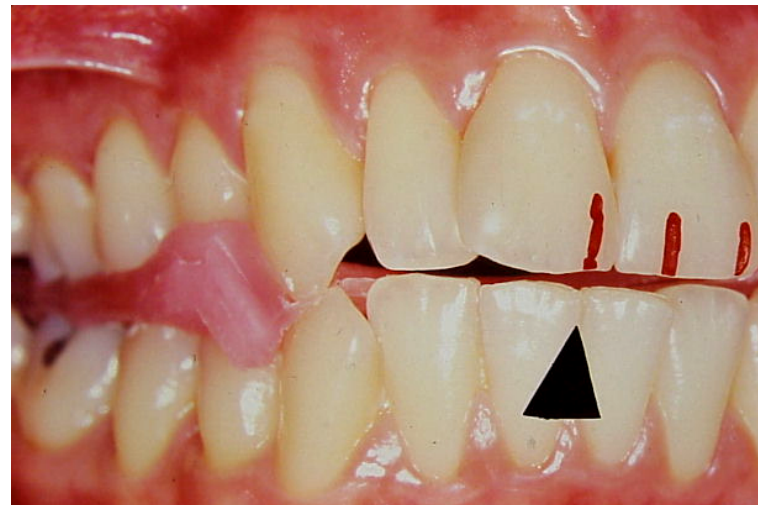
Condylar guidance and  
Bennet angle

MIP/RC



Protrusion

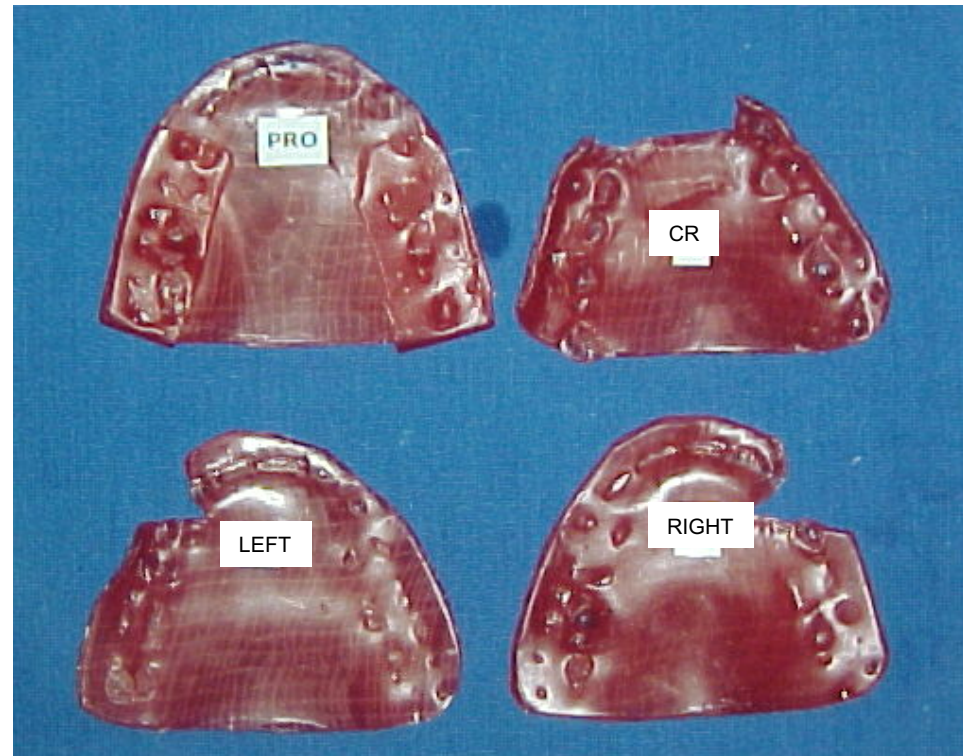
Lateral movement to right



Lateral movement to left

## PROGRAMMING THE ARTICULATOR

Condylar guidance and  
Bennet angle

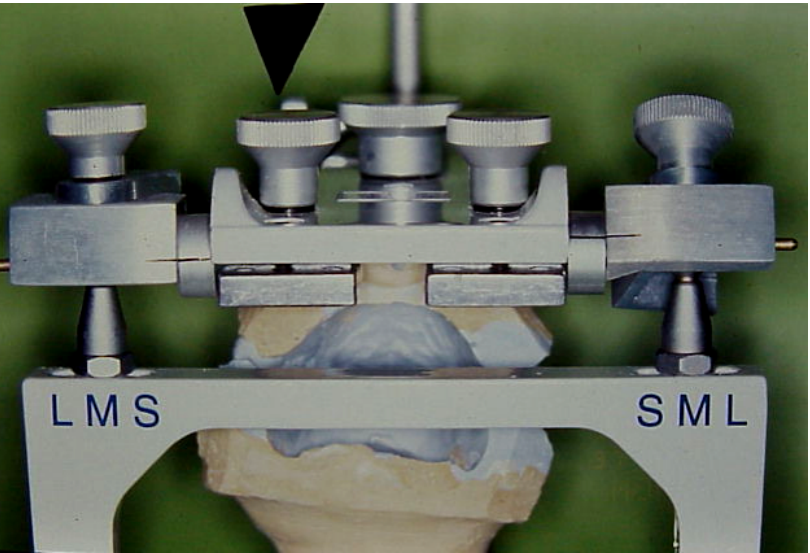


## PROGRAMMING THE ARTICULATOR

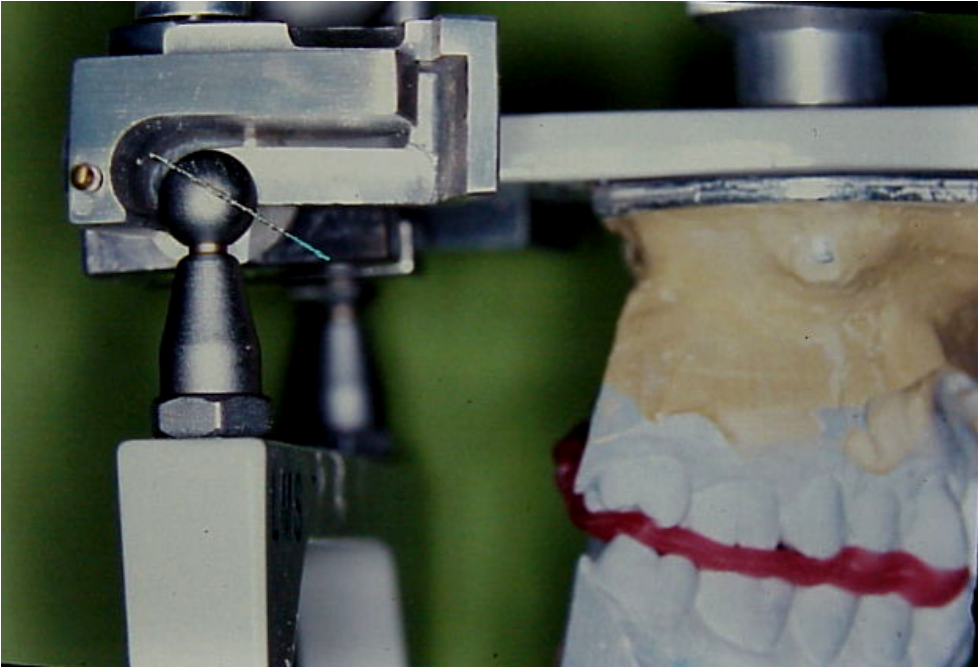
### Condylar guidance



PROTRUSION  
BITE  
REGISTRATION

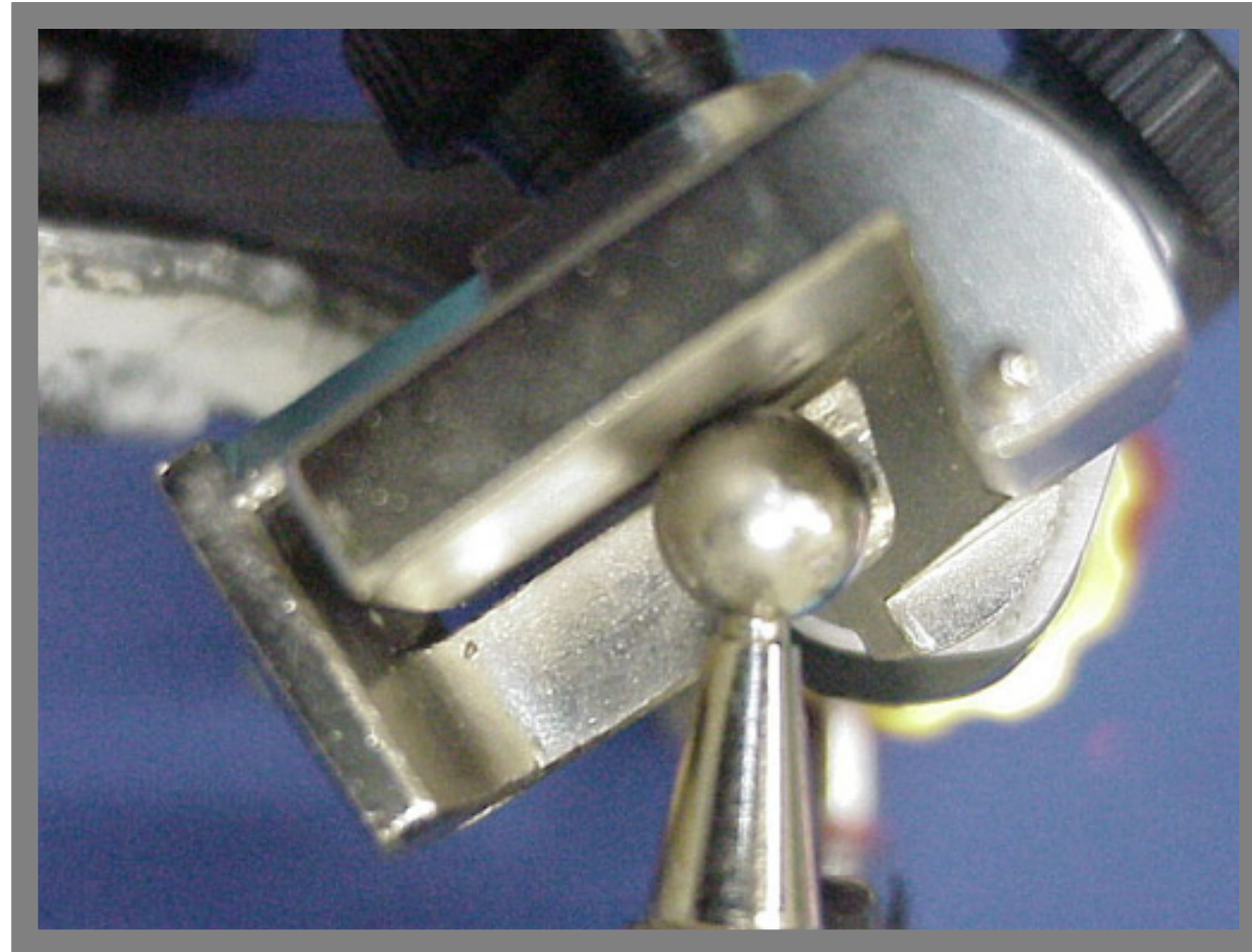
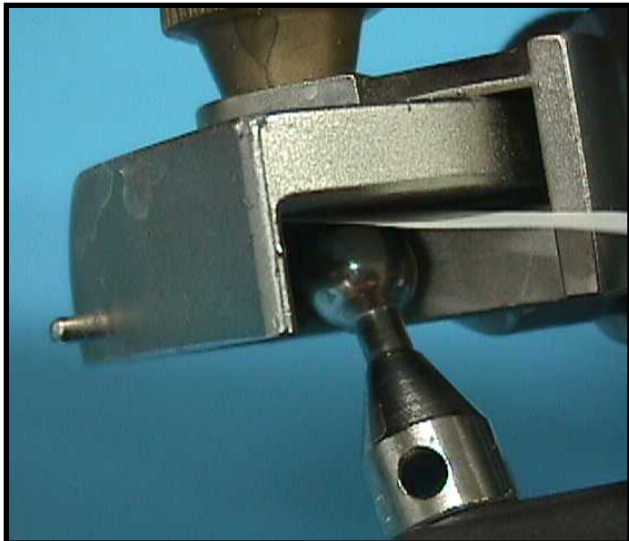


Return Condylar guidance to 0°



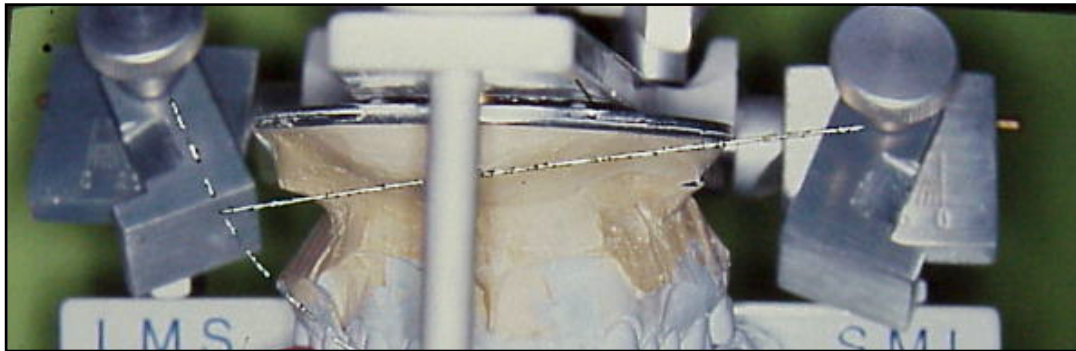
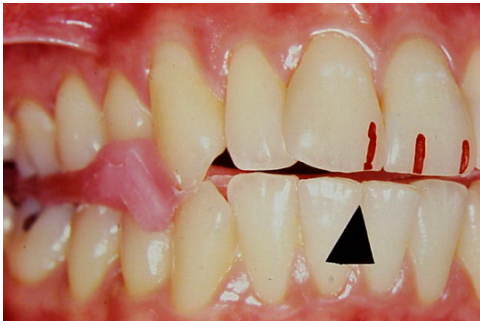
## PROGRAMMING THE ARTICULATOR

Condylar guidance



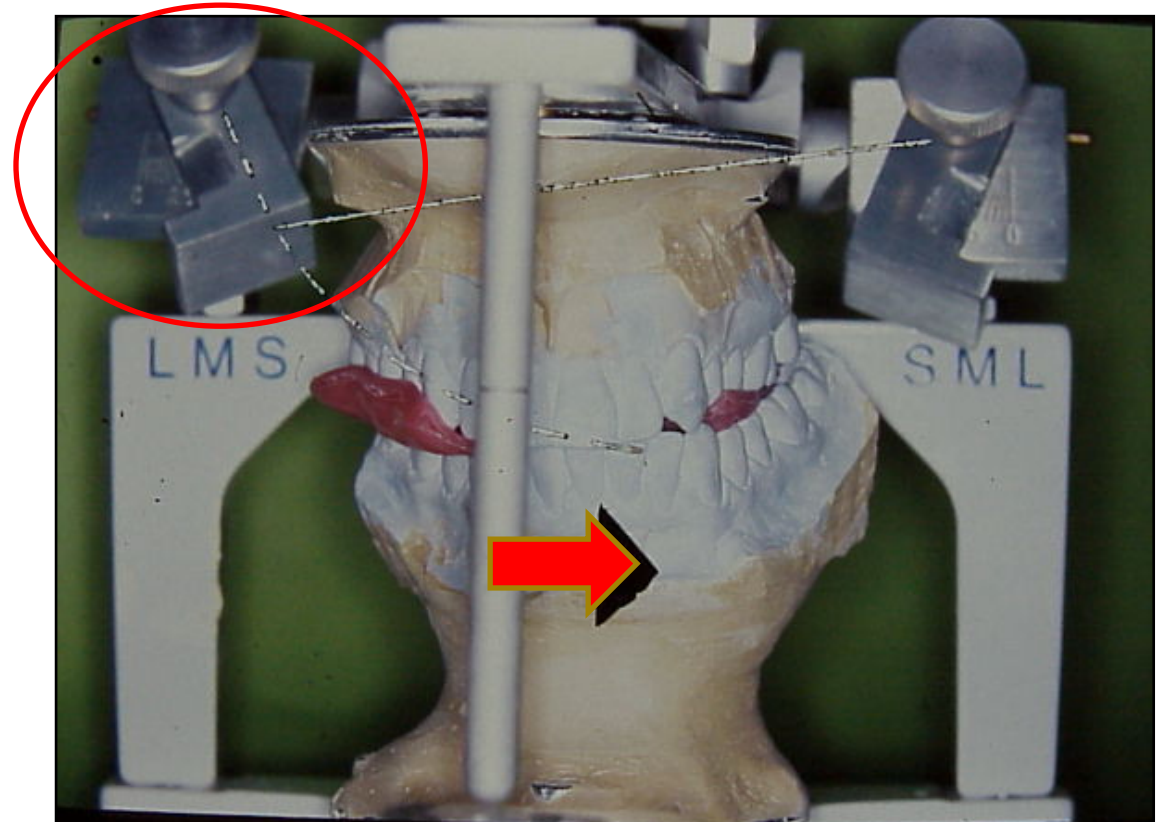
## PROGRAMMING THE ARTICULATOR

Bennet angle



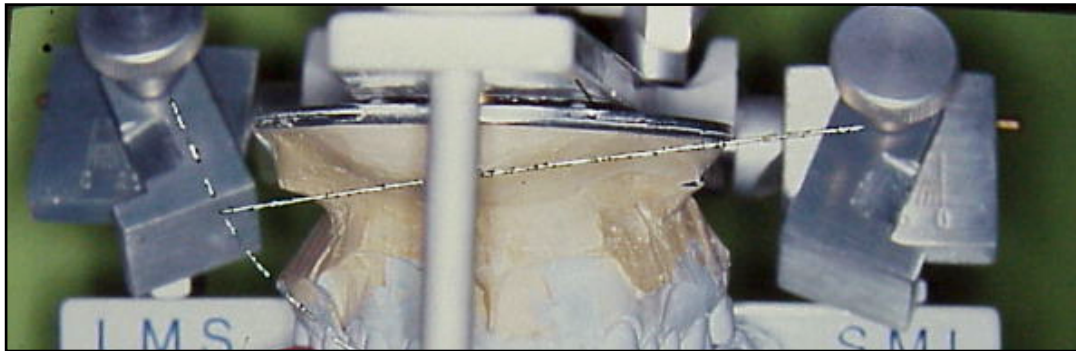
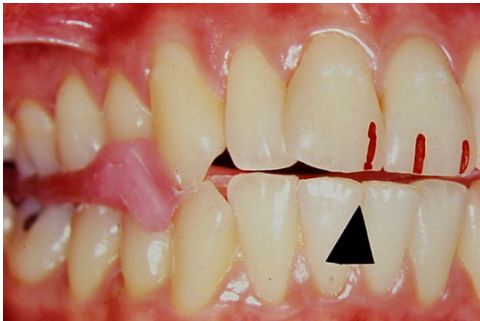
Set Bennet angle = 30°

Adjust the angle in the non-working side



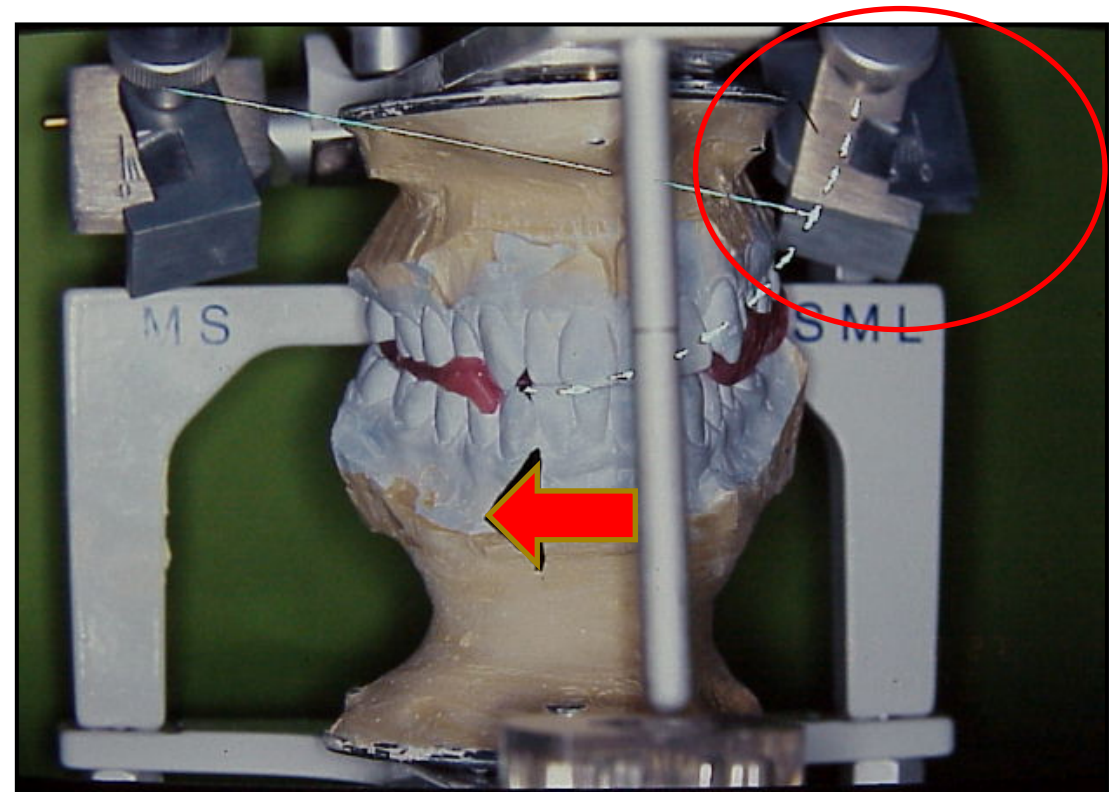
## PROGRAMMING THE ARTICULATOR

### Bennet angle



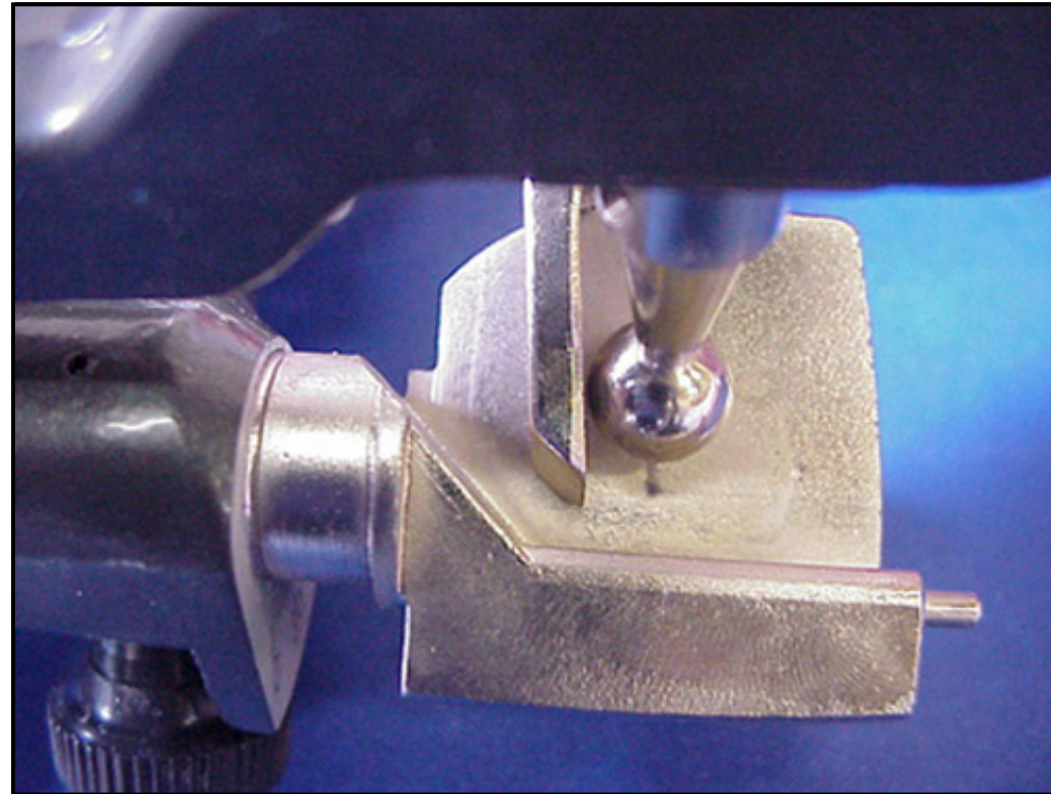
Set Bennet angle = 30°

Adjust the angle in the non-working side



## PROGRAMMING THE ARTICULATOR

Bennet angle



## PROGRAMMING THE ARTICULATOR

Bennet angle



Pre-adjustment for  
mounting of casts =  $0^\circ$



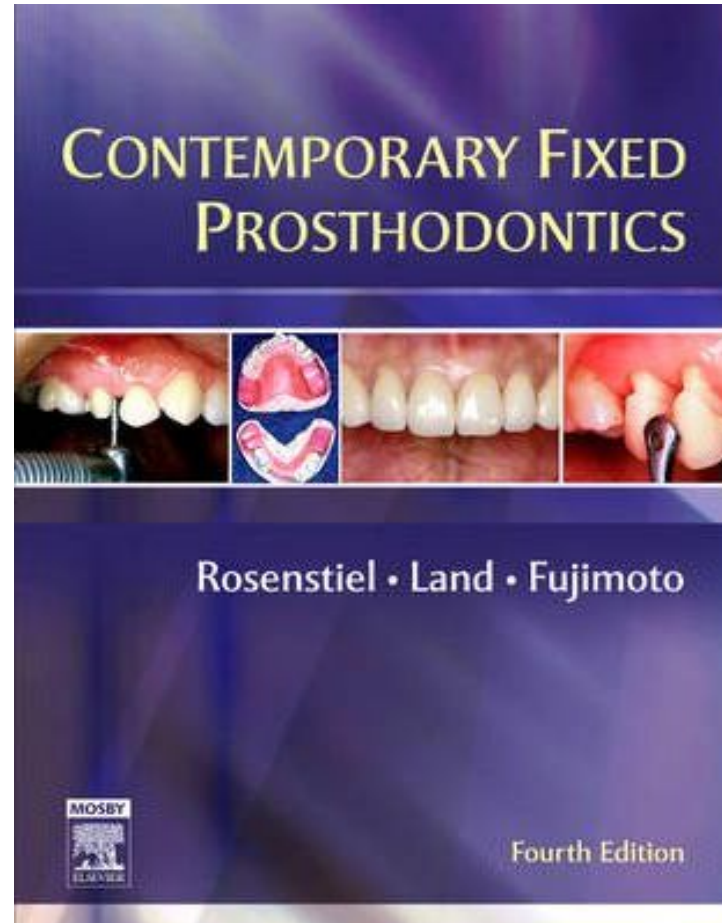
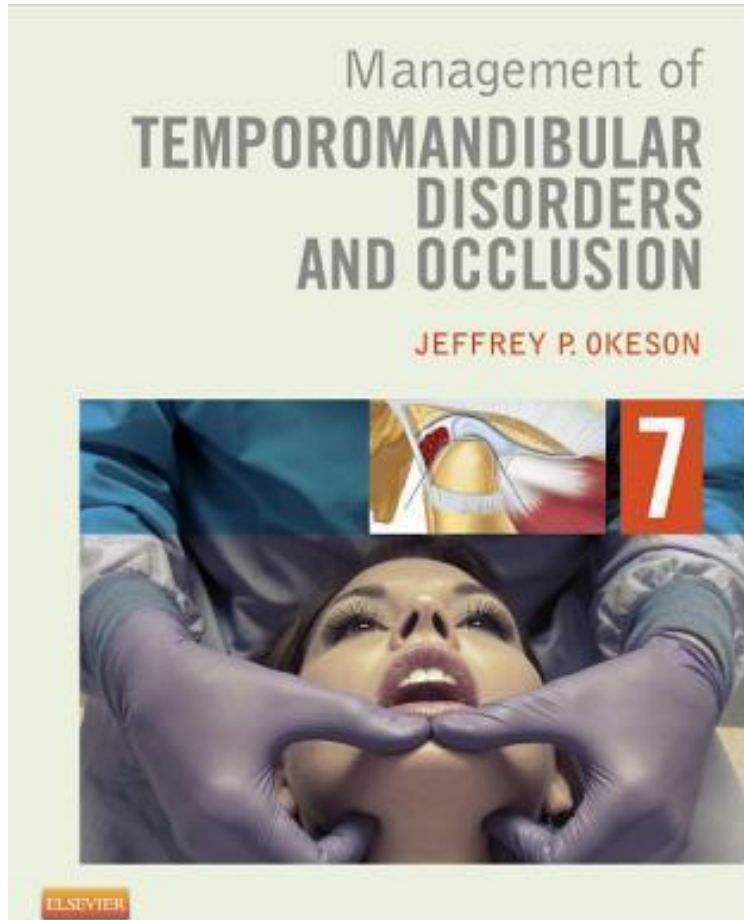
Pre-adjustment =  $30^\circ$



Final adjustment

Needs to be used properly, otherwise errors will be introduced.

- Occlusal problems
- Incorrect articulations
  
- Errors mounting models in the articulator lead to treatment delay, addition of appointment



Thank you