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Registration: Stage II — intermaxillary relations

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In this section, various methods of recording of intermaxillary relations are discussed, as is the determination of appropriate occlusal vertical dimension. Consideration is also given to choice of articulator.

In this part, we will discuss:

- How to determine FWS
- How to relate the mandible to the maxilla at an appropriate OVD in RCP
- How to record other intermaxillary relations
- A range of articulators

Recording the jaw relations is a very important procedure in the production of complete dentures. An error at this stage can result in dentures that are uncomfortable, or unwearable, and may even have the potential to produce lasting damage to many elements of the stomatognathic system.

The intermaxillary relations are, of course, three-dimensional. In order to simplify the recording of jaw relations it is established practice, based on extensive clinical practice and current physiological knowledge, to consider three elements. The first of these is in the vertical plane to establish the amount of jaw separation, while the second and third relate to the horizontal plane (which is concerned with the anteroposterior relations) and the coronal plane when one considers the lateral relations of the jaw.

The vertical relationship

Individuals who have their natural dentition demonstrate a space between the occlusal surfaces of the teeth of the opposing jaws when they are at rest and with the head upright. This space, the freeway space (FWS) or interocclusal distance, is determined by a balance between the elevator and depressor muscles attached to the mandible, and the ‘elastic’ nature of the surrounding soft tissue in a natural dentition. It is usually measured indirectly by noting the difference between the resting vertical dimension (RVD) of the face using, for example, a Willis gauge, and subtracting from this the vertical dimension of occlusion (OVD) with the teeth in occlusion (Fig. 1).

A similar set of circumstances is considered to exist in the edentulous patient — although

the RVD may differ from that which pertained when natural teeth were present. It is now known that the RVD is not a stable position throughout life for a given individual.

However, the RVD may be considered as a factor when determining as to whether a patient will be able to tolerate wearing dentures without intra-oral tissue damage occurring. RVD should also be taken into account as an important aspect of the appearance of the denture-wearing patient. For these reasons it is the starting point from which the OVD is estimated.¹

Because of the role played by the ‘elastic’ properties of the soft tissue environment of the mouth, the importance of developing the form of the upper denture as described in Part 5 is emphasised. This must be done prior to determining the RVD for the edentulous patient. The weight of the soft tissues attached to the mandible plays a very important role in the RVD as does the position of the head. Tilting the head backwards pulls the mandible away from the maxilla, and a forward inclination pushes the mandible and attached structures closer to the maxilla.

Resting vertical dimension (RVD) measurement

Many methods have been advocated for the measurement of the RVD. These include various facial measurements, swallowing methods, biting force measurements, phonetic methods, tactile methods and electromyographic measurements.

We recommend a combination of some of the above for a simplified clinical determination of RVD.

Two measuring points are required in the midline of the face — one related to the nose,

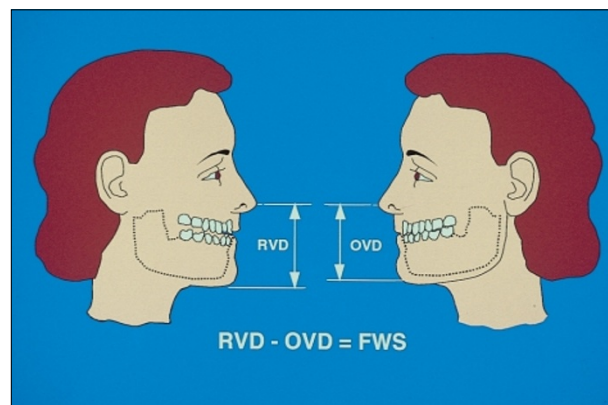


Fig. 1 The difference between RVD and OVD

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REFEREED PAPER

© British Dental Journal

2000; 188: 601–606

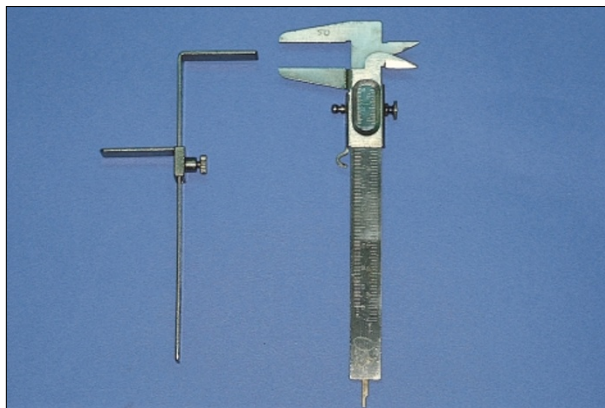


Fig. 2 Willis bite gauge, and a similar instrument, both with an integrated scale, may be used to measure RVD and OVD

and one to the chin. These points must be on sites of minimal influence from the muscles of facial expression to avoid skin movement, and should be chosen only after careful observation of the patient seated normally in the dental chair with the head erect. The measurement is made with the patient in a relaxed and comfortable position, while wearing the previously developed upper base and rim. A Willis bite gauge may be used for the measurement, as it incorporates a suitable scale (Fig. 2) or a pair of dividers and an additional scale can be used.

It may be helpful if the patient moistens the lips with his or her tongue and brings them into light contact prior to recording the measurement. Asking the patient to swallow and relax the jaws is also a useful method. Verification of the measured value can be attempted by asking the patient to say the letter 'm' and to hold the facial expression whilst the measurement is made. The general appearance of the patient's face and its proportions should also be taken into account. Careful observation to guard against unwanted skin movement should be maintained during the recording of measurements.

In conventional techniques, once the RVD has been established, the upper and lower bases and rims are placed in the mouth after the upper rim has been moulded (see Part 5). The lower rim is reduced in height (usually — or added to if undersized), until it contacts evenly the upper rim at a vertical dimension of occlusion some 2–4 mm less than the established RVD. This provides for a freeway space of 2–4 mm, and establishes the OVD.

In establishing the height of the lower rim, the relative height of both the upper and lower rims should be considered. As a practical consideration, an element of reasonable balance between the two rims is desirable. Excessive height of the lower rim can have the effect of 'walling in' the tongue causing a resultant unstable lower denture. On the other hand, deficient depth of the lower rim can result in poor aesthetics and, further, may result in tongue biting. Conventional wisdom, however, would indicate that the

occlusal plane should be below the dorsum of the tongue at rest.

Errors in OVD

Provision of an appropriate OVD is important because of the consequences which can stem from an over- or under- estimation of this value.

Excessive OVD may result in increased risk of trauma to the tissues underlying the dentures as the absence of a freeway space effectively causes continuous clenching of the teeth. Painful mucosa over the denture bearing areas and muscle soreness, particularly associated with the masseter muscle, may become evident. The teeth are liable to contact (causing clicking) during speech and other speech problems caused by difficulty in bringing the lips together (eg 'p', 'b' and 'm' sounds) may occur. Poor aesthetics may be apparent and there is a possibility of temporomandibular joint dysfunction developing (Fig. 3).

Where there is an under-estimation of OVD, lack of support of the angles of the mouth (causing dribbling and possibly angular cheilitis) may be apparent. Masticatory efficiency may be reduced and poor aesthetics, because of a lack of adequate support of the lips and cheeks may be seen. Chin protrusion on closure of the jaws may also occur (Fig. 4).

Care at this stage is required, and, furthermore, it must not be assumed that the value selected is immutable, as the generally quoted value for the freeway space (FWS) is an average one and, as such, it should be appreciated that some patients may require a larger, or smaller, value. For example, where atrophic mucosa exists in a middle-aged adult an increased FWS might prevent/reduce trauma to the residual mandibular tissues (Fig. 5).²

There are several accepted tests which can be applied to verify the established OVD. However, occlusal rims are so different from the form of teeth to be used that it is very difficult to apply tests for suitability of the chosen value at this stage. Further checks on the established OVD will need to be made at a later stage of denture production — the trial stage — and will be dealt with in Part 8.

Registering the intermaxillary relations

The generally agreed position for recording the antero-posterior position of the mandible relative to the maxilla is that of the retruded contact position (RCP). The reasons for this are first that it is a reproducible position in the edentulous patient. Secondly, abnormal contact between opposing dentures when set up in other than the retruded relationship results in denture instability. Next, the apparatus used for reproducing relevant jaw movements (the articulator) operates from the retruded position, and abnormal temporo-



Fig. 3 Excessive OVD results in the orbicularis oris muscle group straining to effect a seal



Fig. 4 Insufficient OVD may result in an ageing effect of the patients

mandibular joint activity may result from patients attempting to accommodate incorrect occlusal relations.³

Following adjustment of the occlusal rims to the selected OVD, the rims should be inserted into the mouth and the patient persuaded to close gently with the mandible in the retruded jaw relationship. The word ‘bite’ should not be used, as this suggests to the patient that forceful closure is required and will result in a mandibular position that is protrusive.

A number of methods have been suggested to assist the patient to achieve retrusion of the mandible. Some patients have the capacity to relax the muscles attached to the mandible so that the operator can readily move the mandible up and down as it rotates about the condyles. In those circumstances, the mandible is in the retruded position, and can be guided there during the registration procedure. Other patients are able to retrude the mandible when the tongue is curled back in the roof of the mouth to feel the posterior border of the upper base, or a shallow ridge of wax placed on the palatal area of the base posterior to the first molar region.

In our opinion, the most positive and successful method is by means of the Gothic-arch (or arrowhead) tracing method, as it readily identifies the most retruded position of the mandible relative to the maxilla from which lateral excursions can be made.

Methods of registration

Recording the retruded contact position (RCP) requires upper and lower rims to be fixed in position with the mandible in its most retruded position and with the jaws separated by the established OVD.

A variety of methods for securing a record of the retruded jaw relations (RJR) have been used with varying degrees of success.

These include:

- Wax squash bite (and its predecessor, the T-block system) (Table 1)
- Wax rims or ‘Manchester’ blocks (Table 1)
- Intra-oral tracing (Gothic-arch tracing) (Table 1)
- Extra-oral tracing.

Wax squash bite

The wax squash bite involves placing a horse-shoe shaped roll of softened wax between the upper and lower rims and having the patient close the jaws together. The lower rim is first reduced in height to provide space for the wax. Results using this method are uncertain because of the lack of control of the vertical dimension, the common difficulty of obtaining mandibular retrusion, and the fact that the record takes no account of mandibular movements other than the final act of closure (Fig. 6). In addition, if the wax wafer is not uni-

Table 1		Summary of relative efficiency of registration techniques for complete dentures
Method	Comments	
Squash bite	Poor control over OVD, no control of mandibular movements, or of stability of bases, uncertainty of RCP.	
Wax rims including Manchester bases	Good control of OVD, good base stability if PMMA used. Uncertainty of RCP, good occlusion development with facebow mounting.	
Intra-oral tracing	Good control of OVD, good base stability, good control of RCP and other mandibular activity. Excellent occlusion and articulation development with facebow mounting.	
NB If, after any of the three techniques have been used, the casts are approximated and examined and the heels are found to contact, then this gypsum contact should be removed prior to articulation otherwise a posterior bite will be incorporated into the set-up and will be evident at the trial insertion.		

formly softened throughout its length, an unstable relationship with the underlying tissues is recorded. An earlier version of this method was the T-block method, in which a T-shaped wax form was used instead of the simpler horseshoe form (Fig. 7). The ‘horizontal’ portion was placed between the rims while the ‘vertical’ part that protruded anteriorly was intended to be moulded to provide a form of contouring of the labial aspects of the rims. This method fell into disuse because of the arbitrary nature of the moulding procedure that also induced the patient to assume non-RCP posturing of the jaw, as well as having the same defects as those mentioned above.



Fig. 5 Atrophic mucosa: an efficient masticatory apparatus with an optimal FWS might result in trauma to the mandibular ridge — intentional increase in FWS might reduce trauma to the denture-bearing tissues of the mandibular denture

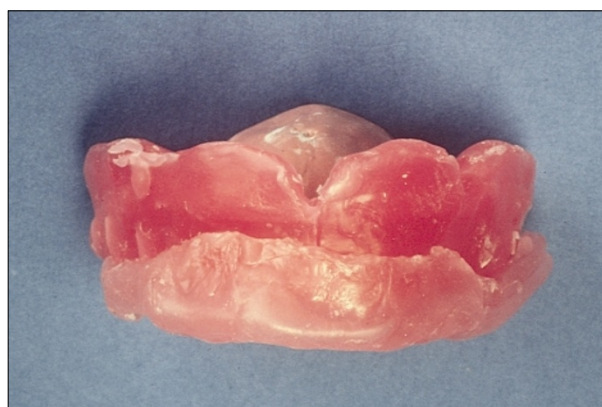
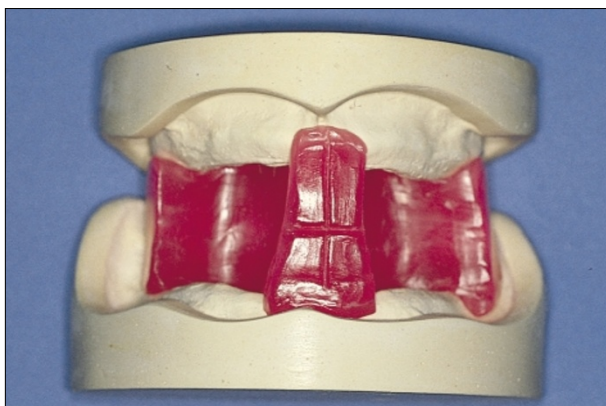


Fig. 6 Typical example of squash bite — insufficient definitions of denture geometry and form are prescribed

Fig. 7 T-block precursor to the squash bite and popular at the onset of the NHS



Wax rims

The conventional method that has a higher degree of success also involves the use of wax interposed between the rims to secure a registration. When the upper rim (aesthetic control base [ACB]) has been formed, and prescribed to suit the patient, the lower rim is placed in the mouth and trimmed until it contacts the upper rim evenly in RCP, at the selected OVD (Fig. 8). This is done by selectively removing points of first contact. These large wax rims may pose problems in inexperienced hands. Even in experienced hands it is not always easy to detect premature contacts along the lengths of the rims bilaterally.

For these reasons, a simplified lower rim has been developed in the University Dental Hospital of Manchester. It contains several elements

incorporated to ensure that the carefully established OVD is maintained, and that the bases are maintained in stable relationship to the underlying tissues during the procedure. The lower base has attached to it two pillars of wax which are situated in the region of the 2nd premolar/1st molar teeth positions (Fig. 9a and b). When the contacts, bilaterally, are even at the selected OVD, the rims may be sealed with registration paste or other such medium as regularly used.

This method using pillars attached to the lower base — which we call the Manchester block method — provides control over the OVD, ensures a stable relationship between the bases and the underlying tissues, and also provides a record that can be simply returned to the mouth to verify its accuracy. To obtain a functional impression of the labial component of the lower arch, carding wax, Plaster of Paris or PVS putty may be attached to the labial aspect of the rim and a closed-mouth impression used to determine the anterior denture-spaced form.

However, the drawbacks of this procedure comprise uncertainty of achieving the most retruded mandibular position, as well as a lack of information on eccentric mandibular movements.

Intra-oral tracing

Our preferred method of obtaining a consistent position of retrusion together with recognition of mandibular movement other than the final point of closure, is by means of an intra-oral tracing — often referred to as a Gothic-arch tracing. This method is based on rotation about the condyles when lateral mandibular excursions are made. When the mandible moves to the left from a central position, it rotates about the left condyle, and similarly, a right lateral movement causes rotation about the right condyle. Between each lateral excursion, the condyles assume their most retruded position (Fig. 10).

This technique uses two pieces of apparatus,

Fig. 8 Conventional upper and lower rims

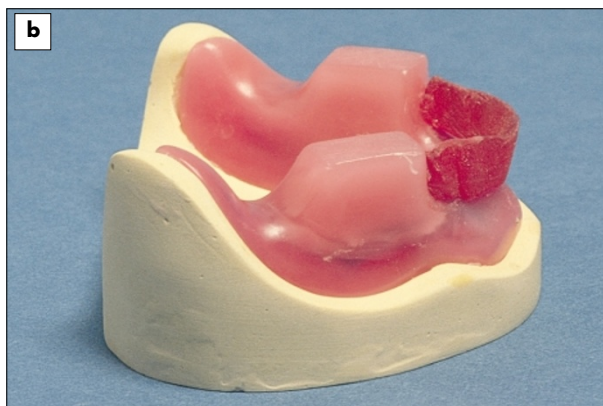
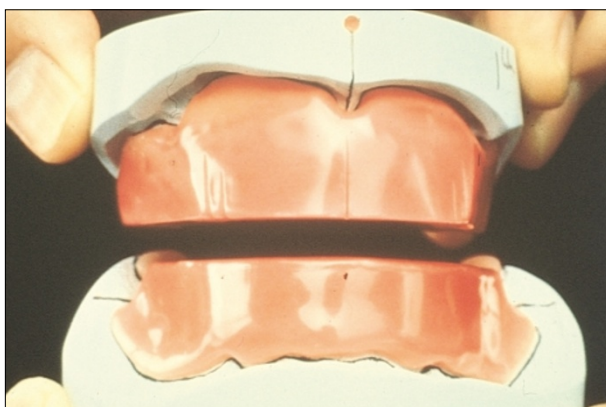


Fig. 9 a) 'Manchester' rims — to simplify complete denture registration technique; b) Addition of carding wax to the labial segment of the lower rim can help create a functional modelling of the denture space anteriorly

one for each arch, both mounted on rigid stable bases, usually made of light-cured polymethylmethacrylate (PMMA). The upper apparatus comprises a metallic plate that spans the maxillary arch. The lower has a bar containing an adjustable central-bearing screw (1mm thread) mounted on wax or compound 'pivots' added to a light-cured PMMA base (Fig. 11). The lower plate lies over the most stable pivotal areas of the arch. The adjustable central-bearing screw is made to contact the upper plate at right angles and at the selected OVD. The bases are adjusted so that no contact between them can occur and the patient can make lateral mandibular excursions with contact of the central-bearing pin on the upper plate only. The patient is requested to swallow, to indicate a 'central' (RCP) position, then asked to make three protrusive movements before returning to RCP. From RCP the patient is asked to make three left lateral excursions and then to return to RCP. Finally, the patient is asked to perform three right lateral excursions before returning to RCP. The patient should then be familiar with the two pieces of apparatus and the practitioner can then proceed to record the tracing. This is done by coating the upper plate with, eg ink from a felt tipped pen and then asking the patient to replicate the protrusive and lateral movements. The alternate lateral jaw movements scribe on the upper plate two arcs of rotation which intersect in a position corresponding to RCP. Clearly, it is from this point that an intersection (arrow-head) with the protrusive movement is also traced (Fig. 12a). To validate this position a perforated perspex cover slip is positioned with the perforation over the arrowhead and waxed in place. The patient is then asked to swallow and confirmation of RCP is achieved by the central bearing screw engaging the perforation (Fig. 12b).

This fixed registration records the vertical and antero-posterior intermaxillary relations. To record the coronal relationship, Plaster of Paris or PVS putty is then placed between the

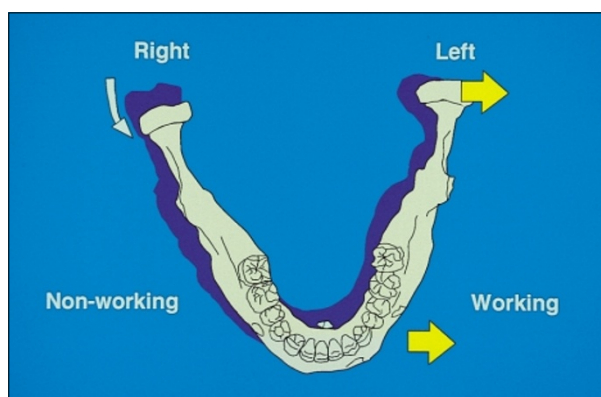


Fig. 10 Line drawing of occlusal view of mandible and arcs of movement about the condyles

bases and the central-bearing screws to ensure an unambiguous relationship (Fig. 12c).

Extra-oral tracing

The extra-oral tracing is somewhat similar to that of the intra-oral, except that the tracing apparatus is attached to plates that protrude between the lips. It is not considered to be as accurate as that of the intra-oral method for edentulous patients because the protrusion of the recording apparatus is so far forward of the pivotal area that tilting and/or deflection of the bases is likely.⁴ In addition, as this technique is not universally taught worldwide, it will not be described further.

Further considerations

When these three-dimensional intermaxillary registrations have been completed, they will be sent to the laboratory along with the ACB and facebow transfer to be articulated. While teeth have still to be selected (*see* Part 7) it is appropriate to consider briefly, the types of articulator on which the casts are to be mounted, as the proper adjustment of these may require additional records.

Articulators for complete dentures

The usage of articulators to enhance clinical practice has been the subject of a recent review⁵ and thus we shall confine our discussion to simple basic points.

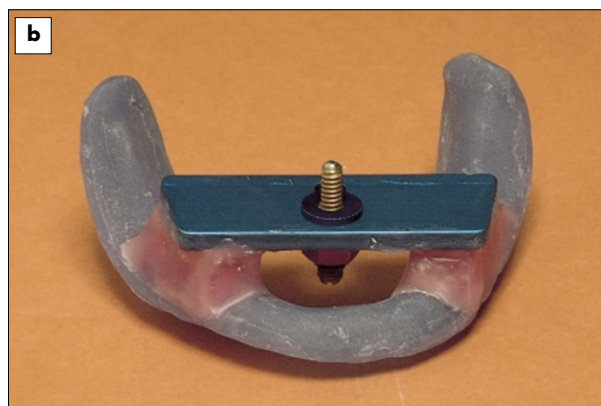


Fig. 11 Apparatus for measuring Gothic arch tracing. a) Upper base plate; b) Lower base, bar and central-bearing screw

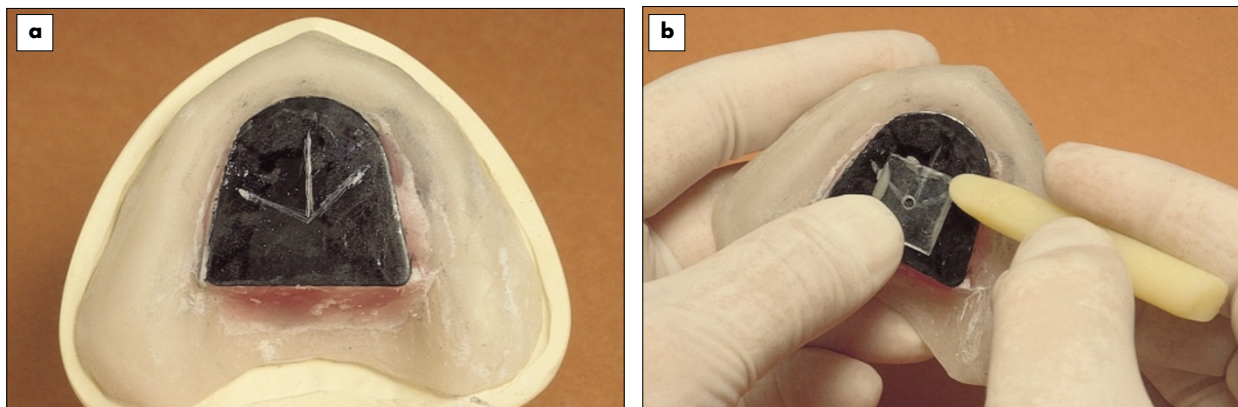


Fig. 12 a) Typical Gothic arch or arrowhead tracing of the mandibular movements
b) Perspex locator placed over the arrowhead point to confirm reproducibility of RCP
c) PVS putty moulded between the upper and lower bases to provide a coronal relationship



Articulators in common use for the production of complete dentures comprise (Fig. 13):

- Simple hinge (plane line)
- Moveable, fixed condylar path
- Semi-adjustable.

The simple hinge articulator allows the construction only of a centric occlusion, whereas the fixed condylar path instrument allows some approximate lateral and protrusive occlusion to be developed. The semi-adjustable articulator allows the establishment of more accurate or customised lateral and protrusive as well as centric occlusion.

Few simple hinge articulators have provision for accepting a facebow record so that this further limits their usefulness. Both the fixed condylar and the semi-adjustable types will accept facebow records, and, in addition, the more adjustable instruments accept protrusive and lateral interocclusal records to allow full benefit of their capability. Facebows improve the accuracy of occlusal development of these articulators. Facebows were discussed in Part 6.

With the maxillary cast mounted via a

facebow transfer and the mandibular arch related to the maxillary arch via the gothic arch tracing, the development of satisfactory eccentric (lateral and protrusive) occlusion and articulation is possible. In addition, small changes (2–3 mm) in the vertical dimension may be achieved on the articulator, should this be required, without the need for a new registration.

Helpful Hints

- 1 Determine what freeway space is appropriate for each patient.
- 2 Confirm RCP is reproducible.
- 3 Ensure the completed intermaxillary records are sealed together and are unambiguous.

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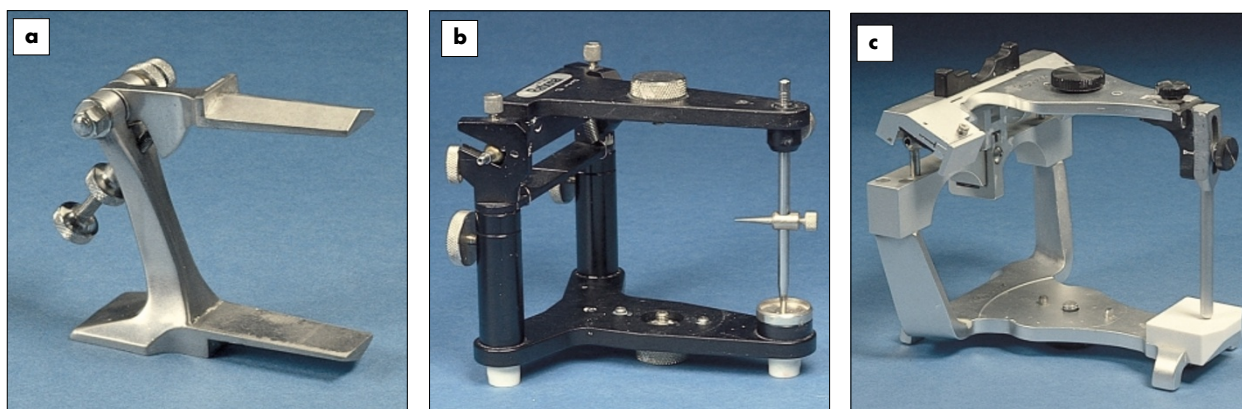


Fig. 13 a) Simple hinge articulator. b) Moveable fixed condylar paths articulator. c) Semi-adjustable articulator