

A positioning device for the edentulous mandible in extraoral radiography

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The long-term effect of different types of mandibular dentures on the resorption of the residual alveolar ridge of the mandible can be studied if a standardized radiographic technique is available. Therefore, it was decided to develop a reliable and reproducible method for fixation of the mandible. All techniques previously described fix the patient's head in a cephalostat and use earplugs and a nasion support. With all these systems the skull is reasonably fixed, but the mandible is not.

This problem can be solved by closing the mandible to the vertical relation of occlusion. If the patient wears complete dentures, however, this is useful only in short-term investigations when minimal resorption does not change the occlusion.

It is also possible that any metal parts in a mandibular denture may overlap the image of the jaw. Using rest face height as a fixed position for the mandible is advantageous in that a radiogram can be made without a lower denture. But, as is well known, the interocclusal distance varies and results in an irreproducible position of the mandible. Furthermore, as time passes there may be considerable and definite changes in the interocclusal distance of edentulous patients, as Tallgren,^{1,2} Carlsson and Ericson,^{3,4} and many others have demonstrated.

Therefore, it is necessary to give attention to the reproducible positioning of the lower border of the mandible since this part is not influenced by the resorption process.

A positioning device for standardized extraoral radiography of the edentulous mandible was developed to fulfill the following requirements: (1) stable fixation; (2) reproducibility of the position; and (3) applicability to different kinds of cephalometric techniques.

SPECIFICATION OF DEVICE

The device consists of three parts (Fig. 1) that can be firmly connected. These are (1) a mandibular support,



Fig. 1. Patient is installed in cephalostat. Mandibular support is connected to modified cephalostat by means of fixation unit. 1, Mandibular support. 2a, Ear fixation pins. 2b, Nasion support of modified cephalostat. 3, Fixation unit.

(2) a modified Wehmer cephalostat, and (3) a connection between the mandibular support and the cephalostat by means of a "fixation unit." The fixation unit permits a reproducible positioning of the support for the mandible in relation to the cephalostat.

The mandibular support

A perspex plate 17 cm wide, 13 cm long, and 1 cm thick, outlined in Fig. 2, supports the lower border of

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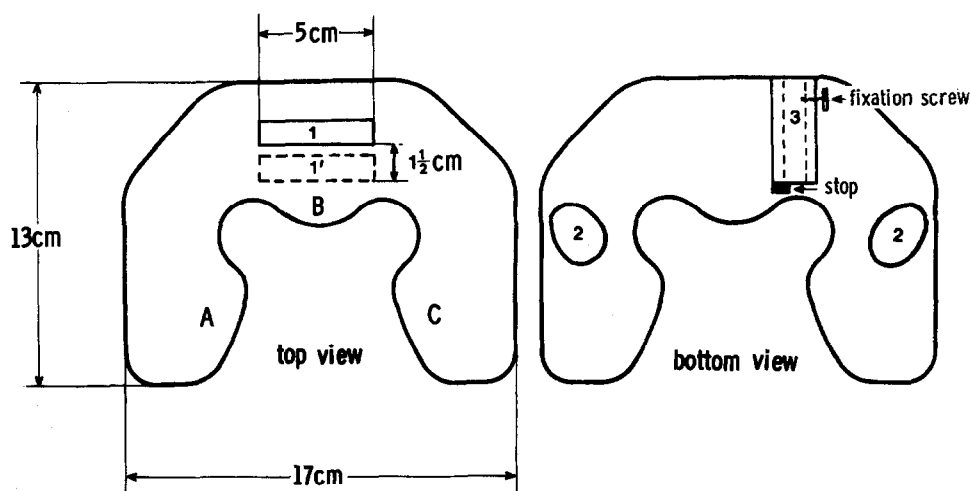


Fig. 2. Line drawing of mandibular support. **Top view:** 1 and 1', Vertical stop. A, B, and C, Regions of support for mandible. **Bottom view:** 2, Thumb grip. 3, Connection slide.

the mandible in three regions (Fig. 2, *top view*, A, B, and C). A 3.5 cm high vertical stop is added to guide the positioning of the frontal part of the mandible (Fig. 2, *top view*, 1). Underneath are two grips that aid the patient in exerting pressure on the desired regions (Fig. 2, *bottom view*, 2). A square slide is also attached to this side to hold the connecting steel bar of the fixation unit (Fig. 2, *bottom view*, 3). This connection is secured by a screw that fits into a center hole of the bar.

For patients who have a very small mandible there is another support on which the vertical stop is positioned 1.5 cm further posteriorly (Fig. 2, *top view*, 1').

The modified cephalostat

The original nasion support of a Wehmer cephalostat, type W 102, is replaced by an L-shaped metal bar (Fig. 3, 1). The horizontal part of this bar contains a groove into which a new adjustable nasion support is fitted (Fig. 2, 2). To the vertical end of the bar a fixation unit is attached for connection with the mandibular support (Fig. 3, 4 and 5).

The fixation unit

This unit is composed of a box containing four electromagnets (Binder, type 10320-05B, Brinkman and Germerood, Nelp, The Netherlands), each with a diameter of 5 cm (Fig. 3, 4) and a perspex "door" (Fig. 3, 5) hinged in front of the four magnets. This door contains a number of conical holes. It serves as a positioning aid for an iron disk 12 cm in diameter with a steel bar that can be connected to the mandibular support (Fig. 4). Each side of the disk has its specific

function. One side is flat for fixation to the electromagnets, and the other side has a cavity for holding a replaceable resin plate. Two notches in the plate correspond to buds in the iron disk to ensure that it is always fitted in the same way. The resin plate is fixed by a screw.

DIRECTIONS FOR USE

Sitting on an adjustable chair, the patient is placed in the cephalostat by means of the ear fixation pins. The porion-subnasal plane is kept horizontal. The head is secured in this position by the nasion support. For subsequent radiographs the position is read from a horizontal and vertical scale and recorded (Fig. 3, 2 and 3).

Holding the support with the disk, the patient is instructed to press it firmly on the lower border of the mandible and chin. During this positioning of the mandibular support the iron disk is free to move only in the space between the magnets and the closed door. This limitation of movements keeps the iron disk in a vertical position. The angle of the support in relation to the porion-subnasal plane varies but can be standardized to a preselected inclination (for example, 15 and 20 degrees) by making the patient open or close the mouth with the support in situ. These inclinations are indicated on the perspex door by colored lines (Fig. 1, 3).

The iron disk can now be fixed by switching on the electric current of the electromagnets, thus fixing the support of the mandible attached to the disk.

The position of the iron disk is recorded by a resin

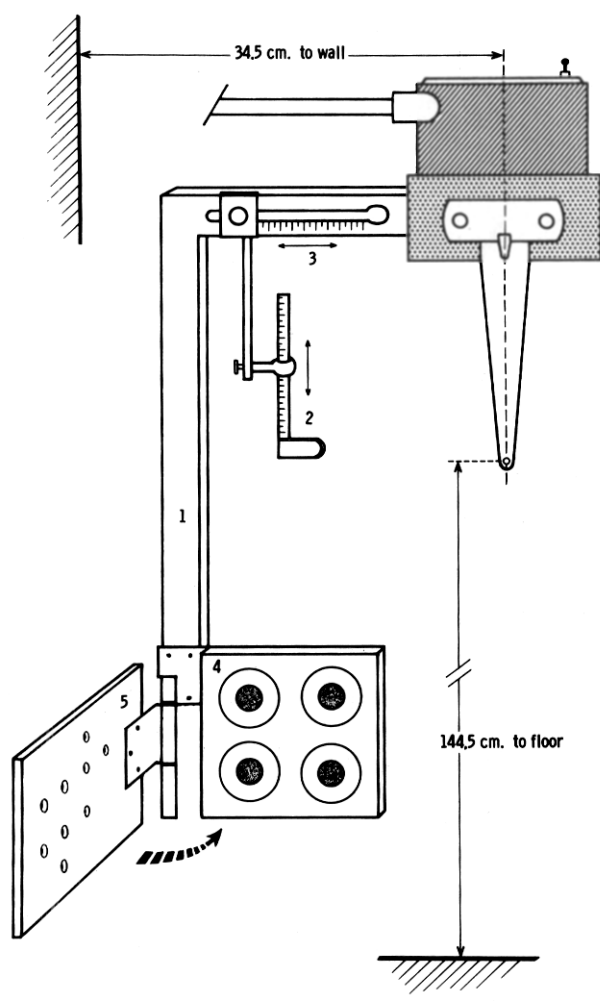


Fig. 3. Modified cephalostat. 1, L-shaped metal bar. 2, Vertical scale of nasion support. 3, Horizontal scale of nasion support. 4 and 5, Electromagnets and perspex door, parts of fixation unit.

plate in combination with two or three resin cones. The procedure is as follows.

1. The hollow side of the disk is filled with a prefabricated resin plate (Fig. 5, left).

2. The resin cones are put into corresponding holes in the perspex door.

3. After the addition of some fast-curing resin to glue the cones to the plate, the door is closed.

This results in an individual key for the repositioning of the mandible (Fig. 5, right).

For subsequent radiographs the patient is reinstalled in the cephalostat again with the ear fixation pins and nasion support. The nasion support is placed according to the formerly recorded position. The disk is positioned with the resin cones fitting into the holes of the

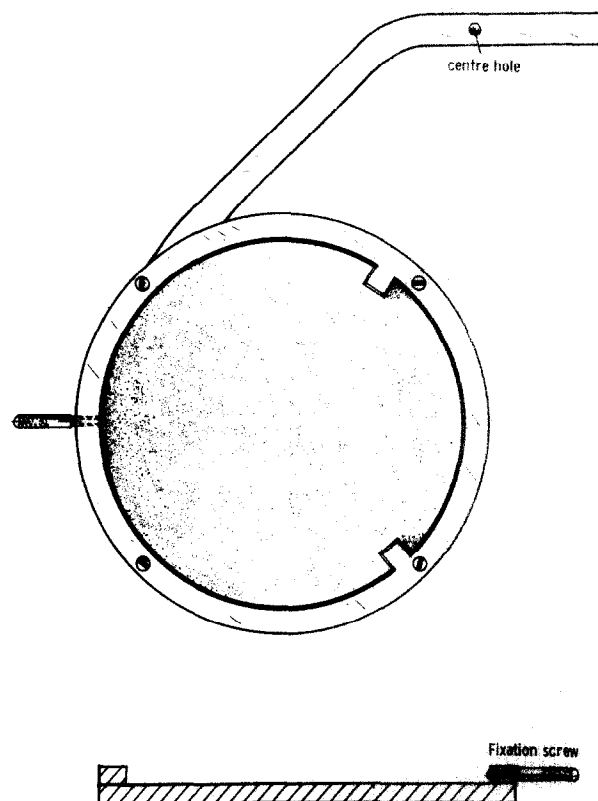


Fig. 4. Iron disk with connecting bar. Side with cavity to hold resin plate is shown.

perspex door. After this door is closed the electromagnets are switched on, thus fixing the disk in the same position as before. The mandibular support is now connected to the disk, and the patient is instructed to exert equal pressure on it with his mandible and chin. The exposures can now be made.

DISCUSSION

The advantage of the electromagnet fixation system is the complete freedom of movement of the mandibular support in a vertical plane during the positioning of the patient.

There are two reasons for using more than one magnet to hold the disk.

1. One magnet cannot prevent a disk from rotating and sliding, even when only small forces are exerted. At least two magnets are necessary to eliminate easy sliding.

2. Differences in the anatomy of patients cause different positions of the disk. Therefore, a larger magnetic field is necessary to ensure at least two active magnets in any situation.

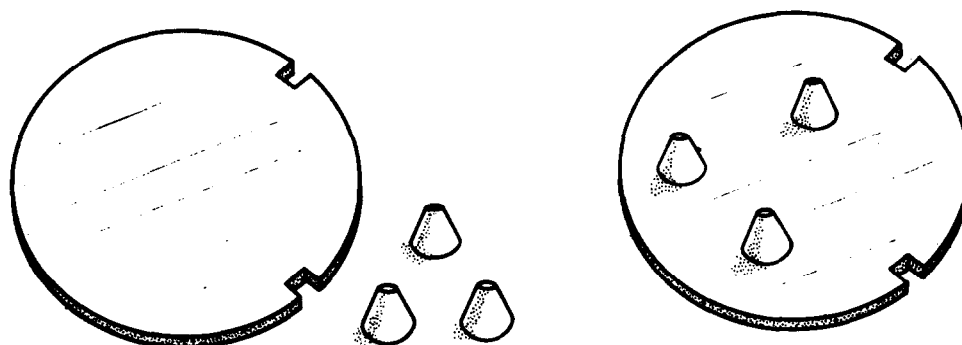


Fig. 5. Left: Prefabricated resin plate (see Fig. 1, 3). **Right:** Resin cones provide key for repositioning mandible (see Fig. 1, 3).

This individual resin reproduction key makes it easy to reposition the edentulous mandible for a series of radiographs. The construction of such a reproduction key takes approximately 15 minutes. The support described permits the patient to exert uniform pressure on it. Minor deviations appear, however, due to the resilience of the soft tissues around ear and nasion fixation. Errors due to these deviations in the positioning of a patient's mandible are under study and will be presented in another article.

SUMMARY

An apparatus to improve the reproducibility of positioning the edentulous mandible for taking extra-oral radiograms was developed.

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