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AN ANALYSER FOR PRE-OPERATIVE PLANNING IN CASES OF JAW ANOMALIES

by

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INTRODUCTION

For the operative correction of more serious cases of mandibular protrusion, open bite and jaw asymmetries one can distinguish two main procedures according to whether the section is performed in the ramus ascendens or in the corpus mandibulæ. The site of the section on the ramus is generally between the foramen mandibulæ and the incisura mandibularis (*Kostecka*, 1928; *Lindemann*, 1943; *et al.*) or in the collum (*Berger*, 1897; *Dufourmentel*, 1929; *et al.*). After sectioning, the mandible is moved into the desired position. When the section is made in the corpus (*Hullihen*, 1849; *Blair*, 1906; *Ernst*, 1934, 1938; *Dingman*, 1944; *et al.*), as large a piece of bone is removed as will give the required result. Among the great number of types of operation the former method is just now the most commonly used in Europe.

It would contribute immensely to the chances of a successful operation if a close study were made on the casts of the jaw relationship obtained before the operation and of the relationship that would result from the intended osteotomy. Some procedures for such an analysis have been reported.

It is, nevertheless, our opinion that this important preparation for the operation has received too little attention. This may have

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its explanation in the fact that these cases are often treated by surgeons alone, for whom the emphasis is naturally on the operation itself. In Sweden, however, the treatment is mainly in the hands of specially trained dentists and plastic surgeons working in close collaboration. This might account for the importance that, in this country, is attached to the pre-operative analysis (see, for example, *Thourén*, 1945).

EARLIER PROCEDURES OF PRE-OPERATIVE ANALYSIS

Members of the Vienna school during the time of *Pichler* modelled the individual shape of the corpus mandibulæ and the ramus ascendens by reference to the casts, and guided by radiographs. By performing the operation on the cast it was then possible to decide upon the most suitable direction of section; that is to say, the direction which resulted in the greatest area of contact of the bone ends after the lower jaw had been set in its new position.

It was feared that if there was no definite relation between the vertical dimension in the position of occlusion and the length of the ramus ascendens, a diastasis would result with consequent impairment of the healing process; or else there would be an overlapping of the bone ends with the risk of increasing the rotation of the upper fragment in a cranio-ventral direction. The malplacement of the upper condylar fragments might, it was thought, interfere with the functioning of the temporo-mandibular joint.

To avoid these dangers a number of involved geometric analyses have been suggested, all of them, however, highly imaginative and of little practical value.

In his pre-operative planning in cases of mandibular protrusion, *Thourén* (1945) worked with a Gysi adjustable articulator. By means of a sliding joint in the upper part, this was modified so as to permit purely horizontal sagittal movement of the upper cast. *Thourén* repeatedly stressed the importance of this "cast operation".

After the performance of the osteotomy the large mandibular fragment, however, is freely suspended in the muscles, ligaments, etc. The setting of the mandible in its new position will thus seldom entail a purely horizontal movement. It will

instead be more as if the mandible were "felt" into position against the upper jaw by a free-hand manipulation.

The disadvantages of a free hand procedure are, however, obvious. No idea is obtained of how great the movement is, whether it is perfectly horizontal or whether there is a tipping or rotation of the mandible. Malplacement and distortion may result; for instance, in respect of the anguli.

To further the development of a method which, while retaining the possibility of manipulation of the lower jaw, eliminates the disadvantages of this free-hand procedure and registers what actually takes place, the authors in collaboration with G. Öqvist¹ have designed an analysing instrument that enables movements in any direction to be measured. The analyser described is the third in an experimental series. Used in some thirty cases, it has proved to meet the demands that might reasonably be made of such an instrument.

DESCRIPTION OF THE ANALYSER

The instrument is made up of five principal components: the *table*, the adjustable *lower component*, the *upper component*, and the *osteotomy indicator* (Figs. 2 & 3). The table and the upper component are connected by a pair of cylindrical upright posts.

The *table* consists of a triangular plate with rounded corners. It stands on three feet. The centre is cut away so as to provide an area of movement of about 750 sq mm for the bolt in the centre of the lower component (Fig. 1). Near the posterior edge of the table the two posts are fixed, these supporting the upper component, and beside each post is a millimetre scale in the form of a rectangular area of engraved parallel lines in two directions at right angles. These provide the means for reading off the horizontal movement of the lower component 0—25 mm dorsally and 0—15 mm laterally and medially (HORIZONTAL REGISTRATION) (Fig. 1).

The *lower component* consists of a plate which is free to slide on the table and which may be locked to it in any desired position by means of a screw. There is also a mounting for the cast

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of the mandible. (Fig. 2). On the horizontal part of the lower component are two flat metal plates leaning a little backwards from the vertical. In size and form these correspond to the rami ascendentes between the anguli and teh sites of the osteotomy. (Fig. 2.) When the lower component is in its most ventral position and symmetrical in the median plane the pointer on each "angulus" indicates a horizontal registration of zero.

The *upper component* is a plate with mounting for the maxillary cast. In the front part of the plate and perpendicular to it is an incisal pin, the lower end of which rests on the table. The upper component is hinged to the intercondylar axis and this is connected through two drum-shaped joints to the posts (Fig. 2). These joints have been designed to permit rotation of the upper cast about an axis that passes medially and horizontally in a dorso-ventral direction.

The *two posts* consist each of a cylindrical tube and a closely fitting rod. The tube stands upright on the table, and the rod is threaded to provide for vertical adjustment. The rods being calibrated in millimetres (VERTICAL REGISTRATION) (Fig. 3) it is possible to record the raising and lowering in the molar regions that may be necessary in order to obtain better occlusion and/or aesthetic conditions in the angulus regions or for the correction of various lengths of rami or angles of the anguli.

Osteotomy indicator. (Fig. 4 on page 76). This measures the optimal direction of osteotomy in relation to the occlusal plane of the mandible. If a shortening of the ramus is desired — *i.e.*, if cranio-dorsal displacement of the angulus would be favorable — the plane of osteotomy should be inclined in the ventral and caudal direction in relation to the mandibular occlusal plane. If a lengthening is desired, the osteotomy plane should be inclined in the dorsal and caudal direction in relation to the occlusal plane. At each side of the upper component and intercondylar axis is a part that represents the condyle — through which passes the axis —, the processus muscularis and the site of osteotomy. The part corresponding to the site of osteotomy consists of a circular disc 3 cm in diameter, which is about the width of the ramus in this regions. The disc is in two halves; one of them is fixed to that part of the upper component that represents the upper part of the ramus with the condyle; the

second half of the disc is fixed to that part of the lower component that corresponds to the lower part of the ramus. The slit between the two halves of the disc represents the osteotomy.

The two parts of the disc are movable and the slit between them may be rotated through a maximum angle of 45° sagittally, so that it is inclined ventro-caudally or ventro-cranially. In the initial position the slit is placed parallel to the occlusal plane. For a given displacement of the mandible it is possible to read off the best direction of the osteotomy by turning the halves of the disc so that they are in contact with one another. What occurs when the upper fragment is for some reason displaced forwards is also indicated since the "processus muscularis" is freely connected to the upper component.

The main function of the osteotomy indicator is to indicate the relative positions that the fragments will assume when the mandible is corrected. If regard is paid only to the desired — or possible — position of occlusion and this would require a dorsal displacement of, for instance, 2 mm on the left and 15 mm on the right side, with the incision inferior in the median plane, it would be necessary to move the angulus and ramus parts 10 mm to the left. This would imply a very extreme alteration in the form of the face with a very convex left side and quite a flat right one. This is infallibly registered by the analyser. If, on the other hand, an asymmetrical face is to be corrected, it is possible to calculate, with sufficient precision for clinical purposes, what may be possible without reducing the chance of healing of the bone and restoring the jaw relationship.

To provide for measurement of the changes of the lower dental arch after the osteotomy *an instrument measuring in three dimensions* (Fig. 11) may be added to the upper part of the analyser. It consists of three vertical rods with points projecting from the plane ends. These rods may be moved into the desired position in the vertical plane since they are supported in tubes. The locking is done with a nut. The movements in the horizontal plane are effected in two mutually perpendicular slides. In this plane no locking is possible, the rods running less freely due to balls and springs mounted in the slides.

The registration is made by marking the lower model with suitable reference points that are easy to find on other occasions.

The number of reference points depends on the appearance of the remaining teeth and what it is desired to register. It may be of interest to record, for example, the perpendicular migration of the lower incisors resulting in a reduction of the inclination and the widening of the dental arches after the operation (*Hogeman*, 1951; pp. 65, 66). By making new lower models and recording the actual centric relation at each follow-up examination, any movement of the reference points may be measured in three planes.

This part of the analyser is of scientific rather than clinical interest.

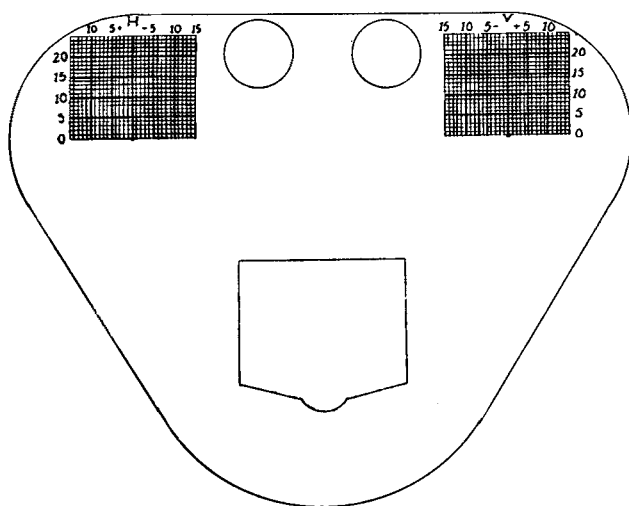


Fig. 1. The table of the analyser.

DISCUSSION

It might be objected that the described analyser is a mean value instrument in respect of the height of the rami ascendentes, the distance between the anguli, and the angle between the corpus and the ramus. As far as our experience allows us to judge, however, this is by no means a drawback. We have accordingly accepted this type after having worked with an analyser permitting many more individual adjustments. The fully

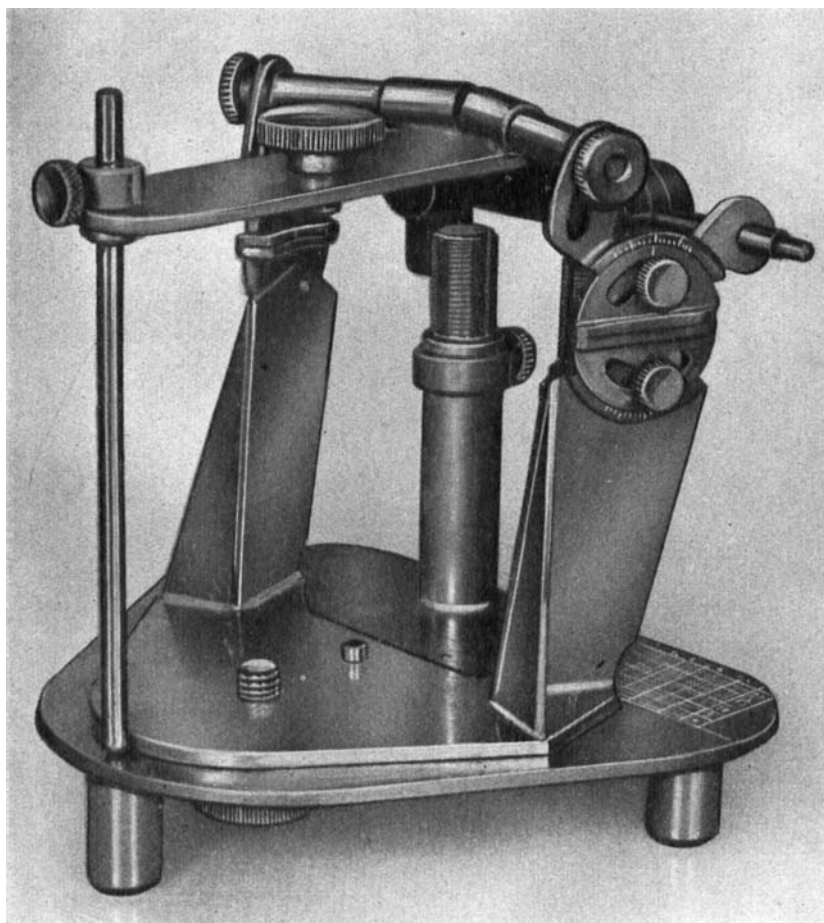


Fig. 2. The analyser in the zero position.

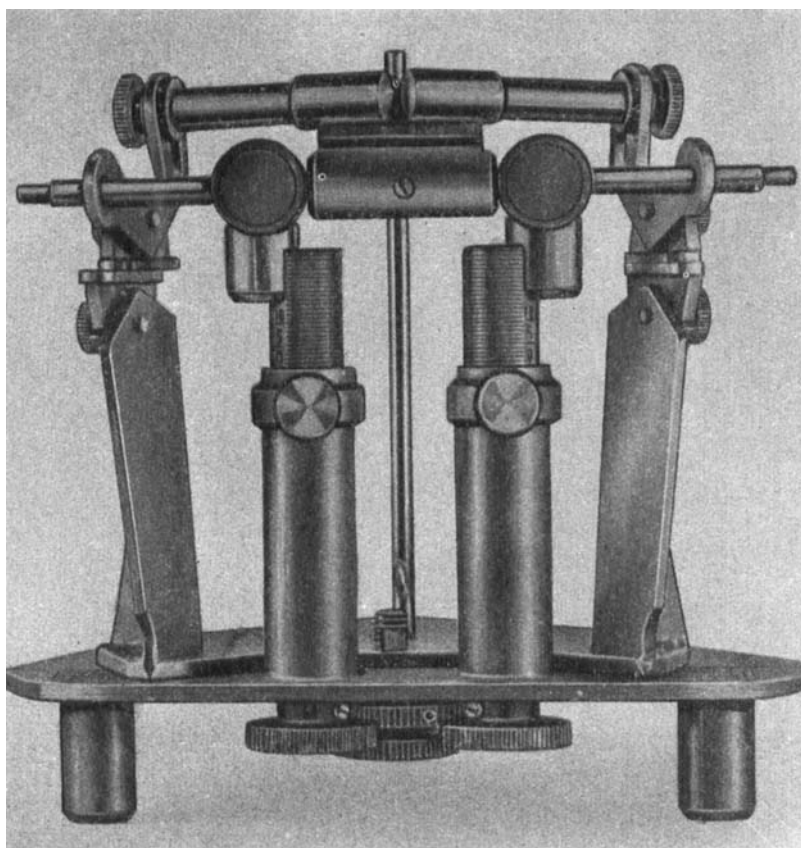


Fig. 3. Back view of analyser.

Fig. 5. Case with teeth in the preoperative centric relation (the zero position on the analyser table).

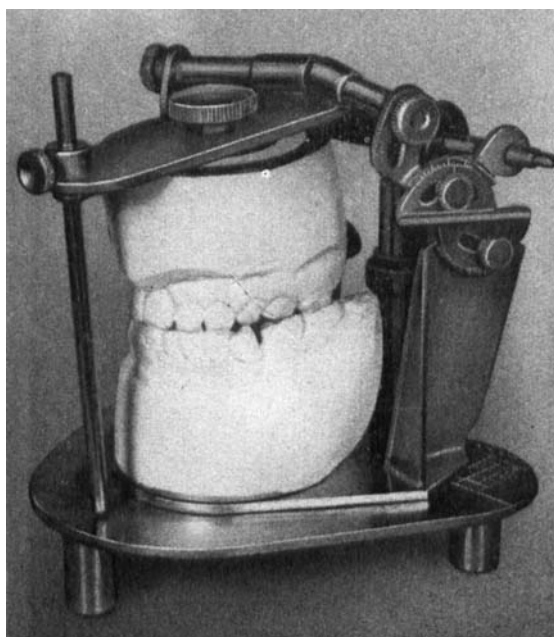
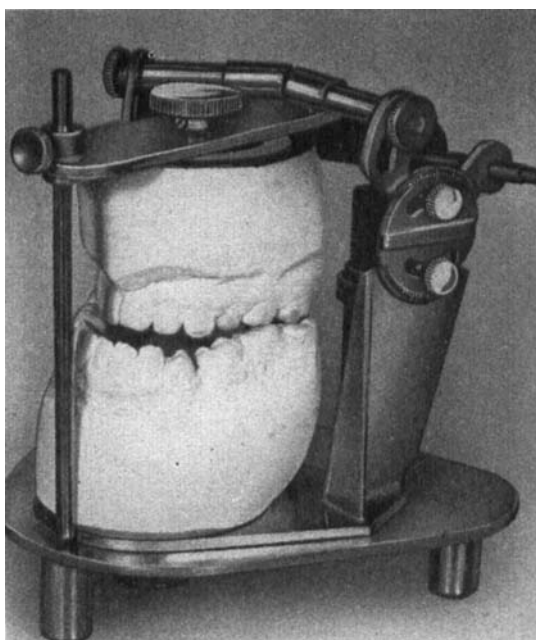


Fig. 6. Same case with teeth in the planned position.

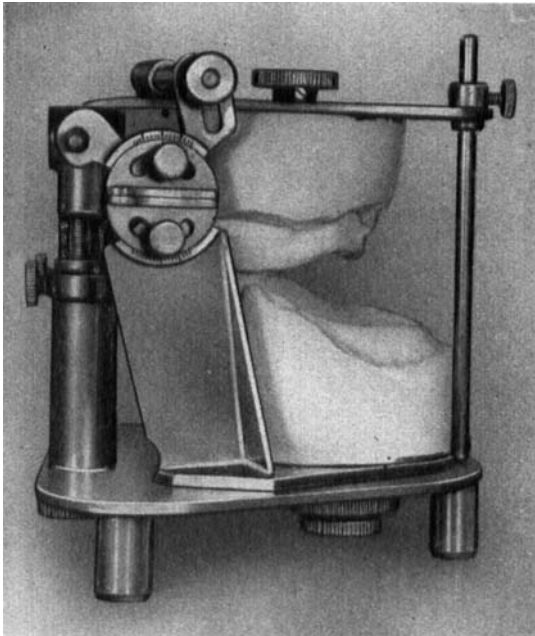


Fig. 7. Edentulous case in the preoperative centric relation (the zero position on the analyser table).

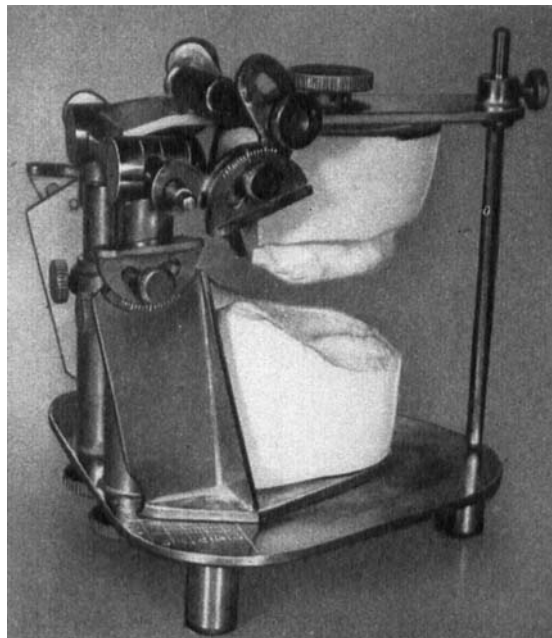


Fig. 8. Edentulous case moved to optimum alveolar ridge relation. The osteotomy indicator illustrates the bone contact after the operation.

Fig. 9. Same edentulous case moved to acceptable alveolar ridge relation. The osteotomy indicator illustrates the bone contact after the operation.

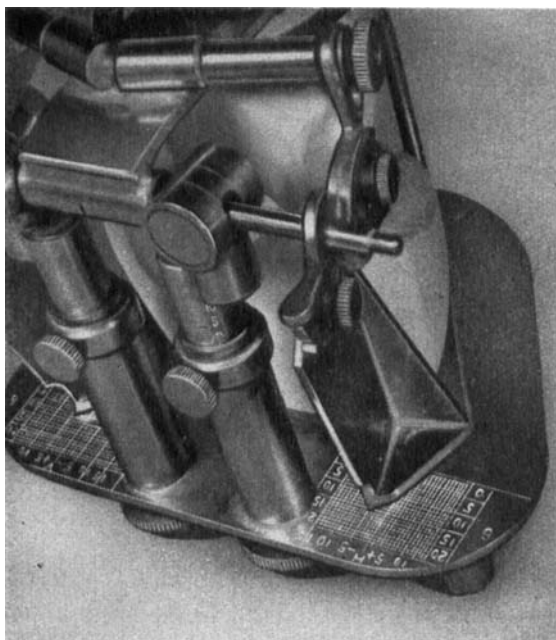
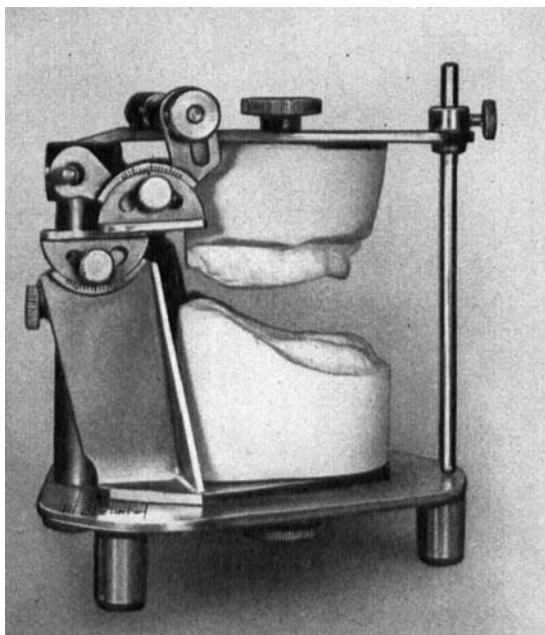


Fig. 10. Same case as above. The horizontal registration shows on the right side: dorsal movement 16 mm, medial movement 5 mm.

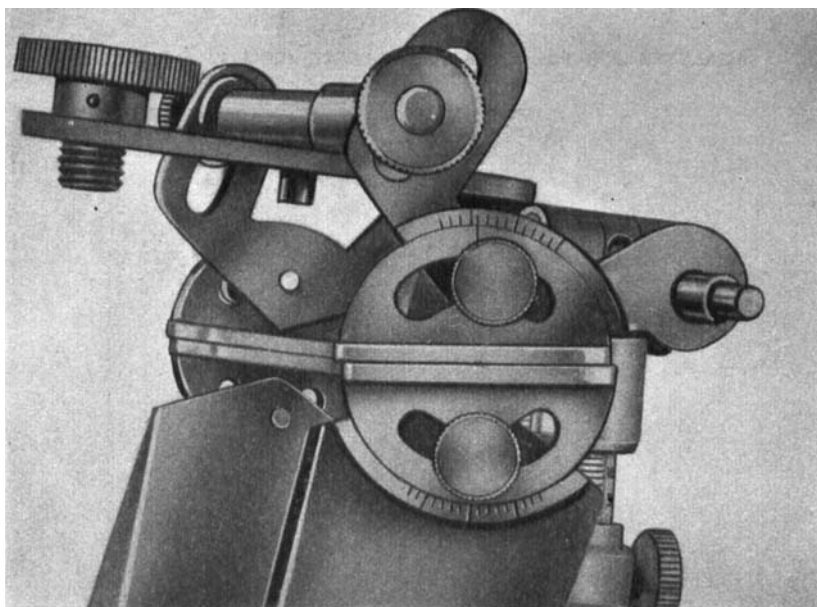


Fig. 4. The osteotomy indicator.

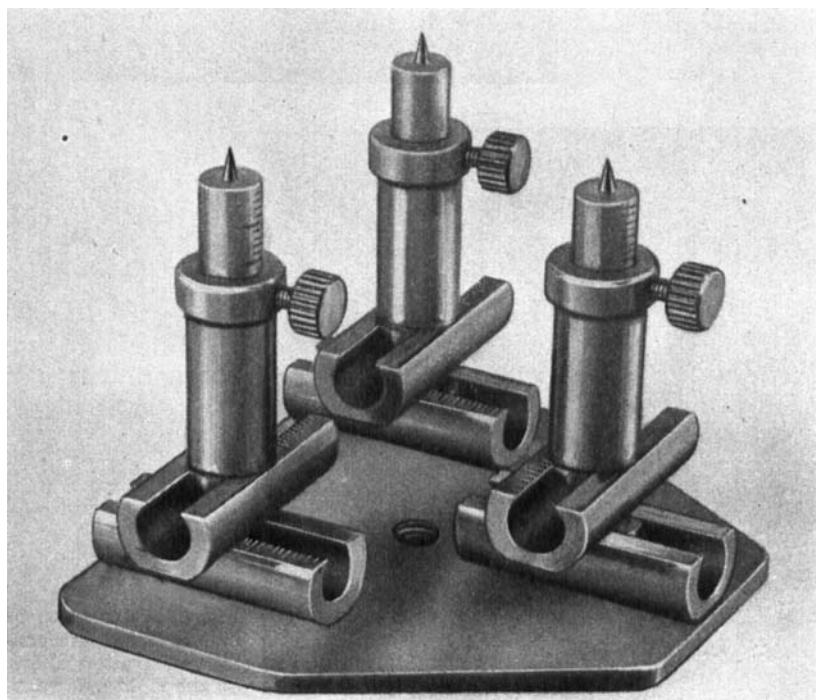


Fig. 11. Instrument for measuring migration of teeth in the lower dental arch after the operation.

individual instrument provided, as far as we can see now, no information about the case that the simpler type reported here does not give, although the technique was considerably more laborious.

SUMMARY

An analysing instrument is described for preoperative analysis on the casts of more serious anomalies of the jaw — such as mandibular protrusion and jaw asymmetries and open bites. It is so designed that the mandibular cast may be moved in any desired direction and measurements can be recorded of the movements executed. Any changes in the mandibular dental arch can be registered after the osteotomy.

ZUSAMMENFASSUNG

EIN ANALYSATOR FÜR DIE PRÄOPERATIVE PLANUNG BEI FÄLLEN MIT KIEFERSTELLUNGSANOMALIEN

Die Verfasser beschreiben einen Analysator für präoperative Analyse schwererer Kieferstellungsanomalien sowie mandibuläre Protrusionen, Asymmetrien und offener Biss. Er ist so konstruiert, dass der Unterkiefer in jeder gewünschten Richtung verschoben werden kann und Grössenmasse der Verschiebungen erhalten werden. Auch können eventuelle Veränderungen am Zahnbogen des Unterkiefers nach der Operation registriert werden.

RÉSUMÉ

UN ANALYSEUR POUR ANALYSE PRÉ-OPÉRATIVE D'ANOMALIES MAXILLAIRES

Les auteurs décrivent un analyseur pour analyse pré-opérative d'anomalies plus prononcées de la position maxillaire telles que protrusions mandibulaires, assymétries et béances buccaux. Il est ainsi construit que la machoire inférieure puisse se déplacer dans toute direction désirées et que les mesures s'en obtiennent, si grands soient les déplacements — on peut également enregistrer d'éventuels changements de l'arc de la machoire inférieure après opération.

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