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BONE-LEVEL DETERMINATION IN THE LATERAL REGIONS OF EDENTULOUS JAWS

A NEW X-RAY CEPHALOMETRIC TECHNIQUE WITH APPLICATION OF OBLIQUE 45° PROJECTION AND METALLIC IMPLANTS

by
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INTRODUCTION

The morphological changes in the jaws after tooth extraction and the wearing of dentures have hitherto been studied longitudinally be means of x-ray cephalometric technique with the application of lateral projection (*Atwood*, 1957, 1962; *Hedegård*, 1962; *Wictorin*, 1964; *Carlsson & Persson*, 1967; *Carlsson, Bergman & Hedegård*, 1967; *Carlsson, Ragnarsson & Åstrand*, 1967). The image sharpness of radiographs using this projection depends on the relation of structures to the median sagittal plane. Thus, whereas a useful reproduction is obtained of the anterior parts of the jaws, the varying distances of the lateral regions to the median plane of the head results in a reproduction of these areas with an overlap of the two sides, with increased blurring and creation of double contours in the distal parts. Consequently, these investigations have in most cases been limited to the anterior parts of the jaws, and in only one investigation have attempts been made to study the changes in the lateral regions of the lower jaw (*Carlsson, Ragnarsson & Åstrand*, 1967).

Both sides of the jaw can be studied separately by means of a projection where the median sagittal plane of the head is turned at an angle of 45° to the film plane (*Margolis*, 1940; *Cartwright & Harvold*, 1954). In exposures

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at this oblique angle, the premolar and molar regions will be reproduced without considerable overlap from other structures.

The image of the jaw area with this projection differs from the lateral one by its lack of a joint median sagittal plane. The structures will be reproduced with varying distortion, depending on their distance from the film plane. An investigation of the magnitude of the distortion within the jaw area has proved that it need affect the dimension of the image only to a low degree — in the lower jaw with a magnitude of up to 5 %, in the upper jaw of up to 8 % (*Barber, Pruzansky & Kindelsperger*, 1961).

The oblique 45° projection has previously been used as a supplement to the lateral projection, mainly for clinical studies of molar eruption and for evaluating the results of serial extraction therapy (*Barber et al.*, 1960; *Graber*, 1966), and for comparative studies of the interrelationship of a number of structures in the lower jaw (*Hatton & Grainger*, 1958, *Israel*, 1966).

On the other hand, this projection does not seem to have been used for longitudinal studies, although radiographs of the jaws with oblique projection have the advantage of a large image area and a reproduction with a distortion of the same or smaller magnitude than in the lateral projection. The varying size of the distortion implies in longitudinal studies that the structures in question must be maintained in constant relation not only to the focus of the x-ray tube and to the film plane, but also to the central ray. The technique also requires special measures in other areas, since a deviation from lateral projection involves the disappearance of the anthropometric measuring points employed till now. The application of metal implants is an obvious solution, since their value as reference points has been proved in studies of the growth pattern of the jaw skeleton (*Björk*, 1955, 1963, 1964).

The purpose of this paper is 1) to describe a reproducible radiological technique using the oblique 45° projection, and 2) to analyze periodic exposures with this technique using implants, in order to evaluate the application of oblique cephalometric radiographs to longitudinal studies of the jaws.

MATERIAL AND METHODS

7 men and 8 women were used for the present investigation.

These persons were chosen with a view to later investigation of the influence of the bilateral free-end saddle denture on the lower jaw. Selection was made between patients who attended the School of Dentistry at Aarhus during 1965. The following criteria were applied in their selection:

1) The general state of health of the patient had to be good judging from the case history and the clinical inspection.

2) The upper jaw must have been edentulous for at least one year, and have been provided with a full denture during the edentulous period.

3) In the lower jaw an entity of remaining teeth had to be present, at most from 5— to —5, at least from 3— to —3. After completed periodontal treatment, the marginal bone had to support at least 50 % of the rooth length, estimated from intra-oral radiographs. The single teeth should not show increasing mobility.

4) The patient should have had instruction in periodontal care, and should be able to show a clinically sound gingiva after six months control.

14 of the patients fulfilled the above mentioned criteria. The 15th, a 77-year old man, had an entity of remaining teeth consisting of 3+, 4 and 3—3. 4, 3— and —3 carried a fixed bridge replacing 2, 1—1, 2.

Implant technique

After previous x-ray examination of the jaw skeleton, each person was supplied with ten implants of tantalum (dimensions 0.5×1.5 mm, one end pointed) in agreement with earlier descriptions (*Björk*, 1955, 1963). Five implants were placed in the mandible: one in the mid-line of the submental region, two bilaterally below the apex of the canine or first premolar, and two bilaterally below the temporal line of the mandible in the retromolar area. In the upper jaw, an analogous position was chosen in the subnasal region, bilaterally in the canine area, and bilaterally in the distal parts of the tuber-area. Where the position of the maxillary sinus did not allow the placing of the posterior implant, an alternative position was chosen in close relation to the implant in the canine area.

After insertion of the implants a radiographic control was made of their position. Most of the implants turned out to be stable during two months of observation. Only in two cases was loosening and migration with later rejection observed, apparently because the implant had been placed at an nsufficient bone depth. In these cases, new implants were inserted.

Radiographic technique

During exposures the subject was placed in a modified Evald cephalostat (*Harvold & Rølling*, 1962). The position of the head was controlled by adjustable stabilized nose and neck rests which were engraved with millimeter scales in order to enable a reproducible position of the rests to be

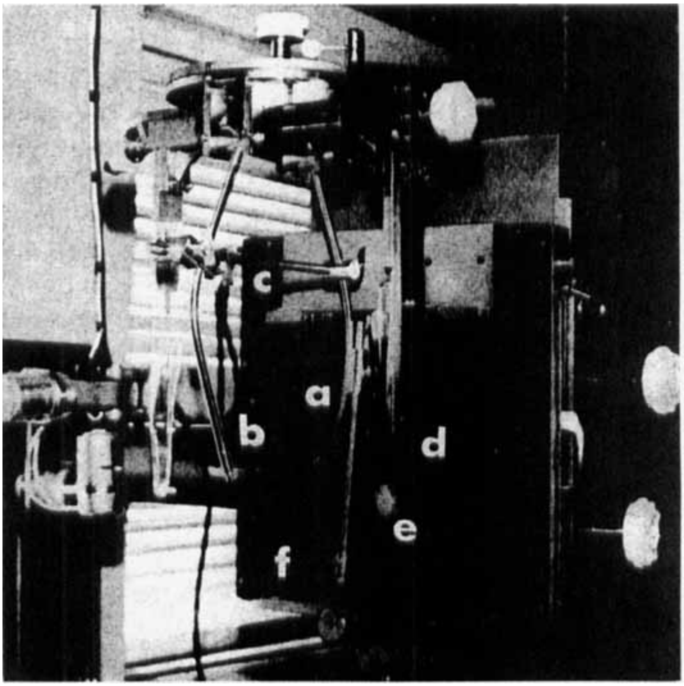

Fig. 1. Supplementary equipment of the cephalostat. a) adjustable nose rest, b) adjustable neck rest, c) transversal strengthening bar ensuring positional stability of the rests. d) stabilizing metal plate in position on holder of the ear rod, e) removable ear plug, f) adjustable chin rest.

obtained. (Fig. 1, a-b-c). Rotation of the head was prevented partly by strengthening the vertical arms carrying the ear rods with metal plates (Fig. 1, d) and partly by using individual acrylic ear plugs with close fit to the ear holes and the ear rods. (Fig. 1, e). The horizontal arms, carrying the ear rods, were provided with millimeter scales to control the position of the latter in relation to the median plane. The position of the lower jaw was controlled by an adjustable chin rest with similar engraved scales on its horizontal and vertical arm (Fig. 1, f). The lower jaw was immobilized with an individual acrylic base-plate fitted to the upper jaw, with contact areas against the retromolar pad areas and the incisors. While in contact, the jaw was held in its retruded position at a level corresponding to bite height.

To ensure corresponding positions for both sides of the jaw in the oblique projection, the following procedure was used:

The patient was seated in a hydraulic chair with the face turned to the film and the median plane of the head aligned in the direction of the central ray. The ear rods of the cephalostat were kept in a tight, but not unpleasant position for the subject, in alignment with the upper wall of the ear holes. The Frankfort plane was kept horizontal by marking the porion and the orbitale on the skin and by orientating the marks with respect to a horizontal beam of light projected across the face. This position of the head was maintained by the nose and neck rests. Impressions for the acrylic ear plugs were then made with alginate by re-setting the ear rods to their former position.

This frontal position was used as the initial position and adjustment to the oblique projection was established by turning the axis of the head and body 45° to the right or to the left. In all cases, the right side was exposed prior to the left.

X-ray equipment with fixed tubus, rotating anode and fixed focus was employed. Further, a constant film-focus distance of 168 cm and a constant distance of 18 cm between the film plane and the median plane of the cephalostat was used. The exposure varied between 65 and 80 kV, at 200 mAs for 0.6 sec. To reduce secondary radiation a primary diaphragm of lead with an opening of 5×5 mm was used, only permitting exposure of the jaw skeleton. A reproduction of the mandible with a definite demarcation between radiopaque and radiolucent structures was hereby obtained. The strong filtration of secondary radiation in the maxillary area resulted in several exposures with too weak a contrast. In these cases, supplementary exposures were made with a reduction of 5—10 KV.

Kodak Blue Brand films were used. These were exposed in aluminium casettes mounted with high definition intensifying screens with a 2 mm lead foil backing in order to absorb the x-rays and to avoid secondary exposure of the film (*Harvold & Rølling*, 1962), A »fine-grain» developer (Gevaert G. 230) was used for 5 min. at 21°C. Fig. 2 shows the size of the reproduced area of the jaws.

The oblique projection involved shading of the peripheral parts of this area, mesially by the opposite ramus of the mandible, and distally by the upper servical vertebrae. Due to the reduced secondary radiation, the main contours of the jaw skeleton could still be determined in most of the shadowed area (Figs. 2 and 3).

Measuring technique

The measurements were carried out directly on the cephalogram, and the values applied at the ensuing analysis were mean values determined after

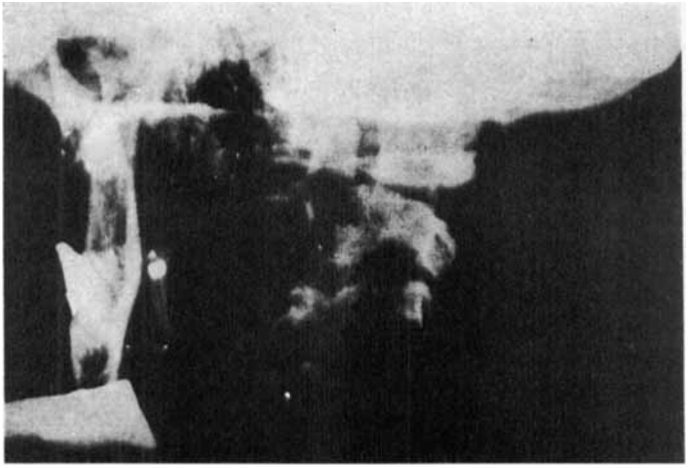

Fig. 2. A 45° oblique radiograph demonstrating the extent of the image area and the position of the implants.

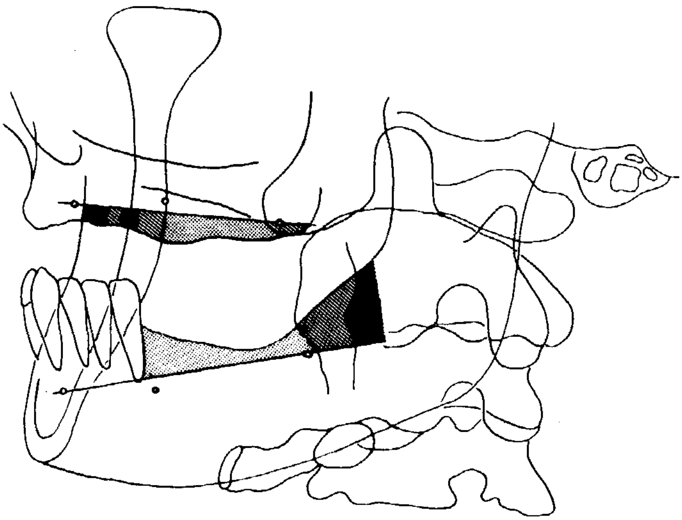

Fig. 3. The reproduction of alveolar bone level with 45° oblique projection. Pointed areas indicate sections reproduced without any interference from bony structures. Hatched areas indicate sections with an insignificant degree of interference. Cross-hatched areas indicate sections with a degree of interference making a safe delimitation of the alveolar bone level impossible.

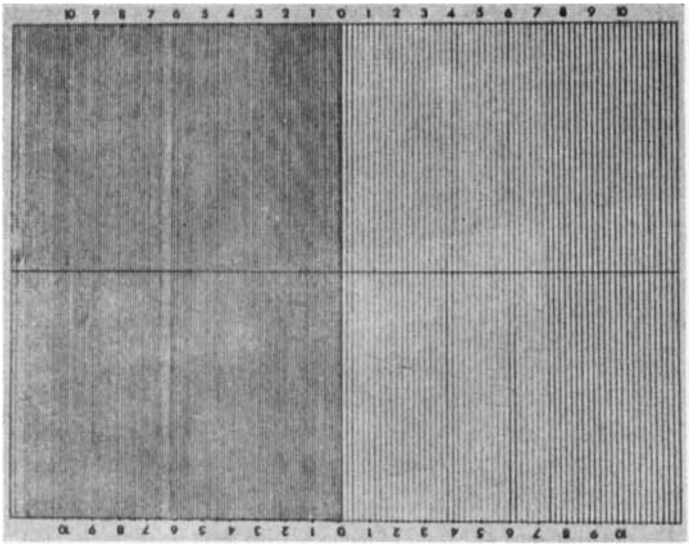

Fig. 4. Measuring sheet.

duplicate measurements. For the present work, a spreading caliper with a dial gauge, with a reading accuracy of 1/10 mm was used. Use was also made of a sheet of cellophane with a traced system of coordinates. Parallel with its y-axis a number of accessory lines were traced, dividing the system of coordinates into two parts, with a line interval of 1.0 and 2.0 mm respectively (Fig. 4). The sheet could be accurately orientated by means of the implants on the cephalogram, using its x-axis as a reference line and the zero point of the system of coordinates in a definite relation to one of the implants.

The accuracy of orientating the sheet was examined by means of duplicate exposures. Measurements were performed by orientating the x-axis of the sheet in a definite position to two implants, and thereafter by measuring the distance from the axis to a third implant on one of the accessory lines of the sheet. The error of the method — s (i), cf. the statistical section — was calculated from a set of 25 measurements, to 0.10 mm.

Analysis of the radiographic technique

By means of the measuring technique described above, the ability of the radiographic technique to reproduce the alveolar bone level was examined on periodic exposures. Paired sets of exposures from each person were used

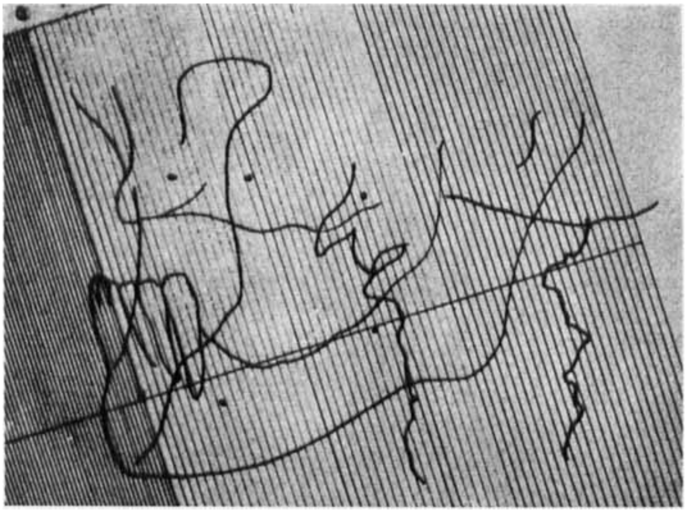

Fig. 5. Orientating technique of the measuring sheet on the radiograph.

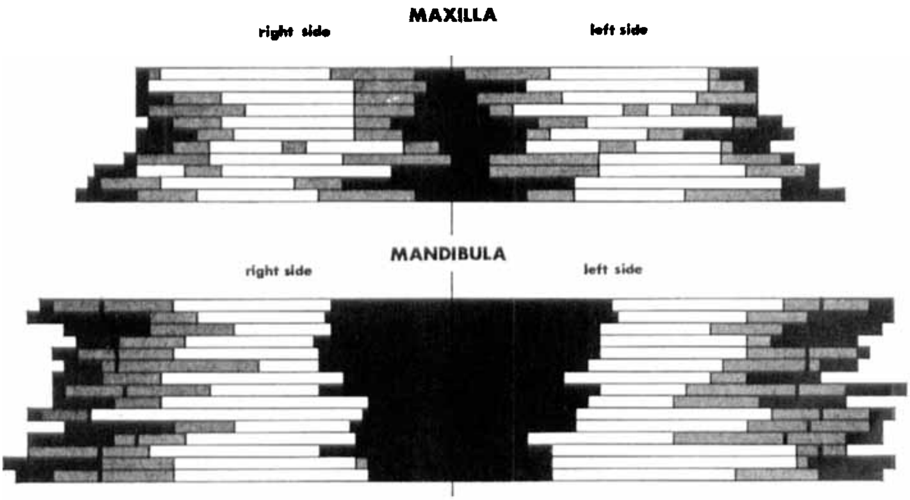

Fig. 6. The extent of alveolar bone level exposed on 45° oblique radiographs. Hatched and cross-hatched signatures are used analogously with Fig. 3. Unhatched signature correspond with pointed signature in Fig. 3. Remaining natural teeth in the lower jaw are indicated by the central cross-hatched area. Vertical black marks designate the position of the posterior lower implant in the retromolar area.

for the investigation, comprising both right and left side exposures. The exposures were made at an interval of 8—14 days by using an identical radiographic technique for each person. The image quality of the mandibular areas enabled an analysis of the jaw to be made for all persons, while an analysis of the corresponding areas of the maxilla had to be postponed in four cases. Prior to the measurements, the contour of the alveolar process was marked on the cephalogram with a thin pencil. The anterior and posterior implants of the jaw side in question were used to orientate the measuring sheet, the anterior implant indicating the zero-point of the sheet. The position of the bone level relative to the implant-determined x-axis was then determined by measurements on the acessory lines, with an interval of 2 mm (Fig. 5). First, the primary exposures were measured, thereafter the corresponding control exposure. The extent of the measured contour in relation to the total area of the alveolar process and the corresponding tooth-bearing area is shown in Fig. 6.

Statistical methods

The following statistical parameters were employed (cf. *Solow*, 1966, tab. 7).

Arithmetical mean $\bar{x}$	$\frac{\Sigma x}{N}$
Variance s^2	$\frac{\Sigma (x-\bar{x})^2}{N-1}$
Standard deviation s	$\sqrt{s^2}$
Standard error of the mean $s(\bar{x})$	$\sqrt{\frac{s^2}{N}}$
Error of the method s(i)	$\sqrt{\frac{\Sigma (x_A - x_B)}{2N}}$
Correlation coefficient r	$\frac{\Sigma (x-\bar{x}) \Sigma y-\bar{y})}{\sqrt{\Sigma (x-\bar{x})^2 \Sigma (y-\bar{y})^2}}$

Values of parameters significant at the 5 % or 1 % levels are indicated with one and two asterisks, respectively.

The calculations of the statistical analysis were performed on the electronic computer GIER.

Analysis of the collected data was carried out in the following way:

1) The corresponding data from the two exposures were analyzed for systematic errors by a Student's t-test. This analysis showed no deviation significantly different from zero at a 1 % level.

2) The error of the method — s (i) — was then calculated for each jaw side on the individual subject (Table I A).

3) The method error — s (i) — was calculated for the material as a whole. The amount of data allowed a calculation of the error for areas reproduced with and without interference on the radiographs, cf. Figs. 3 and 6 and Table I B. Distribution of the values in the two areas was compared by a SNEDECOR's F-test.

4) 30 exposures from Table I A were then used to analyze the influence from errors of projection on the size of the s (i) value. The exposures were divided into three groups representing low, intermediate, and high s (i) — values (Table II).

The displacement of corresponding implants on the periodic exposures was chosen to express the size of projectional divergences, using the difference between the measurements as variables. The following implantal relations were measured: in the sagittal plane (1) the intermaxillary distance between the anterior implants in the upper jaw and the lower jaw, and (2)

Table I.

Determination of alveolar bone level in periodical radiographs in the 45 degree oblique projection. Errors of the method in mm

A. Individual values, according to sex and age of the material

		MAXILLA				MANDIBULA			
sex	age	N	right side	N	left side	N	right side	N	left side
♀	32	21	0.169	21	*0.106*	18	0.138	19	*0.142*
♀	47	15	*0.206*	14	0.165	20	*0.141*	21	0.155
♀	49	16	0.165	16	0.162	22	*0.134*	21	*0.139*
♀	51		—			16	0.189	15	0.174
♀	56	22	*0.127*	19	0.196	20	*0.112*	21	0.132
♀	56	27	*0.134*	24	0.142	14	*0.204*	16	*0.105*
♀	57	24	*0.122*	19	0.137	23	*0.103*	14	0.126
♀	62		—			21	*0.129*	15	0.190
♂	32	23	*0.334*	21	0.255	26	*0.123*	23	0.162
♂	48		—			17	0.133	14	0.169
♂	48		—			21	0.145	23	*0.219*
♂	52	19	*0.129*	17	*0.274*	25	*0.206*	25	*0.158*
♂	57	20	0.150	24	*0.198*	16	0.143	25	*0.194*
♂	66	20	*0.179*	18	*0.129*	26	*0.241*	28	*0.185*
♂	77	22	*0.184*	30	*0.160*	22	*0.193*	17	*0.204*

N = Number of measurements on each radiograph. Italic boldface types denote the use of the corresponding radiographs for the measurements in Table II.

B. Main values of the material, related to absence or presence of interfering bone structures in the area of measurement of Fig. 3 and 6

		N	Areas without interference	N	Areas with interference	F
Maxilla	right side	121	0.139	109	0.220	2.51**
	left side	135	0.132	88	0.237	3.28**
F			1.13		1.15	
Mandibula	right side	184	0.136	123	0.194	2.06**
	left side	183	0.159	114	0.173	1.07
F			1.36*		1.41*	

Table II.

Variation in head position in the 45 degree oblique projection. Positional changes of corresponding implants on periodical exposures. Values in mm. Further details, see text

		Intermaxillary variation		Intramaxillary variation			
		Sagittal plane		Sagittal plane		Transversal plane	
Grouping according to s (i) values	N	range	mean $(\bar{x})$	range	mean $(\bar{x})$	range	mean $(\bar{x})$
1. Low values (0.130 mm)	10	0—1.00	0.31	0—0.10	0.06	0—0.30	0.19
II. Intermediate values (0.130—0.190 mm)	9	0—0.50	0.15	0—0.15	0.09	0.10—0.50	0.30
III. Large values (0.190 mm)	11	0—0.60	0.20	0—0.30	0.09	0.10—1.00	0.45

the intramaxillary distance between the anterior and posterior implants on the same jaw side.

In the transversal plane (3) the intramaxillary relations between, on the one hand, the anterior and posterior implants and on the other hand, the implant from the opposite canine region were examined by use of the measuring sheet. In this case the vertical displacement of the latter implant was used as a variable (Table II). The dispersion of the values in the three groups was analyzed by SNEDECOR's F-test. (5) The connection between the s (i)-value and the error of projection was examined by a correlation analysis.

RESULTS

Table I shows the size of s (i)-values for each side of the jaw for each individual. The values range between 0.10 and 0.33 mm. Table I B shows the corresponding values for the material as a whole. The values for analogous regions showed differences between the right and the left side, which in the maxilla were not statistically significant, whereas in the mandible they showed a significance at a 5 % level. A comparison of the values for the shaded and unshaded areas in the same side of the jaw showed constantly higher values for the shaded areas. Except for the left side of the mandible this difference was statistically significant at a 1 % level (Table I B).

Table II shows the size of displacement of the implants in the sagittal and the transversal plane, related to the size of the s (i) values. In the sagittal plane, the intermaxillary displacements showed moderate averages within the three groups. The corresponding values for the intramaxillary displacements were lower and of a magnitude corresponding to the accuracy of the measuring equipment employed. The mean value in the transversal plane showed a tendency to increase in agreement with the size of the s (i)-value for the group. This increase turned out to be significant, $F^2_{27} = 6.7^{**}$. This tendency was thereafter examined by a correlation analysis, in which the size of displacement showed a low positive correlation with the corresponding s (i)-values, $r = 0.14$.

DISCUSSION

The use of metallic implants in the present study has made it possible to analyze the radiographic technique with greater precision than before. By virtue of their stable position and radiological contrast, these indicators help to reduce error in x-ray cephalometric studies, where difficulties in identifying the anthropological measuring points have hitherto represented the greatest source of error (*Savara, Tracy* & *Miller*, 1966, *Carlsson*, 1967). Consequently the size of the error is lower in the present study (Table I B) than in earlier investigations (*Wictorin*, 1964; *Carlsson*, 1967; *Carlsson, Bergman* & *Hedegård*, 1967).

This accuracy in measurement permitted an analysis of divergences originating from the oblique projection, and an evaluation of their influence on the size of error of the method. In the literature, projectional errors are ascribed a considerable importance as a source of error (*Björk*, 1947, *Koski*, 1954; *Nawrath*, 1961; *van Aken*, 1963; *Carlsson*, 1967), even though present recent investigations have given contradictory results (*Wictorin*, 1964; *Carlsson*, 1967).

Mainly because of the risk of projectional errors, the oblique 45° projection has not yet been used for longitudinal studies (*Barber, Pruzansky* & *Kindelsperger*, 1961). In the present investigation, the radiographic technique only involved minor movements of the persons, judging from the small displacement of the implants on the periodic exposures. The significant relation between the error of the method and the mean of the displacement in the transversal plane may have arisen from minor changes in the patient's position during exposure. Variations in the position of the head had no significant influence on the size of error, since the positive correlation between the size of the s (i)-value and the displacement in the transversal plane was small. Thus, the accessories used as stabilizing elements in the cephalostat technique were able to minimize the influence of projection errors.

The improved precision in the present study indicates that the main source of error originated from local factors. The range of the s (i)-values in Tables I A and I B shows that the use of a primary diaphragm and varying exposure values in the radiographic technique was insufficient to equalize the individual variation in the bone density of the jaws. The central position of the lower jaw in the image area means that the effect of these measures is greater for this jaw, as reflected in the greater uniformity of the s (i)-values in Table I B, while the position of the upper jaw in the periphery of the image area, in connection with the strong filtration of secondary radiation means that a uniform reproduction with sufficient details is difficult to obtain. The measures taken to resolve this problem proved to be of only limited value, since approximately a quarter of the exposures of the upper jaw were useless for detailed studies.

Thus the study demonstrated that the image obtained by the oblique projection is primarily suited to reproducing the lateral segments of the lower jaw. This is in agreement with its main use in most earlier studies (*Barber et al.*, 1960; *Hatton & Grainger*, 1958; *Israel*, 1966). As regards the corresponding areas of the upper jaw, the study has demonstrated the limited value of oblique projection on edentulous persons.

In previous studies of the changes in face height on denture wearers, it has been demonstrated that changes occur to a larger extent in the lower jaw than in the upper jaw (*Tallgren*, 1966). The lateral projection has only been able to register changes in the anterior part of the lower jaw (*Carlsson & Persson*, 1967), while studies of the lateral regions have been complicated by large errors in method and lack of the possibility of analyzing the changes in each side (*Carlsson, Ragnarsson & Åstrand*, 1967).

The oblique 45° projection is suitable for investigating these inaccessible structures. By means of the present technique, it is possible to perform an analysis of more specific areas and at an earlier stage than before.

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SUMMARY

An X-ray-cephalometric study using the oblique 45° projection has been carried out in order to establish the size of the image area obtainable by this projection and the applicability of oblique projection to longitudinal studies of edentulous jaws.

The study was carried out on 15 persons with edentulous upper jaw and a reduced natural dentition in the anterior part of the lower jaw. Tantalum implants were used as indicators in both jaws. Exposures were made in a cephalostat supplied with strengthening ear rests and adjustable nose, neck and chin rests, enabling a reproducible position to be maintained. Individual acrylic ear plugs and bite plates were used as supplementary stabilizing equipment and a standardized radiographic technique was employed.

By means of the technique applied, detailed and uniform exposures of the lateral regions of the lower jaw were obtained. In the upper jaw, the image quality was more variable and a quarter of the exposures were unfitted for detailed analysis. The reproduction of the bone level of the alveolar process was analyzed on periodic exposures made using an identical radiographic technique. A measuring sheet with an orientating accuracy of 0.10 mm was used. Error of method showed values between 0.13 and 0.19 mm in the lower jaw, and between 0.13 and 0.23 mm in the upper jaw.

The influence of projectional errors on the error of the method was analyzed on the basis of a series of measurements of positional changes of corresponding implants on the periodic exposures. Only a weak correlation was found between these factors and the magnitude of the error of method.

The study has proved that the image area in oblique 45° projection can be emplyed successfully in longitudinal detailed studies especially of the lateral regions of edentulous lower jaws.

RÉSUMÉ

DÉTERMINATION DU NIVEAU OSSEUX DANS LES RÉGIONS LATÉRALES DES MÂCHOIRES ÉDENTÉES

NOUVELLE MÉTHODE CÉPHALOMÉTRIQUE PAR RADIOGRAPHIES UTILISANT UNE PROJECTION OBLIQUE À 45° ET DES IMPLANTS MÉTALLIQUES

Une étude céphalométrique par radiographies utilisant une projection oblique à 45° a été pratiquée dans le but de déterminer l'étendue de l'image qu'on peut obtenir avec cette projection et d'établir dans quelle mesure la projection oblique est utilisable pour les études longitudinales sur les mâchoires édentées.

Cette étude a porté sur 15 personnes présentant une mâchoire supérieure édentée et une denture naturelle réduite dans la partie antérieure de la mâchoire inférieure. Des implants de tantale ont été utilisés comme repères dans les deux mâchoires. Les clichés ont été pris en utilisant un céphalostat comportant comme renfort des appuis-oreilles et des appuis réglables pour le nez, le cou et le menton, ce qui permettait de maintenir une position susceptible d'être reproduite. Des plaques d'occlusion et des tampons pour les oreilles individuels en acryl servaient à stabiliser ultérieurement la position; les clichés étaient pris suivant une technique normalisée.

Grâce à la méthode utilisée, on a obtenu des clichés détaillés et uniformes des régions latérales de la mâchoire inférieure. A la mâchoire supérieure, la qualité des clichés était plus variable et le quart des clichés ne pouvaient pas se prêter à l'analyse détaillée. La reproduction du niveau osseux du procès alvéolaire a été analysée sur des clichés périodiques pris en utilisant une technique radiographique identique. La feuille de mesure, utilisée permettait une précision d'orientation de 0,10 mm. Les valeurs de l'erreur liée à la méthode étaient situées entre 0,13 et 0,19 mm à la mâchoire inférieure et entre 0,13 et 0,23 mm à la mâchoire supérieure.

L'influence des erreurs de projection sur l'erreur liée à la méthode a été analysée en se basant sur une série de mesures des déplacements d'implants

correspondants sur les clichés périodiques. On n'a trouvé qu'une faible corrélation entre ces facteurs et la grandeur de l'erreur liée à la méthode.

Cette étude a prouvé que l'utilisation de l'image obtenue en projection oblique à 45° permet d'obtenir de bons résultats dans les études longitudinales détaillées intéressant en particulier les régions latérales des mâchoires édentées.

ZUSAMMENFASSUNG

ZUR BESTIMMUNG DES KNOCHENNIVEAUS IN DER SEITENREGIONEN ZAHNLOSER KIEFER. EINE NEUARTIGE RÖNTGENZEPHALOMETRISCHE TECHNIK BEI ANWENDUNG EINER SCHRÄGEN 45°-PROJEKTION NEBST IMPLANTATEN

Ein röntgenzephalometrisches Methodenstudium wurde zur Erhellung des betreffenden Gesichtsfeldes und dessen Anwendungsmöglichkeiten bei longitudinalen Studien des zahnlosen Kieferskeletts mittels Aufnahmen in der schrägen 45°-Projektion durchgeführt.

Die Untersuchung wurde bei 15 Personen mit zahnlosem Oberkiefer und einen reduzierten restlichen Zahnbestand im frontalen Teil des Unterkiefers vorgenommen. In beiden Kiefern wurden als Indikatoren Tantal-Implantate verwendet. Die Aufnahmen wurden in einem mit unterstützten Ohrenhaltern und verstellbarer Nasen-, Nacken- und Kinnstütze versehenen Zephalostat gemacht. Als ergänzende Stabilisierungsausrüstung wurden individuelle Akrylohrenstöpsel und Akrylplastron für die Kiefer angewendet. Es wurde eine standardisierte, reproduzierbare Einstelltechnik benutzt, und die Exponierungen wurden bei 65—80 KV und zwar bei Abblenden der ausserhalb des Kieferskeletts gelegenen Strukturen vorgenommen.

Mittels der angewendeten Technik wurden von der Seitenregionen des Unterkiefers detailscharfe und gleichmässige Aufnahmen erzielt. Im Oberkiefer war die Bildqualität etwas ungleichmässiger, und 27 % der Aufnahmen erwiesen sich als ungeeignet für eine Detailanalyse. Die Reproduktion von dem Umriss des alveolären Prozesses wurde auf periodischen Aufnahmen in 8—14 tägigen Abständen analysiert. Zur Untersuchung wurde ein Messbogen mit einer Orientierungsexaktheit von 0,10 mm benutzt. Der Methodenfehler bei Messungen im Unterkiefer ergab Werte von 0,13—0,19 mm und im Oberkiefer Werte von 0,13—0,23 wobei die höchsten Werte auf die knochenbeschatteten Partien der Aufnahmen entfielen.

Der Einfluss der Projektionsfehler auf den Umfang der Methodenfehler wurde auf Grund einer Serie von Messungen von den Lagenänderungen der Implantate auf den periodischen Aufnahmen analysiert. Es ergab sich eine nur geringeKorrelation zwischen den beiden Faktoren.

Die Untersuchung tut der, dass die Bildfläche der schrägen 45°-Projection bei longitudinalen Studien verwendbar ist, und dass die angewendete Technik zu Detailstudien von den Seitenregionen des zahnlosen Unterkiefers wohlgeeignet ist.

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