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SURFACE CONTOUR CHANGES AFTER TOOTH EXTRACTION

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USAF School of Aerospace Medicine
Aerospace Medical Division (AFSC)
Brooks Air Force Base, Texas

Task No. 775602

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FOREWORD

This report was prepared by the following personnel in the Dental Sciences Division, USAF School of Aerospace Medicine:

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The authors appreciate the technical help given by Technical Sergeant Emily E. Taylor, Staff Sergeant Delbert L. Tolliver, Staff Sergeant Samuel G. Palmer, Airman First Class Jerome B. Bloom, and Airman Third Class William F. Baker.

ABSTRACT

The SAM Contourator, model B, was used to evaluate dimensional changes of the residual ridge mucosa following the extraction of the maxillary second molar on two subjects. An electronic curve-following device was employed to measure the changes in mucosal topography. The combined contourator - curve-follower error was determined and found to be area dependent. The mesial migration of the maxillary third molar after the extraction of the adjacent maxillary molar had little effect on contour changes in the vertical plane. In the horizontal plane, however, movement of the adjacent molar into the extraction site reduced the loss in residual ridge topography.

This technical documentary report has been reviewed and is approved.


ROBERT B. PAYNE
Colonel, USAF, MSC
Chief, Operations Division

SURFACE CONTOUR CHANGES AFTER TOOTH EXTRACTION

1. INTRODUCTION

The study of contour changes of the alveolar process following tooth extraction, alveolectomy, ridge extension, and other surgical procedures is of vital importance to the oral surgeon since such data are basic to the development of improved technics in oral surgery. Reliable research on this phase of oral surgery has been impeded because of the time and the complicated procedures required for recording and measuring topographic changes of the oral mucosa during transition from alveolar to residual ridges. The dimensional behavior of the maxillary residual ridges has been studied under conditions wherein anterior teeth are extracted and a full or partial immediate denture is inserted. Lisowski (1) studied the effect of removing varying amounts of bone during an alveolectomy on alveolar ridge re-

sorption under immediate dentures. He reported that radical surgical alterations of the alveolar process during tooth extraction resulted in extensive resorption of the ridges under immediate dentures. Lam (2) found that the rate of topographic changes of the residual ridges reached peak activity within 3 to 4 weeks after tooth extraction. He reported that maxillary anterior ridges maintained their shape under relined partial dentures after the fifth month following tooth extraction.

More recently Szmyd and co-workers (3) conducted studies on the dimensional behavior of residual ridge topography following the extraction of maxillary posterior teeth. They measured contour changes for 3 to 6 months prior to the insertion of immediate full dentures and for a total time of 300 days after tooth extraction. They noted that the progressive

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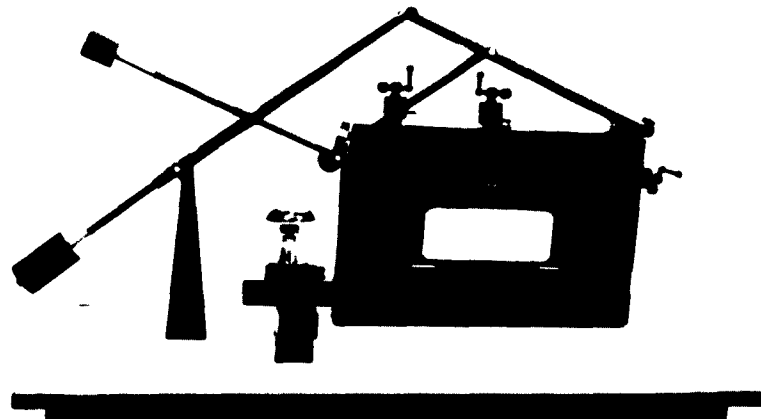


FIGURE 1
SAM Contourator, model B.

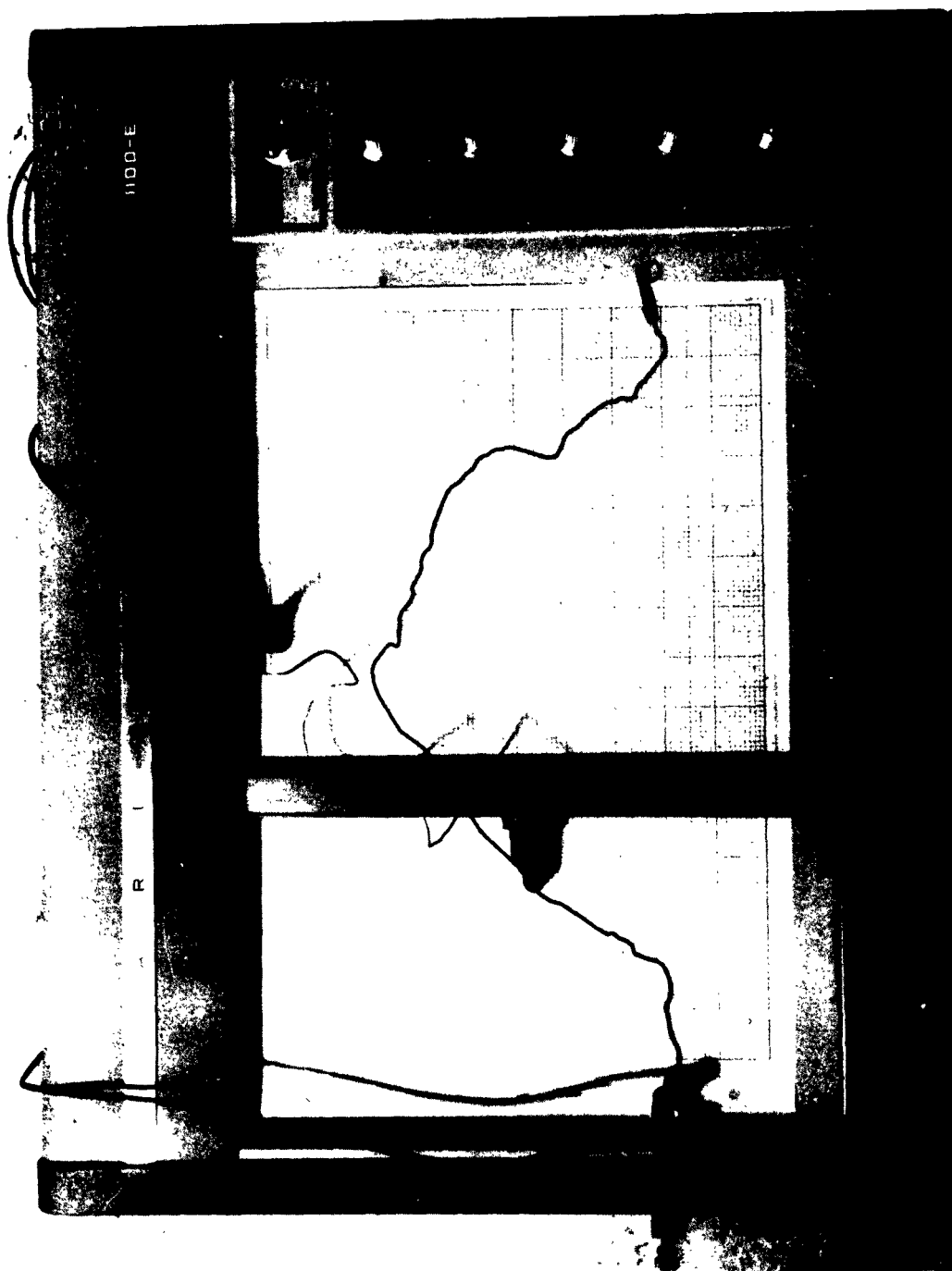


FIGURE 2
Curve-following device.

loss in residual ridge area was still evident at the postextraction time of 300 days.

This paper presents additional findings on the topographic changes of the oral mucosa after tooth extraction. Also presented is the use of a curve-following device to facilitate the task of measuring contour changes of the alveolar ridges.

2. METHOD

The SAM Contourator, model B (fig. 1), was used to evaluate dimensional changes of the residual ridge mucosa following tooth extraction (3). In the present investigation, the method for studying the dimensional behavior of the oral mucosa was modified in that the planimeter was not used to measure contour changes. An electronic curve-following device was employed to scan the area encompassed

by the topographic contours and express the readout obtained in predetermined square units (figs. 2 and 3). The curve-following device translates the X-Y components of the topographic contours into an analog voltage. This voltage is sent into the analog computer where the signal is electronically integrated. The integral of this analog voltage represents the area of the surface contour. A detailed description of the curve-following equipment and the method of operation is available (4, 5).

Mucosal surface contours were recorded by means of tracings taken on dental casts. To obviate variations in the technic for making impressions and dental casts, we standardized the use of dental materials, impression trays, and temperatures and procedures in measuring, mixing, and timing. An index, constructed from the hard palate area and cusp tips of the remaining teeth, was employed to mount successive dental casts in an identical position.

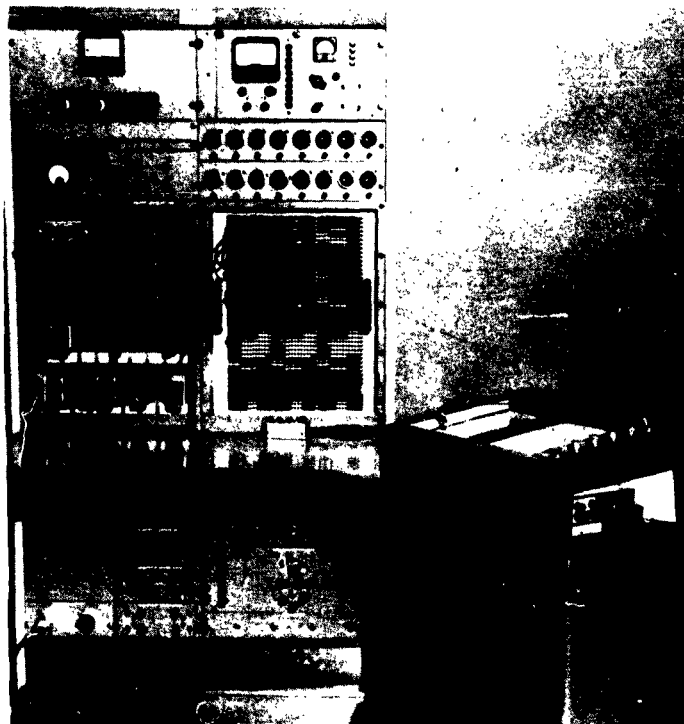


FIGURE 3
Analog computer.

Surface contours were magnified, pantographically, and scribed on stabiline paper. The pantographic device produced an area magnification of 9.3232. A photographic enlarger was employed to magnify the surface contours which had been scribed on the stabiline paper. The photographic apparatus produced an area magnification of 17.7658. After these enlargements were printed, a variplotter-functional generator,¹ in conjunction with the analog computer,¹ was employed to measure the topographic changes of the alveolar ridges. An adjustment factor of 0.0060375 was employed to correct for the total area magnification produced by the pantographic device and by the photographic enlarger.

Analysis of procedural errors

The combined contourator-planimeter error for measuring surface contour changes was analyzed and presented in a previous communication (3). A study was conducted to estimate the combined contourator-curve-follower error for measuring topographic changes. The same contour tracings used in the previous study were also employed in the present experiment. These contour tracings had been made from three forms with different areas. Each of three operators made five contour tracings on each of three forms. The 45 areas represented by these tracings were enlarged, photographically, and measured by the curve-following apparatus.

Linear contour changes

The linear rate and distribution of the resorptive process, after tooth extraction, was also determined from the enlarged contour tracings which have been scribed on the stabiline paper. The landmarks used to study dimensional changes of the residual ridges in the vertical and horizontal planes are illustrated in figure 4. Calipers, graduated to 0.1 mm., were used to make these linear measurements.

Determination of surface contour changes in the vertical plane "1" was made by measur-

¹Variplotter, model 1100E. Functional generator, model 2.040. Analog computer, model 231R. Pace Electronic Associates, Inc., Long Branch, N. J.

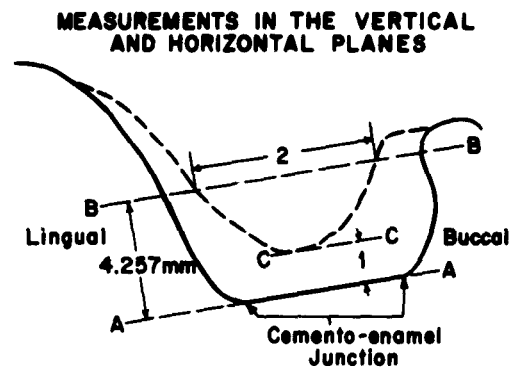


FIGURE 4

Landmarks for linear measurements.

ing the distance between a line, "C-C," tangent to the crest of the maxillary residual ridge and a second on a reference line, "A-A," drawn between the cemento-enamel junction on the buccal and lingual surfaces of the tooth to be extracted (fig. 4).

Measurement in the horizontal plane "2" was made along a line, "B-B," drawn parallel to, and 4.257 mm. below the reference line, "A-A" (fig. 4). Determinations were made between the two points at which reference line "B-B" intersects the contour tracings of the residual ridge on the buccal and lingual surfaces.

An adjustment factor of 0.3275 was employed to correct for the linear magnification produced by the pantographic device.

Tooth migration

Since the dimensional behavior of residual ridge topography may be altered by the movement of an adjacent tooth into the extraction site, the rate of mesial migration of the maxillary third molar following the extraction of the adjacent second molar was determined. The contourator was used to draw a reference line on all of the dental casts in this study. Calipers, graduated to 0.1 mm., were employed to measure tooth migration. Measurements were made on the dental casts at the crest of the alveolar ridge between this reference line and the cemento-enamel junction on the mesial surface on the third molar.

3. CONTOURATOR STUDIES OF THE MAXILLARY SECOND MOLAR AREA

Two subjects were used in a study to measure changes in the residual ridge topography following the extraction of a single tooth.

The gingival tissues around the tooth scheduled for extraction were examined for color, texture, consistency, position, and physiologic form and were found to be within normal limits. No periapical pathology was noted in the roentgenograms. The rate of linear and area contour changes of the residual ridge topography was determined. The surface contours, scribed on stabiline paper, were traced and photographed.

Case 1. The subject was a 28-year-old male requiring the extraction of the maxillary right second molar. Oral examination revealed that all other posterior teeth were missing.

Case 2. The subject was a 26-year-old male requiring extraction of the maxillary left second molar. Oral examination revealed that only the mandibular left first and third molars were missing. The rate of mesial migration of the maxillary third molar was determined.

4. RESULTS AND DISCUSSION

The rate at which topographic changes of the residual ridge occurred in cases 1 and 2 is presented in figure 5. The progressive loss in

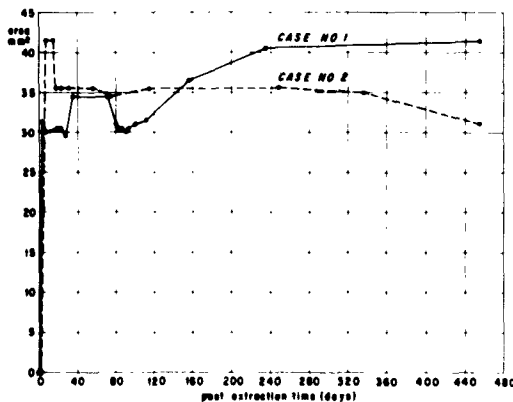


FIGURE 5

Rate of topographic change.

residual ridge area in case 1 was reversed in case 2 because the maxillary third molar migrated toward the extraction site.

The combined contourator-planimeter error for the SAM Contourator, model B, varied from 1.32% for an area of 62.29 mm.², and 0.77% for an area of 142.81 mm.², to 0.40% for an area of 252.95 mm.² The combined contourator-curve-follower error was determined by using the same contour tracing used to determine the combined contourator-planimeter error. The adjusted means and standard deviations, determined from the analog measurements of the tracings, are given in table I.

TABLE I

Analysis of measurements

	Model		
	1	2	3
Number of tracings	15	15	15
Mean (mm. ²)	62.31	141.62	253.22
Standard deviation (mm. ²)	.60	1.20	1.31
Coefficient of variation (%)	.97	.84	.52

Unadjusted means and standard errors were used to determine the coefficient of variation. The standard deviation reflects errors in contourator tracings, photographic enlargements,

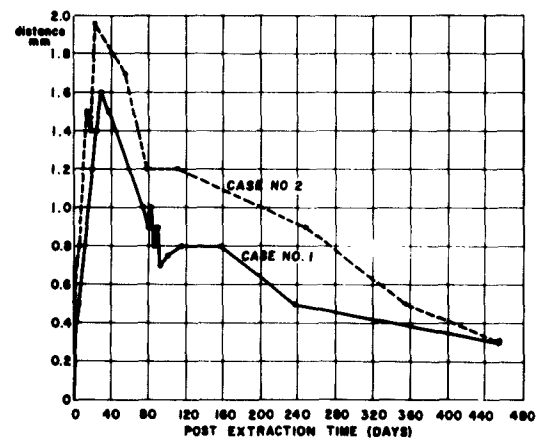


FIGURE 6

Topographic change in vertical plane.

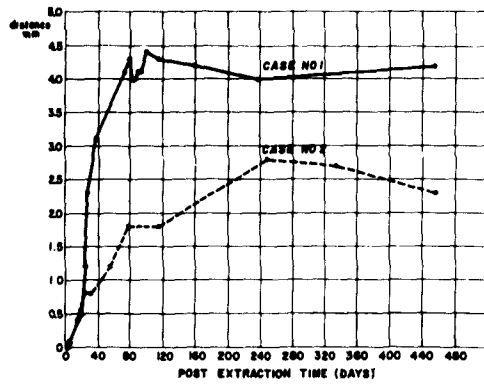


FIGURE 7

Topographic change in horizontal plane.

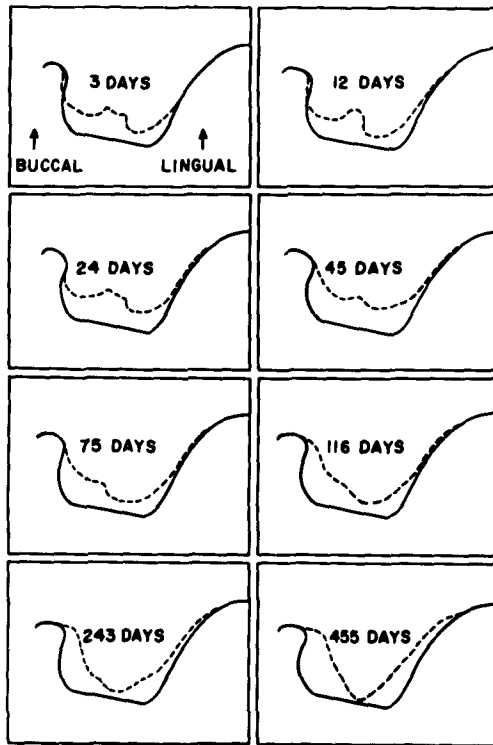


FIGURE 8

Contour changes in case 1.

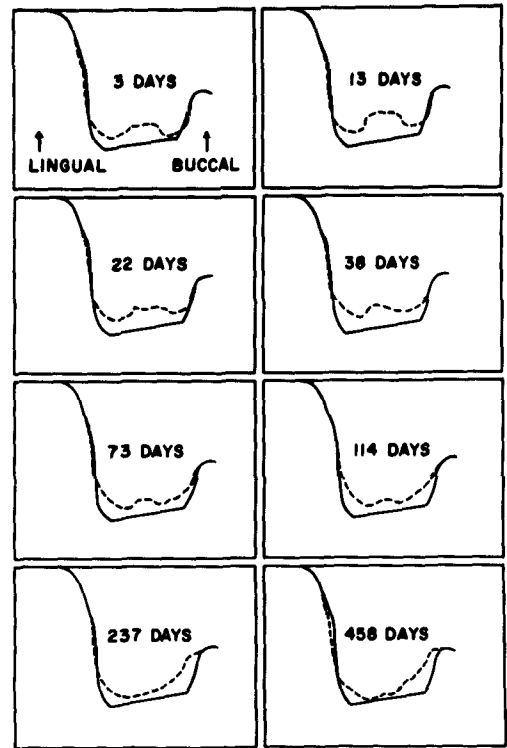


FIGURE 9

Contour changes in case 2.

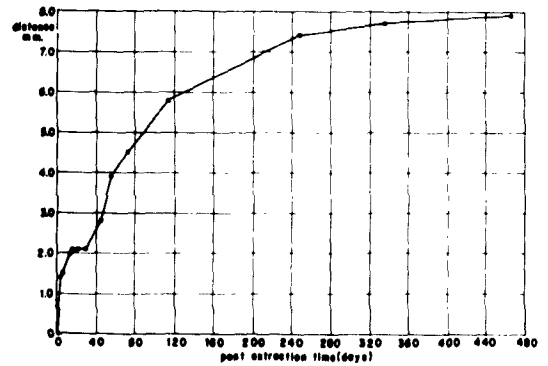


FIGURE 10

Maxillary third molar tooth migration in case 2.

and curve-follower measurements. Examination of the coefficient of variation indicates that the contourator - curve-follower error is related to the size of the area under investigation.

The rate of linear change of the residual ridge topography is presented in figures 6 and 7. The topographic changes of the oral mucosa in the vertical plane were similar for the two cases under investigation. The mesial migration of the third molar in case 2 reduced the rate of loss of the residual ridge topography in the horizontal plane.

The rate of change in surface contours for both subjects is illustrated in figures 8 and 9.

Here, again, it is evident that the mesial migration of the third molar had little effect on contour changes in the vertical plane. In the horizontal plane, however, movement of the adjacent molar into the extraction site reduced the loss in residual ridge topography.

The rate of mesial migration of the maxillary third molar is presented in figure 10. The distal marginal ridge of the maxillary third molar engaged the mesial marginal ridge of the mandibular second molar during a portion of the postextraction observation period, and temporarily interrupted the mesial migration of the maxillary third molar into the extraction site.

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1. Lisowski, C. S. A comparative study of the resorption of the alveolar ridge tissues under immediate dentures. Master's degree thesis, Northwestern University, Chicago, Ill., 1945.
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3. Szmyd, L., C. F. Schuessler, A. A. Brewer, and C. M. McCall, Jr. SAM Contourator, model B—An instrument for measuring changes of surface contours. SAM-TDR-62-93, Aug. 1962.
4. Jackson, A. S. Analog computation. New York: McGraw-Hill, 1960.
5. Function generator kit 17-18E. Pace Electronic Associates, Inc., Long Branch, N. J.

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