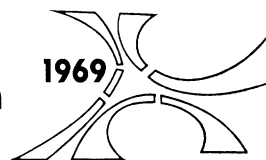


Electronic Data Processing in Cleft Lip and Palate



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Clinical Research of Cleft Lip and Palate Repair. First use of Computerized Data

Operative repair of cleft lip and palate has gained predominance in the rehabilitation of cleft palate patients. This type of surgery is usually performed by specialized maxillofacial or plastic surgeons, often belonging to a team of a so-called cleft palate center. Nearly every day a new paper in this field comes out, confusing the reader with results leading to contrary interpretation. Therefore there exists no unanimous consensus about a preferable procedure for rehabilitating cleft palate patients. Different results so far do not point toward a specific therapy. This suggests to us that the small collections of patient material as evaluated each time could not represent statistical significance as far as any definite conclusion is concerned. Similar problems exist in other surgical specialities (13).

Within the last 30 years in the Westdeutsche Kieferklinik, about 5000 cleft palate patients have been treated. 13,000 operations have been performed. Clinical data derived from patient history, examination, diagnosis, operative treatment and results thereof, as well as the chronological sequence of clinical procedures, have been recorded in patient records and outpatient sheets, guaranteeing a well-filled archive so far untapped for pertinent information. Because of their magnitude, these data cannot be processed in an old-fashioned manner. This means a tremendous loss of recognition and knowledge. Furthermore, disparate accuracy in data recording and evaluation and the emphasis of different aspects of the whole problem during the respective training periods of specialized surgeons make it difficult to standardize patient data obtained from records. Therefore a unified system of documentation is most important for present and future clinical research (5). For

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this reason we have turned to a new method of recording information and data processing already useful in other medical specialties (1-4, 6, 10, 11, 14-16).

Clinical Data from Automatic Collection Until Electronic Data Processing

Figure 1 shows the manner of collecting data and their processing until scientific evaluation. From the very first contact between the cleft palate patient and the doctor until conclusion of rehabilitative treatment in adulthood, all informative data have to be collected in usual patient records and outpatient sheets for forensic reasons. According to standardized types of questions, all pertinent patient data then have to be transferred to a preset marking document without any coding of information (Figure 2). The idea and the disposition of such a marking document are, according to Oberhoffer (12), the most important tasks in the new type of data processing. The particular marking document proposed by the author will be specified subsequently. Filled-in marking documents are collected and put into an optical mark page reader at certain intervals (IBM Form 71462-0, 74195-0, and 74910-2) (Figure 3) (7). In a photo-optical principle of reading, the single marks are perceived, up to a speed of 2000 copies per hour, and are transferred to punched cards by a special automatic punching machine (Figure 4). These punched cards are fed into the central processing unit 360, after passing through a card reader where the data are examined for their plausibility. After this, data are stored in magnetic tape drives, or in a disk storage (Figure 5). With these procedures, automatic data processing is completed.

Questions related to clinical and scientific problems are then translated into a "computer-language" (in our case: Assembler). With the aid of these questions the electronic data processing system can process a large amount of information within a very short period of time; for example, 10 million logical decisions per second (Figure 6). We think in terms of two possibilities of evaluation: a. The data processing system transforms on the basis of the so-called thesaurus markings being stored in a binary modus and being available in the original German language. In that manner an automatically printed brief patient record is put out (Figure 7). b. Depending upon the type of medical question, data are analyzed statistically and printed in related tables. The speed of the rapid printing machine is 1100 lines per minute (Figure 8).

Filling in the Marking Document

The technical problems related to electronic data processing are a matter of concern to cybernetics, programming, and operation of the computer and therefore of secondary interest to the physician. In con-

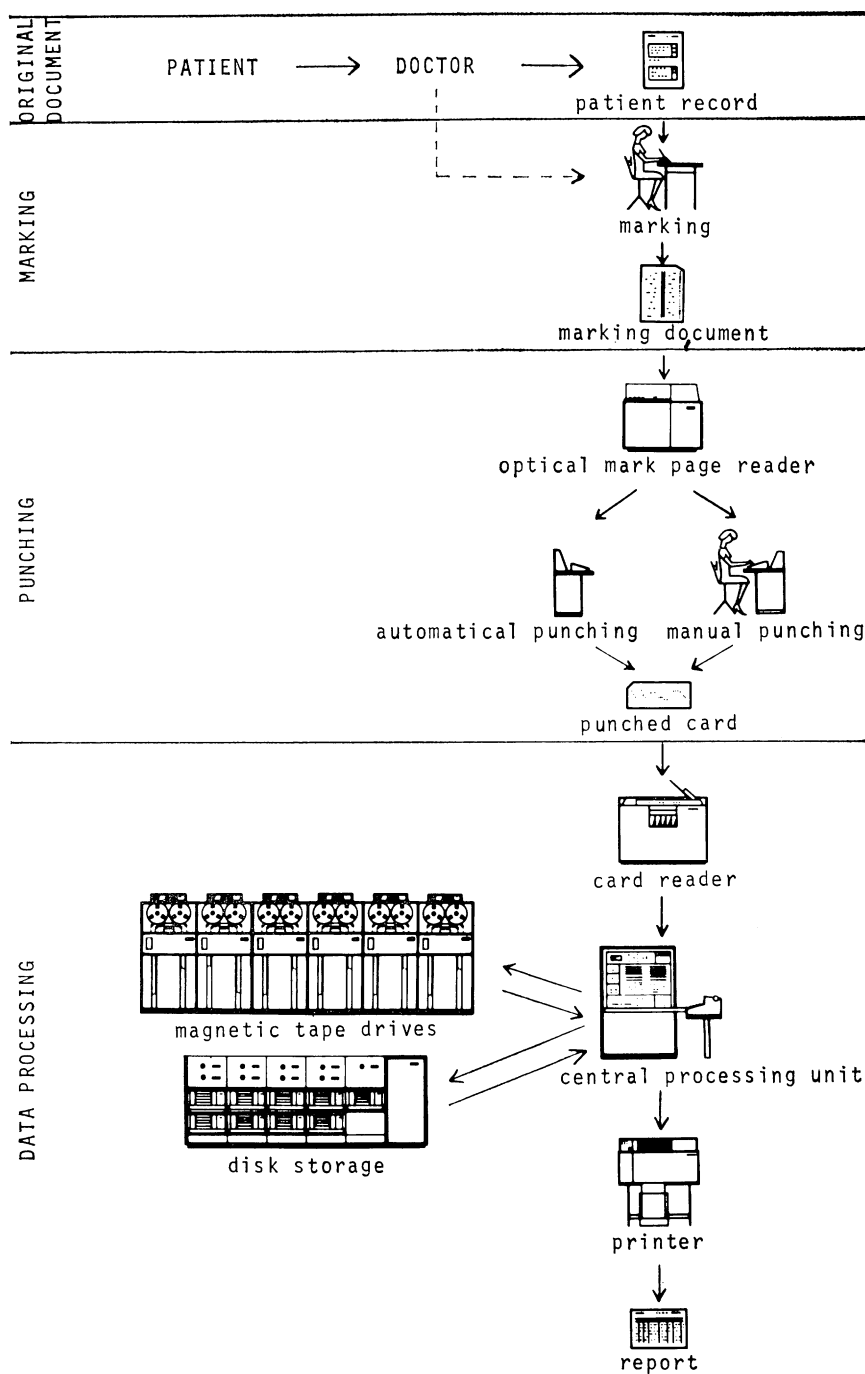


FIGURE 1. Diagram of automatic data collection and electronic data processing.

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Westdeutsche Kieferklinik

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FIGURE 2. Marking document as developed by the author.

trast to that, filling in the marking document (Figure 2) is of prime concern to the physician, making his cooperation mandatory. The marking document is issued to a specific patient, and is identified by the patient's record number. In case of readmission, identification is assured by simultaneous marking of the former patient's record number. On that basis old and new data for the same patient are coupled electronically in the computer. The column "Beleg-Art" (which means the type of

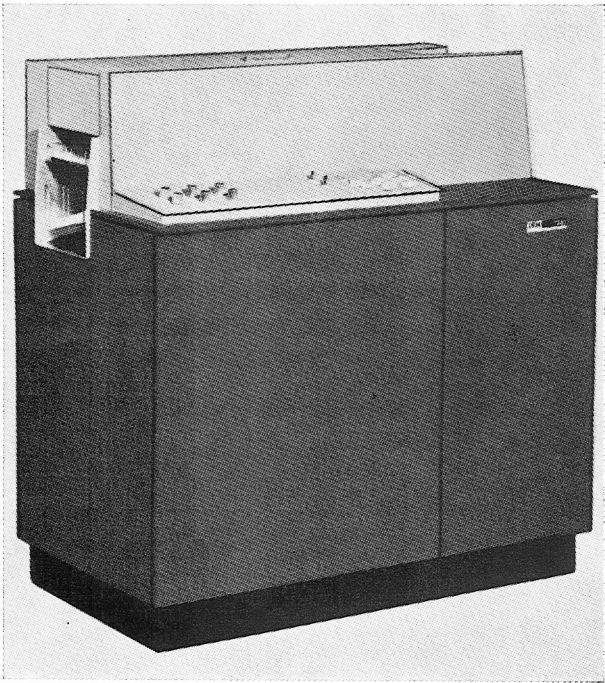


FIGURE 3. Optical mark page reader IBM 1230.

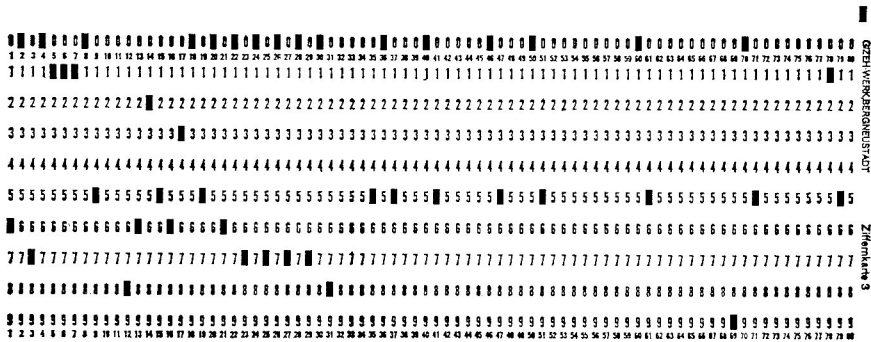


FIGURE 4. Example of an automatically punched card.

marking document) is already premarked with the print of the data sheet. This column identifies the sheet within the collection of all marking documents being evaluated in the same computer center.

In the columns related to patient history and to the patient examination, the date of birth (month and year), first or secondary admission, sex, heredity, and the existence of further malformations are marked.

The clinical diagnosis is next. Clefts are subdivided according to those of the lip, of the alveolar process, of the hard and the soft palate, for the

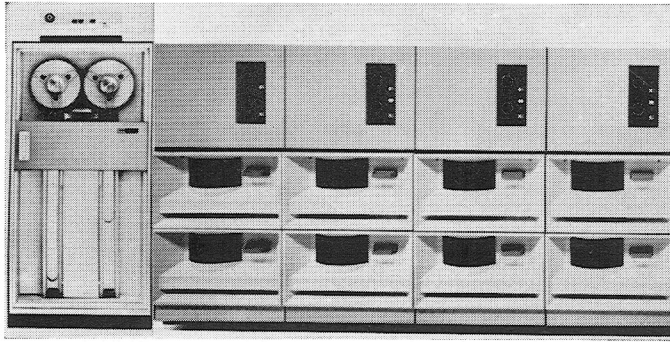


FIGURE 5. Magnetic tape drives (left) and disk storage (right) for storing data.

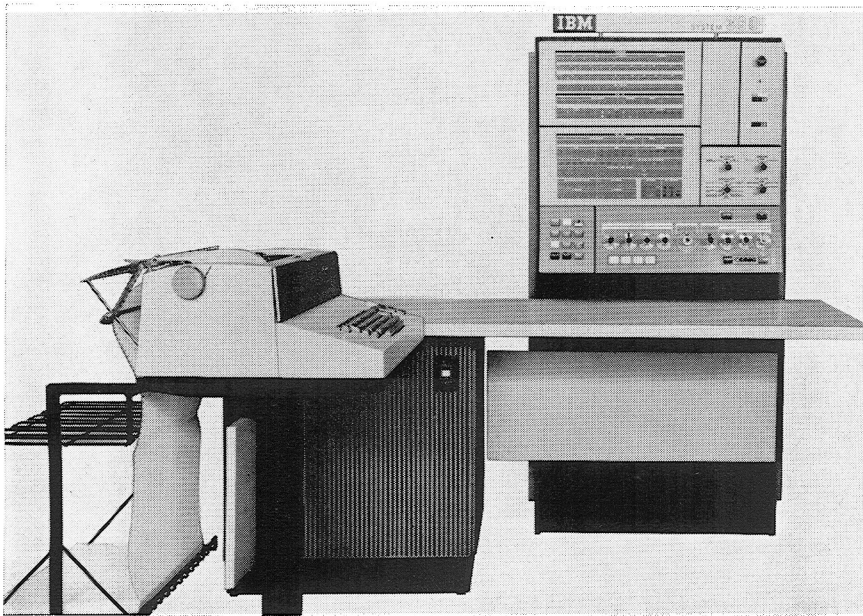


FIGURE 6. Electronic data processing system IBM 360/30 (central processing unit) with console.

left or the right side respectively. For the purpose of failure control and for that of approval of plausibility, the absence of a cleft has to be marked for each anatomical region and for each side specifically.

After marking the date of operation (month and year), the chosen method for plastic repair of the cleft lip should be indicated. If no cleft lip repair was performed, the total block, represented by a different intensity of color, will be marked "no" in the corresponding field.

Then the type of closure of the gap of the alveolar arch is marked, stating whether or not a tilted vomer flap was used, with or without

NUMMER DER KRANKENGESCHICHTE 1968/1784

GEBURTSDATUM 4/1955
 MAENNLICH
 HEREDITAET
 SONSTIGE MISSBILDUNGEN
 SIEHE BEMERKUNGEN

ERSTAUFNAHME NR.1955/1370

DIAGNOSE	LINKS	VOLLSTAENDIGE SPALTE	LIPPE KIEFER HARTER GAUMEN WEICHER GAUMEN
	RECHTS	UNVOLLSTAEND.SPALTE	LIPPE HARTER GAUMEN
		VOLLSTAENDIGE SPALTE	WEICHER GAUMEN

OPERATIONSdatum 11/1955
 LINKS LIPPENSPALTPLASTIK NACH LE MESURIER
 LINKS KIEFERSPALTPLASTIK MIT VOMERKIPPLAPPEN
 LINKS PRIMAERE OSTEOPLASTIK
 MIT SOLIDEM KNOCHENSPAN UND BONE CHIPS

KIEFERORTHOPAEDISCHE BEHANDLUNG VOR UND NACH DER OP.

FOTOS ROENTGENAUFNAHMEN MODELLE

BEMERKUNGEN VENTRIKELSEPTUMDEFEKT

WIEDERAUFNAHME NR.1956/0028

OPERATIONSdatum 01/1956
 RECHTS LIPPENSPALTPLASTIK NACH LE MESURIER

KIEFERORTHOPAEDISCHE BEHANDLUNG VOR DER OPERATION
 FOTOS ROENTGENAUFNAHMEN MODELLE

FIGURE 7. Section of an automatically printed brief patient record in full text.

the help of a primary or secondary bone grafting. In case of osteoplasty the type of transplanted material must be stated specifically.

In the column "cleft palate repair", the following markings are filled in: total, hard palate only, or soft palate only. For the type of typical operations used, frontal and dorsal or only dorsal pedicled flap in different combinations, the methods of Pichler, Schweckendiek, and other authors are rubricated. In the same column an eventual tonsillectomy in

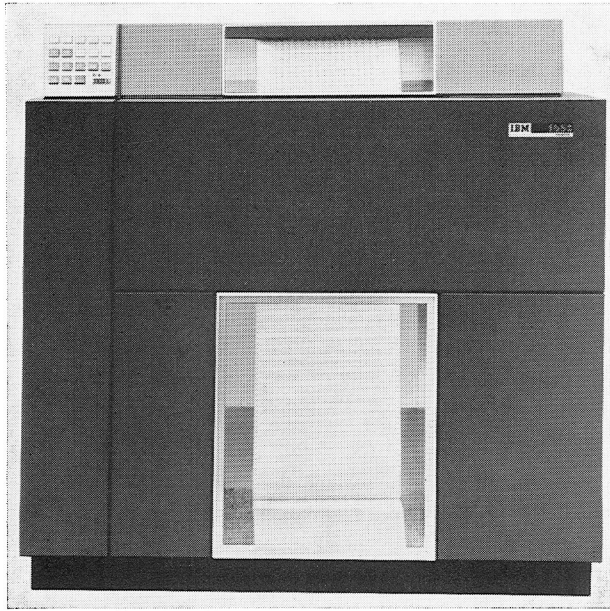


FIGURE 8. Rapid printer IBM 1403.

case of cleft palate is marked. The lengthening of the columella according to a specific technique is also stated.

Corrective operative procedures are correlated with anatomical regions, such as nose, lip, vestibulum, and palate. The transversal enlargement of the upper lip according to Abbe-Neuber is stated separately.

After that, the marking of speech improvement operations is undertaken. In addition, information about orthodontic treatment before or after operation or at a later time is given.

Furthermore, a field is reserved for the indication of eventual complications, such as frontal or dorsal remaining fistulae, either directly behind the alveolar arch or at the margin between hard and soft palate, infection, secondary healing, and hemorrhage.

For further information, it is stated in the lower part of the marking document whether operations of the nose, lip, alveolar arch, or palate have been performed elsewhere. Further marking fields are reserved for existing photographs, x-ray films, and plaster models.

In the case of a "yes" in the column "remarks", noncodable information may be written in capital letters, indicating the number of the patient's record. This type of combined data sheet (12) is processed by an optical mark page reader after work-up. The text formerly written in capital letters is manually punched on cards by an office girl (Figure 9).

On the right side of the marking document, the postoperative results

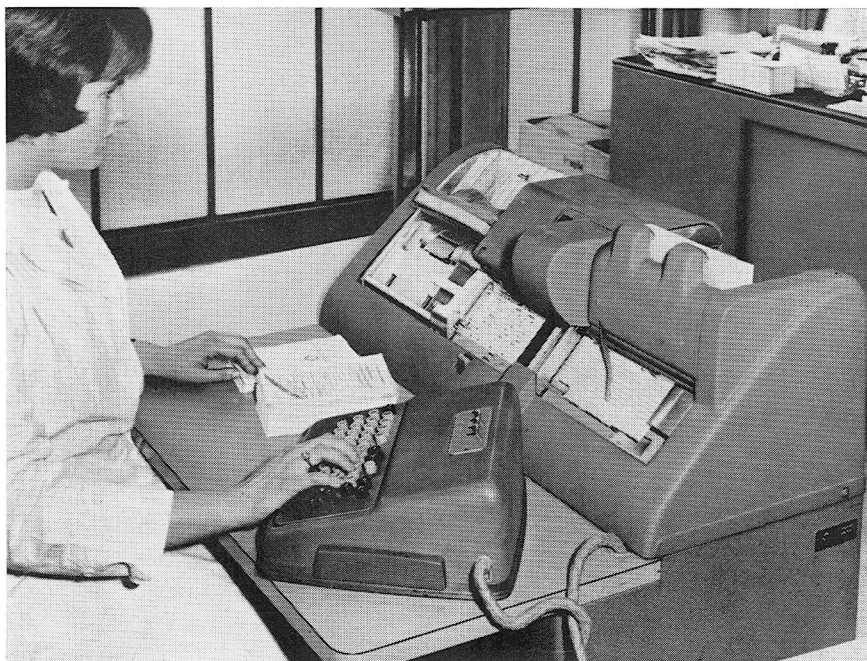


FIGURE 9. Manual punching with interpreting card puncher IBM 026.

are classified including the re-examination date, using a special key for marking. The anatomical, aesthetic, and functional result in its entirety will be graded from *one* to *five*, subdivided into right and left side. The anatomical regions necessary for correction may also be marked. They are subdivided as follows: for the nose: columella, tip, ala, floor, and lumen; for the lip: height, breadth, mucocutaneous ridge, vermilion border, and scars.

Indications are made concerning the adequacy of the sulcus, whether it is of normal size, is too flat, or whether there exists an oronasal fistula or an alveolar cleft.

In complete bilateral clefts the position of the premaxillary bone becomes especially important. Deviations in three different dimensions, rotations around the vertical axis, and the degree of mobility may be marked. The premaxilla may or may not be absent.

The result of cleft palate repair can be documented by the following criteria: optimal; frontal or dorsal fistula; or too short, immobile, or scarred palate.

In the field "occlusion", dysgnathias in the vertical, horizontal, and sagittal planes are categorized for three degrees of deviation. Furthermore, the possibility of bite-correction by means of operative or conservative orthodontic treatment can be marked. A column for possible mental retardation is available.

Speech improvement following cleft palate repair is marked accord-

ing to four categories. In addition, an indication is made as to whether the patient has had speech training. In the last column, various disturbances related to the middle ear are recorded.

Advantages of Electronic Data Processing in Cleft Palate Surgery

What is the immediate advantage of this new procedure for collecting and processing medically important data? According to Ehlers and Wick (4), it constitutes the only practical procedure for obtaining information from clinical findings. It has the further advantage that in large cleft palate centers, important and accurate data are available at any time. Statistical analysis may be programmed in advance and fed into the computer in order to obtain any result under consideration. For instance, the degree of significance of the chi-square test may be derived. Since significant scientific questions for maxillofacial or plastic surgeons remain essentially the same, the preset programs may be applied to ever larger collections of data. The steady increase of the N leads subsequently to results of better clinical relevance and higher statistical significance. Last, but not least, I want to point out that electronic data processing delivers real and actual results at a tremendous time saving and with exceeding accuracy. With the conservative methods of data evaluation, the time necessary for completion of a study may be so long that the results finally obtained may be without any importance.

After surmounting the clinical and technical problems during the initial period, the procedure as proposed has proved to be very useful and profitable for a period of one year in the Westdeutsche Kieferklinik. At this time about 6000 cleft palate operations from 1957 until 1968 have been keyed retroactively in all the aspects mentioned above. Evaluation of computerized data will be accomplished in the central processing unit of the computer center in Duesseldorf by means of an IBM 360/30-unit, two to three times per year. The time necessary for data processing consists of a few minutes only. We expect from these results to find a principally unified way of rehabilitating cleft palate patients, considering individual differences among the patients. For the future we recommend that more cleft palate centers resort to the proposed method of data collection and processing. For maxillofacial departments with fewer cleft palate patients it may prove valuable to participate in a regional cleft palate center, in order to support a common interest in the rehabilitation of cleft palate patients.

Summary

So far only a relatively small number of patients with cleft lips and palates have been followed up and examined regularly. The results therefore have not been uniform and conclusive enough to allow an evaluation of the different methods employed for rehabilitation. For the first time at the cleft palate center of the Westdeutsche Kieferklinik Dues-

seldorf clinical data and therapeutic results have been collected from a total of 5000 patients. To answer defined and programmed questions a computer was utilized. The input data were automatically extracted from a marking document by means of an optical mark page reader. They were then transferred to punched cards and stored on magnetic tape drives or in disk storage. The marking document, designed by the author to collect and process clinical data, is discussed.

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