The Use of Televex in Cleft Palate Research

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In recent years, there has been an increasing emphasis placed upon research in speech generally and upon radiography as a research tool in particular. Static x-ray examinations were used historically in an effort to learn more about the speech mechanism through lateral skull plates. However, this was a highly limited technique because it attempted to reduce dynamic behavior to a single image. The advent of cineradiography and image amplification offered an exciting partial solution because those techniques provided a means for analyzing movement. Methodology presented new challenges to the researcher, especially in the field of speech where new techniques and methods of measurement had to be pioneered. Methodological problems remain the primary concern of interested researchers even as we enter a new era and begin to address ourselves to the currently emerging x-ray television techniques.

The Televex system of the Children's Hospital in Pittsburgh was first used in November of 1960 and involves a television tape recording of the fluoroscopic image mediated through a newly developed Orthicon television camera optically coupled to a nine-inch image amplifier. The system permits recording on television tape and simultaneous viewing on the closed circuit television monitor at the same low levels of radiation that are required for closed-circuit television viewing alone. Satisfactory recordings can be obtained with settings ranging from 0.13 to 0.5 ma and from 60 to 80 kv. A schematic drawing of the equipment appears in Figure 1.

The quality of the taped examinations is excellent, but, as in all technological matters, there are obstacles. With the support of the National Institute of Dental Research, however, efforts are being made to surmount them. It is our purpose here to discuss briefly the problems we encountered and how we have attempted to solve them.

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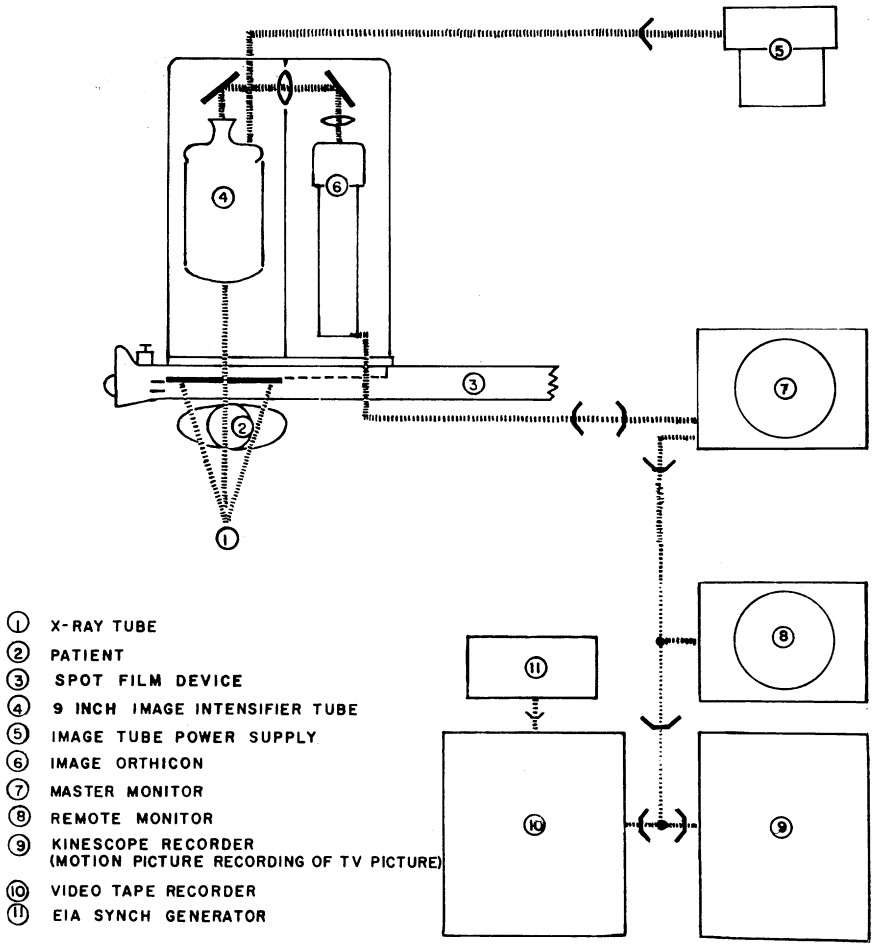

FIGURE 1. Schematic representation of Televex system.

First of all, when the x-ray unit is in position for taking lateral views, the maximum space available is 24 inches. This limitation presented real problems in developing a means for head stabilization. At first, we tried to get along without positioning but learned very quickly that, no matter what other views to the contrary may exist, there must be some standardized procedure for assuring comparable position from one subject to another and for collecting data that can be quantified. We finally got over the first hurdle by purchasing a Wehmer cephalometer and adapted it to our own equipment through the help of Westinghouse engineers. Figure 2 shows the head holder in place. The chair on which the subject is seated is also a Wehmer product and can be raised and lowered in order to make proper adjustments. This arrangement is, we believe, essential to the successful study of the speech mechanism.

A second problem area lies in personnel needs for the equipment. Each

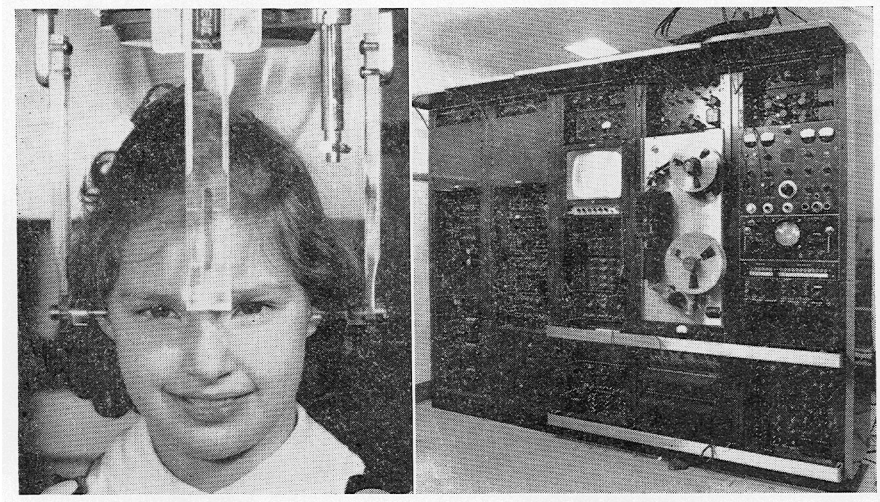

FIGURE 2 (*left*). Technique for head positioning and stabilizing.
FIGURE 3 (*right*). Televex system.

study we have done has involved at least three, and often four, people. A trained radiologist is essential as is an engineer for the control room (Figure 3). A speech researcher must also be present. This team combines the skills that are essential to successful execution of speech studies. However, this type of personnel working with expensive equipment quite obviously increases the cost of research and presents some difficulty in scheduling and coordinating. These things are not serious but they constitute the pesky problems with which all research is encumbered.

A third problem with this procedure lies in the analysis of data. Television tape must be viewed dynamically. It cannot be stopped so that a single segment can be analyzed, structures measured with precision, and tracings done. One way to accomplish this is to transfer the material on the tapes to 16 mm motion picture film. At first, this sounded simple and we had faith that it could be accomplished with dispatch. Unfortunately, after some experience with the technique, we now have considerably more understanding and a little less faith. We are frank to admit that we are not satisfied with the film results. The television tapes, which we cannot use for certain purposes, present a clear and well contrasted study. Contrast is excellent even without the use of radio-opaque materials and definition is often superb. However, x-ray studies are not standardized examinations to the extent that people are not standardized. This is especially true when the research population is made up of individuals with congenital anomalies and deviation in growth resulting in skeletal asymmetries of skull and facial bones. There are differences in the density of bone and soft tissue. Cavities, with which we are so greatly concerned, vary in size and shape. These things must all be taken

into account in the transfer of tape to film and in the developing of negatives. It often means that the film laboratory must process film using a variety of exposure and timing plans. While this can certainly be done, most commercial photographers are unwilling to exercise the care necessary to achieve the kind of results which we need. We are currently of the opinion that a negative film with synchronized sound tract is superior for research purposes to any of the positive films we have tried to study. The negatives are readable and they are traceable (although we are firmly persuaded that the tracing process is probably not the best solution to quantification of these data). More than that, direct analysis of data from television tape is proving to be possible and quite useful.

The advantages of Televex are many. Low exposure with resulting patient safety makes it possible to sample complex and extended speech behavior. Theoretically it would be possible to study a single patient for five to 10 minutes at radiation levels lower than those necessary for a single traditional spot film. Our own studies generally run from three to five minutes so that our behavioral samples of cleft palate speakers who constitute our research population are relatively extensive. This longer look has led us to attempt to develop our data in a much more dynamic manner than has previously been done. It is apparent for example, that studies analyzing palatopharyngeal behavior on isolated vowel sounds will yield information only on the vowels studied and cannot provide answers to what occurs in connected speech. It is equally apparent that velopharyngeal closure does not occur in a single dimension and that what looks like a closed airway in an anteroposterior dimension may not be such if vertical dimensions are added. We have yet to solve the problem of getting views of structural relationships lying in planes other than those visible from lateral views. There is no question, at the end of more than three years of looking, that swallowing and blowing are functions which are separate and distinct from speech so far as total physiology is concerned and that adequacy during one is not necessarily a predictor of adequacy in another. If we have learned anything at all from this experience, it is that our studies of the speech mechanism have been too limited in scope and that any single measurement tends to obscure actual relationships that may exist between anatomy and physiology and the speech end-product. An example of this is that a slightly short, thick, mobile palate seems to produce speech that is considerably less nasal than does a short, thin, mobile palate. Our experience suggests that studies broad in conception may be necessary to provide realistic direction to more specific studies.

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