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Palatography and Myo-functional Therapy

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Several methods have been utilized as measurement procedures in swallowing research. Among them, the most commonly used appear to be clinical inspection (Hanson, 1969), cinefluorography (Hanson, 1969, 1970, Rosenblum, 1963), pressure transducement and palatography (Kaires, 1957, Kydd, 1964, Ladefoged, 1957, Mason, et al., 1974, Proffit, 1972). Cinefluorography and some forms of pressure measurement and palatography require extensive equipment and laboratory setup. These requirements essentially preclude their use in the everyday clinical activities of the myo-functional clinician.

The purpose of this article is to report on the use of a rather simple method of palatography to supplement clinical inspection in the evaluation of swallowing patterns. This method allows inspection of contact zones made by the tongue against the palatal and dental structures during deglutition.

Palatography has been extensively used by speech scientists and linguists to evaluate tongue-palate-dental contact zones during articulation. The specific procedures used in palatography vary. Indirect palatography utilizes a pseudopalate coated with a material which is easily removed upon contact by the tongue. In this procedure, after the articulation under study has been completed, the pseudopalate is removed for analysis. Direct palatography is achieved by coating the subject's palate with materials such as activated charcoal mixed with chocolate and then the palatogram is obtained by photographing the contact zones for analysis. (Moses, 1964).

Kydd and Belt (1964) utilized a method of palatography which allowed analysis of dynamic and continuous contact during articulation. They placed pressure transducers at strategic positions on a pseudopalate made of transparent plastic. When the tongue contacted one of the transducers, an electrical measurement of the contact was amplified and processed through a readout system. This procedure allowed sequential articulation to be analyzed in terms of tongue-palate-dental contact zones.

More recently, Proffit (1972) conducted longitudinal tongue pressure studies of both normal and lisping subjects during swallowing and articulation utilizing tiny strain gage transducers mounted in a palatal appliance. Computer printout of the analogue pressure waves produced by tongue contact on the transducer allowed analysis of pressure, duration of contact, area under the pressure curves (time-pressure integral) and time relationships between pressure curves at the recording locations on the pseudopalate. Significant dif-

ferences in mean time-pressure integrals around the maxillary arch for utterances of /isi/ among two lisping groups and one normal group were found. Although the methodology undoubtedly was valid and reliable, its equipment and laboratory requirements essentially preclude its use clinically.

Direct palatography is a rather simple technique achieved by coating a subject's palate and dental structures, producing the sample of articulation, and then photographing the palate and dental structures for analysis. This method has the disadvantage of being two dimensional as contrasted with the three dimensional pseudopalate method, or the continuous record revealed by pressure transducers, but has the advantage of being inexpensive and clinically more practical.

Subjects and Methodology

It was the intent of this study to determine the reliability of simple direct palatography in analyzing tongue contact zones on the dental and palatal structures during swallowing, and to utilize this procedure to discriminate between swallowing patterns which had been clinically evaluated as either tongue-thrust or normal.

Twenty subjects were used as the experimental group in this study. Each subject had been referred by various orthodontists to one of three speech pathologists specially trained in myo-functional therapy for tongue thrust swallow. Using criteria previously reported (Hanson, Barnard, Case, 1969), the diagnosis of tongue thrust was confirmed. Prior to the initiation of myo-functional therapy for each subject, a direct palatogram was obtained. Since it was important that the subjects did not know the purpose of the palatogram, specific instructions were given to insure good results without a verbal artifact influencing the procedures or results. Each subject was seated in the room where the palatogram was to be obtained and given the following verbal instructions:

I want to see where your tongue contacts when you swallow. I will first put some honey on your teeth and the roof of your mouth. Then I will spray your mouth with the powder (50% activated charcoal and 50% chocolate powder). Then I want you to swallow as naturally as possible. Be sure your tongue touches your mouth only during the swallow. Do not let your tongue touch anything either before or after you swallow. Open your mouth widely after you swallow.

The subject was then taken through a practice run to determine if the instructions were understood. The subject was then prepared for the swallow, asked to swallow, and then photographed using a Polaroid CU-5 Dental Camera with palatal reflector. The photographic record obtained became the first palatogram (before therapy) for the experimental subject. Each subject was then given therapy for the tongue thrust utilizing a program modeled after Barrett and Hanson (Hanson, 1967). After the therapy program had been completed and the subject's swallowing pattern evaluated as "normal", the subject was seen for the second palatogram (after therapy) using the same procedures. These procedures were followed for each of the twenty experimental subjects.

Twenty control subjects were also chosen by matching to the experimental subjects on the variables of age, sex, dental occlusion, palatal contour and symmetry, and degree of tongue thrust swallowing pattern. Palatograms of the matched control group were taken at the beginning and end of a period of time corresponding to the therapy time for the experimental subjects. The same palatographic procedures were used for each group.

Analysis of the Palatograms

Each palatogram in this study (80 total: 2 for each experimental subject and 2 for each control subject) was evaluated independently by three judges. In no instance did

a judge know whether a particular palatogram was taken of an experimental or control subject, or whether it was a first or second palatogram. The judges only knew that some were taken of swallows clinically evaluated as being tongue thrust, and some of normal swallows.

The judges first evaluated the area of the central and lateral incisor teeth and decided whether the palatogram indicated tongue contact. If yes, the degree of contact (light, moderate, heavy) was evaluated. Following these procedures, the palatograms were evaluated in the areas of the cuspids and premolars (first right side, then left), molars, hard palate, and rugae. The judge was then asked to make a general statement concerning the palatogram: Palatogram indicates an essentially normal swallowing pattern, or an essentially tongue-thrust swallowing pattern.

Results

Hypothesis #1: Reliability of palatographic analysis. (Accepted) It was determined that judges could reliably determine on a judgement-rejudgement basis the nature of a palatogram (tongue thrust or normal). The data obtained from re-analysis of twenty of the original eighty palatograms as compared with the original analysis for each of the three judges were as follows:

Judge #1: Point-biserial correlation of .90
Judge #2: Point-biserial correlation of .88
Judge #3: Point-biserial correlation of .87

These correlation coefficients were all significant beyond the .01 level and allowed acceptance of the hypothesis of judgement reliability.

Hypothesis #2: The first (pre-therapy) and second (post-therapy) palatograms of the experimental group would be judged significantly different, and the difference would parallel the clinical distinction of tongue thrust versus normal swallowing pattern. (Accepted) the McNemar X^2 obtained was 4.92 ($p. < .05$) and allowed acceptance of the change hypothesis for the experimental group. It was apparent that the pre-therapy palatograms were different in a predictable way from the post-therapy palatograms. The specific nature of the difference was obtained by analyzing in great detail the nature and degree of contact on the structures being analyzed as revealed by the palatograms. The data were too numerous to report completely in this article. However, a conclusion of the data would be appropriate. It was found that the most discriminating difference between the first and second palatograms of the experimental group was the lack of contact on the incisor teeth during swallowing in the second (after therapy) palatograms.

Hypothesis #3: The first and second palatograms of the control group would not be judged significantly differently and the patterns demonstrated would parallel the clinical evaluation. (Accepted) The McNemar X^2 of .00 ($p. > .05$) allowed acceptance of the sameness hypothesis. Therefore, it was apparent that the palatograms of the control subjects did not change over time and the pattern demonstrated was consistent with the clinical evaluation of tongue thrust. Further analysis revealed that all structures analyzed on the control group palatograms indicated severe contact on both first and second palatograms.

Discussion

The data in this study indicated that persons who have been clinically judged as having a tongue thrust swallowing pattern will to some degree manifest in a predictable

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April, 1975

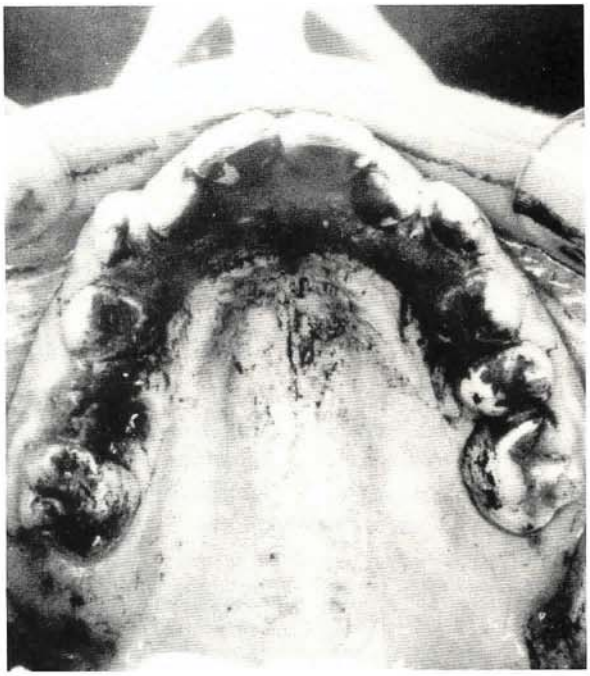


FIG. 1 Experimental S # 20 Second palatogram (after therapy) Judged Normal

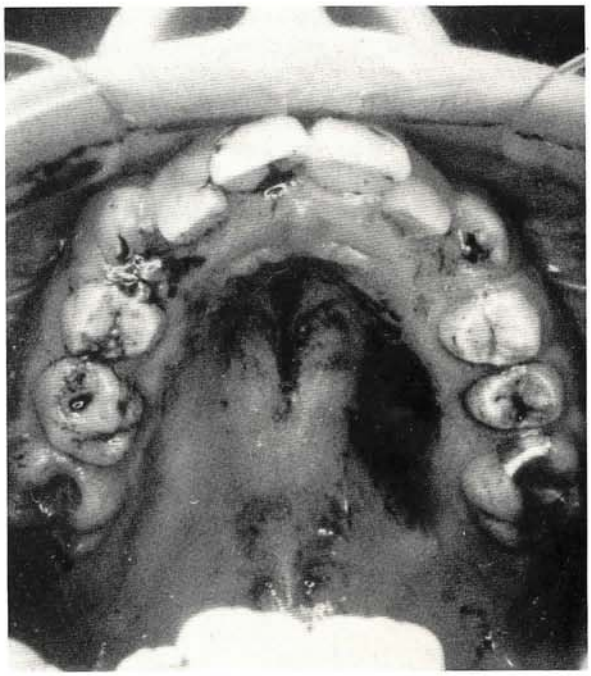


FIG. 2 Experimental S # 20 First palatogram (pre-therapy) Judged tongue thrust



FIG. 3 Control S # 20 First Palatogram Judged tongue thrust

way a tongue thrust pattern on a direct palatogram. On the contrary, subjects treated for tongue thrust and clinically judged as having a normal swallowing pattern manifested a lack of tongue contact on the dental structures on a direct palatogram. These differences were particularly disciminable in the area of the incisor teeth.

Figure 1 shows a typical palatogram which was judged as demonstrating a normal swallowing pattern. (Photo of Experimental Subject #20 second palatogram, judged normal) Note the activated charcoal and chocolate powder remained on the dental arch and in the anterior rugae area, but significant contact in the palatal area and posterior rugae is shown.

Figure 2 shows this same experimental subject's first (pre-therapy) palatogram (Photo of Experimental Subject #20, first palatogram, judged tongue thrust) Note tongue contact on all dental structures, rugae, and partial palatal area was revealed. This palatogram was judged as manifesting a tongue thrust swallowing pattern, consistent with the clinical evaluation.

Figures 3 and 4 show typical control subject palatograms (first and second respectively). (Photographs of Control S #20 first palatogram for Figure 3 and Control S #20 second palatogram for Figure 4.) These palatograms both reveal severe contact on the complete dental arch and moderate (Figure 3) to severe (Figure 4) contact in the palate areas. These patterns were consistent with the clinical evaluation of tongue thrust.

Conclusion

The procedures of direct palatography used in this study were simple, inexpensive, and graphically revealed differences between normal and tongue thrust swallowing

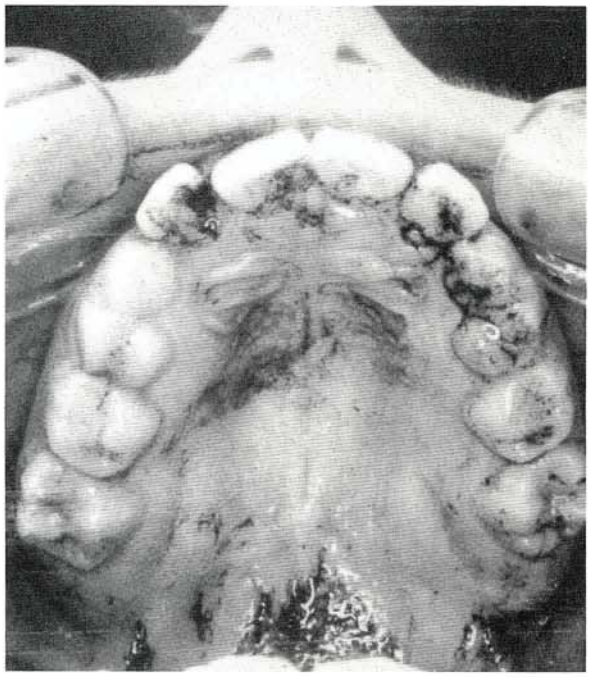


FIG. 4 Control S # 20 Second Palatogram Judged tongue thrust

patterns in a manner consistent with clinical evaluation expectancies. These data reveal that direct palatography can be used clinically to support the myo-functional clinician in establishing an accurate evaluation of tongue thrust. Direct palatography also constitutes a graphic record of contact zones between the tongue and the dental-palatal structures during swallowing.

It should be maintained that these data do not determine the validity of direct palatography in deglutition research other than on the level of "face" or "surface" validity, but that sufficient evidence is presented to justify its use clinically in myo-functional therapy.

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