# Appraisal Of Speech Defects In Dental Anomalies With Reference To Speech Improvement*

JOHN S. RATHBONE, D.D.S. and
JOHN C. SNIDECOR, Ph.D.
*Santa Barbara, Cal.*

In the summer of 1952, Rathbone[5] initiated a study to ascertain the relative effectiveness of the orthodontist in appraising the speech defects of his patients prior to orthodontic treatment. Dr. John Snidecor, Professor of Speech at the University of California, Santa Barbara College, cooperated in devising, testing, and recording techniques and served as criterion judge for this experiment. As this study took form, it was expanded to include the prediction of speech defects from models alone, the relation of the severity of the malocclusion to the severity of the speech defect, and the reappraisal of the speech defect following all orthodontic treatment with no speech correction. It is, therefore, the purpose of this paper to review the results of the original study and to present the results of the reappraisal of the speech defect following all orthodontic treatment with reference to speech improvement. This is a report of a clinical study which was done with a limited population and with the resources that were readily available.

In the original study ten cases were picked which before orthodontic treatment had various types of malocclusions and definite speech defects. The sample is small, but both authors feel that these ten cases are indicative of what one can expect.

Read before the Angle Society of Orthodontia, Washington, D. C., October, 1957.

Our method of testing was by using test sentences devised by Snidecor. The procedure followed was to have the orthodontist rate the severity of the malocclusion, the models were then examined by the speech therapist to determine what dental sounds he would predict as defective and the degree of predicted deviation. Each patient was then asked to read the test sentences and all defects were noted and graded by each examiner. All procedures of testing were done independently by each examiner. The above testing was done prior to orthodontic treatment.

Of the ten subjects in the original study, four presented very marked malocclusions, four had marked malocclusions and two had slight malocclusions. All subjects presented normal hearing and intelligence. Orthodontic correction was oriented toward effective structures for speech as well as toward the more traditional goals of the orthodontist. Pound[4] and others have pointed out clearly the need for such considerations.

The test sentences used in the original study and in the reappraisal are stated directly below:

### TEST SENTENCES

1. Post-dental (tongue back of the anterior teeth) *n, t, d, r, l, s, sh, z, zh, y.*

   *n* - Her name was Ann and she lived near Dan.

*t* - Terry counted the kittens and took three for his sister.
*d* - Donald did not have the doll or the dog, but he did have an old radio.
*r* - Roy watched the rabbit run around the chair.
*l* - The lad lit the lamp and did his school work.
*s* - The six sisters in red dresses sang school songs.
*sh* - She washed the dishes and put them on the shelf at the shop.
*z* - The boys were surprised at the zebra in the zoo.
*zh* - Their father hid the television set in the garage.
*y* - The young girl was amused by the three yards of yellow yarn which she found in the yard.

2. Lingua-Dental (tongue and teeth sounds) *th* (unvoiced) *th* (voiced).
*th* (unvoiced) - The thin thief stole the three thimbles, but could find nothing else.
*th* (voiced) - That lathe belongs to my father and brother.
3. Labio-dental (lip and teeth sounds) *f, v.*
*f* - His father found the loaf of bread and coffee on the sofa.
*v* - He has seven vests, one for every suit.
4. Post-dental Combinations (tongue back of anterior teeth, each sound is a combination of two sounds) *ch, j.*
*ch* - The teacher told the children to chew the cherries carefully.
*j* - Jack ate the jam and drank his orange juice.

Stated very briefly the major conclusions from the first study were as follows:

1. The nature and history of the problem were presented.
2. The use of simple test sentences as a means of diagnosing speech defects proved to be a reliable guide for the orthodontist. This assumption is based on the percentage agreement, 91.4%, reached by the orthodontist with the speech therapist in regard to the more common dental fricative sounds, *s, sh, z* and *zh*. When all dental sounds were considered our percentage agreement was only 51.3%, a figure which could be expected as a result of the lack of speech training on the part of the orthodontist.
3. There is no one-to-one relationship between the severity of the malocclusion and the severity of the speech defect. This is in keeping with the findings of Kessler[3] who has pointed out that many individuals with malocclusions have satisfactory speech by virtue of their ability to compensate in producing sounds. The previous works of Bruggeman[1] and Fymbo[2] support this view. For the same reason models alone in judging defective sounds were found to be insufficient in accuracy for the prediction of faulty dental sounds.

## Four Year Re-evaluation, with Reference to Speech Improvement

After a period of four years, eight of the ten original subjects were available and re-examined with the same speech test stated above. In view of the fact that the speech correctionist was a more critical judge than the orthodontist, only his test results were utilized. It was also thought that the continuous contact with the subjects might cause an unintentional and unpredictable bias on the part of the orthodontist.

Conditions established for the re-evaluation were as follows:

1. At the time of the first test and the beginning of orthodontic treatment public school speech therapists and parents were re-

quested not to institute speech therapy until dental correction was completed.
2. The speech re-test was completed without reference to the results of the test administered four years before.
3. Prior to re-test all orthodontic treatment had been completed, both active and retentive.

Upon original examination all of the subjects presented highly noticeable defective speech. Of the sixteen dental sounds tested a mean of 6.4 sounds were found defective for all ten subjects, and a mean of 6.4 for the eight subjects here reported. One subject presented only three faulty sounds in the original test, whereas another subject had twelve faulty sounds.

When all subjects are considered, one finds that all dental sounds were faulty, but that errors tended to concentrate on the dental fricatives, *s, z, sh, zh,* and *th.*

In the second test the same concentration of errors in a milder degree occurred in these fricatives with fewer errors in the other dental sounds. Careful study of the final casts indicated few, if any, residual organic and structural reasons for residual defective sounds. If the speech therapist had judged faulty sounds from the casts alone, as he did in the first study, few, if any, sounds would have been predicted as faulty.

Despite residual errors in all cases the spontaneous improvement in speech articulation following orthodontic correction was dramatic. Without speech correction faulty sounds dropped from a mean of 6.4 to a mean of 1.5. In other words, for eight cases and from sixteen sounds tested a mean of 6.4 sounds was found defective before orthodontic treatment, and a mean of 1.5 sounds was found faulty four years later when re-tested using the same test sentences. The residual speech errors noted on re-testing were observed only in the highly noticeable fricative sounds.

Because all of the subjects presented normal intelligence, normal hearing, and now present excellent to good occlusion, it can readily be predicted that speech therapy should be highly productive at this time and would probably eliminate all noticeable errors in the articulation of the remaining faulty fricative dental sounds.

The following case, which is demonstrated in Figure 1 left, was selected as an example because of the severity of the malocclusion and the various dental conditions present which could contribute to defective speech.

This subject was a female eighteen years of age who had a very marked Class I malocclusion. This case presented the following dental conditions pertaining to speech: 1) high palate, 2) narrow maxillary width due to crossbite on the right side, 3) severe maxillary anterior rotations, 4) maxillary anterior spaces, 5) thick maxillary anterior alveolar ridge, and 6) a mild maxillary protrusion. About the only dental condition missing was an openbite and in this case the bite is slightly closed.

The treatment of this case involved the extraction of the four permanent first bicuspids and the placement of edgewise bands on all mandibular and maxillary teeth including second molars. Active treatment with a series of archwires and the employment of elastics took a period of approximately twenty-two months. At this time all bands were removed and a removable maxillary Hawley plate with a fixed mandibular cuspid to cuspid retainer were placed. The retention period covered eighteen months during which the maxillary retainer was worn continuously for twelve months and at night only for the last six months. This subject was continued under observation following retention and the case has maintained itself in

excellent condition, as shown in Figure 1 right. Considering the age of this patient, the results achieved were most gratifying.

## Summary

Based on a study of subjects prior to

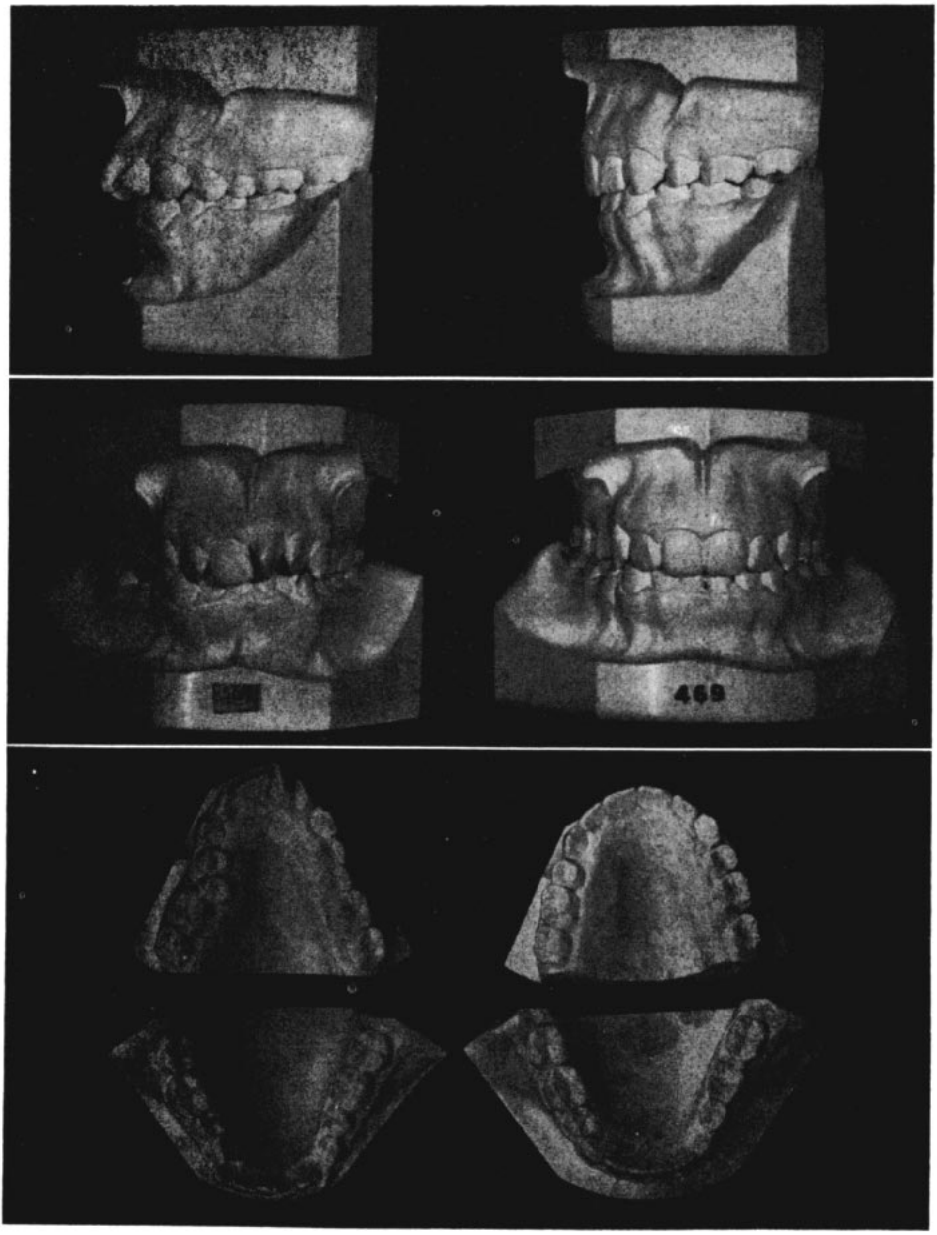

Fig. 1 Left, before treatment with defective sounds *t, d, r, s, l, sh, z, zh, th, ch,* and *j*. Right, following treatment with residual defective sounds *s, z,* and *th*. The high palate is still present and a mild overbite; these two factors could cause residual speech errors in that the combination of the two could affect correct tongue placement for maximum results. Slight maxillary anterior spaces not shown in the photographs are contributing factors.

orthodontic treatment and a re-study of them four years later following all orthodontic correction, the conclusions stated below appear tenable:

1. Orthodontic treatment without speech correction reduced the number of faulty dental sounds from a mean of 6.4 to a mean of 1.5. Subjects were intelligent and had normal hearing.
2. Despite orthodontic treatment, residual speech errors were observed in the highly noticeable fricatives *s, z, sh, zh,* and *th,* but to a lesser degree both qualitatively and quantitatively. Other dental sounds had improved to the point where errors were not detectable.
3. A careful study of the final casts indicate few, if any, reasons for these errors and point to the need for speech therapy with an optimistic view for perfect or near perfect speech.
4. Generally speaking, this study supports the view that improved structural factors predict improvements in speech with residual errors that can be reduced or eliminated through speech therapy.

## Practical Application of Speech in an Orthodontic Office

Using this study in conjunction with the work of Bruggeman[1] and others, we believe there are definite applications of speech testing and recommend that these can be followed in the orthodontist's office. These recommendations concern three factors which should be discussed with the parents:

1. Testing and evaluation of defective sounds by use of test sentences previously outlined.
2. General development of speech sounds, especially the dental sounds.
3. Dental anomalies associated with speech defects, and predicted improvement resulting, in part, from orthodontic correction.

In considering the testing and evaluation of defective sounds, it must be simple and require little time, as speech is only a small part of an orthodontic diagnosis. Such testing by the orthodontist has been shown to be valid and can be done by simple test sentences or words selected from such sentences when reading skill is limited. By actual testing, the orthodontist is in a position to confirm whether the patient has a speech defect or not.

The next step is to explain the general development of speech. This can be stated simply that speech sounds, except the very simple vowels, develop in a normal child gradually and progressively until the seventh year and that most, if not all, of the sounds will be articulated correctly. Speech is a learned process, and a child will assume the speech standards that exist in his environment. One simple way of grading the difficulty of speech sounds was shown by Wellman[6], Case, Mengert and Bradbury, in which they considered the age at which the sounds in question are made correctly by 75% of the children tested. The following is their reference table for dental sounds adapted from *Speech Sounds of Young Children*:

1. 75% at 2 years of age - *n, t, d.*
2. 75% at 3 years of age - *f, z.*
3. 75% at 4 years of age - *v, r, l, y* (you), *ch, j,* (judge).
4. 75% at 5 years of age - *th* (voiced), *th* (unvoiced), *s, sh, zh* (measure).

Perfection in their production for most children need not be expected until about their seventh birthday. The parents should now have an idea on how speech sounds develop and why their child of six to eight years with spaces or unerupted laterals should hiss when making an s sound. Group four sounds are all friction sounds and de-

pend to a marked degree on effective structure and function of the articulatory mechanism.

The next step which should be discussed is that of the dental anomalies which are associated with speech defects. For this purpose, the graduate thesis of Bruggeman[1] was used, utilizing only the results of the female group, because females are able to produce better speech where the abnormal occlusion is the same.

The following dental anomalies are associated with speech. The sounds expected to be found faulty are listed with each dental anomaly.

Spaces — all dental sounds except *n* and *y* especially *s, sh, z, zh* are friction sounds.

High palate — dental sounds *s, z, th, r* and *l.*

Width of arch — dental sounds *s, z, th.*

Open bite — dental sounds *s, sh, z, zh, th,* and, occasionally, *t* and *d.*

Degree of Protrusion — dental sounds *s, sh, z, zh*
other friction sounds and, occasionally, other dental sounds.

Thickness of alveolar ridge in upper anterior region — dental sounds *s, sh, z,* the friction sounds.

Severity of rotated teeth — same as spaces.

The orthodontist is now in a position to point out what dental conditions exist in the malocclusion that *could* contribute to the child's speech defect. As previously shown, a child or person has the ability to compensate for defective structure in the production of sound, and for this reason one cannot predict that a definite dental condition will cause a definite speech defect. Such dental conditions can only be a guide in the consideration of any speech defect.

After consideration of all these factors, and where the malocclusion is severe and can be a factor in defective speech, it is frequently our recommendation that speech therapy should be delayed until orthodontic treatment is completed or well under way. Likewise, defective speech can be a factor as to the time to institute orthodontic treatment in order that the child may have a better oral mechanism with which to articulate the dental sounds.

The recognition of speech defects is another service that orthodontists can render their patients in considering any malocclusion. Such recognition could be the deciding factor in the determination of when to start treatment. Improvement in speech can be predicted with improved structural factors and any residual errors can be reduced or eliminated by the process of learning.

Therefore, the orthodontist's responsibility to speech disorders is, first, to be able to recognize defective sounds and to recognize the importance the dental structure has in relation to the production and articulation of speech sounds. Second, it is his responsibility to place the oral structure in the most normal possible relationship so that rehabilitation of speech can be accomplished.

*1808 State St.*

## Bibliography

1. Bruggeman, Carl F.: A Study of the Relation of Malocclusion of Teeth and Oral Deformities to Articulatory Defects of Speech in Children, Unpublished thesis, University of Iowa, 1934.
2. Fymbo, Floyd H.: The Relation of Malocclusion of the Teeth to Defects of Speech, *Arch. of Speech,* 1: 204-216, 1936.
3. Kessler, Howard E.: The Speech of Your Young Dental Patients, *Dental Survey,* August 1951.
4. Pound, Earl: Esthetic Dentures and Their Phonetic Value, *J. of Prosthetic Dentistry,* 1: 98-111, 1951.
5. Rathbone, John S.: Appraisal of Speech Defects in Dental Anomalies, *The Angle Ortho.,* 25: 42-48, 1955.
6. Wellman, B. L.; Case, I. M.; Mengert, I. G.; Bradbury, D. E.: *Speech Sounds of Young Children,* published by the University of Iowa, Iowa City, 1931.