

A PRELIMINARY STUDY ON THE SIMULTANEOUS RECORDING  
OF LARYNGEAL MUSCLE ACTIVITIES AND THE GLOTTAL SHAPE  
DURING SPEECH UTTERANCE

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In order to study the laryngeal control for voiceless consonants, a laryngeal view through the fiberscope <sup>1)</sup>, electromyograms of the intrinsic laryngeal muscles, and speech signals were recorded simultaneously.

In the present study, sequential changes of glottal width were examined in correspondence with electromyography during speech utterance.

Experimental Procedures:

The object laryngeal muscles we selected were the interarytenoid muscle (INT) and the posterior cricoarytenoid muscle (PCA). These two muscles were reported to act reciprocally with each other. <sup>2)</sup>

The voiceless consonants were /t/, /s/ and their geminates /Qt/, /Qs/, which were placed in the same vocalic environment in test words.

Test words were as follows:

/seHteH/

/seQteH/

/teHseH/

/zeQseH/

These are all meaningful Japanese words uttered without accent in the Tokyo dialect.

These test words were uttered eight times in random order by an adult male speaker of the Tokyo dialect.

A fiberscope was inserted through the nose of the subject and positioned in the hypopharynx so as to obtain a good view of the glottis during the utterance. The glottal view was photographed by a 16 mm cine-camera at a rate of 50 frames per second. As a measure of the glottal width, the distance between the vocal processes was measured frame by frame. The electromyogram of the INT and PCA was recorded using hooked wire electrodes inserted orally. <sup>3)</sup>

Speech signals, electromyograms and the timing mark from the cine-camera were recorded simultaneously on a 7-channel data recorder (Fig. 1). By this method, laryngeal images during the utterance, electromyograms and speech signals could be synchronized (Fig. 2). Electromyograms reproduced from magnetic tapes were fed into a computer (PDP-9) to obtain the averaged electromyogram envelope curve of each muscle (Fig. 3).

## Results:

We may summarize the experimental findings as follows:

1. The PCA and the INT show a reciprocal pattern in electromyographic activity during speech.
2. The degree of the glottal opening and the electromyographic activity of the PCA increase during the utterances of /t/, /Qt/, /s/ and /Qs/ in this order.
3. PCA activity is seen during an opening phase of the glottis.
4. The peak of PCA activity is seen 40 - 50 msec. prior to the peak of the glottal width for the voiceless consonant.

## References

- 1) M. Sawashima and S. Miyazaki: Glottal Opening for Japanese Voiceless Consonants. Annual Bulletin, (Research Institute of Logopedics and Phoniatics) No. 7 1-9, 1973.
- 2) H. Hirose and T. Gay: The Activity of the Intrinsic Laryngeal Muscles in Voicing Control: An Electromyographic Study. Status Report on Speech Research (Haskins Laboratories) SR-28, 115-142 (1972).
- 3) H. Hirose: Electromyography of the Articulatory Muscles: Current Instrumentation and Technique. Status Report on Speech Research (Haskins Laboratories) SR-25/26, 73-86 (1971).

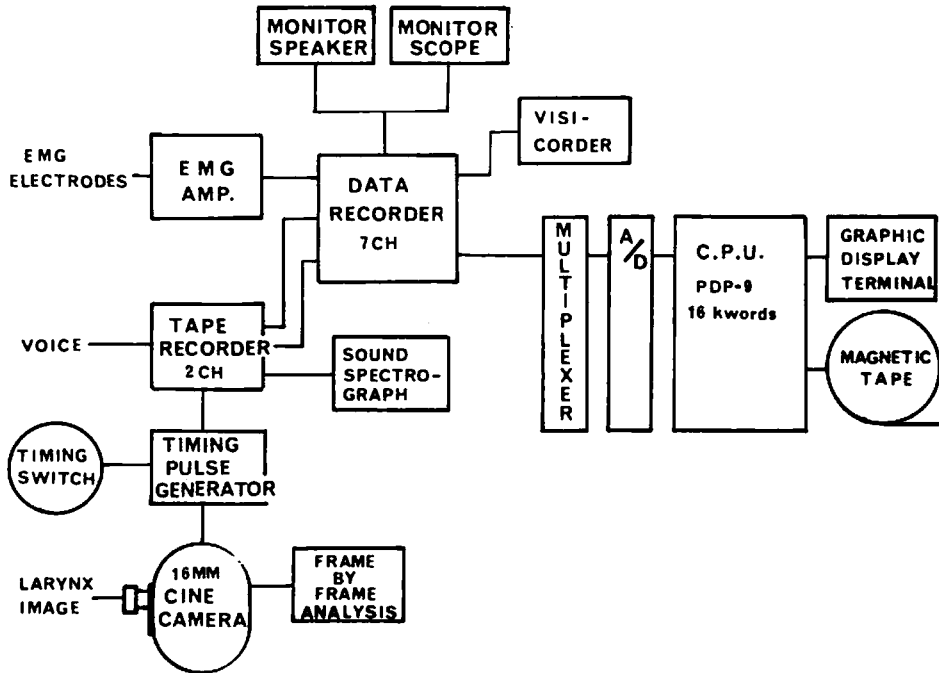


Fig. 1: Block diagram of the experimental set-up.

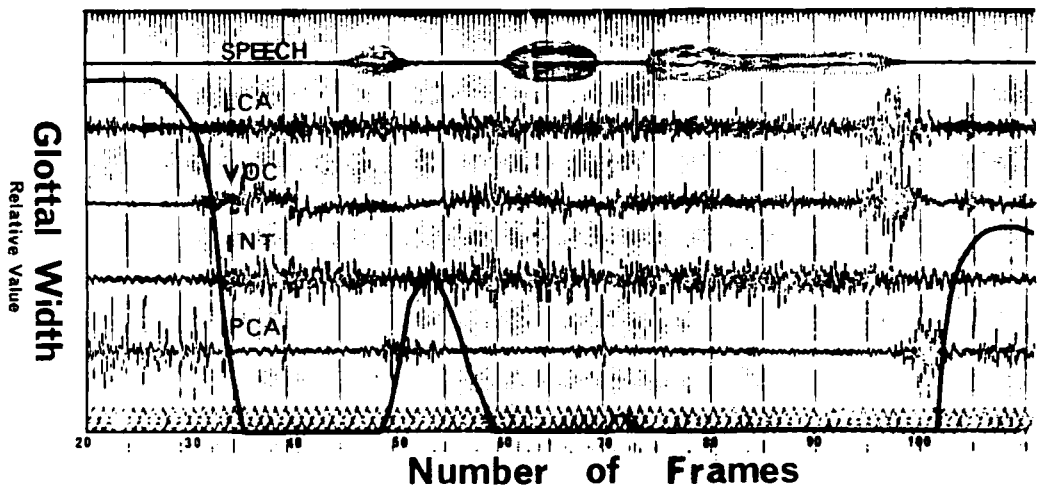


Fig. 2: An oscillographic trace of electromyograms and speech overlapped with glottal opening in an utterance /zeQseHtojuH/.

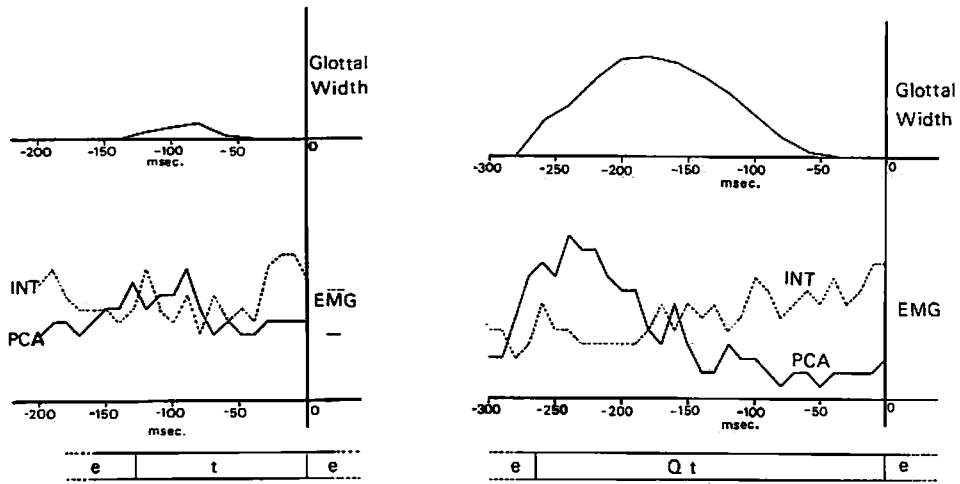


Fig. 3a: Averaged glottal width (above) and EMG (below) patterns for /t/ and /Qt/ with the line-up point at the onset of following /e/.

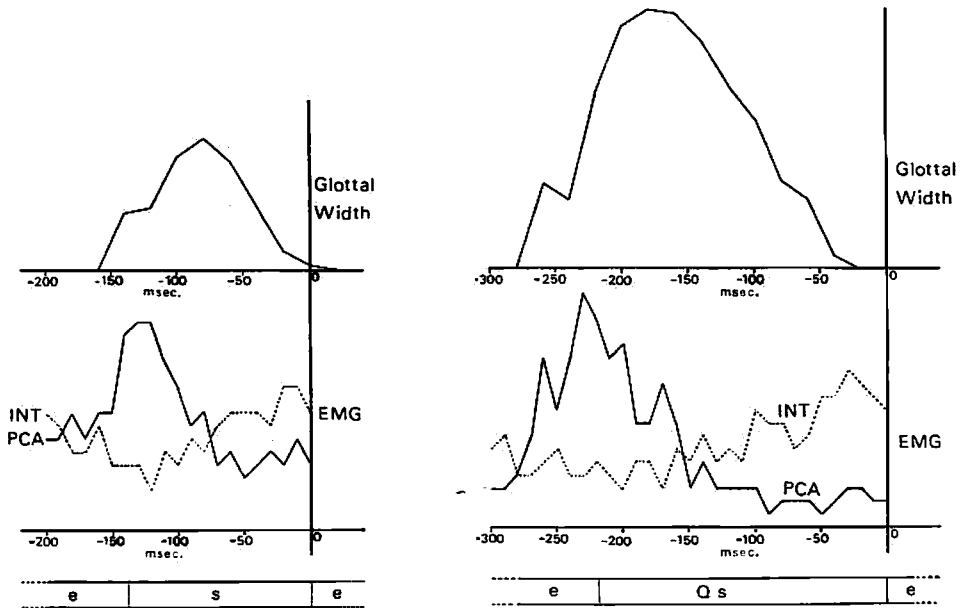


Fig. 3b: Same as Fig. 3a for /s/ and /Qs/.

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