Critical Review: Effectiveness of the Acoustic Analysis of Voice in the Detection of Early Bulbar Signs in Patients with Amyotrophic Lateral Sclerosis

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The purpose of this critical review was to evaluate the effectiveness of using instrumental

both amplitude and frequency measures. Seventy-five percent of the data were also reanalyzed to ensure reliability using the Pearson product-moment correlation coefficients for repeated measures (Aronson, 1992).

Along with its strengths, however, this paper is a quasi-experimental study and contains a moderate level of evidence. The sample size was also very small and the possible effects of gender were not

1999). Results indicated that five of the eight measures analyzed (jitter, coefficient of variation for frequency, shimmer, number of harmonics and maximum phonatory frequency range) were abnormal in both groups with bulbar and no bulbar involvement. When the group with bulbar involvement was compared to the control group, increases in jitter, coefficient of variation for frequency (CVF), and shimmer, were found. A decrease in the number of harmonics and maximum phonatory frequency range were found ($p<0.001$). The group without bulbar involvement indicated similar results but demonstrated an increase in CVF. When both groups were compared with each other, an increase was found in jitter, CVF, and shimmer ($p<0.001$). In predicting bulbar involvement, they found that 73% of patients in the bulbar group were identified, but only 52% were identified in the non-bulbar group.

This study demonstrates strengths such as a larger sample size, control for gender effects, and the inclusion of patients without bulbar symptoms. However, as in the other studies, this is a case-control study therefore the evidence is considered moderate. Other weaknesses include patient inclusion: for patients to be considered asymptomatic only two speech–language pathologists were used and no tests of intelligibility were done. Despite some weaknesses, this study demonstrated relative strengths in both its design and sample size selection.

Kent et.al conducted a study with 10 women with ALS and 15 female controls. In addition to studying acoustic measures (phonatory function and formant analysis), they studied intelligibility and pulmonary measures. Results for the phonatory acoustic measures, which included fundamental frequency, jitter, shimmer and signal-to-noise ratio, indicated that 5 out of 10 patients were 2 standard deviations above the control means for jitter. In addition, 6 out of 10 patients were 2 standard deviations above the control mean for shimmer. Signal to noise ratio values were found to be typically lower than that of the control group ($p=0.05$). There was no significant difference found for fundamental frequency because the values were distributed either too high or too low compared to the values of the control group.

This study demonstrated several strengths. The authors studied and compared intelligibility data obtained to the acoustic data which allowed them to assess whether any acoustic abnormalities could be detected even when intelligibility was not affected. Having done voice analysis on a group of men with ALS, they were able to compare and contrast between this study and the previous one to determine any differences of gender in this disease. They also reported all intelligibility scores, phonetic contrasts and graphs of all formant analyses. Along with these strengths are some critical weaknesses such as the statistical analysis of the phonation measurements. The statistical (t-test) results were not clearly reported. This study was a quasi-experimental case control design and therefore provides only moderate evidence.

Acoustic Measures in Men and Women

Silbergleit, Johnson and Jacobson, conducted an acoustic study in which they included 20 patients with ALS

Vorperian, Kent and Duffy (2003), all three studies demonstrate abnormalities in jitter, shimmer, and signal-to-noise ratio values. Although changes over time may not have yielded consistent results for these acoustic measures, they did demonstrate abnormal phonatory acoustic measures that were present early in the patients" disease progression.

However, these are longitudinal case studies and they represent a lower level of evidence. In the study by Watts et. Al. (2001), the authors do not represent their data with appropriate statistical testing. In addition two of the three subjects across all three studies had bulbar symptoms at the beginning of the studies hence abnormal phonatory acoustics might be expected. Therefore, the results of all three studies should be treated conservatively.

A Protocol for Acoustic Analysis of Voice

In a retrospective series by Kent, Vorperian, Kent and

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