

## Application of Automatic Kinematic analysis program for the Evaluation of Dysphagia in ALS patients

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### Introduction

Dysphagia in motor neuron disease may increase the risk of malnutrition, dehydration, and aspiration pneumonia. Though VFSS is considered as the primary evaluation tool, it is a qualitative evaluation. A kinematic analysis of VFSS can provide detailed movement of the anatomical structures and bolus, revealing subtle abnormalities of swallowing. The subsequent contractions of suprahyoid and infrahyoid muscles accomplish the circular motion of hyoid bone and the infrahyoid muscles assist in prolonged laryngeal elevation and UES opening. The hyoid muscles coordinate the movement of hyoid bone and directly affect swallowing function. However, manual extraction processes of kinematic analysis require expert skills as well as a lot of time and labor. Moreover, the accuracy of diagnosis can vary in accordance with the degree of skillfulness of the examiner. To overcome these limitations, we developed an automated kinematic analysis program (AKAP) that analyzes the trajectory of the hyoid bone via a visual tracking Method. The aim of this study is to investigate the hyoid movement of motor neuron disease patients using AKAP and compare with nondysphagic subjects.

### Method

30 motor neuron disease patients (12 males; mean age 67.6) from 40 to 88 years of age who conducted VFSS. Ten non-dysphagic subjects were enrolled (5 males, mean age 52.8) from 40 to 71 years of age as a control group. VFSS were conducted with thin fluid and yogurt. Hyoid bone movement were analyzed by dividing into vertical, horizontal distance with four peak point (A, B, C, D) and time of each points were also calculated. (Figure 1)

### Results

Time ABC, Time ABCD, and Duration C were significantly increased in MMD patients (Time ABC  $p=0.026$ , Time ABCD  $p=0.01$ , Duration C  $p<0.001$ ) when swallowing fluid. In swallowing FT2, only Time ABC and Duration C were increased. (Time ABC  $p=0.012$ , Duration C  $p=0.009$ ) However both vertical and horizontal distances were not significantly different in fluid and FT2.

### Conclusion

In Conclusion, the dysphagia of MMD is caused by delayed hyoid bone movement by weakness of hyoid muscles although the distance does not change. The parameters of

kinematic analysis could be used to quantitatively evaluate the dysphagia in motor neuron disease.

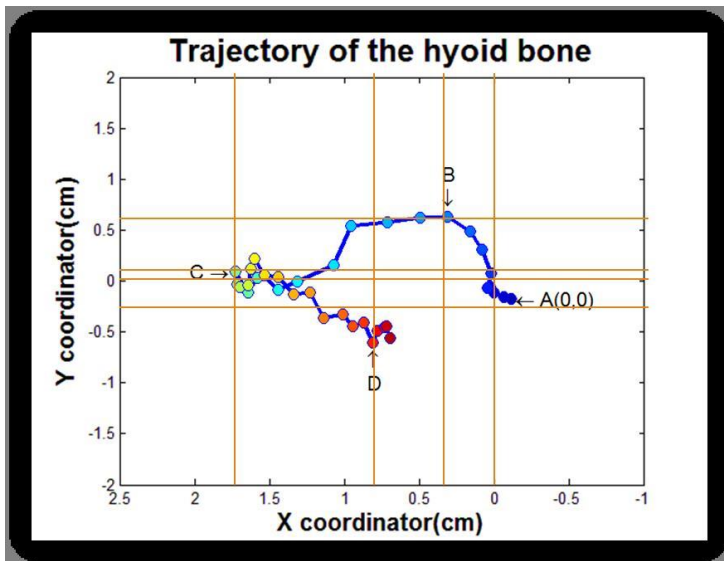


Figure 1 AKAP Result example