

# Utility of Swallowing Tests by Dual Energy Subtraction (DES)

Department of Radiation, National Cancer Center

Yuichi Nagai

## Introduction

Shimadzu SONIALVISION safire digital R/F systems incorporate a diverse range of functions. The utility of one of these functions, tomosynthesis, is becoming widely reported for clinical diagnostic imaging. However, while energy subtraction has a long history, its clinical utility has been little reported. Here, we report on our investigations into the utility of dual energy subtraction for videofluoroscopic swallow examinations, which are becoming more frequently performed.

## Aim

To investigate the utility of dual energy subtraction for swallow examinations.

## Method

1. Capture images at the instant of drinking barium. Indicate the radiography conditions and image acquisition conditions. (X-ray tube voltage: 60 kV / 120 kV; image acquisition conditions: 7.5 fps / 15 fps)
2. Perform dual energy subtraction post-processing (Fig. 1 to Fig. 4).
3. Investigate the clinical utility of the images.



Fig. 1 Soft Tissue Extraction

Fig. 2 Bone Extraction



Fig. 3 High-Voltage Image

Fig. 4 Low-Voltage Image

## Results

The difference in image acquisition rate affects the appearance of artifacts (red arrow) during subtraction (Fig. 5).

The barium can be observed as it passes through the epipharynx, hypopharynx, and upper esophagus. Fig. 6 shows a frontal energy-subtraction radiographic image of the vertebral column. This soft-tissue extraction offers simple leak detection at postoperative anastomotic sites.

Fig. 7 shows lateral views where bone extraction processing offers greater utility for the observations of the passage of barium from the epipharynx to the upper esophagus.

Energy subtraction was effective due to the barium stagnation at the postoperative leakage site (red arrow).



Fig. 5 (a) 7.5 fps, (b) 15 fps

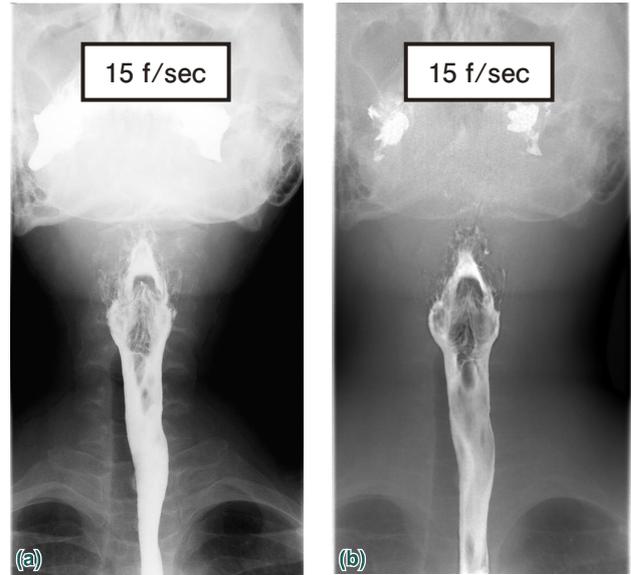


Fig. 6 (a) Conventional Image, (b) Soft-Tissue Extraction Image

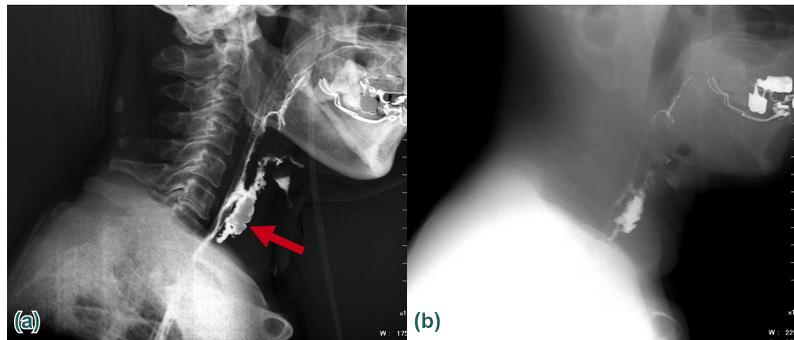


Fig. 7 (a) Bone Extraction Image, (b) Soft-Tissue Extraction Image

## Conclusions

Energy subtraction processing is normally used for stationary objects. However, by increasing the image acquisition rate, it can obtain clear subtraction images for dynamic observations. Further studies are required into the optimization of the energy difference (60 kV to 120 kV) used for this investigation. The swallow examinations performed during this investigation showed utility at 15 fps image acquisition rate, bone extraction image processing, and 60 kV to 120 kV radiography energy. Trials have just begun on dual energy subtraction for the videofluoroscopic swallow examinations. The optimal conditions remain to be determined in the future.

### \* Supplementary Information

Energy subtraction may be undesirable in some cases (particularly, soft-tissue extraction – bone elimination processing), as it is important to observe the vertical movements of the laryngeal prominence (thyroid cartilage) for postoperative follow-ups.

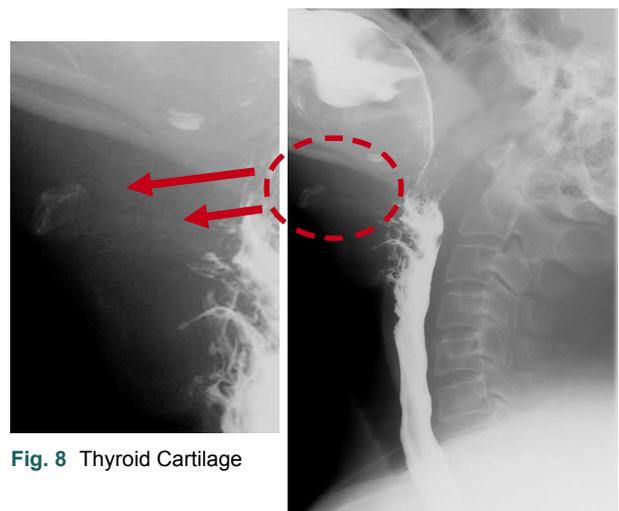


Fig. 8 Thyroid Cartilage

### Acknowledgements

We wish to thank Mr. Asai and Mr. Ono, Department of Head and Neck Oncology and Plastic Surgery, National Cancer Center, and Nurse Suzuki of Swallowing Specialist Ward 14B for their guidance and cooperation related to the videofluoroscopic swallow examinations.