V. 1.   Standardization of the Head-neck PET Images

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Introduction

Masticatory jaw movement and swallowing are controlled by the cooperative masticatory muscles and tongue activities[1,2]. In order to clarify the cooperative stomatognathic system, the activities of the masticatory muscles and tongue has been analyzed. The most common approach for this purpose uses electmyograph. However, it has been very difficult to record simultaneous activities of various muscles and/or many parts of ones.

Our purpose is to quantitatively visualize activities of masticatory muscles and tongue during mastication using by positron emission tomograghy (PET), by pixel-base. In this report, we generated a standerdized three-dimensional head-neck PET images by using spatial normalization technique (Friston et al.).

Subjects and methods

This study protocol was approved by the Human Ethics Review Committee of this institution and written informed consent was taken from all subjects.

1: Spatial standardization of the head-neck transmission images

We used the head-neck transmission images of 20 healthy Japanese male volunteers (19-48y). The transmission scans were obtained by using external rotating line source ($^{68}Ge/^{68}Ga$). The twenty transmission images were visually registered to the standard plane; namely the Frankfort plane (include the lower orbital point and the bilateral external auditory miatus), the mid-sagital plane and the miatal perpendicular plane (perpendicular to the Frankfort plane through external auditory miatus). These registered images were averaged to form a raw template images (T0). Then each original transmission images were spatially normalized onto the raw template (T0) using linear transformations provided by the Statistical Parametric Mapping software (SPM 96). The final template (T1) was generated by averaging of these 20 transformed images (Fig.1).

2: Spatial standardization of the head-neck emission images

The head-neck [^{18}F]Fluorodeoxyglucose (FDG) emission images (original emission image E0) were spatially normalized using the original transmission images T0. The parameters for the linear affine components and non-linear transformations were then used to transform emission images. The smoothing kernel of 8 mm FWHM filter was used to reduce possible errors in the transformation[3]. Emission images of fourteen healthy Japanese male volunteers (21-29y) were used. They were divided into two groups, 6 volunteers masticated voluntarily, and the remaining 8 subjects masticated on the right side. Each subject chewed gums for 30 min after the intravenous injection of FDG (approximately 1.79mCi).

Results

The standardized head-neck transmission images were shown in Fig. 1. The skull and external auditory miatus of the standardized transmission image (T1) are more clear-cut than those of registered transmission image T0. However, variance was found in the periphery of menton.

The standardized head-neck emission images of voluntary and right-side mastication groups are shown in Fig. 2 and 3, respectively. Masseter, lateral pterygoid muscles and tongue activities can be confirmed clearly. Moreover, the parts activated high or low were shown in the same muscles. In the voluntary mastication group, the activities of the bilateral lateral pterygoid muscles, left medial pterygoid and masseter muscles were observed. Whereas the activities of the only left lateral pterygoid muscle, right medial pterygoid and masseter muscles were recoded in the right-side mastication group.

Discussion

We suggest the potential use of standardization of the PET head-neck images to visualize activity of masticatory muscles, especially masseter, lateral pterygoid muscle and tongue in this study. Moreover, the differences of activities according to the parts of the same muscle were confirmed clearly. However, in order to standardize more various masticatory muscles and parts of ones, and to become highly precise, it needs to record and analyze more PET images of various quantitative jaw movements.

References

1) Moller E., Acta Physiol Scand. 69, 1-229 (1966).
2) Ramsey G. H. et al., Radiol. 64, 498-518 (1955).
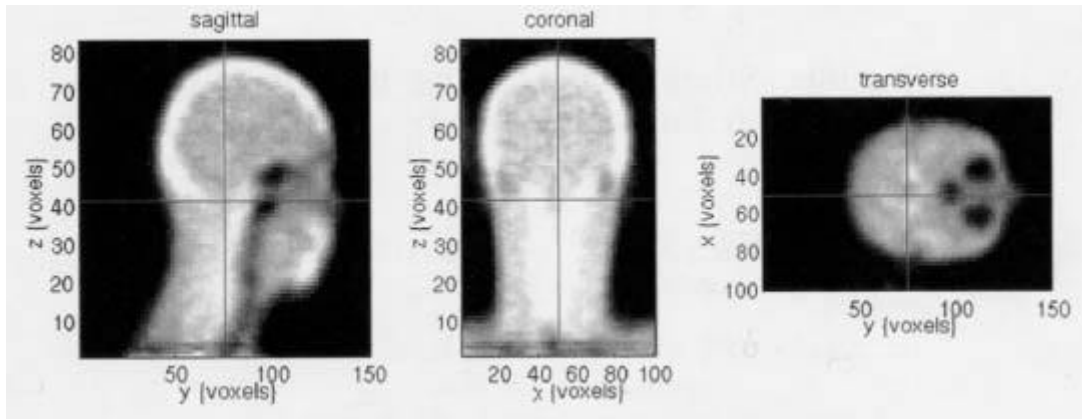3) Friston K. J., Human Brain Mapping 3, 165-189 (1995).

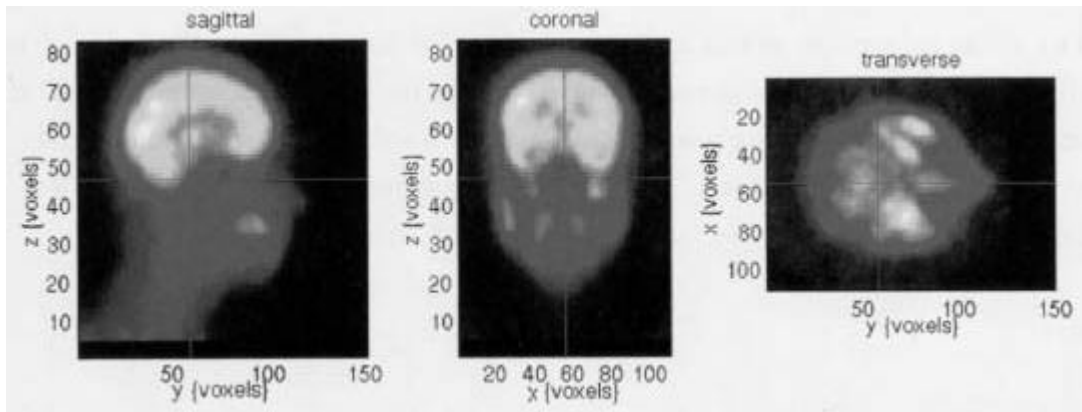Fig.1. Standardized transmission images.

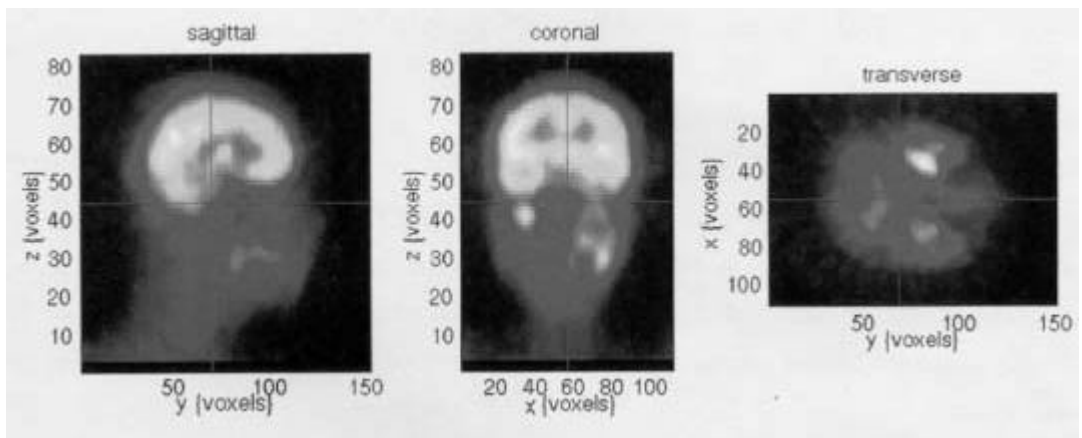Fig.2. Standardized emission images of the voluntary mastication group.

Fig.3. Standardized emission images of the right-side mastication group.