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学位論文名	An Involvement of Trigeminal Mesencephalic Neurons in Regulation of Occlusal Vertical Dimension in the Guinea Pig （三叉神経中脳路核ニューロンによる咬合高径の制御）
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論文内容の要旨

INTRODUCTION

Occlusal vertical dimension (OVD), the distance between the mandible and maxilla, is considered to be crucial for individuals to perform oral functions, such as mastication, speaking, and swallowing. Several studies have demonstrated that the inappropriate OVD induces morphological and physiological changes, namely, deformation in the mandible, changes in muscular attachments, and changes in masticatory muscle fiber composition. Recently, Yagi et al. (2003) studied the temporal change of the OVD in bite-raised guinea pigs, and showed that the OVD in these animals decreased to the same level as that of naive controls within 5 days. However, the sensory mechanism involved in this OVD regulation is still unclear. Since sensory information arising from MesV neurons may be involved in the regulation of the OVD, we examined the effect of MesV lesion on the temporal change in the OVD in the present study.

MATERIALS & METHODS

Forty-seven young male Hartley guinea pigs (4-6 postnatal weeks old) were divided into 4 groups : naive controls, OVD-raised animals without MesV lesions (bite-raised controls), OVD-raised animals with MesV lesions (bite-raised MesV-lesioned animals), and MesV-lesioned animals without raising the OVD (MesV-lesioned controls). A bite-raising appliance was fixed to the lower incisor with bonding resin under ketamine anesthesia (110 mg/kg, i.m.) after chlorpromazine (12.5 mg/kg, i.p.) application. Continuous eruption of the molars filled the space between the upper and lower molars for 7-10 days after the appliance attachment. The appliance was removed 10 days after bonding. Lateral radiographic cephalograms were taken using a soft X-ray system. The radiographs were fed into a computer using a scanner, and the skeletal and crown length and the OVD were analyzed using image-processing programs.

Five to seven days after the appliance attachment, the animals were placed in a stereotaxic frame under

ketamine anesthesia. An isotonic-transducer was fixed to the lower incisor with dental cement to monitor vertical jaw movements. A glass-coated elgiloy electrode with impedance of 1-3 MΩ at 1 kHz was stereotaxically inserted into the MesV. MesV neurons were identified by single unit or multiunit activities responding to passive jaw opening and palpation of the masseter muscle. The MesV was coagulated by 40 μA DC current injection through the electrode for 40s. After the experiments, the animals were perfused with 0.1 M phosphate buffer followed by 10% formaldehyde under deep anesthesia with pentobarbital. The brainstem was transversely sectioned (50 μm thickness) and stained with cresyl-violet. Histological quantification was performed using Lucivid and Neurolucida.

Statistical comparisons were performed using an unpaired t-test or one-way ANOVA using HSD method of Scheffé's test. The level of $P<0.05$ was taken as significant. All statistical values are presented as mean± SEM.

RESULTS

MesV neurons were identified by ramp-and-hold stretch of the mandible. The MesV was reconstructed to examine the coagulated regions in the brainstem. The number of MesV neurons in an animal in naive controls and bite-raised MesV-lesioned animals were 2338±126 (N=6) and 671±146 (N=7), respectively.

The bite appliance was fixed to the lower incisor to raise the OVD, and was removed 10 days after fixation. The increase in the OVD was 3.3±0.1 mm (11.4±0.6%, N=12) in bite-raised controls and 3.6±0.3 mm (12.5± 1.1%, N=11) in bite-raised MesV-lesioned animals when the appliance was removed. The OVD continuously decreased for 6 days after the removal of the appliance in bite-raised controls until it reached the OVD in naive controls. The OVD then increased at a similar rate as the OVD in the naive controls. The change of the antero-posterior length of the cranium in bite-raised controls was almost similar to that of naive controls. The time course of change in the crown length in bite-raised controls was almost similar to that of the OVD.

In contrast, bite-raised MesV-lesioned animals revealed only a slight decrease of the OVD after removal of the appliance. In these animals, the minimum value of the OVD, which was taken 15 days after the removal of the appliance, was significantly larger than that of naive controls and bite-raised controls ($P<0.05$). The OVD in bite-raised MesV-lesioned animals then increased at a similar rate to that of naive controls. The crown length in bite-raised MesV-lesioned animals decreased to the same level as the OVD in naive controls, and then increased at a rate similar to that of naive controls. The antero-posterior length in bite-raised MesV-lesioned animals was slightly larger than that of naive and bite-raised controls at≥20 days after the removal of the appliance.

DISCUSSION

The main finding of this study is that bite-raised MesV-lesioned animals showed only a slight decrease in OVD in contrast to a sharp recovery of the OVD in bite-raised controls. This finding suggests that MesV neurons contribute to the regulation of the OVD. The present results may be ascribed to the loss of muscle spindle sensation, although MesV neurons also receive impulses arising from periodontal mechanoreceptors. The putative proof for this assumption derives from the fact that those edentulous subjects who have not periodontal sensation can detect the comfortable OVD level.

However, MesV-lesioned controls showed increases in their OVD no larger than that of naive controls, presumably due to the activities of the surviving MesV neurons that supply periodontal mechanoreceptors. This is because most of the spindle afferent neurons that were identified by ramp-and-hold stretch of the mandible or masseter palpation have been destroyed. As long as the mandible position is near the resting position, even inaccurate information of muscle tension can be calibrated by the information of bite force detected

by periodontal mechanoreceptor.

CONCLUSION

The temporal OVD change in the guinea pig was measured to study the effect of MesV lesions on the OVD. The OVD of bite-raised MesV-lesioned animals decreased slightly after the removal of appliance while that of bite-raised controls fell rapidly down to the level of naive controls. These results suggest that MesV neurons are involved in the OVD regulation.

論文審査の結果の要旨

本研究は、生体固有の適切な咬合高径の調節に対する三叉神経中脳路核の役割を解明することを目的とした。咬合挙上した動物は、挙上対照群と中脳路核破壊群に分けた。中脳路核破壊群は挙上対照群と比較して、挙上装置除去後の咬合高径の減少が軽微であり、減少が止まるまでの期間が遅延された。また、同群は挙上対照群とは異なり、挙上された咬合高径が装置除去後も正常対照群と同じ高径までは減少しないことを示した。以上の結果により、三叉神経中脳路核は咬合高径の維持調節に重要な役割を演じていることが明らかとなった。

よって本研究は、博士（歯学）の学位を得る資格があるものと認める。