Change of Eye Position in Patients with Orthophoria and Horizontal Strabismus under General Anesthesia

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We studied the relationship between eye position in the awakened state and in the surgical plane of anesthesia in orthophoric and horizontal strabismus patients. We classified 105 orthophoric and horizontal strabismus patients into 5 groups, measured the eye position at the primary position by photographic measurement of the corneal reflex positions and undertook a quantitative study of eye position. Under general anesthesia, the mean divergence was 39.7±8 PD for the esotropia group, 36.6±11.7 PD for exophoria, 27.4±8.1 PD for orthophoria, and 11.1±10.2 PD for exotropia I (≤30 PD). Therefore, the esotropia group had the largest amount of divergence among the groups, but the eye position of the exotropia II (>30 PD) group was rather convergent at 11.0±6.5 PD. According to the eye position of the fixating and nonfixating eyes in the esotropia group, both eyes converged with an angle deviation of 14.4±4.8 PD divergent and 14.1±4.8 PD divergent, respectively (P=.71). In the exotropia groups (I, II), the fixating eye diverged but the nonfixating eye rather converged. Therefore, the angle deviation was 19.0±2.1 PD divergent for the fixating eye and 18.2±6.4 PD divergent for the nonfixating eye (P=.68). In conclusion, under general anesthesia, eye positions in the awakened state and in the surgical plane of anesthesia were convergent or divergent, and showed a tendency to converge into the position of 25-35 PD divergent. Therefore, we could not distinguish fixating eye from nonfixating eye under general anesthesia.

Key words: Converge, Diverge, Photographic measurement

Generally, eye position after general anesthesia in orthophoria and strabismus has been reported to be divergent.1-8 In 1890, Grut1 reported that eye position during sleep, death, blindness, and after anesthesia is divergent, and in 1958 Moller2 measured the change of eye position after ether anesthesia. Subsequently, numerous studies have reported the eye position after general anesthesia in strabismus and orthophoria patients, and even the correlation of eye position after general anesthesia has been reported. In Korea, it has been reported by Lee et al3, Kim et al4, An et al5, and Lim et al6 in strabismus patients, and by Lee and Kim7 on orthophoria. In these studies, eye position was measured during the awakened state by the alternative prism cover test, and after general anesthesia the squint angle was measured by Hirschberg or Krimsky prism test. Therefore, the shortcoming of these studies is the lack of objectivity in the comparison of eye position between before and after anesthesia. However, in 1987 Brodie27 applied Hirschberg to enumerate the evaluation of eye position by taking the pictures of the front view and quantitatively measuring the corneal reflex position. This method is known to be more...
objective for evaluating eye position and has been reported in Korea by Lee and Lee.26

In our study, pictures of horizontal strabismus patients and orthophoria individuals in the awakened state and under general anesthesia were taken by digital camera, the corneal reflex position was assessed by measuring the distance based on the nasal limbus, and the change of the monocular position was also measured by distinguishing between the fixating and nonfixating eyes. In addition, it was examined whether the eye position during the awakened state correlated to that under general anesthesia. Further investigation included the change of the position of both eyes in orthophoria, and the change of the position of both nonfixating and fixating eyes in strabismus patients.

MATERIALS AND METHODS

The study was performed from August 2002 to March 2003 on 30 patients with orthophoric eye position, 30 exophoria patients who underwent surgery for horizontal strabismus, 30 exotropia patients, and 15 esotropia patients (total 105 patients). Patients with a history of extraocular muscle surgery, neurological diseases, and accompanied vertical strabismus were excluded from the study population. The age distribution was from 4 years to 38 years with a mean age of 12.5 years.

The squint angle was measured one day prior to surgery by asking the patients to stare at the focus of the camera at 40 cm distance in front, placing a ruler on the forehead, and taking pictures. At the time of photography, the corneal reflex was almost on the center of the cornea of orthophoria and exophoria (intermittent exotropia), that of the fixating eye was on the center of the cornea and that of the nonfixating eye was skewed from the center of the cornea to the nasal limbus in exotropia patients, whereas in esotropia patients that of the fixating eye was in the center of the cornea and that of the nonfixating eye was skewed from the center of the cornea to the lateral limbus.

Anesthesia was induced after the inhalation of oxygen by administering 5 mg/Kg pentobarbital and 1 mg/Kg succinylcholine, after which endotracheal intubation was performed. Anesthesia was subsequently maintained by carbon dioxide and oxygen, and 20-30 minutes after anesthesia the muscle relaxant vecuronium (0.1 mg/Kg) was administered, and eye position was measured. The eye position under general anesthesia was measured by placing a ruler on the spot 40 cm vertically above the glabella of the patient, and taking pictures by digital camera.

The calculation of the squint angle was measured by defining the middle of the nasal limbus and lateral limbus as the center of the cornea, the reflex spot on the cornea was determined. Subsequently, in the orthophoria group, the distance from the center of the cornea and the corneal reflex was measured, whereas in the strabismus eyes, the distance from the nasal limbus to the corneal reflex was subtracted from half of the corneal diameter, and the difference before and after anesthesia was calculated by the difference of the distance from the nasal limbus to the corneal reflex spot. The results in millimeters were multiplied by 14 according to the conventional conversion rate of 14 Prism diopter/mm,14 and taken as the squint angle. In all calculations, the right and left eyes were calculated separately and subsequently added (Fig. 1).

Statistical analysis was performed using SPSS 11.5, the mean value within each group was compared by t-test and Mann-Whitney test, the mean value among each group was compared by Kruskal-Wallis one-way ANOVA, and p value less than 0.05 was considered statistically significant.

RESULTS

In the orthophoria group, the eye position before anesthesia was 3.9±3.5 PD and after anesthesia was 31.4±7.6 PD, giving a divergence of 27.4±8.1 PD. In the exotropia group, before anesthesia was 5.6±3.5 PD and