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ABSTRACT

TITLE: Surgical correction of strabismus in monkeys: II. Longitudinal evaluation of neuronal responses in the Oculomotor nucleus

ABSTRACT BODY:
Purpose: Strabismus surgery is well documented in both the literature and in practice with varying levels of success and permanence. Potentially, muscle remodeling and/or central neural adaptation affects the final state of misalignment after treatment. Our goal was to assess central adaptation by examining responses of medial rectus motoneurons (MRMN) in the oculomotor nucleus of strabismic monkeys following surgical correction.
Methods: The study included one rhesus monkey with an exotropia (strabismus angle: OD: ~30°, OS: ~15°) that was induced in infancy using an optical prism-viewing paradigm. Surgical treatment when animal was ~6years old involved recession of the lateral rectus (LR) and resection of the medial rectus (MR) of the left eye only. We recorded from 21 MRMNs prior to treatment and from 70 MRMNs over the first 6 months following treatment. MRMN firing rates (FR) and horizontal eye position and velocity acquired during a horizontal smooth pursuit task (0.3Hz, ±15°) were used to identify regression coefficients in a first-order model (FR = K*Epos + R*Evel + C). K and C coefficients were then used to compute the population MR neuronal drive (ND) necessary to produce static deviation of the non-fixating eye before surgery (pre), <1 month after surgery (post1), ~6 months after surgery (post6).
Results: Strabismus angle (SA) was reduced by ~35% at post1. SA during OS view gradually increased back to its pre-surgery value while SA during OD view was still reduced by ~28% of its pre-surgery value at post6. Analysis of MRMN in the left OMN showed that the ND to the MR of the treated left eye was decreased although the strabismus angle was reduced at post1 (pre:67 ±45 sp/s, post1:25 ±40 sp/s). Analysis of MRMN in the right OMN indicated that the ND to the MR of the untreated right eye was increased at post1 (pre:56 ±25spk/s, post1:109 ±42 spks/s). At post6, the ND to both MR approached pre-surgery values (Lt OMN: 66 ±54 spks/s; Rt OMN: 44 ±33 spk/s).
Conclusions: The reduced ND to the treated eye at post1 effectively counters the desired outcome of surgery; post1 increase in ND to the untreated right eye is consistent with Hering's law. The longitudinal (post6) changes in NDs to both treated and untreated eyes (approaching pre-surgical values) suggest a significant role of neuronal adaptation in addition to muscle remodeling in setting the steady-state strabismus angle.
(No Image Selected)

DETAILS

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