Reduction of Consecutive Esotropia Using Modified Contralateral Recession and Resection for Recurrent Intermittent Exotropia

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ABSTRACT

Purpose: To report consecutive esotropia in contralateral lateral rectus recession and medial rectus resection for recurrent intermittent exotropia after unilateral lateral rectus recession and medial rectus resection and to evaluate the surgical outcome of modified contralateral lateral rectus recession and medial rectus resection for exotropia after unilateral lateral rectus recession and medial rectus resection.

Methods: A total of 36 patients were included in this retrospective study. As a primary surgery for exotropia, all patients underwent unilateral lateral rectus recession and medial rectus resection on the non-dominant eye. Patients were subsequently assigned to either conventional contralateral lateral rectus recession and medial rectus resection (surgical dosages based on Wright’s surgical table) (n = 19; conventional group) or modified contralateral lateral rectus recession and medial rectus resection (surgical dosages reduced by 5 prism diopters on Wright’s surgical table) (n = 17; modified group) for recurrent exotropia. Surgical success rates were evaluated. Reoperation or prism glasses prescription rates due to consecutive esotropia were evaluated.

Results: The mean follow-up durations after reoperation were 25.8 and 24.0 months in the conventional and modified groups, respectively. The surgical success rates were 73.7% and 82.4% (P = .538, Fisher’s exact test) and the recurrence rates were 0% and 17.6% (P = .059, Fisher’s exact test), respectively. The reoperation or prism glasses prescription rates due to consecutive esotropia were 26.3% and 0%, respectively (P = .025, Fisher’s exact test).

Conclusions: Final outcomes were better in the modified group compared to the conventional group. Consecutive esotropia was significantly more frequent in the conventional group than in the modified group. In surgery for recurrent exotropia, a reduction of the surgical dosage will reduce the incidence of consecutive esotropia.

INTRODUCTION

The most common surgical procedures for intermittent exotropia are unilateral lateral rectus recession and medial rectus resection or bilateral lateral rectus recession.1,2 Surgical success rates of exotropia vary from 58% to 79% based on previous studies.3,4 It is common to reoperate on patients with exotropia because recurrence rates tend to increase over time.

The surgical treatment for recurrent exotropia depends mainly on the primary surgery.5 Bilateral or unilateral medial rectus resection is performed on patients with a previous bilateral lateral rectus recession. Unilateral lateral rectus recession or contralateral lateral rectus recession and medial rectus resection is performed on patients with a previous lateral rectus recession and medial rectus resection. It is thought that if versions are full, the patients can be treated as if they had not previously
undergone surgery. Surgery based on conventional surgical dosages to recess the lateral rectus muscle or resect the medial rectus muscle on the previously unoperated eye has been considered the easiest and most predictable surgery for patients with recurrent exotropia. If any underaction is found, an assessment of generated force and forced ductions, the latter assessed either preoperatively or intraoperatively, is necessary to determine whether the limitation is due to restriction. If there are any limitations or anatomical changes due to primary surgery, modification of the surgical dosage is required. In this study, no underaction was found preoperatively. However, we experienced consecutive esotropia after conventional surgical dosages of contralateral lateral rectus recession and medial rectus resection in patients who previously underwent lateral rectus recession and medial rectus resection. Therefore, we reduced surgical dosages by 5 prism diopters (PD) from the conventional contralateral lateral rectus recession and medial rectus resection. We were unable to find any reports through a comprehensive MEDLINE literature search that directly compared the surgical results of conventional and modified (surgical dosages reduced by 5 PD) contralateral lateral rectus recession and medial rectus resection. Therefore, we performed this study to compare the surgical outcomes of modified and conventional contralateral lateral rectus recession and medial rectus resection for exotropia after unilateral lateral rectus recession and medial rectus resection.

**PATIENTS AND METHODS**

The medical records of 36 patients who underwent surgery for recurrent exotropia from 2000 to 2012 were retrospectively reviewed. Ethical approval for this study was obtained from the Institutional Review Board of Keimyung University Dongsan Medical Center, Korea.

All patients underwent unilateral lateral rectus recession and medial rectus resection on the non-dominant eye as the primary surgery performed by a single surgeon (SYL). A secondary operation following recurrent exotropia was considered at least 1 year after the primary surgery. Subsequently, patients were assigned to either conventional contralateral lateral rectus recession and medial rectus resection (surgical dosages based on Wright’s surgical table) (n = 19; conventional group) or modified contralateral lateral rectus recession and medial rectus resection (surgical dosages reduced by 5 PD on Wright’s surgical table) (n = 17; modified group) for recurrent exotropia.

Inclusion criteria for this study were basic type of recurrent exotropia according to the Buri classification, an exodeviation of 20 to 40 PD at distance after primary surgery, and a minimum follow-up period of 6 months after the secondary operation. Exclusion criteria were coexistent restrictive or paralytic strabismus, congenital anomalies or neurological deficits, amblyopia, or previous ocular surgery other than strabismus surgery.

All patients underwent complete ophthalmic examinations including cycloplegic refraction with 1% cyclopentolate chloride. The angle of deviation was determined by the alternate prism cover test at distance (5 m) and near (33 cm) for all fields of gaze using accommodative targets with the patients’ best corrected vision. Recorded patient characteristics included age at onset of deviation, gender, age at primary and secondary surgeries, time to recurrence after primary surgery, interval between consecutive surgeries, preoperative deviation at distance and near during the primary and secondary surgeries, fixation preference, presence of lateral incomitance, and inferior or superior oblique dysfunction. Lateral incomitance was defined as a change of 5 PD or more in the lateral gaze from the primary position.

All surgeries were performed under general anesthesia using Wright’s surgical table. Surgical dosages were based on the largest angle of deviation in the conventional group. If the angles of deviation at distance and near were equal, surgical dosages were reduced by 5 PD and applied in the modified group. If the differences of the angles of deviation at distance or near were more than 5 PD, the smaller angle of deviation was considered the target dipter in the modified group. The decision regarding whether to use the conventional or modified approach was made by the operator.

Postoperative alignment was measured during the postoperative week 1, months 1, 3, and 6, year 1, and final follow-up visits. The rates of surgical success and angles of deviation were measured. The surgical success rate was defined as an alignment between 8 PD of exodeviation and 8 PD of esodeviation at the primary position at distance. Recurrence was defined as an alignment of 9 PD or more of exodeviation. Consecutive esotropia was defined as a persistence of 9 PD or more of esodeviation at distance after postoperative month 6. Reoperation or prism glasses prescription rates due to consecutive esotropia were evaluated.

Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) software (ver-
The independent t test was used for comparisons of postoperative deviation at distance and near, age at onset, age at surgery, cycloplegic refraction spherical equivalent, duration from onset to surgery, time to recur after surgery, and preoperative deviation at primary and secondary surgeries at distance and near between the groups. Fisher's exact test was used for comparison of the rates of surgical success, recurrence, and reoperation or prism glasses prescription due to consecutive esotropia. A P value of less than .05 was considered statistically significant.

**RESULTS**

Patient characteristics are listed in Table 1. The mean follow-up period after the secondary surgery was 73.3 ± 41.3 months (range: 12 to 105 months) and 71.8 ± 37.0 months (range: 12 to 108 months) in the conventional and modified groups, respectively. The groups were not significantly different regarding the angles of deviation at distance and near during the primary surgery (P = .93 vs .33, respectively). The mean ages at the time of the primary and secondary surgeries and the interval between the surgeries did not differ significantly between the groups (P = .78, .77, and .59, respectively). The time to recur after surgery did not differ significantly (P = .92).

**Table 2** shows the success rates for the conventional and modified groups. At postoperative month 1, the success rates were 78.9% and 100% in the conventional and modified groups, respectively, with a significant difference (P = .048, Fisher’s exact test). Six months after the secondary surgery, the success rates were 68.4% and 88.2%, respectively (P = .159). The final success rates were 73.7% and 82.4%, respectively (P = .538). The mean follow-up periods were 73.3 ± 41.3 and 71.8 ± 37.0 months, respectively. Preoperative and postoperative mean and standard deviations of distance exodeviation are

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**TABLE 1**

Patient Characteristics in the Conventional and Modified Groups

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Conventional Group (n = 19)</th>
<th>Modified Group (n = 17)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at surgery (y)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Primary surgery</td>
<td>6.05 ± 1.62</td>
<td>5.88 ± 2.03</td>
<td>.78 b</td>
</tr>
<tr>
<td>Secondary surgery</td>
<td>9.63 ± 2.31</td>
<td>9.88 ± 2.69</td>
<td>.77 b</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary surgery</td>
<td>4/15</td>
<td>10/7</td>
<td></td>
</tr>
<tr>
<td>Interval between primary and secondary surgeries (mo)</td>
<td>45.5 ± 23.5</td>
<td>50.5 ± 32.3</td>
<td>.59 b</td>
</tr>
<tr>
<td>Time to recurrence after primary surgery (mo)</td>
<td>27.5 ± 18.8</td>
<td>28.4 ± 29.4</td>
<td>.92 b</td>
</tr>
<tr>
<td>Preoperative deviation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At primary surgery</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Distance (PD)</td>
<td>27.8 ± 5.39</td>
<td>27.6 ± 7.71</td>
<td>.93 b</td>
</tr>
<tr>
<td>Near (PD)</td>
<td>27.4 ± 5.14</td>
<td>29.7 ± 8.52</td>
<td>.33 b</td>
</tr>
<tr>
<td>At secondary surgery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance (PD)</td>
<td>22.8 ± 5.31</td>
<td>24.2 ± 7.03</td>
<td>.43 b</td>
</tr>
<tr>
<td>Near (PD)</td>
<td>23.1 ± 4.84</td>
<td>27.5 ± 8.91</td>
<td>.14 b</td>
</tr>
<tr>
<td>Follow-up period (mo)</td>
<td>73.3 ± 41.3</td>
<td>71.8 ± 37.0</td>
<td>.89 b</td>
</tr>
<tr>
<td>Presence of dominant fixation (n [%])</td>
<td>18 (94.7)</td>
<td>15 (88.2)</td>
<td>.60 c</td>
</tr>
<tr>
<td>Lateral incomitance (n [%])</td>
<td>3 (15.8)</td>
<td>6 (35.3)</td>
<td>.26 c</td>
</tr>
<tr>
<td>Oblique muscle dysfunction (n [%])</td>
<td>5 (26.3)</td>
<td>3 (15.8)</td>
<td>.74 c</td>
</tr>
</tbody>
</table>

*conventional group = conventional contralateral lateral rectus recession and medial rectus resection; modified group = modified contralateral lateral rectus recession and medial rectus resection (surgical dosages reduced by 5 PD); PD = prism diopters

aValues are presented as mean ± standard deviation unless otherwise indicated.
bIndependent t test.
cFisher’s exact test.
shown in Table 3. At the postoperative month 1, 3, and 6, year 1, and final follow-up visits, overcorrection was more prominent in the conventional group than in the modified group \((P = .032, .024, .007, .013, \text{ and } .003, \text{ respectively})\).

The recurrence rates were 0% and 17.6% in the conventional and modified groups, respectively. The reoperation or prism glasses prescription rates due to consecutive esotropia after secondary surgery were 26.3% and 0%, respectively (Table 4). Consecutive esotropia was more prominent in the conventional group than in the modified group \((P = .025, \text{ Fisher’s exact test})\).

**DISCUSSION**

In this study, the success rate of modified contralateral lateral rectus recession and medial rectus resection in recurrent exotropia was comparable with that of conventional contralateral lateral rectus recession and medial rectus resection and showed a significantly lower risk of overcorrection without a higher risk of recurrence. The tendency to drift toward exodeviation after surgery is known to stabilize 6 weeks postoperatively and becomes constant 6 months postoperatively in patients with exotropia.\(^8,9\) However, this was not observed in our study. The amount of postoperative exodrift was minimal.
in the conventional group and seemed to esodrift until 6 months postoperatively. Thus, the conventional group showed consecutive esotropia in 26.3% of cases. After reducing the surgical dosage, the lower rate of 0% of consecutive esotropia was reported in the modified group and the amount of postoperative esodrift was minimal.

Early postoperative overcorrection of more than 10 PD on postoperative day 1 has been known to be a predictive factor of surgical success in exotropia surgery. However, it has been reported that this is not true after bimedial or unilateral rectus resection for recurrent exotropia that had bilateral lateral rectus recession as the primary surgery. Kim et al. reported that an initial overcorrection of 20 PD or more was reduced to 10 PD or less within 4 weeks after surgery in most patients during their primary surgery for exotropia. However, of all of our patients with recurrent exotropia who had an initial overcorrection of 9 PD or more at postoperative week 1 in the conventional group (57.9%), 21.1% still had more than 9 PD of overcorrection at postoperative week 4, 31.6% had more than 9 PD of overcorrection at postoperative month 6, and 26.3% had more than 9 PD of overcorrection at the last follow-up examination, thereby requiring base-out prism glasses or reoperation.

There is a tendency toward esodrift with increasing time postoperatively. However, minimal esodrift tendency has been observed after contralateral lateral rectus recession and medial rectus resection for recurrent exotropia after unilateral lateral rectus recession and medial rectus resection. Because the exact cause and pathophysiology of esodrift remain unknown, the underlying mechanism for lower esodrift tendency after contralateral lateral rectus recession and medial rectus resection is uncertain. One possible explanation for the minimal postoperative esodrift tendency after reoperation may be the characteristics of the resection procedure. Yang and Hwang reported that an initial large overcorrection may not be required after unilateral or bilateral medial rectus resection as the primary surgery and that the surgical dosage of bilateral medial rectus resection may need to be reduced in recurrent exotropia as compared to the primary surgery. Regarding patients with recurrent exotropia, an initial large overcorrection may not be required when we consider contralateral lateral rectus recession and medial rectus resection procedures after previous unilateral lateral rectus recession and medial rectus resection. Reducing the surgical dosage in the modified group showed less consecutive esotropia, with comparable final surgical success rates. Recurrence rates were not statistically significantly different in the conventional and modified groups.

In this study, four patients in the modified group had a difference of more than 5 PD in distance and near measurements. We could not definitively determine whether the smaller angle operation caused less overcorrection or whether the reduction of 5 PD in the surgical dosage selection helped to prevent postoperative esotropia. However, after we excluded the four patients who had a difference of more than 5 PD in the distance near measurements from the modified group, there were 13 patients in the modified group. These 13 patients did not show any consecutive esotropia. Therefore, we presume that a reduction in the surgical dosage can help prevent consecutive esotropia.

It has been widely believed that if versions are full, patients can be treated as if they had no surgical history. The conventional surgical dosages to recess the lateral rectus muscle or resect the medial rectus muscle on the previously unoperated eye are considered the most predictable surgery options for patients with recurrent exotropia. However, if there is any limitation or anatomical changes due to primary surgery, a modification of the surgical dosage is needed. In this study, even if underaction was not observed preoperatively, the primary lateral rectus recession and medial rectus resection still affected the surgical result of the secondary lateral rectus recession and medial rectus resection in the contralateral eye. Limitations or minimal anatomical changes that do not cause underaction might have affected the surgical results of the secondary lateral rectus recession and medial rectus resection in the contralateral eye. Further studies examining these minimal anatomical changes through the use of imaging technologies such as orbit magnetic resonance imaging are required.

A limitation of this study is the fact that it was a retrospective study and selection bias could have occurred. However, because the demographics of the study participants were not statistically significantly different between the two groups, our study may remain a useful comparative case series. The results need to be confirmed by further prospective studies. However, because consecutive esotropia is an undesirable condition for both the surgeon and
In this study on patients with recurrent exotropia, conventional contralateral lateral rectus recession and medial rectus resection showed a significantly higher rate of overcorrection in the early and late postoperative periods. Therefore, the surgical dosage for contralateral lateral rectus recession and medial rectus resection in recurrent exotropia should be reduced. A novel modification for contralateral lateral rectus recession and medial rectus resection in recurrent exotropia after unilateral lateral rectus recession and medial rectus resection might be useful to reduce the rate of consecutive esotropia after a secondary operation for patients with recurrent exotropia.

To reduce consecutive esotropia after surgery for recurrent exotropia after previous unilateral lateral rectus recession and medial rectus resection, surgical dosages reduced by 5 PD from the conventional surgical table are highly recommended. In recurrent exotropia surgery, intentional overcorrection in the immediate postoperative period should be avoided. More attention is needed for patients with contralateral lateral rectus recession and medial rectus resection for recurrent exotropia after unilateral lateral rectus recession and medial rectus resection to prevent the induction of immediate postoperative overcorrection.

REFERENCES