

Advances in surgery procedures for convergence insufficiency-type intermittent exotropia

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resection(s) with or without a slanting procedure. Merits and demerits of different surgery procedures and the deficiencies of different studies are also elucidated in this paper.

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Abstract

Intermittent exotropia with convergence insufficiency is defined as a greater exodeviation measured at near than at distance of at least 10 prism diopters and it is harmful to binocular vision at earlier time. This paper mainly introduces three operation patterns including lateral rectus recession(s) with or without a slanting procedure, unilateral lateral rectus recession with medial rectus resection, and medial rectus resection(s) with or without a slanting procedure.

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Key words: Intermittent exotropia; Convergence insufficiency; Surgery procedures; Merits and demerits; Deficiency of of prior research

Core tip: Although numerous operation patterns have been developed for intermittent exotropia with convergence insufficiency, there is not a standard protocol. This paper mainly summarizes three operation patterns including lateral rectus recession(s) with or without a slanting procedure, unilateral lateral rectus recession with medial rectus resection and medial rectus

Convergence insufficiency-type intermittent exotropia is defined as a greater exodeviation measured at near than at distance of at least 10 prism diopters^[1]. The symptoms of the convergence insufficiency include headaches, asthenopia, difficulty with reading or near tasks and diplopia^[2]. In slight cases, symptoms could be alleviated by non-surgical means, such as orthoptic treatment, base-in prism reading glasses, vision therapy and psychotherapy^[3,4]. Surgery is reserved for refractory cases that do not respond to these measures or for patients whose deviations are too poorly controlled, or too large at distance or at near to be treatable by nonsurgical means^[5]. This review mainly aims to outline the current viewpoints in the surgical interventions to treat convergence insufficiency-type intermittent exotropia. The various surgical treatments for convergence insufficiency-type intermittent exotropia include lateral rectus recession(s) with or without a slanting procedure, unilateral lateral rectus recession with medial rectus resection and medial rectus resection(s) with or without a slanting procedure.

LATERAL RECTUS RECESSION(S) WITH OR WITHOUT A SLANTING PROCEDURE

Raab *et al*^[6] conducted bilateral lateral rectus recessions

for exodeviations with different distance-near relationships. Seven patients with exotropia at near 10 prism diopters or more than at distance were treated with the bilateral lateral rectus recession procedure. Only two had a reduction of the near angle to less than 10 prism diopters at the 6 mo follow-up. Yang *et al*^[7] conducted a comparative study between bilateral lateral rectus recessions and unilateral lateral rectus recession with medial rectus resection. In their study, the convergence insufficiency-type intermittent exotropia patients were divided into three groups based on patients' response to monocular occlusion and bilateral lateral rectus recessions were performed based on near deviation which was augmented by 1 mm in both eyes. After 2 years, cumulative probabilities of success of bilateral lateral rectus recessions were much lower than those of unilateral lateral rectus recession with medial rectus resection in patients with convergence insufficiency-type intermittent exotropia maintained after monocular occlusion.

In 1999, Snir *et al*^[1] proposed slanted lateral rectus recession(s) for the treatment of convergence insufficiency-type exotropia. In their study, the upper horn of the muscle of the patients was recessed according to the distance exodeviation, and the lower horn was recessed according to near exodeviation. Twelve patients underwent slanted lateral rectus recession(s) while six control subjects underwent standard lateral rectus recession(s), and the postoperative follow-up period was 12 mo. Slanted lateral rectus recession(s) decreased the exotropia to < 8 prism diopters in all patients at distance and in 11/12 patients at near. Additionally, the mean difference between the distance and near exodeviation was reduced from 14 prism \pm 4.5 prism diopters preoperatively to 2.9 prism \pm 2.4 prism diopters postoperatively. All the patients in the control group demonstrated postoperative deviations of < 8 prism diopters at distance, but had residual exodeviations > 8 prism diopters at near. The authors concluded that slanted lateral rectus recession(s) improved the postoperative results and significantly decreased near-distance differences compared with the standard lateral rectus recession(s).

There are very few studies about standard lateral rectus recession(s) and none of them had optimistic results. According to Snir's study^[1], it is well known that the effect of slanted lateral rectus recession(s) was better than that of the standard lateral rectus recession(s). However, the sample size in this study was small, and both unilateral lateral rectus recession and bilateral lateral rectus recessions were included. Whether lateral rectus recession(s) with a slanting procedure is useful to convergence insufficiency-type exotropia still needs further research.

UNILATERAL LATERAL RECTUS RESECTION WITH MEDIAL RECTUS RESECTION

Burian *et al*^[8] reported that 16 patients with convergence

insufficiency were treated by unilateral lateral rectus recession with medial rectus resection. All of their patients had distance exotropia ranging from 10 to 40 prism diopters, whereas at near they ranged from 20 to 40 prism diopters. Surgical amounts were not listed. 81% of these patients had exotropia greater than 10 prism diopters at near, while 38% measured more than 20 prism diopters postoperatively. Only two patients had esotropia at distance at the latest follow-up examination and both measured less than 15 prism diopters.

Kraft *et al*^[9] first described an improved unilateral recession-resection surgery biased to medial rectus strengthening more than lateral rectus weakening for treatment of exotropia with convergence weakness, that is, unilateral medial rectus resection based on the near deviation with lateral rectus recession based on the distant deviation. Fourteen patients whose exodeviation at least 8 prism diopters for distance that increased at least 8 prism diopters for near were treated surgically using the procedure. The approach can successfully collapse the near-distance differences while satisfactorily aligning both distance and near fixation.

Choi *et al*^[10] conducted this procedure and also found that all 14 patients' distance and near deviation are reduced, and near-distance differences are successfully collapsed from 11.3 to 4.6 prism diopters with a low risk of long-term postoperative esotropia. Besides, Yang and Hwang^[7] compared the effect of bilateral lateral rectus recessions and unilateral lateral rectus recession with medial rectus resection, and recommended unilateral lateral rectus recession with medial rectus resection in patients with convergence insufficiency-type intermittent exotropia maintained after monocular occlusion.

Wang *et al*^[11] prospectively compared the surgical outcomes of different surgery procedures in children with convergence insufficiency-type intermittent exotropia. The authors concluded the improved unilateral lateral rectus recession with medial rectus resection procedure in which medial rectus resection based on the near deviation with lateral rectus recession based on the distant deviation has a better alignment than the unilateral medial rectus resection and bilateral medial rectus resection surgeries. However, all the three surgery procedures can reduce the near-distance differences.

MEDIAL RECTUS RESECTION(S) WITH OR WITHOUT A SLANTING PROCEDURE

In 1976, Von Noorden^[12] reported six patients who underwent bilateral medial rectus resections for exotropia of the convergence insufficiency-type. Four patients decreased in the near exodeviation significantly, but prisms were required to treat postoperative esotropia at distance for several weeks. At final examination, all patients experienced significant symptomatic relief. Hermann^[13] also conducted this procedure and all 14 patients showed dramatic relief of severe asthenopic symptoms. Although exotropia at near would return, occasionally to the origi-

nal angle of deviation, the symptoms did not return.

Kushner^[14] performed bilateral medial rectus resections for exotropia of the convergence insufficiency-type in six patients and found an undercorrection rate of 83%, although he did not report the preoperative strabismus angles or dosages of surgery.

Choi *et al.*^[5] ran a study about bilateral medial rectus resections containing 21 patients. All patients had a history of prolonged difficulties at near work unrelieved by nonsurgical treatment. Unilateral or bilateral medial rectus resection(s) were done with the adjustable suture, which was tied on the first postoperative day, and the mean postoperative follow-up period was 9.1 mo. Postoperatively Fresnel prisms were used temporarily in patients manifesting a consecutive esotropia with diplopia at distance. At the final follow-up examination, patients' mean exodeviation at distance was reduced from 11.4 to -2 prism diopters (esodeviation) and at near, from 25.7 to 3 prism diopters. Their mean near-distance difference was collapsed from 14.3 prism diopters preoperatively to 5 prism diopters postoperatively. In that study, bilateral medial rectus resections with adjustable suture combined with intentional postoperative aggressive overcorrection and the use of Fresnel prisms were effective in intermittent exotropia of the convergence insufficiency-type. The intentional overcorrection during the immediate postoperative period at distance and near was required to prevent long-term undercorrection.

Nemet *et al.*^[15] first reported that slanted bilateral medial rectus resection was effective in the convergence insufficiency-type exotropia. Because straight-ahead gaze is used mainly for distance vision and downgaze is used mainly for near vision, they recommended the use of slanted resection of the medial rectus muscle, in which the lower margin was resected more than the upper. Biedner^[16] reviewed 3 patients who underwent single medial rectus slanting resection. In his study, all 3 patients were aligned to within 10 prism diopters of orthophoria in all fields of gaze without persistent postoperative diplopia and had their asthenopic complaints eliminated. However, Choi *et al.*^[17] found that medial rectus slanting resection was unsatisfactory in terms of reducing exodeviation and collapsing near-distance differences after long-term follow-up. Ten patients receiving slanted bilateral medial rectus resection were included into their study. The upper edge of the medial rectus was resected according to the distance exodeviation and the lower edge of the medial rectus was resected according to near exodeviation. The medial rectus was reattached at its original insertion after resection. With a mean postoperative follow-up period of 38.9 mo, no patients met the criteria for surgical success and all the patients had recurrent exotropia^[17].

The authors who advocated medial rectus with or without a slanting procedure used a diverse amount of resection for a range of near deviations, which made specific surgical dose-response predictions difficult for other surgeons who are faced with this pattern of exodeviation. Therefore, it is not surprising that the postoperative

alignments in these patients varied greatly^[10].

CONCLUSION

Although numerous operation patterns have been developed for intermittent exotropia with convergence insufficiency, there is not a standard protocol for the disease in the aspect of the design of operation and the evaluation of success rate and clinical outcome. It is necessary to choose an appropriate surgery type, because intermittent exotropia with convergence insufficiency damages binocular vision at earlier time. Future prospective, multicenter and randomize studies with larger samples and longer duration of follow-up are needed to provide reliable evidence to guide the choice of an applicable operation style.

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