Single eye surgery by hang-back recession vs muscle transplantation in large-angle esotropia

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Background A two horizontal muscle surgery cannot treat a very large angle of esotropia of more than 80 prism diopters (pd). A single eye surgery would not correct such a large angle. Supramaximal recession and resection would lead to restriction of ocular motility. True muscle transplantations have been tried for this abnormally wide-angle esotropia.

Purpose The aim was to compare monocular surgery by hang-back recession vs muscle transplantation, regarding the technique, the expected results, and the possibility of minimizing the risk of complications, such as scleral perforation and a lost or slipped muscle.

Patients and methods The study is a prospective and nonrandomized study that was held at the Ophthalmology Department, Al-Azhar University Hospitals, Egypt, during the period between May 2016 and May 2018 on 30 patients presenting with esotropia. A total of 15 patients had undergone medial rectus recession using the hang-back technique and 15 patients had undergone medial rectus recession with muscle transplantation. Conjunctival recession was done at the end of surgery, and lateral rectus resection was done in both groups. Their ages ranged from 4 to 58 years. Overall, 19 patients were males and 11 were females.

Results There were nonstatistically significant differences between the two groups in all the follow-up visits.

Conclusion True muscle transplantation is a safe alternative option and as effective as hang-back technique for large-angle esotropia. The procedure is stable in the long term, with some motility limitation in maximum adduction.

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Introduction

Large-angle strabismus demands a sequence of operations to be effectively coordinated. Bilateral surgery is also required [1]. The medial rectus recession means that the muscle replaces its initial insertion. It is the easiest and most effective way to weaken the medial rectus and the most widely performed strabismus management technique [2]. If a recession for a specific muscle is planned, a suture is inserted in the tendinous part of the muscle and the muscle is removed from the sclera's attachment [3]. Afterward, several mms are recessed backward and then secured to the sclera. This change from the original position to a new location on the sclera effectively relaxes muscle pull and allows the eye to move straighter [4]. The risk is highest when the muscle is reattached to the sclera, where the needle will penetrate the sclera carefully. As sclera thinned, during traditional recession, there is greater risk of scleral perforation [5]. Until possible care can be considered, the detection of perforation is important. In many cases, scleral perforation is probably ignored [6]. A small piece of uvea or a vitreous bead at the end of the suture needle is also used for recognizing scleral perforation. Indirect ophthalmoscopy may be used when a scleral perforation is suspected for inspection of the retina underlying the surgical site [7]. A safe technique for wide-angle esotropia treatments is true muscle transplantation. The procedure is stable in long term also. This simple procedure is one of the most important tools in the hands of a strabismus surgeon who handles patients with very large angles of esotropia [2]. The alternative technique of muscle weakening, the hang-back technique, is accomplished by starting with a limbal conjunctival incision, exposure, hooking, and dissection of the muscle from the check ligaments, muscle dissection from the intermuscular septa, taking a central locking knot in the muscle bulk near the insertion, and two locking sutures at the two edges, and then the insertion tendon is cut [8]. This technique has the advantage of avoiding scleral pass, removing the potential for the suture knot to slip if superficial and minimizing the risk of perforation if deep, and allows more recession to be planned [9].

In this study, we aimed to compare medial rectus recession using monocular surgery with the hang-back technique vs muscle transplantation.

Patients and methods

This was a prospective nonrandomized study conducted at Al-Azhar University Hospitals, Department of Ophthalmology, Egypt, in the period between May 2016 and May 2018. It was conducted on 30 patients presenting with esotropia. Their ages ranged from 4 to 58 years. Overall, 19 patients were males and 11 were females.

All patients were thoroughly checked, and refraction was done before surgery.

Inclusion criteria

Patients with esotropia of more than 80 pd were included.

Exclusion criteria

The following were the exclusion criteria:

(1) Muscular paralysis.
(2) High myopia.
(3) Ciancia syndrome.
(4) Dissociated vertical divergence.
(5) Accommodative esotropias.
(6) Large vertical deviations associated with esotropia.
(7) Alphabetic syndromes and previous surgeries in either eye.

Surgical technique

Patients were classified into two groups:

Group A included 15 patients who had undergone a recession in the medial rectus with the hang-back technique; in this technique, the medial rectus is exposed and dissected, and a central locking knot was made in the muscle bulk, two locking knots at the edges are made, the muscle is dis-inserted, the sutures are attached to the stump of the original tendon of insertion, and the muscle was left to be hanged back by the distance in mm needed, avoiding the needle from passing in the sclera.

Moreover, conjunctival recession at the end of surgery was carried out to just cover the surgical knot of the hang-back thread in the stump of the original insertion; the aim of this recession of the conjunctiva was to keep the underlying hanging thread straightened, not redundant, to ensure that the site of reattachment of the muscle be at the planned site. Lateral rectus resection was done on the same eye.

Group B included 15 patients who had undergone a recession of the medial rectus with muscle transplantation technique. Medial rectus muscle in the lower nasal quadrant was dissected and separated by a fornix incision. The muscle insertion was tied with a nonabsorbable 6-0 prolene suture. The insertion of the muscle was incised.

6-0 Vicryl suture was placed at a desired distance from lateral rectus muscle insertion as in a routine resection of rectus muscle and another pair of 6-0 Vicryl suture was placed at insertion. Next, the lateral rectus muscle was hooked into two single arms. The muscle was then incised from its insertion, and the 6-0 Vicryl sutures placed behind them were passed through the original insertion. The excess muscle stump was cut. The stump was then placed on the medial rectus site and the distal end of this stump was sutured to the next end of medial rectus with the 6-0 prolene already on the medial rectus. Now, elongated muscle from the medial rectus insertion site was sutured at the desired distance as in a usual rectus muscle recession.

Moreover, conjunctival recession was done at the end of surgery, and lateral rectus resection was done on the same eye.

Follow-up

Patients received follow-up on day 1, 1 month, 6 months, 1 year, and 2 years. Postoperative alignment was evaluated using prisms and cover tests. Any postoperative complication was reported.

Ethical committee approval

The Ethics Board of Al-Azhar University approved the study, and each participant in the study received informed written consent.

Statistical analysis

The data collected were coded, processed, and analyzed using SPSS version 21 for Windows and the Statistical Package for the Social Sciences (SPSS Inc., Chicago, Illinois, USA). Chi-square test was carried out for comparison of groups. Quantitative information was shown as a mean±SD and range. The number and percentage of quality data were presented. Student *t* test was used in two groups for comparison. *P* less than 0.05 was regarded as significant in statistics.

Results

This study including 30 cases of esotropia, operated by two different techniques. All demographic data are shown in Table 1. Age in patients with hang-back recession technique ranged between 8 and 57 years, with a mean value of 23.86±15.254 years, whereas in

Table 1 Comparison of demographic data between the two groups

	Hang-back recession (*n*=15)	Muscle transplantation (*n*=15)	*P* value
Age			
Range (years)	8–57	4–58	0.671
Mean ±SD	23.86±15.254	22.52±16.160	
Sex [*n* (%)]			
Male	9 (60.0)	10 (66.7)	0.845
Female	6 (40.0)	5 (33.3)	
Visual acuity			
Oculus Dexter	0.777±0.321	0.733±0.352	0.533
Oculus Sinister	0.876±0.209	0.916±0.167	0.300

Table 2 Comparison between the two groups regarding the angle

	Hang-back recession (*n*=15)	Muscle transplantation (*n*=15)	*P* value
Preoperative			
Range	80–100	80–100	0.250
Mean ±SD	90.74±6.697	89.26±6.050	
Postoperative			
After 1 day			
Range	0–30	0–30	0.696
Mean ±SD	8.84±6.650	8.28±7.619	
After 1 month			
Range	0–32	0–32	0.817
Mean ±SD	10.14±7.01	9.82±6.775	
After 6 months			
Range	2–32	2–32	0.938
Mean ±SD	9.72±6.481	9.82±6.317	
After 1 year			
Range	2–35	2–35	0.874
Mean ±SD	9.82±6.772	10.02±5.752	
After 2 years			
Range	2–35	2–35	0.903
Mean ±SD	10.84±7.683	10.66±7.070	

Case examples of both groups.

patients with muscle transplantation technique, it ranged between 4 and 58 years, with a mean value of 22.52±16.160 years. Patients sex show that more than half of patients in the two groups were male [9 (60%) and 10 (66.7%), respectively]. Visual acuity measured in decimal fraction showed no significant statistical difference between the two groups according to Oculus Dexter and Sinister (P=0.533 and 0.300, respectively).

Table 2 shows the angle preoperatively in two groups with a mean value of 90.74±6.697 and 89.26±6.050 pd, respectively, and at the postoperative visits, the angle was decreased more in patients with muscle transplantation technique than from those with hang-back recession technique, with a mean value of 10.84 ±7.683 and 10.66±7.070 pd, respectively. Statistically differences between both groups were significant.

A comparison between the two groups regarding angle is illustrated in Figs 1–8 and shows statistically nonsignificant differences between both groups.

Discussion

Two main issues have discouraged the performance of studies evaluating monocular surgery with large medial rectus recession (≥10 mm). The first issue suggested that the operated eye would experience postoperative motility limitations [3].

The second issue suggested that the operated eye would begin to move outward in the long term owing to large medial rectus recessions, likely leading to consecutive exotropia, particularly in children [10].

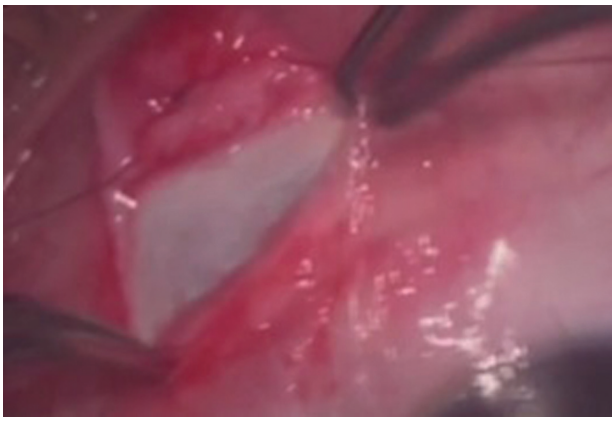
The first issue was dispelled by the authors of the original study through measurements of lateral angles of deviation, as well as postoperative photographs and videos, which demonstrated good motility in the operated eye [11].

The effectiveness of the transplanted muscle in terms of the correction of strabismus is proved, and it is also established that the tissue remains viable but may lose its contractile properties [12].

There is scant literature on the humans, the stability of angle, and follow-up of the patients. Few cases have been reported by Diamond [12] and Amitava *et al.* [1].

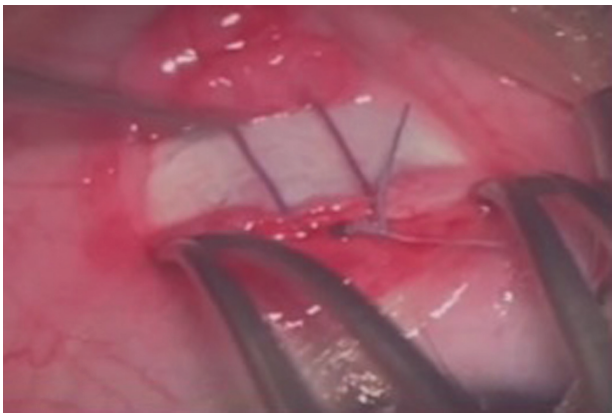
In the present study, patients' age in surgery by hang-back recession technique was ranged between 8 and 57 years, with a mean value of 23.86±15.254, whereas in patients with muscle transplantation technique was ranged between 4 and 58 years, with a mean value of 22.52±16.160. Patients' sex showed that more than half of patients in the two groups were male [9 (60%) and 10 (66.7%), respectively], and regarding age and sex, there was no statistically significant difference between the studied groups.

Figure 1



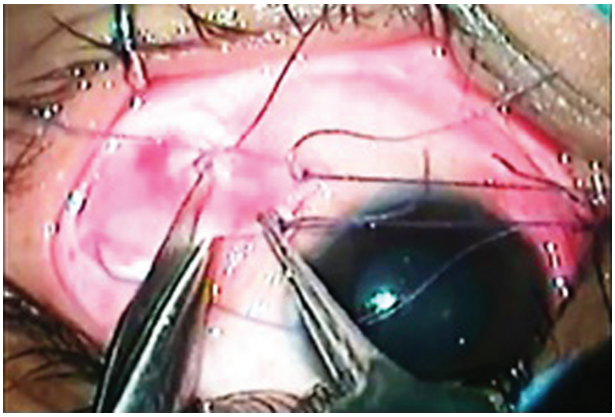
Cutted medial rectus muscle from its insertion.

Figure 2



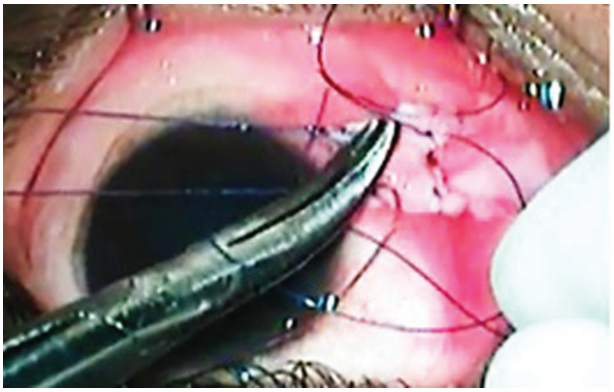
Medial rectus muscle hang-back recession.

Figure 3



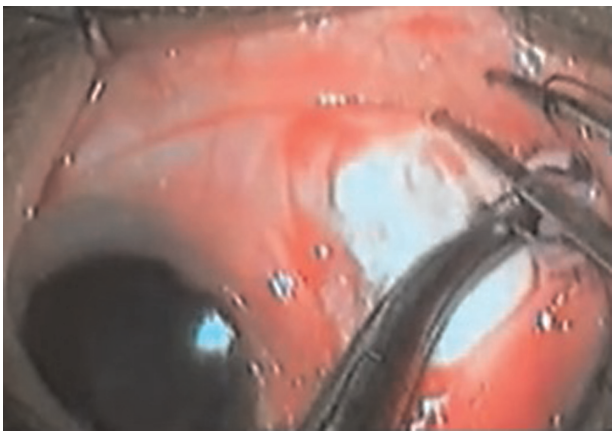
Lateral rectus resection.

Figure 4



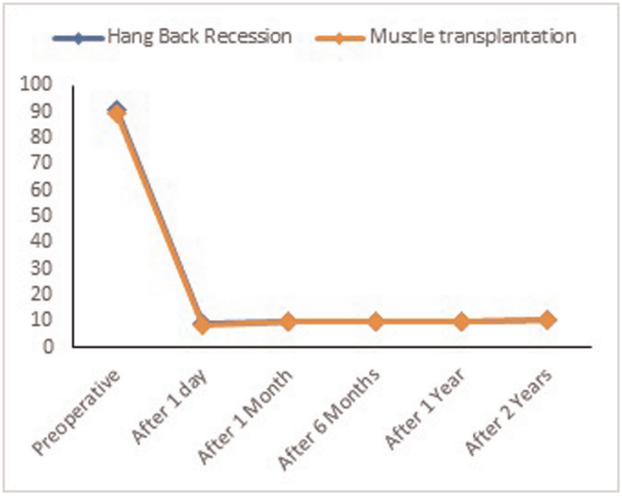
Resected part of lateral rectus muscle is transplanted into medial rectus muscle.

Figure 5



Transplantated medial rectus muscle recession.

Figure 6

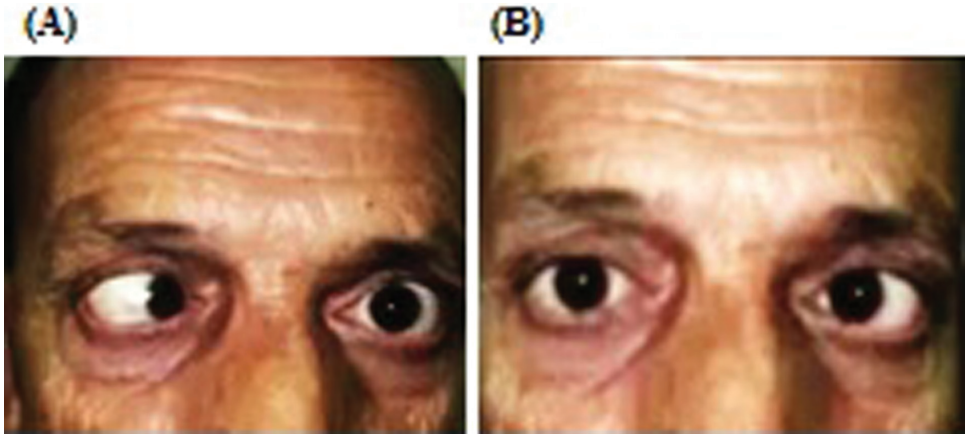


Comparison between the two groups regarding angle. The vertical limb represents the angle, and the horizontal limb represents the time.

In a study done by Jethani *et al.* [2] on a series of 22 large-angle esotropic patients treated with muscle transplantation, the mean age was 32.21 ±13.1 years, and there were 14 males and eight females.

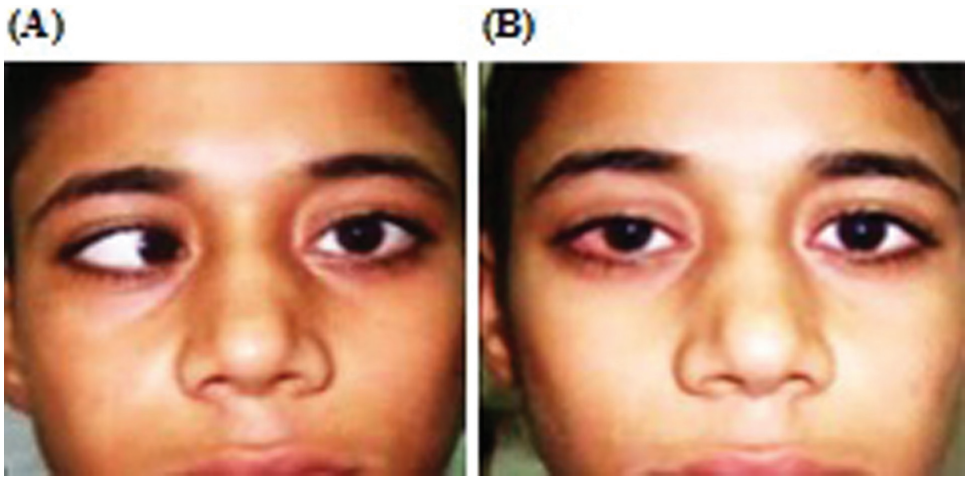
A very large angle of esotropia of more than 80 pd cannot be treated by a two horizontal muscle surgery [13]. True muscle transplantation for such abnormally

Figure 7



(a) Right esotropia 100 PD had undergone right. Lateral rectus resection 11 mm and hang- back recession of medical rectus 10 mm. (b) Result after 6 months of follow-up.

Figure 8



(a) Right esotropia 80 PD had undergone right. Lateral rectus resection 10 mm and medical rectus transplantation with recession 6 mm. (b) Result after 6 months of follow-up.

large-angle esotropia has been tried, but the experience is only for nine cases [12].

At the preoperative time, the angle in the two groups had a mean value of 90.74±6.697 and 89.26±6.050 pd, respectively, and at postoperative times, the angle was decreased more in patients with a muscle transplantation technique than in patients with a hang-back recession technique, with a mean value of 10.84±7.683 compared with 10.66±7.070 pd, with no statistically significant differences between the two groups in all follow-up times.

Another study by Jethani *et al.* [2] reported that the mean preoperative angle was 92.4±13.5 pd base out. At the end of the 2-year follow-up, the mean postoperative angle was 12.3±9.9 pd. The amount of deviation over a 2-year period was more or less constant. No delayed deviation or improvement of the outcome after 3-month postoperative period was seen.

Another study by Gigante *et al.* [3] stated that the mean angle of deviation 6 months after surgery for the 36 patients included in this analysis was 9.89 (6.30). A total of 32 patients (88.88%) had good results, two (5.55%) had fair results, and two (5.55%) had poor results. These results demonstrated preservation of motility with good amplitude in most of the operated eyes, suggesting no significant limitation in ocular rotation.

Medial rectus muscle recession is an effective treatment for esotropia by the traditional surgical approach where the tendon is directly sutured to the sclera following the recession of the muscles or by the hang-back recession technique [14].

Another research performed by Spierer and Spierer [14] aimed at comparing the operational effect of the hang-back with the traditional rectus muscle recession for infantile esotropia and reported that the mean baseline difference between the two groups was statistically different: 42.7 (SD 11.6) PD in group 1 and 54.3 (SD 16.8) PD in group 2 (P=0.001). The mean angle of esotropia after operation was 3.0 (SD 7.5) PD in group 1 and 8.7 (SD 12.1) PD in group 2 (P=0.03) and was not significant in adjusting the mean esotropic angle after operation. (Adjusted means and standard error for hang-back operation and classic recession were 3.36 (SD 2.04) PD and 8.46 (SD 1.82) PD, respectively (P=0.08).

The hang-back recession technique has the advantage of putting the hang-back stitch close the ora serrata anteriorly. The sclera at muscle insertion is thicker than with traditional bimedial recession in which sutures are located in the sclera. It reduces the risk of scleral and retinal perforation [15]. Nelson [16] claimed that a hang-back recession is useful in patients with infantile esotropia in which large rectus muscle recessions are carried out in small globes. The reduced amounts of induced astigmatism immediately after surgery is another advantage of hang-back surgery.

With the help of muscle transplantation, the effective length of the muscle could be increased and therefore, the results could be improved. The chances of any rejection of the transplanted muscle are virtually nil. We believe that the movement restriction in the extreme gaze on the side of the muscle transplantation is seen as a result of the excessive weakening of the muscle, but the muscle is still anterior to the equator, and therefore the motility restriction is minimal.

A hang?back recession will also have two major problems: first, the muscle may creep forward with such a large recession on hang-back (we are doing close to 14–15 mm from the insertion and almost 20 mm from the limbus), and the second problem that it would attach to a point that would be posterior to the arc of contact, and hence, the restriction of ocular motility in the ipsilateral direction was obvious.

Our series of 30 patients show that a very large-angle esotropia can be successfully treated preserving the comitancy by a single eye surgery with a stable outcome for 2 years by either hang-back recession or muscle transplantation.

Conclusion

True muscle transplantation is a safe alternative option and as effective as hang-back technique for a large-angle esotropia. The procedure is stable in the long term also, with some motility limitation in maximum adduction.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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