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Assessment of periosteal fixation of partial VRT and lateral rectus in subjects of exotropic duane retraction syndrome: A prospective clinical study

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***Abstract*---**Owing to the ability of the lateral rectus to contract during adduction is regained, the surgical procedures only partly relieve the problem. Complete relief is seen only when the innervation to the lateral rectus, which is misdirected, is managed effectively. The present study was conducted to prospectively evaluate the efficacy of periosteal fixation of the lateral rectus muscle and periosteal fixation along with the partial VRT in subjects with Exo-DRS. 15 subjects with Exo-DRS were randomly divided into two groups, where Group I (n=7) subjects were treated with periosteal fixation of the lateral rectus muscle and Group II (n=8) subjects were treated using periosteal fixation of the lateral rectus muscle with split VRT. At 1 week, 1 month, and 3 months postoperatively, exophthalmometry, binocular single visual field, abduction and adduction range, and prism bar cover test was assessed. Adduction changed postoperatively from -1.7 to -0.5 in subjects of Group I and from -1.3 to -0.5 in subjects of Group II. TBSF (Total binocular single visual field) was 14.5 in subjects of Group I preoperatively and was 11.6 in subjects of Group II postoperatively. This change postoperatively was significant in both groups. In Group I. Adduction in Group II preoperatively was 16.1 which increased to 17.2 postoperatively. Adduction in both the groups showed an alteration by 1mm. The present study concludes that

periosteal fixation is efficacious in eliminating the innervation to the lateral rectus muscle and improves ameliorate the primary position exodeviation, and hence, the adduction range and the head position. Abduction seen in exo-DRS can be corrected by transpositioning the partial vertical rectus following periosteal fixation of the lateral rectus.

***Keywords*---**Duane retraction syndrome, exotropic Duane retraction syndrome, periosteal fixation, vertical rectus transposition, strabismus surgery.

Introduction

Stilling–Turk–Duane syndrome which is also termed as DRS (Duane retraction syndrome) is an anomaly in the eye movement, is congenital, and is characterized by globe retraction and palpebral fissure narrowing on attempting adduction, and variable horizontal duction deficits. Duane syndrome is occasionally associated with the down shoot or upshoot. DRS has been described in status for a very long time, dating back to the 19th century.[1] This syndrome constitutes approximately less than 5% of all strabismus forms. Heuck in 1879 was the first to report globe retraction in adduction and congenitally anomalous eye movements. Later, many other authors described in detail this clinical congenital anomaly. Possible etiopathogenesis and clinical features of DRS were described for the first time in detail in the case series by Alexander Duane.

Later following the technologic advantages, and with the introduction of genetic analysis, muscle electrophysiology, and neuroimaging, strabismus was understood to a wide extent, hence, now is considered as CCDD (congenital cranial dysinnervation disorder). This understanding has helped greatly in understanding and managing this complex disorder.[2] Various surgical interventions are described in the literature to manage Exo-DRS (exotropic Duane retraction syndrome) type II. These surgical interventions are supramaximal recession of the lateral rectus, lateral rectus Y-splitting with/without a recession, and differential recession of both medial and lateral recti of the eye affected.[3] Using these procedures, correction of head posture is seen with exodeviation correction. However, the difficulty of the globe down shoot/upshoot and co-contraction in adduction and retraction persisted with some improvement.

Owing to the ability of the lateral rectus to contract during adduction is regained, the surgical procedures only partly relieve the problem. Complete relief is seen only when the innervation to the lateral rectus, which is misdirected, is managed effectively.[4] Hence, few authors advocate extirpation of the lateral rectus muscle or periosteal fixation in subjects with Exo-DRS. Additionally, VRT (vertical rectus transpositioning) in full-thickness is used for abduction forces improvement.[5] The present study was conducted to prospectively evaluate the efficacy of periosteal fixation of the lateral rectus muscle and periosteal fixation along with the partial VRT in subjects with Exo-DRS.

Materials and Methods

The present study was conducted to prospectively evaluate the efficacy of periosteal fixation of the lateral rectus muscle and periosteal fixation along with the partial VRT in subjects with Exo-DRS. The present study was carried out at SMBT Institute Medical Sciences and Research Center, Dhamangaon-Dhoti, Nashik, Maharashtra after obtaining clearance from the concerned Ethical committee. The study included a total of 15 subjects from both genders with Exo-DRS. Included 15 subjects were randomly divided into two groups, where Group I (n=7) subjects were treated with periosteal fixation of the lateral rectus muscle and Group II (n=8) subjects were treated using periosteal fixation of the lateral rectus muscle with split VRT. No subject had undergone any previous surgery in the eye.

At the first visit, at baseline, all the subjects underwent complete ocular motility workup including nine gaze measurements, Prism bar cover test, and grading for adduction and abduction underaction. The grading was done on a 0-4 scoring scale where 0: Full rotation up to the canthus 1: slight limitation, 2: half of the range from the midline to canthus, 3: slight movement not up to halfway, and 4: no movement from the midline. Lister's perimetry was used to assess the extent of the binocular single visual field, wherever, it can be measured. Hertel's exophthalmometer measured the exophthalmometry measurements. All the subjects were recalled at 1 week, 1 month, and 3 months postoperatively, and all the parameters were assessed at all the recall visits.

Periosteal fixation of the lateral rectus muscle was carried out by a single surgeon with expertise in the field and in all the study subjects. Under either local anesthesia/general anesthesia, a passive forced duction test was done with the limbal conjunctival incision. Following incision, lateral rectus dissection was done from Tenon's capsule and intermuscular membrane present around, and it was separated on a muscle hook. On the muscle insertion, sutures were placed and were separated from the globe via Westcott scissors. The periosteum present adjacent and 5mm posterior to the orbital rim was exposed laterally to the muscle (lateral rectus), which was later fixed to the orbital wall using periosteal bite. The edges of the intermuscular membrane that were cut, were sutured to sclera together followed by the suturing of the conjunctival incision. The recessions were done wherever needed, especially in cases with short conjunctiva.

In Group II, along with lateral rectus periosteal fixation, partial VRT was also done utilizing the same lateral limbal conjunctival incision. Inferior and superior rectus muscles were isolated from the background and were carefully separated. At 9 mm posterior to the insertion, using a split, the lateral half of each vertical muscle was detached from the nasal portion carefully to preserve the nasal anterior ciliary vessel in the remaining halves. On the vertical rectus muscle, on the lateral portion, sutures were given followed by muscle insertion removal to allow transportation. Transportation was done to reattach it to the inferior border or superior to the lateral rectus muscle. The reattachment was done at a 7mm distance from actual lateral rectus muscle insertion. Ductions were placed intraoperatively to avoid vertical incomitance and movement restrictions. The collected data were subjected to the statistical evaluation using SPSS software

version 21 (Chicago, IL, USA) and one-way ANOVA and t-test for results formulation. The data were expressed in percentage and number, and mean and standard deviation. The level of significance was kept at $p<0.05$.

Results

The present study was conducted to prospectively evaluate the efficacy of periosteal fixation of the lateral rectus muscle and periosteal fixation along with the partial VRT in subjects with Exo-DRS. The study was included a total of 15 subjects from both genders with Exo-DRS. Included 15 subjects were randomly divided into two groups, where Group I (n=7) subjects were treated with periosteal fixation of the lateral rectus muscle and Group II (n=8) subjects were treated using periosteal fixation of the lateral rectus muscle with split VRT. The present study assessed the preoperative and post-operative parameters in the two groups of the study subjects, and the results are shown in Table 1 and Table 2. It was seen that preoperative exotropia in Group I was -26.4 in Group I and -21.5 in group II which improved postoperatively to 0.8 in group I and -8.5 in Group II. The mean change is seen from -26.4 to 0.8 in positive in the subjects of Group I where only periosteal fixation was done and has changed from -21.5 to -8.5 in the subjects of Group II where periosteal fixation with split VRT was done.

Preoperative abduction was -3.6 in Group I and was -3.4 in Group II subjects. Abduction in Group I improved postoperatively to -3.4 from -3.6, whereas, in subjects of Group II abduction changed from -3.4 to -2.6 dioptres. Adduction preoperatively was -1.7 in subjects of Group I and was -1.3 in subjects of Group II. Adduction changed postoperatively from -1.7 to -0.5 in subjects of Group I and from -1.3 to -0.5 in subjects of Group II. TBSF (Total binocular single visual field) was 14.5 in subjects of Group I preoperatively and was 11.6 in subjects of Group II postoperatively. TBSF changed from 14.5 to 23.5 postoperatively in subjects of Group I where only periosteal fixation was done, whereas, in subjects of Group II where periosteal fixation with split VRT was performed, TBSF changed from 11.6 to 26.2 (Table 1 and 2). This change postoperatively was significant in both groups.

On assessing the pre-operative and post-operative parameters in two groups of the study subjects based on Mean Hertel ex ophthalmometry, it was seen that in Group I, the preop primary position was 19.3 which did not change postoperatively, preop abduction was 20.1 which decreased to 19.6 postoperatively, whereas, preoperative adduction was 18 which increased postoperatively to 18.8. In Group II, preoperative primary position and abduction were 18.2 and no change was seen in primary position and abduction postoperatively, and it remained 18.2. Adduction in Group II preoperatively was 16.1 which increased to 17.2 postoperatively. Adduction in both groups showed an alteration by 1mm (Table 3).

Discussion

The present study was conducted to prospectively evaluate the efficacy of periosteal fixation of the lateral rectus muscle and periosteal fixation along with the partial VRT in subjects with Exo-DRS. The study was included a total of 15

subjects from both genders with Exo-DRS. Included 15 subjects were randomly divided into two groups, where Group I (n=7) subjects were treated with periosteal fixation of the lateral rectus muscle and Group II (n=8) subjects were treated using periosteal fixation of the lateral rectus muscle with split VRT. The present study assessed the preoperative and post-operative parameters in the two groups of study subjects. It was seen that preoperative exotropia in Group I was -26.4 in Group I and -21.5 in group II which improved postoperatively to 0.8 in group I and -8.5 in Group II. The mean change is seen from -26.4 to 0.8 in positive in the subjects of Group I where only periosteal fixation was done and has changed from -21.5 to -8.5 in the subjects of Group II where periosteal fixation with split VRT was done. These findings were consistent with the results of Rao VB et al[6] in 2003 and Morad Y et al[7] in 2005 where periosteal fixation showed comparable results to the present study by authors in their respective studies.

The present study showed that preoperative abduction was -3.6 in Group I and was -3.4 in Group II subjects. Abduction in Group I improved postoperatively to -3.4 from -3.6, whereas, in subjects of Group II abduction changed from -3.4 to -2.6 dioptres. Adduction preoperatively was -1.7 in subjects of Group I and was -1.3 in subjects of Group II. Adduction changed postoperatively from -1.7 to -0.5 in subjects of Group I and from -1.3 to -0.5 in subjects of Group II. TBSF (Total binocular single visual field) was 14.5 in subjects of Group I preoperatively and was 11.6 in subjects of Group II postoperatively. TBSF changed from 14.5 to 23.5 postoperatively in subjects of Group I where only periosteal fixation was done, whereas, in subjects of Group II where periosteal fixation with split VRT was performed, TBSF changed from 11.6 to 26.2. This change postoperatively was significant in both groups. These results were in agreement with the findings of the studies by Andalib D and Javadzadeh A[8] in 2008 and Britt MT et al[9] in 2005 where authors reported that adduction, TBSF, and abduction showed comparable results following periosteal fixation.

Pre-operative and post-operative parameters in two groups of the study subjects as assessed based on Mean Hertel ex ophthalmometry, it was seen that in Group I, the preop primary position was 19.3 which did not change postoperatively, preop abduction was 20.1 which decreased to 19.6 postoperatively, whereas, preoperative adduction was 18 which increased postoperatively to 18.8. In Group II, preoperative primary position and abduction were 18.2 and no change was seen in primary position and abduction postoperatively, and it remained 18.2. Adduction in Group II preoperatively was 16.1 which increased to 17.2 postoperatively. Adduction in both the groups showed an alteration by 1mm. These results were comparable to the studies of Parsa CF[10] in 2006 and Velez FG et al[11] in 2004 where authors showed similar results in their subjects using Hertel ex ophthalmometry.

Conclusion

Within its limitations, the present study concludes that periosteal fixation is efficacious in eliminating the innervation to the lateral rectus muscle and improves ameliorate the primary position exodeviation, and hence, the adduction range and the head position. Abduction seen in exo-DRS can be corrected by transpositioning the partial vertical rectus following periosteal fixation of the

lateral rectus. However, the present study had a few limitations including a small sample size, short study duration, and geographical area biases. Hence, more longitudinal studies with a larger sample size and longer monitoring period will help reach a definitive conclusion.

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Tables

Table 1
Pre operative and post operative parameters in subjects of Group I (OU: Oculus uterque, OS: Oculus sinister, OD: Oculus dextrus)

Age	Eye	Preop exotropia	3 months postop exotropia	Preop Abduction	3 months Postop Abduction	Preop Adduction	3 months Postop Adduction	Preop TBSF	3 months Postop TBSF
20	OU	-25	-6	-3.5	-3.5	-1	0	15	35
21	OU	-25	-7	-4	-3.5	-1	-0.5	21	29
24	OS	-35	-7	-4	-3.5	-1.5	-0.5	0	0
21	OS	-20	+20	-3.5	-2.5	-1.5	0	28	40
25	OU	-25	-8	-4	-3.5	-4	-0.5	24	36
27	OS	-22	+12	-4	-4	-2.5	-1	0	0
26	OD	-30	-7	-3.5	-3.5	-1.5	-0.5	21	29
Mean		-26.4	0.8	-3.6	-3.4	-1.7	-0.5	14.5	23.5

Table 2
Pre operative and post operative parameters in subjects of Group II

Age	Eye	Preop exotropia	3 months postop exotropia	Preop Abduction	3 months Postop Abduction	Preop Adduction	3 months Postop Adduction	Preop TBSF	3 months Postop TBSF
20	OU	-30	-6	-3.5	-2.5	-2	-1	14	25
6	OD	-14	-6	-4	-2.5	-0.5	-0.5	15	35
20	OS	-15	-2	-4	-3	-1	0	7	35
24	OS	-20	-12	-3.5	-2.5	-1	0	18	38
20	OU	-20	-10	-4	-3	-2.5	-2	0	9
16	OS	-20	-10	-4	-2.5	-2	-1	14	18
18	OS	-30	-20	-4	-3.5	-1.5	-0.5	15	25
20	OS	-20	-10	-3.5	-2.5	-1	-0.5	14	35
Mean		-21.5	-8.5	-3.4	-2.6	-1.3	-0.5	11.6	26.2

Table 3
Mean Hertel exophthalmometry pre operative and post operative parameters in two groups of the study subjects

Group	Preop Primary position	Postop Primary position	Preop Abduction	Postop Abduction	Preop Adduction	Postop Adduction
I	19.3	19.3	20.1	19.6	18	18.8
II	18.2	18.2	18.2	18.2	16.1	17.2