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"A" AND "V" PHENOMENA *†

BY

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BIELSCHOWSKY (1935), Danis (1948), and Ringland Anderson (1959) noted divergence on looking up and convergence on looking down in normal individuals. Urrets-Zavalia (1955) stressed the need for examination of the amplitude of deviation on upward and downward gaze. Urist (1951, 1954a, b) gave the name of Urist's syndrome to secondary vertical squints and classified them into four groups. Albert and Costenbader (1959) gave the name of "A and V syndrome" to vertically incomitant squint and described "A" and "V" esotropia and exotropia. They did not define the limits of normal deviation in the direct up and down positions of gaze.

Material and Methods

We have studied 55 patients with the "A" and "V" phenomena who attended the Ophthalmic Departments of Rajendra Hospital, Patiala, and the All-India Institute of Medical Sciences.

The time of onset of squint, and any past illness, injury, or other abnormality were recorded.

Besides the usual fundus examination and refraction, the angle of deviation in different directions of gaze was measured by:

(a) Hirschberg method.
(b) Prism bar and cover test.
(c) Synoptophore.

A pen torch-light was fixed on a stand at a fixed distance of 33 cm. The horizontal deviations, if any, were measured on movements of 25° upwards and downwards from the primary position. Photographs were taken in three directions of gaze (upwards, downwards, and in the primary position) in our fifty cases of pure "A" and "V" phenomena and in all nine directions of gaze in our five cases of impure "A" and "V" phenomena. The deviations were measured for near as well as for distance with and without correcting glasses. The head was always kept fixed and straight.

Observations

(A) General Factors

(*i*) *Refractive Error* (Table I, opposite).—Of the 55 cases, 51 were hypermetropic (32 less than 2 D, 11 between 2 and 4 D, 8 hypermetropic astigmatism). The other four were myopic. Like Urist (1954a, b) we found that the phenomenon was commoner in hypermetropes. The degree of refractive error does not appear to have any effect.

(*ii*) *Age and Sex* (Table II, opposite).—All 55 (28 females and 27 males) gave a history of deviation since childhood. The condition appears to be equally common in both sexes and is perhaps congenitally determined. The role of heredity could not be determined.

(*iii*) *Type of Squint*.—In thirty cases the squint was alternating and in 25 it was unilateral.

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TABLE I
REFRACTIVE ERROR IN "A" AND "V" PHENOMENA IN 55 CASES

Type of Case			Hypermetropia (51)		Myopia (4)		Astigmatism	
			Less than 2 D	More than 2 D	Less than 2 D	More than 2 D	Hyper-metropia	Myopia
Pure (50)	Esotropia	V	18	5	–	1	3	–
		A	3	2	–	–	–	–
	Exotropia	V	8	–	1	–	3	2
		A	3	–	–	–	1	–
Impure (5)			–	4	–	–	1	–
Total			32	11	1	1	8	2

TABLE II
SEX INCIDENCE IN "A" AND "V" PHENOMENA

Type of Case			Type of Squint					
			Unilateral		Alternating		Total Both Sexes	
			Male	Female	Male	Female	No.	Per cent.
Pure	Esotropia	V	10	6	5	6	27	50
		A	1	2	–	2	5	9
	Exotropia	V	1	2	6	5	14	25
		A	2	1	1	–	4	7
Impure			–	–	1	4	5	9
Total			14	11	13	17	55	100

In 37 cases the squint was convergent and in 18 cases it was divergent. The type of squint does not appear to be important.

(*iv*) *Facial Abnormalities.*—There was no hypoplasia of the malar bones, canthal deformities, or lid margin deformities, so that the "A" and "V" phenomena do not appear to be associated with other congenital deformities as suggested by Miller (1960).

(B) Classification

The condition has been variously classified by Urist (1951, 1952, 1954a, b), Albert and Costenbader (1959), Villaseca (1955, 1961), and Tamler (1961). Our new classification attempts to rectify the deficiencies of previous methods and includes types of case which would otherwise not fit in.

(*1*) *Pure Type* (50 Cases).—There is a variation in the horizontal strabismus as the patient looks up and down with no vertical incomitance in any of the nine positions of gaze. This may be further divided into "A" or "V" types of esotropia and exotropia (Table III, overleaf).

(*2*) *Impure Type* (5 Cases).—Besides the horizontal strabismus which occurs on looking

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TABLE III
TYPE 1. PURE "A" AND "V" PHENOMENA (50 CASES)

Case No.	Type 1		Pre-operative Angle (°)			Post-operative Angle (°)			Operation
			Up	Primary	Down	Up	Primary	Down	
1	Esotropia	V (27)	0	+28	+28	0	0	0	L medial rectus recession
2			0	+15	+25	0	0	0	L medial rectus recession
3			0	+15	+35	0	0	0	L medial rectus recession
4			+5	+15	+15	−15	−5	0	R medial rectus recession
5			0	+20	+30	0	+2	+4	R medial rectus recession
6			+10	+15	+20	0	0	0	L medial rectus recession
7			+5	+20	+35	0	0	+5	L medial rectus recession
8			−5	+20	+30	−10	0	0	R medial rectus recession
9			+5	+30	+35	0	0	+5	L medial rectus recession
10			0	+10	+10	0	0	0	R medial rectus recession
11			0	+15	+15	0	0	0	L medial rectus recession
12			+20	+35	+45	0	0	+10	Bilateral medial rectus recession
13			+10	+25	+35	0	0	0	Bilateral medial rectus recession
14			+15	+25	+45	0	0	0	Bilateral medial rectus recession
15			+10	+45	+55	0	+5	+10	Bilateral medial rectus recession
16			+15	+35	+45	0	0	+10	Bilateral medial rectus recession
17			+35	+35	+55	0	0	+5	Bilateral medial rectus recession
18			+15	+30	+45	0	0	+5	Bilateral medial rectus recession
19			+40	+45	+60	+3	+5	+10	Bilateral medial rectus recession
20			0	+30	+45	0	0	+9	Bilateral medial rectus recession
21			+30	+50	+60	0	0	+5	Bilateral medial rectus recession
22			+15	+15	+25	0	0	0	L medial rectus recession; lateral rectus resection
23			+15	+30	+45	−5	+5	+10	R lateral rectus resection; medial rectus recession
24			0	+20	+20	−5	−4	0	L lateral rectus recession; medial rectus recession
25			+10	+25	+45	−2	+5	+5	R lateral rectus resection; medial rectus recession
26			+30	+40	+45	0	+5	+5	L medial rectus recession; lateral rectus resection
27			+25	+35	+35	−3	+2	+4	R medial rectus recession; lateral rectus resection
28		A (5)	+15	+15	0	+12	+10	−4	R medial rectus recession
29			+15	+15	0	+12	+10	−4	R medial rectus recession
30			+35	+30	+10	+15	+5	0	L lateral rectus resection
31			+30	+20	0	0	−2	−18	L medial rectus recession; lateral rectus resection
32			+55	+25	0	+5	0	0	Bilateral lateral rectus resection
33	Exotropia	V (14)	−30	−20	−10	−5	0	0	Bilateral lateral rectus recession
34			−25	−15	0	0	0	0	Bilateral lateral rectus recession
35			−25	−15	−15	−5	0	0	Bilateral lateral rectus recession
36			−30	−15	−15	−15	−10	0	R lateral rectus recession; medial rectus resection
37			−55	−35	−35	−10	−10	0	R lateral rectus recession
38			−20	−12	−5	−12	0	0	R medial rectus resection
39			−15	−15	0	0	0	0	Bilateral lateral rectus recession
40			−25	−15	−5	0	0	0	Bilateral lateral rectus recession
41			−35	−15	0	−5	0	0	Bilateral lateral rectus recession
42			−15	−15	0	0	0	0	R lateral rectus recession
43			−15	−15	0	0	0	0	R lateral rectus recession
44			−20	−20	0	0	0	+5	L medial rectus resection; lateral rectus recession
45			−30	−20	−15	0	0	0	Bilateral lateral rectus recession
46			−25	−15	0	0	0	0	Bilateral lateral rectus recession
47		A (4)	−10	−18	−35	−10	−10	−20	L lateral rectus recession
48			−10	−15	−30	0	0	−5	Bilateral medial rectus resection
49			−45	−45	−55	−12	−12	−20	L lateral rectus recession
50			−10	−25	−25	0	0	−5	Bilateral medial rectus resection

up and down, there is vertical incomitance in one or more of the other positions of gaze. This group may be further sub-divided into three patterns (Table IV):

(*i*) The left eye remains hypertropic on dextroversion and the right eye on laevoversion (1 case).
(*ii*) The right eye remains hypertropic on dextroversion and the left eye on laevoversion (3 cases).
(*iii*) The same eye remains hypertropic on both dextro- and laevoversion (1 case).

TABLE IV
TYPE 2. IMPURE "A" AND "V" PHENOMENA (5 CASES)

Case No.	Type 2	Pattern	Pre-operative Angle (°)			Post-operative Angle (°)			Operation
			Up	Primary	Down	Up	Primary	Down	
51	V-Esotropia	(i)	+10	+25	+35	0	0	+5	Bilateral medial rectus recession
52		(ii)	+35	+35	+55	0	+5	+20	Bilateral medial rectus recession
53		(ii)	+25	+35	+45	+15	+5	0	L lateral rectus resection; medial rectus recession
54		(ii)	+25	+35	+55	0	+10	+10	Bilateral medial rectus recession
55		(iii)	+7	+15	+30	0	+5	+5	Bilateral medial rectus recession

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TYPE (1) ESOTROPIA

"V" Esotropia.—This was the condition most frequently encountered, 27 cases (50 per cent.) being of this type.

A young man aged 18 years was admitted on March 29, 1962, with a history of squint since childhood. The ocular media and the fundi were normal. No facial abnormality was detected. There was a left convergent strabismus of 15° in the primary position, 25° on looking down, and no deviation on looking up. There was no vertical incomitance in any direction of gaze (Fig. 1*a*).

Prism Bar Readings

UP

	ESO–0°	ESO–0°	ESO–0°	
RIGHT	ESO–15°	ESO–15°	ESO–15°	LEFT
	ESO–25°	ESO–25°	ESO–25°	

DOWN

Synoptophore: No simultaneous macular perception. Objective angle 15° in the primary position.

Visual Acuity: Right eye 6/9, with + 1·5 D sph., + 0·5 D cyl., axis 180°.
Left eye 6/60, with + 4 D sph., + 0·75 D cyl., axis 180°.

Operation.—On March 31, 1962, the left medial rectus was recessed by 6 mm. On discharge, 4 days later the patient had straight eyes. After 4 months there was no strabismus (Fig. 1*b*).

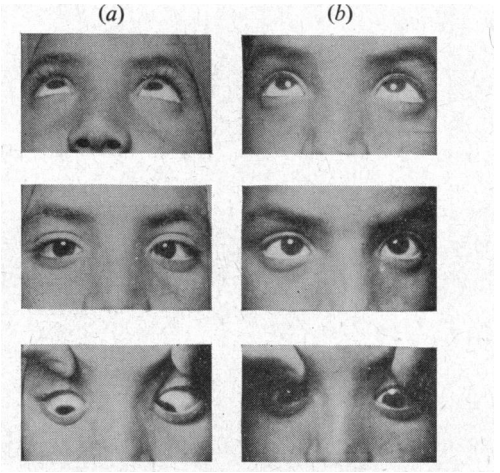

FIG. 1 (*a*).—"V" esotropia before operation.
(*b*).—After 6 mm. recession of left medial rectus.

Comment.—Cases with an angle of deviation less than 35° were treated either by recession of the medial rectus of the squinting eye (11 cases) or recession of the medial rectus and resection of the lateral rectus of the squinting eye (6 cases). Between 35° and 55°, a bilateral recession of the medial rectus with or without resection of the lateral rectus was performed, especially if the difference in deviation between looking down and the primary position was more than 10°. Operation on the medial rectus corrected the esodeviation in the primary position and on looking down without affecting deviation on looking up, whereas an operation on the lateral rectus was ineffective.

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"A" Esotropia.—Five cases (9 per cent.) were found in which the esotropia was greater on looking up than on looking down.

A woman aged 24 years was admitted on April 27, 1962, having had crossed eyes since childhood. There was no facial abnormality. There was 30° of esotropia in the primary position which increased to 35° on looking up and decreased to 10° on looking down. Cover tests revealed no vertical incomitance (Fig. 2*a*).

Prism Bar Readings

UP

	ESO–35°	ESO–35°	ESO–35°	
RIGHT	ESO–30°	ESO–30°	ESO–30°	LEFT
	ESO–10°	ESO–10°	ESO–10°	

DOWN

For near, the angle of deviation was 30° and for distance it was only 15°. No variation in the angle of deviation was obtained by correcting the refractive error.

Synoptophore: The subjective angle could not be measured because of suppression of the left eye. Objective angle 30°. No binocular vision.

Visual Acuity: Right eye 6/6, with + 2 D sph.
Left eye 6/60, with + 2 D sph.

Operation.—On April 30, 1962, a 7 mm. resection of the left lateral rectus was done. 4 months later the deviation in the primary position was 5° esotropia, with 15° on looking up and none on looking down (Fig. 2*b*). There was no vertical incomitance.

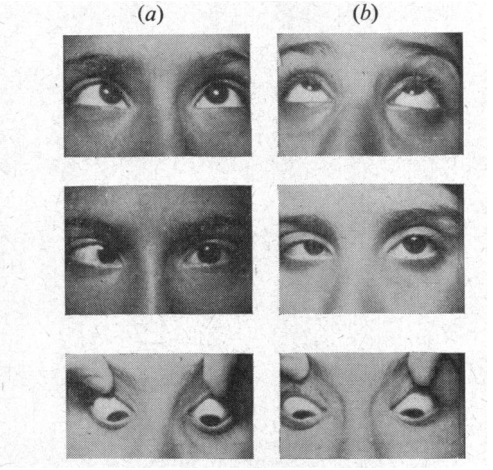

FIG. 2 (*a*).—"A" esotropia before operation.
(*b*).—After 7 mm. resection of left lateral rectus.

Comment.—Resection of the lateral rectus muscle produced asymmetrical results, correcting more esodeviation on looking up and less on looking down.

Recession of the medial rectus did not correct esodeviation on looking up but resulted in exodeviation on looking down, *i.e.* the "A" component was aggravated. Even when the medial rectus recession was combined with lateral rectus resection, the results were unsatisfactory and some exodeviation was noticeable. Bilateral resection of the lateral recti

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resulted in correction, showing an asymmetrical action. Deviation on looking up and straight ahead was corrected by resection of the lateral rectus.

TYPE (1) EXOTROPIA

"V" Exotropia.—In fourteen cases (25 per cent.) the horizontal exodeviation on looking up was more than that in the primary position and on looking down.

A boy aged 13 years was admitted on April 3, 1962, with a history of outward deviation of the right eye since childhood. There was no facial deformity. There was 15° exotropia in the primary position and on looking up and none on looking down. There was no vertical incomitance (Fig. 3*a*). The angle of deviation was the same for near and distance.

Prism Bar Readings

UP

	EXO–15°	EXO–15°	EXO–15°	
RIGHT	EXO–15°	EXO–15°	EXO–15°	LEFT
	EXO–0°	EXO–0°	EXO–0°	

DOWN

Synoptophore: The subjective angle could not be measured because of suppression of the right eye. Objective angle −18°. No binocular vision.

Visual Acuity: Right eye 6/6, with + 1 D sph.
Left eye 6/60, with + 1 D sph.

Operation.—On April 5, 1962, both lateral recti were recessed 7 mm. After 4 months there was no deviation for near and distance (Fig. 3*b*) and no vertical incomitance.

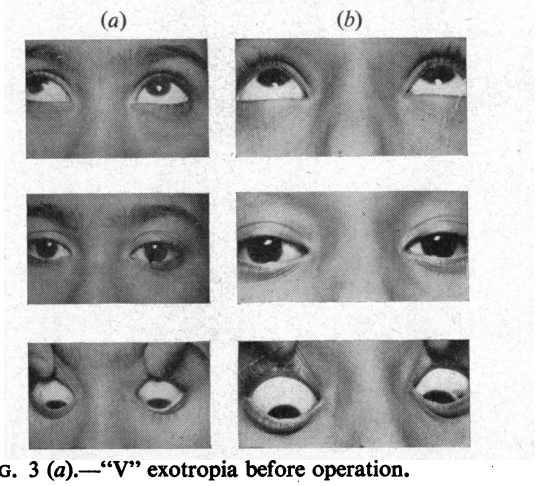

FIG. 3 (*a*).—"V" exotropia before operation.
(*b*).—After 7 mm. recession of both lateral recti.

Comment.—Recession of the lateral rectus resulted in a cure in the majority of cases. If the medial rectus was resected alone it resulted in esotropia. Even when medial rectus resection was combined with lateral rectus recession the results were unsatisfactory. The observations indicate that the medial rectus is stronger than the lateral rectus in these cases.

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"A" Exotropia.—In four cases (7 per cent.), the exodeviation was greater on looking down, with no vertical incomitance.

A girl aged 15 years was admitted on April 10, 1962, with a history of deviation of the left eye outwards since childhood. No facial abnormality was detected. There was 18° of exotropia in the primary position which decreased to 10° on looking up and increased to 35° on looking down (Fig. 4*a*). The deviation was the same for near and distance. There was no vertical incomitance.

Prism Bar Readings

UP

	EXO–10°	EXO–10°	EXO–10°	
RIGHT	EXO–18°	EXO–18°	EXO–18°	LEFT
	EXO–35°	EXO–35°	EXO–35°	

DOWN

Synoptophore: The subjective angle could not be measured because of suppression of the left eye. Objective angle 18°.

Visual Acuity: Right eye 6/12, with + 1 D sph.
Left eye 6/60, with + 1 D sph.

Operation.—On April 12, 1962, the left lateral rectus was recessed 8 mm. 4 months later, 10° of exotropia on looking up and straight ahead and 20° on looking down was still present. The deviation on looking down was corrected more than that on looking up (Fig. 4*b*).

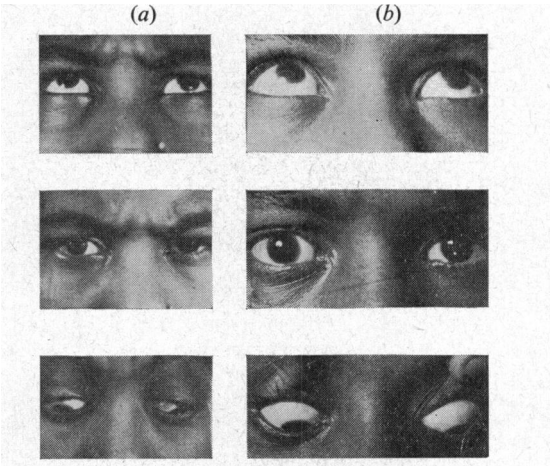

FIG. 4.—"A" exotropia (*a*) before and (*b*) after operation.

Comment.—The results of surgery in cases of this kind were not encouraging. A reduction in "A" exotropia can be achieved by bilateral resection of the medial recti.

TYPE (2) IMPURE "A" AND "V" PHENOMENA

The incidence of the impure type in our series was 9 per cent. although Urist (1951) reported 100 per cent. We have added a third pattern to the two described by Tamler (1961).

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Pattern (i).—The left eye remains hypertropic on dextroversion and the right eye on laevoversion.

A girl aged 15 years was admitted on April 20, 1963, with a history of alternating inward deviation of the eyes since childhood. The deviation in the primary position was 45° esotropia which decreased to 35° on looking up and increased to 55° on looking down. There was left hypertropia of 8 prism dioptres in the primary position (Fig. 5*a*).

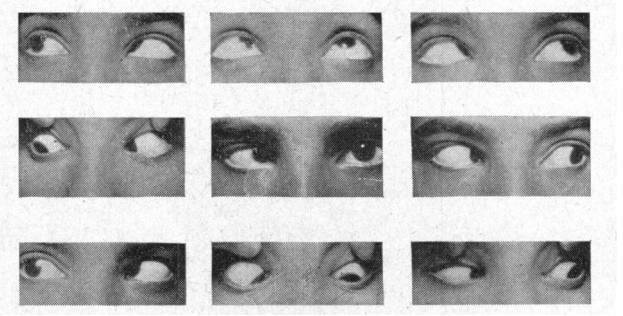

FIG. 5 (*a*).—Impure "A" and "V" phenomena pattern (i) before operation. Left eye hypertropic in all the right fields and right eye in all the left fields of gaze.

Prism Bar Readings

UP

	ESO–35° LH–8°	ESO–35° LH–5°	ESO–35° RH–8°	
RIGHT	ESO–45° LH–8°	ESO–45° LH–8°	ESO–45° RH–8°	LEFT
	ESO–55° LH–5°	ESO–55° LH–5°	ESO–55° RH–5°	

DOWN

Synoptophore: Objective angle 45°. No binocular vision.

Visual Acuity: Right eye 6/12, with + 2 D sph.
Left eye 6/18, with + 3 D sph.

Operation.—On April 23, 1963, both medial recti were recessed by 6 mm. After 3 months the deviation on looking up was nil, and in the primary position there was 5° of esotropia which increased to 15° on looking down. Hypertropia was also present in all positions, though it had decreased (Fig. 5*b*).

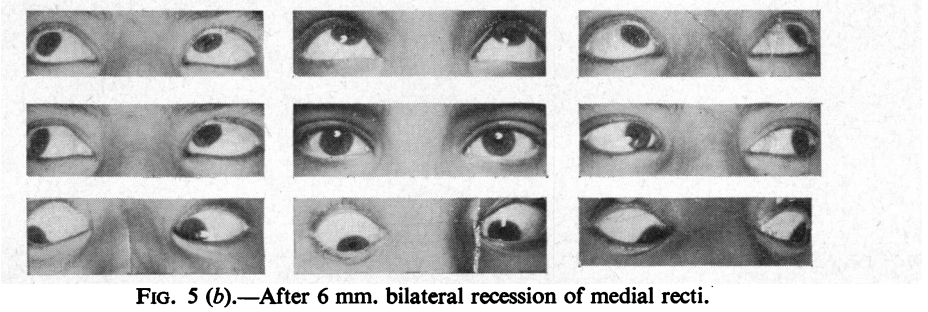

FIG. 5 (*b*).—After 6 mm. bilateral recession of medial recti.

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Prism Bar Readings after Operation

UP

	ESO–0° LH–2°	ESO–0° LH–2°	ESO–0° RH–2°	
RIGHT	ESO–5° LH–3°	ESO–5° LH–3°	ESO–5° RH–2°	LEFT
	ESO–15° LH–3°	ESO–15° LH–3°	ESO–15° RH–1°	

DOWN

Comment.—The patient had alternating concomitant convergent squint with impure "V" esotropia (Pattern 1), the left eye being higher on dextroversion and the right on laevoversion. After bilateral recession of the medial recti, the "V" esotropia was markedly reduced with correction of hypertropia. This agrees with the view of Urist (1951) that the vertical incomitance in the "A" and "V" phenomena is secondary to the horizontal deviation. It does not appear that it is due to bilateral paresis of the obliques or vertical recti as suggested by Tamler (1961).

Pattern (ii).—The right eye remains hypertropic on dextroversion and the left eye on laevoversion.

A woman aged 45 years was admitted as a case of alternating concomitant squint with impure "V" syndrome. The esodeviation in the primary position was 35°, and this increased to 45° on looking down and decreased to 25° on looking up. The deviation was the same for near and distance (Fig. 6*a*, opposite).

Prism Bar Readings

UP

	ESO–25° RH–2°	ESO–25°	ESO–25° LH–4°	
RIGHT	ESO–35° RH–2°	ESO–35°	ESO–35° LH–2°	LEFT
	ESO–45° RH–2°	ESO–45°	ESO–45° LH–2°	

DOWN

Synoptophore: Objective angle 35° esotropia. Subjective angle could not be measured. No binocular vision.

Operation.—Both medial recti were recessed 5 mm. After 3 months the patient had developed "A" esotropia. Esodeviation was 15° on looking up, 5° in the primary position, and nil on looking down. There was no vertical incomitance (Fig. 6*b*, opposite).

Comment.—After recession of both medial recti "A" esotropia appeared, which supports the view that there is no dysfunction of the vertical rotators in "V" esotropia; the fact that it can change into "A" esotropia shows that this condition is due to a dysfunction of the horizontal recti only.

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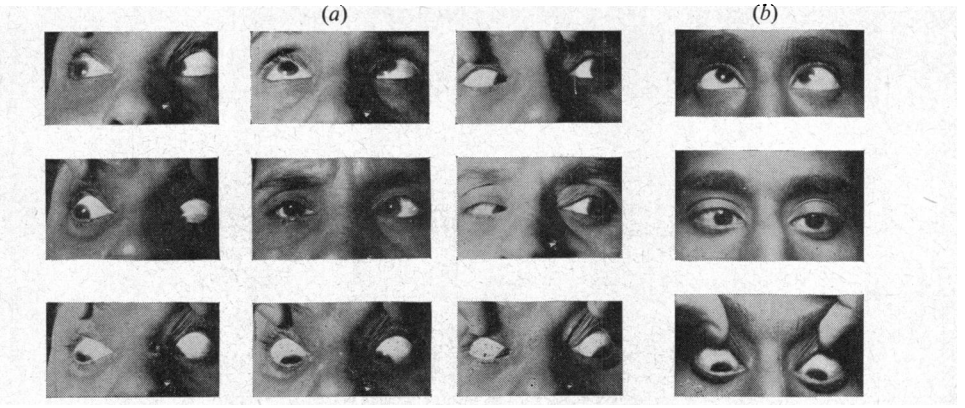

FIG. 6 (*a*).—Impure "A" and "V" phenomena pattern (ii). Right eye hypertropic in all the right fields and left eye in all the left fields of gaze.

FIG. 6 (*b*).—Appearance 3 months after operation.

Pattern (iii).—One eye only remains hypertropic on both laevo- and dextroversion.

A boy aged 13 years was admitted on February 26, 1962, with a history of alternating concomitant convergent squint since childhood. There was 18° of esotropia on the primary position, 7° on looking up, and 30° on looking down. The left eye was hypertropic by 6° on both dextro- and laevoversion. The deviation was the same for near and distance (Fig. 7*a*).

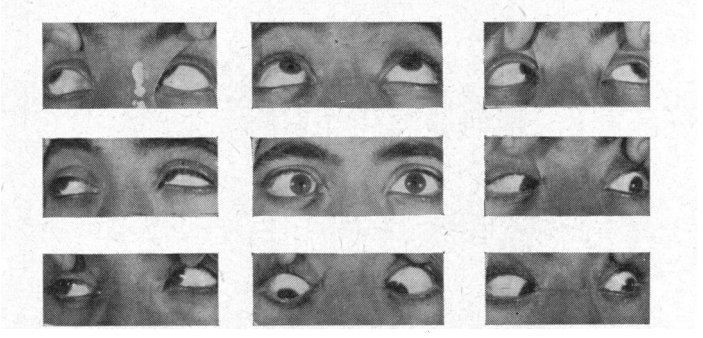

FIG. 7 (*a*).—Impure "A" and "V" phenomena pattern (iii). Left eye hypertropic by 6° in all directions of gaze.

Prism Bar Readings

UP

	ESO–8° LH–6°	ESO–7° LH–7°	ESO–8° LH–7°	
RIGHT	ESO–18° LH–6°	ESO–18° LH–6°	ESO–18° LH–7°	LEFT
	ESO–30° LH–6°	ESO–30° LH–6°	ESO–30° LH–6°	

DOWN

Synoptophore: Objective and subjective angles 18° esotropia as detected by the lion crossing over the cage. No binocular vision.

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Visual Acuity: Right eye 6/12, with + 20 D sph. + 1 D cyl., axis 75°.
Left eye 6/18, with + 5 D sph.

Operation.—On February 28, 1962, both medial recti were recessed by 4 mm. On April 2, 1962, the left eye was still hypertropic in all positions of gaze, but the hypertropia was reduced to 2°. There was esotropia of 5° on looking down and in the primary position but none on looking up (Fig. 7*b*).

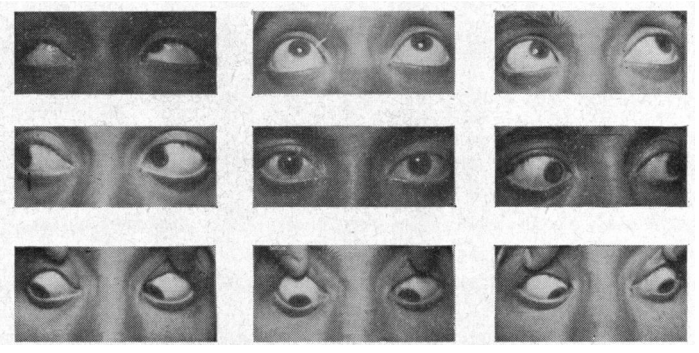

FIG. 7 (*b*).—After bilateral recession of medial recti.

Prism Bar Readings after Operation

UP

	ESO–0° LH–3°	ESO–0° LH–2°	ESO–0° LH–2°	
RIGHT	ESO–5° LH–3°	ESO–5° LH–2°	ESO–5° LH–2°	LEFT
	ESO–5° LH–3°	ESO–5° LH–2°	ESO–5° LH–2°	

DOWN

Second Operation.—On May 2, 1962, the left eye was examined to find any rectus muscle abnormality, but none was detected.

Comment.—As the "V" esotropia disappeared after bilateral recession of the medial recti, it is assumed that the fault in this case may have been over-action of the medial recti with secondary vertical deviation. We do not agree with Tamler (1961) who explains "V" esotropia as being due to bilateral superior oblique paresis with predominant action of the inferior rectus.

Discussion

In the present series we have operated only upon the horizontal recti, either recessing or resecting them. We feel that the vertically-acting muscles play no primary role in the "A" and "V" phenomena.

Urist (1951, 1954a, b, 1958, 1960), Breinin (1957), and Villaseca (1961) believe that the conditions are caused by dysfunction of the horizontal recti. Our results support this and apparently contradict the theory of dysfunction of the vertical recti (Fink, 1959; Miller, 1960), of the obliques, or of multiple dysfunction of the horizontal and vertical muscles (Brown, 1953; Jampolsky, 1957; Dunlap, 1960, 1961;

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Albert and Costenbader, 1959; Hamilton, 1960; Tamler, 1961). Our observations indicate that in "V" tropias there is probably a dysfunction of the medial recti, and in "A" tropias of the lateral recti. There may be an innervational aberration whereby the horizontal recti are functionally connected to the vertical muscles. In "V" tropias the medial recti may be related to the obliques, and in "A" tropias the lateral rectus muscles may be similarly related to the vertical rectus muscles.

Summary and Conclusions

(1) A new classification of the "A" and "V" phenomena has been devised which differs from those of Urist (1951–1954), Villaseca (1961), and Tamler (1961), and attempts to rectify their omissions.

(2) The results of surgery in 27 cases of "V" esotropia, five cases of "A" esotropia, fourteen cases of "V" exotropia, four cases of "A" exotropia, and five cases of impure "A" and "V" phenomena are given.

(3) It is pointed out that the fault in the "A" and "V" phenomena lies in the horizontal rectus muscles.

(4*a*) The best approach for correction is bilateral recession in "V" tropias and bilateral resection in "A" tropias. Symmetrical surgery on the horizontal muscles produces a symmetrical result. By the recession of the medial recti in pure "V" esotropia, the deviation is corrected more on looking down and less on looking up.

(*b*) Recession of the medial recti in cases of "V" esotropia corrects the deviation by from 86 to 100 per cent. without producing an overcorrection on looking up.

(*c*) Uneven results are obtained with horizontal muscle surgery. If in "V" esotropia ipsilateral lateral and medial recti are operated upon, the results are far inferior to those obtained when only the medial recti are recessed.

(*d*) There is no obvious vertical muscle defect in cases of impure and pure "A" and "V" phenomena. On the other hand this series shows that the vertical incomitance in cases of "A" and "V" phenomena in the cardinal directions of gaze is secondary to the horizontal deviation as it tends to disappear after operation on the horizontal recti only.

(*e*) The medial rectus muscles, generally speaking, are stronger than the lateral rectus muscles.

(*f*) In this series, we have seen that the incidence of impure "A" and "V" phenomena is only 9 per cent. In most of these cases the "A" and "V" phenomena are not associated with vertical incomitance in any direction of gaze. This further supports the idea that these phenomena are due to dysfunction not of the vertical but of the horizontal muscles.

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