Urrets-Zavalia published the first of a series of papers in 1948, that laid emphasis on performing measurements of strabismic patients with the eyes in the straight upward and downward positions of gaze. He also highlighted the fact that oblique overactions and underactions are associated with increased or decreased convergence or divergence in these positions. Urist introduced this concept to American literature in 1951, and Albert suggested the excellent descriptive terms A and V patterns, which now have worldwide acceptance. They are also said to be vertically incomitant comitant horizontal deviations. A-esotropia is the least type of pattern amongst the four main type, otherwise the diamond pattern is the least of all.

**Classification**

“A” and “V” patterns describe horizontal strabismus that is vertically incomitant and is characterized by a substantial change in the horizontal deviation from the midline position in upgaze as compared to downgaze. Approximately 12–50% of strabismus patients have “A” or “V” patterns. “A” and “V” patterns are relatively frequent in patients with infantile-onset strabismus. “A” pattern (Figure 1) is present when a horizontal deviation shows a more convergent (less divergent) alignment in upgaze compared with downgaze. “V” pattern (Figure 2, 3) describes a horizontal deviation that is more convergent (less divergent) in downgaze compared with upgaze. The “A” pattern is considered clinically significant when the difference in the measurement between upgaze and downgaze, approximately 25° and 35° from the primary position respectively, is at least 10 prism diopters. The “V” pattern is considered clinically significant when the difference is at least 15 prism diopters. Other patterns include “Y” where exodeviation is present only in upgaze, lambda (“λ”) where exodeviation is present only in downgaze, or “X” where exodeviation is present in downgaze and upgaze compared to the primary position.

**Etiology**

A great amount of emphasis has been laid down on the role of horizontal, vertical, oblique muscle dysfunctions, facial characteristics, and abnormal muscle insertions. At present,
there is no consensus regarding the pathophysiology of A and V patterns. Several hypothesis have been given.

**Horizontal Muscle overaction:** Urist believed that horizontal rectus muscles were responsible for this incomitance, in V esotropia overaction of the medial rectus muscles caused the increased convergence in downward gaze and overaction of the lateral rectus muscles was responsible for the increased divergence in upward gaze. Conversely, increased divergence in downward gaze in A exotropia was thought to be caused by underacting medial rectus muscles and in A esotropia by underacting lateral rectus muscles.

**Vertical Rectus Muscle:** Brown had the opinion that A or V patterns may be caused by primary anomalies in the function of the vertical rectus muscles in which adduction is the tertiary action. For example, if the superior rectus muscles are primarily underacting, their adductive effect in upward gaze will decrease; in fact, the eyes will diverge in upward gaze because of secondary overaction of the inferior oblique muscles. In downward gaze, secondary underaction of the superior obliques will cause decreased abduction and secondary overaction of the inferior rectus muscles, resulting in increased adduction of the eyes, which, according to Brown, would produce a V pattern.

**Oblique Muscle Overaction or Underaction:** Most of the A-V patterns have anomalies of the oblique muscles, since elevation in adduction is frequently associated with a V pattern and depression in adduction with an A pattern type of strabismus. The inferior oblique is an abductor also, and secondary or primary overaction of that muscle will result in a relatively less convergent or more divergent position in upward gaze, producing a V pattern. The opposite principle applies to weakness of inferior oblique muscles or overaction of superior oblique muscles. This combination would cause an A pattern to develop. The pronounced beneficial influence of surgery on oblique muscles for correction of A and V patterns lends much credence to this view.

**Sagittalization of oblique muscle insertions:** Increased frequency of the “A” and “V” pattern strabismus has been associated with craniofacial dysmorphisms such as upslanted and downslanted palpebral fissures, plagiocephaly, and hydrocephalus. In such cases the strabismus could be related to anomalies in the orientation of superior oblique and inferior oblique muscles, leading to a misdirected muscle force.

The role of sagittalization – the oblique muscle becoming more parallel to the sagittal (anteroposterior) axis and desagittalization-when the oblique muscles become more parallel to the coronal plane have been stressed by Gobin. If the superior oblique is desagittalised due to the retroplacement of trochlea (as in plagiocephaly), it becomes a poorer depressor. And relatively the inferior oblique becomes more sagittalised in relation to the superior oblique making it a stronger depressor. This relative action can cause A and V patterns (Figure 4).
Sensory Deprivation: Guyton and coworkers had the view that loss of fusion predisposes the oculomotor system to cyclodeviations of the eyes which, in turn, cause A and V patterns according to the mechanism proposed by Weiss. Guyton and Weingarten showed that formerly fusing patients with intermittent exotropia who lost fusion after surgical overcorrection may develop A or V patterns.

Abnormal Muscle Insertion: Anomalies of insertions horizontal, vertical or oblique muscles are also known to cause A and V patterns. In V patterns the insertion of medial recti have been reported to be higher than the normal and those of lateral recti lower than normal.

Evaluation

Motor testing: Alternate prism cover testing is performed with head held in primary gaze using an accommodative target at 20ft (6 m). The measurements are made in upward (25°) and down ward gaze (35°) to establish whether an A or V pattern is present and if so whether it is clinically significant. Stuart and Burian established that divergence of the visual lines in upwardgaze and convergence in downward gaze are physiologic variants. Thus, only a V pattern in which the difference in deviation between upward and downward gaze is 15 Δ or more should be considered a significant vertical incomitance. Since an A pattern is never found as a normal variant, a limit of 10 Δ has been set beyond which an A pattern is thought to be significant.

Pseudo A and V Patterns: A pseudo V pattern may be seen in patients with accommodative esotropia. This occurs if the patient having a small amount of hyperopia is tested without using hyperopic correction. Uncorrected hyperopia gives rise to accommodation in primary and downgaze, as opposed to upgaze, simulating a V pattern. Similarly V- Pattern strabismus may also be seen in cases of intermittent exotropia.

Sensory testing: Binocular function is seen to decreased in patients with A or V pattern. Helevenston and colleagues hypothesised that these patients have sliding anomalous retinal correspondence when changing from upgaze to downgaze. Worth four dot testing can reveal a fusion response at near but seldom at distance. The prevalence of amblyopia and other forms of sensorial adaptation with A and V patterns was reported not to differ from that with other forms of strabismus. But patients with Y- or λ-pattern exotropia tend to have better stereacuity.

Treatment: The surgical goals in patients with A and V patterns are to eliminate motor obstacles to maintaining, improving, or regaining comfortable single binocular vision and, when this is not possible, to restore the patient’s normal facial configuration. Surgery may be necessary also to eliminate chin elevation or chin depression. Early correction is suggested for patients who appear to have a chance of establishing binocular fusion in the functional positions of gaze (primary and reading position).

Surgical Strategy: A strategy must be carefully developed when deciding on corrective surgery for A- and V- pattern strabismus, due to complex actions of the cyclovertical muscles in the extreme positions of gaze or when there are coexisting defects in orbital anatomy, muscle function may not be normal.

If oblique muscles are significantly overacting or underacting, they should be the target of surgery. If there is no oblique muscle dysfunction, treatment of the pattern by upshift and downshift of the recessed or resected horizontal rectus muscle can be effective. The MR is always transposed towards the apex of the V (downshift) or the A (upshift). The LR is upshifted to correct V patterns and downshifted to correct A patterns.

In addition slanting recession or differential recession can be done to correct A or V pattern. In slanting recessions the slant or differential recession determines the relative weakening effect. A slant of medial rectus with more recession of inferior end would correct a V-esotropia. For A-esotropia, the slant is reversed. Similar thing follows for lateral recti also in cases of exotropia. V-esotropia requires more recession of the upper end and A esotropia requires more recession of lower end of recessed lateral recti.

Figure 4: Sagittalization and desagittalization of superior oblique (SO) sagittal axis (SA). TN- Normally placed trochlea TD- Posteriorly placed trochlea (desagittalization), TS- Anteriorly placed trochlea (sagittalized),
Surgical Management

A-Pattern Esotropia
(a) Patients without superior oblique (SO) muscle overaction - Recession and symmetric supralacement of the tendons of the MR muscles by one-half tendon width is suggested (Figure 5).
(b) Patients with SO muscle overaction - Bilateral SO tenotomy/posterior tenectomy and horizontal rectus recessions to correct esotropia in primary gaze.

A-Pattern Exotropia
(a) Patients without SO muscle overaction - Recession and symmetric infraplacement of the tendons of the LR muscles by one-half tendon width is suggested.
(b) Patients with SO muscle overaction - Bilateral SO tenotomy/posterior tenectomy combined with symmetric surgery on the horizontal rectus muscles to correct exotropia.

V- Pattern Esotropia
(a) Patients without inferior oblique (IO) muscle dysfunction - Recession and symmetric infraplacement of the tendons of the MR muscles by one-half tendon width (Figure 5).
(b) Patients with IO muscle dysfunction - Weakening of IO muscles is combined with appropriate MR recession.

V-Pattern Exotropia
(a) Patients without IO muscle dysfunction - Recession of the LR muscles with supralacement by one-half tendon width.
(b) Patients with IO muscle dysfunction - IO muscle should be weakened symmetrically and appropriate recession of the LR muscle performed to correct exodeviation in primary gaze.

Y-Pattern
Y esotropia or exotropia usually have IO overaction with evidence of fundus excyclotorsion. Bilateral weakening of IO muscle reduces or eliminates the pattern in upgaze.

Lambda (λ) Pattern
Bilateral weakening of SO will reduce the λ pattern if SO overaction is present. Asymmetric weakening may cause problematic vertical and torsional diplopia.

Conclusions
In view of the various factors responsible for causing pattern strabismus, every case should be treated as being different. The treatment plan should also be specific to that particular case and a backup plan should be kept in mind for the surprises offered during surgery.

References