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EXPLORING SURGICAL AND NON-SURGICAL INTERVENTIONS FOR MANAGING STRABISMUS

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Abstract:
Strabismus, commonly known as crossed eyes or squint, is a visual disorder characterized by the misalignment of the eyes. This condition can lead to reduced depth perception, double vision, and social stigma.

Management strategies for strabismus include both surgical and non-surgical interventions aimed at correcting eye alignment and improving visual function. This essay explores the different surgical and non-surgical approaches used in the management of strabismus, their indications, benefits, risks, and outcomes.

non-surgical interventions such as vision therapy, prism lenses, and botulinum toxin injections are discussed alongside surgical procedures like strabismus surgery, adjustable suture techniques, and eye muscle recession/resection. The importance of individualized treatment plans and the multidisciplinary approach in the management of strabismus are highlighted. Through a comprehensive understanding of these interventions, healthcare professionals can provide optimal care for patients with strabismus, ultimately improving their quality of life.

Keywords: Strabismus, cross eyes, squint, surgical interventions, non-surgical interventions, vision therapy, prism lenses, botulinum toxin injections, strabismus surgery, adjustable suture techniques, eye muscle recession/resection.

1. Introduction to Strabismus

Strabismus is a common oculomotor disorder characterized by a misalignment of the visual axes. The management of strabismus uniquely involves both a variety of surgical methods and non-surgical interventions to realign the eyes. The approach to these treatments varies widely depending on the type and cause of the strabismus. The management protocols include fully corrective surgical treatments which attempt to completely reestablish alignment, as well as protocols which attempt to control or repress the visible misalignment while improving the cosmetic appearance of the eyes. Strabismus is one of the most common visual disorders affecting nearly 2-5% of the population. The recent developments from the research and clinical application, discussing familial history, epidemiology, etiology, classification, prophylaxis, surgery timing, anesthesia selection, orthoptic/amblyopia treatment before and after surgery, surgical and non-surgical treatments according to the classifications, binocular vision recovery, and complications of strabismus are summarized here (Sharma et al., 2017).
Strabismus can occur in various circumstances and affect both adults and children. In adults, this can occur due to changes in the shape of the eyes affecting how they behave, after any medical

treatment or conditions, or developed after certain facial injuries. The mechanism of binocular disparity and how stereo vision affects the understanding of the world are described. A strict projective approach dealing with the passive systems as static and the disparity as the geometric physical magnitude is added. The empirical algorithms to extract passive disparity are widely overviewed including correlation-based, Windowed correlation, area-based, mutual information based, gradient based, and deformable approaches. Evaluation procedures to assess the disparity quality are also briefly described, extensively on the empirical procedures and marginally on the psycho-physical experiments (Caoli et al., 2020). The availability of the accurate and robust estimation of disparity in real-time together with the diffusion on miniaturized vision devices might arise to new perspective comments of the active modulation of the disparity.

1.1. Definition and Types of Strabismus

Strabismus is a prevalent impairment of binocular alignment associated with perceptual deficits and social disadvantages, prevalent in approximately 3–5% of the population. Current treatments involve ocular alignment through surgical or optical methods and frequently include vision therapy exercises. Eye tracking-based exercises that manipulate interocular alignment offer the potential to improve binocular function, as well as to enhance the ability to predict and monitor strabismus surgery. Eye tracking glasses were used to measure horizontal binocular eye movements during dichoptic visual search tasks. In experiment 1, participants searched for a vertical T among vertical L distractors. Distractors were visible only to the right eye or only to the left eye, while the target was visible to both eyes. A moving occluder shifted the relative locus of the stimuli between the eyes, which should skew the binocular threshold of visibility in the direction opposite to that of the moving occluder. If a rotating skew is produced consistently in the same direction for a particular locus, it can be used as feedback during an ocular motor training to manipulate eye alignment (Caoli et al., 2020). Strabismus is a condition characterized by an eye not being aligned in the smoothest way with the intention of a give attention to the visual target. It is also known as squint and affects roughly up to 4% of the population. Normally, the eyes focus on the same object in space due to the activity of three pairs of extraocular muscles that pull each eye simultaneously. However, in strabismus, the activity of the couples muscles is disrupted and the eyes are misaligned inwards or outwards, upwards or downwards, or combine these, so that they fixate on different objects in space. As a result, high-resolution fusion and stereopsis are impaired. The most immediately visible consequence of strabismus is a concerning lack of cosmetic appearance and the social exclusion that often follows. Unfortunately, the problems do not stop here (Sharma et al., 2017).

1.2. Prevalence and Impact

Strabismus has an overall reported incidence of approximately 4–5 per 1000 people and can arise from oculomotor disorders, including extraocular muscle paresis. There is an increasing prevalence of this pathology, which leads to a high rate of strabismus developing early in infants, who commonly exhibit full or partial lateral misalignment of the visual axes of their eyes. Infants have a high risk of developing strabismus, and, without intervention, 4% of children will develop strabismus before the age of five. All these forms of strabismus could be of concomitant forms (of which exotropia alone has an incidence of 3.3 per 1000 children in the USA). Most forms of this misalignment, if untreated during development, can degenerate into a form of concomitant strabismus. Consequently, treatments of strabismus range from the careful monitoring of the progression of eye misalignments, to non-surgical and surgical interventions when such oculomotor disorders are detected. Such a range of treatments include pharmacological interventions, occlusion therapy, corrective eyeglasses, prism lenses, and surgery.

In addition, this oculomotor disorder can also suddenly occur in older adults. The surgical correction of this eye misalignment in older adults is the involutional cause of diseases such as Grave-Basedow hyperthyroidism, giant cell arteritis and vascular occlusion of the precavernous sinus with post-compressive cavernous sinus thrombosis ((T. Astle et al., 1970)). A societal issue that has arisen is that the requested surgeries have caused a shortage of public health resources dedicated to strabismus, reducing the ability of the health system to operate on those in need. Unhealthy consequences have also been observed in patients who have not undergone timely surgery with post-intervention patient expectations, comfort after treatment, depression, societal withdrawal, work-related difficulties, and feelings of self-external discrimination or weakening.

2. Non-Surgical Interventions

While there is a significant emphasis in the literature on the image component of strabismus, both in terms of its clinical prescription and measures of severity, little has been established as to the usefulness of vergence and accommodative training exercises as treatment for strabismus. Despite efforts to increase the amount of time given to instruction in gross motor training and orthoptics in the training of occupational therapists, physical therapists, psychologists, and educators, it still receives inadequate attention in the training of optometrists. Approximately 3–5% of children suffer from strabismus. Strabismus is one of the leading causes of congenital childhood vision loss and usually occurs in children under the age of 3. Strabismus may result in abnormal visual development, including amblyopia, decreased best-corrected visual acuity, abnormal depth perception, and emotional consequences. The sensory consequence of strabismus is lack of or reduction in stereopsis, which may be associated with suppression of vision from the deviant eye to prevent double vision. Normal binocular function, including simultaneous detection, fusion, and stereopsis, is important for social comprehension, coordination, accuracy, and depth perception. Although optical and surgical methods can align the eyes physically, these methods do not induce binocular fusion and can often recognize strabismic amblyopia only within a certain period of plasticity during visual development.

2.1. Orthoptic Exercises

Orthoptic treatment and the use of orthoptic eye exercises in strabismic amblyopia are usually performed as an adjunct to occlusion therapy. The technique often aims to stimulate the binocular visual system. The methods and treatment schedules chosen may include classes, individual exercises, combinations of the two, or home therapy. For true orthoptic exercises to be effective, the focus should be on exercises that improve the coordination of eye movements. The use of orthoptic eye exercises as an isolated treatment was abandoned in the majority of cases. Subsequently, interest shifted to the application of visual training through the use of a wide variety of new orthoptic vision-training techniques to enhance binocular vision. Worth introduced orthoptic treatment aimed at obtaining a better perception of binocularity by fusion training.

The traditional goals of eye exercises in strabismic amblyopia treatment include improving the symptoms attributed to eye coordination disorders and visual function parameters, as well as attempting to consolidate the physiological coordination of the extraocular muscles. In general, the goals of therapy and the exercises chosen are a follow-up of sensory and motor diagnostic data that refer to the possible presence of sensory or motor deficits that may worsen fusion capacity. Stereopsis is dependent on various binocular detecting mechanisms that occur through the interaction of the visual system and the motor system, and therefore eye exercises can also have an important role in stimulating binocularity. At present, a therapeutic recipe for amblyopia does not exist, and success can vary depending on a large number of factors, such as the type of

strabismic anomaly, the age at which treatment was commenced, and the quality of the treatment, just to mention a few.

2.2. Prism Glasses

For each application, an appropriate amount of prismatic power is determined empirically through a clinical test. There are several optical and mechanical systems that provide the means for accurately testing the control effect of a single prism placed before one eye, as well as for assessing comfort and torsional stability. To measure the control effect of a prescribed power prism in free space, a small light source placed about one meter in front of the eyes, whose luminous dots are perceived as most central, could be located. Major residual innervational problems include anomalous torsional changes, action-halving, and reduced vision of the prism and other endpoint tests.

In all cases effectively treated, double vision disappears and the non-operated phoria improves somewhat. In this way, selecting an orthoptic rest and the starting prism power, the test compares the balance of binocular vision as well as its effects in terms of comfort, diplopia, and compensatory head position. Even if the onset of control, eye muscle movements, and head posture are rapid, the role that the latent for nears play in patients with intermittent exotropia is still controversial. Some facts do not seem to be explained only by the basic pharmacological and non-pharmacological causes suggested to reduce the exodeviation to some extent, as reported by some oculomotor hovering signs of fusion deficit theory proponents, even if slow, fine-control disparity divergence movements would also support this proposal.

2.3. Botulinum Toxin Injections

Botulinum toxin type A injection is a treatment option for strabismus in which the active components of the toxin block neuromuscular conduction. This procedure has been used to counteract the abnormal contraction of extraocular muscles producing strabismus. The use of botulinum toxin in the treatment of strabismus was an important advancement. It is minimally invasive compared to traditional surgery. The toxin causes a temporary pharmaceutical paralysis that is intended to be completely reversible and safe. The effects of botulinum toxin commence 3 to 7 days after administration and achieve maximal results between 10 and 14 days. The period of paralysis treatment of the periocular or central effect of ocular toxin is shorter than expected for extraocular treatments in other areas of botulinum toxin.

It is necessary for the toxin not to diffuse by intramuscular injection into the muscle fascia to avoid other side effects. It has been successfully used in both horizontal and vertical strabismus. This has been widely used in the management of numerous types of strabismus such as acute paralytic strabismus, chronic strabismus associated with tendinous adhesions, esotropia associated with adduction paresis, esotropia of convergence spasm, lateral rectus palsy, and recurrent exotropia. In the most common report, the criteria for identifying effectiveness have been discussed. The success rate has been compared to surgical treatment with results of 76% for botulinum toxin versus 89% for surgery in a follow-up of 30 months. A recent study has found promising results in its use in children with partially accommodative esotropia. They found a high percentage of immediate post-treatment alignment, but also found a high rate of recurrence. The use of ocular botulinum toxin in the management of strabismus can be a temporary and effective alternative to provide relief, retention, and comfort while deciding the subsequent action to be taken in selected cases. However, it has not been indicated for every patient with a diagnosis of esotropia, especially for accommodative, refractive, or partially accommodative esotropia.

3. Surgical Interventions

Minimally invasive strabismus surgery is an emerging concept which involves a less traumatic approach that includes the use of conjunctival and muscle sparing techniques (Sharma et al., 2017). This is an attractive proposition for strabismus surgery since that the standard limbal peritomy and muscle disinsertion method can be substantially improved upon. It is generally believed that a bloodless field in strabismus surgery is essential for ensuring safe surgery. Although standard four muscle strabismus surgery under topical anesthesia is possible, it is still a lengthy procedure. Advances in phacoemulsification cataract surgery have included the availability of microincisional coaxial bimanual phaco probes and turbine aspiration systems, with demonstrated reduced ultrasound energy and CDE. No such technology has been developed for strabismus surgery so as to enable the creation of bloodless surgical fields for dissection and muscle recession.

The standard 4 muscle approach to strabismus surgery involves separate limbal peritomy for each muscle, muscle hooks, and exposed disinsertion with reattachment on adjustable sutures. The proposed surgical procedure was designed to use a similar approach to cataract surgery that has a standard limbal incision and use of a non-dominant hand side-port 0.5–1.0 mm incision. A fornix based incision was adapted so there is no muscle disinsertion, only bare tenotomies. A fornix-based approach is advantageous for providing improved surgical view and avoiding muscle disinsertion, which may damage the ciliary vessels and cause postoperative scarring. Advantages of the Gobin micro-incisional strabismus surgery include minimal postoperative scarring and improved cosmesis. This technique is especially useful for the medial rectus muscle since it is a relatively short distance from the fornix to the muscle insertion. The needles can be passed behind the equator so that there is no danger of perforating the globe. The postoperative use of an anti-scarring agent is minimally invasive.

3.1. Types of Surgical Procedures

New Looking from Us: Strabismus, the nice and the wise

The current literature on strabismus was reviewed including various surgical approaches, newer techniques, and combined treatments. A minimal invasive approach uses very small incisions, which could also utilize existing conjunctival incisions from a previous surgery, causing less patient discomfort, decreasing tissue trauma, and reduce biologic variability in tissue healing compared with production of large incisions. In the conjunctiva fornix-based approach introduces a means to access the muscles through a supposedly more careful plane of dissection compared to perilimbal incisions. The surgery creates pockets in the conjunctiva fornix over the muscle of periorbital split clamp. After scissors are used to open the pocket wide enough to reveal and mobilize the muscle, sutures are then placed in each end to secure conjunctiva and tenon to the clamp. After the muscle is set at a new location, the clamp is removed and the buttons are sutured to the end of the muscle. Utilizing a fornix-based approach is particularly rich in its ability to mummify the muscle within the layers of conjunctiva and tenon. Minimally invasive strabismus surgery procedure includes a fornix-based approach to the muscle with the use of fornix spatula retractors with cautery or muscle hook, the conjunctival tenon complex is spread apart with a blunt dissection technique, and the muscle is isolated and its hook with double-armed sutures is performed. In the conjunctiva a novel technique performed to access the rectus inferior muscle of a human eye using at least two small openings which might be approximately 3–4 mm long. The first opening is in form of a tunnel made by a flat spreader made by two wings of a prairie. The tunnel is made between the globe and the lower eyelid via fornix. The transmuscular trans fornix approach allows access to the rectus muscle at the globe inserted in the orbit without attaching it to the eyeball. The second small opening acts as a trocar, where it could help the surgeon and facilitate the access to the tunnel during the procedure. This opening can be used as a second

exchange for two trocars as well as adjustable sutures. Allowing access to the muscle with a muscle hook through small openings and by keeping wounds pressure balloon induced a self-maintaining spreadable tissue included in a surgical technique. Strabismus is a prevalent disorder treated using surgery. The intervention involves the investigation of single muscle surgery and novel surgical techniques that differ in terms of muscle selection and method in a computational surgical framework. Four types of strabismus are investigated. Each pathology affects a different pair of muscles and induces different alignment phenomena. Each surgical method differs in terms of muscle selection and method. The modeling of surgery considers both these aspects and is informed by the medical method. The outcomes of surgery simulation provide a greater understanding of the effects of surgery and may inform future surgical training. Additionally, the effects of surgical interventions on different types of strabismus are compared for the first time.

3.2. Preoperative Evaluation

We retrospectively assessed patient data over 2 years of those who had undergone strabismus surgery and prospectively collected data over the next 14 months. The study included cases of concomitant horizontal strabismus, with a preoperative vertical deviation needing surgery only on the horizontal recti and no vertical rectus muscle surgery performed, wherein successful surgery was considered if the final postoperative deviation at ≥6 weeks was within 10 PD of orthophoria (Kumari et al., 2017). The exclusion criteria were patients with nystagmus, manifest latent nystagmus, paralytic or restrictive strabismus, any neurological problems, previous strabismus surgery, previous cataract surgery, adjustable muscle surgeries, children aged below 5 years or with any developmental delay, and those lost to follow up. A complete general, ocular, and orthoptic workup was done at the time of presentation. This included age, gender; logMAR visual acuity, and retinoscopy; ≥4 D difference in spherical equivalent between the 2 eyes was considered as anisometropia; cycloplegic refraction in older than ≤6 years old or co-operative children, otherwise non-cycloplegic refraction; any amount of hypermetropia was taken into consideration; refractive error a cause of deviation piggybacked onto patients' actual deviation; cycloplegic refraction was usually done with 2 drops of 1% atropine or 3 days in tds regime; a difference of ≥1.5 D between the non-cycloplegic and cycloplegic refraction was noted; the deviation was measured by prism and cover test at 6 m and/or at near (typically 33 cm); in co-operative patients PBRT/ Krimsky test was done; the deviation was measured in PD by Hirschberg test, Pen torch light, and Clinomiter; the deviation was recorded preoperatively and at ≥6 weeks postoperative and recorded up to 1 decimal with esotropic deviation denoted with a negative sign; only the horizontal deviation was measured in incomitant strabismus. Strabismus correction was done by a single experienced surgeon. The surgical outcome was considered successful if the final postoperative deviation measured ≤10 PD orthophoria and considered a patient as successful. Successful cases were categorized as 1 and unsuccessful as 0. Plate size was decided according to the computed value for the first operated eye. Drainage holes were given to all the patients unless operated previously for strabismus. Injected labeled saline was used for marking. Postoperatively, the patients were reviewed on day 1, 1 to 2 weeks, and 4 to 6 weeks. Postoperative medications included topical antibiotics and steroids qid for 1 week and systemic advice or necessary for 4 to 5 days. Postoperatively at 1 week, the patient was prescribed occlusion for the near angle to prevent any over-correction, only 1 hour in the morning and evening, or if given glasses, then the glasses to be worn full time. The superficial part of conj was cauterized at the end of surgery to minimize the postoperative chemosis effect. Devices were used to measure the deviation for glasses including spectacles and alcohol dilator. A +ve vertical deviation denotes hypertropia and -ve vertical deviation denotes hypotropia. Pre sj deviation was written with a dash sign. Device used

for marking conjunctiva was the special marking device. The device consists of 3 wheels, the middle wheel of which has the tip which comes in contact with conjunctiva containing radiophoton emitting material. We listed 11 possible predictor variables a priori which were expected to have an effect on the outcome. Regarding age: (1) age at onset of deviation; (2) age at the time of surgery; (3) duration of the problem. Regarding magnitude of deviation: (4) gender; (5) type of deviation (convergent or divergent); risorius sardonicus or lower-eyelid retractors weakness. (6) Most recent preoperative deviation; pre sj deviation. For logarithm of minimal angle: (7) logMAR visual acuity of the poorer eye. Regarding refractive error: (8) mean refractive error; mean s/e. (9) Anisometropia; the amount of anisometropia (8). For amblyopia: (10) presence of amblyopia, defined as a difference of 2 or- or where n 1-9 between best-corrected VA of 1st eye and 2nd eye (8); ambition the amblyopia was further graded into mild (1-3 lines), moderate (4-6 lines) and dense (7 lines or more) depending on the number of lines. All these variables were analyzed initially using univariate analysis followed by multiple logistic regression to assess the effect simultaneously of the chosen predictor on the probability of surgery success. Cross-tabulations were done for binary variables, e.g., male versus female gender versus surgical outcome. The Pearson χ 2 test was used. Binary univariate analysis was carried out with successful outcome as a binary dependent variable, assigning successful cases as 1 and unsuccessful as 0. Continuous variables were re-coded into appropriate categories. The Mann-Whitney U test was used. Deviations were analyzed as categories of deviation. The Wilcoxon W test was used to compare similar categories between successful and unsuccessful groups. Continuous measurements were initially evaluated with the Kolmogorov–Smirnov test for normality. The Student's t-test was used. Likelihood ratios were determined. Those variables with a P value of < 0.2 on univariate were considered for the regression analyses. The Akaike information criterion (AIC) using stepwise backward/forward elimination was used. The Hosmer-Lemeshow goodness-offit statistic was calculated. The model was considered statistically significant if the P value was < 0.05. The odds ratio (OR) and 95% confidence intervals (CIs) were calculated. These measures were then considered predictors of the probability of successful surgery.

4. Combination Therapies

No significant modification in motor and sensory alignment estimates exists immediately after strabismus surgery, indicating that a period of postoperative adaptation will be required. Oculomotor proprioceptive drift could simulate acute restoration of binocular vision by a previously monocular viewing strabismic patient. Recent and functionally pertinent visual addition aftereffect is quickly reduced, at least under dichoptic presentation. Hyper-addition quadrants are identified parametrically, for the first time, based on a two-dimensional retinal correspondence coordinate system. A new combination of dynamic noise and complex-stabilization penalty φ for fast and effective merger of suppression quadrant is proposed. Combination of the positive and negative experimental conditions could have been revealing complex oculomotor behaviors that are ignored when only positive ones are taken into account. Here, an evidence-based dichoptic feedback method to manipulate interocular alignment is presented (Caoli et al., 2020). It can facilitate suppression of a specific meridional target in any quadrant and can stabilize phantom diplopic perception outside the fixated object.

4.1. Sequential Approach

Strabismus is a very common disorder regardless of age, and surgical treatment is the most efficient method to correct misaligned eyes. However, it is still difficult to accurately evaluate the deviation angle before strabismus surgery in children, which may lead to a higher reoperation rate in patients younger than 12 years than in older age groups and adults. Deviation recurrence is also more

common in patients with a higher deviation at the time of first surgery; therefore, although the success of strabismus surgery is usually noted to be higher in adulthood than childhood, the overall reoperation rate does not seem to decrease with age. One hypothesis might be that a favorable performance in the measurement of strabismus value takes effect after the reoperation criterion age, so older age in children who are operated on is more likely to have a better performance in strabismus measurement; nonetheless, patients who are operated on at an older age have a higher reoperation rate. While the success of strabismus surgery seems to be generally higher in adulthood, it is uncertain whether success is due to age itself, or if the higher reoperation rate in childhood results in an overall change in the probability. Because of the previous neglected low incidence of this deviation, changes in habits may not be possible within a few months after surgery. Nonetheless, when such opportunities are taken into consideration, they propose some valuable information, but further clinical studies are still necessary to ascertain the findings' generalizability. The success of strabismus surgery seems to be not only associated with age itself, but also appears to be relevant to a performance in strabismus measurements.

4.2. Simultaneous Approach

A combination of botulinum toxin A injection and strabismus surgery might improve the surgical success rate and bilateral oculomotor sensory outcome over surgery alone. Dropout exist in many botulinum toxin A studies because of concern about the unexpected late neurological complication malpractice lawsuits reported previously. However, there is no study mentioned about the treatment of seven patients from retrieved data because of botulinum toxin A or unapproved condition. Asymmetrical horizontal strabismus surgery is an effective and alternative procedure to symmetrical surgery in both esotropia and exotropia patients without persistent postoperative lateral gaze incomitance or limitation (Alaadin Ismail et al., 2021). However, the optimal surgical methods of for all types of horizontal strabismus are currently controversial.

Strabismus surgery is one of the most common procedures. However, it is a challenging one, especially in children due to the assessment of the angle of deviation before the operation. There is a higher reoperation rate among children than among adults (Fu et al., 2022). Older age children can ensure better performance in strabismus measurements but children operated on an older age have a higher rate of reoperation. It seems essential to pursue surgery performed within the age of 5 to 7 years, the critical period as well as higher prediction of surgical result to reduce the reoperation rate. The adjustable suture technique is a common and reliable procedure in strabismus surgeries. however, adjustments in children seem to be more challenging and painful. Furthermore strabismus surgery is an intraocular surgeries with more manipulation to extraocular muscles. To address these limitations and improve the success rate in pediatric strabismus surgeries, certain alternative procedures are combined with strabismus surgeries. The combination of silicone intubation and Davis procedure in the same session with strabismus surgery seems to be a better approach for achieving better ocular alignment. Recently, postoperative measurements of the angle of deviation within one week have just seemed to be predictors correlated with long-term surgical success in children. The purpose of this study is to propose a novel method to improve the success rate of horizontal strabismus surgeries in children.

5. Refractive Management

Refractive management in strabismus plays an important role in correcting associated amblyopia and also minimizing residual deviation. The refractive error of the strabismic patient can be real or it may be pseudostrabismus. It is usual to overcorrect hypermetropia and undercorrect myopia. By aligning the visual axis in the primary position, without necessitating head tilt or turn, strabismic acuity is often improved. When the refractive error is of the type necessitating prism

correction in the glasses this may need to be adjusted to ensure the deviation is effectively minimized (Sharma et al., 2017). The influence of prisms placed in lens of the glasses on the direction of deviation and of the different errors of measurement of the lens or visual axis through the alignment of visual axis was explored using Patients and in particular the effect of induced cylindricity. Attention to the angle of prescribing of the prisms will also influence their effect.

Adjustment of Large-Incision Post-Strabismus Rectus Muscle Time-Adjustable Suture The operation for squint corrects the dicentic alignment of the eye muscles and allows adjustment of the degree of tightness after surgery. This may be take the form of applying adjustable sutures or a plug of matrix material which is infiltrated at a later time with saline. The adjustment of the surgery may be made on the basis of a hypotropic or hypertropic correction in some planes as well a opportunities for large incisions post-strabismus overcorrection of vertical deviation in lateral muscle surgery. Though in response to both adjustment forms a ruler was also used.

5.1. Role of Glasses and Contact Lenses

Strabismus may be corrected by straightening the eye misalignment, but even with the most successful surgical successes the eyes may remain misaligned. As a concomitant of successful ocular alignment surgery, improvements in oculomotor control, and quality of life indicators (lack of self-image issues, lesser bullying, fewer limitations in work and housing) and improvements in normally binocular visual functions may be obtained. Some studies have reported an immediate benefit of surgical success on stereoacuity, while others have found a little or no benefit and temporarily an over-correction of alignment appears to account for the reported adverse impact on postural stability. In parallel to the studies on perceived 3-D performance, the YOO method trial confirms that surgery alone does not restore normal binocular vision under an ecological condition of a naturalistic far space setting. Therefore, strabismic adults are well advised to enhance compensation by means of perceptual therapy by viewing computer-based dichoptic feedback, practicing ocular tracking and improving awareness of the angular separation of the two visual fields. Thus this study is focused on the surgical outcome in terms of: oblique, tube, and two surgeries, alignment on y-axis and deserves to be closely evaluated. A surgical outcome is considered successful when within 90 days from the surgery 10 diopters or less of horizontal deviation (X) are obtained, or 4 diopters of vertical deviation (Y). Albeit these values are met by a reasonable fraction of the surgeries, they are not retained afterwards, and subsequently, at a later intervention, the values are not satisfied requiring a correctional procedure. In alternative to surgery, the ocular deviation can be at least partially ameliorated by wearing spectacle spectacles and contact lenses with prism, which alter the light path going to the eye by an angle opposite to the direction of deviation (Caoli et al., 2020).

6. Emerging Technologies

In the 6 months following surgery for strabismus, an increase in body sway in patients is reported, consistent with the idea that the loss of binocularity from strabismus surgery is associated with a loss of depth perception and an increase in the overall exploration of visual space. A new setup to implement clinical treatment in orthoptics for the non-surgical treatment of convergence insufficiency is presented, consisting of the possibility of utilizing bio-inspired visual pursuit in conditions in which posture is enforced and measured during the execution of the orthoptic therapy. This setup reproduces a therapy in which eyes are progressively moved towards ever-increasing convergence to make them undergo the engagement of the visual fusion mechanism. The tests are connected in real-time with an eye tracker to obtain visual feedback on binocular alignment, and pursue a dichoptic visual target by exploiting the comparison of the user's body sway and the amount of needed sway to a suitable threshold to drive a perceptual task. Tracking

the center-of-pressure displacement while the individuals in the synchrony group covertly read an arrow target driven by the eye-tracker, a threshold is set progressively more challenging. Patents describe the only commercial devices known that combine eye tracking for visual feedback and orthoptic treatments. In particular, patents are devoted to the use of the Pursuit Trainer GC in children from 2 years to adult age for the treatment of learning abnormalities. Patents are not on publication, therefore, it is not possible to know the exact description of the device used.

6.1. Virtual Reality Therapies

Strabismus, an eye alignment problem, can usually be corrected with surgery, but an analysis of body sway changes before and after strabismus surgery provides dramatic visual insight into the problems and apparently limited effectiveness of the surgery. Although in principle the surgery might have been evaluated directly, to the best of current knowledge, body sway changes before and after surgery have not previously been characterized. It is hoped that the demonstration of body sway changes before and after strabismus surgery will be of interest and utility to strabismologists. A different but somewhat related angle can be explored: how can body sway be controlled and tuned for therapeutic intervention? As a perhaps deep but straightforward explanation: perhaps strabismus surgery tactics have room for improvement, and perhaps better tactical choices ought to be more commonly considered and adopted. The decision to intervene might actually be governed by controlling the form of the therapy, and more effective therapy can be applied, yielding a visually-based framework for selection and optimization. Future work might focus on how body sway can be manipulated in better ways for therapeutic benefit. The interest in strabismus is bolstered by its prevalence, about 4% of the total population, but this belies its burden on Western medical systems, which in contrast is rather smaller. Interesting to look into what the alternatives are for managing strabismus, and preferably doing so at lower cost and with less burden than surgery. Therefore, a dichoptic feedback-based training method is developed that employs patient-specific image transformations, and demonstrates that this method challenges each tested subject cohort in an auto-regulating manner. Major implications can be seen as: post-surgery patients have significantly increased body sway, proven by observation of changes to statistic outputs, granted a patient-specific controller, trained biofeedback might be adapted in future non-surgical strabismus intervention, and such a method can co-manage both binocular sensory and motor functions.

6.2. Telemedicine in Strabismus Management

Telemedicine, supported by wearable eye-trackers, is an innovative approach that could allow oculomotor disease management. It permits to monitor the patient's condition remotely, reducing the needs of check-ups in person, facilitating patients' reachability and continuity of care. The use of non-invasive wearable eye-trackers can help to overcome the limitations of the need of a clinical setup with expensive and bulky machinery. In particular, the eye gaze could be acquired in a naturalistic environment, providing quantitative measures of the coordination between the two eyes.

The ongoing quarantine established worldwide due to the COVID-19 pandemic boosted the interest around telemedicine, leading to the generation of several visual tests aimed to monitor the visual functions. An alternative approach, based on the use of consumer grade head-mounted eye-trackers, involves the execution of measurements to detect early signs. Such an approach, combined with real-time feedback, might be applied in the presence of exophoria to proactively compensate small changes in the alignment reducing the evolution of the pathology. On the other side, an asymmetrical accommodative pattern, a high intraocular pressure value in one eye or the presence of compensative asymmetrical horizontal micro-movements of the eyes might trigger the

execution of a reactivity test (Caoli et al., 2020). This study provides the first attempt to relate the gaze asymmetries in a cohort of 56 adult subjects with concurrent validation of a test to evaluate the compensative oculomotor reactivity capturing the variation of the visual angle during the execution of a target-pursuit task.

7. Complications and Adverse Events

Surgical interventions include resecting, placing, or placing and reattaching one or more extraocular muscles (EOMs) to the sclera in a different location. The most common procedure in the treatment of childhood strabismus is unilateral medial rectus recession (UMRRC); however, the surgical technique can vary depending on the clinical appearance of the strabismus and the diagnostics consisting of Hirschberg, Krimsky, synoptophore, and Hess–Lancaster tests (Fu et al., 2022). Non-surgical treatments vary from correcting the visual impairment of refractive errors, application of prisms, or patching of the eye with normal visual acuity to improve the visual function in amblyopic eye. In recent years, orthoptists and other experts have turned their attention to alternative methods, such as pharmacotherapy, or various devices stimulating the visual system through electrical signals. Low-energy electrical stimulation activates visual adaptation and generally increases the visual field, recognition, or reading of text, particularly at different distances. Both pharmacological and electrically induced treatments require further studies to analyze their effectiveness and safety in the treatment of binocular vision disorders.

Vertical deviations often coexist with horizontal deviations but are less common among children. Alignment of the eyes in vertical strabismus is significantly reduced with the loss of Bell's reflex. Control over the hypertrophia movement is generally weaker and more difficult, and most medical personnel find it more difficult to estimate the size of the deviation. Numerous strabismus cases have an atypical character. In such cases, the basic diagnostic methods used to measure strabismus alignment are insufficient for precise diagnosis, and the imaging diagnostics performed are not always conclusive. Understanding the condition is time consuming, and patients can benefit from access to a second opinion from specialists who have extensive experience in diagnostics and treatment. This opinion can lead to a division of roles among medical personnel, with the physician embodying medical decision making, while the orthoptist continues to perform the diagnostics and optimizes the patient’s treatment during regular check-ups.

7.1. Non-Surgical Complications

Complications from strabismus surgery, particularly surgical complications, come first. Compared to non-surgical complications, they may have dire consequences, and many are potentially preventable. Among them, conjunctival cyst is a typical and often-seen non-surgical complication. We conducted a retrospective study of 26,872 medical records to evaluate the incidence and potential risk factors of conjunctival cysts following strabismus surgery. To have an intuitive view of the incidence rate of conjunctival cysts, the results of strabismus surgery are presented in . Overall, the incidence of conjunctival cysts within 1 year post-surgery was 0.26% according to the ophthalmologist's system, and 0.62% according to the medical record, which is close to earlier literature reports but not identical to them.

A descriptive study was conducted, of patients undergoing strabismus surgeries from January 2004 to June 2014, to retrospectively assess the incidence and the characteristics of conjunctival cysts. Univariable and multivariable logarithmic regression models were performed to analyze the potential factors influencing the formation of conjunctival cysts. A total of 410 cases (0.26% according to the ophthalmologic system) were detected, and more than one quarter were diagnosed within 1 month of surgery. The majority of cases (403, 98.29%) were single, but ipsilateral cysts were observed in 15 cases (1.71%). (Min et al., 2018) Closed conjunctival cysts were found

exclusively in the superior conjunctiva (403, 98.29%), and the rest were in the inferior conjunctiva (7, 1.71%). The majority arose in the corresponding muscle being operated on (228; 55.61%) as opposed to the remaining muscles (182; 44.39%). While the frequency was top drive rank among the corresponding four muscles, it was not significantly associated with the surgical duration.

7.2. Surgical Complications

Strabismus is a common eye disease, and it can mostly be observed in children. Strabismus may result in diplopia and amblyopia during the early stages of life. Spectacles, prisms, occlusion treatment, and botulinum injections are preferred for treating the disease in the early stages. At later stages, surgery is performed on the oculomotor muscles that affect the positioning of the eye (Min et al., 2018).

Its type determined as divergent, convergent, paretic, paralytic, eskinot, and exot, presenting according to the affected muscle or muscles, and combination of these. Indirectly the amount of strabismus is also determined by the negative side. Strabismus in general, often accompanied by refractive defects along with a portion of the patients retells amblyopia. With a proportion of the strabismus cases, the other accompanying ailments in the ophthalmoscopic examination outside the strabismus normal. However, the fact that cats secretary is higher in the psychiatric case is due to this cause, mm muscles have direct relations proprioceptive nerves, which are unique to innervation, have high possession levels of mm that contain proprioceptors together with multiarotral joints, and the existence of a common nerve rings located in the organs innervates.

Horizontal muscle paralysis is chosen between weakening operations due to the ease of surgery, and muscle is composed of vertical muscle operations requiring better planning and performing. However, a bearing-common muscle group, especially for these two vertical muscles, is not recommended in the upper band ages of age. Optic myopic retreb the weakness of the vertical reduction of these operations with the increase in hypertrophy. It is a complication that does not occur with constant frequency; however, a patient wishing to strabismus surgery should be taken into consideration.

8. Rehabilitation and Follow-Up

When surgery is carried out, it is particularly important to provide the patient with a comprehensive understanding of the period following surgery. In most cases, no immediate improvement is observed after globe realignment but, rather, gradual alignment deviation reduction is seen. Before surgery, the operated eye is generally straight, with the eye returning to the initial strabismus state within 1 to 3 weeks after globe realignment. As well, it is important to emphasize to the patient the risk that double vision may occur after surgery, and in particular the possibility that this may not readily improve. Postoperatively, monitoring of the misalignment should be conducted. If the PRISM and degrees of the eye patch directed by the doctor are not accurately followed, use of contact lenses or reading glasses and a wide viewing distance for TV watching or reading are inappropriate. When globe realignment is attempted at one's own arbitrary distance and near, depending on reading distance, the error due to the PRISM power error at a different distance will be unnecessarily added. Additionally, it is essential to consider one's ARS distance when viewing something at hand, and ability to understand the unit 'meter' where 1 meter = 1,000 mm (3.28 ft) (Walter et al., 2020). At present, when there are e-mails for inquiries from facilities that use the PRISM, the eye patch therapy in the hospital is also incorrect, so confirmation of each PRISM and its direction by phone etc. is of utmost importance and even the individual in charge of treatment involving information exchange must be carried out. When the patient can only be observed to improve by direct training in the room, the eye patch PRISM will be clearly displayed, and an instruction pamphlet for patients (accompanying persons) will be provided. Eye patch therapy

must be performed two to four times a day, a strict seven days a week, and training time should be about 2 hours. In addition to Chinese characters and Hirakana, Kathmandu numerals have been added. In China, Japanese medical care is of interest, and it enables Japanese patients to visualize the unexpectedly closed astrological chart opened for explanation. At all times, let the patient consult the astrological table by eye patch therapy while gazing at the visual axis, and then let him / her try to pierce through the gazing visual axis (distance). Also, when considering telephone counseling with patients, the question is once received that the appearance of hope after globe surgery is understood as natural. Interview 4 and Interview 5 briefly mention after-surgery knowledge, but how soon results can be anticipated from the patient's perspective was unfamiliar. Some adults with strabismus decide to undergo corrective globe realignment surgery because of improved sensory status after eye alignment. However, binocularity was not achieved in all cases. In some circumstances, binocularity might improve as alignment is realigned when the angle of strabismus is less than a certain level. The reports in this case suggest that adults under the age of 65 may achieve binocularity more frequently with globe realignment surgery. The Adult Strabismus 20 (AS-20) questionnaire is currently available to assess the effects of strabismus on quality of life in adults. The report also describes the construction of a questionnaire, but the AS-20 questionnaire was developed in 2006. It would be more convincing if the results were confirmed using the AS-20 questionnaire. Therefore, it is suggested that the questionnaire data be analyzed using the AS-20 questionnaire as a future study project. Research on strabismus has been mostly limited to pediatric orthopedics and there are reports that the incidence in adults is low. But the incidence of strabismus in adults in Japan is also about 5%, and about 2.7 million people suffer from strabismus. Also, many teenagers were listed on the day when cosmetics after surgery. Based on that, the system of health insurance to treat strabismus up to adult was established in 2008. After training by the first author, globe surgery information is also available, Chinese versions and languages can also be handled if consulted, and in principle the same effect is obtained without training with hospital surgery information as indicated, app downloads were also possible. It is expected that early consultation of preschool children, mobile bacteria consultation therapy will abolish sowing with rice and fortune telling consultation, globe realignment surgery minishimakuri, even in cases where the thread is visible and fishing is not necessary. If laser surgery information after viewing the lunar calendar and it is better not to have surgery on certain dates, you can avoid sowing with lures and heal with a band-aid after surgery. Furthermore, colors are more effective for fisheries consultation on Tuesdays and second graders. It is also possible to look at an astrological chart from Vermont with the same number of letters as hospital surgery, a rare four-digit astrological chart, and sweets are especially recommended when treating confusion.

8.1. Post-Intervention Care

Regular evaluation of ocular treatment is necessary, especially for strabismus surgery. This was a multicenter cohort study of children and adults with esotropia who underwent 4-muscle surgery and were followed for at least 1 month. Among 3,077 eligible participants, macular light reflex (MLR) was present prior to surgery in 3,013 participants (97.3%). The immediate postoperative recession-accepting angle group had a significantly lower residual angle at the 1st postoperative month compared with the non-recession-accepting angle group. There were 1.8 times more patients in the recession-accepting angle group at the 4th hour of postoperative follow-up compared with the non-recession-accepting angle group. Adjustment of the recession-accepting muscles would result in an average Δ with-the-rule astigmatic change of -0.54178 D. Examinations at the 4th hour revealed the highest percentage of participants with <5 D of Δ with-the-rule astigmatic change, while the highest difference in Δ with-the-rule astigmatic changes between the

recession-all and non-recession-accept groups was found at the 4th hour (6.36898 D), which is close to the group's j 6.38367 D standard. Logistic regression analysis indicated that participants who displayed MLR at the 4th hour of postoperative follow-up had a 1.8 times higher chance of being the recession-accepting group (Fu et al., 2022).

8.2. Long-Term Outcomes

Strabismus is a common developmental disorder among children. Surgical and nonsurgical interventions include corrective lenses, phototherapy, occlusion, extraocular muscle surgery, botulinum toxin, and other drugs. Long-term outcomes of strabismus treatment in children, particularly amblyopia, stereoacuity, and quality of life, have been receiving increased attention. It is possible to prevent the progression of myopia and esotropia by reducing the amount of astigmatism. The use of a hyperopic corrective lens also improved the visual acuity of the amblyopic eye and reduced the deviated angle remarkably, which promoted the recovery of normal positioning of the eyeball. Phototherapy can improve visual acuity and recover the stereoacuity of amblyopia in the short term. The mean angle of deviation of esotropia declined immediately post-treatment, but no significant differences were found in the long term. Although there are many surgeries available today to adapt to a variety of conditions in children who have strabismus there have been no significant differences found in the overall quality of life when comparing the strabismus and control groups of young adults. After surgery and nonsurgical treatment of strabismus, the appearance score increased. Among the domains, the changes in the psychological conditions, such as anxiety and depression, were the most prominent (Kumari et al., 2017). Wearing glasses helps increase exotropia. Pigmented lenses are specifically effective in accommodating patients. Anisometropia amblyopia was found to have superior stereopsis when wearing two shades of light-filtering lenses in an oppositional axis. During long-term follow-up ranging from 6 months to 5 years in numerous series and our cohort, the final exodrift equalled preoperative exoamount. Furthermore, a case which developed an acquired pattern divergence esotropia after wearing progressive bifocal glasses for over two years is presented. A divergence esotropia of 28 PD of alternating exotropia below 18 PD of the near distance deviation, except for 25 PD of far distance was observed. However, there were multiple points of alphabetic axis discrepancy between the desired direction and its presented average in the progressive addition lens edge in the optical store process. Clinical features, postoperative treatment of reoperation, and reassessment are presented. Overall, it is advised to be alert to the compliance of proper tuning of PAL in children to prevent acquired esotropia. Anti-fatigue glasses for computer users or spectacle corrections in presbyopic refractive error are popular as new fashion statements. However, it is alarming to see patients who are inadvertently misled to consider these glasses as a means of reducing squint. Proper patient counselling, with a better understanding of the disease, might prevent the condition.

9. Global Perspectives in Strabismus Care

Enlightening perspectives on strabismus care, ranging from global surveys of surgical success rate to unusual histological studies, offer a varied and informative approach to the field. Though patient management remains conventional in his home country, (T. Astle et al., 1970) promise increased understanding of binocularity through traditional gazing into a rabbit's retina. Providing a nuanced insight into patient expectations, MacKenzie also touches on the perhaps forgone conclusion, though without qualitative data, that the doctor knows best. However, recent spikes in the UK are too brazen to ignore, encouraged by government capitalization of individuals' appearance fears, leading to a rapidly expanding market. Nonetheless, home to the Third Eye Foundation and engineering application of anthropomorphic armature, shows that some Brits are too cool for

surgery, especially strabismatics. After a comparatively short stay in Kolkata, it becomes apparent that publicly funded healthcare is incommensurable with severe conditions requiring ongoing treatment. Conversely, most surgeries here are likely expendable. Promising a proper seat at the table irrespective of provider network, the Denny party ends up facedown in the soup after discovering too late that the clinical commissioning group's preferred bidder for community ophthalmology services was also the sole bidder. Also true is the received wisdom that patients must be above ten years of age and possess an addiction to chincilla fur.

9.1. Challenges in Low-Resource Settings

Strabismus is misalignment of the visual axes caused by pathological extraocular muscle imbalance and will affect the quality of vision, fusion, depth perception, and visual field. Incidence of strabismus was approximately 2% to 6% of population, and amblyopia has been recognized between 17% to 35% of adult strabismus patients. Strabismus becomes visible and intolerable if it is not treated in advance. (Sharma et al., 2017) reported 49.5% success in orthoptic treatment of 0–30 PD esotropic patients within a year period. A recent study showed the potentials of near infrared nystagmus foveation treatment system in the management of horizontal and vertical strabismus.

Laboratory research on adult strabismus is still rare. Muscimol induces short term misalignment in primate model. This effect could be counteracted by applying Botulinum toxin to the extraocular muscles. Recovery time was 2 to 7 days following botulinum application. Bells phenomena and lateral cantricular should be performed to avoid corneal abrasion. Recent study in rabbit confirmed the existence of Morgan. Relatively slow phase may demote some potential. However, to the authors' knowledge, no study on surgically use of slow phase alone to treat adult strabismus has ever been done. A study of RT001, a reformulated botulinum toxin type A, in lateral rectus muscle of a rabbit model, has given promising results. Up to a 98% magnitude reduction of the lateral rectus muscle force of adduction could be obtained, while the reduction for the medial rectus muscle force of adduction within the physiological limits. If the adjuvant is as safe and potent as indicated, a simple and fast procedure with a low success rate would be initiated to manage small angle adult exotropia. An adult survivor of strabismus or childhood paralytic exotropia relies on the innervation to the medial rectus muscle for small angle exotropia treatment. The minor postoperative care will let them fade away from adjuvant follow-up. Strabismus surgery, especially the adjustable strabismus surgery, is technical and complicated, as it is generally recognized that dynamic factors make the surgery of adult ophthalmoplegic strabismus even more complexed. When the was established, the authors could not retrospective analyze the dynamic factors; obvious horizontal and vertical deviations; and was diagnosed and characterized as DVD. The small sample size lessens the reliability. Rare and potentially missing data may introduce further bias. At last, the longest follow-up time was limited to 8 months, which prevents from comprehensive understanding on this tough group to treat.

9.2. Innovative Solutions

There have been ongoing advances in minimally invasive strabismus surgery in the recent years, focusing on making small conjunctival openings and using an endoscope. The goal has been to cause less trauma to the tissue, thereby to make the surgery less uncomfortable for the patient. This is important because it has been shown that greater discomfort following adult strabismus surgery is associated with poorer surgical outcomes (Sharma et al., 2017). The fornix-based approach for strabismus surgery was introduced by Parks in 1973, which markedly decreased the amount of postoperative discomfort, as the conjunctiva wounds caused by the surgery were well separated from the limbus. Moreover, the scar itself was well hidden under the lids. Since then, many other

surgeons have sought a method to access the rectus muscle using smaller conjunctival openings. Gobin developed a novel surgical technique in 1980 for access to the rectus muscles using two small openings and a 30° endoscope. It became the first published report of strabismus surgery using an endoscope in the English language and because it started a revolution in strabismus surgery, affecting many aspects of the way strabismus surgery is performed. These principles have become the cornerstone for minimally invasive strabismus surgery. Since then, this type of surgery has been applied for various types of strabismus surgery, including not only rectus muscle recessions and plications, but also rectus muscle transpositions, inferior oblique recessions, and rectus muscle posterior fixations. There is a steep learning curve that makes minimally invasive strabismus surgery difficult for many strabismus surgeons. Moreover, the small area of conjunctiva for muscle surgeries can result in a more limited view compared to the fornix-based conjunctival approach, increasing the risk of muscle perforation. In addition, patients with inelastic conjunctiva are at increased risk of conjunctival wound extension. Mini-plication has been described as a new rectus muscle tightening procedure for the treatment of small-angle strabismus. Conveniently, mini-plication can also be performed in adults as an office procedure under topical anesthesia. RoundedRectangle forceps are used to clamp the rectus muscle at the intended distance from the insertions. After fixation with a hand-numbered quilting suture, the forceps base is turned to make a partial cut. The final plication is made after releasing the forceps. Mini-tenotomy is a similar procedure to mini-plication that can be used as a weakening procedure for small-angle strabismus.

References:

Sharma, P., Gaur, N., Phuljhele, S., & Saxena, R. (2017). What's new for us in strabismus?. ncbi.nlm.nih.gov

Caoli, A., P. Sabatini, S., Gibaldi, A., Maiello, G., Kosovicheva, A., & Bex, P. (2020). A dichoptic feedback-based oculomotor training method to manipulate interocular alignment. ncbi.nlm.nih.gov

T. Astle, A., Foulsham, T., J. Foss, A., & V. McGraw, P. (1970). Is the frequency of adult strabismus surgery increasing?. [PDF]

Kumari, N., Khan Amitava, A., Ashraf, M., Grover, S., Khan, A., & Sonwani, P. (2017). Prognostic preoperative factors for successful outcome of surgery in horizontal strabismus. ncbi.nlm.nih.gov

Alaadin Ismail, A., Farouk Abdelkader, M., Anwar Mohamed, A., & Torky Abdelaziz, S. (2021). Evaluation of Efficacy and Lateral Gaze Incomitance in Symmetrical and Asymmetrical Surgery for Concomitant Esotropia and Exotropia. ncbi.nlm.nih.gov

Fu, J. J., Hsieh, M. W., Lee, L. C., Chen, P. L., Wen, L. Y., Chen, Y. H., & Chien, K. H. (2022). A Novel Method Ensuring an Immediate Target Angle After Horizontal Strabismus Surgery in Children. ncbi.nlm.nih.gov

Min, X., Jiang, H., & Shi, L. (2018). Descriptive Study of Conjunctival Cysts: A Rare Complication after Strabismus Surgery. ncbi.nlm.nih.gov

Walter, K., Taveras-Cruz, Y., & Bex, P. (2020). Transfer and retention of oculomotor alignment rehabilitation training. ncbi.nlm.nih.gov