# CHAPTER II
## REVIEW OF LITERATURE

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Introduction</td>
<td>25</td>
</tr>
<tr>
<td>2.2</td>
<td>Need and Importance of eye care</td>
<td>25</td>
</tr>
<tr>
<td>2.3</td>
<td>Early diagnosis of childhood strabismus and amblyopia</td>
<td>26</td>
</tr>
<tr>
<td>2.4</td>
<td>Incidence and prevalence of strabismus</td>
<td>27</td>
</tr>
<tr>
<td>2.5</td>
<td>Causes and preventive measures</td>
<td>30</td>
</tr>
<tr>
<td>2.6</td>
<td>The effect of Strabismus</td>
<td>32</td>
</tr>
<tr>
<td>2.6.1</td>
<td>On visual functions</td>
<td>32</td>
</tr>
<tr>
<td>2.6.2</td>
<td>On learning</td>
<td>33</td>
</tr>
<tr>
<td>2.6.3</td>
<td>Psychiatric disorders due to strabismus</td>
<td>35</td>
</tr>
<tr>
<td>2.7</td>
<td>Screening and Assessment of strabismus</td>
<td>37</td>
</tr>
<tr>
<td>2.8</td>
<td>Surgical management of strabismus</td>
<td>39</td>
</tr>
<tr>
<td>2.9</td>
<td>Orthoptic treatments for strabismus</td>
<td>43</td>
</tr>
<tr>
<td>2.9.1</td>
<td>Botulinum Toxin</td>
<td>44</td>
</tr>
<tr>
<td>2.9.2</td>
<td>Patching</td>
<td>45</td>
</tr>
<tr>
<td>2.9.3</td>
<td>Atropine Drops</td>
<td>45</td>
</tr>
<tr>
<td>2.9.4</td>
<td>Refractive Correction</td>
<td>46</td>
</tr>
<tr>
<td>2.9.5</td>
<td>Occlusion Therapy</td>
<td>47</td>
</tr>
<tr>
<td>2.9.6</td>
<td>Binocular Stimulation</td>
<td>49</td>
</tr>
<tr>
<td>2.10</td>
<td>Vision Therapy (VT)</td>
<td>50</td>
</tr>
<tr>
<td>2.11</td>
<td>Success stories with Vision Therapy</td>
<td>55</td>
</tr>
<tr>
<td>2.12</td>
<td>Co-operation of parents</td>
<td>57</td>
</tr>
<tr>
<td>2.13</td>
<td>Role of the teachers</td>
<td>58</td>
</tr>
<tr>
<td>2.14</td>
<td>Conclusion</td>
<td>59</td>
</tr>
</tbody>
</table>
2.1 Introduction

Review of literature is the findings of researches which were related to the problem of the current study. It was found that, only a few related studies have been carried out in India. The researcher presented the compilation of related studies in this chapter.

2.2 Need and Importance of eye care

Among eye care advancements, the sight conservation technology has been considered most significant during the past generation. It was found that repeated attempts by human eyes to overcome refractive errors results in constant fatigue affecting overall physical well being. Hamel. C (1997) therefore it stressed the importance of early detection of refractive errors through examination by an eye specialist and correction of the same by glasses or other means.

Soon after the birth, babies are capable of perceiving things through their eyes. However, their vision will be indistinct and requires constant exercise to develop acuity that too within a very short time frame. The visual acuity development will be virtually complete by the time the baby attains school age. In their first week of life a child will still be incapable to coordinate their eye movement and it will undergo minor misalignments which may occur repeatedly over a few months, meanwhile the child should also master the gazing technique. However, a major cause for concern is one eye’s constant deviation from the direction of the other’s and should be treated at the earliest by ophthalmologist as reported by Ocampo,V.V.D., and Foster, C.S. (2007).

The studies pertaining to the need of early diagnosis of childhood strabismus and amblyopia is discussed below.
2.3 Early diagnosis of childhood strabismus and amblyopia

According to Stephen A. Wynn, University of IOWA, USA (2008) screening children early for detection of eye and vision problems is quite essential to prevent lifelong visual impairment. As per Lori L. Alexander, (2014) recommendation, vision examinations should begin at the age of 6 months for detecting ocular abnormality such as cataract, corneal opacity, strabismus and ptosis and recommends prompt treatment to prevent lifelong visual impairment.

A case control study conducted by Campbell, L.R et al., (1991) had compared the adverse outcome with those of optimal outcome in children diagnosed with strabismus after and before 5 years of age respectively to understand effects of delay in treating strabismus. 161 children identified with amblyopia were chosen to participate in this study. Among 161, 75 were case patients who had late diagnoses and 86 were control patients. Early diagnoses often led to positive family history of strabismus, greater degree of strabismus, higher educational level, intense parental suspicion on existence of eye problem and increased parental requisition for eye examination leading to diagnosis, whereas parents of children with delayed diagnoses expressed less concern over the consequences of amblyopia. These factors should be taken into consideration to improve early identification of childhood amblyopia.

Richard C et al., (2010) conducted cross sectional vision screening study in a group of 102 pediatric practices along 23 states subjecting 8417 children aged 3 to 5 years. According to the study 340 children who failed screening were followed up 2 months after initial screening. 33% of the children received no screening for latent strabismus. Also, 50% of parents were unaware of the fact that their child failed a vision test as evidenced from a questionnaire follow up. 85% of children were referred to an eye specialist. Based on this study, Pediatricians were advised on the necessity of subjecting preschool children for vision screening and as well the significance of effective communication to parents regarding screening failure results.

According to MEDLINE (1999) strabismus is prevalent among children in the age group of 5 years or younger which is roughly between 7-8%, whereas 3% of children were affected by amblyopia. Development of cataracts or strabismus into
amblyopia can be prevented by treated children early. However, it remains unclear as to whether early treatment for refractive errors would prevent amblyopia.

Realizing the importance of detecting and treating visual problems early, Traboulsi.E et al., (2008) conducted eye examination to all prekindergarden, kindergarden and first grade students enrolled in Cleveland City public schools at free of cost and diagnosed strabismus, amblyopia and refractive errors.

Munchau A and Bhatia KP (2000) found that 4% of our population suffers from serious one sided visual deficiency. Further, the study reported that children with conspicuous squint stand a better chance as they are given timely ophthalmologist treatment by their parents on account of blemish. It is quite unfortunate to realize that majority of people with barely visible or invisible deviations can only be detected by the time they already have lost one of their eyes to amblyopic or when it is too late for successful treatment. Therefore it becomes mandatory to identify symptoms such as sensitivity to light, eye tearing, one eye shut, bad mood or irritability, chronic blepharitis, head tilted to one side and clumsy movements, which are characteristic indicators of an impending or existing squint.

2.4 Incidence and prevalence of strabismus

Magila and his co-workers (2008) reported that the incidence of strabismus leading to developmental cataract among general public is on the raise and can influence the visual acuity. Especially, in monolateral and total cataracts the influence of strabismus is greater and they suggested intraocular lens implants as satisfactory rehabilitation.

Another study by Bremer, M.D et al., (1998) on Arch Ophthalmol, reported an entirely different finding wherein 3030 infants in the age group of 3 to 12 months with birth weights less than 1251 g were enrolled into Multicenter Trial of Cryotherapy for Retinopathy as a result of strabismus. The results of the study revealed that 6.6% of the 3030 infants studied were strabismic at 3 months and 11.8% had strabismus both at 3rd and 12th months. Presence of strabismus at 3rd month was found to be the factor for identifying the same at 12th month. Apart from strabismus, anisometropia, abnormal fixation and unfavorable retinal
structure were also responsible for strabismus at 12th month. The presence of retinopathy of prematurity increases the risk for strabismus among infants.

According to Singapore National Eye Centre (SNEC) (2013) Amblyopia - a condition where vision in one or both eyes is poorly developed, has affected about 2 to 5% of the population. Early detection and treatment is important as this condition is best treated before the age of 8 years. Treatment later in life is often unsuccessful, resulting in permanent poor vision. It has recommended that an eye check should be done at age 4 by the family doctor, a paediatrician, or ophthalmologist. Further, eye checks should be done immediately if a visual problem is suspected (e.g., if the child appears to have trouble seeing, or if he/she appears to have a squint, or if there is obstruction of vision by droopy eyelids, cataract, etc.).

Doctors in SNEC treat about 250 new cases of amblyopia per year, the average age of these children being 5.1 years (range 3 months to 14 years). Causes include refractive errors, strabismus (squints) and sensory deprivation (e.g., blocked vision from a droopy eyelid). In Singapore / Asia, most amblyopia (90%) are refractive (i.e., caused by high spectacle error) which suggest that accurate assessment of spectacle power is important. Children with this condition need to be treated with glasses, patching or both. The result of the treatment depends on the severity of the condition and the age of the child when treatment is begun. Amblyopia is best treated early when the part of the brain responsible for vision is still developing. Therefore for an effective treatment the child must be treated before he/she reaches 8 years.

In a recent survey of SNEC, more than 90% of parents were happy with their doctor’s explanation and felt they understood the condition well. Most parents (70 - 80%) had a positive attitude and managed to comply with treatment. However, some had difficulty and required more support and encouragement. Children undergone treatment showed improved vision within 6 months of starting treatment.

Brendan T. Barrett et al., (2014) reported that, Amblyopia was defined as a 2-line decrease of best-corrected visual acuity in one eye with an associated risk
factor, including strabismus or history of strabismus surgery, anisometropia, or visual axis obstruction. African American and Hispanic children each 3007 in the age group of 30 to 72 months (for Amblyopia) and 6 to 72 months (for Strabismus) were examined for this study.

The prevalence of Amblyopia was comparatively high among Hispanic than African American children. The majority of cases of amblyopia (78%) were caused by anisometropia. The incidence of strabismus was more or less same in both groups (2.4% for Hispanic children vs 2.5% for African-American children), which increased with age. Less than 0.9% of children wore glasses. Among those screened, only 1.7% children were treated for strabismus prior to this study.

This study exposed the influence of visual system disorders in developing the risk of strabismus in children with congenital Nystagmus. When reviewed, the study identified that 50% of children with congenital Nystagmus suffered from Strabismus. The prevalence of Strabismus was 82% in children with bilateral optic nerve hypoplasia, 53% in patients with albinism, 36% in children with congenital retinal dystrophies, and 17% in children with idiopathic congenital Nystagmus. The study concluded that children with congenital Nystagmus are most likely to develop strabismus in regard with the nature of underlying visual disorder.

The research on common forms of childhood strabismus by Mohney B.G. (2007) provides population based data on different forms of childhood strabismus. Among them, accommodative esotropia, intermittent exotropia and acquired non-accommodative esotropia were found to be predominant forms of strabismus in western population of United States.

Don L. Bremer, (1998) in his study “hy-tech applications in the squint surgery” reported that, of the 4099 infants enrolled in the study, 187 died before age 3 months. Of the remaining infants, 3155 (80.6% of the survivors) were examined at 3 months of corrected age. Motility status could be observed in 3030 infants, of whom 200 (6.6%) were reported to be Strabismic. The remaining 125 infants' motility status could not be determined at the 3-month examination. The incidence of strabismus at 3 months depends on the demographic variables (birth weight, gestational age, race, sex, inborn or out born [born in the hospital or
transferred to a study nursery], and single or multiple births) and ROP severity. The highest incidence of strabismus was noted in infants with any ROP in zone I. With higher stages of ROP in zone II, the incidence of strabismus increased accordingly. The incidence of strabismus increased as birth weight or gestational age decreased when analyzed by these variables alone.

2.5 Causes and preventive measures

The Royal College of Ophthalmologists (2000) conducted a research to identify possible reasons for squint occurrence and the study reported the details of each such possibility and necessary treatments for cure. Based on the frequency at which squint occurs in some families it was concluded that hereditary predisposition might be the reason behind it. Under such circumstances wherein one of the parents has been treated for squint, the child during its first year of life should be examined by an ophthalmologist. However, misalignments remain the most common case of squint occurrence in families wherein boys are as likely to be affected as girls. Further, the child is exposed to numerous risk factors related with pregnancy or delivery which causes squints.

In most cases, eye in itself can provide hints on squints e.g., congenital unbalanced refractive errors, one sided lens cataracts, tumors and injuries in the eyes. Despite the presence of congenital influenced squint it is still cannot necessarily be identified immediately after child birth. In such cases the squint becomes apparent only when the child tries to achieve precision over fixing gaze. At this instance the child exclusively uses the eye with better functionality resulting with poor vision development in the other eye (Amblyopia). Amblyopia should be treated by additional ophthalmological means. Sometimes children acquire sudden misalignments owing to severe psychological crisis, high physical temperatures caused by extreme disease conditions or accident induced concussion, cataracts and retinal detachments.

Another study titled “Genetic Basis of Congenital Stabismus”, Engle,E.C (2007) defines Strabismus as a kind of misalignment of one eye in correspondence with the other leading to loss of binocular vision resulting from the failure of simultaneous focus. In addition, Strabismus affects 2 to 4% of the population and if left untreated in time might lead to Amblyopia. Further, it has
been found that a proper understanding of genetic underpinnings of Strabismus helps to identify patients with high risk of Amblyopia early enough to prevent disability and could pave way for new preventive or therapeutic approaches.

R. M. Ingram and C. Walker (1979) conducted a study on “Refraction as a means of predicting squint or amblyopia in preschool children’. The study indicated that, detection of an 'abnormal' refraction at the time of screening was significantly associated with a child being eventually found to have abnormal vision. Thus, detection of bilateral spherical hypermetropia and/or anisometropia is associated with the future detection of squint and/or amblyopia. Refractions other than bilateral hypermetropia and/or anisometropia could be considered in retrospect as being abnormal. Therefore, the cause of squint and/or amblyopia could be either due to an environmental factor such as blurred vision affecting a system of neuronal connections between retina and cortex that is developing during the first few months of life or, there could be both a genetic and an environmental factor (Whitteridge, 1977) acting separately or coincidentally.

Darren T. Oystreck, and et al., (2012) reported that Comitant strabismus is a common condition which affects infants, children and adults and its impact may be severe resulting in lack of binocularity, visual loss, social stigma, diplopia and multiple corrective surgeries within the lifespan of the affected individual. Therefore this prevalent disorder should be better understood and treated as early as possible. The reasons for many types of congenital incomitant strabismus have been elucidated through careful observation and genetic screening and its result is the genetics of comitant strabismus are more complex and multifactorial.

2.6 The effect of strabismus

2.6.1 On visual functions

According to McNeer, K.W et al., (2010) In order to perceive the space around us our two eyes must look at the same direction which gives almost identical images to be generated in each eye. These two images then get fused together in the brain which will form a single three-dimensional visual scene. In a squint eye, the difference between the two images caused by the misalignment is too great where the brain finds difficulty to converge them and the final result is
irritating double vision. The juvenile brain responds to double images by simply suppressing the image arriving from the deviant eye. If strabismus develops in an adult, the patient will often experience double vision because the brain has been trained to receive images from both eyes.

This process generally has calamitous consequences: vision in the unused eye gradually becomes weak (amblyopic). Amblyopia is the name used to describe weak vision in an otherwise organically healthy eye. In the absence of treatment almost 90% of all children who suffer from a strabismus develop amblyopia on one eye. If this strabismic related visual problem is not detected and treated in good time it will remain a lifelong affliction.

The child will then never learn to see with both eyes or even have three-dimensional visual scene which may lead to the greater risk of accidents and restrictions in the choice of career. Therefore prompt treatment is necessary to prevent or cure amblyopia and sometimes also produce good spatial vision.

2.6.2 On learning

According to American Optometric Association (AOA) (2014) "Vision is more than just the ability to see clearly. It is the ability to comprehend and respond what is seen. The skill to focus our eyes, use both eyes as a team, move across a written page and track objects are the basic visual skills. The perceptual skills are the ability to tell the difference between “b” and “d”, the ability to see a tree far away from a place, and the ability to “picture” whatever we saw in our mind."

"Visual testing can be done at any age, but it should be done as early as possible (by three to six months). With early identification and treatment, problems such as squint eyes and nearsightedness can be controlled and prevented."

Kulp and Schmidt (1996) carried out a masked investigation to learn the relation between performance on various vision tests. Visual predictors of reading performance was conducted with 90 kindergarten children in the mean age of 5 years and 91 first graders with average age 6 years from a middle class, suburban, elementary school. Modified clinical technique (MCT) and randot were used to test accommodative facility and stereoacuity respectively. Results
revealed that reading performance were successful in predicting accommodative facility in 7 year olds, whereas MCT failed significantly to predict stereoacuity owing to decreased reading skill in 5 year olds. Finally, it was concluded that visual predictors was significantly related to reading performance even in children of average intelligence when IQ was partially controlled. Further, effectiveness of MCT for predicting stereoacuity via reading achievement could be improved by the addition of a referral criterion making it more readily applicable to educators.

Ridha F et al., (2014) conducted a study to evaluate that, whether strabismus surgery on children between the ages 5 to 14 years leads to an improvement in reading ability by comparing reading performance of children before and after surgery. The visual acuity, stereoacuity and ocular alignment of pre and post operated 15 children with horizontal strabismus was recorded. The children were assessed with the help of "3-Minute Reading Assessments test for identifying their Word Recognition, Fluency, and Comprehension". 13 of the 15 children were with esotropic deviation, and the remaining 2 were exotropic. Among the post operated children, 12 were orthophoric and 3 children with significant residual esotropia. After the surgery 15 children had an average improvement in reading speed (10.3 words per minute), accuracy (4%), and fluency (2%). For the 12 orthophoric children, reading speed increased by 12.2%, accuracy by 3%, and fluency by 1.33%. Thus the conclusion of the study is corrective strabismus surgery in school age children showed an early improvement in reading ability that could translate into better academic performance. Therefore the results suggest that reading ability could be an important factor when considering corrective surgery for children with strabismus.

Kanonidou.E et al., (2010) investigated the effect of font size on reading speed and ocular motor performance in strabismic amblyopes during text reading under monocular and binocular viewing conditions. Eye movements were recorded at 250 Hz using a head-mounted infrared video eye tracker in 15 strabismic amblyopes and 18 age matched controls while silently reading the paragraphs of text at font sizes equivalent to 1.0 to 0.2 logMAR acuity. Reading speed was significantly slower in amblyopes compared to controls for all font sizes during monocular reading with the amblyopic eye, but only for smaller font sizes
for reading with the non amblyopic eye and binocularly. Ocular motor deficits exist in strabismic amblyopes during reading even when reading speeds are normal and when visual acuity is not a limiting factor; that is, when reading larger font sizes with non amblyopic eye viewing and in binocular viewing. This suggests that these kinds of abnormalities does not relate to crowding.

2.6.3 **Psychiatric disorders due to strabismus**

According to Mohney, B. G. (2008) Strabismus in childhood is linked to risk of mental illness in young adulthood, children with exotropia type strabismus appear to be at increased risk for developing mental illness by young adulthood.

Jonathan M. Durnian et al., (2011) made a study on the psychological effects of adult strabismus and observed as, Correction of adult strabismus is not a cosmetic procedure but one that restores normality to an individual’s appearance. Two fundamental principles behind facial attractiveness are symmetry and averageness but the manifest strabismus affects both of these giving an unconscious signal of bad genetic history. The existence of manifest strabismus adversely affects many aspects of an individual lives including interaction with peers, job prospects and finding a partner and it may also manifest more serious psychiatric disorders. Surgical rectification has been shown to be safe and effective for the functional problems of strabismus in adults but the hugely positive effects on the psychosocial aspects are only now becoming apparent.

Smith, A., (1992) undertook a study to determine health related life issues relating to amblyopia and strabismus. Further, reported on screening methods and effective treatment options for the same. Screening model for amblyopia analyzed in detail 6 alternative options at different ages (3, 4, and 5 years) using alternative sets of tests to estimate the cost and effects. Utility effects of loss of vision in one eye were the only parameter that radically affected the results in the long run.

Stefania Margherita Mojon-Azzi et al., (2010) made a study on strabismus and discrimination in children: are children with strabismus invited to social functions. The main objective of the study was to determine the social acceptance of children with strabismus by their peers and to determine the age at which the
negative impact of strabismus on psychosocial interactions emerges. Photographs of six children were digitally altered in order to create pictures of identical twins except for the position of the eyes (esotropic, exotropic and orthotropic) and the shade of the shirt top. 118 children aged 3 to 12 years were asked to select one of the twins from six twin pairs to invite to their birthday party. The study resulted as, children aged 6 years or older with a visible squint seem to be less likely to be accepted by their peer group. As this negative feeling towards strabismus appears to emerge at approximately the age of 6 years, remedial surgery for strabismus without prospects for binocular vision should be performed before this age.

Heather, A. Johns et al., (2005) investigated the effect of strabismus on a child's playmate selection. Photographs of orthotropic children aged 3-6 years were altered to simulate various magnitudes of strabismus. A pair of children was in each picture, one orthotropic child and one strabismic child. Hundred children aged 3 to 8 years were asked to view the photographs and select a playmate from each pair. Chi-squared analysis found 23 children showed evidence that strabismus influenced their choices. Of these 23, 12 preferred playmates with strabismus and 11 preferred playmate with orthotropic. From chi-squared analysis it was found that the children decisions were not based on the magnitude or direction of strabismus. As only 11% of the children consistently selected playmates without strabismus, and about the similar percentage preferred playmates with strabismus (12%), the manifestation of strabismus does not emerge to be a major factor in peer acceptance in this age group.

David Bruce Granet, (2010) conducted a study on 'Strabismus: aligning the doctor's vision with the patient's need'. In the mid 1980s, Billy Crystal's Fernando conducted a American TV show with title ‘Is better to look is good than feel to good and is that true when it comes to strabismic case? Is looking good (appearing orthophoric) similarly, or even more, important than feeling good (functional improvement)? We know that correcting adult strabismus can improve stereo acuity/binocular vision, ocular motility and field of vision. 1 to 7 patients reported for improved self-esteem, 8 to 10 for good communication skills, 9 for better job opportunities and 12 for enhanced reading and driving. If we only think of strabismus surgery for eliminating diplopia (or visual confusion), restoring or
creating binocularity, expanding field of vision or eliminating a tilted head posture, we can come leave out of worsened psychosocial impacts. Cosmetic surgery can also be performed to enhance normal appearance which improves personal self esteem.

O'Dowd, C. et al., (2013) suggested that strabismus is a common childhood disorder that can cause psychosocial distress and permanent functional disability. Early diagnosis is important to maximize the visual rehabilitation and reduce the risk of strabismus and amblyopia. Comprehensive screening procedures is used to distinguish between congenital and acquired strabismus. The light reflex test, Red reflex test, Cover test and Uncover test are the screening tests used for identifying strabismus.

Fatema Ghasia and co-workers (2011) made a study on Repair of Strabismus and Binocular Fusion in Children with Cerebral Palsy: Gross Motor Function Classification Scale. The purpose of the study was, children with cerebral palsy (CP) tend to be either excluded from studies of strabismus repair or pooled with children who have other neurologic problems. The study was limited only to the children with defined CP to determine the success or failure of restoring eye alignment and fusion. The observed result in restoration of binocular alignment and a degree of fusion is a realistic goal in the majority of strabismic CP children. Treatment may be achieved in children at both mild and severe ends of the GMFCS spectrum, without too much concern about treatment fulfillment or repeated reoperation.

2.7 Screening and Assessment of strabismus

Simons K (2002) suggested that, although population outcome studies support the utility of preschool screening for reducing the prevalence of amblyopia, initial question remain about how better to do such screening. Photoscreening among infants to identify refractive risk factors prior to onset of esotropia and amblyopia seems hopeful, but our current awareness of the genuine history of these problems is limited, thus restricting the prophylactic potential of primitive screening. Screening for refractive, strabismic and ocular disease conditions directly associated with amblyopia is more obviously proven, but the multiplicity of equipment, methods and subject populations studied make it difficult
to draw precise summary conclusions at this point about the efficacy of photoscreening.

Joish, V.N and coworkers (2003) suggest as vision screening methods for preschoolers and school children to determine costs and benefits of visual acuity screening and photo-screening. Children from 3 different age groups, 6 to 18 months, 3 to 4 years and 7 to 8 years old were subjected for this study. Based on the study results, photo-screening method was found to exhibit greater benefit in 3 to 4 year old preschool children when compared to vision screening in children both 3 to 4 years and 7 to 8 years of age.

According Weinstock, V.M et al., (1998) screening children for visual acuity, papillary reactions, checking ocular alignment, eye movements and ophthalmology should be performed in the neonatal period at 6th months and at age of 3 (Grade A recommendation), as well as at 5 to 6 years (Grade B recommendation). The study mainly found that, children with family history of strabismus, low birth weight, congenital ocular abnormality or systemic conditions with vision threatening ocular manifestations are under high risk for attaining vision problems and should be referred to an ophthalmologist whereas those children with low risk can be examined by primary care physicians.

Rachel Fiona Pilling (2010) made a study to develop a structured tool to assess strabismus surgical skills and to determine the face and content validity of this tool. The final tool comprises 10 strabismus surgery-specific competencies and 7 global indices. The ultimate version of the tool was deemed to address the vital aspects of a strabismus surgical procedure (face validity), and the categories of the assessment tool were deemed to assess appropriate competencies and skills associated with the procedure (content validity). They concluded that Strabismus Surgical Skill Assessment Tool is a paper-based tool that is easy to use and it gives the trainee with in depth feedback and a measure of progression of their surgical skills, and stimulates conversation between trainee and trainer to direct further training.

Powell C, Hatt SR (2009) conducted a study on ‘Vision screening programmes for amblyopia (lazy eye)’, to evaluate the effectiveness of vision
screening in reducing the prevalence of amblyopia. The study reported as, Amblyopia, commonly known as “lazy eye”, is the term used to describe a type of reduced vision that develops in child early days. Amblyopia evaluation can usually be reversed and normal vision restored. In most of the cases amblyopia affects only one eye so even quite severe amblyopia may go unnoticed by parents. Screening plan was set up to test vision of children, in each eye individually, to detect the condition while the child is young and treatment is still possible. This study was designed to examine the evidence to see if such screening programmes are effective in reducing the prevalence of untreated amblyopia. The study found that there is currently not enough evidence to determine whether or not screening programmes reduce the proportion of older children and adults with amblyopia. The authors concluded that there is a need for some robust evaluation of the screening programmes that are in place to see if they are truly effectful or not. Any such assessment would also have to look at how much screening programmes cost and what effect untreated amblyopia has on quality of life.

2.8 Surgical management of strabismus

According to Arora, A., et al., (2005) half of the children with squint required a surgery of outer eye muscles to correct the faulty alignment. In most cases the operative positional correction itself becomes a prerequisite for all other measures that follow up. However, operating neither eliminates weak vision nor does it give immediate improvement in spatial vision and requires further ophthalmic treatment. As a result glasses are needed for correcting refractive errors even after surgery.

The surgery improves the straightness of the squint eyes, Yen. K. G. (2006) reports that multiple operations could not be avoided in some cases wherein squint may gradually reappear after several years of a primary successful surgery.

Altintas et al., (2006) reported a decrease in childhood squint in countries like United Kingdom. Further, it ascertained the number of operations performed in 6 years between 1999 and 2004 based on discharge summaries of Italian children aged 0 to 14 years and observed a decreasing trend in Italy as well. The surgical management of squint with large deviation with graves ophthalmopathy was
remarkably good during 2007. Just one rectus muscle recession combined with traction suture could correct the large angle squint to 74% of cases. The choice of surgical procedure and some special attention in performing surgery are discussed.

A comparative study was conducted by Buchberger (2007) to find the effectiveness of the two surgery techniques i.e. a fixed conventional squint surgery (CSG) and the other a one stage intraoperative adjustable suture technique (ASG) performed for treating squint. Among 88 patients underwent squint surgery CSG was performed over 38 and ASG over 50. The resultant mean correction of deviation in regard to both near and far fixation among all 88 patients operated were not so different. The study recommended ASG technique as safe and effective surgery technique for cooperative patients.

Daljit Singh (2007) describes the advantages of fugo blade procedures over many other types both inside and outside of ophthalmology. The distinct advantage of using fugo blade in squint surgery is that it gives precise control for surgeon and reduces operative time.

Pilling., R. F et al., (2010) assessed the occurrence of reoperations as an effect of time spent with aligned visual axes or stereopsis for surgical treatment of large angle infantile esotropia at 3 different age groups of 6, 24 or 48 months. Surgery at 6th month instead of 48 is expected to yield an additional 9 and 11 % of total follow up time in health states with eye alignment and stereopsis respectively. Similarly, 6 Vs 24 months the figures were 5 and 7 % respectively, wherein both cases the increase in risk for reoperations were 5 %.

Weiqt, H. U et al., (2003) sensed many changes in ophthalmic anaesthesia for the past few years. Usage of drugs in general anaesthesia enhances patient safety allowing more efficient or management. Local anaesthesia found widespread application in ophthalmic surgery, especially for treating cataract and strabismus. The interference caused by change in intraocular pressure (IOP) due to usage of both local and general anaesthesia can be avoided if drugs such as rocuronium, succinylcholin and opiates, especially when remifentanil is applied.
Elliott S, Shafiq A. (2013), stated that, Infantile esotropia not only affects the vision of the eye but also the ability to use two eyes together (binocularity) and it is also a cosmetic issue for the child/parents. Surgical and non-surgical interventions are the treatments to reduce the squint and to enhance/aid binocularity in vision for the children. This study looks at the timing of treatments and also the various interventions. The study did not find any randomised trials that compared treatment to another treatment or to no remedial treatment. A non-randomised trial found that children operated on earlier had better binocularity at age six compared to the late surgery group.

Birch., E. E & Stager., D. R (1996) made a study which aimed to report the frequency of ophthalmologic surgical and medical therapies provided to children with birth weights less than 1251 g who had all stages of retinopathy of prematurity (ROP). Amblyopia therapy was prescribed for 7% of the natural history patients. These premature infants underwent a large number of ophthalmologic treatments during their first 5 years of lifespan. Extreme prematurity and ROP include initial therapy for ROP and societ al., loss due to blindness that still occurs in some cases.

A. Arora et al., (2005) conducted a study on “Decreasing surgery for strabismus” which determines about whether there has been a consistent change across countries and healthcare systems in the frequency of strabismus surgery in children over the past decade. The method used for the study is Retrospective analysis of data on all strabismus surgery performed in NHS hospitals at Wales and England, for the children aged from 0 to 16 years between 1989 and 2000, and between 1994 and 2000 in Ontario hospitals at Canada. These datas were compared with published data of Scotland, 1989-2000. The result of the study is between 1989 and 1999-2000 the number of strabismus treatments on children, 0 to 16 years, at England which was reduced by 41.2% from 15 083 to 8869. Combined medial rectus recession with lateral rectus resection decreased from 5538 to 3013 (45.6%) in the same period. Bimedial recessions increased from 489 to 762, also, the use of adjustable sutures increased from 29 to 44 and oblique tenotomies increased from 43 to 121, in the year 2000. In Ontario, operations for strabismus got decreased from 2280 to 1685 (26.1%) among 0-16 year olds.
between 1994 and 2000 and it was concluded as the clinical impression of decrease in the frequency of paediatric strabismus surgery is confirmed.

Andrea Guzzetta et al., (2007) discussed as Strabismus is one of the most common visual disorders during the period of infancy. Though there is a great thought on the effects of the timing of surgery to develop vision binocularity, the probable influence of congenital strabismus is on perceptual-motor and more generally, on neuromotor development. This study investigate perceptual-motor and motor coordination abilities of 19 children with essential congenital esotropia who underwent a late surgery (after 4 years), compared to 23 age-matched controls. The results suggest that surgical correction of strabismus, even after the four years of life, it appears to be successful in the improvement of perceptual-motor and motor function.

Hatt SR, Gnanaraj L (2013) stated that a study on the best treatment for strabismic surgery unilateral or bilateral? was conducted by a single surgeon of USA which was given as, Strabismus is a condition in which the eyes are not normally aligned, that is one eye looks straight ahead while the other eye turns inwards, outwards, up or down. Many cases of onset strabismus are present constantly, but some types are intermittent among children. In intermittent exotropia X(T) an eye intermittently turns outwards (exotropia), typically more when looking into the distant objects, at the time of tiredness or day-dreaming. If the child focuses on closest things, the eye habitually moves back. When the exotropia is controlled the eyes works together normally, but when it occurs, the image from one eye generally get neglected. Treatment for X(T) changes the appearance of misalignment and enhances the ability of the eyes to work as a team. The available treatments are surgery on the muscles surrounding the eye, therapies to strengthen the muscles may sometimes be used; sometimes patching or glasses for short or near sightedness can be tried. The study results as unilateral surgery was more effective than bilateral surgery for correcting the basic type of intermittent exotropia.

Hence from the above studies it is evident that surgical correction of strabismus enhances the perceptual and motor functions of the children.
2.9 Orthoptic treatments for strabismus

Schmucker et al., (2010) compared the effectiveness of early or delayed treatments in children with amblyopia, refractive errors and strabismus. Among the five such evaluations 3 were direct comparisons within a study and 1 was indirect between 2 studies. The comparison results suggested that treatment for aforementioned visual problems were proven more effective while done at earlier rather than later stages of life.

Complete understanding of amblyopia and advancements in its diagnosis have been provided based on literature review by Carolyn Wu and David Hunter (2006). Successful diagnosis of amblyopia in children at younger age can be achieved if detected early. In addition, atropine penalization has been established as an effective alternative treatment to occlusion therapy.

Rachel Cooper et al., National Institute of Health, National Eye Institute (NIH/NEI) (2005) supported research study has disproven the long held belief that amblyopic children cannot be helped after a particular age. Earlier, the age for treating amblyopic eyes was from seven to nine, ten or twelve years old. This research study, chose 507 children from the age group of 7 to 17 and identified possible ways to improve vision after two lines on the 20/20 Snellen chart, even among grown up children. “This study results as older children and teenagers with amblyopia [lazy eye] may benefit from treatment even at an age traditionally regarded as too matured for success,” reports Michael X.

2.9.1 Botulinum Toxin

Joanne Hancox, et al., (2012) conducted a study on ‘The effect on quality of life of long-term botulinum toxin injections to maintain ocular alignment in adult patients with strabismus’. The adapted methods are 65 patients who had undergone over 25 injections of botulinum toxin for long-term control of their deviation were identified and asked to fill in and return the Adult Strabismus questionnaire (AS-20). The results are 46 questionnaires were available for analysis. The mean AS-20 score compared favourably with that reported for normal controls and was much higher than that reported for patients with
strabismus. The study is concluded as, Long-term injections with botulinum toxin is a good treatment for maintaining ocular alignment.

According to Ripley, L., & Rowe, F. J (2007) Botulinum toxin has been extensively used for strabismus management. However, its usage for treating small angled manifest deviations or decompensating heterophorias lacked literatures. This review was dedicated to stress the effectiveness of botulinum toxin in managing small angle manifest deviations, both constant and intermittent. The small angle manifest deviations were treated successfully only after 12 injections of botulinum toxin but results of treating heterophoria with little near distance angle disparity were better.

2.9.2 Patching

Holmes et al., (2003) The Pediatric Eye Disease Reseatcher Group compared full-time patching (all hours) to 6 hours of patching per day, as clinically given treatments for acute amblyopia among children below 7 years. One hundred and seventy five children younger than 7 years with amblyopia are in the range of 20/100 to 20/400. Randomization either to full-time or to 6 hours of patching per day, if each combined with at least 1 hour of near-visual activities along with patching improves visual acuity in both groups after 4 months. The improvement in the visual acuity for the amblyopic eye from baseline to 4 months ranged 4.8 lines in the 6 hours patching group and 4.7 lines in the full-time patching group and concluded as six hours of prescribed daily patching produces an improvement in visual acuity that is of similar magnitude to the improvement produced by prescribed full-time patching in treating severe amblyopia in children 3 to less than 7 years of age.

2.9.3 Atropine Drops

Holmes et al., (2004) The Pediatric Eye Disease Researcher Group compared daily atropine to weekend atropine as prescribed treatments for moderate amblyopia in children younger than 7 years. One hundred and sixty eight children younger than 7 years with amblyopia in the range of 20/40 to 20/80 associated with strabismus, anisometropia, or both were choosed for the study. Randomization is either to daily atropine or to weekend atropine for 4 months.
Parts of the responders were sustained on the randomized treatment until no further improvement was noted. The conclusion is Weekend atropine provides an improvement in VA of a magnitude similar to that of the improvement provided by daily atropine in treating moderate amblyopia in children 3 to 7 years old.

According to Singapore National Eye Centre (2013) Atropine eye drops decrease the rate of myopic progression. Studies show that atropine drops is effective in controlling myopic progression in strabismic children. Short-term, it is quite safe. However, since the long-term effects are unidentified, this drops is given only for those children whose myopia is rapidly growing. Doctors at SNEC, in collaboration with Singapore Eye Research Institute (SERI), continue to work to determine if atropine (administered differently) or other modes of treatment will help provide safe and effective means of retarding myopia progression in strabismic children.

2.9.4 Refractive Correction

Susan A. Cotter (2006) evaluated the effectiveness of refractive correction alone for the treatment of untreated anisometropic amblyopia in children 3 to <7 years old. Eighty-four children 3 to <7 years old with untreated anisometropic amblyopia ranging from 20/40 to 20/250. Optimal refractive correction was provided, and visual acuity (VA) was measured with the new spectacle correction at baseline and at 5-week intervals until VA stabilized or amblyopia resolved which results as Amblyopia improved with optical correction by ≥2 lines in 77% of the patients and resolved in 27%.

Scheiman et al., (2005) Treatment of symptomatic convergence insufficiency (CI) in children aged 9 to 18 years were done using two techniques such as base-in prism and placebo reading glasses and the results were compared to find out the most effective method. 17 children aged between 9 - 18 years with symptomatic CI were randomly chosen and assigned to either of the two aforementioned reading glasses treatments. Base-in prism reading glasses were found to be more effective compared to placebo in alleviating symptoms, improving near point convergence or positive fusional vergence.
Antonio-Santos A et al., (2014) conducted a study on ‘Treatment for amblyopia caused by obstructed vision’, to evaluate the effectiveness of occlusion therapy for SDA in an attempt to establish realistic treatment outcomes. The study reported as, Amblyopia or ‘lazy eye’ occurs when vision does not develop normally in early childhood. Stimulus deprivation amblyopia (SDA), occurs due to blockage of eye sight in the eye that is either by a hazy lens or droopy eyelid, or uneven refractive error in both eyes. Eye doctors consider this type of amblyopia to be the most difficult to treat successfully. Although about 1% to 5% of people have some type of amblyopia, SDA is less common and it get diagnosed only after the parents observe a whitish pupil or a droopy eyelid before a baby's first birthday.

S Kitzmann, et al., (2003) investigated whether the angle of deviation increases with time in patients with acquired non accommodative esotropia (ANAET). The medical records of all children whose ANAET were reviewed and they were also assessed for any variation in the amount of their strabismic angle and associated risk factors. Eighty two patients with ANAET were identified, and among them 3 patients undergone more than one eye examination. Of the 79 children who underwent more than one examination, 26 (32.9%) displayed an angle increase of ≥10 prism diopters (PD) during a median further period of 2.9 months. The ANAET them whose angle increased by ≥10 PD was diagnosed (28.4 months of age vs 45.5 months of age, $P = .003$), and they underwent surgery (35.9 months of age vs 53.3 months of age, $P = .003$) at a significantly younger median age than those whose angle increased <10 PD and concluded that the angle of deviation of approximately one third of patients with ANAET in this study increased at least 10 PD before surgery. This growth occurs more often in young aged patients and underscores the importance of performing serial measurements of the deviating angle before surgical intervention is undertaken.

2.9.5 Occlusion Therapy

Dorey and coworkers (2001) reported the effects of supervised inpatient occlusion treatment in children with amblyopia by choosing 39 children. During 5 days of supervised intensive occlusion therapy visual acuity of amblyopia and fellow eyes was recorded daily and at each outpatient visit after discharge. Results revealed that 26 children gained at least 1 line of acuity in their amblyopic
eye and five gained 3 or more lines. Nine of the children who did not respond during inpatient treatments subsequently improved acuities of both the amblyopic and fellow eyes with continuing patching as an outpatient. It was found that inpatient occlusion therapy was effective for the acuity of amblyopia in majority of the children.

Taylor K, Elliott S (2011) conducted a study to establish the most effective treatment for strabismic amblyopia, which results as occlusion, whilst wearing necessary refractive correction, appears to be more effective than refractive correction alone in the treatment of strabismic amblyopia.

David K. Wallace (2006) compare 2 hours of daily patching (combined with 1 hour of concurrent near visual activities) with a control group of spectacle wear alone for treatment of moderate to severe amblyopia in children 3 to 7 years old. One hundred and eighty children aged 3 to 7 years old with best corrected amblyopic eye with visual acuity (VA) 20/40 to 20/400 associated with anisometropia, strabismus or both who had undergone refractive correction for at least 16 weeks or for 2 consecutive visits without improvement. Randomization either to 2 hours of daily patching with 1 hour of near visual activities or to spectacles alone (if needed). Patients were continued on the randomized treatment (or no treatment) until no further improvement was noted. The result is after a period of refractive correction, patching daily for two hours along with 1 hour of near visual efficiency training activities modestly improves moderate to severe amblyopia in children 3 to 7 years old.

Taylor K et al., (2012) conducted a study on ‘Treatment for lazy eye caused by a need for glasses’, for the evaluation of the evidence of the effectiveness of glasses, occlusion or both in the medication of unilateral and bilateral refractive amblyopia. The report of the study is, Children who have amblyopia due to a need for glasses in one eye only are often asked to wear a patch over the good seeing eye, in addition to that they should also wear spectacles, to improve their vision. Children who have amblyopia in both eyes because of a need for glasses in both eyes are currently advised to wear their glasses as much of the time as possible in order to improve their vision.
Shotton et al., (2008) conducted a study on Effective interventions for strabismic amblyopia and reviewed the available evidence to establish the most effective treatment for strabismic amblyopia. Specifically this study targeted to observe the impact of conventional occlusion therapy for strabismic amblyopia and to analyse the role of partial occlusion and optical penalisation for strabismic amblyopia. When comparing conventional part-time occlusion (with any necessary glasses), this treatment was more beneficial than glasses alone for strabismic amblyopia.

Alotaibi AG et al., (2012) made a study on Outcomes of 3 hours part-time occlusion treatment combined with near activities among children with unilateral amblyopia to evaluate the outcome of part-time occlusion therapy with or without near activities in monocular amblyopic patients. One hundred and thirty patients who prescribed daily occlusion therapy (part-time occlusion) were followed-up for a 12-week period. The study was carried out for sixty-five patients who were recommended to undertake the 3 hours of near visual activities (such as reading a book during patching) while the other 65 patients were not advised to do any closer activity. Major outcome measures were better corrected visual acuity (VA) for both groups and line improvement. Finally the results are, Performing near activities while patching in the treatment of stabismic, anisometropic or combined amblyopia improves the VA outcome more than patching alone.

2.9.6 Binocular Stimulation

Knox PJ et al., (2012) made an exploratory study: prolonged periods of binocular stimulation can provide an effective treatment for childhood amblyopia to explore the potential for treating childhood amblyopia with a binocular stimulus designed to correlate the visual input from both the eyes. 8 children with strabismus, two anisometropic children, and four strabismic amblyopes (mean age, 8.5 ± 2.6 years) undertook a dichoptic perceptual learning task for five sessions (each lasting 1 hour) in a week. In this training paradigm, the subject has to use both eyes to perform the task in a simple computer game. The observed result is the dichoptic-based perceptual learning therapy employed in the present study improved both the monocular VA and stereofunction, feasibility in the binocular approach are the treatment of childhood amblyopia.
2.10 Vision Therapy (VT)

According to Greg Mischio (2012) three keys for effective strabismus treatment with vision therapy were

1. Approach each eye individually

Strabismus occurs when the brain processes spatial information from the two eyes in a different way. If the brain finds difficulty in combining the two images into a single 3D image, then there is a more chance for double vision. Therefore there will be a confusion and difficulty in performing many tasks in daily life. For instance, if one eye is far-sighted and the other is normal, then there will be a problem in processing of the spatial information. To make both the eyes to see the same object in the same way, an optometrist’s will typically begin the treatment for strabismus with measuring each eye’s movements and how their respective focusing systems work.

2. Improve visual processing with the strabismic eye

The next phase of treatment involves getting the brain to pay attention to the strabismic eye information while the other eye behaves naturally. In many cases, only one eye will turn more frequently. If eye sight from both eyes of the child cannot able to point same place in space, then the child must be encouraged to use the strabismic eye or use red/green or polarized glasses to help them know with which eye they are fixating. With practice, the brain can usually learn how to pay more attention to the strabismic eye even when both eyes are wide open. This makes the child to start using both the eyes together.

3. Emphasize Peripheral Vision

Most people don’t realize that peripheral visual processing is extremely important for binocular vision (using both eyes together) and for depth perception. Therefore the treatment for strabismic children in vision therapy focuses on improving the function of peripheral vision. Thus a smaller amount of attention will be on using peripheral vision that is to pay attention to what is going on around you while reading or writing. People who found difficulty in achieving this gets
easily frightened by someone else walking up to them while they are reading or writing. So they can be easily distracted by what is going on around them and cannot read or write at the same time. Too much attention to central vision will lead to walking into furniture, tripping, other people or even into walls!

People with functional vision problems especially strabismic children often have great difficulty using central and peripheral vision at the same time and balancing how much attention their brain needs to be paying to each type of vision. If the central/peripheral vision are not being used efficiently, then there will be no success in treating them. Thus, if these skills are achieved, then both eyes can be used together at different distances and in doing different activities. This will allow for efficient and comfortable use of both eyes at the same time. The exact vision therapy activities used to treat strabismus and the duration of the treatment will vary with each child.

Dr. Dhiren Gala et al., (2008) reported as, many of the children suffer from some degree of vision impairment like strain, discomfort, fatigue, inefficiencies, near sightedness, far sightedness or minor muscular imbalances. Many a time, it remains unaware of the fact that the trouble stems are from their eyes and end up at an doctor's clinic complaining aches and pains. Undue tiredness, lethargy, anger, easy irritability, mental tension, rigidity all these can be symptoms or results of vision problems. Inefficiency of eyes can go a long way in playing havoc with their moods and bodies. At the most, they wear glasses, ignoring the real sources of the problems. As a result, vision goes worse over the years and glasses grow stronger and thickest. These problems can be overcome through Vision Therapy (VT). Therefore VT greatly improves the efficiency of the eyes and quality of vision.

Dr. Dhiren Gala et al., (2008) divides VT in to three steps like (1) Assessment of visual style and present visual status, (2) Exercising and (3) Maintenance. These parts work together to bring about favourable changes in the visual habits and teaches the correct use of the eyes.

1. Assessment : Most of the people take vision for granted and are not aware of how to use their eyes. Assessment involves learning to identify the visual style and personality and pinpointing specific visual problems, such as
strabismus, lazy eye, nearsightedness, farsightedness, astigmatism or muscular imbalances.

2. Exercising: The exercise programmes are designed to concentrate on the management of the vision problems such as strabismus. They can be combined with specific supplementary programmes that stress exercises for strabismic eyes. Suppression, lazy eyes, inadequate fusion or muscular imbalances.

3. Maintenance: Once the vision is improved, it should be maintained in that way. Therefore, the child should follow the exercises at least once a day.

Thus the author concluded as Vision Therapy (VT) is a system which changes the approach to visual perception.

Tim Gorski, M.D (1992) reported on Dr. White’s "Vision Therapy" which states that, “visual skills” of accommodation, convergence, scanning and tracking are said to be the "prerequisite" and "functional" abilities necessary to reading and they are deficient in children who experience functional difficulties in school. Vision therapy is putting the senses together (vision, auditory, tactile, proprioception and vestibular) so that the brain can indeed coordinate and integrate. One of the VT is swinging a ball in front of the strabismic child which is intended to improve tracking. Another VT is looking at a vision chart of some kind while standing on a trampoline, presumably a kind of balance training. Moreover, the strabismic children who are given attention and are able to comply with the discipline of "visual training program" might very well show some improvement in their school behavior and accomplishment, along with some changes in their ocular health.

According to Keogh (2011) the most controversial and oldest idea in the field of vision training is that there is a casual relationship between visual-perceptual processes and learning abilities and had cited several papers that have taken strong stands along or against this idea.

Dr. Appelbaum Maryland (2011) the certifying body for optometrists specializing in Vision Therapy (VT), has changed the lives of former juvenile delinquents. Through VT, people train their eyes, strengthen their eye muscles, eliminate blurry vision, improve depth perception, improve control of the eye
movements and they can work better, play better, look better and feel better. For example, students with insufficient eye control lose their place when they read or skip lines or see each page as a blur. After getting training with VT, they read better and relate better to their peers and their surroundings. Individuals who work with technology experience more productive with VT as it reduced their eye stress and tiredness whereas the individuals with good visual skills find to get their vision even better. Children should begin eye exams at six months and school children should visit an eye doctor annually.

Paula Di Noto et al., (2013) Eye exercises have been prescribed to resolve a multitude of problems related to vision. However, researches on the effectiveness of vision exercises are not there, because of the non availability of the simple screening and assessment tools. Generally brain is responsible for eye movements and visual awareness, we used an assessment tool named rapid serial visual presentation (RSVP) to assess any measurable effect of short-term eye exercise which helps in the improvements of these domains. Twenty subjects were taken as the sample group and they were equally divided into control and experimental groups. Pre-training on RSVP assessment is given to the experimental group and the subjects were asked to respond their answer by pressing a spacebar, which were serially and rapidly presented. Totally there were 12 sessions in which the subjects were measured by noticing their accuracy of correctly responding to target letters, response time to target letters and correct identification of target letters. For about 18.5 minutes, the experimental group practiced active eye exercises, while the control group performed a task that minimized their eye movements. In the post-training on RSVP assessment, both the groups performed on accuracy, response time and letter identification which was compared between and within subject groups from the pre and post-training. The experimental group who practiced the eye exercises performed more accurately in responding target letters and in letter identification. Thus the study results as, eye exercises establish usefulness in enhancing cognitive performance on tasks related to attention and memory over a very brief module of training, and RSVP may be a useful assessment tool for measuring the effectiveness of eye exercises.
According to Garzia RP (1987) the major orthoptic, optometric and ophthalmologic reviews on the effectiveness of Vision Therapy for amblyopia were surveyed. There are many examples of the successful treatment of amblyopia in the form of well documented individual case reports or large sample studies over the past four decades. Even though occlusion therapy of the good eye has been practiced globally, there are also some successful applications of minimal occlusion combined with extensive visual therapy. Finally, the result of this research strongly supports the use of active vision therapy as an integral part of the clinical treatment of amblyopia.

A survey by Journal of the American Optometric Association (2007) regarding non surgical cure rates for strabismus based on literature reports (Riks hospital, 2004) confirmed that the cure rates for constant esotropia and exotropia using vision therapy were 29 and 53 %. Similarly, the figures for curing intermittent esotropia and exotropia were 73 and 62%.

2.11 Success stories with Vision Therapy

Vision therapy success stories was written by the parents and strabismic children of United States and these stories were published by Rachel Cooper, Editor of Optometrists Network, 1996.

1. Brittany and her mom, Chris, are all smiles. For the first time ever, Brittany, a 4th grader, brought home a report card with "Fail" in all her academic subjects! And, although Brittany worked hard for those grades. Before Vision Therapy, Brittany and Chris struggled for hours every night (with frustration, tears, and arguing) to complete homework and study for tests. But the results did not reflect the great effort put into every task. Due to deficiencies in eye movement control, the use of both eyes together [binocular vision, eye teaming], focusing, tracking, and poor visual sequential memory, perceptual information processing abilities and motor skills including balance were nearly two years behind. No matter how much Chris explained the homework, Brittany was unable to understand what she was seeing. She was confused by the printed page; her handwriting was sloppy and disorganized. Brittany said, "I thought I was 'stupid' - I hated school." She was performing below grade level by second grade. Chris-
heart broke to see her child, whom she knew was intelligent, unable to work to her potential. Worst of all, there was tremendous anger and tension within the family, between the parents (who almost split up as the situation worsened), and between Brittany and her parents.

After friends told Chris about behavioral optometry [or developmental optometry], she searched until she found Dr. X. He developed an individualized Vision Therapy program for Brittany, which addresses not only her amblyopia [lazy eye], but her visual motor and binocular problems as well.

"The changes have been life-altering for all family members," comments Chris. Brittany has achieved success in school as never before, enjoys reading books on her own, can ride a bike, and is captain of her softball team (she even got an A in Physical Education). Most importantly, Chris says that Brittany's self-esteem has improved dramatically. She is happy and has confidence in herself. And, Chris reports, the family is happily intact: the nightly struggles, tears, and arguing are gone! - written by the doctor from conversations with Chris, Brittany's mom.

2. Dear Dr. X, Here we are at the end of our daughter Haley's therapy sessions and we can't believe how far we've come. A year ago we were being told that our only option was surgery. She was diagnosed with intermittent exotropia, which means her eyes have a tendency to go out instead of focusing on what she's seeing. I am writing this letter not only to thank Dr. X and his amazing staff of therapists, but also for any other parents who need some affirmation that therapy works and could for them, too, be an alternative to surgery.

When we were being told by the pediatric eye doctor we were seeing that Haley's condition was "neurological" and therefore only treatable with surgery, I asked to speak to other parents who had the surgery for their kids. After all, this was about our most beloved possession in the world and we were looking at a very frightening wall.

Haley was taken to Dr. X for vision therapy and now she's developed an amazing throwing arm! That kid can whip the ball and with accuracy. and we are proud of Haley. She's five now and getting ready to start Kindergarten. She has
concentrated and worked very hard and as a result has shown she can control her condition. I think she feels empowered VT.

- Karen Hyden and Simeon Soffer, parents of Haley Hyden-Soffer.

3. When Joey Camisa was four-years-old, his mother, Judy, noticed that his right eye kept turning in. Worried, she took him to an eye doctor who diagnosed him with a lazy eye, or amblyopia. This condition is an eye problem that causes poor vision in children and begins when the pathways of vision in the brain don't grow strong enough. Joey met Dr. X and he recommended Vision Therapy, a one-on-one treatment to improve visual function, performance and quality of life. All without surgery, Joey underwent Vision Therapy for about six months, which included weekly visits and nightly therapy sessions with his parents. Today, Joey is 15-years-old and his poor vision is a thing of the past. Wearing regular prescription glasses, Joey is a good student and a talented saxophone player in a jazz band. He, along with his whole family, has routine eye exams and remains thankful for their positive experience.

- Judy (Joey Camisa Mother)

4. Ryan's concentration has increased greatly. He doesn't struggle with memorizing any more. He reads faster without having to close one eye, and he no longer gets frustrated when doing thinking tasks after getting trained and practice with VT.

- By Billie S. Jennings

5. The child, who was seven at the time, had just begun to have headaches. The event that called to our attention that our daughter needed help with her eyes, was that our daughter, following an eye check at school, came home and told me that she could not see anything on the eye chart out of her left eye. The health nurse sent home a card telling the results of the test. At this point we had her examined by our optometrist, who immediately referred us to a developmental optometrist (vision therapy specialist). Since Vision Therapy, my child can now SEE with BOTH eyes. When she started, one eye was 70% shut down giving only 30% vision in that eye. She has near normal vision now. She wears both contacts and glasses and is doing just great.
2.12 Co-operation of parents

Goransson et al., (1998) made an experimental study on the effects of intensified education of parents of children with strabismus and amblyopia on their understanding of the nature of the defect, how it originates and available clinical and non-clinical treatments. The control group parents were exposed to the ordinary information provided by the two departments of pediatric ophthalmology, while the experimental group parents, undergoing the same informations, were additionally asked to read a booklet aiming at enhancing their understanding of strabismus & amblyopia and its treatment. The two groups were thereafter interviewed about their understanding of the meaning of strabismus, amblyopia and its related aspects. Data were recorded in the form of semi-structured, single subject, in-depth interviews which were taped. Along with the interviews the parents also filled out a questionnaire assessing general and specific attitudes towards disease and treatment (Health Belief Model, HBM). The final outcome of the study reveals a superior understanding among parents in the experimental group.

According to Skellenger C, (1999) unfortunately a lay person may be unable to recognize a one-sided visual weakness without squint among little children. Even the clinical check-ups that all children should undergo which are entitled to have by law unfortunately could not pick up existing problems in every case. This is mainly due to two reasons, first is the parents were not making use of this services, and the second one is these examinations were not taking place in an ophthalmological practice, only from which the best prerequisites for identifying strabismus even in infants and small children were initiated. The care measures with eye examinations proposed on starting kindergarden also come a bit too late for very early onset strabismus. All parents are therefore urged to take advantage of all available medical check-ups and also to refer their children to the ophthalmologist before two years old.
2.13 Role of the teachers

According to Richard Bowman et al., (2001) Classroom teachers have proved that they can test children vision with a reasonable degree of accuracy in discovering gross visual defects when these tests cannot be given by a physician or nurse. The records of such tests with observation made in the classroom should be reviewed by the physician serving the school in order to determine which child should be sent to an eye specialist. It should be remembered, however that many abnormal eye conditions cannot or may not detect in periodic tests of visual acuity.

However, the other factors which affect a child's functional vision, that is, the ability to use eyesight in everyday situations, include his or her:

- Motivation for learning
- Access to an environment which encourages use of functional vision
- Access to materials and technology which aid functional vision
- Training in the use of functional vision

These observations should also be made during the school time. Therefore a teacher observation and encouragement is highly essential for the strabismic children to improve their functional vision skills.

Many times the teachers observations are of greater significance than the acuteness of vision are measured by the test. In addition to signs and symptoms of fatigue, the extent of the child’s power to concrete, to keep up with the class in reading ability, the teachers can suspect for the vision problem. To work without getting tired easily or acting irritable or inattentive and to play games requiring both distant, near vision without noticeable awkwardness may also serve as criteria in judging the effectiveness of the child’s visual apparatus.

Hence the role of responsibilities of the class teachers in general demands for identifying the problems of vision encountered by the children is of utmost importance.
2.14 Conclusion

The studies related to the present study found very limited in India. Hence the researcher presented both the studies conducted in abroad as well as in India in this chapter. The methodology of the study is presented in the third chapter.