CHAPTER – II

REVIEW OF RELATED LITERATURE

The study of relevant literature is an essential step to get a clear idea of what has been done, with regard to the problem under study. Such a review brings about a deep and clear perspective of the overall field. The reviews of literature are generally used as a basis for inductive reasoning for locating and synthesizing all the relevant literature on a particular topic.

The research for reference material is a time consuming but fruitful phase of the research program. A familiarity with the literature in any problem area helps the students to discover what is already known, what others have attempted to find out, what methods have been promising disappointing, and what problems remain to be solved.

The literature in any field forms the foundation upon which all future work will be built. A serious and scholarly attempt has been made by the scholar to go through the related literature and a brief review of the studies related to the present problem is described in this chapter.

2.2 Critical literature

2.2.1 Reviews related to vision training on Basketball

Ryu(2013) investigated the role of central and peripheral vision in expert decision making. A gaze-contingent display was used to selectively present information to the central and peripheral areas of the visual field while participants performed a
decision-making task. Eleven skilled and eleven less-skilled male basketball players watched video clips of basketball scenarios in three different viewing conditions: full-image control, moving window (central vision only), and moving mask (peripheral vision only). At the conclusion of each clip participants were required to decide whether it was more appropriate for the ball-carrier to pass the ball or to drive to the basket. The skilled players showed significantly higher response accuracy and faster response times compared with their lesser-skilled counterparts in all three viewing conditions, demonstrating superiority in information extraction that held irrespective of whether they were using central or peripheral vision. The gaze behaviour of the skilled players was less influenced by the gaze-contingent manipulations, suggesting they were better able to use the remaining information to sustain their normal gaze behaviour. The superior capacity of experts to interpret dynamic visual information is evident regardless of whether the visual information is presented across the whole visual field or selectively to either central or peripheral vision alone.

Uchida et al., (2013) evaluated the effects of changes in the video replay speed on the spatial visual search strategy and ability to predict free throw success. We compared eye movements made while observing a basketball free throw by novices and experienced basketball players. Correct response rates were close to chance (50%) at all video speeds for the novices. The correct response rate of experienced players was significantly above chance (and significantly above that of the novices) at the normal speed, but was not different from chance at both slow and fast speeds. Experienced players gazed more on the lower part of the player's body when viewing a normal speed video than the novices. The players likely detected critical visual information to predict shot success by properly moving their gaze according to the shooter's movements. This pattern did not change when the video speed was decreased, but changed when it was increased. These findings suggest that temporal information is important for predicting action outcomes and those such outcomes are sensitive to video speed.
Rita et al., (2007) examined whether basketball jump shooting relies on online visual (i.e. dorsal stream-mediated) control rather than motor preprogramming. Seventeen expert basketball players (eight males and nine females) performed jump shots under normal vision and in three conditions in which movement initiation was delayed by zero, one, or two seconds relative to viewing the basket. Shots were evaluated in terms of both outcome and execution measures. Even though most shots still landed near the basket in the basenese of vision, end point accuracy was significantly better under normal visual conditions, where players tended to undershoot the basket. In addition, an overall decrease of inter-joint coordination strength and stability was found as function of visual condition. Although these results do not exclude a role of motor pre-programming, they demonstrate that visual sensory information lays an important role in the continuos guidance of the basketball jump shot.

Quintana et al., (2007) designed to evaluate visual abilities such as distance visual acuity, binocular horizontal visual field, simple and choice visual reaction times, and stereoscopic vision in skilled 11- to 13-yr.-old basketball players participating in a 15-day summer training camp. On a test battery, visual abilities were monitored in 473 players of the Spanish Basketball Federation over a 5-yr. period. The players showed outstanding scores on distance visual acuity and stereoscopic vision, and good visual reaction times and horizontal visual fields. When scores were compared by sex and age, significant differences on certain visual measures were observed. Many players showed crossed eye-hand dominance. Visual screening programs may help promote visual health among junior basketball players and could be used for performance training. Using the basketball jump shot as experimental task Qudejans(2002) investigated
whether in dynamic tasks in which the target can be seen until ball release, continuous, instead of pre-programmed, motor control is possible. Tested this with the temporal occlusions paradigm: 10 experts shooters took shots under four viewing conditions, namely, no vision, full vision, early vision (vision occluded during the final 350 milliseconds before ball release), and late vision (vision occluded until the final 350 milliseconds). Late – vision shooting appeared to be as good as shooting with full vision while early vision performance was severely impaired. The results imply that the final shooting movements were controlled by continuous detection and use of visual information until ball release. The data further suggest that visual and movement control of aiming at a far target develop in close correspondence with the style of execution.

Sanderson and Whiting, (1974) found each of 30 Ss was given tests of dynamic and static visual acuity and then participated in a ball- catching task. Performance in the latter task was an inverted U-shaped function of duration of the occulted period, the time between the termination of the 80-msec. viewing period and the estimated onset of the “latency period” (the point in time at which the ball could no longer serve to cue Ss response). Dynamic and static visual acuity scores were not significantly correlated but, with static visual acuity pitiable out, dynamic visual acuity and catching performance were significantly correlated.

Bard and Fleury,(1976) found that expert basketball players had a tendency to make repeated sequence of fixation on a pair of offensive- defensive players, giving more importance to the opponent, whereas beginners ignored the defensive players rather fixating on their partners. Similarly in a study on the visual search of gymnastics judges attending to a film presenting a balance beam routine, bard, Fleury, Cairese, and
Halle, (1980) found a significant difference between the location of fixations of expert and novice judges. This difference rested in the notable number of fixations on the lower limbs of the gymnast by the novice judges, whereas the experts did not obtain these cues.

2.1.2 Vision Training Reviews on Soccer

Harpham et al., (2013) determined the relationship between traditional and visual sensory reaction time measures, and the association between visual and sensory performance and head impact severity in college football players. Thirty-eight collegiate football players participated in the study. We used real-time data collection instrumentation to record head impact biomechanics during games and practices. Our findings reveal no significant correlations between reaction time on traditional and visual sensory measures. We found a significant association between head impact severity and level of visual and sensory performance for multiple assessments, with low visual and sensory performers sustaining a higher number of severe head impacts. Our findings reveal a link between level of visual and sensory performance and head impact biomechanics. Future research will allow clinicians to have the most appropriate testing batteries to identify at-risk athletes and create interventions to decrease their risk of injurious head impacts.

Junior et al., (2009), investigated peripheral vision training (PVT) and its effect on attack runs during indoor soccer, taking into account dominant laterality (brain hemisphere function) in both learning speed and offensive skills. Ten beginner indoor soccer players aged 10.4 ± 2.31 years, from Lar da Criança Padre Franz Neumair, Ititioca, Niterói, Rio de Janeiro, Brazil, participated in the study. The boys were divided into an experimental group (EG, n = 5) and a control group (CG, n = 5) with similar dominant laterality (brain hemisphere function) (H) (EG: 80% left H and
20% right H, CG: 60% left H and 40% right H). The players underwent nine training sessions, followed by a championship, and then six additional sessions, followed by a second championship. Each championship was filmed for scout video analysis. Two-way ANOVA revealed a significant difference in peripheral vision during offensive runs between CG and EG, with marked acquisition of peripheral vision in EG. The quality of the attack runs was significant (two-way ANOVA). EG was the better team at the beginning of the attack runs and during attack development, whereas CG was better at attack finalization during the first championship. EG showed more competence in attack run finalization during the second championship. No significant difference in the number of goals scored was observed between the two groups (two-way ANOVA, p>0.05). The frequency of participation in the training sessions was significant (t-test for independent samples, p<0.05), with EG attending more sessions. In conclusion, EG acquired peripheral vision, a finding suggesting that PVT improves the attack capacity of indoor soccer players.

Zisi et al. (2003) made a dynamic analysis of the ground reaction forces developed on the supporting foot during instep kicking to investigate the relation between specific perceptual and motor abilities and the performance of this skill. 45 young soccer players (11-13 years of age) participated in a series of laboratory tests assessing simple, choice, and discrimination reaction time, sustained attention, depth perception, and sense of kinesthesia. Kicking performance measured by the amount of impulse (calculated as the integral of force) developed on the supporting foot during kicking. There was a significant correlation of the kicking impulse with choice reaction time (r = -.54) and attention reaction time (r = -.41). Stepwise regression analysis indicated that choice reaction time accounted for 29% of the variation in the anterior/posterior kicking impulse and 16.4% of the variation in the medio/lateral kicking impulse. The significant relation between kicking impulse and measures
Montes et al., (2001) investigated the eye-hand and eye-foot usual reaction time among young soccer players and to compare those with non-soccer players in order to evaluate possible differences. A vision screening of 53 young male soccer players belonging to the Valencia Soccer Club was done. Soccer players were divided in three categories, with mean ages of 8.2 +/- 0.5 years (range, 8 to 9 years old), 10.6 +/- 0.2 years (range, 10 to 11 years old), and 12.7 +/- 0.3 years (range, 12 to 13 years old). An age matched sample of 60 young male none-soccer players served as a control group population. Mean ages in this population were 8.3 +/- 0.6 years, 10.5 +/- 0.4 years, and 12.6 +/- 0.2 years of each categories, respectively. Eye-hand and eye-foot visual reaction times were determined in players and non-players by means of a computer-controlled stimuli device. We obtained a mean and standard deviation value (in seconds) of eye-hand reaction time in soccer players of 0.301 +/- 0.037, 0.256 +/- 0.40, and 0.282 +/- 0.043, respectively. The values for eye-foot reaction time in players were: 0.412 +/- 0.062, 0.406 +/- 0.046, and 0.387 +/- 0.034, respectively, for each category, and for non-players of 0.496 +/- 0.081, 0.460 +/- 0.026, and 0.446 +/- 0.054, respectively. There are statistically significant difference between eye-hand and eye-foot reaction times between players and non-players (p<0.05). There was no correlation between visual reaction times and age (p>0.05). Eye-hand and eye-foot visual reaction times were found to be difference between the two populations evaluated. The results show difference between soccer and non-players, with the soccer players demonstrating faster reaction times.
2.1.3 Vision Training Reviews on Volleyball

*Sumesh et al., (2014)* determined the purpose of this study the investigators randomly selected thirty two volleyball players(n=32) from school of physical education and sports science, Kannur University and B S E Volleyball club Alappey who were equally divided in to experimental group and control group(n=16). Their age ranged from 20 to 25 years. The experimental group got sports vision training according to training programme and each training session was for one hour and the total duration of the training programme was for six weeks. During this period, the control group was let off without any training. The effect of vision training on the serving ability was tested. The pre test was conducted on the experimental and control group. After six weeks of training post test was conducted. ‘T’ test was used to analyse the data. From the statistical analysis it is evident that in serving test item significant changes were noticed after training.

*Abd El et al., (2008)* determined to recognize the impact of the dominant eye training on both hand and foot speed response of dominant and non dominant hand and foot in volleyball players. The researcher use heuristic research sample consisted of one group of intentional (15) Player from physical education college students participating in the Minia University College team to play volleyball for the academic year 2008/2009, Application of Visual training programme proposed for the dominant eye for eight weeks, The results showed that visual training programme proposed for the dominant eye is having a positive impact on the hand and foot speed response (dominant/non dominant), although differences between percentages percentage improvement of hand and foot speed response (dominant/non dominant) For the dominant hand and foot. One of the most important recommendations The need for attention to Visual exercises for both dominant or non dominant eye in light of the nature and pattern of (Uncrossed, Crossed) domination for their impact on performance.
Abd El et al., (2009) determined to design sports vision Exercise and identifying its effects on the performance of the Libero player. Research hypotheses:

1. Training by using sports vision exercises Enhancing the performance level of the visual Skill under study for. the Libero player in volleyball.  
2. Training by using sports vision exercises positively affects the performance of the Libero player in volleyball.

Research Methodology: The researcher has utilized the experimental method using the one group system and adopting the way of pre and post measurement.  

Research sample: The research sample included the Libero player on Minia club (the basis of the group is only one player) , who is purposefully selected to do the Experimental program, representation trials of (30) trials in each position of the following once (1.6.5) as much as (10) trials for each position . the researcher analyzed (3) trials of each position , they are the best trials in which the athlete performed that is regarded as his best ones concerning the technical sides the possibility of analyzing the trial.  

Findings:  
1. Training by using sports vision exercises under study positively affects on the time division of performance paths in Serve Reception Skill 
2. Training by using sports vision exercises under study positively affects on the total time of performance paths, and positively affects on the speed of Motor performance by enhancement the point of move leg speed in pre- reception phase (the first step)
3. Training by using sports vision exercises positively affects the performance of the Libero player in volleyball.

Recommendations: 
1. Applying the sports vision exercises with the volleyball Libero player.  
2. Paying attention by efficient the role of sports vision exercises in volleyball field generally and in dig specially.
3. Paying attention to using vision exercises because of its effective and aiming impact on developing the level of defence performance, particularly in the main part of the daily season, and according to the suitability of the nature of this part's aims and requirements.
2.1.4 Vision Training Reviews On hockey

*Wimshurst et al., (2012)* conducted a study on Visual skills and playing positions of Olympic field hockey players. Many sports require fine spatiotemporal resolution for optimal performance. Previous studies have compared anticipatory skills and the decision-making process in athletes; however, there is little information on visual skills of elite athletes, particularly hockey players. To assess visual skills of Olympic hockey players and analyze differences by playing position, and to analyze improvement of visual skills after training, 21 Olympic field hockey players were pre- and post-tested on 11 visual tasks following a 10-wk. visual training program consisting of computer-based visual exercises. There were no mean differences at pre-test between players of different positions, suggesting that performance on these visual skills was independent of playing position. However, after training, an improvement was seen in all players (when scores were averaged across all 11 visual tasks) with goalkeepers improving significantly more.

*Schwab et al., (2012)* investigated whether a sports vision training program improves the visual performance of youth male field hockey players, ages 12 to 16 years, after an intervention of six weeks compared to a control group with no specific sports vision training. The choice reaction time task at the D2 board (Learning Task I), the functional field of view task (Learning Task II) and the multiple object tracking (MOT) task (Transfer Task) were assessed before and after the intervention and again six weeks after the second test. Analyzes showed significant differences between the two groups for the choice reaction time task at the D2 board and the functional field of view task, with significant improvements for the intervention group and none for the control group. For the transfer task, we could not find statistically significant improvements for either group. The results of this study are discussed in terms of
theoretical and practical implications. Key points Perceptual training with youth field hockey players Can a sports vision training program improve the visual performance of youth male field hockey players, ages 12 to 16 years, after an intervention of six weeks compared to a control group with no specific sports vision training? The intervention was performed in the "VisuLab" as DynamicEye(®) Sports Vision Training at the German Sport University Cologne. We ran a series of 3 two-factor univariate analysis of variance (ANOVA) with repeated measures on both within subject independent variables (group; measuring point) to examine the effects on central perception, peripheral perception and choice reaction time. The present study shows an improvement of certain visual abilities with the help of the sports vision training program.

Suresh Kumar (2011) examined the impact of sport vision training for enhancing selected visual skills and performance factors of novice Hockey players. To achieve the purpose of the study 30 novice Hockey players, age ranged between 17 and 22 years were selected. They were divided into experimental and control group randomly. The experimental group alone underwent the sports vision training programme for six weeks while the control group was not given any training. Prior to the administration of the test the investigator had a meeting with the subjects. The objectives and purpose of the test was made clear to the subjects so that they are aware of what they are expected to do. The selected variables and test items were speed of recognition & visual search in Tachistoscope test, eye –hand speed & eye-foot speed in visual reaction timer and Speed dribbling & Shooting accuracy in Henry-Friedal field Hockey. The paired 't' test was used to find out the difference between experimental and control group. The present findings supports that vision training has significant effect upon the speed of recognition & visual search that was measured through the test of Tachistoscope, eye hand speed and eye foot speed that was measured through the
test of Audio visual reaction timer and Speed dribbling & Shooting accuracy was measured through the Henry-Friedal field Hockey test for experimental group. The control group showed no significant improvement in speed of recognition & visual search, eye-hand speed, eye-foot speed, Speed dribbling and Shooting accuracy. Thus the hypothesis stated by the researcher was accepted. It clearly shows that vision training programme given to the players was effective and it can be improved by means of sincere practice.

**Martell and Vickers (2004)** tested whether the significant gaze that differentiates elite and non-elite athletes occurred either: early in the task and was of more rapid duration or late in the task and was of longer duration, A cognitive approach to visual search in sport, in, or whether a more complex gaze control strategy was used that consisted of both early and rapid fixations followed by a late fixation of long duration prior to the final execution. We tested this using a live defensive zone task in ice hockey. Results indicated that athletes temporally regulated their gaze using two different gaze control strategies. First, fixation/tracking (F/T) gaze early in the trial were significantly shorter than the final F/T and confirmed that the elite group fixated the tactical locations more rapidly than the non-elite on successful plays. And secondly, the final F/T prior to critical movement initiation (i.e. F/T-1) was significantly longer for both groups, averaging 30% of the final part of the phase and occurred as the athletes isolated a single object or location to end the play. The results imply that expertise in defensive tactics is defined by a cascade of F/T, which began with the athletes fixating or tracking specific locations for short durations at the beginning of the play, and concluded with a final gaze of long duration to a relatively stable target at the end. The results are discussed within the context of gaze research in open and closed skills, as well as theoretical models of long-term memory and decision making in sport.
2.2.1 Reviews Related Allied Literature

Hoshina (2013) found that visual functions might have some effects on the performance of baseball players. We measured static, kinetic, and dynamic visual acuity (SVA, KVA, and DVA, respectively) of Japanese professional baseball players to ascertain whether there would be any difference in SVA, KVA, and DVA among player groups stratified according to their performance level. The subjects were 102 male professional baseball players with a mean age of 26 years who were members of a Japanese professional baseball club from 2000 to 2009. They were stratified into three groups according to their performance level: A (players who were on the roster of the top-level team all the time throughout the study period), B (players who were on the roster of the top-level team sometimes but not all the time), and C (players who were never on the roster of the top-level team). They were interviewed for the use of corrective visual aids, and examined for SVA, KVA, and DVA. The measurements of these parameters were compared among groups A, B, and C. We also investigated and analyzed the association of KVA or DVA with player position (pitchers or fielders) and with hand dominance for batting. KVA was compared between the pitchers and the fielders because they each require different playing skills. DVA was compared between the right-handed and the left-handed batters. There was no statistically significant difference among groups A, B, and C. There was a statistically significant difference in KVA between the pitchers and the fielders (t-test; P < 0.05) There was no statistically significant difference in DVA between the right-handed and the left-handed batters. There was no significant difference in the examined visual functions among player groups with different performance levels.
Clark et al., (2012) conducted a study on High-Performance Vision Training Improves Batting Statistics for University of Cincinnati Baseball Players. Baseball requires an incredible amount of visual acuity and eye-hand coordination, especially for the batters. The learning objective of this work is to observe that traditional vision training as part of injury prevention or conditioning can be added to a team's training schedule to improve some performance parameters such as batting and hitting. All players for the 2010 to 2011 season underwent normal preseason physicals and baseline testing that is standard for the University of Cincinnati Athletics Department. Standard vision training exercises were implemented 6 weeks before the start of the season. Results are reported as compared to the 2009 to 2010 season. Pre season conditioning was followed by a maintenance program during the season of vision training. The University of Cincinnati team batting average increased from 0.251 in 2010 to 0.285 in 2011 and the slugging percentage increased by 0.033. The rest of the Big East's slugging percentage fell over that same time frame 0.082. This produces a difference of 0.115 with 95% confidence interval (0.024, 0.206). As with the batting average, the change for University of Cincinnati is significantly different from the rest of the Big East (p = 0.02). Essentially all batting parameters improved by 10% or more. Similar differences were seen when restricting the analysis to games within the Big East conference. Vision training can combine traditional and technological methodologies to train the athletes' eyes and improve batting. Vision training as part of conditioning or injury prevention can be applied and may improve batting performance in college baseball players. High performance vision training can be instituted in the pre-season and maintained throughout the season to improve batting parameters.
Erickson et al., (2011) evaluated the quality of visual performance skills in the most appropriate, accurate and repeatable manner. This study determines the reliability of the visual performance measures assessed with a computer-based system, known as the Nike Sensory Station. One hundred twenty five subjects (56 men, 69 women), age 18 to 30, completed phase 1 of the study. Subjects attended 2 sessions, separated by at least 1 week, in which identical protocols were followed. Subjects completed the following assessments: visual clarity, contrast sensitivity, depth perception, near far quickness, target capture, perception span, eye hand coordination, go, no go, and reaction time. An additional 36 subjects (20 men, 16 women), age 22 to 35, completed phase II of the study involving modifications to the equipment, instructions and protocols from phase I. results show no significant change in performance over time on assessment of visual clarity, contrast sensitivity, depth perception, target capture, perception span, and reaction time. Performance did improve over time for near far quickness, eye hand coordination, and go/no go. The results of this study show that many of the Nike Sensory Station assessments show repeatability and no learning effect over time. The measure that did improve across sessions show an expected learning effect caused by the motor response characteristics being measured.

Maman et al., (2011) conducted to see the efficacy of vision training so that it can be optimal for regular practice. Thirty healthy male university level tennis players aged 18-25 (21.6±2.23) years with normal vision participated in the study and were randomly allocated into three groups: Group I - experimental (n=10), Group II – control (n=10) & Group III - placebo (n=10). Pre-training readings for reaction time, depth perception, ocular motility (revised Hart chart), and accommodation (Hart chart) were measured for all groups. The experimental group underwent eight weeks of vision training three days a week for 30 minutes each. The placebo group was instructed to
watch televised tennis matches, while the control group was not given any training. At the end of eight weeks’ training, the pre-training evaluation protocol was repeated. Pre- and post-test results were obtained for reaction time, depth perception, accommodation, saccadic eye movements and tennis performance. The statistical analysis indicated significant improvement in all mentioned visual variables in the experimental group (p<0.001) and the placebo group (p<0.01), and non-significant results in the control group.

Biswas and Sandhu (2011) conducted a study on role of sports vision and eye hand coordination training in performance of table tennis players. Successful performance in interceptive tasks depends upon the acquisition of visual information about the approaching object. The present study therefore evaluated the effects of sports vision and eye hand coordination training on sensory and motor performance of table tennis players. 45 University level table tennis players were randomly divided into 3 equal groups of n=15. The experimental group underwent 8 weeks of sports vision and eye hand co-ordination training. The placebo group read articles pertaining to sports performance and watched televised table tennis matches, while the control group followed only routine practice sessions for 8 weeks. Measures of visual function and motor performance were obtained from all participants before and immediately after 8 weeks of training. Statistically significant pre to post training differences were evident by better improvement in visual variables and motor performance for the experimental group as compared to placebo and control. The present study therefore concluded that visual training program improves the basic visual skills, which in turn are transferable into sports specific performance.
Zimmerman et al., (2011) found building blocks of effective sports vision are visual acuity and contrast sensitivity. Proper measurement of these spatial vision attributes is necessary for repeatability in the clinic or in the laboratory. The most repeatable method of testing visual acuity is with logMAR charts—either the Bailey-Lovie chart or the Early Treatment Diabetic Retinopathy Study chart. The Pelli-Robson and the Mars are the most repeatable contrast sensitivity tests. Athletes may or may not demonstrate superior visual acuity and contrast sensitivity compared with age-matched non athlete populations, and the optical quality of their eyes may be similar. Dynamic visual acuity in athletes and their performance are typically superior to those of non athletes. How these differences relate to on-field performance is not known. Other changes to the visual system because of refractive surgery or contact lens wear may increase higher order aberrations and reduce low-contrast visual acuity. The ability to improve already-normal visual acuity is unclear although contrast sensitivity can improve with fast-paced video games. Tinted contact lenses help reduce discomfort glare and speed up adaptation but do not have an appreciable effect on visual acuity and contrast sensitivity. The use of valid and repeatable visual acuity and contrast sensitivity tests is essential for measuring the differences in visual performance among athletes and non athletes. The development of a standardized dynamic visual acuity test is needed as are well-controlled scientific studies to evaluate the benefits of sports vision training.

Kirschen and Laby (2011) found sports vision as an academic discipline is in its infancy. This review traces its history on many different fronts: early work, research, organizations, literature, cultural environment, sports injuries, and a view of the future. This article was presented as the opening remarks to the first-ever academic sports vision meeting held at Fen way Park in Boston, Massachusetts, in January 2010.
Ghasemi et al., (2011) compared visual skills of expert and novice athletes; referees' performance has not been addressed. Visual skills of two groups of expert referees, successful and unsuccessful in decision making, were compared. Using video clips of soccer matches to assess decision-making success of 41 national and international referees from 31 to 42 years of age, 10 top referees were selected as the Successful group and 10 as the Unsuccessful group. Visual tests included visual memory, visual reaction time, peripheral vision, recognition speed, saccadic eye movement, and facility of accommodation. The Successful group had better visual skills than the Unsuccessful group. Such visual skills enhance soccer referees' performance and may be recommended for young referees.

Schneiders et al., (2010) determined young male motor sport athletes from the New Zealand Elite Motor sport Academy and healthy age and sex-matched controls. Vision performance tests comprising; Static Visual Acuity (SVA), Dynamic Visual Acuity (DVA), Gaze Stabilization Test (GST), and the Perception Time Test (PTT). Motor sport athletes demonstrated superior visual acuity compared to age and sex-matched controls for all measures, and while this was not statistically significant for SVA, GST and DVA, it reached statistical significance for the PTT (p<0.05). This preliminary investigation into the visual ability of motor sport athletes demonstrated that they may have superior visual performance when compared to controls. Increased visual acuity and perception time may not only act to increase performance, but may also reduce the risk of potential injury. This study highlights the need for further research into the area of visual performance, particularly in motor sport and other high-speed sports, where such skills might be integral to performance and injury reduction.
Abernethy (2009) found the roles of clinical and experimental optometry in the improvement of sports performance are considered in the light of existing research knowledge in vision and sport. A parallel is drawn between the manner in which the human performer uses vision to control skilled movement and the operation of a high speed computer and a distinction is made between the reception and perception stages of visual information-processing. It is suggested that the reception of visual information is largely limited by the physical characteristics of the visual system (‘hardware’) and a role for the clinical optometrist is proposed in terms of ensuring that adequate levels of visual ‘hardware’ exist for athletes. It is further suggested that enhancement of visual ‘hardware’ beyond normal levels is unlikely to improve sports performance substantially as perceptual performance appears to be primarily limited by the strategies (‘software’) performers have developed with the unique processing demands of their particular sports. Some examples of ‘software’ differences between expert and novice performers are provided and the effectiveness of altering perceptual strategies as a means of enhancing sports performance is considered.

Gray (2009) conducted a study to find the influence of visual, auditory, and tactful information on baseball swing. Bat/ball contact produces visual (the ball leaving the bat), auditory (the "crack" of the bat), and tactile (bat vibration) feedback about the success of the swing. They used a batting simulation to investigate how college baseball players use visual, tactile, and auditory feedback. In Experiment 1, swing accuracy (i.e., the lateral separation between the point of contact and "sweet spot") was compared for no feedback (N), visual alone, auditory alone, and tactile alone. Swings were more accurate for all single-modality combinations as compared to no feedback, and visual produced the greatest accuracy. In Experiment 2, the congruency between visual, tactile, and auditory was varied so that in some trials, the different modalities
indicated that the simulated ball contacted the bat at different points. Results indicated that batters combined information but gave more weight to visual. Batting training manuals, which typically only discuss visual cues, should emphasize the importance of auditory and tactile feedback in baseball batting.

*Bressan (2003)* determined the effectiveness of three different approaches to improving sports performance through improvements in “sports vision”: (1) a visual skills training program, (2) traditional vision coaching sessions, and (3) a multi-disciplinary approach identified as sports vision dynamics. Seventy women (ages of 19-24) were matched on the basis of their netball passing skills and their performance on visual skills tests, in order to form four groups of similar abilities. The intervention programs were conducted in 30-minute sessions, twice a week for five consecutive weeks. Group 1 received vision dynamics; Group 2 received vision coaching; Group 3 received visual skills training; and Group 4 was the control group. All three groups receiving vision enhancement interventions achieved a significant increase in their netball passing speed. Subjects receiving vision dynamics and visual skills training also achieved a significant increase in their passing accuracy. The percentage of improvement in both speed and accuracy gains indicated that the vision dynamics programs produced much greater gains than either of the other two treatment programs. These results indicate that sports vision dynamics appear to be the most effective approach to helping players maximise their use of vision during sport performance. A new visual training program improves game skills in elite players, in team sports, vision is the undisputed king among the special senses. "Good eyes" are important for motor skills like catching a ball or contacting a ball with a bat, but they also contribute to the rapid succession of decisions that comprise tactical elements like player movement and shot selection in everything from table-tennis to soccer.
Wood and Abernethy (1997) conducted a study on an assessment of the efficacy of sports vision training programs. Thirty young subjects were assigned equally to visual training, reading (placebo), and control groups. Visual and motor tests were administered before and after 4 weeks of training or control activity to determine whether any improvements in performance had occurred. Significant improvements on some aspects of vision were apparent for the visual training group, but their improvements in both vision and motor performance were no greater than for either of the other groups. There was no evidence for visual training improving either visual or motor performance beyond levels due simply to test familiarity. The benefits of the visual training exercises commonly used by optometrists to enhance sports performance are therefore open to question.

Kirscher (1993) discussed on sports training procedures. Eye exercises have been designed to provide an opportunity for athletes to practice the visual skills essential to popular sports activities. These exercises, which may be used at home or in the office, emphasize visual recognition, motor coordination, and concentration. Home exercises that are commonly employed include the Brock string, flip-card exercises, and ball on a string (Marsden ball). Office exercises usually include the use of specialized equipment such as the tachistoscope and the saccadic fixator. Complicates such as plus and minus lenses, yolk prisms, and strobe lights may be employed to enhance concentration while performing the exercise.

Hitzeman and Beckerman (1993) discussed on sports vision. The demands on the visual system during athletic performance are among the most rigorous of any activity. Because vision influences the capacity of an athlete to perform the tasks of a sport, scientific research has been performed to investigate the link between skill and
vision. Most research efforts have been directed toward identifying the visual skills necessary for sports and determining if the skills of athletes differ from those of non-athletes. These efforts, though incomplete, have suggested that certain visual skills are important to performance in selected sports and that the visual skills of athletes and non-athletes do differ. There is as yet a paucity of research to support the hypothesis that the visual skills of athletes can be enhanced by visual training and that enhanced visual skills will result in improved athletic performance. Additional research efforts are needed to answer the many intriguing questions posed by the relationship between vision and sports.

Rouse et al., (1989) conducted using samples of non-athletic college students and college baseball players. The experimental population consisted of 17 male baseball players ranging in age from 19-24 years. The control population was made up of 25 male graduate students ranging in age from 23-29 years. Subjects reported the direction of a 20/25 "Landolt C" target exhibiting uniform angular motion produced by a projection system. Angular target velocities between 10 deg/sec and 110 deg/sec with an exposure time of 400 ms were used. The results showed a statistically significant difference between the two groups' DVA. The mean DVA for the baseball players was 82.35 deg/sec and 69.90 deg/sec for the control group.

Stine et al., (1982) reviewed on vision and sports. The basis for training visual abilities to enhance sports performance is explored. Optometric intervention in sports assumes the following statements to be true: 1. Athletes have better visual abilities than non-athletes and better athletes have better visual abilities than the poorer athletes, 2. Visual abilities are trainable, and 3. Visual training is transferable to the performance of the athlete. The literature demonstrates that athletes have better visual abilities than
non-athletes. Studies have shown this to be true in the following areas of vision: Larger extent of visual fields, larger fields of recognition (peripheral acuity), larger motion perception fields, lower amounts of heterophoria at near and far, more consistent simultaneous vision, more accurate depth perception, better dynamic visual acuity, and better ocular motilities. The literature also shows that all of the above skills are trainable. Two studies are cited that support the belief that visual training is transferable to athletic performance but they suffer from inadequate experimental design.

Brown (1972) found the relative contribution to dynamic visual acuity (DVA) of eye movement behaviour and peripheral acuity for moving targets has not been previously investigated. The present paper reports an experiment in which eye movements were measured while DVA was determined. Retinal target image position and velocity errors during ocular pursuit were derived from the eye movement data and were used in conjunction with data describing peripheral acuity for moving targets to derive DVA as a function of target angular velocity. There is good correspondence between the measured and derived values of DVA, indicating that position and velocity errors are the main determinants of DVA.

Bressan (2003) determined the effectiveness of three different approaches to improve sports performance through improvement in sports vision, a visual skill training program, traditional vision coaching session and a multi-disciplinary approach identified as sports vision dynamics. Women (ages of 19-24) were matched on the basis of their netball passing skill and their performance on visual skills test, in order to form four groups of similar abilities. In intervention programs were conducted in 30min sessions, twice a week for five consecutive weeks. Group 1 received vision dynamics, group 2 received vision coaching, group 3 received visual skills training and
group was control group. All these groups receiving vision enhancement intervention achieved a significant increase in their netball passing speed. Subjects receiving vision dynamics and visual skills training also achieved in significant increase their passing accuracy. The percentage of improvement in both speed and accuracy gains indicated that the vision dynamics program produced much greater games than either of the other two treatment programs. These results indicate that sports vision dynamics appear to be the most effective approach to help players maximize their use of vision during sports performance.

*Quevedo et al., (1999)* investigated the influence of specific visual training in shooting initiation performance. Seventy-one first-year university students were divided randomly into two groups. The experimental group followed a nine-session shooting training program that included technical, physical and psychological components, along with specific visual exercises. The control group followed the same program with one difference: this group received theoretical lectures on psychological training techniques instead of doing visual exercises. Pre- and post-test results were obtained for shooting, concentration, saccades and visual acuity. Statistical analysis indicated significant gains in the four mentioned variables for the experimental group. The control group also showed significant differences in the three first variables but no significant improvement in visual acuity. No significant differences in shooting performance were observed between groups. The effect of vision training on sports initiation performance is still not clear. It cannot be assumed that the improvement is transferable to the performance of precision shooting at the stage of sports initiation.
Tate et al., (1997) investigated the influence of specific visual training program on batting performance in cricket players. Thirty club level male cricket batsmen were randomly divided into three equal groups. The experimental group followed six weeks of visual training program, on alternate days. The placebo group was given simple reading material and watched televised cricket matches for six weeks' duration, while the control group followed routine cricket practice. Pre- and post- test results were obtained for reaction time, depth perception, accommodation, saccadic eye movements and batting performance. Statistical analysis indicated significant improvement in all mentioned visual variables and batting performance in the experimental group (p<0.001). The placebo (p<0.05) and control group (p<0.05) also showed some improvement in batting performance but no significant improvement in visual variables was observed (p>0.05). It can be concluded that the visual training program improves visual skills of cricketers, which could lead to improvement in the batting performance.

2.3 Summary of Review of related literature

The investigator collected critical reviews related to vision training methods in basketball and other games. The reviews helped the investigator to adopt a suitable methodology and further discuss the results with scientific approach.