Match! Finding the best lenses for sport part two

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Competencies covered:
Dispensing opticians: Communication and Refractive management
Optometrists: Communication, Assessment of visual function and Binocular vision

Part 2 The Dispensing

Describes how science informs and clinically justifies the dispensing, built around the specific needs of the individual athlete

The clinical importance of dispensing

Sport is an occupation and differs from other occupations only in the level of visual demand, which can be at its most extreme. Sport is also an important and diverse occupational consideration in ophthalmic optics. The principles of Sportvision argued in Part 1 confirm the clinical importance of dispensing and the need for optometrists and dispensing opticians to work closely together in the same practice.

Diagnosis of visual deficiency

On average, the competitive athlete's vision is no better than the rest of the population[13]. There is always a high percentage of visual deficiency amenable to correction, which varies from one sport to another. Athletes in those sports with a high visual demand will self select and athletes with visual problems will be lost to the elite population. Visual correction allows disadvantaged players to compete on level terms.

High visual demand sports might include downhill skiing, ice hockey, sailing, snooker and tennis. Other popular sports, like soccer and rugby, may not have such a high acuity demand, but require other qualities such as peripheral awareness, speed and endurance with a higher incidence of refractive error more likely. The overall visual demand of the sport will be an important determinant in the design of the Sports appliance and mode of correction and this needs a structured visual task analysis **(Table 1).**

Type of sport

Another dispensing criterion is the type of sport, this gives an indication of ocular hazard and the need for protection and the required strength of the frame. Sport can be broadly divided into two types, dynamic and controlled[14]. In reality, it is generally a mixture of the two in varying proportions **(Table 2)**.

The problem of denial

One of the biggest barriers to an effective optometric and dispensing solution is the problem of denial – athletes may want to feel that their sporting difficulties are due to anything but vision. Visual deficiency is still perceived as a sign of weakness posted by the stigma of spectacles. Unless the need for visual intervention is clearly demonstrated in relation to the subjects' own experience, advice will be only grudgingly accepted if at all. The effect of ophthalmic optical intervention could be profound visually

- Target size and distance
- Speed of target
- Speed of athlete
- Contrast of the target against its background
- Colour of target and background
- Ambient light levels (indoors or out)
- Position of luminaires, or the sun
- Environmental pollution
- Precipitation and wind speed
- Reflectivity of the playing surface and surrounds
- Environmental distracters (sound)
- Duration and energy demand of the period of competition

Table 1: Sporting visual task analysis

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This article has been approved for **1 CET point** by the **GOC**. It is open to all FBDO members, including associate member optometrists. The multiple-choice questions (MCQs) for this month's CET are **available online only**, to comply with the GOC's Good Practice Guidance for this type of CET. Insert your answers to the six MCQs online at **www.abdo.org.uk**. After log-in, go to 'CET Online'. Please ensure that your email address and GOC number are up-to-date. The pass mark is 60 per cent. The answers will appear in the June issue of *Dispensing Optics*.

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Figure 1: Retinoscopy

Dynamic	Control
Athletics	Archery
Soccer	Bowls
Yachting	Shooting
Squash	Darts
Hockey	Snooker

Table 2: Sport types

and psychologically and there needs to be a clear understanding of this on both sides. Without this understanding the eye examination is unlikely to proceed to a dispensing.

The diagnostic elements of sport vision performance

The visual principles proposed in Part one require visual performance to be broken down into its single elements (individual visual skills) to address any deficiency in the primary skills of Aiming and Anticipation (based on depth perception). Six diagnostic elements of visual performance and dynamic fixation[14] are proposed, which are common to all occupations including sport **(Table 3)**.

These elements of visual performance (some familiar some new) form the basis of the Sportvision screening battery of tests evolved to diagnose and demonstrate visually related

Figure 2: A logMAR chart

Figure 3: OMB chart

Test	Significance
Retinoscopy **(Figure 1)**	Looks for gross errors, anisometropia, astigmatism, demonstrates and allows an explanation of the importance of correction
High and low contrast logMAR vision **(Figure 2)**	Facilitates statistical analysis to give an accurate measure of changing and different performances. Demonstrates real life vision at low contrast and the possibility of reduced contrast sensitivity
Dominant eye	Ocular dominance can cause problems in aiming sports where an arrow is aimed at a target or a foot is aimed at a ball[9]
Objective muscle balance **(Figure 3)**	Muscle balance measure gives the athlete a better appreciation of binocular imbalance, which can be related directly to sporting deficit and refractive error
Brock string **(Figure 4)**	Measures fixation disparity in the sporting context. Raises underlying visual problems to a conscious level
The Eye Bright Test for colour preference and light sensitivity[15] **(Figure 5)**	Colour preference gives an indication of light sensitivity and the tint to be prescribed. Research in dyslexia, headaches and light sensitivity supports this measurement[16]
Dynamic fixation[14] **(Figure 6)**	Gives a measure of eye speed and tracking ability also an indication of innate skeletal muscle physiology (proportion of fast to slow twitch fibres)

Table 3: The diagnostic elements of sport visual performance

Figure 4: Using the Brock String

Figure 5: The Eye Bright Test

Figure 6: Measuring dynamic fixation

Continued overleaf

1. History and Symptoms 2. Dominance a. Type 1(R) b. Type 2 (left tendency) 3. Proportions of primary visual skills a. Aiming b. Anticipation 4. Type of sport a. Dynamic b. Control	5. Elements of visual performance a. Refractive error (retinoscopy) b. High and low contrast vision c. Eye dominance d. Muscle balance (Howel phoria) e. Fixation disparity f. Colour preference and light sensitivity (The Eye Bright Test) 6. Dynamic fixation (tracking and eye speed
7. Full eye examination	

Table 4: Protocol for investigating sporting visual deficiency

sporting deficiency. These tests demonstrate as well as measure the visual effects of, for example poor low contrast vision, a fixation disparity, or a strong colour preference and are an essential part of breaking down the barriers between practitioner and athlete.

When testing or justifying a dispensing in an individual athlete or team two things need to be achieved:

- Visual deficiencies likely to lead to sporting deficit need to be measured
- Any deficiency in one or more elements of visual performance needs to be related to sporting performance to justify to the athlete why vision and therefore correction is important

The primary sporting visual skills of aiming and anticipation (based on depth perception) and the diagnostic elements of vision (including dynamic fixation), form the basis for a protocol for investigating sporting visual deficiency. When the tests are used to screen a team of athletes they can justify clinically any optometric or dispensing intervention. In these circumstances where there is a sporting deficit amenable to correction it is much more likely that the athlete will accept dispensing advice. **Table 4** shows the protocol for investigating sporting deficiency.

Diagnostic tests

The diagnostic tests illustrate how data can be directly related to visual deficiency and well-understood dispensing measures. Deficiencies in any of the diagnostic elements of sporting visual performance each have their own dispensing implications.

Lenses

Vision and ametropia

Reduced LogMAR vision at high contrast combined with anomalous retinoscopy findings will have a direct effect on visual and therefore sporting performance and require refractive correction.

Muscle balance and sensory fusion

Poor muscle balance (objective muscle balance test) or sensory fusion (fixation disparity) will affect depth perception and possibly aiming, both critical factors in sporting performance. Prism correction and refractive error are used to solve these problems with or without contact lenses.

Low contrast vision

Greater than expected reduction in vision at low contrast is related to reduced contrast sensitivity. This can often be addressed by correcting any refractive error and cleaning protein off the contact lenses. The possibility of underlying pathology needs to be investigated.

Colour preference and light sensitivity

Colour preference gives an indication of light sensitivity. A yellow tint will enhance contrast where there are media opacities or there is mild amblyopia, by eliminating the veiling background haze and light scatter due to blue and ultraviolet radiation.

Figure 7: Generic sports frame *(Courtesy of Adidas)*

Preference for a blue tint and strong dislike of yellow is an indication of light sensitivity because yellow light (550nm is the peak sensitivity of the human visual system) is disturbing for light-sensitive athletes. They favour blue because blue filters absorb yellow light.

Lens transmission

Once it is accepted that visual information equates directly to sporting performance, everything should be done to maximise and maintain light transmission through the lens for example:

- Anti-reflection coatings
- Hard coat, sustains lens performance/transmission
- Hydrophobic and oleophobic coatings keeps lenses clean and water repellent
- Cleaning cloths and solutions to maintain transmission
- High index materials to keep lens thickness and weight down
- Aspheric lenses to minimise peripheral aberrations
- Trivex and polycarbonate materials to protect the globe cornea and adnexa from damage

Wrap lenses

One of the most important characteristics of the generic sport frame is its wrap-around construction **(Figure 7)**. The mechanical advantages of this type of frame in sport are:

Face form angle	Lens power	Sphere	Cylinder	Axis	Prism base
FF 0	Trial frame	+3.25	+0.75	155	0
FF 28	In wrap frame	+2.50	+1.25	168	1.5 in
FF 21	In wrap frame	+3.00	+1.00	163	1 in

Table 5: Change of dioptric power with changing face form angle *(Courtesy of r+h)*

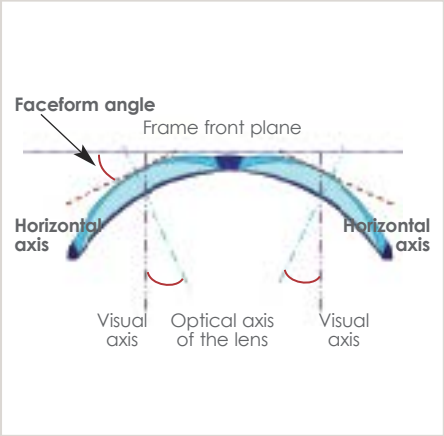

Figure 8: The face form angle *(Courtesy of r+h)*

Figure 9: Measurement of face form angle *(Courtesy of r+h)*

Figure 10: Face form angle gauge *Courtesy of Shamir)*

Figure 11: Well-fitting cyclist eyewear *(Courtesy of Norville)*

- Protection from side incident non-ionising radiation
- Protection from wind and foreign bodies
- Unrestricted peripheral field when glazed with high base curve sports lens
- Maximised protection when a small aperture clip lens insert is required

The power of these lenses has to be recalculated **(Table 5)** to take into account off axis viewing and changes in material thickness, which occur in larger wrap lenses.

Table 5 shows (FF 0) a typical refraction result, sphere, cyl and axis with no prism required. FF 28 shows how the prescription has to be re-calculated in a tightly wrapped frame, where a change in sphere, cyl, axis and prism is caused by increasing the face form angle. A smaller wrap FF 21 is shown for comparison.

Dispensing therefore requires this additional measure of face form angle **(Figures 8, 9 and 10)**.

The face form angle (horizontal inclination or dihedral angel) is measured with a special gauge available with instructions from the manufacturers It is important to take this measurement with the frame in situ as temple width can affect the angle of the front.

Sports frames

There is a large range of sports frames available from various manufacturers **(Table 6)**, some are specialised and easily recognisable like snooker specs, swimming goggles and shooting specs; others have more specialised features like ventilation, brow protection and spectral filters, but with a similar generic design.

The choice of appliance and mode of correction depends on the athlete and the sport. Manufacturers will give guidance on the application of the sport frame and filters, but the practitioner needs to design the ideal appliance around the athlete and then go to the list of available solutions to find the one that most closely matches the desired benefits.

Sports Vision is a bespoke, premium service, which aims to maximise every aspect of visual performance. This cannot generally be done with one-specification-fits all, the visual demands on the elite athlete do not fit comfortably with this model of eye care. **Figure 11** shows specialist fitting and adjustments in cycling and **Table 7** shows the features and benefits of modern Sports Vision appliances and lenses.

Contact lenses

Contact lenses are an important

Adidas	Nike
Norville(specialists and protective wear)	Zeiss (clay target shooting)
Rudy Project	Maui Jim
Inland	Academy Eyewear
Sport lens suppliers: Shamir, Rupp+Hubrach, Quincey eyewear	

Table 6: Sport frame suppliers

Impact resistant housing eg SPX (Silhouette) Polycarbonate, ocular Adjustable sides Adjustable bridge Inserts for higher power optical correction
Wrap construction Glaze with high base curve lenses Reduced spatial distortion in high base curve lenses. Increased peripheral awareness
Anti-fog Bridge and temple protection Head band Unit construction
Breakaway and quick release sides Pantoscopic adjustment Anti-reflection coating Scratch resistant Contrast enhancing tints Wrap protection over contact lenses Convenient
Positive physiological impact Protection for ocular adnexa Protection from blunt and penetrating ocular trauma
Prism control available Maintains tear layer stability High fashion, cosmetically attractive Light and immovable
Non ionising radiation protection Head wrap fit High grip silicone covered sides

Table 7: Features and benefits of modern Sport Vision appliances and lenses

Continued overleaf

Optometric	Dispensing
- No differential prismatic effect in different positions of gaze	- Tinted lenses to control UV and visible glare
- Correction of astigmatism and other eye aberrations	- Protection from non-ionising radiation
- Correction of muscle balance problems, due to the prescription (eg decompensated esophoria related to hyperopia, affecting depth judgement and timing)	- Do not steam up
- Correction of monocular problems which affect depth perception	- Reduced risk of facial trauma due to lens fragments or frame edges.
- Correction of small amounts of astigmatism with toric soft lenses, aspherics or RGP lenses to improve contrast sensitivity	- No disturbing movement when jogging
- Correction of low levels of myopia down to –0.25 (equivalent to –0.75 under correction based on the modal value for athletic groups[8]), which can be highly symptomatic.	- No problems with poor fit or frame slipping
- Correction of hyperopia in young athletes leading to decompensated esophoria	- Cosmesis
- Reduced off axis aberrations	- Full wrap protection from plano sunglasses over contact lenses
	- Increased peripheral awareness,wider field of view. No blind areas in field and by frame.
	- Reduced magnification effect
	- Reduced spatial distortion
	- Good vision in the rain

Table 8: Optical benefits of contact lenses in sport

mode of correction in sport and binocular visual development[18]. They have important optical properties **(Table 8)**.

Peripheral awareness

Perhaps the biggest advantage of contact lenses over a flat-front frame is peripheral awareness. If there is a risk of trauma a protective plano optical appliance in a wrap construction can be used to protect the eyes without reducing peripheral awareness.

Magnification

The magnification effect of an optical correction is minimised by contact lenses, but someone who is habituated to the use of spectacles will find it very difficult to adjust to contact lenses in the short term when fine judgements of depth are required. For instance, in table tennis, the timing of a top-spin smash relies critically on the distance of the bat from the ball. A discrepancy probably of half a millimetre can have a dramatic effect on the timing. In optics, colleagues will be familiar with patients who have got used to inaccurately centred lenses, negative face form angle and twisted frames who may complain when the appropriate corrections are made according to best theory. Reality is, in effect, what the brain has got used to.

Prism

The essential difference in terms of prismatic effect between contact lenses and spectacles is that contact lenses move with the eye.

With spectacles, because the lens is fixed in front of the eye, any deviation of the eye from the optical axis of the spectacle lens will induce a prismatic effect. Even if the power of the two lenses is the same, when an athlete looks to the right in a pair of minus lenses and the induced base out prism in the right lens is balanced by base in prism in the left eye, the image will be progressively displaced as the amount of version increases.

The effect on the visual system is to continually change the relationship between the position of the object in space and the amount of version movement that is required to see it. This effect will be greater in higher power lenses and anisometropia even without any consideration of other aberrations as the visual axis moves away from the optical centre. Similar considerations occur with divergence and convergence. Inevitably, these subtle adjustments to binocular co-ordination will increase the delay before the eyes settle to maximise stereopsis.

Conclusion

The most popular modes of correction are contact lenses and spectacles, (orthokeratology and laser correction are beyond the scope of this article) and the decision to fit either is based on the clinical judgement of the practitioner. Effective dispensing requires knowledge of the pros and cons of each type and often the best solution will be a combination of both.

The relationship between vision and sporting performance has been underestimated and not fully understood. The principles of Sportvision and consideration of dominance type give a better understanding of the visual requirements of each athlete. This helps to identify and quantify the key visual tasks in each sport, which is an essential precursor to the successful sports dispensing

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