Sports Vision:
What is the connection between sports and vision?

Gabriëlle Janssen, optometrist
Gabriëlle Janssen, optometrist

- Fellow of the American Association of Optometry
- Bachelor Business Administration
- Sports Vision (AJAX)
- Contact lenses
- Pre- en postoperative management of cornea transplants
- Lecturer optometry
- Medical Advisor NGO Eye Care Foundation
- Board Member of the Dutch Optometry Association
Sports performance

- Biomechanical factors
- Strength
- Condition
- Visual factors
- Cognitive factors
- Etc. Etc.
Sports performance

- Biomechanical factors
- Strength
- Condition
- **Visual factors**
- Cognitive factors
- Etc. Etc.
The ocular and visual characteristics of an athletic population
Beckerman SA and Hitzeman S. Optometry 2001; 72:8 498-509

1. 25% of athletes competing at a high level had never a complete eye examination
2. 29% had visual symptoms
3. 28% had less than 20/25 or 0,8 visual acuity
4. Protection eye wear was not often used
Screening ADO Den Haag 2010

- Visual Acuity
- Binocular vision
- Color Vision
- Dominance
- Contrast Sensitivity
- Eye-Hand coordination
- Eye-Feet coordination
- Accommodation-vergence
Wat is Sports Vision?

1. Detection of visual problems
2. Optimizing visual acuity
3. Improvement of visual skills
4. Protection and Prevention
Perceptual Mechanism

A. Visual resolution (VA, CSF, DVA)

B. Depth perception (Stereopsis, Vergence)

C. Eye movements (Saccades, Visual pursuits)

D. Peripheral vision
1. Detection of visual imperfections
<table>
<thead>
<tr>
<th>Sport</th>
<th>Importance +</th>
<th>Importance -</th>
</tr>
</thead>
</table>
| Hockey | Visual Acuity  
Dynamic visual acuity  
Visual persuits  
Eye-hand coordination  
Depth perception  
Reaction time  
Peripheral vision |  |
| Running | Peripheral visual acuity | Visual Acuity  
Dynamic visual acuity  
Visual persuits  
Eye-hand coordination  
Depth perception  
Reaction time  
Peripheral vision |  |
| Golf | Visual Acuity  
Visual persuits  
Eye-hand coordination  
Depth perception | Reaction time  
Peripheral vision  
Dynamic visual acuity |  |
• Alignment of the preferred leg

• Professional: less eye movements
  • Professional: head and legs
  • Non-Professional: arms, chest and legs

• Professional starts later
2. Optimizing visual acuity

1. Glasses

2. **Contactlenses**: soft or RGP, orthokeratology

3. **Refractive Surgery**: Lasek, Lasik or implant lenses
Glasses

+• Stable vision
  • Can give some protection

-• Fog up
  • Splattered by rain or perspiration
  • Limited peripheral vision
  • Can cause extra trauma
Soft contact lenses

+ • Peripheral vision
  • No fog up
  • Comfortable
  • Day lenses are preferred to reduce the risk of complications

- • May dry out
  • Not always stable vision
  • Risk of dislocation
  • Not always full correction
RGP

+ 
  + Peripheral vision
  + No fog up
  + Low risk of complications

- 
  - May dry out
  - High risk for corpus alienum
  - May get lost
  - Not always stable vision
  - Risk of dislocation
  - Not very comfortable
Orthokeratology

<-4 dpt

+ 

• Peripheral vision
• Reversible
• Feels like no ametropia
• Stable vision during the day

- 

• It takes some weeks to obtain good visual acuity
• Risk of glare and halo’s
• Limited correction
• Risk of complications because of night wear
### Incidence non-severe and severe Microbial Keratitis per 10,000 contact lens wearers a year

<table>
<thead>
<tr>
<th>Material</th>
<th>Non-severe keratitis</th>
<th>Severe keratitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>DW RGP</td>
<td>5.7</td>
<td>2.9</td>
</tr>
<tr>
<td>DW hydrogel</td>
<td>9.1</td>
<td>6.4</td>
</tr>
<tr>
<td>DW Silicone hydrogel</td>
<td>55.9</td>
<td>0.0</td>
</tr>
<tr>
<td>EW hydrogel</td>
<td>48.2</td>
<td>96.4</td>
</tr>
<tr>
<td>EW silicone hydrogel</td>
<td>98.8</td>
<td>19.4</td>
</tr>
</tbody>
</table>

Morgan PB, Efron N, Incidence of keratitis of varying severity among contact lens wearers, 2005
Lasek
+2 dpt - -6 dpt

+

- Peripheral vision
- Greater confidence in vision
- Less worry about eye problems and fluctuating vision
- No concerns about glasses or contact lenses
- Feels like ametropia
- Less risk of complications than Lasik, implant lenses, etc

- Reduced contrast sensitivity
- Risk of glare and halo’s
- Irreversible
LASIK
+3 dpt - -8 dpt

+  
-  

• Peripheral vision
• Greater confidence in vision
• No concerns about glasses or contact lenses
• Feels like ametropia

• Reduced contrast sensitivity
• Risk of glare and halo’s
• Dry eyes
• Irreversible
• Risk of complications: flap dislocation
Phakic Implantlens
+10 dpt - -20 dpt

+  
-  

• Peripheral vision
• Greater confidence in vision
• No concerns about glasses or contact lenses
• Feels like ametropia
• No reduction of contrast sensitivity

• Risk of complication
• After Phakic implantlens hockey with eye protection advisable
3. Improvement of visual skills
Visual skills and playing positions of Olympic field hockey players.

Wimshurst ZI, Sowden PT, Cardinale M.

Author information

Abstract
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 than any other position. This suggests the possibility of improving visual skills even in an elite population.

PMID: 22582689 [PubMed - indexed for MEDLINE]
Improvement?

• Some visual skills can be improved
• Visual skills – improvement performance ≠ absolute identification
• Need of more evidence based research
4. Protection and prevention
# Epidemiology

## Table 1. Categories of Sports Eye-Injury Risk to the Unprotected Player*

<table>
<thead>
<tr>
<th>High Risk</th>
<th>Moderate Risk</th>
<th>Low Risk</th>
<th>Eye Safe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small, fast projectiles</td>
<td>Tennis</td>
<td>Swimming</td>
<td>Track and field†</td>
</tr>
<tr>
<td>Air rifle</td>
<td>Badminton</td>
<td>Diving</td>
<td>Gymnastics</td>
</tr>
<tr>
<td>BB gun</td>
<td>Soccer</td>
<td>Skiing (snow and water)</td>
<td></td>
</tr>
<tr>
<td>Paintball</td>
<td>Volleyball</td>
<td>Noncontact martial arts</td>
<td></td>
</tr>
<tr>
<td>Hard projectiles, sticks, close contact</td>
<td>Water polo</td>
<td>Wrestling</td>
<td></td>
</tr>
<tr>
<td>Basketball</td>
<td>Football</td>
<td>Bicycling</td>
<td></td>
</tr>
<tr>
<td>Baseball/softball</td>
<td>Fishing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cricket</td>
<td>Golf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lacrosse (men’s and women’s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hockey (field and ice)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squash</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Racquetball</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fencing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intentional injury</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boxing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-contact martial arts</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


†Javelin and discus have a small but definite potential for injury. However, good field supervision can reduce the extremely low risk injury to near negligible.
Aye for an eye?
Gary Brown, ncca.org

- 25% of the injuries are to the head or face
  - Eyelid laceration
  - Corneal abrasion
  - Orbital fractures
  - Conjunctiva
  - Other
Open & Closed bulbus

The Mechanisms and Prevention of Sports Eye Injuries
Paul F. Vinger, M.D.
<table>
<thead>
<tr>
<th><strong>Sport</strong></th>
<th><strong>Minimal Eye Protector</strong></th>
<th><strong>Comment</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseball/softball (youth batter and base runner)</td>
<td>ASTM F910*</td>
<td>Face guard attached to helmet</td>
</tr>
<tr>
<td>Baseball/softball (fielder)</td>
<td>ASTM F803 for baseball*</td>
<td>ASTM specifies age ranges</td>
</tr>
<tr>
<td>Basketball</td>
<td>ASTM F803 for basketball*</td>
<td>ASTM specifies age ranges</td>
</tr>
<tr>
<td>Bicycling</td>
<td>Helmet plus streetwear/fashion eyewear</td>
<td></td>
</tr>
<tr>
<td>Boxing</td>
<td>None available; not permitted in sport</td>
<td></td>
</tr>
<tr>
<td>Fencing</td>
<td>Protector with neck bib</td>
<td></td>
</tr>
<tr>
<td>Field hockey (men’s and women’s)</td>
<td>ASTM F803 for women’s lacrosse,* goalie, full-face mask</td>
<td>Protectors that pass for women’s lacrosse also pass for field hockey</td>
</tr>
<tr>
<td>Football</td>
<td>Polycarbonate eye shield attached to helmet-mounted wire face mask</td>
<td></td>
</tr>
<tr>
<td>Full-contact martial arts</td>
<td>None available; not permitted in sport</td>
<td>Contraindicated for functionally one-eyed athletes</td>
</tr>
<tr>
<td>Ice hockey</td>
<td>ASTM F513 face mask on helmet,* goaltenders, ASTM F1587*</td>
<td>HECC or CSA certified; full-face shield</td>
</tr>
<tr>
<td>Lacrosse (men’s)</td>
<td>Face mask attached to lacrosse helmet</td>
<td></td>
</tr>
<tr>
<td>Lacrosse (women’s)</td>
<td>ASTM F803 for women’s lacrosse*</td>
<td>Should have option to wear helmet</td>
</tr>
<tr>
<td>Paintball</td>
<td>ASTM F1776 for paintball*</td>
<td></td>
</tr>
<tr>
<td>Racquet sports (badminton, tennis, paddle tennis, handball, squash, and racquetball)</td>
<td>ASTM F803 for selected sport*</td>
<td></td>
</tr>
<tr>
<td>Soccer</td>
<td>ASTM F803 for selected sport*</td>
<td></td>
</tr>
<tr>
<td>Street hockey</td>
<td>ASTM F513 face mask on helmet*</td>
<td>Must be HECC or CSA certified</td>
</tr>
<tr>
<td>Track and field</td>
<td>Streetwear with polycarbonate lenses/fashion eyewear†</td>
<td></td>
</tr>
<tr>
<td>Water polo/swimming</td>
<td>Swim goggles with polycarbonate lenses</td>
<td></td>
</tr>
<tr>
<td>Wrestling</td>
<td>No standard available</td>
<td>Custom protective eyewear can be made</td>
</tr>
</tbody>
</table>

Prevention

A. Polycarbonate ASTM F803
B. Mineral
C. Allyl Resin Plastic
D. High-Index Plastic
Summary

• High number of athletes never had an eye examination

• In hockey: visual acuity, visual pursuits, eye-hand coordination, depth perception, reaction time and peripheral vision are important

• Preferred correction: soft contact lenses, orthokeratology or Lasek

• Playing hockey causes a high risk for ocular trauma
Conclusion

- Eye examination can improve sport results

- Superior visual skills are of little consequence compared with the cognitive processing of the visual information

- No evidence based results for enhancement of visual skills in sports (behavioral optometry)
Recommendation