Vision and falls research: the story so far

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Vision and falls research: the story so far

- Vision, refractive error & spectacle correction, eye disease and surgery, two eyes
- Vision and its correction and falls
  - Epidemiological studies
  - Lab based studies
  - Intervention trials
- Cataract surgery and falls
  - Past and current research
- Optometrists and ophthalmologists role in falls prevention
Key definitions

The landscape of "vision" is complex – how well somebody sees visual acuity (VA) or...

Refractive error and its correction – glasses

Distance and near

Bifocals and multifocals

Eye disease – reduces vision

Cataract surgery affects vision and refractive error, and changes refractive correction – 2 eyes

Key definitions
Refractive error

- Refractive errors affect ~1/5 of persons 40 years or older in Australians\(^1\)
- Approx 300,000 Australians may have visual impairment due to refractive error
- ~17% prevalence of myopia in Australia\(^2\)

\(^1\)The Eye Diseases Prevalence Research Group Arch Ophthalmol. 2004;122:495-505
Types of spectacle lenses

- Single vision lenses
  - sphere, astigmatism
- Bifocal
- Trifocal
- Progressive / multifocal / varifocal
Spectacle lenses and magnification

- Myopic correction minifies
- Hyperopic correction magnifies
- Alters the view of the world
Spectacles and Visual Distortion

Distortion of the image:
Every 1D difference causes 2% change in image size
Vision and falls

- Vision used to spot hazards and obstacles around us and negotiate steps.
- Vision also used in balance control. Standing with eyes closed, for example, increases sway up to 70%.
Vision & refractive correction and falls: the evidence

- Epidemiological studies
- Clinic studies
- Lab-based studies
- Intervention trials
Vision and falls
Epidemiological studies

- Visual acuity is a major risk factor for falls (mean odds ratio or OR of ~ 2.5).
- Other aspects of vision (e.g. visual fields, contrast sensitivity, depth perception) may be even more important.

Rubinstein, 2006; Age & Aging.
Ivers et al., 2000; Am J Epidemiol.
Freeman et al. 2007; Invest Ophthalmol Vis Sci.
Clinic studies

- UK geriatric clinic study.
- 51% of fallers had visual impairment (VI).
- 79% of this VI was correctable: 40% refractive error, 39% cataract.
- 60% had not had an eye exam in the last 3 years.

Jack et al., 1995; Gerontology
Bradford vision & mobility lab

- Prof David B Elliott
- Optometry, Medical Engineering and Health Studies staff.
- Two AMTI forceplates.
- 8 - camera Vicon assessment system.
- Balance control and stepping up or down with refractive blur, cataract and multifocals.
Lab-based studies: reduced vision from refractive & cataract blur

- Refractive blur decreases standing balance control.
- With cataract: slow down and increase toe clearance
- This increases single support time and increases M-L instability.
- Elderly people particularly suffer from ‘sideways’ falls.

Anand et al., 2003; Invest Ophthalmol Vis Sci.
Heasley et al., 2004; Invest Ophthalmol Vis Sci.
Buckley et al., 2005; Gait & Posture.
Does visual impairment cause falls? (Can we correct visual impairment?)

- Epidemiological studies; clinical studies and lab. based studies – all “YES”.

- Bilateral visual impairment \((VA<6/12)\) up to 30% in older population in the UK.

- 50-75% of this appears to be correctable by updating spectacles and cataract surgery.
Epidemiological studies: Multifocals and bifocals

- Reading area of multifocals blurs (and magnifies) steps etc.
- Other problems of ‘jump’, double vision, peripheral distortions.
- Multifocal wearers over twice as likely to fall.
- Involved in more edge-of-step accidents.

Lord et al., 2002; J Am Geriatr Soc
Davies et al., 2001; Safety Science.
Lab. studies: Multifocals

- No increased toe clearance.
- Multifocals increase step hits and reduce precision of toe clearance and foot placement.
- Less control when stepping down.
- Single vision lenses improve all these factors in adapted multifocal wearers.

Johnson et al., 2007; Invest Ophthalmol Vis Sci.
Johnson et al., 2008; J Am Geriat Soc.
Timmis et al., 2010; Invest Ophthalmol Vis Sci.
Intervention trials

Surprisingly limited improvements.

One study showed improvement only when combined with exercise; two cataract surgery studies show good improvement in falls rate, but two others show no significant improvement.

Why?

- Day et al., 2002; Br Med J
- Brannan et al., 2003; Br J Ophthalmol
- Harwood et al., 2005; Br J Ophthalmol
- McGwin et al., 2006; J Am Geriat Soc
- Foss et al., 2006; Age & aging
Optometric intervention study (~300 intervention and 300 control).
Found *increased* falls rate in study group!
Likely due to adaptation problems.
Full prescription given in all cases.
The study did not control for spectacle type (control group had more single vision lens wearers, intervention group more multifocal wearers).
Adaptation problems

- Why; if vision is better?
- Magnification effects can make:
  - Steps look bigger or smaller.
  - Steps look closer or further away.

Spectacle magnification effects
Spectacle magnification effects
Recommendations for optometrists

- Avoid large changes of refractive correction
- Elderly ‘at risk’ single vision lens wearers must not be swapped into multifocals.
- Regular multifocal wearers who subsequently fall into an ‘at risk’ group, should be advised distance SV lenses when walking outside (BUT only if they regularly go outside) and multifocal lenses for other tasks such as watching TV, shopping, driving etc.

Haran et al. (2010). Br Med J
Cataract surgery intervention studies

- UK RCT into cataract surgery & falls
- Reduction in falls rate with first eye surgery:
  rate ratio 0.66 (CI 0.45 – 0.96)
- Not with second eye surgery:
  rate ratio 0.68 (CI 0.39 – 1.19)

Harwood et al 2005
WA hospital linkage data

- 15,000 cataract surgeries
- Linked hospitalisation data
- Did not reduce risk of falls requiring hospitalisation
  Meuleners et al 2012
- Second analysis showed falls risk highest between first and second eye cataract surgery
  Meuleners et al 2013
Monet post-cataract surgery (1922)

RE: +10.00/-4.00x90  6/18

“The distortion and exaggerated colours that I see are quite terrifying. As for going for a walk in these spectacles, it’s out of the question for the moment”

(Letter to G. Clemenceau, 30th August 1923)
Binocularity and stereopsis

Relative disparity = α - β
Loss of depth perception
Falls and binocularity

- 40% of population attributable risk for hip fracture due to poor visual acuity or stereopsis
  Ivers et al 2000
- Older persons with poor stereopsis increased falls risk
  Cummings et al 1995
  Nevitt et al 1989
Recommendations for ophthalmologists

- Perform cataract surgery to improve vision and reduce falls risk
- Minimise the time between first and second eye cataract surgery
- Consider the refractive impact of cataract and cataract surgery on timing of surgeries
- However, the evidence is limited at this time
Current research

- NHMRC Project Grant 1048302
- Falls risk associated with cataract and after first and second eye cataract surgery
- Keay, Meuleners, Pesudovs, McCluskey, Boufous, Ng, Morlet, Stapleton
- $775,261.89 (2013-2015)
The FOCUS Study

- Falls in Older people with Cataract, a longitudinal evaluation of impact and risk
- Prospective, 24 month, cohort study
- N=717, 5 sites, 3 states
- Systematically investigate falls and falls-related injury in older people with cataract

The FOCUS Study

- Separate effects of first and second eye cataract surgery
- Type and timing of refractive correction
- Vision
- Risk factors
- Depression, community participation, mobility and quality of life
- Current recruitment 68/717
The role of vision in falls is complex.

Visual impairment and wearing multifocals are significant risk factors for falls.

Reducing visual impairment helps.

Optometrists can help by careful prescribing in frail, older patients.

Ophthalmologists can help by reducing time between cataract surgery.

More research is required.
Thank you for your attention

Any questions?