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



Refractive error

 Refractive errors affect ~1/5 of persons 40 years or older in Australians¹
 Approx 300,000 Australians may have visual impairment due to refractive error

~17% prevalence of myopia in Australia²

¹The Eye Diseases Prevalence Research Group *Arch Ophthalmol*. 2004;122:495-505 ²Wensor et al *Arch. Ophthalmol*.1999;117:658–63.

Vision impairment due to uncorrected refractive error by age cohort. Estimated numbers, Australia 2004.





Types of spectacle lenses

Single vision lenses sphere, astigmatism
 Bifocal
 Trifocal
 Progressive / multifocal / varifocal





Imaging properties: Cosmetic properties:

The bound of the b





Spectacle lenses and magnification

Myopic 1 correction minifies **Hyperopic** correction magnifies Alters the view of the world



Spectacles and Visual Distortion

Normal

Distortion of the image: Every 1D difference causes 2% change in image size Barrel- hyperopia

Pin cushion- myopia

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%.

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Vision & refractive correction and falls: the evidence

Epidemiological studies

Clinic studies

Lab-based studies

Intervention trials



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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.*

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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

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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.

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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.

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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 Ophthalomol 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

Cumming et al. (2007) J Am Geriat Soc

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).

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Adaptation problems

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



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Elliott & Chapman (2010). Invest Ophthalmol Vis Sci

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

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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

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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, its out of the question for the moment"

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

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Binocularity and stereopsis



Relative disparity = $\alpha - \beta$



Loss of depth perception

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Falls and binocularity

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

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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 evaUation of impact and riSk

Prospective, 24 month, cohort study
 N=717, 5 sites, 3 states

Systematically investigate falls and fallsrelated injury in older people with

cataract

Keay L, Palagyi A, McCluskey P, Lamoureux E, Pesudovs K, Lo S, Ivers R, Boufous S, Morlet N, Ng J, Stapleton F, Fraser M, Meuleners L. Falls in Older people with Cataract, a longitudinal evalUation of impact and riSk: the FOCUS study protocol. *Inj Prev* 2014 Jan 15 [Epub ahead of print]

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

Summary



 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?





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