Visual Functions and Spectacle Usage in Elderly Patients Sustaining A Simple Fall

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Abstract :

Aim : The aim was to study visual functions and spectacle usage in elderly patients sustaining a simple fall. Objectives were to study (i) the compromise in binocular visual acuity, contrast sensitivity, binocular visual fields and stereopsis (ii) the frequency of use and type of spectacles (iii) association of visual functions and spectacle use with simple fall

Methods : This was a prospective cross-sectional observational study of a one-year study duration (July 2018-July 2019). Consecutive patients above 60 years of age presenting to Ophthalmology OPD for refraction were recruited. History of experiencing a simple fall in the previous six months, duration since their last ophthalmology consultation and details regarding spectacle used was taken. Binocular visual acuity, contrast sensitivity, distance stereopsis, and Esterman binocular field were assessed. These factors were then analysed to study any association with history of simple fall.

Result : Out of 399 patients enrolled in the study, 229 (57.4%) were females and 170 (42.6%) males. The mean age of the patient was 65±3 years (61-78 years. 274 (68.4%) patients presented with visual acuity of less than 6/18. 128 (32.1%) patients were not using any glasses and 221 (55.4%) patients had not taken ophthalmology consultation in the previous two years. History of simple fall was given by 110 (27.6) patients. Patients with reduced distance stereopsis (p=0.00 CI 1.389-3.408), depressed binocular visual fields (p=0.01 CI 1.116-2.736), more than two years since last ophthalmology consultation (p=00 CI 1.83-4.81) and without glasses (p=0.00 CI 1.508-3.757) were more likely to have experienced simple fall in previous six months.

Conclusion : More than 50% of the elderly in the present study suffered from visual impairment, reduced stereopsis and depressed binocular visual fields and approximately one-third of them sustained falls in the previous six months. Elderly patients without spectacle correction, impaired contrast sensitivity, and depressed binocular fields were more likely to experience a simple fall.

Introduction :

It is well documented that poor vision is an important risk factor in falls caused by postural instability and that impaired vision is highly prevalent and commonly unreported in the elderly population, particularly women.[1,2,3,4] Reduced contrast sensitivity, stereopsis, use of multifocal glasses and visual field loss are other important risk factors contributing to falls.[5,6,7,8] Falls and associated fractures are an important cause of morbidity and mortality in the elderly. A study highlighted the association of potentially treatable visual impairment and fractures in elderly population. The authors also concluded that a lack of provision of ophthalmic services may be cause of fracture associated with fall in elderly.[9]

According to population estimates, India is home to more than 100 million elderly (above 60 years) and this figure is expected to treble by 2050.[10] With numerous studies pointing to association between impaired visual functions and falls among elderly, there is a paucity of such studies in elderly Indian population. Furthermore, with pressing shortage of ophthalmic care, unrecognised visual impairment is not uncommon in India.[11] The present study thus aims to study visual functions and assess the presence of visual impairment and spectacle use among elderly sustaining simple fall in the previous six months.

Methodology :

Consecutive patients presenting to Ophthalmology out-patient department (OPD) for refraction were screened. Patients above 60 years of age were identified and enrolled in the study after taking their informed consent. All the participants were enquired if they had experienced any 'simple fall' in the previous six months. A simple fall was defined as any fall due to tripping, slipping, colliding against an obstacle or stepping on an uneven surface. Any fall from height, following road traffic accidents, fights or brawls and under the influence of alcohol was excluded. All the study participants were also enquired about the time since their last ophthalmic consultation. Previous medical records were screened to ascertain the time since last ophthalmic consultation. Binocular visual acuity (VA) and contrast sensitivity assessment was done using Snellen and Pelli-Robson's charts respectively. Visual acuity assessment using spectacles was done for patients who had spectacles at presentation and the type of spectacle in use was also recorded. Distance stereopsis was measured using Randot Test. Esterman binocular visual field (EBVF) testing using Humphrey Visual Field Analyser was also done for all patients.

Visual impairment was defined as presenting binocular VA <6/18, Contrast Sensitivity was considered abnormal if below 1.5 and Visual field impairment was defined as a loss of 20 or more points on BVF.[5,9,12] Distance stereopsis less than 100 seconds of arcs was considered abnormal .[12]

Statistics and sample size calculation :

A sample size of 323 patients was calculated considering average fall prevalence of 30% using Cochran's formula N=Z2P(1-P)/e2 (Z=1.96,P=0.3,e=0.05). Descriptive analysis of numerical data was done in range and mean with standard deviation. Number of subjects with visual impairment, reduced contrast sensitivity and stereopsis, and compromised BVF was expressed in percentages. Comparison of visual functions and demographic characteristics between patients with and without fall was done using independent t-test and Chi-square test was applied to study their association with fall.   A 'p' value of <0.05 was considered to be statistically significant. Statistical analysis was done using Statistical Package for Social Sciences software version .[21]

Results :

In the study population of 399 patients above the age of 60 years, there was a female preponderance (57%). The mean age of patients was 65.27 ± 3 years (61-78 years). More than 55% of patients in our study had not visited any Ophthalmologist/Optometrist in previous two years and about one third of the patients were not found to be using any glasses at presentation .

Table 1 : Clinico-epidemiological profile of the patients

1.	Age
	a. 65.27±3 years (Mean±SD)
	b. 61 - 78 years (Range)
2.	Gender
	a. Male: 170 (42.6%)
	b. Female: 229 (57.4%)
3.	Last Ophthalmic Consultation
	a. ⩾ 2 years: 221 (55.4%)
	b. < 2 years: 178 (44.6%)
4.	Using Glasses at Presentation
	a. Yes: 271 (67.9%)
	b. No: 128 (32.1%)
5.	Type of Glasses
	a. Muti/Bifocal: 162 (59.8%)
	b. Unifocal: 109 (40.2%)
6.	History of Fall
	a. Yes: 110 (27.6%)
	b. No: 289 (72.4%)

Among those who were using spectacles, almost 60% of patients were found to be using multifocal/bifocal glasses. Majority of the patients in our study were found to be visually impaired with 69% of patients presenting with binocular vision <6/18 on Snellen's chart.

110 (27.6%) patients gave history of experiencing at least one instance of simple fall in last six months of presenting to us. Mean age of the patients with fall history was 66±4 years. Most of the patients were females. Almost 65% of patients in our study suffered from visual impairment. Among other visual functions, almost 62% patients had impaired EBVF, 30% had abnormal contrast sensitivity and 50% had abnormal distance stereopsis (Table 2).

Table 2 : Clinico-epidemiological profile of the patients

1.	Binocular Visual Acuity
	a. ⩽6/18 : 274 (68.7%)
	b. >6/18: 125 (31.3%)
2.	Contrast Sensitivity
	a. ⩽1.5: 132 (33.1%)
	b. >1.5: 267 (66.9%)
3.	Stereopsis
	a. <100 seconds of arc: 146 (36.6%)
	b. ⩾100 seconds of arc: 253 (63.4%)
4.	Esterman Binocular Visual Field
	a. <20 points depression: 192 (48.1%)
	b. ⩾20 points depression: 207 (51.9%)

Majority (68%) of patients with history of fall were using multifocal/bifocal glasses. We also found significantly better binocular visual acuity (p=0.009) and contrast sensitivity (p=0.034) among those using multifocal/bifocal glasses compared to monofocal glasses.

There was no significant association between gender (p=0.51, C.I 0.552-1.348) and age (P=0.65, C.I 0.746-1.426) with history of fall in our study. The patients who did not seek any ophthalmic consultation in the previous two years were 2.9 times more likely to sustain fall (p=0.000, C.I 1.83-4.81). Visual function analysis did not reveal any statistically increased risk of fall with impaired visual acuity (p=0.27, C.I 0.484-1.228) and contrast sensitivity (p=0.41, C.I 0.512-1.322). However, patients with reduced distance stereopsis and abnormal EBVF were 2.17 times (p=0.001, C.I 1.389-3.408) and 1.74 times (p=0.014, C.I 1.116-2.736) more likely to have experienced fall respectively .

Table 3 : Factors associated with history of simple fall among elderly (Statistically significant figures in bold)

Factor	Risk Estimate for simple fall	P-value (<0.05)	Confidence Interval (95%)
Gender	0.8	0.51	0.552-1.348
Impaired Visual Acuity	0.7	0.27	0.484-1.228
Impaired contrast Sensitivity	0.8	0.41	0.512-1.322
Reduced Distance Stereopsis	2.2	0.00	1.389-3.408
Abnormal Esterman Binocular Visual Field	1.7	0.01	1.116-2.736
Time since last Ophthalmology Consultation (> 2 years)	2.9	0.00	1.83-4.81
Use of Glasses	2.4	0.00	1.508-3.757
Type of Glasses	1.5	0.15	0.844-2.859

Though there was no significant relation between the type of glasses and fall (p=0.155 CI 0.844-2.859), those not using glasses were 2.4 times more likely to fall compared to those using glasses (p=0.00 CI 1.508-3.757).

Discussion :

Studies from the developed world have reported an association of poor vision and female gender with fractures in elderly following fall.[4,9] However, about 30% to 50% of falls result in minor injuries only.[9] Unlike past studies, we have analysed visual functions in all patients sustaining fall and thereby have tried to eliminate any bias created by recruiting only patients with fractures. We found 26.7% of our study participants with female preponderance to give history of fall in previous six months. This is similar to the reported prevalence range of falls across various regions of India . Unlike previous study, we did not find any association between gender and fall. This could probably be because we have considered all patients sustaining falls and not only fracture, given the fact that females are more prone to fractures .

Visual impairment is a common occurrence in elderly and a higher fall prevalence ratio among those with reduced distant visual acuity has been reported in past studies.[15] Alike a past study, in this study too binocular visual acuity was measured with glasses among those who had them at presentation and without glasses among those who did not.[9] This is believed to emulate the true visual status routinely experienced by the participants. Futher more, measuring best corrected vision may undermine the actual prevalence of visual impairment. Community based studies from India have reported 25% to 36% prevalence of visual impairment among elderly [16,17] In contrast to this, we have found 69% of the participants in our study to be suffering from visual impairment. Since the study participants were recruited from an Ophthalmology OPD, over

estimation of visual impairment among participants is plausible. More than 65% of the participants with fall in our study presented with impaired binocular distant visual acuity . In spite of higher occurrence of visual impairment among fall patients, our study did not find any significant association between visual impairment and fall. This lack of significance could be explained by relatively high occurrence of visual impairment in the overall study population. Furthermore, studies have pointed to contrast sensitivity, depth perception and visual field loss besides visual acuity to be associated with falls among elderly.[5,24] Similarly, this study also points to a significant association between reduced distance stereopsis and depressed binocular visual fields with increased risk of fall. These results not only implicate impaired visual functions other than visual acuity for fall among elderly but also a regular need for their assessment.

Interestingly, 67% of the patients in our study were wearing spectacles, which is higher than the spectacle prevalence rate of 29% among elderly reported from south India.[20] This higher prevalence could again be due to bias created by selecting patients from Ophthalmology OPD. Our study found that those patients who were not using any glasses at presentation were twice more likely to have experienced fall. This reiterates the need to address uncorrected refractive error among elderly as a preventive measure against fall. Majority of the patients wearing glasses in our study were using multifocal glasses, a trend similar to the reported trend of spectacle use in India.[25] Unlike the previous studies, we did not find any significant increased risk of fall with multifocal compared to monofocal glasses in our study.[8] Detailed analysis revealed that among those with history of fall, both visual acuity and contrast sensitivity was better in patients using multi focal glasses. Perhaps image jump occurring due to changes in spectacle position while walking may be a factor for causing falls. Having said this, more than 55% of the participant had not consulted any eye care services in the previous two years. In a past study, more than 70% patients with hip fracture following fall had not seen an Ophthalmologist or an Optometrist in the preceding 3 years.[9] We found that those who had not consulted any Ophthalmologist in the last two years were 2.9 times more at risk of fall compared to those who took consultation. This suggested that perhaps majority had not got their refraction done over last two years and continued to use old glasses. Thus wearing inappropriate glasses can also enhance the risk of falls in elderly.[24]

Based on these observation we propose regular examination of distance stereopsis, contrast sensitivity and binocular visual fields in addition to visual acuity assessment of elderly patients especially in an Ophthalmology setup. Since uncorrected refractive error is high among elderly, prescribing appropriate glasses would reduce the incidence of falls among them. We also propose the use of only distance correction while walking, especially in elderly to avoid falls.

We noticed a few shortcomings in our study. Since this was a tertiary care based institutional study, the results of the study

may not be applicable on general population. Though the study was able to identify the visual risk factors among elderly with falls, a case control study design would have better elucidated the association of risk factors with fall. An analysis of coexisting ocular morbidities could have also explained the causes of visual impairment, this was not the objective of the present study. Furthermore, the occurrence of falls reported in the present study was subject to patient's recall and thus may not be totally reliable.

Conclusions :

Over 50% of elderly in the present study suffered from visual impairment, reduced stereopsis and depressed binocular visual fields and approximately one third of them sustained fall in previous six months. There was significant association between impaired stereopsis and binocular visual field with fall. Spectacle usage was seen in 67% of the elderly and majority of them used multifocal glasses. Though there was no association of fall history and type of glasses used, those who did not use any glasses were twice more likely to have experienced simple fall.

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LIKE – A NEW TECHNIQUE

Dr Krueger and others are beginning clinical investigation of a technique popularised by Dr Theo Seiler, called LIKE (lenticular implantation keratoplasty). This involves shaping donor corneal tissue with Bowman's layer using a lenticule cavity unit, which defines the precise shape profile and power. The implanted lenticule power is targeted to be greater, and placed under the large LASIK flap of moderate-to-high hyperopia eyes, making it possible to later lift the flap for a myopic or customised ablation enhancement. In the first 12 eyes treated for up to +8.5D in Europe and India, five have so far received a laser ablation one-to-three months after implantation, and one required a replacement implant.

Of the first nine, no eye lost more than one line and three gained two lines at six months. Four had slight, temporary lenticular haze, less than typically seen with LASIK, Dr Krueger said. LIKE-shaped lenticules are also being shaped for treating keratoconus by placing the lenticule in a corneal stromal pocket.

"High hyperopia, presbyopia and keratoconus are just a few of the errors that will implement this technology in the future. Refractive eye-banking will be the emerging, new market and partnership that brings this technology to our field,"

Dr Krueger concluded.