

A STUDY OF OCULAR SIGNS IN NORMAL AND PATHOLOGICAL AGING

ANN MACFARLANE DOBA

R. MITCHELL MSc, MEd, DipAppSci(Cumb), DOBA

M. WILLIAMSON BA(Hons), MB, BS

G. A. BROE BA, FRACP

Lidcombe Hospital, Sydney

Abstract

This paper is a part of a larger study to define "senescent gait disorder". The ocular signs of three groups of patients are compared. Group 1 are normal senescent patients, Group 2 have senescent gait disorder and Group 3 have senile dementia of the Alzheimer type. Vision, stereopsis and ocular motility are evaluated.

Key words: *Visual acuity, stereopsis, ocular motility, normal senescence, senile gait disorder, senile dementia of the Alzheimer type.*

It is estimated that fourteen percent of the population will be over the age of sixty-five by the year 2000. As a consequence, normal and pathological aging must receive more attention from health professionals. As vision is involved in all tasks associated with daily living and leisure, preserving good sight in the elderly is of the greatest importance.

The main causes for failing vision in the elderly are senile macular degeneration, cataract and glaucoma. Ocular movements in the elderly and other ocular signs are useful diagnostic tools and markers of disease processes but have been given very little attention. Orthoptists with their special skills should be involved in studies of the normal and pathological ocular signs in the elderly.

With this in mind I became involved in a study of elderly subjects carried out at Lidcombe Hospital to try to define "Senescent gait disorder". In order to do this, three groups of subjects are studied, one—the normal group, two—the senescent gait disorder group and three—the senile dementia of the Alzheimer type group.

Senile gait disorder or (SGD) is a neurological disorder of gait and balance in elderly people which contributes significantly to disability. It affects 24% of the elderly, 75 and over living in our community.^{1,2}

It is associated with flexed posture, mild generalised slowing and tendon reflex and eye movement changes.

Senile dementia of the Alzheimer's type (SDAT) is a dementia in which there are specific patterns of cognitive impairment, i.e. memory and praxis.

The clinical study in this paper, and more particularly in the planned longitudinal follow-up, was designed to determine whether SGD represented a normal aging of the nervous system or an early stage of a known neurological disorder of aging, in particular Alzheimer's disease.

METHOD AND RESULTS

Three age and sex matched groups are Group 1 ($n=41$) who were volunteers from the community and were without any gait or balance defect; Group 2 ($n=24$) who were volunteers

TABLE 1
Causes of Reduced Vision

	Normal	SGD	SDAT	Framingham	Mitchell/Sarks
Cataract	37.3%	37.5%	14.3%	15.5%	22.4%
S.M.D.	12.4%	0	0	12.7%	22.4%
Glaucoma	12.2%	16.7%	0	3.3%	4.5%
Strabismus	2.4%	4.2%	4.8%	—	—
Other	34.7%	16.7%	9.5%	—	3.8%

who had noticed difficulty with gait or balance, the senescent gait disorder group (SGD) and Group 3 ($n=21$) who were from nursing homes and who had a clinically confirmed diagnosis of senile dementia of the Alzheimer type (SDAT). Subjects with any neurological or orthopaedic disease affecting gait were excluded as were those with any medications which could affect the study.

Assessment was in five areas:

1. Clinical neurology/neuro-ophthalmology
2. Neuropsychology
3. Clinical neurophysiology
4. CAT scan
5. Blood examination.

The neurology assessment confirmed that the group of elderly subjects selected on the basis of a disorder of gait showed an increased frequency of flexed posture, slowing of limb movements, action tremor, absent ankle jerks and reduced vibration sense compared with the normal controls. The results of areas 2-5 are not yet available.

Ocular examination: The examination consisted of the taking of the history, visual acuity, VER's stereoacuity, cover tests, presence of nystagmus, ocular movements, range of pursuit movements, velocity of saccadic movements, convergence and fundus photographs. The glasses were checked to provide information to account for changes in visual acuity and were, as expected for this age group, bifocals, near glasses and aphakic lenses. Trauma was not significant.

Pathology: The known causes of reduced vision are compared with the analyses done by others.^{3,4} The figures were higher in all groups but this may be due to being a relatively small sample.

Fundus photographs were not available at the time of publication and may alter the SMD figures in particular.

Distance visual acuity: The F test showed a difference in the right eye between the normal and the SGD group and between the normal and the SDAT group whereas the left eye did not. There is no explanation for this.

TABLE 2
Visual Acuity at Six Metres

Right eyes	Normal	SGD	SDAT	
Mean	2.29	2.79	3.29	$p < 0.05$

t test: normal versus SGD 2.825 (significant)
normal versus SDAT 2.758 (significant)
SGD versus SDAT 1.226 (not significant)

Left eyes	Normal	SGD	SDAT	
Mean	2.22	3.0	2.81	$p < 0.05$

t test is not significant.
Key: 1 = 6/6; 2 = 6/9; 3 = 6/12; 4 = 6/18, 6/24; 5 = < 6/24

Near vision: There was no significant difference between the groups.

TABLE 3
Visual Acuity at 1/3 Metre

	Normal	SGD	SDAT
Mean	1.44	1.42	1.81

Key: 1 = N5/N6; 2 = N8/N10; 3 = N12/N16; 4 = N18; 5 = < N18.

VER: The VER showed a reduced latency in the normals compared to known standards for younger subjects. The SGD and SDAT groups had an even longer latency. Eyes with reduced acuity and obvious pathology were not tested.

TABLE 4
VER Latency (milliseconds)

	Normal (n=67)	SGD (n=39)	SDAT (n=31)
Mean	116.9	123.4	121.7

Stereoacuity: An analysis of all patients in the three groups showed no significant difference. A further analysis was then done using only those subjects who met the same criteria as used in another survey⁵ i.e. near visual acuity of N5, orthophoria or heterophoria only and good convergence (near point of less than five centimetres). The *t* distribution showed that the SGD and the SDAT groups were significantly below the normal group but that there was no difference between the SGD group and the SDAT group.

TABLE 5
Stereopsis (Seconds of Arc) on Wirt-Titmus Test, with Criteria as Described

	Normal	SGD	SDAT	
Mean	55.5	78.18	110	(<i>p</i> < 0.05)

t test: normal versus SGD 2.223 (significant)
normal versus SDAT 3.408 (significant)
SGD versus SDAT 1.210 (not significant)

Cover Tests: The prevalence of constant strabismus was 7.85%, higher than in the younger normal population, but lower than the prevalence found by Longhurst and Macfarlane⁶ of 17%. However an analysis of the groups shows that the SDAT group has a significantly higher prevalence of strabismus and a lower prevalence of heterophoria. The normal and SGD groups are similar to one another.

Nystagmus: This was not significant as the numbers were too small.

Ocular movements: Ocular rotations were performed and underactions, overactions and 'A' and 'V' patterns were noted but these were not statistically significant.

Abnormal pursuit movements were noted in five subjects in the normal group, seven subjects in the SGD group and in five subjects in the SDAT group. They mostly showed a cogwheeling type of pursuit movement.

Range of ocular movements: From the literature the normal limits of upward gaze vary from forty to fifty degrees in young subjects.^{7,8,9} It has been noticed that a reduction in elevation occurs in the elderly but Chamberlain¹⁰ tested elevation monocularly. Since in normal ocular movement situations both eyes elevate together, measurements were taken with both eyes elevating together in case the input from both eyes differed from each eye on its own.

A simple test seemed preferable in view of the age and concentration of the subjects especially the SDAT group.

The head was placed on the centre of the chinrest of the Rayner arc perimeter with the eyes level with the central target. A light was moved along the perimeter arc with the examiner and an observer watching the light's reflection on the subject's pupil. The instant the reflection moved from its normal position this was considered the limit of movement and recorded in degrees. An N5 target would have been preferable to ensure that foveal fixation was maintained but this presented too many problems.

From the following the differences in velocity can be seen between the groups.

Range of elevation: Mean—Normals 48.54°; SGD 42.67; SDAT 43.85°. There was a signifi-

TABLE 6
Cover Test

	Distant cover test			Near cover test		
	Normal	SGD	SDAT	Normal	SGD	SDAT
Strabismus	7.5%	8.3%	12.5%	4.88%	4.17%	9.5%
Heterophoria	27.5%	12.5%	6.25%	70.73%	79.17%	66.7%
Orthophoria	65%	79.2%	81.25%	21.95%	12.5%	14.29%
Int. strab.				2.44%	4.17%	9.52%

cant difference between the normal group and the SGD group.

Range of depression: Mean—Normals 59.17; SGD 57.83; SDAT 63.85. There was a significant difference between normals and the SGD and between the SGD and SDAT groups.

Range to the right: Mean—Normals 58.61; SGD 57.38; SDAT 58.85. There was no significant difference.

Range to the left: Mean—Normals 57.07; SGD 56.53; SDAT 56.45. There was no significant difference.

Further statistical analysis is available on request.

Velocity of ocular movements: Still using the arc perimeter, a light was placed at 30°. The patient was asked to look from the central white target straight ahead (0 degrees) to the light at 30°. The time taken to do six saccadic movements from the light to the target was recorded by stopwatch with an observer. Undershoots, overshoots difficulty in initiating the saccade, and slowness in initiating the saccade were noted. Abnormal saccades were found in 12 of the normal group, 8 of the SGD group and 7 of the SDAT group. These figures were not significant between the groups.

TABLE 7
Velocities in Seconds

Mean in seconds	Normal	SGD	SDAT
Elev.	3.49	3.93	5.01
Dep.	3.31	3.91	5.07
Right	3.32	3.97	4.59
Left	3.44	3.75	4.63

Elev. Significant difference between normal and SDAT and SGD and SDAT
 Dep. Significant difference between normal and SGD and normal and SDAT and SGD and SDAT
 Right: Significant difference between normal and SGD and normal and SDAT
 Left: Significant difference between normal and SDAT and SGD and SDAT

Convergence: The means show a significant difference between the normal and the SGD and the SDAT groups but the *t* distribution shows a dif-

ference between the SGD and the normal groups and not the SDAT group.

TABLE 8
Convergence

	Normal	SGD	SDAT
Mean (cm)	3.86	7.25	6.11

t test: SGD versus normal 2.587 (significant)
 SDAT versus normal 1.313 (not significant)
 SGD versus SDAT 0.621 (not significant)

DISCUSSION

From study of the tables a normal elderly subject has some reduction in visual acuity, stereopsis and the range of elevation. Also the incidence of strabismus is higher, probably due to a larger number of eyes with markedly reduced vision. Velocities in all directions are slower compared with younger subjects, between 3.0 secs and 3.5 secs for elderly subjects and 1.9 and 2.2 secs for younger subjects.¹¹

The SGD group shows differences from the normal group in the following areas; stereopsis with criteria, range of depression and elevation, velocity of depression, elevation and dextroversion, convergence and VER latency.

The SDAT group show differences from the normal group in the following areas, stereopsis with criteria, strabismus, range of elevation, velocity in all directions, convergence and VER latency. Therefore there is a similarity between the ocular signs of the SGD subject and the SDAT subject as both differ from the normal group in stereopsis with criteria, range of elevation, velocities, convergence and VER latency. It remains to be seen if this is a consistent finding in the other areas of examination to link these diseases.

It can be seen how important it is to have knowledge of the ocular signs of the normal elderly subject in order to evaluate the pathological signs. It is to be hoped that gerontology is a field of study for orthoptists in the future.

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