ORIGINAL ARTICLE

Vision problems in ischaemic stroke patients: effects on life quality and disability

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Background and purpose: Vision problems after cerebral infarction are an increasingly acknowledged problem. Our aim was to investigate the effect on quality of life and post-stroke disability.

Methods: Patients admitted to the Stroke Unit, Department of Neurology, Haukeland University Hospital, between February 2006 and July 2008 with acute cerebral infarction were prospectively registered in the NORSTROKE Registry. Patients received a postal questionnaire at least 6 months after stroke. The questionnaire included 15D©, EuroQol 5D (EQ-5D™), the Hospital Anxiety and Depression Scale (HADS), the Fatigue Severity Scale (FSS) and the Barthel Index (BI).

Results: Of 328 responders, 83 (25.4%) reported a vision problem. Vision problems were associated with older age (71.8 years vs. 66.5 years, $P = 0.001$), higher National Institutes of Health Stroke Scale score on admission (5.9 vs. 3.8, $P < 0.001$), higher modified Rankin Scale day 7 (2.0 vs. 1.4, $P < 0.001$) and lower BI day 7 (85.7 vs. 93.9, $P = 0.002$). Patients with vision problems had lower median EQ-5D utility score (0.62 vs. 0.80, $P < 0.001$), lower median 15D utility score (0.73 vs. 0.89, $P < 0.001$), higher median HADS score (12 vs. 5, $P < 0.001$), higher median FSS score (5.6 vs. 4.3, $P < 0.001$) and lower median BI (95 vs. 100, $P < 0.001$) on long-term follow-up. Patients with self-reported vision problems scored lower on all sub-scores of BI on follow-up (all $P < 0.001$).

Conclusion: One in four patients reported a vision problem on follow-up after cerebral infarction. Vision problems after cerebral infarction reduce quality of life and are associated with increased disability. Thorough diagnostic evaluation and targeted rehabilitation is important.

Background

Homonymous hemianopia is the most readily recognizable vision problem after stroke. Less recognized vision problems are eye motility deficits, visual perceptual difficulties (e.g. neglect), reduced vision acuity, ptosis, anisocoria and non-homonymous hemianopia visual field defects (VFDs) amongst others [1]. VFDs affect 20%–57% of stroke patients [2]. Eye motility deficits, although more difficult to detect, have been reported to be occurring more frequently than VFDs; a recent Cochrane review reported 70% [3].

Vision problems post-stroke have received limited attention and their prevalence remains undetermined. The existing research on vision problems is not stroke specific; stroke-specific reports are mainly limited to VFDs. Discrimination between ischaemic stroke, cerebral hemorrhage and transient ischaemic attack is seldom provided. However, as shown by Rowe *et al.* [4], amongst stroke patients with a suspected visual difficulty only 8% had normal vision. In the same study,

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68% of patients had eye motility deficits, 49% had VFDs, 26% had low vision and 20% had perceptual difficulties. An investigation amongst nursing home residents in several European countries mapping sensory deficits reported that 32% had a vision or hearing impairment and 32% had both [5] (not stroke specific).

Vision problems after stroke have been correlated with increased mortality [6], falling [7], institutionalization, social isolation and depression [8], and are a negative predictor of rehabilitation outcome [9]. Vision problems have also been shown to have a substantial effect on quality of life [10–13] and on activities of daily life (ADL) [1,2,14,15]. Still, stroke patients with vision problems are rarely offered thorough investigation and/or visual rehabilitation [16]. Lately, vision problems after stroke have received increasing attention. Targeted rehabilitation is possible for several vision problems [17]. There is still not enough evidence from randomized controlled trials to conclude whether interventions for VFDs and eye motility deficits are effective [2,3]. This indicates that more research is needed and should not be misinterpreted as grounds to dismiss visual rehabilitation. Like patients with motor or speech deficits, patients with vision problems should be offered a thorough diagnostic evaluation and targeted rehabilitation.

This study aims to characterize patients with self-reported vision problems on long-term follow-up after cerebral infarction. To our knowledge, this is the first study available that characterizes patients with vision problems (and not only VFDs) after cerebral infarction on long-term follow-up.

Methods

All patients with acute stroke admitted to the Stroke Unit, Department of Neurology, Haukeland University Hospital, between February 2006 and July 2008 were prospectively registered in the NORSTROKE Registry. The Bergen NORSTROKE Registry is an extensive community-based database of all stroke patients admitted to the Department of Neurology. All patients with stroke in the population area of this university hospital are admitted to this department. The stroke unit is highly specialized, with access to all diagnostic and treatment modalities, and is involved in extensive research activity. All patients included in the Bergen NORSTROKE Registry are recorded by experienced doctors as having suffered an acute infarction based on a thorough history, clinical examination and computed tomography and/or magnetic resonance imaging scans of the brain. Initial stroke severity is assessed by the National Institutes of Health Stroke Scale (NIHSS) on admission. The modified Rankin Scale (mRS), the Barthel Index (BI) and the NIHSS are performed on day 7 or at discharge if earlier. For further methodological details see previous publications [18–20].

A postal questionnaire was provided for all ischaemic stroke patients alive at least 6 months post-stroke. The questionnaire was composed of 15D© [21], EuroQol 5D (EQ-5D™) [22], the Hospital Anxiety and Depression Scale (HADS) [23], the Fatigue Severity Scale (FSS) [24] and the BI. The patients were asked to rate their general health as very good, good, neither good nor bad, bad and very bad (1–5). Pain was rated from 1 to 10 on a visual analogue scale (VAS). EQ-5D and 15D are generic, standardized, self-administered measures of health-related quality of life, which can be used as a profile and single index score measure [25,26]. EQ-5D consists of five questions regarding mobility, self-care, pain/discomfort, usual activities and anxiety/depression. Each question has three answer categories: no problem, some problem, and major problem [25]. 15D consists of 15 questions (mobility, vision, hearing, breathing, sleeping, eating, speech, excretion, usual activities, mental function, discomfort and symptoms, depression, distress, vitality, and sexual activity), each with five possible answers. Utility scores for EQ-5D and 15D were produced ranging from 0 to 1 where 0 = being dead and 1 = no problem on any dimension [26]. Depression or anxiety was defined as HADS-D or HADS-A ≥ 8 [27]. Pain was defined as a VAS score >0.

Information on vision problems were obtained from question 2 on 15D. The patient was asked to rate themselves as (i) having no difficulty reading newspapers or watching TV with or without glasses, (ii) having some difficulty reading newspapers or watching TV, (iii) having great difficulty reading newspapers or watching TV, (iv) not able to read or watch TV but able to walk around without help, or (v) not able to walk around without help, almost blind. A vision problem was defined as an answer >1.

The study was approved by the local ethics committee (REK Vest). Informed consent was obtained from all patients or by proxy.

Statistics

Data are presented as fractions with percentages, means ± standard deviations and medians with interquartile ranges as appropriate. Student's t test, the χ^2 test, the Wilcoxon rank-sum test and logistic regression were performed as appropriate. All statistical analysis was performed with STATA 13.0 College Station, Texas, USA [28].

Results

From February 2006 to July 2008, 783 patients suffered stroke, 616 (78.7%) had cerebral infarction, 89 transient ischaemic attack (11.4%) and 78 hemorrhage (10.0%). The questionnaire was provided to 541 live patients with cerebral infarction and was returned by 328 (response rate 61%). For demographics of responders versus non-responders see the previous publication [18]. Mean time from index stroke to follow-up was 372 days (range 185–757 days) [18]. Information on vision was missing for one responder.

Normal vision was reported by 244 (74.6%) patients, some difficulty with reading and watching TV by 61 (18.9%), great difficulty by 16 (4.9%), not able to read/watch TV but able to walk around without help by four (1.2%) and not able to walk around without help or almost blind by two (0.6%). Any response other than normal vision was categorized as a vision problem, yielding 83 patients (25.4%) with a self-reported vision problem.

Patients reporting a vision problem were older (71.8 years vs. 66.5 years, $P = 0.001$) and less likely to have been employed (24.4% vs. 39.6%, $P = 0.02$) or married (55.6% vs. 69.2%, $P = 0.03$), and more often

Table 1 Characteristics on admission of patients with self-reported vision problems on follow-up after cerebral infarction ($n = 327$)

	Vision problem ($n = 83$)	Normal vision ($n = 244$)	
	n (%)/mean ± SD	n (%)/mean ± SD	P
Age (years)	71.8 ± 14.3	66.5 ± 12.4	0.001
Female	37 (44.6)	85 (34.8)	0.1
Employed prior to infarction	19/78 (24.4)	89/225 (39.6)	0.02
Married prior to infarction	45/81 (55.6)	162/234 (69.2)	0.03
Prior cerebral infarction	17/81 (21.0)	27/244 (11.1)	0.02
Prior myocardial infarction	14 (16.8)	24 (9.8)	0.08
Diabetes mellitus	8/81 (9.9)	23/243 (9.5)	0.9
Hypertension	41/82 (50.0)	126/241 (52.3)	0.7
Atrial fibrillation	18 (21.7)	44 (18.0)	0.5
Depression	18/61 (29.5)	28/207 (13.5)	0.004
Smoking	47/78 (60.3)	136/233 (58.4)	0.8
Time from symptom onset to admission (median, IQR)	3.2, 1.4–6.7	3.2, 1.5–7.0	0.9
NIHSS score on admission	5.9 ± 6.4	3.8 ± 4.2	<0.001
Horizontal eye movement	0.17 ± 0.48	0.07 ± 0.28	0.04
Visual field	0.51 ± 0.83	0.14 ± 0.44	<0.001
modified Rankin Scale	2.0 ± 1.3	1.4 ± 1.2	<0.001
Barthel Index	85.7 ± 28.3	93.9 ± 16.7	0.002

Account of missing data: 121 missing on time from symptom onset to admission, four missing on NIHSS, 50 missing on horizontal eye movement and visual field and three missing on BI. For further account of missing data see denominators. IQR, interquartile range; NIHSS, National Institutes of Health Stroke Scale.

Table 2 Univariate analysis of function and quality of life on follow-up for patients with self-reported vision problems after cerebral infarction ($n = 327$)

	Vision problem ($n = 83$)	Normal vision ($n = 244$)	P
General health[a], median (IQR)	3 (3–4)	2 (2–3)	<0.001
Pain VAS, median (IQR)	2 (0–5)	0 (0–3)	0.008
Pain, VAS > 0, n (%)	49 (59.0)	108 (44.3)	0.02
Headache, n (%)	15 (18.1)	24 (9.8)	0.05
EQ-5D utility score, median (IQR)	0.62 (0.23–0.73)	0.80 (0.69–1)	<0.001
15D utility score, median (IQR)	0.73 (0.63–0.82)	0.89 (0.79–0.95)	<0.001
HADS, median (IQR)	12 (6–19)	5 (2–10)	<0.001
Depression, HADS-D ≥ 8, n (%)	15/71 (21.1)	14/231 (6.1)	<0.001
Anxiety, HADS-A ≥ 8, n (%)	11/67 (16.4)	15/217 (6.9)	0.02
FSS, median (IQR)	5.6 (4.4–6.6)	4.3 (2.8–5.6)	<0.001
Barthel Index, median (IQR)	95 (75–100)	100 (95–100)	<0.001
Feeding, mean ± SD	8.0 ± 3.3	9.5 ± 1.9	<0.001
Transfers (bed−chair), mean ± SD	13.2 ± 3.9	14.8 ± 1.3	<0.001
Grooming, mean ± SD	4.1 ± 1.9	4.9 ± 0.80	<0.001
Toilet use, mean ± SD	8.7 ± 3.2	9.7 ± 1.5	<0.001
Bathing, mean ± SD	3.3 ± 2.4	4.5 ± 4.4	<0.001
Mobility (on level surfaces), mean ± SD	12.9 ± 4.1	14.5 ± 2.2	<0.001
Stairs, mean ± SD	7.8 ± 3.6	9.4 ± 2.0	<0.001
Dressing, mean ± SD	7.4 ± 4.0	9.4 ± 1.8	<0.001
Bowels, mean ± SD	8.5 ± 3.0	9.6 ± 1.6	<0.001
Bladder, mean ± SD	7.8 ± 3.3	8.9 ± 2.3	<0.001
Independent, Barthel Index ≥85, n (%)	47/67 (70.2)	202/218 (92.7)	<0.001

Account of missing data: 1 missing on general health, 77 missing on pain, 212 missing on pain VAS, 49 missing on EQ-5D, 61 missing on 15D, 38 missing on HADS, 40 missing on BI, 9 missing on feeding and bathing, 29 on transfer, 8 on grooming and dressing, 10 on toilet use and bladder, 20 on mobility, 14 on stairs and 16 on bowels.

FSS, Fatigue Severity Scale; HADS, Hospital Anxiety and Depression Scale; IQR, interquartile range; VAS, Visual Analogue Scale.

[a]General health: 1 (very good) to 5 (very bad).

had prior cerebral infarction (21.0% vs. 11.1%, $P = 0.02$) as well as prior depression (29.5% vs. 13.5%, $P = 0.004$). They had higher baseline NIHSS score (5.9 vs. 3.8, $P < 0.001$), and sub-scores on eye movement (0.17 vs. 0.07, $P = 0.04$) and visual field (0.51 vs. 0.14, $P < 0.001$) were higher. mRS day 7 was also higher (2.0 vs. 1.4, $P < 0.001$) and BI day 7 lower (85.7 vs. 93.9, $P = 0.002$) (Table 1).

Patients with vision problems rated their own general health as poorer (3 vs. 2, $P < 0.001$), and had more pain (59.0% vs. 44.3%, $P = 0.02$) and headache (18.1% vs. 9.8%, $P = 0.05$). Their median EQ-5D utility score was lower (0.62 vs. 0.80, $P < 0.001$) as was median 15D utility score (0.73 vs. 0.89, $P < 0.001$). Median HADS score was higher (12 vs. 5, $P < 0.001$), and more were depressed (21.1% vs. 6.1%, $P < 0.001$) or had anxiety (16.4% vs. 6.9%, $P = 0.02$); median FSS score was higher (5.6 vs. 4.3, $P < 0.001$). Median BI on long-term follow-up was lower for patients reporting vision problems (95 vs. 100, $P < 0.001$); all BI sub-scores were also lower (all $P < 0.001$) and fewer patients were independent (70.2% vs. 92.7%, $P < 0.001$) (Table 2).

Logistic regression showed that vision problems (dependent variable) were independently associated with general health [odds ratio (OR) 1.95, 95% confidence interval (CI) 1.34–2.85, $P < 0.001$], EQ-5D utility score (OR 0.07, 95% CI 0.02–0.27, $P < 0.001$), 15D utility score (OR 0.0002, 95% CI 0.00–0.006, $P < 0.001$), HADS score (OR 1.12, 95% CI 1.06–1.18, $P < 0.001$), depression (OR 3.12, 95% CI 1.09–8.93, $P < 0.05$) and FSS score (OR 1.47, 95% CI 1.17–1.84, $P < 0.001$). Logistic regression analyses for BI and sub-scores showed that vision problems (dependent variable) were independently associated with BI (OR 0.96, 95% CI 0.94–0.98, $P < 0.001$), feeding (OR 0.80, 95% CI 0.71–0.91, $P < 0.001$), transfers (OR 0.76, 95% CI 0.63–0.91, $P < 0.001$), grooming (OR 0.65, 95% CI 0.50–0.86, $P < 0.001$), toilet use (OR 0.80, 95% CI 0.68–0.95, $P < 0.001$), bathing (OR 0.77, 95% CI 0.66–0.90, $P < 0.001$), mobility (OR 0.82, 95% CI 0.72–0.93, $P < 0.001$), stairs (OR 0.80, 95% CI 0.71–0.90, $P < 0.001$), dressing (OR 0.78, 95% CI 0.70–0.88, $P < 0.001$) and being independent (OR 0.18, 95% CI 0.08–0.44, $P < 0.001$). For details on which confounders were adjusted for in each logistic regression model see Table 3.

Figure 1 shows mean EQ-5D in relation to vision status on 15D based on the Lowess smoother function. EQ-5D drops as patients report more vision problems on long-term follow-up after

Table 3 Logistic regression analyses with self-reported vision problems on follow-up after cerebral infarction as dependent variable ($n = 314$)

	OR (95% CI)	Age	Sex	mRS	Prior depression	HADS	FSS
General health	1.95[b] (1.34–2.85)	1.02 (0.99–1.05)	1.26 (0.67–2.39)	1.24 (0.97–1.57)	1.38 (0.63–3.02)	–	–
Pain VAS	1.11 (0.98–1.26)	1.03 (1.00–1.06)[a]	1.14 (0.57–2.28)	1.20 (0.92–1.56)	2.20 (0.94—5.13)	–	–
Pain, VAS > 0	1.67 (0.89–3.13)	1.03[a] (1.00–1.05)	1.21 (0.65–2.27)	1.29[a] (1.02–1.64)	2.08[a] (1.01–4.30)	–	–
Headache	2.28 (0.97–5.39)	1.03[a] (1.01–1.06)	1.22 (0.66–2.28)	1.29[a] (1.02–1.64)	2.21[a] (1.08–4.53)	–	–
EQ-5D utility score	0.07[b] (0.02–0.27)	1.02 (0.99–1.05)	1.47 (0.72–3.02)	1.07 (0.80–1.43)	1.66 (0.68–4.03)	–	–
15D utility score	0.00[b] (0–0.01)	0.99 (0.96–1.02)	1.63 (0.75–3.54)	1.03 (0.75–1.42)	0.61 (0.22–1.74)	–	–
HADS	1.12[b] (1.06–1.18)	1.03 (0.99–1.06)	1.51 (0.74–3.08)	1.18 (0.89–1.56)	0.96 (0.37–2.52)	–	–
Depression	3.12[a] (1.09–8.93)	1.02 (0.99–1.05)	1.39 (0.70–2.75)	1.27 (0.97–1.66)	1.67 (0.70–3.99)	–	–
Anxiety	2.28 (0.83–6.22)	1.02 (0.99–1.05)	1.55 (0.77–3.11)	1.33[a] (1.02–1.73)	2.05 (0.88–4.80)	–	–
FSS	1.47[b] (1.17–1.84)	1.02 (0.99–1.05)	1.41 (0.72–2.73)	1.26 (0.97–1.63)	2.0 (0.91–4.37)	–	–
Barthel Index	0.96[a] (0.93–0.99)	1.01 (0.98–1.04)	1.31 (0.59–2.92)	–	0.99 (0.34–2.88)	1.06 (1.00–1.14)	1.03 (0.99–1.06)
Feeding	0.79[a] (0.67–0.92)	1.02 (0.99–1.05)	1.59 (0.75–3.39)	–	1.21 (0.44–3.27)	1.07[a] (1.01–1.14)	1.03 (1.00–1.05)
Transfers	0.75[a] (0.58–0.96)	1.01 (0.98–1.05)	1.22 (0.55–2.70)	–	1.01 (0.35–2.89)	1.07[a] (1.01–1.14)	1.03 (1.00–1.07)
Grooming	0.71[a] (0.50–0.99)	1.02 (0.99–1.05)	1.60 (0.76–3.38)	–	1.07 (0.40–2.87)	1.07[a] (1.01–1.14)	1.03 (1.00–1.06)
Toilet use	0.84 (0.69–1.03)	1.02 (1.00–1.05)	1.66 (0.79–3.50)	–	1.05 (0.39–2.79)	1.07[a] (1.01–1.14)	1.03 (1.00–1.06)
Bathing	0.83[a] (0.70–0.99)	1.02 (0.99–1.05)	1.54 (0.73–3.24)	–	1.13 (0.43–3.00)	1.08[a] (1.02–1.15)	1.02 (0.99–1.06)
Mobility	0.83[a] (0.71–0.96)	1.01 (1.00–1.04)	1.51 (0.71–3.22)	–	1.15 (0.43–3.09)	1.07[a] (1.01–1.14)	1.03 (0.99–1.06)
Stairs	0.82[a] (0.71–0.94)	1.01 (0.98–1.04)	1.39 (0.65–2.98)	–	1.16 (0.43–3.09)	1.07[a] (1.01–1.14)	1.03 (0.99–1.06)
Dressing	0.82[a] (0.72–0.95)	1.01 (0.98–1.04)	1.75 (0.82–3.72)	–	1.11 (0.41–3.06)	1.07[a] (1.00–1.13)	1.02 (0.99–1.06)
Bowels	0.91 (0.74–1.11)	1.02 (0.99–1.05)	1.68 (0.80–3.52)	–	1.04 (0.40–2.72)	1.08 (1.02–1.15)	1.03 (1.00–1.06)
Bladder	0.95 (0.83–1.09)	1.02 (0.99–1.05)	1.58 (0.76–3.28)	–	1.10 (0.42–2.84)	1.08[a] (1.02–1.15)	1.03 (1.00–1.06)
Independent	0.27[a] (0.10–0.73)	1.01 (0.98–1.05)	1.30 (0.58–2.91)	–	0.97 (0.34–2.74)	1.08[a] (1.01–1.15)	1.02 (0.99–1.06)

Account of missing data: see Tables 1 and 2. CI, confidence interval; FSS, Fatigue Severity Scale; HADS, Hospital Anxiety and Depression Scale; OR, odds ratio; VAS, Visual Analogue Scale.[a]$P < 0.05$; [b]$P < 0.001$.

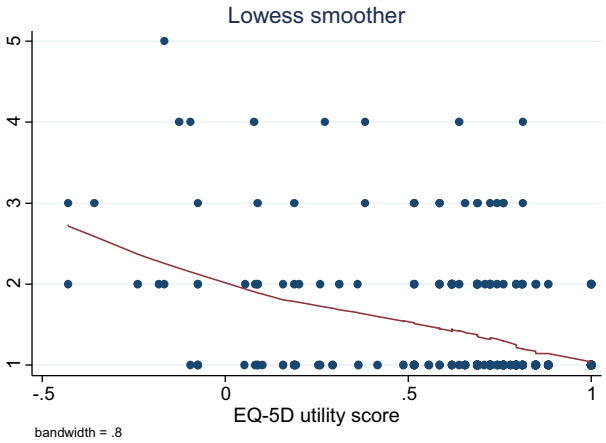

Figure 1 Mean EQ-5D utility score and score on vision status on 15D on long-term follow-up after cerebral infarction.

infarction. Figure 2 shows strategies for visual rehabilitation.

Discussion

One in four patients in this study reported a vision problem. Problems with vision after infarction are often underreported, because either patients do not recognize their own problem [29] or the physician fails to recognize the problem as vision related [30–32]. Our findings also probably underestimate the real prevalence of vision problems because our data are self-reported. Still our findings indicate that vision problems are common and should be considered in the rehabilitation process. Figure 2 gives rehabilitation strategies.

Our data do not provide information on type of vision problem and it cannot be assumed that all vision problems are related to the cerebral infarction. However, vision problems are detrimental to patient outcome regardless of etiology, and attention on a general level is warranted. The majority of our patients reported minor to moderate vision problems.

Patients reporting a vision problem were significantly older, less often employed or living with partner and had suffered more depression and cerebral infarction. Patients reporting a vision problem had significantly more severe infarctions as measured by NIHSS, mRS and BI. This could represent a bias in our material, because vision problems often need to be quite profound to be recognized by the patient/physician and could be overlooked in patients with milder strokes. Vision problems often produce secondary ailments such as headache and fatigue since

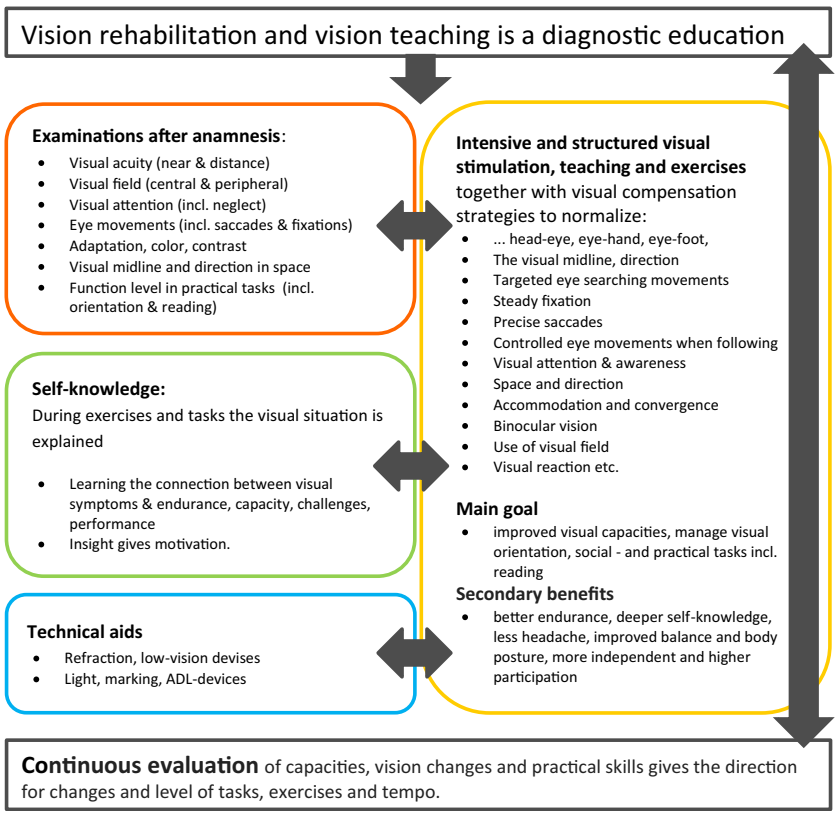

Figure 2 Strategies for visual rehabilitation.

the patient has to work hard to complete ADL with their limited vision. These secondary symptoms may seem more prominent and may mask the underlying vision problem [33].

Patients with vision problems rated their own general health as significantly poorer, and their utility scores on EQ-5D and 15D were also significantly lower after adjusting for confounders. Scores on HADS and FSS were higher. This confirms, as found in previous studies, that vision problems are correlated with a reduced health-related quality of life and depression after adjusting for confounders. The correlation between fatigue and vision problems has not to our knowledge been demonstrated before. Patients who reported vision problems scored lower on all subcategories of BI. This may partly be related to the strokes being more severe, but it also highlights how poor vision affects patients' ADL [14,15].

A strength of the present study is that the NORSTROKE Registry is a community-based registry and our findings are representative for the whole of Bergen county and can probably also be generalized to the Norwegian population. Weaknesses include no objective data on vision problems and a relatively low response rate (although comparable to other studies using postal questionnaires).

In conclusion, one in four patients reported a vision problem on long-term follow-up after cerebral infarction. Patients reporting vision problems rated their own general health as significantly poorer, had lower health-related quality of life, and more often suffered depression and fatigue. Thorough diagnostic evaluation and targeted rehabilitation should be provided.

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Disclosure of conflicts of interest

The authors declare no financial or other conflicts of interest.

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