

## Quality of life in glaucoma patients: Comparison of medical therapy, trabeculectomy, and glaucoma drainage device surgery

Shruti Muralidharan, Suresh Kumar, Parul Ichhpujani, Hennaav Kaur Dhillon

**Purpose:** To compare the quality of life (QoL) in patients with glaucoma on medical therapy and after trabeculectomy and glaucoma drainage device (GDD) using vision, glaucoma, and surgery-specific questionnaires. **Methods:** This cross-sectional study enrolled 30 patients of moderate to severe glaucoma, each in medical, trabeculectomy, and GDD groups. National Eye Institute Visual Function Questionnaire 25 (NEIVFQ-25), Glaucoma Quality of Life (GQL-15), and Surgery Specific Questionnaire (SSQ) were administered, and cumulative scores were compared. **Results:** The mean age of the participants was  $58.95 \pm 13.6$  years with a male preponderance (73.3%, n = 66). The mean scores (SD) in the medical, trabeculectomy, and GDD groups using NEIVFQ-25 were 68.97 (6.98), 72.83 (7.81), and 75.20 (8.77), respectively, those using GQL-15 were 20.63 (6.00), 26.23 (9.12), and 28.43 (7.74), respectively, and for the SSQ, they were 74.33 (8.75) and 72.10 (5.92) in trabeculectomy and GDD groups, respectively. NEIVFQ-25 showed a better QoL in the GDD group compared to the medical group, whereas GQL-15 showed a better QoL in the medical group and comparable QoL in trabeculectomy and GDD. Both these QoL scores correlated to the LogMAR visual acuity. SSQ scores did not show a significant difference in the QoL across both surgical groups. **Conclusion:** NEIVFQ-25 questionnaire scores provided a holistic measure of QoL. GQL-15 assessed the activity limitation and visual disability of the patients but did not take into account the general health and psychological factors influencing the QoL. We did not find a significant difference between trabeculectomy and GDD using the SSQ. For QoL assessment in medically or surgically treated glaucoma, vision-specific and disease-specific questionnaires should always be used in conjunction.

**Key words:** GDD, glaucoma, GQL-15, NEIVFQ-25, quality of life

The primary goal of successful glaucoma therapy, medical or surgical, is to reduce intra-ocular pressure (IOP), with the definitive endpoint being prevention of long-term visual disability. Clinicians emphasize on serial IOP measurements, visual field testing, and retinal n.erve fiber layer (RNFL) analysis to measure treatment effects, whereas patient concerns are always vision-centric, ocular surface discomfort, and the fear of going blind.

In this context, quality of life (QoL) as perceived by patients' ability to lead a healthy and independent life becomes an important barometer of success of any therapeutic modality be it medical or surgical.<sup>[1,2]</sup> Although the components of a good QoL differ among individuals and societies, vision has consistently been one of its key determinants.

Glaucomatous damage causes significant restrictions of activities related to daily living, thus limiting independence. Preventing this, treating other visual co-morbidities, and minimizing treatment-associated discomfort improve QoL in these patients. Addressing issues related to QoL allows both clinicians and patients to re-orientate toward common, realistic goals, leading to a more harmonious relationship and better concordance.

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Although there exist several research papers related to QoL and glaucoma, with the addition of newer drugs (such as Ripasudil, Netarsudil, Tafluoprost, etc.) and newer glaucoma drainage devices (GDDs) such as Aurolab Aqueous Drainage Implant (AADI, Aurolab, India), the QoL effects need to be constantly re-explored. Such evaluations help to convince the health regulatory and health technology assessment bodies about the need for development of newer drugs and devices/implants.<sup>[3]</sup>

To the best of our knowledge, no study from India has compared the QoL in patients with glaucoma on medical therapy in eyes post trabeculectomy and post GDD placement. We measured the QoL in all the three using both vision-specific (NEIVFQ25) and glaucoma-specific GQL15 instruments along with a Surgery Specific Questionnaire (SSQ).

### Methods

This hospital-based cross-sectional qualitative study was conducted at a multi-specialty tertiary care institute in North India. We enrolled 90 patients of moderate to severe glaucoma

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registered in the glaucoma services of the ophthalmology department. The study was registered with the Clinical Trials Registry of India (CTRI) prior to enrolment of the first participant (CTRI No.:CTRI/2020/05/025441). The study was approved by the institutional ethics committee and was in accordance with the tenets of the Declaration of Helsinki.

Out of the 90 enrolled patients, 33% (n = 30) were on medical therapy for a period of 3 months to 1 year and 33% had undergone trabeculectomy or a GDD (n = 30 in each group) at least 3 months prior to enrollment.

Patients with an already compromised QoL owing to physical disability, hearing disability, or neuropsychiatric conditions, who had a trabeculectomy/implant surgery within the 3 months preceding the study period or a cataract surgery in combination with trabeculectomy in the same sitting (phaco-trabeculectomy), and patients of mild glaucoma or those on monotherapy (receiving single drug therapy) were excluded.

### Participants and data collection methodology

A careful detailed history including treatment received, family history of glaucoma, age at diagnosis of glaucoma, clinical manifestations, details of surgery, and post-operative status of the patient was taken in all cases. All patients underwent a detailed clinical examination that included uncorrected and best corrected visual acuity (VA) (UCVA, BCVA) assessment, slit lamp examination, +90 D fundus examination, IOP measurement using a calibrated Goldmann applanation tonometer, and automated visual field (VF) testing. A Humphrey perimeter HVF 750 II (Zeiss Meditec, Dublin, CA) using the SITA-Fast 24-2 protocol was used to test VFs. The patients noted to have advanced VF defects on analysis of the 24-2 protocol were subjected to the 10-2 algorithm. Staging of glaucomatous damage was performed according to the Hodapp Anderson Parrish criteria.

VA values were converted to the LogMAR scale for statistical analysis.

### Quality of life assessment

All enrolled were assessed by a single interviewer (MS) with orally administered QoL instruments and NEIVFQ-25 and GQL15 questionnaires. The patient was explained the components of the tool in their vernacular language. The questionnaires were not translated into Hindi or Punjabi in the print version, but when the questions were asked to the patient(s) while interviewing, they were asked in Hindi or Punjabi (if the patient did not understand English). To check the clarity, simplicity, relevance, and interpretation of the orally translated questions, by the Hindi- and Punjabi-speaking populations, a pre-test was carried out on ten glaucoma patients. This pre-testing was performed independently in the presence of the senior authors (SK and PI).

Owing to the coronavirus disease 2019 (COVID-19) pandemic and nationwide lockdown and considering the patients' inability to visit the outpatient department, the patients enrolled in the period between June 2020 and December 2020 were administered the questionnaire telephonically and their responses were recorded. The phone interviews were scheduled after taking an appointment from the patient. The patient was asked questions when he/she was not occupied with other personal or professional work and had time to listen to each question fully and answer it after giving a thought to it.

For the rest of the patients (enrolled between December 2020 and August 2021), the questionnaires were administered

during the clinic visits. The items were scored according to the recommended scoring algorithm for that questionnaire.

**NEIVFQ-25 Questionnaire:** It consists of 25 vision-targeted questions representing global vision rating (1), difficulty with near vision activities (3), difficulty with distance vision activities (3), limitations in social functioning because of vision (2), role limitations because of vision (2), dependency on others because of vision (3), mental health symptoms because of vision (4), driving difficulties (3), limitations with peripheral (1) and color vision (1), and ocular pain (2) plus an additional single-item general health rating question. Higher values of NEIVFQ-25 indicate better QoL, whereas lower values indicate a lower QoL.

**GQL-15 Questionnaire:** It is composed of 15 items, which addresses four factors of visual disability, that is, central and near vision, peripheral vision, outdoor mobility, and dark adaptation and glare. Item level responses for each factor are coded on a scale of 0 to 5, wherein 0 signifies abstinence from activity owing to non-visual reasons, 1 indicates no difficulty, and 5 represents severe difficulty.

**Surgery-specific Questionnaire:** The patients in the surgical groups (n = 60), that is, trabeculectomy and GDD, were also interviewed on the basis of an SSQ taken with due permission from the study by Klink *et al.*,<sup>[4]</sup> which had questions pertaining to the influence of surgery on daily activities, post-operative complaints, subjective outcomes of surgery, rate of revision surgeries, patients' post-operative mood, and the post-operative course.

## Results

Of the 90 patients, 60 were treated surgically and 30 medically. Of those treated surgically, 30 had undergone GDD placement and 30 had undergone trabeculectomy. Patients who underwent both trabeculectomy and GDD were analyzed in the GDD group. Nine received a non-valved Aurolab Aqueous Drainage Implant (AADI, Aurolab, India), and the rest 21 received a valved GDD, Ahmed Glaucoma Valve (FP7 model, AGV; New World Medical, Rancho Cucamonga, California, USA).

The proportion of cases with moderate glaucoma was 22.2%, and that with severe glaucoma was 77.7%. Both the study groups were comparable with respect to socio-demographic parameters such as age and gender. The mean age was  $58.95 \pm 13.6$  years (60–69 years). No statistically significant difference was observed between the three groups in any of these factors. There was a predominance of males (73.3%) in our study. Sixty-five (72.2%) patients did not suffer from any systemic co-morbidity. None of the patients was uncomfortable in answering the questions, either in the person interview or in the telephonic interview. There were no technical call-related failures when telephonic interview was conducted.

Demographic and basic clinical details are elucidated in Tables 1 and 2. Table 3 shows scores using all three questionnaires across the groups.

### Anti-glaucoma drugs

All patients (30/30; 100%) in the medical group, 63.3% (19/30) in the trabeculectomy group, and 60.0% (18/30) in the GDD group were on anti-glaucoma drugs.

There was a significant difference between the various groups in terms of distribution of anti-glaucoma drugs ( $\chi^2 = 15.535$ ,  $P = <0.001$ ).

The mean (SD) of the number of drugs was the highest in the medical therapy group, 2.77 (0.94), followed by the GDD group, 1.53 (1.53), and last the trabeculectomy group, 1.50 (1.41).

There was a significant difference between the three groups in terms of the number of drugs ( $\chi^2 = 15.658$ ,  $P = <0.001$ ), with the median number of drugs being the highest in the medical therapy group, showing a significant decrease in medications post surgical intervention.

### Comparison of quality of life scores across study groups

#### NEIVFQ-25 Score

The mean (SD) of NEIVFQ-25 total score in the medical, trabeculectomy, and GDD groups was 68.97 (6.98), 72.83 (7.81), and 75.20 (8.77), respectively. There was a significant difference between the three groups in terms of NEIVFQ-25 total ( $\chi^2 = 6.622$ ,  $P = 0.036$ ), with the median (IQR) NEIVFQ-25 total being the highest in the GDD group, suggesting a better overall QoL in this group. On pairwise comparison, there was no significant difference between QoLs among the two surgical groups as well as medical versus trabeculectomy. There was no significant association of NEIVFQ-25 scores with the age and gender of patients. NEIVFQ-25 scores were significantly associated with LogMAR VA (both eyes), and there was a weak negative correlation implying a reduced QoL with poorer vision.

**Table 1: Summary of baseline data**

Baseline data	Mean±SD    Median (IQR)    Min-Max    n (%)
Age	
20-29 Years	2 (2.2)
30-39 Years	4 (4.4)
40-49 Years	19 (21.1)
50-59 Years	15 (16.7)
60-69 Years	32 (35.6)
70-79 Years	14 (15.6)
80-89 Years	3 (3.3)
≥90 Years	1 (1.1)
Gender	
Male	66 (73.3)
Female	24 (26.7)
Previous Intervention	
None	27 (30.0)
LI	3 (3.3)
Trabeculectomy	23 (25.6)
GDD	16 (17.8)
Trabeculectomy+GDD	12 (13.3)
LI+Trabeculectomy	7 (7.7)
LI+GDD	2 (2.2)
Anti-Glaucoma Drugs (Yes)	66 (77.4)
Number of Drugs	1.93±1.43    2.00 (0.25-3.00)    0.00-5.00
Systemic Disease	
None	64 (71.9)
DM	6 (6.7)
HTN	9 (10.1)
DM+HTN	9 (10.1)
Others	1 (1.1)
Drug Allergy (Yes)	2 (2.2)

LI: Laser iridotomy; GDD: Glaucoma drainage device; DM: Diabetes mellitus; HTN: Hypertension; SD: Standard deviation; IQR: Inter-quartile range)

#### GQL-15 Score

The mean (SD) of GQL-15 total in the medical group, trabeculectomy group, and GDD group was 20.63 (6.00), 26.23 (9.12), and 28.43 (7.74), respectively.

There was a significant difference between the three groups in terms of GQL-15 total ( $\chi^2 = 15.827$ ,  $P < 0.001$ ), with the median GQL-15 total being the highest in the GDD group, suggesting a poorer QoL.

On pairwise comparison, differences in QoL scores were statistically significant between GDD and medical therapy and between medical therapy and trabeculectomy groups. However, GDD and trabeculectomy groups were not significantly different in terms of GQL-15 score.

GQL-15 scores were not found to be influenced by the age and gender of patients; however, they were significantly associated with LogMAR VA [both eyes (OU)] and severity of glaucoma. There was a moderate positive correlation between LogMAR UCVA and BCVA (OU) and GQL-15 total, and this correlation was statistically significant, signifying a reduced QoL with poorer vision. The mean (SD) of GQL-15 total was 21.00 (6.42) in the moderate group and 26.51 (8.34) in the severe group. There was a significant difference between the groups in terms of GQL-15 total ( $\chi^2 = 12.920$ ,  $P = 0.002$ ), with the median GQL-15 total being the highest in the severe group.

#### SSQ Score

The mean (SD) of SSQ total in the trabeculectomy group was 74.33 (8.75) and 72.10 (5.92) in the GDD group. There was no significant difference between the groups in terms of SSQ Total ( $\chi^2 = 0.642$ ,  $P = 0.423$ ). SSQ scores were also found to be not associated with age, gender, and other socio-demographic parameters.

## Discussion

QoL is a patient-centric parameter of efficacy of glaucoma therapy, be it medical or surgical. Regular assessment of health-related QoL is important to discern changes in the patient's QoL over time so that treatment can be tailor-made.

In our study, the three groups were comparable in terms of age. The mean  $\pm$  SD age (years) of our study population was lower ( $58.9 \pm 13.7$ ) than that described by Khanna *et al.*<sup>[5]</sup> ( $69 \pm 13$ ). Goldberg *et al.*<sup>[6]</sup> and Onakoya *et al.*<sup>[7]</sup> also studied a cohort with an older mean age than our study population,  $70 \pm 9$  years and  $63 \pm 12$  years, respectively. Kumar *et al.*, in their study to assess QoL in varying severity of glaucoma in the Indian population, included patients whose mean age was  $62 \pm 9.4$  years.<sup>[8]</sup>

We had male preponderance (73.3%), similar to a previous study from our center (64%).<sup>[8]</sup> This could be explained by the fact that in the Indian population, male members of the family are more likely to visit hospitals for ailments. On the contrary, Goldberg *et al.*<sup>[6]</sup> (urban Australian population) and Onakoya *et al.*<sup>[7]</sup> who studied QoL in glaucoma patients in the rural Nigerian population, observed female preponderance of 59.5% and 61.4%, respectively. Khanna *et al.*<sup>[5]</sup> compared QoL in medically and surgically treated glaucoma patients (American population) and noted a female preponderance (63%).

Hypertension and diabetes are the common co-morbidities associated with glaucoma.<sup>[9]</sup> Nearly one third of our study subjects had underlying co-morbidities, which included hypertension, diabetes, and hypothyroidism. Among these, hypertension was the most common, both for the overall cohort and for the three groups separately. We found that the maximum number of study subjects in our cohort was between

**Table 2: Comparison of baseline parameters between study groups**

Parameters	Group			P
	Medical Therapy (n=30)	Trabeculectomy (n=30)	GDD (n=30)	
Age (Years); Mean±SD	59.67±12.48	57.87±13.23	55.03±16.89	0.454 <sup>1</sup>
Age Intervals; n (%)				0.575 <sup>2</sup>
20-29 Years	0 (0.0)	0 (0.0)	2 (6.7)	
30-39 Years	0 (0.0)	1 (3.3)	3 (10.0)	
40-49 Years	7 (23.3)	7 (23.3)	5 (16.7)	
50-59 Years	7 (23.3)	4 (13.3)	4 (13.3)	
60-69 Years	10 (33.3)	13 (43.3)	9 (30.0)	
70-79 Years	4 (13.3)	4 (13.3)	6 (20.0)	
80-89 Years	2 (6.7)	0 (0.0)	1 (3.3)	
≥90 Years	0 (0.0)	1 (3.3)	0 (0.0)	
Gender; n (%)				0.506 <sup>3</sup>
Male	20 (66.7)	22 (73.3)	24 (80.0)	
Female	10 (33.3)	8 (26.7)	6 (20.0)	
Previous Intervention*** n (%)				<0.001 <sup>2</sup>
None	27 (90.0)	0 (0.0)	0 (0.0)	
Trabeculectomy	0 (0.0)	22 (73.3)	0 (0.0)	
GDD	0 (0.0)	0 (0.0)	16 (53.3)	
Trabeculectomy + GDD	0 (0.0)	0 (0.0)	12 (40.0)	
LI+Trabeculectomy	0 (0.0)	8 (26.6)	0 (0.0)	
LI	3 (10.0)	0 (0.0)	0 (0.0)	
LI+GDD	0 (0.0)	0 (0.0)	2 (6.7)	
Anti-Glaucoma Drugs (Yes)***; n (%)	30 (100.0)	19 (63.3)	18 (60.0)	<0.001 <sup>3</sup>
Number of Drugs***; Mean±SD	2.77±0.94	1.50±1.41	1.53±1.53	<0.001 <sup>4</sup>
Systemic Disease; n (%)				0.453 <sup>2</sup>
None	20 (66.7)	24 (82.8)	20 (66.7)	
DM	3 (10.0)	1 (3.4)	2 (6.7)	
HTN	2 (6.7)	2 (6.9)	5 (16.7)	
DM+HTN	5 (16.7)	1 (3.4)	3 (10.0)	
Others	0 (0.0)	1 (3.4)	0 (0.0)	
Drug Allergy (Yes); n (%)	0 (0.0)	2 (6.7)	0 (0.0)	0.326 <sup>2</sup>

LI: Laser iridotomy; GDD: Glaucoma drainage device; DM: Diabetes mellitus; HTN: hypertension); \*Significant at P<0.05, 1: One-Way ANOVA, 2: Fisher's exact test, 3: Chi-squared test, 4: Kruskal-Wallis test

**Table 3: Comparison of QoL scores across the three groups using all three instruments**

Parameters	Group			Kruskal-Wallis Test	
	Medical Therapy (n=30)	Trabeculectomy (n=30)	GDD (n=30)	$\chi^2$	P
NEIVFQ Total					
Mean (SD)	68.97 (6.98)	72.83 (7.81)	75.20 (8.77)	6.622	0.036
Median (IQR)	68 (65-72)	72 (66.5-79.75)	76.5 (66-83.25)		
Range	54 - 84	56-88	63 - 88		
GQL-15 Total					
Mean (SD)	20.63 (6.00)	26.23 (9.12)	28.43 (7.74)	15.827	<0.001
Median (IQR)	18 (17-23)	24 (18.25-33)	28 (23.25-34)		
Range	15-39	15-43	16 - 45		
SSQ Total					
Mean (SD)	NA	74.33 (8.75)	72.10 (5.92)	0.642	0.423
Median (IQR)	NA	72.5 (67-80.75)	72 (69-74.75)		
Range	NA	56-92	61 - 85		

60 and 69 years of age (35.6%), and in this age group, systemic co-morbidities are likely to coexist with glaucoma. To the best of our knowledge, no other published literature studying QoL in glaucoma considered the systemic co-morbidities of the patients.

Three fourths of our cohort comprised severe glaucoma cases as compared to Goldberg *et al.*,<sup>[6]</sup> Onakoya *et al.*,<sup>[7]</sup> and Kumar *et al.*,<sup>[8]</sup> where about one third constituted severe glaucoma. The above findings suggest that our cohort not only had relatively

younger patients but also had a higher proportion of severe glaucoma as compared to other published series, which could affect the QoL scores. The lack of education and awareness about glaucoma in the Indian general population, as estimated by population-based studies, is a reason for late presentation at an advanced stage of the disease, although we did not study the socio-demographic factors like literacy.<sup>[10]</sup>

Two thirds of our patients (60/90) had undergone a surgical procedure for glaucoma. Out of the 30 in the GDD group, there were 12 who had received both procedures (GDD post a failed trabeculectomy). In the study by Khanna *et al.*,<sup>[5]</sup> 36 patients (41.3%) had undergone GDD, whereas 51 (58.6%) had undergone trabeculectomy. We observed that the need for additional anti-glaucoma medications to maintain target IOP became significantly less in the surgical groups. Onakoya *et al.*,<sup>[7]</sup> Goldberg *et al.*,<sup>[6]</sup> and Kumar *et al.*<sup>[8]</sup> did not study glaucoma subjects who had undergone glaucoma surgery.

The QoL assessment of our study patients was performed using NEIVFQ-25 and GQL-15 instruments. Both however showed contrasting results.

#### QoL assessment by NEIVFQ-25

The mean (SD) of NEIVFQ-25 total in the medical group, trabeculectomy group, and GDD group was 68.97 (6.98), 72.83 (7.81), and 75.20 (8.77), respectively, with the higher score signifying a better QoL. This difference in the three groups was statistically significant ( $p = 0.036$ ). The QoL was noted to be better in GDD as compared to medical and trabeculectomy groups. Additionally, pairwise comparison between the three groups showed significantly better QoL in the GDD group compared to the medical group, whereas trabeculectomy and GDD had a comparable QoL with NEIVFQ-25. We also found a negative but weak correlation between LogMAR VA (OU) and NEIVFQ-25 scores (Spearman correlation coefficient = -0.3). Age, gender, underlying comorbidities, and drug allergies did not have any bearing on the composite QoL scores.

Contrary to this, Khanna *et al.*<sup>[5]</sup> assessed QoL in medical ( $n = 73$ ) versus surgical ( $n = 87$ ; GDD = 36; trabeculectomy = 51) treatment groups using NEIVFQ-25 and did not find any significant difference in the QoL between the groups, but with the Adult Strabismus-20 (AS-20) questionnaire, they found a significantly lower HRQoL in the GDD group. This was attributed to the effect of GDD on HRQoL, which had a component related to diplopia and strabismus. AS-20, being a tool-sensitive to strabismus and diplopia, detected this difference between QoL in GDD and trabeculectomy. The tube versus trabeculectomy (TVT) study also studied QoL at 5 years follow-up with NEIVFQ-25 and noted no significant difference between the two interventions.<sup>[11]</sup>

Our findings suggest that patients with a GDD implant reported better QoL, possibly related to multiple factors such as improvement in VA, lesser dependence on anti-glaucoma medications, and lesser intensive post-operative follow-up as compared to trabeculectomy. Our findings reiterate the importance of vision-centric outcomes to determine the success of therapeutic interventions, whether medical or surgical. Although a reduced cost of long-term therapy has been identified as one of the factors for better socio-demographic QoL, this domain was not studied by us.

Any vision-related QoL instrument is expected to measure the impact of vision on everyday activities, emotional well-being, and independence. Among the patient reported outcome measures (PROMs) used in the context of glaucoma, NEIVFQ-25 is the most used. It addresses the three

components recommended by the World Health Organization's International Classification of Functioning Disability and Health (WHO-ICF) for measuring health-related consequences of a disease: impairment, activity limitations, and participation restriction.

#### Assessment of QoL using GQL-15

The mean (SD) of GQL-15 total in the medical group, trabeculectomy group, and GDD group was 20.63 (6.00), 26.23 (9.12), and 28.43 (7.74), respectively, with the higher score signifying a poorer QoL. There was a significant difference between the three groups in terms of GQL-15 total ( $p < 0.001$ ), with the median GQL-15 total being the highest in the GDD group, suggesting a poorer QoL. Additionally on pairwise comparison, differences in QoL scores were statistically significant between GDD and medical therapy and between medical therapy and trabeculectomy groups, whereas GDD and trabeculectomy groups were not significantly different in terms of GQL-15 scores. GQL-15 scores also showed a moderate positive correlation with LogMAR VA (OU), with higher scores signifying more visual disability. In addition, the GQL-15 score was also seen to be significantly associated with severity of glaucoma, with higher scores in severe glaucoma.

Kumar *et al.*<sup>[8]</sup> noted GQL-15 scores – mean (SD) of  $19.38 \pm 6.38$  and  $32.36 \pm 6.27$  in moderate and severe glaucoma, respectively. This compared favorably with our scores of  $21 \pm 6.42$  and  $26.51 \pm 8.34$  in moderate and severe glaucoma, respectively. Studies by Goldberg *et al.* and Onakoya *et al.* also showed a similar worsening of QoL with increasing severity of glaucoma. Similar to the NEIVFQ-25 scores, there was however no significant correlation of the GQL-15 scores with age, gender, and underlying co-morbidities. There is no study at present utilizing the GQL-15 questionnaire in evaluating QoL in patients subjected to surgical intervention.

The GQL-15 questionnaire was developed specifically for patients with glaucoma based on aspects of day-to-day visual functions that are impaired by glaucoma. Although the questionnaire measures vision-related activity limitations, it does not in the strictest sense fulfil the criteria for a vision-related QoL. Inability to assess the emotional, social, and independence domains makes it a non-QoL assessing tool. It primarily measures self-reported visual disability and not vision-related QoL.<sup>[6]</sup> This explains the dichotomous findings between both instruments used in our study. The higher scores (more visual disability) in the GDD implant group with the GQL-15 questionnaire is possibly related to the severity of glaucoma and the resultant visual disability.

Several other factors that include diplopia, strabismus, foreign body perception, and so on have also been reported to contribute to poorer QoL. Khanna *et al.*<sup>[5]</sup> used the AS-20 questionnaire and Diplopia questionnaire for assessing QoL of glaucoma patients that had undergone GDD and trabeculectomy, and in their study, the AS-20- interactions subscale showed the greatest difference for GDD versus trabeculectomy.

#### Assessment of QoL using SSQ

We also utilized an SSQ designed by Klink *et al.*,<sup>[4]</sup> administered to the surgical groups to assess the influence of surgery on daily activities, post-operative complaints, subjective outcomes of surgery, and patients' post-operative mood.

Klink *et al.* in their study compared the QoL scores between patients of trabeculectomy and canaloplasty (CP) to ascertain the difference if any in patient satisfaction among the two groups. They found CP to be superior to trabeculectomy in terms of patient satisfaction as severe bleb-related complications

as associated with trabeculectomy were avoided. In our study however, the mean (SD) of SSQ total in the trabeculectomy group was 74.33 (8.75) and 72.10 (5.92) in the GDD group and the difference was not statistically significant. More prospective long-term studies with a greater sample size utilizing this questionnaire are required to validate its usefulness as a tool in measuring post-surgical QoL.

Overall, our study showed a significantly better QoL in the GDD group compared to the medical group when assessed by NEIVFQ-25 owing to improvement in VA, lesser dependence on anti-glaucoma medications, and lesser intensive post-operative follow-up. In contrast to this, the medical group showed the best QoL when assessed by GQL-15, possibly related to the severity of glaucoma and the resultant visual disability in the surgical group. Also, other factors such as diplopia, strabismus, foreign body perception, and so on have also been reported to contribute to poorer QoL specially with GDD.

Based on this discussion, NEIVFQ-25 is considered a vision-related QoL measure.

The strength of the current study was that glaucoma evaluation was performed in a standardized manner in all individuals, thereby limiting mis-classification. Also, questionnaire administration was carried out by one investigator alone, reducing inter-observer errors. The fact that three QoL questionnaires were used provided for a more comprehensive assessment of the QoL of the study participants.

There are some limitations to our study. Its cross-sectional nature prevents us from assessing the temporal relationship between glaucoma and QoL scores. A longitudinal assessment of QoL would have served a better purpose. The study included data of only North Indian patients, which is why the results may not be applicable on patients from South India. Results from a developing nation as ours cannot be extrapolated to developed countries where they have more mobility, access to driving, and higher literacy. Orally administered questionnaires are a subjective measure of activity limitation, influenced by patient's own perception. Response to the same question may vary according to the patient's subjective assessment of his/her limitations and on the way the question is asked. Also, the questionnaire was telephonically administered in some patients because of the unprecedented COVID-19 situation, which may have influenced the responses. None of those patients had COVID or had recovered from COVID-19 as that could have influenced the QoL scores. Some patients in the GDD group were instilling a single anti-glaucoma medication, and this can be a confounding factor.

## Conclusion

NEIVFQ-25 questionnaire scores provided a more holistic measure of QoL in patients undergoing treatments including glaucoma, medical, or surgical. However, it was more time-consuming in terms of administration. GQL-15 was more user-friendly, and although it assessed the activity limitation and visual disability of the patients, it did not consider the general health and psychological factors influencing the QoL. Also, because of the paucity of literature related to use of GQL-15 in surgically treated patients, more studies are required to validate its usefulness in surgical group of patients. We did not find a statistically significant difference between trabeculectomy and GDD using the SSQ.

For assessment of QoL in glaucoma patients treated medically or surgically, vision-specific and disease-specific questionnaires should always be used in conjunction. Additionally, use of questionnaires such as AS-20 and DQ, which are sensitive to strabismus and diplopia occurring as a complication of GDD, may be able to pick up subtle QoL changes in the above-mentioned group of surgical patients as well.

A new, comprehensive questionnaire needs to be developed, which could better distinguish between medical and surgical treatments in terms of vision and treatment-related QoL and also includes the patients' perspective of treatment effects as well as address requirements of regulatory and health authorities.

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## Conflicts of interest

There are no conflicts of interest.

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