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The Psychosocial and Clinical Outcomes of Orbital Decompression Surgery for Thyroid Eye Disease and Predictors of Change in Quality of Life

Sadie Wickwar, MSc, PhD,[1,2] Hayley McBain, PhD, CPsychol,[1,3] Daniel G. Ezra, MD, FRCOpth,[2,4] Shashivadan P. Hirani, PhD, CPsychol,[1] Geoffrey E. Rose, DSc, FRCOphth,[2,4] Stanton P. Newman, DPhil, CPsychol[1]

Purpose: Thyroid eye disease (TED) has been found to reduce quality of life for many patients because of changes in their appearance and vision, although some seem to adjust better than others. This study was designed to investigate whether a patient's quality of life changes after having orbital decompression for improvement of appearance, vision, or both, and whether any demographic, clinical, or psychosocial factors can predict which patients might benefit from this surgery.

Design: This study used a within-subjects repeated-measures design, in which patients were assessed before and at 6 weeks and 6 months after surgery.

Participants: A total of 123 adults (aged >18 years) with TED and undergoing orbital decompression surgery were recruited at Moorfields Eye Hospital.

Methods: Participants received lateral wall, medial wall, 2.5 wall, or 3 wall decompression and were followed up after surgery with a range of psychosocial and clinical assessments.

Main Outcome Measures: The Graves' Ophthalmopathy Quality of Life (GO-QOL) scale was completed at each time point, and this was used as the dependent variable in each hierarchical multiple regression model.

Results: Significant improvements were found in all clinical characteristics after orbital decompression and in most psychosocial variables. The GO-QOL visual function scores did not change significantly until 6 months after surgery. In contrast, GO-QOL appearance scores changed significantly by 6 weeks after surgery and continued to increase to 6 months, reaching a minimal clinically important difference for this scale. None of the changes in clinical or psychosocial outcomes significantly predicted change in GO-QOL visual function. However, the hierarchical regression model explained 79% of the variance in change in GO-QOL appearance, with change in subjective evaluation of appearance being the only unique predictor of change in appearance-related quality of life.

Conclusions: This study highlights the importance of appearance-related cognitions in predicting quality of life outcomes after surgery. Implications for clinical practice need to be considered in light of the limitations of this study, but it is suggested that psychosocial interventions targeting appearance-related cognitive processes, in particular personal evaluation of appearance, could enhance the quality of life outcomes for patients with TED undergoing orbital decompression surgery. *Ophthalmology 2015;■:1–9 © 2015 by the American Academy of Ophthalmology.*

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Thyroid eye disease (TED) requires a complex management regimen that includes regular assessment of disease severity and activity, these being the markers for treatment decisions. Mild TED is characterized by mild lid retraction and soft tissue involvement, proptosis up to 3 mm above normal, transient or no diplopia, and corneal exposure responsive to lubricants.[1] Moderate to severe TED involves more significant lid retraction (>2 mm), soft tissue involvement, proptosis more than 3 mm above normal limits, and constant or inconstant diplopia, having a substantial impact on daily activities.[1] Approximately 10% of patients develop the severest forms of TED that are sight-threatening and require immediate intervention.[2] Orbital decompression surgery is one of a number of possible interventions for TED but is a major surgery involving the removal of fat, bone, or a combination of both from the orbits. Thus, it is only offered to patients with moderate to marked proptosis with inactive disease or active and sight-threatening TED.[2,3]

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Thyroid eye disease has been found to have a significant impact on quality of life related to both appearance and vision before rehabilitative surgery,[4–6] but less is known about quality of life after the rehabilitative surgeries offered to patients with TED. Evidence to date suggests there is variability in quality of life after orbital decompression,[3,7–10] but the limited quality of prior studies, some with inadequate sample size, means that there is limited reliable evidence for the psychosocial benefits of this major surgery for TED.[11]

Reconstructive surgery is commonly founded on the belief that an improvement in the appearance of a disfiguring condition will lead to improved quality of life.[12] Many patients are pleased with the outcome of aesthetic enhancing procedures, but some report dissatisfaction.[13,14] Recent studies have suggested that reduced levels of psychologic distress will only follow if surgery reduces *subjective* noticeability of a condition, regardless of an objectively successful result.[15] With increasing evidence that questions the relationship between clinical factors and quality of life,[16] there is a greater focus on examining the individual psychologic factors that might predict patients' psychologic adjustment to the changes in vision and appearance caused by TED.[17] Other than quality of life, there is a wealth of psychosocial factors that have not been assessed after surgery for TED, and these factors could explain some of the variance between participants that is unexplained by clinical factors. Potentially relevant factors include appearance concerns, fear of the negative evaluation of others, social comparisons, and subjective visibility, which have been found to significantly explain variability in quality of life after realignment surgery for strabismus.[18]

Identifying factors that predict psychologic outcomes after reconstructive and aesthetic surgery has become a priority in recent years.[14] In the context of TED, this would enable practitioners to target specific psychologic processes when developing interventions to improve quality of life. Few studies have examined how potential psychosocial factors could explain quality of life after surgery in patients with TED.[11] Given that decompression is major surgery and patients can have unrealistic expectations that it will return them to their "normal" premorbid state,[19] an investigation of this nature is long overdue.

This study was designed to establish whether orbital decompression in patients with TED has an impact on quality of life and other psychosocial factors, the extent to which quality of life outcomes can be predicted using clinical and psychosocial measures at the time of presentation, and whether postoperative changes in the clinical and psychosocial factors could explain changes in quality of life.

Methods

Ethics

Ethical approval was obtained from the North London Research Ethics Committee (reference 11/H0724/6). Decompression of up to 3 orbital walls is part of the usual treatment at Moorfields Eye Hospital, and the study adhered to the tenets of the Declaration of Helsinki. Informed consent was obtained from all participants.

Study Design

This study used a within-subjects repeated-measures design, whereby patients were assessed before surgery and again 6 weeks and 6 months postsurgery.

Participants

Participants were recruited from Moorfields Eye Hospital, London. Patients aged 18 years or older who had received a consultant-led diagnosis of TED were approached by a researcher (SW) on the day they were listed for orbital decompression surgery and invited to take part in the study. Patients were excluded from the study if they did not have a comprehensive understanding of English (as identified by the consultant) or their consultant considered them too ill or distressed to take part in the study.

Measures

Participants were asked to provide demographic details before orbital decompression. They also completed a range of psychosocial questionnaires before and 6 weeks and 6 months after surgery. Treating clinicians provided clinical measurements at these same time points, which reflect standard follow-up times after orbital decompression surgery at Moorfields Eye Hospital.

Demographic and Clinical Measures

Self-reported age, gender, and ethnic background were collected before surgery. Participants were given a list of 11 categories that classify the various ethnic groups or backgrounds (Office for National Statistics, 2003) and asked to tick the box that best described their background. Clinical measures were collected by a clinician at each of the 3 study time points and included the length of time TED had been present (disease duration), stability of thyroid function, treatment history, laterality of TED and planned surgery, smoking status, upper and lower margin reflex distances 1 and 2 (millimeters), and the presence of superficial punctate keratitis (SPK), diplopia, or congestive orbital disease. Congestive orbital disease is associated with increased intraocular pressure, deep orbital vascular congestion, and optic neuropathy and is sometimes termed "hydraulic orbit."[20] Disease activity was measured using the widely used Clinical Activity Scale (CAS),[21] a 10-item measure of pain, redness, swelling, and impaired orbital function. Snellen visual acuity was measured for each eye[22] and converted to logarithm of the minimum angle of resolution; logarithm of the minimum angle of resolution values range between −0.20 and 2.1. A score of 2.2 was assigned to patients with counting-fingers vision or worse. Optic neuropathy was considered present with abnormal Ishihara color testing (if not color-blind), and testing for a relative afferent pupillary defect was used in addition. Proptosis (millimeters) was assessed with an exophthalmometer (Oculus), and the degree of asymmetry between eyes was noted.[24] The need for further surgery after orbital decompression was recorded at each follow-up.

Primary Outcome Measure

The Graves' Ophthalmopathy Quality of Life (GO-QOL) questionnaire is a validated disease-specific measure[8] that has been recommended for investigation of treatments for TED.[23] The GO-QOL consists of 2 subscales: vision-related quality of life and appearance-related quality of life.[8] The Australian version of the GO-QOL[4] has been used in this study, because an item about "bicycling" has been replaced by 2 more culturally relevant items about "limitations in work" and "domestic duties." Subscale scores were calculated following questionnaire

guidelines,[8] and higher scores on each subscale indicate better health-related quality of life.

Psychosocial Measures

Participants were asked to complete a range of questionnaires at each time point. These were selected from a framework of adjustment to TED developed by the research team (Fig 1), adapted from The Appearance Research Collaboration's[24] framework of adjustment to living with a disfigurement. The original version of the framework contains the constructs that have been demonstrated to be involved in psychologic adjustment to appearance-altering conditions in a body of research on the psychology of appearance. Appearing first in the framework are the predisposing factors, or social context, in which adjustment takes place, including demographic characteristics and clinical factors, such as disease severity. Next are the intervening cognitions, or thought processes, that have been identified as potentially useful in explaining the difference in adjustment from patient to patient. These have been grouped into the following: *social cognitions*, which include fearing others' negative evaluations, making comparisons with others in a social context and perceptions of social support; *appearance-specific cognitions*, including appearance-related distress, perceptions of own appearance (valence of appearance), the importance of appearance (salience of appearance), and perceived visibility of the disfigurement; and *mood*, which includes anxiety and depression. Psychologic well-being, or *quality of life*, features in the framework as the outcome of adjustment to living with a disfiguring condition. The choice of questionnaires for this study was based on the concepts from the framework identified as important predictors of quality of life in TED in a previous study.[17]

Existing validated measures and brief versions of questionnaires were used where possible and are described as follows:

The Brief Fear of Negative Evaluation scale[25] measures the extent to which an individual is concerned by others' opinions of them. This validated tool consists of 12 items, and higher scores indicate a greater fear of negative evaluation from others.

The Iowa-Netherlands Comparison Orientation Measure[26] measures how well respondents feel they are doing in life when comparing himself or herself to others. Higher scores on this validated 11-item tool indicate a greater tendency to make social comparisons.

The Multidimensional Scale of Perceived Social Support[27] measures subjective levels of social support from family, friends, and significant others. Higher scores on each 4-item subscale indicate greater perceived social support.

The Derriford Appearance Scale 24[28] measures the impact of appearance-related distress on social anxiety and avoidance. Higher scores on this validated brief questionnaire represent greater levels of appearance-related distress and social avoidance.

The Centre for Appearance Research Valence Scale and Centre for Appearance Research Salience Scale[29] measure how an individual evaluates his or her own physical appearance (Centre for Appearance Research Valence Scale) and the extent to which physical appearance is important to the individual (Centre for Appearance Research Salience Scale). Higher scores on each brief measure indicate a more negative self-evaluation of appearance and that greater value is placed on appearance, respectively.

Perceived Visibility of ~~Graves' ophthalmology (GO)~~: Patients were asked to rate how visible they thought their proptosis was to other people on a 7-point Likert scale from 1 (not at all visible) to 7 (extremely visible).

The Hospital Anxiety and Depression Scale[30] is designed to screen for depression and anxiety in patients with health problems. Higher total subscale scores on this validated measure indicate greater levels of anxious or depressed mood. Cutoff scores were also applied to identify noncases (0–7), doubtful cases (8–10), and cases of possible clinical anxiety or depression (scores of ≥11).

Statistical Analyses

An estimate of sample size was based on the required size for multilevel modeling, which assumes a hierarchical structure, whereby data are organized to reflect that time is nested within the

PREDISPOSING FACTORS		INTERVENING PSYCHOLOGICAL PROCESSES			OUTCOMES
Demographic (BLOCK 1)	**Clinical (BLOCK 2)**	**Socio-cognitive Factors (BLOCK 3)**	**Appearance-specific Cognitions (BLOCK 4)**	**Mood (BLOCK 5)**	**Quality of Life**
Age Gender Ethnicity Relationship status	Disease duration Smoking Previous treatments Thyroid function Laterality of TED Laterality of surgery Optic neuropathy LogMAR Exophthalmos Asymmetry Corneal SPK Hydraulic orbit MRD1 MRD2 Diplopia CAS score	Fear of negative evaluation (BFNE) Social comparisons (INCOM) Perceptions of social support (MSPSS)	Appearance-related social anxiety & avoidance (DAS24) Evaluation of own appearance (CARVAL) Salience of appearance (CARSAL) Perceived visibility	Anxiety (HADS) Depression (HADS)	GO-QOL visual function GO-QOL appearance

Figure 1. The potential variables to be used in the hierarchical multiple regression to explore factors associated with quality of life. Framework adapted from Clarke et al.[24] BFNE = Brief Fear of Negative Evaluation; CARSAL = Centre for Appearance Research Salience Scale; CARVAL = Centre for Appearance Research Valence Scale; CAS = Clinical Activity Scale; DAS24 = Derriford Appearance Scale 24; GO-QOL = Graves' Ophthalmopathy Quality of Life; HADS = Hospital Anxiety and Depression Scale; INCOM = Iowa-Netherlands Comparison Orientation Measure; logMAR = logarithm of the minimum angle of resolution; MRD1 = margin reflex distance 1; MRD2 = margin reflex distance 2; MSPSS = Multidimensional Scale of Perceived Social Support; SPK = superficial punctate keratitis; TED = thyroid eye disease.

participant. Recent recommendations suggest that 20 to 60 participants should be recruited for each level in the structure.[31,32] Because this study used 2 levels (time and participant), a minimum sample of 40 and a maximum of 120 were required. Multilevel modeling examined the significance of changes over time, from before to after surgery. To examine whether significant change was seen between each time point, pairwise comparisons were performed on adjusted mean scores. Effect sizes were calculated using partial eta-squared (η^2p) when data were continuous, and the odds ratios (Expβ) were calculated when data were categoric. The clinical variables optic neuropathy, SPK, diplopia, and congested orbit were the only variables assessed categorically.

Hierarchical multiple regressions were used to assess (1) whether any factors measured at baseline could predict the direction of change in quality of life (from before to after surgery) and (2) whether any factors measured before and after surgery that were found to alter with the surgery could predict the change in quality of life. Residualized change scores were calculated by regressing the variable at time 1 (baseline score) from the same variable at time 3 (6-month postoperative score). Variables entered into each regression model were chosen on the basis of their significance in predicting each dependent variable (the GO-QOL subscales) in prior univariate regression analyses ($P < 0.05$); the order used to enter the predictors into the regression was based on the framework outlined in Figure 1. Entry methods were used for the hierarchical regressions, and Cohen's f^2 was used to calculate effect sizes of each of these regressions.

As a means of a sensitivity analysis, patients who had completed only the baseline questionnaire were compared with those who completed both this and at least 1 follow-up questionnaire, using *t* tests and Pearson's chi-square tests (significance set to 0.05).

Results

Participants

A total of 192 patients were identified as eligible for the research. Of these, 135 (70%) agreed to take part, and 123 of the 135 (91%) returned their initial questionnaire. Two participants were removed from the baseline analysis because of high proportions of missing data (>50%). Because of small numbers of patients in some categories of ethnic background, this was collapsed into 3 groups: white ethnic background, Asian ethnic background, and black ethnic background. Of the 121 participants assessed before surgery and described in a previous publication,[17] 84 (69%) responded to the 6-week follow-up questionnaire after their surgery and 86 (71%) responded to the 6-month follow-up questionnaire. Analysis of differences between responders and nonresponders found that patients of white ethnic background were more likely to respond to follow-up than other ethnic groups (chi-square [1]=4.79, $P < 0.05$), as were nonsmokers (chi-square [3]=11.43, $P < 0.05$). Baseline characteristics of the study sample are shown in Table 1.

Postoperative Changes

All clinical variables changed significantly after surgery, as shown in Tables 2 (continuous variables) and 3 (categoric variables): For continuous variables (proptosis, asymmetry, visual acuity, lid retraction, and activity), most improvement occurred by 6 weeks after surgery, with no further statistically significant changes between 6 weeks and 6 months. This effect was also observed for the categoric variables optic neuropathy and congestive orbital disease. However, for the presence of SPK and diplopia, statistically significant improvements were not observed until 6 months after surgery.

Statistically significant improvements were also observed in the majority of psychosocial variables, with the exception of social support and social comparison (Table 4). Improvements in appearance-related quality of life, mood, appearance-related social anxiety and avoidance, valence and salience of appearance, and perceived visibility were found 6 weeks after surgery and were maintained 6 months later. Changes in appearance-related quality of life reached a large minimal clinically important difference, but vision-related quality of life failed to improve statistically until 6 months after surgery, as did fear of negative evaluation (Table 4). Appearance-related quality of life remained lower than vision-related quality of life (Fig 2), and a large variation between participants was observed (Table 4).

Table 1. Baseline Characteristics for the Study Group of 121 Patients with Thyroid Eye Disease Being Considered for Orbital Decompression

Variable	No. (%)	Range	Mean ± SD
Age (yrs)		22–79	47.1±12.3
Gender			
Male	33 (27%)		
Female	88 (73%)		
Ethnicity			
Asian	11 (9.1%)		
White British/Irish/other	95 (79%)		
Black African/Caribbean/other	15 (12%)		
Relationship status			
Married/living with partner	73 (60%)		
Single/other	48 (40%)		
Disease duration (mos)		4–336	62.0±42
Laterality of TED			
Bilateral	101 (83%)		
Unilateral	20 (17%)		
Laterality of planned surgery			
Bilateral	79 (65%)		
Unilateral	42 (35%)		
Treatment history			
Previous immunosuppression	58 (48%)		
Previous radiotherapy	18 (15%)		
Previous surgery	14 (12%)		
Thyroid function			
Stable	106 (88%)		
Unstable	15 (12%)		
Visual acuity (logMAR conversion)*		0–2	0.1±0.4
Corneal SPK	39 (32%)		
Congested orbit	25 (21%)		
Optic neuropathy	15 (12%)		
Diplopia	62 (51%)		
Margin reflex distance 1 (mm)*		1.5–13	5.92±2.1
Margin reflex distance 2 (mm)*		4–11	6.73±1.4
Exophthalmometry (mm)*		15–33	23.7±2.7
Asymmetry (mm)		0–8	1.8±1.8
CAS		0–9	1.12±1.9
Smokers	38 (31%)		

CAS = Clinical Activity Scale; logMAR = logarithm of the minimum angle of resolution; SD = standard deviation; SPK = superficial punctate keratitis; TED = thyroid eye disease.

*■■■

Table 2. Adjusted Means for Continuous Clinical Variables before (Baseline) and after (6 Weeks and 6 Months) Surgery and Analysis of Variance (F) with Respect to Time

Variable	Baseline (M ± SD)	6 Weeks (M ± SD)	6 Months (M ± SD)	Variance Analysis with Respect to Time	Effect Size (η^2_p)	Baseline to 6 Weeks	Baseline to 6 Months
Exophthalmometry	23.7±2.45	19.3±2.41	19.1±2.39	$F_{2,\ 149.80}=252$, $P < 0.001^{\dagger}$	0.77	4.41, $P < 0.001^{\dagger}$	4.58, $P < 0.001^{\dagger}$
Asymmetry	1.84±1.48	0.83±1.48	0.75±1.47	$F_{2,\ 161.90}=20.2$, $P < 0.001^{\dagger}$	0.20	1.02, $P < 0.001^{\dagger}$	1.09, $P < 0.001^{\dagger}$
logMAR	0.08±0.25	0.00±0.25	−0.01±0.24	$F_{2,\ 160.40}=4.53$, $P < 0.05^{*}$	0.05	0.08, $P = 0.029^{*}$	0.09, $P = 0.031^{*}$
MRD1	6.00±1.82	5.29±1.78	5.29±1.79	$F_{2,145.94}=8.26$, $P < 0.001^{\dagger}$	0.10	0.71, $P = 0.001^{*}$	0.71, $P = 0.004^{*}$
MRD2	6.77±1.25	5.46±1.25	5.47±1.25	$F_{2,156.65}=46.4$, $P < 0.001^{\dagger}$	0.37	1.31, $P < 0.001^{\dagger}$	1.30, $P < 0.001^{\dagger}$
CAS	1.17±1.44	0.64±1.42	0.40±1.43	$F_{2,155.20}=9.41$, $P < 0.001^{\dagger}$	0.11	0.53, $P = 0.007^{*}$	0.77, $P < 0.001^{\dagger}$

Estimated marginal means.
CAS = Clinical Activity Scale; logMAR = logarithm of the minimum angle of resolution; MRD1 = margin reflex distance 1; MRD2 = margin reflex distance 2; SD = standard deviation.
$^{*}P < .05$.
$^{\dagger}P < .001$.

Because the majority of change was found at the 6-month follow-up, residualized change scores were calculated for the change from baseline to 6-month scores after surgery for each of the dependent variables described in the following sections.

Predictors of Change in Quality of Life Measured at Baseline

Vision-Related Quality of Life. Univariate linear regressions indicated that the only statistically significant preoperative predictors of change in GO-QOL visual function included ethnic background ($F_{(1,83)}=5.11$, $P < 0.05$, $f^2=0.06$), congested orbits ($F_{(1,81)}=6.24$, $P < 0.05$, $f^2=0.08$), diplopia ($F_{(1,82)}=4.74$, $P < 0.05$, $f^2=0.06$), and CAS ($F_{(1,83)}=11.13$, $P < 0.05$, $f^2=0.10$). Because these variables feature in the "predisposing factors" category in Figure 1, the variables were entered in 2 steps (ethnic background, then clinical factors). This model of ethnic background and clinical factors explained only 16% of the observed variance in the change in GO-QOL visual function ($R^2 = 0.16$, $F_{(4,78)}=3.74$, $P < 0.05$, $f^2=0.19$). Beta coefficients indicated that although the overall model was significant, there was no single significant predictor measured at baseline of change in vision-related quality of life after surgery (Table 5, available at wwwaaojournal.org).

Appearance-Related Quality of Life. The only statistically significant predictors of change in GO-QOL appearance measured before surgery included ethnic background ($F_{(1,83)}=4.75$, $P < 0.05$, $f^2=0.06$), previous radiotherapy ($F_{(1,74)}=4.19$, $P < 0.05$, $f^2=0.06$), congested orbit ($F_{(1,81)}=4.72$, $P < 0.05$, $f^2=0.06$), diplopia ($F_{(1,82)}=8.46$, $P < 0.05$, $f^2=0.10$), and CAS ($F_{(1,83)}=7.88$, $P < 0.05$, $f^2=0.09$). As previously, variables were entered into the regression in 2 steps. This regression model accounted for 20% of the observed sample variation in the change in GO-QOL appearance ($R^2 = 0.20$, $F_{(4,70)}=3.17$, $P < 0.05$, $f^2=0.25$). Beta

Table 3. Frequencies of Categoric Clinical Variables before (Baseline) and after (6 Weeks and 6 Months) Surgery, and Probabilities of Presence with Respect to Time

Model Parameter	Baseline No. (%)	6 Weeks No. (%)	6 Months No. (%)	β	Standard Error β	Wald Chi-Square	*P*	Exp(β)	95% CI for Exp(β)
Optic neuropathy	12 (11.2)	4 (3.7)	2 (1.9)						
Intercept				−2.07	0.31	45.67	**<0.001**†	0.13	0.069–0.230
6 wks vs baseline				−1.13	0.50	5.08	**0.024***	0.32	0.121–0.863
6 mos vs baseline				−1.55	0.61	6.33	**0.012***	0.21	0.064–0.711
Punctate keratopathy	33 (72)	27 (25.2)	13 (12.1)						
Intercept				−0.77	0.21	13.77	**<0.001**†	0.46	0.307–0.695
6 wks vs baseline				−0.22	0.27	0.66	0.418	0.80	0.469–1.369
6 mos vs baseline				-1.02	0.34	8.91	**0.003***	0.36	0.185–0.705
Diplopia	56 (52.3)	51 (47.7)	38 (35.5)						
Intercept				0.08	0.19	0.15	0.696	1.08	0.74–1.571
6 wks vs baseline				−0.03	0.22	0.02	0.891	0.97	0.637–1.481
6 mos vs baseline				−0.50	0.23	4.58	**0.032***	0.61	0.383–0.959
Congested orbit	20 (18.7)	3 (2.8)	5 (4.7)						
Intercept				−1.43	0.25	33.27	**<0.001**†	0.24	0.146–0.388
6 wks vs baseline				−2.03	0.65	9.61	**0.002***	0.13	0.037–0.474
6 mos vs baseline				−1.43	0.52	7.57	**0.006***	0.24	0.086–0.662

CI = confidence interval.
$^{*}P < 0.05$.
$^{\dagger}P < 0.001$.

Table 4. Adjusted Means for Continuous Psychosocial Variables before (Baseline) and after (6 Weeks and 6 Months) Surgery, and Variance Analysis (F) with Respect to Time

Measures	Baseline (M ± SD)	6 Weeks (M ± SD)	6 Months (M ± SD)	Variance Analysis with Respect to Time	Effect Size (η^2_p)	Baseline to 6 Weeks	Baseline to 6 Months
GO-QOL visual function	63.4±29.3	65.0±27.4	71.4±27.8	$F_{2,\ 130.52}=5.30$, $P = 0.006$*	0.08	−1.60, $P = 0.873$	−8.02, $P = 0.008$*
GO-QOL appearance	35.4±26.2	48.7±24.7	54.9±25.1	$F_{2,\ 131.55}=31.0$, $P < 0.001$†	0.32	−13.23, $P < 0.001$†	−19.46, $P < 0.001$†
HADS anxiety	9.43±4.52	7.23±4.20	7.04±4.29	$F_{2,\ 156.80}=27.0$, $P < 0.001$†	0.26	2.21, $P < 0.001$†	2.40, $P < 0.001$†
HADS depression	7.87±4.52	6.09±4.21	5.81±4.32	$F_{2,\ 120.04}=14.9$, $P < 0.001$†	0.20	1.77, $P < 0.001$†	2.06, $P < 0.001$†
DAS24	52.2±14.2	44.1±14.3	41.2±15.4	$F_{2,\ 68.01}=17.2$, $P < 0.001$†	0.34	8.11, $P < 0.001$†	11.04, $P < 0.001$†
CARSAL	25.4±5.41	23.4±4.92	23.2±5.28	$F_{2,\ 102.71}=5.96$, $P = 0.004$*	0.10	1.95, $P = 0.006$*	2.17, $P = 0.013$*
CARVAL	41.3±9.66	34.0±9.65	31.8±9.88	$F_{2,\ 90.99}=21.9$, $P < 0.001$†	0.33	7.24, $P < 0.001$†	9.50, $P < 0.001$†
Visibility	5.76±1.68	4.01±1.62	3.75±1.63	$F_{2,\ 157.24}=58.6$, $P < 0.001$†	0.43	1.76, $P < 0.001$†	2.01, $P < 0.001$†
MSPSS friends	15.3±3.86	15.3±3.56	15.5±3.66	$F_{2,\ 110.52}=0.23$, $P = 0.794$	0.01	0.01, $P = 1.000$	−0.20, $P = 0.935$
MSPSS family	15.5±4.12	16.1±3.84	15.6±3.91	$F_{2,\ 131.88}=1.95$, $P = 0.147$	0.03	−0.64, $P = 0.195$	−0.10, $P = 0.991$
MSPSS significant other	15.9±4.69	16.0±4.26	16.2±4.43	$F_{2,\ 161.38}=0.27$, $P = 0.766$	0.01	−0.29, $P = 0.987$	−0.29, $P = 0.858$
BFNE	38.1±8.95	36.7±8.28	36.1±8.39	$F_{2,\ 102.80}=3.93$, $P = 0.023$*	0.07	1.46, $P = 0.054$	2.02, $P = 0.033$*
INCOM	35.9±6.80	35.1±6.46	35.6±6.54	$F_{2,\ 133.57}=0.73$, $P = 0.485$	0.01	0.77, $P = 0.545$	0.35, $P = 0.936$

Estimated marginal means.
BFNE = Brief Fear of Negative Evaluation; CARSAL = Centre for Appearance Research Salience Scale; CARVAL = Centre for Appearance Research Valence Scale; DAS24 = DAS24 = Derriford Appearance Scale 24; GO-QOL = Graves' Ophthalmopathy Quality of Life; HADS = Hospital Anxiety and Depression Scale; INCOM = Iowa-Netherlands Comparison Orientation Measure; MSPSS = Multidimensional Scale of Perceived Social Support; SD = standard deviation.
*$P < 0.05$.
†$P < 0.001$.

coefficients indicated that although the overall model was significant, there was no single predictor measured at baseline of change in appearance-related quality of life at 6 months after surgery (Table 6, available at www.aaojournal.org).

Predictors of Change in Quality of Life Measured before and after Surgery

Vision-Related Quality of Life. Residualized change scores were calculated for all predictive variables. Eight change variables independently predicted change in visual GO-QOL to a significant level: change in diplopia ($F_{(1,72)}=5.88$, $P < 0.05$, $f^2=0.08$), change in support from significant others ($F_{(1,81)}=5.51$, $P < 0.05$, $f^2=0.07$), change in fear of negative evaluation ($F_{(1,71)}=5.30$, $P < 0.05$, $f^2=0.07$), change in social comparison ($F_{(1,77)}=4.36$, $P < 0.05$, $f^2=0.06$), change in social anxiety and social avoidance ($F_{(1,28)}=6.26$, $P < 0.05$, $f^2=0.22$), change in valence of appearance ($F_{(1,39)}=6.86$, $P < 0.05$, $f^2=0.18$), change in anxious mood ($F_{(1,82)}=10.56$, $P < 0.05$, $f^2=0.13$), and change in depressed mood ($F_{(1,79)}=20.51$, $P < 0.001$, $f^2=0.26$). The regression model was not significant ($R^2 = 0.36$, $F_{(8,16)}=1.12$, $P = 0.40$, $f^2=1.29$) (Table 7, available at www.aaojournal.org), thus suggesting that none of the variables measured before and after surgery could predict the change observed in vision-related quality of life.

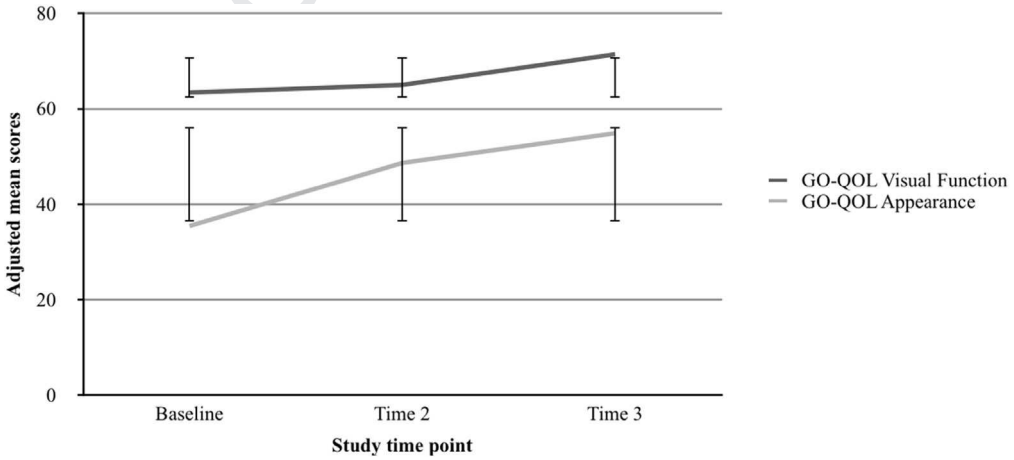

Figure 2. Time-related change in Graves' Ophthalmopathy Quality of Life (GO-QOL) subscale scores with standard deviation error bars.

Appearance-Related Quality of Life. Ten variables independently predicted change in GO-QOL appearance to a significant degree: change in upper eyelid retraction ($F_{(1,69)}$=4.54, $P < 0.05$, f^2=0.07), change in congested orbit ($F_{(1,73)}$=4.94, $P < 0.05$, f^2=0.07), change in support from significant others ($F_{(1,81)}$=7.22, $P < 0.05$, f^2=0.09), change in family support ($F_{(1,82)}$=5.72, $P < 0.05$, f^2=0.07), change in fear of negative evaluation ($F_{(1,71)}$=9.88, $P < 0.05$, f^2=0.14), change in valence of appearance ($F_{(1,39)}$=51.86, $P < 0.001$, f^2=1.3), change in social anxiety and social avoidance ($F_{(1,28)}$=19.67, $P < 0.001$, f^2=0.70), change in perceived visibility ($F_{(1,75)}$=17.08, $P < 0.001$, f^2=0.23), change in anxious mood ($F_{(1,82)}$=11.71, $P = 0.001$, f^2=0.14), and change in depressed mood ($F_{(1,79)}$=29.57, $P < 0.001$, f^2=0.37). When these variables were entered into the model, they accounted for 79% of the variation in GO-QOL appearance change from baseline to 6 months ($R^2 = 0.79$, $F_{(11,13)}$=4.55, $P < 0.05$, f^2=3.76). Improvement in subjective evaluation of appearance was the only variable to provide a unique contribution to predicting improvement in appearance-related quality of life from before to 6 months after surgery (Table 8, available at www.aaojournal.org).

Discussion

This study was designed to establish what impact orbital decompression surgery might have on clinical and psychosocial well-being, whether before surgery we can predict how well patients adjust, and whether changes in clinical and psychosocial factors from before surgery to 6 months afterward can explain changes in quality of life.

Despite the resolution of optic neuropathy as early as 6 weeks after surgery, vision-related quality of life did not significantly change until 6 months after surgery and did not reach a minimal clinically important difference. It is possible that presence of double vision until 6 months after surgery might explain a continued lack of ability to carry out daily activities, including reading and driving. Double vision at baseline did contribute to the model that aimed to explain change in vision-related quality of life after surgery. Conversely, appearance-related quality of life improved significantly at 6 weeks and continued to significantly improve up to 6 months after surgery, reaching a large minimal clinically important difference. In this sample, it seems that orbital decompression has the biggest impact on appearance-related quality of life and is less effective at improving vision-related outcomes. Significant improvements in appearance-related quality of life have been observed after orbital decompression surgery in previous studies,[8,10] although vision-related quality of life was found to show more improvement in previous studies.[3,9,10] However, our sample was somewhat different before surgery because less patients were affected by their vision. This is supported by the small percentage of the sample experiencing optic neuropathy before surgery.

Orbital decompression surgery attempts to improve clinical factors in TED that cause pain, discomfort, and an altered appearance. Proptosis, eyelid retraction, optic neuropathy, visual acuity, and congestive orbital disease were all found to improve as early as 6 weeks after surgery in this study, supporting the effectiveness of orbital decompression at improving these clinical outcomes. Some other variables seem to take longer to demonstrate improvement, including superficial keratitis and double vision.

Appearance-related social anxiety and avoidance, importance of appearance, personal evaluation of appearance, perceived visibility of TED, and mood were all found to improve as early as 6 weeks after surgery. Fear of negative evaluation was found not to improve until 6 months after surgery, suggesting that the emotions associated with social factors take some time to change after surgery. This finding supports previous research that has found patients often need considerable time to adjust to changes in facial appearance and might still be unsure about the reactions of others after orthognathic surgery.[33] Perceptions of social support from friends, family, and significant others remained the same over time. The tendency to make social comparisons was also found not to change after surgery, suggesting that this is a more stable characteristic.

Ethnic background was the sole demographic variable predicting change in quality of life with surgery: Patients who identified themselves as being from a nonwhite ethnic group experienced greater improvements in both vision- and appearance-related quality of life, compared with patients who identified themselves as from a white ethnic group. Individuals from nonwhite ethnic backgrounds have been found to report more worry about their appearance and an increase in perceived noticeability when they have a visible difference,[16] suggesting that this greater improvement after surgery might be due to a worse perception of their appearance before treatment. Ethnic background and a number of preoperative clinical variables were found to predict a small proportion of the variation in quality of life changes with surgery. None of these variables provided a unique contribution to the model, however, and a large proportion of the variance remains unexplained. Therefore, surgeons should be cautious about assuming that patients with particular disease severity or attitude toward their own appearance will adjust poorly after surgery. It is possible that factors not measured in this study might better explain change in some areas of quality of life, and links have been made in recent years between unmet expectations and poor psychosocial adjustment after surgery.[14]

Improvements in eyelid retraction and congested orbit did not predict change in appearance-related quality of life when entered into the model with intervening cognitive process variables. These findings reflect previous surgical studies in TED that have found weak correlations between clinical changes and quality of life outcomes.[8,34] The notion that subjective appraisals of appearance will predict psychologic well-being better than clinical measures of severity[15] also has been supported. In patients with strabismus, personal evaluation of appearance has been found to be a more important factor in predicting adjustment than other clinical factors.[18] This finding has highlighted an important intervening psychosocial factor to consider when developing future psychosocial interventions to help improve outcomes of surgery for patients with TED.

Study Limitations

There are limitations to the present study. Orbital decompression is part of a treatment pathway, with some patients undergoing further surgery (e.g., eyelid lowering), and the 6-month follow-up did not assess the longer-term benefits of decompression or whether quality of life continued to improve after such further surgery. Establishing the long-term benefits of decompression and additional surgery would aid clinicians when informing patients about how much they might benefit from these various surgeries to improve their appearance and, ultimately, their quality of life. It would also be beneficial to establish whether not meeting patients' expectations of orbital decompression could influence their quality of life outcomes after surgery, as suggested in the context of aesthetic surgery.[13,14]

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[1] City University London, School of Health Sciences, London, United Kingdom.

[2] Moorfields Eye Hospital, London, United Kingdom.

[3] East London Foundation Trust, London, United Kingdom.

[4] UCL Institute of Ophthalmology, NIHR Biomedical Research Centre for Ophthalmology, London, United Kingdom.

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Author Contributions:

Conception and design: Wickwar, McBain, Ezra, Hirani, Rose, Newman

Data collection: Wickwar, McBain, Ezra, ~~Hirani~~, Rose, ~~Newman~~

Analysis and interpretation: Wickwar, McBain, Ezra, Hirani, Rose, Newman

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Overall responsibility: Wickwar, McBain, Ezra, Hirani, Rose, Newman

Abbreviations and Acronyms:
CAS = Clinical Activity Scale; **GO** = Graves' ophthalmology; **GO-QOL** = Graves' Ophthalmopathy Quality of Life; **SPK** = superficial punctate keratitis; **TED** = thyroid eye disease.

Correspondence:
Stanton P. Newman, DPhil, CPsychol, City University, Room A224 College Building, Northampton Square, London, EC1V 0HB. E-mail: Stanton.newman.1@city.ac.uk.

Table 5. Results of Hierarchical Regression With Change in GO-QOL Visual Function as the Dependent Variable and Baseline Demographic and Clinical Factors as the Predictive Variables

	β Coefficient	Standard Error β	*t*	*P*
Constant	0.69	0.25	2.75	**0.007***
Ethnicity	−0.48	0.27	−1.82	0.073
CAS	−0.11	0.07	−1.68	0.097
Hydraulic orbit	−0.18	0.33	−0.54	0.592
Diplopia	−0.26	0.22	−1.19	0.237

Note. $R^2 = 0.06$ for Step 1 ($P < 0.05$), $R^2 = 0.16$ for Step 2 ($P < 0.05$). CAS = Clinical Activity Scale; GO-QOL = Graves' Ophthalmopathy Quality of Life.

Table 6. Results of Hierarchical Regression With Change in GO-QOL Appearance as the Dependent Variable and Baseline Demographic and Clinical Factors as the Predictive Variables

	β Coefficient	Standard Error β	*t*	*P*
Constant	0.80	0.26	2.94	**0.004***
Ethnicity	−0.50	0.28	−1.80	0.077
Prior radiotherapy	−0.60	0.40	−1.41	0.164
Hydraulic orbit	−0.01	0.34	−0.02	0.987
Diplopia	−0.37	0.23	−1.59	0.118
CAS	−0.10	0.07	−1.54	0.127

Note. $R^2 = 0.05$ for Step 1 ($P < 0.05$), $R^2 = 0.20$ for Step 2 ($P < 0.05$). CAS = Clinical Activity Scale; GO-QOL = Graves' Ophthalmopathy Quality of Life.

Table 7. The Final Step of the Hierarchical Multiple Regression Model to Examine Change Predictors of Change in GO-QOL Visual Function at 6 Months After Surgery

	β Coefficient	Standard Error β	*t*	*P*
Constant	1.69	0.20	0	1.0
Diplopia	−0.29	0.25	−1.16	0.264
MSPSS Significant other	0.09	0.21	0.44	0.669
BFNE	0.01	0.26	0.03	0.981
INCOM	−0.23	0.26	−0.87	0.399
CARVAL	0.03	0.30	0.10	0.921
DAS24	−0.30	0.30	−1.01	0.327
HADS Anxiety	−0.06	0.27	−0.22	0.832
HADS Depression	−0.16	0.28	−0.56	0.582

Note. $R^2 = 0.08$ for Step 1 ($P = 0.184$), $R^2 = 0.21$ for Step 2 ($P = 0.343$), $R^2 = 0.34$ for Step 3 ($P = 0.218$), $R^2 = 0.36$ for Step 4 ($P = 0.754$). BFNE = Brief Fear of Negative Evaluation; CARVAL = Centre for Appearance Research Valence Scale; DAS24 = Derriford Appearance Scale 24; GO-QOL = Graves' Ophthalmopathy Quality of Life; HADS = Hospital Anxiety and Depression Scale; INCOM = Iowa-Netherlands Comparison Orientation Measure; MSPSS = Multidimensional Scale of Perceived Social Support.

Table 8. Final Step of the Hierarchical Regression Model Used to Examine Predictors of Change in GO-QOL Appearance 6 Months After Surgery

	β Coefficient	Standard Error β	*T*	*P*
Constant	1.80	0.12	0.00	1.000
MRD1	−0.25	0.16	−1.59	0.136
Hydraulic orbit	0.04	0.15	0.26	0.796
INCOM	−0.11	0.16	−0.70	0.497
BFNE	−0.16	0.17	−0.97	0.349
MSPSS Significant other	0.10	0.16	0.64	0.530
MSPSS Family	−0.10	0.18	−0.55	0.593
CARVAL	**−0.64**	**0.19**	**−3.42**	**0.005***
DAS24	−0.24	0.21	−1.19	0.255
Perceived visibility	0.03	0.17	0.19	0.850
HADS Anxiety	0.25	0.17	1.44	0.173
HADS Depression	−0.22	0.18	−1.24	0.235

Note. $R^2 = 0.12$ for Step 1 ($P = 0.246$), $R^2 = 0.39$ for Step 2 ($P = 0.141$), $R^2 = 0.75$ for Step 3 ($P = 0.003$), $R^2 = 0.79$ for Step 4 ($P = 0.300$). BFNE = Brief Fear of Negative Evaluation; CARVAL = Centre for Appearance Research Valence Scale; DAS24 = Derriford Appearance Scale 24; GO-QOL = Graves' Ophthalmopathy Quality of Life; HADS = Hospital Anxiety and Depression Scale; INCOM = Iowa-Netherlands Comparison Orientation Measure; MRD1 = margin reflex distance 1; MSPSS = Multidimensional Scale of Perceived Social Support.

The Psychosocial and Clinical Outcomes of Orbital Decompression Surgery for Thyroid Eye Disease and Predictors of Change in Quality of Life

Sadie Wickwar, MSc, PhD, Hayley McBain, PhD, CPsychol, Daniel G. Ezra, MD, FRCOpth, Shashivadan P. Hirani, PhD, CPsychol, Geoffrey E. Rose, DSc, FRCOphth, Stanton P. Newman, DPhil, CPsychol

~~By using the Graves' Ophthalmopathy Quality of Life scale,~~ appearance-related quality of life improved significantly as a result of orbital decompression surgery for people with thyroid eye disease, and this is better explained by improvements in ~~psychologic~~ factors than clinical factors.