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NEW CONCEPT

Perception of Control Over Eating After Bariatric Surgery for Super-Obesity—a 2-Year Follow-Up Study

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Abstract
Background Physiological and psychosocial factors might contribute to differences in weight loss, eating behaviour and health-related quality of life (HRQoL) after bariatric surgery. The aim of this study was to investigate how perceived control over eating changes after bariatric surgery and whether it affects outcome in super-obese patients.
Methods In a retrospective analysis of a prospective study (n=60), 49 patients were divided into two groups based on eating control 2 years after surgery, as assessed by the Three-Factor Eating Questionnaire-R21 (TFEQ-R21): 29 with good eating control (GC) and 20 patients with poor eating control (group PC). Eating behaviour and generic and condition-specific HRQoL was assessed by questionnaires.
Results There were significant differences in all TFEQ-R21 domains 2 years after surgery in favour of group GC; uncontrolled eating $p<0.001$, emotional eating $p<0.001$ and for cognitive restraint $p=0.04$. The improvement in HRQoL 2 years after surgery was significantly less in group PC compared to group GC in 7 of 8 SF-36 domains ($p<0.05$). Mean (SD) percentage of excess body mass index lost was similar between groups, 71.2 (17.8) in group GC versus 65.4 (17.4) in group PC 2 years after surgery ($p=0.27$). However, group GC had a significant weight loss between first and second year after surgery ($p<0.001$) compared to group PC ($p=0.15$).
Conclusions In super-obese patients, perceived poor control over eating 2 years after bariatric surgery was associated with lower HRQoL and more emotional and cognitive restraint eating, than good control overeating.

Keywords Bariatric surgery · Super-obesity · Uncontrolled eating · Loss of control · Treatment outcome ·

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Eating behaviour · Health-related quality of life · Weight loss · TFEQ-R21

Introduction

To date, bariatric surgery is the only successful treatment of severe obesity. Such operations are associated with sustained long-term weight loss, remission or improvement of co-morbidities and improvement in health-related quality of life (HRQoL) [1–3]. However, longitudinal studies have demonstrated contradictory results in terms of weight loss maintenance, HRQoL improvements and patient satisfaction, and for some patients, it is challenging to obtain sustained long-term benefits after bariatric surgery [4–9].

Both physiological and psychosocial factors might be of importance for differences in outcome after bariatric surgery. Physiological mechanisms in weight loss include meal-stimulated gut hormones [10] and energy metabolism [11]. Also, higher preoperative body mass index (BMI) appears to be associated with lower excess weight loss [12]. Research examining psychosocial factors is inconsistent, and few reliable psychosocial predictors for post-operative outcome have been identified [12–15]. However, post-surgical eating patterns, such as binge eating, grazing, emotional overeating and uncontrolled eating, have consistently been shown to predict poorer weight loss, greater weight regain and psychosocial outcomes 1 and 2 years after surgery [14–19].

Qualitative studies indicate that perceived control of eating and food intake is a key aspect for bariatric patients both before and after surgery [20–22]. Patients awaiting surgery often report a complex relationship to food, such as frequent emotional eating (EE) or food addiction [21, 23]. Other studies reveal how patients experience an undesired ability to fall back into less healthy eating habits overtime post-surgery [20, 24]. We hypothesised that sense of control overeating during the second year after bariatric surgery may affect outcome. The aim of this study was to investigate how perceived control over eating changes during the first 2 years after bariatric surgery for super-obesity, analysing whether these changes affect weight loss and HRQoL at 2 years.

Material and Methods

Study Sample

The study group comprised 60 patients included in a randomised clinical trial comparing laparoscopic gastric bypass and duodenal switch for treatment of super-obese patients (BMI range 50–60 kg/m^2). All patients underwent a consultation prior to surgery, during which a process of fully informed consent to participate was conducted and patients were enrolled in the study. This consultation involved a multi-disciplinary team, consisting of a surgeon, nurse and a dietician [25]. Follow-up rate were 98 and 97 % respectively at 1 and 2 years follow-up. Between-group comparisons of changes in weight loss, vitamin status, HRQoL, gastrointestinal symptoms, eating behaviour and adverse events have previously been published [25–28].

Selection of Participants

The inclusion criteria for this retrospective analysis of data was that patient had completed all prospective collected data on weight and questionnaire, i.e. Three-Factor Eating Questionnaire-R21 (TFEQ-R21), Short-Form 36 Health Survey (SF-36) and Obesity-related Problem Scale (OP), at baseline, 1- and 2-year follow-up. This criterion was fulfilled by 49/60 patients. Of the remaining 11 patients, 1 was lost to follow-up and 10 had failed to complete the questionnaires correctly. There were no significant differences in baseline characteristics between the excluded and included patients regarding age, gender, BMI or perceived uncontrolled eating. As illustrated in Fig. 1, the 49 participants were divided into two study cohorts based on their TFEQ-R21 Uncontrolled Eating (UE) scale score at 2 years after surgery. A higher UE score indicates a greater risk of losing control over eating when feeling hungry or exposed to external stimuli. Group GC (good eating control) consisted of 29 patients who scored below the mean value for UE (<28.7). Group PC (poor eating control) consisted of 20 patients whose UE score was greater than the mean (>28.7). Our mean score was in line with that observed in a non-obese healthy group [29].

Data Collection

Data were collected by self-administered questionnaires before surgery and at 1- and 2-years follow-up.

Eating behaviour was assessed by TFEQ-R21 across three domains:

- *Uncontrolled Eating* scale measures the tendency to lose control over eating when feeling hungry or when exposed to external stimuli.
- *Emotional Eating* scale assesses the propensity to overeat in relation to negative mood states, e.g. loneliness, anxiety or depression.

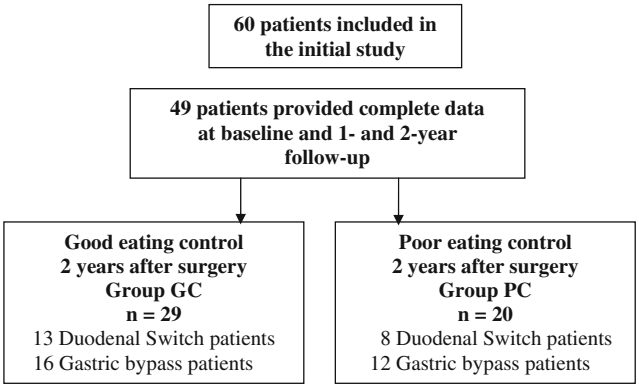


Fig. 1 The selection processes based on the initial 60 patients included in the trial. A total of 49 patients had complete data (TFEQ-R21, SF-36, OP-scale and weight) at all-time points and were included in the present analysis

- *Cognitive Restraint* scale measures conscious restriction of food intake to influence body weight and body shape [30, 31].

HRQoL

Generic HRQoL was assessed by SF-36 across eight domains: physical function, role-physical, bodily pain, general health, vitality, social function, role-emotional and mental health. The first four domains reflect physical health and the last four mental health [32].

Psychosocial Function

Obesity-related Problems (OP) scale was used to measure psychosocial functioning (i.e. obesity-specific HRQoL), where subjects self-assessing the impact of their obesity across eight social situations [33].

Weight was measured with the participants wearing no shoes but light clothes, for which 1 kg was subtracted [27]. Percentage of excess BMI loss (%EBL) was used to report weight loss. This calculation used BMI 25 kg/m^2 as the threshold for overweight: [(baseline BMI−follow-up BMI) / (baseline BMI−25)]×100.

Statistical Analysis

Data were analysed using IBM's Statistical Package for the Social Sciences version 20. For non-normally distributed data, Wilcoxon Signed Rank Test was used to compare changes in continuous variables over time. Mann-Whitney *U* test was used for comparisons between two unrelated groups. Student's *t* test was used for normally distributed values between groups and paired *t* test within groups. Correlation coefficients were calculated using Pearson's or Spearman's rho, as appropriate. Chi-square tests or Fisher's exact tests were applied on categorical data. Statistical significance was set at a *p* value (two-sided) of less than 0.05.

Magnitude of group differences was further determined by calculating effect size (ES) to permit assessment of the importance of a group difference and facilitate comparisons across measures. The ES of a between-group difference was estimated by calculating the mean difference divided by the pooled standard deviation and defined using standard criteria proposed by Cohen: trivial (0 to <0.20), small (0.20 to <0.50), moderate (0.50 to <0.80) and large (>0.80) [34].

The local Ethics Committee approved the trial protocol, and written informed consent was obtained from all individual participants included in the study (ClinicalTrial.gov registration number: NCT00327912).

Results

There were no significant differences in baseline characteristics between the GC and PC groups regarding age, BMI, surgical technique or gender (Table 1).

Eating Behaviour

Mean TFEQ-R21 scores in the two groups at baseline and at 1- and 2-year follow-up are presented in Fig. 2. There were significant group differences between UE (p=0.001) and EE (p=0.02) at baseline. Mean (SD) pre-surgery scores for UE and EE in GC group were 31.5 (17.7) and 38.3 (27.5), respectively, versus 51.0 (19.7) for UE and 58.6 (24.2) for EE in PC group. At 2 years after surgery, these differences had markedly increased, and the mean scores for UE were 12.5 (7.2) in GC group and 52.2 (16.3) in PC group (p<0.001). Calculation of effect size (ES) indicated a very large difference between the groups for UE with an ES value of 3.39 2 years after surgery (Fig. 2). A similar pattern was observed for EE with mean scores of 18.0 (19.5) in GC vs. 58.1 (16.3) in PC group (p<0.001), which corresponds to a large ES of 1.90.

Group GC reported significant improvements in UE and EE from baseline to 1 year (p=0.002) and 2 years (p<0.001) after surgery (Fig. 2). Within group PC, UE and EE significantly improved between baseline and 1 year after surgery (p<0.05) but deteriorated to baseline levels between 1- and 2-year follow-up (p<0.001 for UE; p=0.05 for EE).

There was no significant difference in cognitive restraint (CR) between the two groups at baseline or 1 year. At 2 years, however, group PC reported significantly higher CR: 49.4 (19.5) versus 35.8 in group GC (p= 0.04). Group PC also had a significant increase in CR

Table 1 Patient characteristics

	Group GC (n=29)	Group PC (n=20)
Sex M/F	9/20	4/16
Age[a] (range)	36 (26–44)	36 (21–49)
Pre-operative BMI (kg/m^2)[b]	54.7 (3.4)	55.6 (3.6)
2 years post-operative BMI (kg/m^2)[b]	33.4 (5.0)	35.4 (5.3)
% EBL (baseline to 2 years post-op)[b]	71.2 (17.8)	65.4 (17.4)
Surgical technique		
GBP (%)	55	60
DS	45	40

GC good eating control, *PC* poor eating control, *GBP* gastric bypass, *DS* duodenal switch

[a] Median

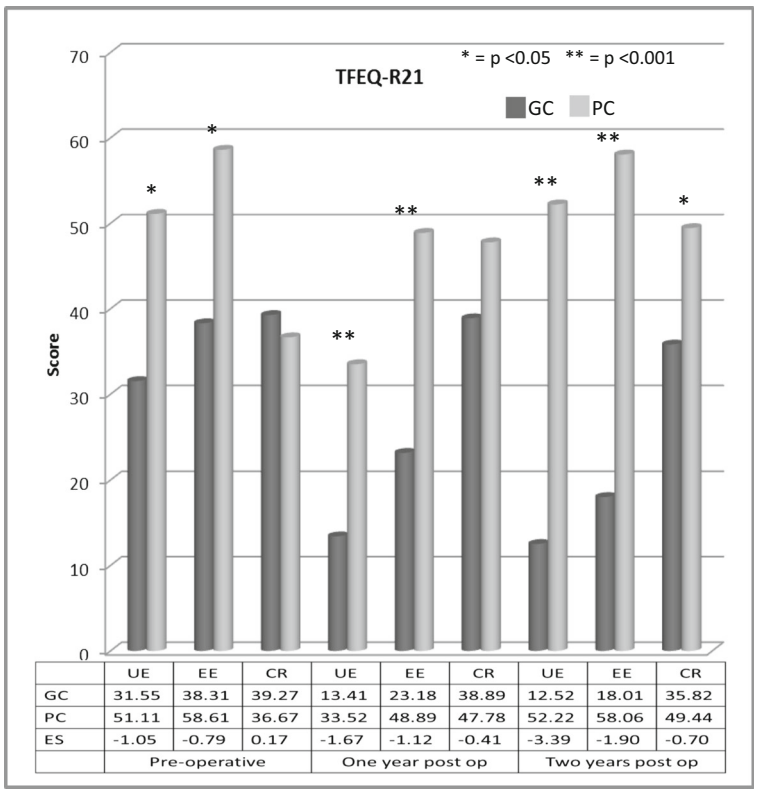
[b] Mean (SD)

from baseline to 2 years, from 36.7 (13.2) to 49.4 (19.5) (p<0.05), while no significant change was observed in GC group.

Neither patient age (r=−0.04, n.s) nor gender (r_s=−0.06, n.s.) were significantly associated with UE 2 years after surgery.

Generic HRQoL

Comparisons between group GC and PC showed no significant differences in the SF-36 subscales at baseline (Table 2). At 1-year follow-up, significantly better scores were noted for social function (p<0.05) and mental health (p<0.05) in group



	UE	EE	CR	UE	EE	CR	UE	EE	CR
GC	31.55	38.31	39.27	13.41	23.18	38.89	12.52	18.01	35.82
PC	51.11	58.61	36.67	33.52	48.89	47.78	52.22	58.06	49.44
ES	-1.05	-0.79	0.17	-1.67	-1.12	-0.41	-3.39	-1.90	-0.70
	Pre-operative			One year post op			Two years post op		

Fig. 2 TFEQ-R21 scores before and at 1 and 2 years after bariatric surgery in patients with good versus poor control of eating 2 years after surgery

TFEQ-R21: Three-Factor Eating Questionnaire-R21
UE: Uncontrolled Eating
EE: Emotional Eating
CR: Cognitive Restraint
GC: Good Eating Control
PC: Poor Eating Control
ES: Effect size of between-group differences in TFEQ-R21 scale scores. Criteria: trivial (0 to <0.20), small (0.20 to <0.50), moderate (0.50 to <0.80) and large (0.80+) differences.
Scale range: 0-100. Higher scores indicate more uncontrolled, emotional or restraint eating.
P-values are results from between-group comparisons (Mann-Whitney U-test)

GC. After 2 years, group GC reported significantly better generic HRQoL compared to group PC in seven of eight SF-36 domains. Effect size estimates indicated large between-group differences for general health and vitality, moderate differences for physical function, social function, role-emotional and mental health, and small differences for role-physical and bodily pain (Table 2).

Between baseline and 2-year follow-up, the GC group had significant improvements in all SF-36 domains except mental health ($p=0.06$): physical function, role-physical, bodily pain and general health ($p<0.001$), and vitality, social function and role-emotional ($p<0.05$).

In the PC group, significant improvements were observed for five of the eight SF-36 subscales from baseline to 2 years post-operatively: vitality ($p=0.01$), physical function, physical role, bodily pain and general health ($p<0.05$). There were no significant improvements in social function, role-emotional or mental health at follow-ups.

Psychosocial Function and Condition-Specific HRQoL

Results for the obesity-specific OP-scale revealed no significant difference between the groups at 2-year follow-up (Fig. 3) ($p=0.20$). Both groups showed significant improvement in psychosocial function from baseline to 2 years after surgery ($p<0.001$).

Weight Loss

There were no significant differences in weight reduction between the two groups at 1 and 2 years after surgery ($p=0.86$ and $p=0.27$). GC group lost 63.7 % (15.6) and 71.2 % (17.8) of their overweight (%EBL) after 1 and 2 years, respectively. PC group had lost 62.9 % (6.7) after 1 year and 65.4 % (17.4) after 2 years. However, GC group had a significant weight loss between 1 and 2 years after surgery ($p<0.001$), in contrast to PC group ($p=0.15$).

Conclusion

The main finding of this study was that eating behaviour varied substantially among patients 2 years after surgery. From 49 patients, significantly more dysfunctional eating patterns were observed in the group identified as having poor eating control both at baseline and after 1 and 2 years. Between-group differences in UE and EE were large even before surgery but had increased significantly at 2-year follow-up. Group PC also

Table 2 SF-36 health profiles at baseline and 1- and 2-year follow-up after bariatric surgery in patients with good (group GC) versus poor (group PC) eating control 2 years after surgery

	SF-36 scales[a]							
	PF	RP	BP	GH	VT	SF	RE	MH
Baseline								
GC group[2]	50.9 (27.6)	55.2 (34.2)	48.4 (28.6)	48.9 (19.2)	38.8 (23.8)	56.5 (35.5)	70.1 (34.4)	66.6 (20.9)
PC group[3]	52.8 (17.8)	47.5 (35.7)	45.9 (29.4)	45.3 (21.6)	35.6 (22.6)	68.1 (28.8)	61.7 (37.0)	60.5 (21.9)
p value	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Effect size[4]	−0.08	0.22	0.09	0.18	0.14	−0.36	0.24	0.28
1 year								
GC group	88.1 (18.2)	84.3 (27.0)	74.8 (28.4)	80.4 (20.3)	62.9 (26.2)	90.5 (17.6)	91.1 (19.9)	80.2 (14.0)
PC group	82.3 (15.3)	80.0 (27.0)	63.9 (29.2)	72.4 (17.9)	51.6 (25.8)	73.1 (27.0)	77.1 (30.1)	67.8 (20.3)
p value	n.s	n.s	n.s	n.s	n.s	*	n.s	*
Effect size	0.35	0.16	0.38	0.42	0.44	0.78	0.56	0.72
2 years								
GC group	92.9 (7.5)	86.9 (24.9)	75.1 (30.2)	83.2 (17.8)	67.0 (25.0)	87.9 (21.3)	88.8 (19.5)	76.7 (20.6)
PC group	84.8 (15.8)	78.4 (28.6)	62.5 (28.0)	64.3 (24.7)	46.6 (20.0)	71.3 (26.6)	72.5 (30.2)	64.3 (19.4)
p value	*	*	n.s	*	*	*	*	*
Effect size	0.70	0.31	0.43	0.89	0.91	0.70	0.66	0.62

Scale range: 0–100. Higher scores indicate better health status. Effect size of between-group differences in SF-36 scale scores. Criteria: trivial (0 to <0.20), small (0.20 to <0.50), moderate (0.50 to <0.80) and large (0.80+) differences

PF physical function, *RP* role-physical, *BP* bodily pain, *GH* general health, *VT* vitality, *SF* social function, *RE* role-emotional, *MH* mental health

GC group (good eating control): uncontrolled eating scores <28.7 2 years after surgery

PC group (poor eating control): uncontrolled eating scores >28.7 2 years after surgery

*$p<0.05$ (Mann-Whitney *U* test)

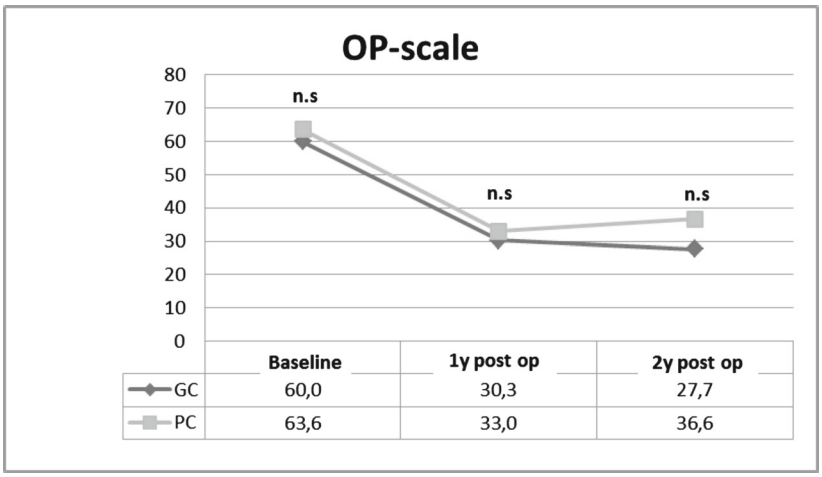


Fig. 3 Psychosocial functioning before and after bariatric surgery in patients with good (group GC) and poor (group PC) eating control 2 years after surgery

OP-scale: Obesity-related problems scale
Scale range: 0-100, where a higher score indicates more psychosocial restrictions due to obesity
P-values are results from between-group comparisons (Mann-Whitney U-test)

reported higher cognitive restraint after 2 years. Improvements in eating behaviour were observed in group PC after 1 year, but after 2 years, they had returned to baseline levels, while major improvements in group GC were stable after 1 and 2 years.

Patients with poor eating control reported worse generic HRQoL 2 years after surgery, and no significant improvements in social function, role-emotional or mental health were observed at 2-year follow-up. A qualitative study found that patients who had difficulties controlling eating behaviour after bariatric surgery also expressed a high level of disappointment about their life situation [20]. Other studies have found an association between uncontrolled eating after surgery and worse mental health [17, 18]. In the present study, patients with poor eating control experienced worse mental health but reported also slightly worse physical health status 2 years after surgery.

Both groups reported less psychosocial restriction due to their obesity after surgery, and we found no significant differences between the groups at follow-up. One possible explanation is that no patient remained super-obese, which reduces the negative impact of obesity on psychosocial functioning. The positive effects on psychosocial function after bariatric surgery have been described by others [35]. However, group GC had a continued positive trend in OP between the first and second year, in contrast to group PC who experienced deterioration during the second year. The absence of a significant difference between the groups might be explained by type II statistical error, with a small sample size.

An interesting finding is that group GC, in contrast to group PC, experienced continued significant weight loss during the second year after surgery, although total weight loss did not differ significantly between groups at 2 years. Several studies have reported that loss of eating control after surgery is associated with less weight loss [16, 19, 36] and insufficient weight reduction leads to lower HRQoL and decreased patient satisfaction [3, 37]. Since the differences between the two study groups might continue to increase after 2 years, we plan to evaluate outcomes after 5 years.

Our results suggest that assessment of eating behaviour after surgery is important, since the long-term outcome depends on the patients' ability to maintain the initial changes in eating habits. Our findings show that TFEQ-R21 is a useful tool for identifying those at high risk for dysfunctional eating patterns, especially during the second year after surgery when some patients seem to experience problems with control overeating. Development of interventions to support patients with high risk eating patterns is important in order to optimise the long-term outcome of bariatric surgery. Cognitive behavioural therapy has been found to have a beneficial effect on dysfunctional eating and HRQoL for bariatric patients suffering from emotional and/or binge eating. The objective of treatment is to provide strategies to better cope with uncontrolled and emotional eating [38–40].

The small study group is a limitation, and since all participants were super-obese, the results may not be representative of bariatric patients in general. Also, we used a retrospective design since this was the best approach for addressing our hypothesis that a subgroup of patients begin to have problems with eating control during the second year after surgery.

In conclusion, eating behaviour varied substantially among patients 2 years after surgery, and two groups with good or poor eating control were identified. The group with poor eating control reported worse generic quality of life, but there was no difference in weight loss between the groups 2 years after surgery.

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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