

ORIGINAL ARTICLE

Impact of Bariatric Surgery on Intervertebral Disc Pathology and Low Back Pain

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Background: Obesity is a growing global health concern associated with a range of comorbidities, including chronic low back pain (LBP) and intervertebral disc (IVD) degeneration. Bariatric surgery (BS) is a well-established intervention for significant weight reduction; however, its impact on spinal health, particularly LBP and disc pathology, remains inconclusive. This study aimed to assess the effects of bariatric surgery on intervertebral disc height and chronic low back pain using both imaging and clinical outcome measures.

Methods: This retrospective pre–post observational study analysed 31 obese patients (BMI ≥ 30 kg/m²) with chronic LBP who underwent bariatric surgery at a single tertiary hospital. Clinical outcomes, including BMI, Visual Analogue Scale (VAS) for pain, Disability Rating Index (DRI), and Roland-Morris Disability Questionnaire (RMD), were assessed before surgery and postoperatively after a minimum follow-up of 3 months. MRI scans were evaluated using the modified Pfirrmann grading system to assess disc degeneration. Statistical analyses included paired t-tests and Wilcoxon signed-rank tests.

Results: The study cohort had a mean age of 42.8 years, with 87% of participants being female. Postoperative BMI was significantly reduced ($p < 0.001$), confirming effective weight loss. However, there were no statistically significant improvements in VAS, DRI, or RMD scores nor in Pfirrmann grades at any lumbar level ($p > 0.05$). A significant association was found between older age (>40 years) and higher postoperative RMD scores ($p=0.010$).

Conclusion: While bariatric surgery effectively reduces BMI, it does not appear to confer statistically significant short- to mid-term benefits for LBP or IVD degeneration. These findings suggest that weight loss alone may be insufficient to address spinal pathology and highlight the need for integrated, multimodal management strategies. Further long-term prospective studies are needed to evaluate the potential delayed effects of weight reduction on spinal health.

Keywords: Bariatric surgery, low back pain, intervertebral disc degeneration, obesity, MRI, Pfirrmann grading, spinal health

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Introduction

Obesity is a preventable, multifactorial disease that poses a wide range of health risks to patients and has become a global health burden due to its rising prevalence. Body mass index (BMI) – a calculation of an individual's body weight relative to their height – is typically used to classify different levels of obesity. These categories are overweight (25.0–29.9 kg/m²); obesity Class 1 (30.0–34.9 kg/m²); Class 2 (35.0–39.9 kg/m²); and Class 3, also known as morbid obesity (>40.0 kg/m²).^{1,2} In 2021, the six leading contributors to disability-adjusted life years (DALYs) due to high BMI were diabetes mellitus, ischemic heart disease, hypertensive heart disease, chronic kidney disease, lower back pain, and stroke, among other health issues³. It is estimated that 40% of the world's adult

population will be overweight, while 20% will be considered obese by 2030⁴. As of 2024, the obesity rate in Bahrain has escalated to 41%⁵. Additionally, a surge in intervertebral disc degeneration and lower back pain has been recorded, affecting around one-third of obese individuals and adding to the considerable strain on the public health system⁶.

Lower back pain (LBP) is acknowledged as a serious concern among obese patients, with weight loss frequently recommended as a primary treatment despite a lack of robust research supporting its therapeutic effectiveness. This recommendation stems from the association of obesity with lower back pain due to its role in increasing axial load on the spine and adipose-derived inflammation^{4,7}. Central obesity, in particular, shifts the body's centre of gravity, resulting in

excessive mechanical stress on the intervertebral discs and facets, which diminishes disc space and heightens lumbar lordosis. Furthermore, the metabolic activity in adipose tissue is known to elevate pro-inflammatory factors such as TNF- α , IL-6, and CRP, which further exacerbate disc degeneration and chronic inflammation^{7,8}. Moreover, obese patients with vertebral conditions necessitating spinal surgery tend to benefit less than those with a lower BMI and are at higher risk for complications including infections and venous thromboembolism⁹.

Given the multifactorial link between obesity and low back pain, weight reduction has emerged as a feasible treatment strategy in the comprehensive management of obese patients with spinal pathology, particularly via bariatric surgery (BS). Over the last few decades, the rise of bariatric surgical procedures has significantly contributed to weight reduction and alleviation of related comorbidities, especially when conservative weight loss methods have proven ineffective¹⁰. The dramatic weight loss post-surgery results in axial offloading and reduces inflammation, theoretically facilitating improvements in disc compression, degeneration, and pain. Nevertheless, bariatric surgery is not without its complications. In regards to spinal health, BS has been linked to a notable decrease in bone mineral density and increased risk of fracture, as well as spinal diagnoses, including stenosis, disc herniation, and spondylolisthesis^{11,12}. These effects tend to be more pronounced in post-menopausal women, a population with the highest prevalence of both obesity and low back pain¹³. These conflicting findings contribute to ongoing controversy regarding the appropriateness of BS for treating intervertebral pathology in obese individuals. Multiple studies have indeed shown a decrease in lower back pain, inflammatory cytokines, and quality of life following bariatric surgery^{7,10}. Nevertheless, other studies displayed negligible findings, and there remains a lack of definitive data on intervertebral disc height changes following significant weight reduction⁶.

Magnetic resonance imaging (MRI) is a widely used technique for assessing intervertebral disc degeneration. Pfirrmann et al¹⁴, devised a grading system for disc degeneration based on aspects such as MR signal intensity, disc structure, the distinction between nucleus and annulus, and disc height. The primary aim of this study is to observe the impact of substantial weight reduction achieved post-bariatric surgery on intervertebral disc height and its effects on low back pain in obese individuals. These parameters will be investigated by comparing MRI findings using the Pfirrmann grading scale and assessing pain/disability by the Visual Analog Scale (VAS), Disability Rating Index (DRI), and the Roland-Morris Disability Questionnaire (RMD).

Methods

Study Protocol

A total of 31 patients suffering from chronic low back pain who were undergoing bariatric surgery from 2016 to 2020 at a single university hospital from the Orthopaedic Surgery, General Surgery, and Radiology Departments were retrospectively enrolled and analysed in this retrospective pre-post observational study, following meeting the set inclusion and exclusion criteria. A convenience sampling technique was implemented, where all male and female patients aged 20 to 80 years who meet the inclusion and exclusion criteria were enrolled. A total of 31 patients were enrolled, including 4 males and 27 females, resulting in a predominantly female cohort. Data were collected from the radiology and the HOPE health record system at the hospital, supplemented by communication with patients and their families. The collected data was then used to investigate the impacts of post-bariatric weight reduction on intervertebral disc height and its effects on low back pain in the enrolled participants. Ethical approval was received by the overseeing research ethics committee. Patients were included if they were obese (defined as a BMI ≥ 30 kg/m²), aged between 20 to 80 years, and had undergone a bariatric surgical procedure (Laparoscopic Sleeve Gastrectomy, Laparoscopic Roux-en-Y Gastric Bypass, Mini Gastric Bypass). Moreover, patients must have presented with episodes of low back pain greater than four weeks in duration and had at least 1-year follow-up for low back aches. Lastly, patients were required to have a preoperative MRI and a postoperative MRI obtained at least 3 months after bariatric surgery. The mean postoperative follow-up duration was 24 ± 18 months, with a range of 3 to 73 months. Exclusion criteria included prior lumbar spine surgery, psychological disorders, suspected secondary gain related to MRI utilization, prescription narcotic dependence, and referred pain of visceral or somatic origin. These exclusions were applied to reduce potential confounding from factors that could independently affect pain perception, functional disability scores, symptom reporting, or the attribution of symptoms to lumbar disc pathology.

Data Collection

The data collected from patients included clinical information regarding their bariatric surgery, MRI imaging findings, and orthopaedic visits were taken from the HOPE online database system utilized by the hospital. Additionally, participants' responses to the Visual Analog Scale for Pain (VAS Pain) were collected, where the VAS Pain scale is a unidimensional measure of pain intensity, widely used in diverse adult populations to categorize the level of pain that a patient experiences. Additionally, clinical outcomes were evaluated using the Roland Morris Disability (RMD) Questionnaire and the Disability Rating Index (DRI). Lastly, MRI findings, including intervertebral disc changes and intervertebral height, were assessed using a modified Pfirrmann grading system based on routine radiological interpretation by multiple radiologists. Because of the retrospective nature of the study, formal blinded reassessment of the scans was not performed.

Statistical Analysis

All collected participants' data was anonymized and tabulated using spreadsheets. Standard descriptive statistics, including means and standard errors, were used to summarize the continuous measures and frequencies and percentages for the categorical measures for posterior stabilized and cruciate retaining groups. Statistical data were analysed using Statistical Packages for Social Sciences (SPSS) version 26 Armonk, NY: IBM Corporation. Categorical variables were shown as numbers and percentages, while continuous variables were presented as mean and standard deviation. A Paired t-test was conducted to determine the differences between BMI, VAS, DR, and RMD before and after bariatric surgery. Differences in Pfirrmann grade before and after surgery were analysed using the Wilcoxon signed-rank test. Given the exploratory nature of this retrospective study, no formal adjustment for multiple comparisons was performed; therefore, the results should be interpreted with appropriate caution. In addition, the Fischer Exact test was used to determine the association between patients' characteristics and age group. A P-value <0.05 was considered statistically significant.

Results

This study reviewed 31 patients before and after undergoing bariatric surgery and investigated the relevant changes in BMI, intervertebral disc, and height changes, as well as relevant VAS, DRI, RMD, and Pfirrmann MRI staging scores. Table 1 shows patients' mean age was 42.8 years (SD 10.6), with participants over 40 years old being dominant in the study (61.3%). Also, the majority of the patients in the study were female (87.1%). The mean postoperative follow-up duration was 24 ± 18 months (range: 3–73 months).

Table 1: Demographic characteristics of the patients (n=31)

Study variables	N (%)
Age in years (mean ± SD)	42.8 ± 10.6
≤40 years	12 (38.7%)
>40 years	19 (61.3%)
Gender	
Male	04 (12.9%)
Female	27 (87.1%)

In Table 2, the paired t-test indicates that the BMI levels after surgery were statistically significantly lower than before surgery ($p < 0.001$) (see also Figure 1). No significant differences were observed between VAS, DRI, and RMD before and after bariatric surgery ($p > 0.05$).

Table 2: Paired t-test of BMI, VAS DRI, and RMD before and after bariatric surgery (n=31)

Factor	Pre-Surgery Mean ± SD	Post-Surgery Mean ± SD	P-value §
BMI in kg/m ²	39.8 ± 7.89	31.2 ± 7.01	<0.001 **
VAS	6.52 ± 2.74	5.52 ± 2.26	0.127
DRI	770.9 ± 273.5	680.6 ± 355.4	0.178
RMD	7.32 ± 5.24	6.77 ± 5.38	0.630

§ P-value has been calculated using paired sample t-test.

** Significant at $p < 0.05$ level.

In Figure 1 below, a comparison of BMI value in kg/m² can be seen as measured before bariatric surgery and after surgery, where a significant reduction in BMI can be seen post-surgery ($p < 0.001$).

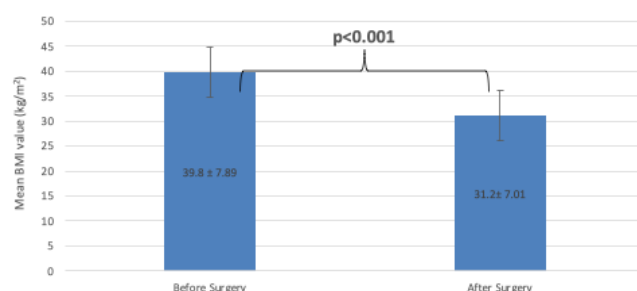


Figure 1: Comparison of BMI preoperatively and postoperatively after bariatric surgery.

Comparison of pre- and postoperative Pfirrmann grades at L1–L2, L2–L3, L3–L4, L4–L5, and L5–S1 using the Wilcoxon signed-rank test showed no statistically significant differences (all $p > 0.05$).

Table 3: Comparison of Pfirrmann grading before and after bariatric surgery using the Wilcoxon signed-rank test (n=31)

Factor	Pre-Surgery N (%)	Post-Surgery N (%)	P-value §
Pfirrmann L1-L2			

Stage 1	15 (48.4%)	12 (38.7%)	0.763
Stage 2	07 (22.6%)	13 (41.9%)	0.763
Stage 3	06 (19.4%)	04 (12.9%)	0.763
Stage 4	02 (06.5%)	01 (03.2%)	0.763
Stage 5	01 (03.2%)	01 (03.2%)	0.763
Pfirrmann L2-L3			
Stage 1	09 (29.0%)	08 (25.8%)	0.467
Stage 2	08 (25.8%)	12 (38.7%)	0.467
Stage 3	07 (22.6%)	05 (09.7%)	0.467
Stage 4	04 (12.9%)	03 (09.7%)	0.467
Stage 5	03 (09.7%)	03 (09.7%)	0.467
Pfirrmann L3-L4			
Stage 1	08 (25.8%)	05 (16.1%)	0.166
Stage 2	06 (19.4%)	09 (29.0%)	0.166
Stage 3	12 (38.7%)	10 (32.3%)	0.166
Stage 4	03 (09.7%)	05 (16.1%)	0.166
Stage 5	02 (06.5%)	02 (06.5%)	0.166
Pfirrmann L4-L5			
Stage 1	04 (12.9%)	01 (03.2%)	0.808
Stage 2	08 (25.8%)	12 (38.7%)	0.808
Stage 3	09 (29.0%)	08 (25.8%)	0.808
Stage 4	06 (19.4%)	07 (22.6%)	0.808
Stage 5	04 (12.9%)	03 (09.7%)	0.808
Pfirrmann L5-S1			
Stage 1	05 (16.1%)	05 (16.1%)	0.317
Stage 2	09 (29.0%)	08 (25.8%)	0.317
Stage 3	04 (12.9%)	09 (29.0%)	0.317
Stage 4	10 (32.3%)	07 (22.6%)	0.317
Stage 5	03 (09.7%)	02 (06.5%)	0.317

§ P-value has been calculated using the Wilcoxon signed rank test.

When comparing the age group and the postoperative characteristics of the patients (Table 4), it was found that the mean value of RMD was statistically significantly higher

among the older age group ($p=0.010$) (see also Figure 2). No significant differences were observed between the age group and the rest of the postoperative characteristics, including BMI, VAS, DRI, and all Pfirrmann stages ($p>0.05$).

Table 4: Postoperative characteristics of the patients according to age group (n=31)

Factor	Age ≤40 years N (%) (n=12)	Age >40 years N (%) (n=19)	P-value §
BMI in kg/m2 (mean ± SD)	31.2 ± 9.00	31.2 ± 5.68	0.981 ‡
VAS (mean ± SD)	5.08 ± 2.57	5.79 ± 2.07	0.407 ‡
DRI (mean ± SD)	650.0 ± 389.6	700.0 ± 341.6	0.710 ‡
RMD (mean ± SD)	3.75 ± 5.03	8.68 ± 4.77	0.010 ** ‡
Pfirrmann L1-L2			
Stage 1-2	10 (83.3%)	15 (78.9%)	1.000

Pfirrmann L2-L3			
Stage 1-2	08 (66.7%)	12 (63.2%)	1.000
Stage 3-5	04 (33.3%)	07 (36.8%)	1.000
Pfirrmann L3-L4			
Stage 1-2	06 (50.0%)	08 (42.1%)	0.724
Stage 3-5	06 (50.0%)	11 (57.9%)	0.724
Pfirrmann L4-L5			
Stage 1-2	06 (50.0%)	07 (36.8%)	0.710
Stage 3-5	06 (50.0%)	12 (63.2%)	0.710
Pfirrmann L5-S1			
Stage 1-2	06 (50.0%)	07 (36.8%)	0.710
Stage 3-5	06 (50.0%)	12 (63.2%)	0.710

§ P-value has been calculated using the Fischer Exact test.

† P-value has been calculated using an independent sample t-test.

** Significant at $p < 0.05$ level.

In an exploratory age-stratified analysis, postoperative RMD scores were higher among patients aged >40 years compared with those aged ≤ 40 years (Figure 2; $p = 0.010$).

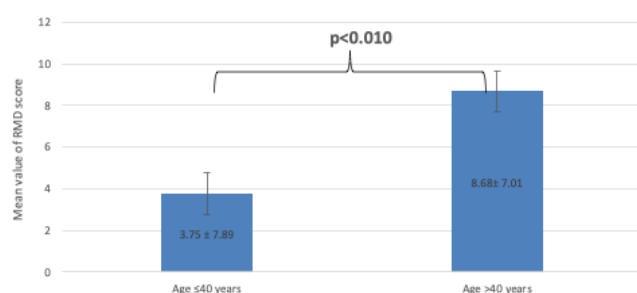


Figure 2: Comparison of Roland-Morris Disability (RMD) mean value according to age group postoperatively.

Discussion

In analysing the demographic and clinical characteristics of our 31-patient cohort, the mean age of patients was 42.8 years, with most participants being above the age of 40 (61.3%), and a predominant female majority of 87.1% of the patients. The female majority of participants with LBP aligns with the growing literature indicating a higher prevalence of LBP in women compared to men¹⁵. There was a statistically significant BMI reduction post-bariatric surgery ($p < 0.001$) with no statistically significant improvements in LBP before and after bariatric surgery as expressed through the VAS, DRI, and RMD scores ($p > 0.05$), as well as no significant change in disc degeneration as portrayed by the Pfirrmann stages ($p > 0.05$). From a clinical perspective, the mean change in VAS was 1.0 point (6.52 to 5.52), and the mean change in RMD was 0.55 points (7.32 to 6.77), both of which fall below commonly cited thresholds for minimal clinically important change in low back pain outcomes. This suggests that, in addition to being statistically non-significant, the average postoperative changes were also unlikely to represent clinically meaningful improvement at the group level. An exploratory age-stratified

analysis showed higher postoperative RMD scores among patients older than 40 years ($p = 0.010$). However, given the small sample size, additional subgroup comparisons, and lack of adjustment for multiple testing, this observation should be interpreted cautiously and considered hypothesis-generating. While bariatric surgery is well-established for its metabolic and cardiovascular benefits, its impact on musculoskeletal disorders, particularly low back pain (LBP) and intervertebral disc (IVD) degeneration, remains less definitive. Our findings with regard to no statistically significant improvement in LBP despite BMI reduction echo previous studies in the literature, which demonstrate that reductions in BMI do not consistently translate into proportional improvements in LBP. Lee et al.¹⁶, using data from the Korean National Health and Nutrition Examination Survey, reported no significant relationship between weight change and chronic LBP in individuals over 50 years of age, even in those with a ≥ 6 kg weight reduction. Similarly, a meta-regression analysis including five studies found no statistically significant correlation between BMI reduction and pain score improvement or decrease in pain score ($r = 0.034$, $p = 0.19$).⁶ Lidar et al.¹⁷ also failed to identify a significant relationship between decreased BMI and back pain improvement ($r = 0.231$, $p = 0.218$), highlighting the complexity of LBP pathophysiology and suggesting that weight loss alone may be insufficient in alleviating symptoms.

Conversely, some prospective studies demonstrate a positive correlation between post-bariatric weight loss and reductions in LBP severity. Lidar et al.¹⁷ reported that a 37 kg average weight loss over 12 months was associated with a significant reduction in axial and radicular LBP. Vincent et al.¹⁸ and Khoeir et al.¹⁹ similarly observed substantial reductions in LBP severity by 54% and 44% respectively and improvements in quality-of-life post-bariatric surgery. These discrepancies may be attributed to variations in study design, sample characteristics, follow-up duration, and whether disc degeneration had already progressed beyond reversibility at the time of intervention. Moreover, mechanical offloading via

weight loss may not be enough to reverse structural disc pathology once it has advanced. Nevertheless, as Johnston et al.²⁰ noted, even modest weight loss can yield clinically significant improvements in symptoms, but the absence of direct correlation with BMI change suggests other mechanisms, possibly inflammatory or neuroplastic, may mediate pain perception.

One explanation for the limited symptom relief in some patients is the persistence of chronic structural changes. Samartzis et al.²¹ emphasized that advanced disc degeneration, characterized by disc space narrowing, osteophytic changes, and spinal canal stenosis, is unlikely to be reversible through mechanical unloading through weight loss alone. Moreover, obesity may exert its effects not only through mechanical loading but also through systemic inflammatory responses mediated by adipocytokines (e.g., leptin, tumour necrosis factor- α [TNF- α], Interleukin-6 [IL-6]) and vascular insufficiency to the vertebrae, through atherosclerosis and high serum lipids, contributing to disc hypoxia and degeneration²¹. Age-related alterations in supraspinal pain processing may also explain variability in patient outcomes. Older adults may experience enhanced or diminished pain perception due to neurodegenerative changes affecting pain modulation pathways, including the insular cortex, striatum, and prefrontal cortex.²² This could mask or amplify reported LBP despite anatomical improvements post-surgery, complicating the interpretation of subjective pain outcomes²². Methodological limitations in our study may have further contributed to these results. The relatively short postoperative follow-up period may have been insufficient to capture the full extent of disc rehydration or remodelling. Additionally, the small cohort sample size, predominance of female participants (87%), and absence of a non-surgical control group limit the generalizability and inferential strength of our findings. In particular, the female predominance may reduce generalizability to male patients and more sex-balanced bariatric populations.

Our study highlights that while bariatric surgery may facilitate significant weight loss and potential mechanical offloading, it should not be considered a standalone solution for managing LBP or IVD pathology. Multimodal management strategies, including physiotherapy, targeted trunk muscle activation, and patient education, remain essential for optimizing outcomes. The 2021 JOSPT clinical practice guidelines emphasize exercise interventions tailored to pain location and chronicity, including core strengthening, movement control, and multimodal approaches, particularly in older adults and those with chronic or postoperative pain²³. Additionally, clinicians must counsel patients that while weight loss improves cardiovascular and metabolic health, its impact on spinal symptoms may be delayed or limited by irreversible disc pathology, central sensitization, or altered pain processing²⁴.

Despite the absence of statistically significant changes in Pfirrmann grades at any lumbar level after bariatric surgery (all $p > 0.05$), some non-significant directional changes were observed on MRI; however, these should not be interpreted as evidence of definite disc improvement. At the L2-L3 level, the number of patients with Grade 2 degeneration increased from 8 (25.8%) preoperatively to 12 (38.7%) postoperatively. A similar pattern was observed at L3-L4, with Grade 2 cases increasing from 6 (19.4%) to 9 (29.0%), and at L4-L5, from 8 (25.8%) to 12 (38.7%). These shifts, although not reaching statistical significance, suggest mild regression in degenerative changes in some mid-lumbar discs, possibly reflecting early biomechanical unloading following significant weight loss, and potential rehydration in mid-lumbar segments, which are less burdened than the lower L5-S1 segment. Conversely, the lower lumbar segments, particularly L5-S1, showed minimal change, with the majority of patients remaining in Grades 3 to 5, consistent with irreversible degeneration due to sustained axial load over time. Notably, 11 out of 31 patients (35.5%) demonstrated improvement by at least one Pfirrmann grade at one or more lumbar levels. While not statistically significant, these isolated disc-level improvements underscore the heterogeneity in disc response to weight loss and suggest early signs of remodelling may occur in less severely degenerated discs and may be possible even within a short follow-up period of 3 to 12 months.

The notion that weight gain or obesity places an increased axial load on the mid-lumbar has been demonstrated in previous studies, where a study by Urquhart et al.²³ specifically examined the relationship between obesity and intervertebral disc height across different lumbar levels. They found that obesity was associated with reduced disc height at the L1-L2 and L3-L4 levels. However, no significant relationship was observed at the lumbosacral junction (L5-S1), consistent with our study's findings²³. This suggests that the impact of obesity on disc height may vary along the lumbar spine, potentially due to differences in biomechanical loading or susceptibility to degeneration at different levels²³. Lidar et al.'s¹⁷ study further supports this claim, where they found that reduction in body weight after bariatric surgery in morbidly obese patients was associated with a significant radiographical increase in the L4-L5 disc space height as well as a significant clinical improvement in axial back and radicular leg pain one-year post-surgery, suggesting that substantial weight loss can lead to radiographic improvements in disc morphology.

Obesity contributes to intervertebral disc degeneration not only through increased axial loading but also via metabolic and inflammatory mechanisms, where adipose tissue secretes pro-inflammatory cytokines such as TNF- α , IL-6, and leptin²⁵. These mediators accelerate matrix breakdown and disrupt disc cell homeostasis, contributing to higher Pfirrmann grades and disc height loss²⁵. Weight loss, particularly through bariatric

surgery, can reduce these inflammatory signals and mechanical stresses, potentially restoring glycosaminoglycan content, improving disc hydration, and stabilizing the micro-nano environment of the intervertebral disc²⁶. Additionally, improved vascular supply and nutrient diffusion associated with weight loss may promote disc regeneration and preservation of extracellular matrix components like collagen and proteoglycans, both of which are closely linked to Pfirrmann grade progression²⁷. While longitudinal studies directly showing improvements in Pfirrmann grading post-weight loss are sparse, the correlation between high BMI and increased disc degeneration severity, as seen in the Mexican cohort study, supports a mechanistic link and the potential for radiological improvement following sustained weight reduction²⁷.

Given that disc degeneration is a chronic process, the relatively short time window in our study may have been insufficient to capture the full potential for disc remodeling post-surgery. Furthermore, the disconnect between radiological findings and patient-reported clinical outcomes (VAS, DRI, RMD), supports the complexity of LBP pathophysiology and supports the notion that Pfirrmann grading alone may not fully capture symptomatology or functional impact. These findings have direct implications for clinical practice and patient education within King Hamad University Hospital (KHUH) and the broader Bahraini healthcare system. Given the high prevalence of obesity and increasing demand for bariatric surgery, our results underscore the need for integrated care models that include postoperative physiotherapy and pain management services. Educating patients on realistic expectations, post-surgery is crucial for informed decision-making and long-term adherence to rehabilitation programs. Incorporating spine-specific assessments and preoperative counselling into bariatric protocols may enhance outcomes and reduce the burden of chronic musculoskeletal complaints on the healthcare system.

Future studies should involve larger, multicentre cohorts with stratification by age, sex, and baseline disc degeneration. Prospective longitudinal studies with extended follow-up, ranging from two and up to five years, are also essential to evaluate the durability of post-surgical improvements and potential disc regeneration. Incorporating advanced MRI techniques such as T2 mapping or quantitative water content analysis could provide more sensitive assessments of early disc recovery. Additionally, age-based stratification in future work may help clarify whether younger patients, who may have more regenerative potential, are more likely to benefit radiologically from weight reduction. Although some individual patients may have experienced symptomatic benefit, the present analysis was based on aggregate pre- and postoperative summary measures, and the proportion of patients achieving clinically meaningful improvement was not specifically analysed. Future studies should incorporate responder analyses based on predefined minimal clinically

important difference (MCID) thresholds. Lastly, investigating the efficacy of combining bariatric surgery with other modalities of treatment, such as structured rehabilitation programs, may also help optimize spinal outcomes.

Limitations

This study is constrained by its single-centre retrospective design, modest sample size, and potential selection bias. The relatively small cohort may have limited the statistical power to detect small to moderate but clinically meaningful changes in pain scores and Pfirrmann grading, increasing the risk of type II error. This concern is particularly relevant given the multiple comparisons performed across lumbar levels. In addition, multiple clinical outcomes and lumbar-level comparisons were assessed without formal correction for multiple testing, which increases the risk of type I error. Accordingly, statistically significant associations should be interpreted cautiously and considered exploratory. In addition, Pfirrmann grading was based on routine radiological assessment in a retrospective setting, and formal blinded reassessment of the scans was not performed, which may have introduced observer-related bias. Moreover, postoperative physical activity levels and participation in rehabilitation or physiotherapy were not measured or adjusted for, which may have influenced pain and functional outcomes independently of bariatric surgery itself. The lack of long-term imaging follow-up precludes assessment of delayed regenerative changes in the IVD. Furthermore, the absence of a matched non-bariatric control group limits our ability to discern whether observed trends were surgery-specific or simply reflective of natural disease progression, undermining the potential long-term effects that bariatric surgery may offer with regards to delaying the progression of LBP and IVD degenerative pathologies.

Conclusion

This study demonstrated that although bariatric surgery resulted in significant weight loss among obese patients, it did not yield statistically significant improvements in low back pain scores or intervertebral disc degeneration within the observed follow-up period. Although Pfirrmann grade changes were not statistically significant, 11 of 31 patients (35.5%) showed improvement at one or more lumbar levels, but overall, no statistically significant radiological improvement was observed during the follow-up period. These findings suggest that the relationship between obesity, spinal pathology, and symptom relief is multifactorial and may not be solely attributable to mechanical offloading. Given the complex pathophysiology of chronic low back pain, including potential irreversible disc changes and altered pain processing, bariatric surgery should be considered part of a comprehensive treatment plan rather than a stand-alone intervention. Future large-scale, prospective studies with longer follow-up durations and combined therapeutic strategies are warranted to fully elucidate the role of weight loss in spinal health and patient-reported outcomes.

Abbreviations

BMI: Body Mass Index

LBP: Low Back Pain

IVD: Intervertebral Disc

BS: Bariatric Surgery

MRI: Magnetic Resonance Imaging

VAS: Visual Analog Scale

DRI: Disability Rating Index

RMD: Roland Morris Disability Questionnaire

TNF- α : Tumor Necrosis Factor-alpha

IL-6: Interleukin-6

CRP: C-Reactive Protein

DALYs: Disability-Adjusted Life Years

MR: Magnetic Resonance

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Competing interests: The authors declare that they have no competing interests.

Ethics approval and consent to participate: Ethical approval was received by the Royal Medical Services research ethics committee, providing the ethical approval for conducting research at KHUH (IRB-20-335). All participants provided informed consent prior to their involvement in the study.

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