

*Original article***Prior bariatric surgery is effective on morbidly obese patients following total knee arthroplasty.**Shingo Iwata^{1,2)}, Akeo Hagiwara²⁾, Keiichiro Nakamae³⁾

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Abstract

It is reported that bariatric surgery is effective in patients with morbid obesity, especially when there is difficulty in weight reduction or rebound phenomenon from therapy including internal medicine. Generally orthopedic operations for patients with knee osteoarthritis (both sides) and a high body mass index (BMI) over 50 kg/m², have a risk of post-operative complications and sometimes functional improvement cannot be expected. We report here a case where total knee arthroplasty (TKA) was successfully performed for both sides after the weight reduction by laparoscopic sleeve gastrectomy (LSG). A 60-year-old morbidly obese male (BMI 50.8 kg/m²) was referred for bariatric surgery consultation. The patient complained of continuous severe knee joint pain, and was ordered to undergo weight reduction by an orthopedic surgeon before performing TKA, and then introduced to our hospital. Past and present illness included epilepsy, and accompanied with obesity-related complications; hypertension, dyslipidemia, fatty liver, sleep apnea syndrome, and type 2 diabetes (border-line). The educational admission was conducted aiming to reduce the risk of LSG and learn adequate lifestyles for weight reduction therapy. By the team medical treatment for weight reduction, including LSG, the operation was successful and his post-operative condition was maintained; BW 84 kg 8 month after LSG, a 58 kg reduction from the first visit. Ten months after LSG, a left side TKA was performed, and 4 months later, a right side TKA performed. After LSG, obesity-related complications were markedly improved. Furthermore, after TKA, knee pain was relieved, knee joint swelling disappeared, and his walking distance was extended. This case of morbid obesity showed that successful weight reduction was obtained by pre-performing LSG, thus reducing the risk of TKA and protecting against complications, and the activity of daily life and quality of life was improved by as a result of the team medical treatment.

KEY WORDS: morbid obesity, weight reduction before surgery, laparoscopic sleeve gastrectomy (LSG), bariatric surgery, total knee arthroplasty (TKA), knee osteoarthritis

Introduction

In patients with obesity and metabolic syndrome, oxidative stress and glycative stress are generally high. The numbers of these patients have increase nowadays, and it became a social problem against which it's necessary to take measures. Medical therapy alone is often ineffective for patients with morbid obesity and sometime induces a rebound. Especially for these patients, on the other hand, bariatric surgery is reported to be effective¹⁾. It is known that bariatric surgery reduces prevalence of obesity-related complications and improves the quality of life (QOL) and mortality²⁻⁴⁾. With the worldwide increase in the obese population, the number

of bariatric surgery procedures has increased⁵⁾. On the other hand, although bariatric surgery is still not generalized and related reports⁶⁾ are few from Japan, laparoscopic sleeve gastrectomy (LSG), as a bariatric surgery procedure, has been covered by medical insurance in Japan for patients with morbid obesity since 2014, and the number of patients undergoing this surgery tends to be increased steadily.

Insurance coverage requirements in Japan are as follows: Even if medical therapy for more than 6 months is performed, weight reduction is insufficient; Body mass index (BMI) is 35kg/m² or more; A patient accompanied with one or more of

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type 2 diabetes mellitus (T2DM), hypertension, dyslipidemia, sleep apnea syndrome (SAS). However, obesity is an exacerbation factor for the locomotor disorders including knee osteoarthritis (OA) or lumbar joint disorders. In the present report, we introduce a case of super obesity with knee OA, where bariatric surgery decreased the high operation risk due to obesity, followed by total knee arthroplasty (TKA).

Case presentation

The patient: A male at the age of 60 years.

Chief complaint: To receive bariatric surgery.

Anamnesis: At the age of 20, body weight (BW) 90 kg; At the age of 28; epilepsy attack and medication started; At the age of 30, BW 100 kg; At the age of 35, enucleation of brain tumor (BW 110 kg); At the age of around 50, knee pain increased, consulted an orthopaedist and diagnosed as knee OA; At the age of 54, BW 130 kg and consulted an internist. Tried weight reduction, at first 20 kg reduction then rebounded to over 140 kg. Knee symptoms deteriorated, accompanied by back pain, walking distance decreased. The orthopaedist told the patient that TKA should be taken into consideration but is difficult unless BW is reduced to less than 90 kg. The patient tried conservative weight reduction but the result was only 1 kg weight reduction. Since obesity was physical-therapy resistant and accompanied with SAS, hypertension and fatty liver, the internist recommended bariatric surgery and then introduced him to our hospital.

Past history: At the age of 3, epilepsy attack, diagnosed as benign brain tumor.

Operation history: At the age of 35, enucleation of brain tumor, no attack after the surgery.

Family history: Mother; hypertension, subarachnoid hemorrhage.

Life history: Smoking history, none; Drinking history, none.

Medication history: For both-side knee pain, loxoprofen sodium hydrate 120 mg/day, rebamipide 200 mg/day, esomeprazole magnesium hydrate 20 mg/day, and mosapride citrate hydrate 15 mg/day; for epilepsy attack, aripiprazole 9~15 mg/day, carbamazepine 800 mg/day, diazepam 20 mg/day, and eszopiclone 3 mg/day; for hypertension, azilsartan 10 mg/day and controlled release nifedipine 60 mg/day.

Clinical data of the first visit: Morbid obesity was recognized with a height; 167.4 cm, BW; 142.3 kg, BMI; 50.8 kg/m² and blood pressure; 163/78 mmHg (under medication). Endocrine tests excluded secondary obesity. Electro-cardiogram shows within normal range. Computed tomography showed no abnormal finding, except fatty liver.

Upper GI endoscopy: No abnormal finding. Helicobacter pylori negative.

Colonoscopy: Four polyps were noted and, performing polypectomies, turned out to be adenoma by pathological diagnosis.

Pulmonary function tests: % vital capacity (%VC) 90.2% and forced respiratory volume 1.0 (sec) % of Gaensler (FEV 1.0 %-G) 80.96%. Function recovered to the level with %VC 98.9% and FEV 1.0 %-G 82.05%. Spirogram data also ameliorated by the weight reduction before the surgery.

Ethical standard

Before starting this surgery, a written consent was obtained from the patient. This study was implemented in compliance with the Helsinki Declaration (as revised in 1975, 1983). This study was approved by the ethics committee of this hospital

Aims for the therapy

The aims of the educational hospitalization were as follows: 1) weight loss and getting into good health for the operation 2) evaluation of the capability for the patient to endure dietary restrictions 3) guidance for appropriate eating manners 4) observation and assessment of behavioral patterns of having low caloric diet including a formula meal 5) assessment to judge if he would be able to withstand more severe diet control post-operation 6) loss of weight to reduce the quantity of visceral fat so that the lateral division of liver, which was compensatory hypertrophy due to fatty liver, could be reduced to as little as possible for the surgery to be conducted safely.

Flow from the educational admission, at the operation and postoperative course;

Figure 1 shows the time course and changes of BW. In the first admission among the four educational admissions, patient's BW reduced from 142 kg to 132 kg in one month by the diet therapy starting from 1,000 kcal/day. In the second admission, after one week period of discharge, the BW maintained at 130 kg without increase, the diet therapy started again from 1,000 kcal/day; BW reduced from 130 kg to 125 kg. In the third admission, BW reduced from 124 kg to 118 kg by 1,000 kcal/day diet. In the fourth admission, BW reduced from 118 kg to 114 kg, and BMI became less than 40 kg/m² by 800 kcal/day diet additionally using the formula diet. The patient adhered to dietary instructions during the educational admission and BW was reserved as the same level after discharge. Then we judged as indications for bariatric surgery and prepared for the fifth hospitalization. The weight reduction was successful from 142.3 kg (BMI 50.8 kg/m²) at the first visit to 114.0 kg (BMI 40.7 kg/m²) by 28 kg as a result of the diet and exercise therapy during four admissions of 3 weeks each.

The visceral fat area was measured at the first admission and just before the surgery by using a visceral fat measuring device (HDS-2000; Dualscan, Omron Healthcare Co., Ltd., Kyoto, Japan)⁷⁾. Visceral fat area reduced from 243 cm² to 183 cm². **Table 1** shows the data of blood biochemical examination at the first visit and just before the operation; noted abnormal values in hepatic enzymes. LSG was performed 4 months after the first educational admission.

LSG⁸⁾: Under a general anesthesia, the procedure involved a longitudinal resection of the omentum majus starting from the antrum at the point 4 cm from the pylorus in greater curvature of the stomach and finishing at the His angle. After resection of the omentum, the stomach was resected on the side of greater curvature by a surgical stapling device with the guidance of an endoscope. Thus, after surgically removing

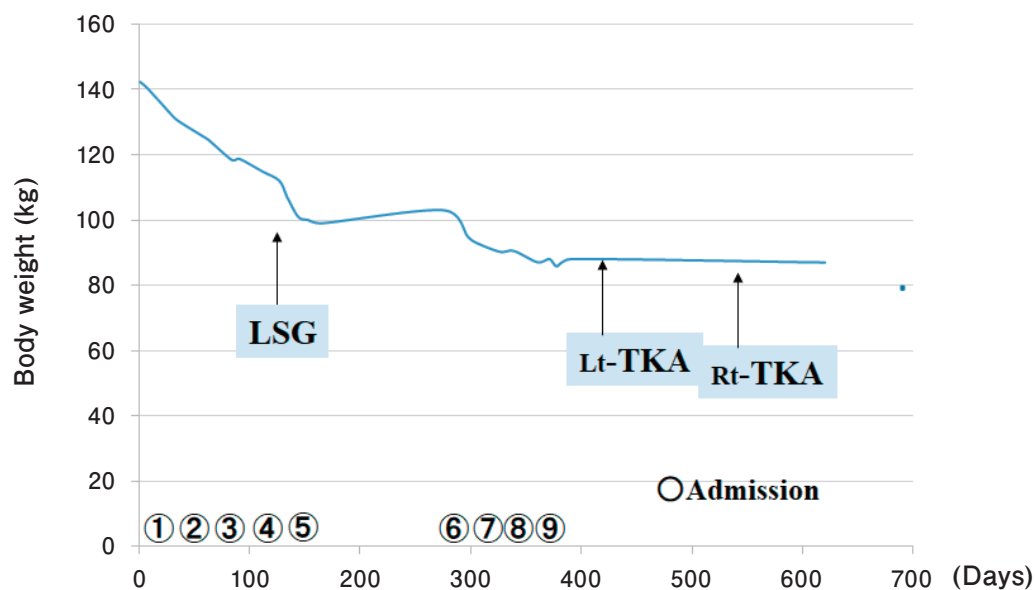


Fig. 1. Clinical course (Changes in body weight)

LSG, laparoscopic sleeve gastrectomy; TKA, total knee arthroplasty.

Table 1. Laboratory data on first visit, preoperative day 1, and postoperative 17 months.

		First visit	Pre-LSG 1	Post-LSG 17 M
WBC	/ μ L	5900	4800	3300
Hb	g/dL	14.8	14.5	13.4
Hct	%	45.3	43.4	40.0
Plt	$\times 10^4$ / μ L	22.5	18.6	17.7
TP	g/dL	7.8	7.6	6.7
Alb	g/dL	4.7	4.6	4.0
T-Bil	mg/dL	0.5	0.8	0.6
AST	IU/mL	53	70	17
ALT	IU/mL	81	124	16
ALP	IU/mL	340	237	206
LDH	IU/mL	221	167	128
γ -GTP	IU/mL	315	158	67
BUN	mg/dL	12	8	11
CRE	mg/dL	0.80	0.71	0.72
T-Chol	mg/dL	189	191	177
HDL	mg/dL	78	67	86
LDL	mg/dL	86	110	91
TG	mg/dL	209	87	56
HbA1c [NGSP]	%	5.7	5.3	5.2
CRP	mg/dL	0.45	0.71	0.09

Pre-LSG 1, day 1 before LSG; Post-LSG 17 M, 17 months after LSG; LSG, laparoscopic sleeve gastrectomy; WBC, while blood cell; Hb, hemoglobin; Hct, hematocrit; Plt, platelet; TP, total protein; Alb, albumin; T-Bil, total bilirubin; AST, aspartate transaminase; ALT, alanine transaminase; ALP, alkaline phosphatase; LDH, lactate dehydrogenase; γ GTP, gamma glutamyl transpeptidase; BUN, blood urea nitrogen; CRE, creatinine; T-Chol, total cholesterol; HDL, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol; TG, triglyceride; NGSP, national glycohemoglobin standardization program; CRP, C-reactive protein.

a stomach section, a small diameter gastric tube, which is a reduced stomach portion, was produced. It was confirmed by the endoscope that there was no bleeding, nor contraction within the stomach, after reinforcing the staple-line.

Post-operative complications were not observed, BW reduced to 99 kg, and then the patient was discharged. After discharge, his BW increased to 103 kg. This is because his home was away from our hospital, he could not exercise due to knee joint pain, and no close hospital was available for post-operative bariatric surgery care. Thus, he was admitted again for diet and education. At the time when BW was reduced to 85 kg (BMI 30 kg/m²), less than 90 kg average, TKA of the left side was performed, followed by TKA of right side 4 month later.

According to the Japanese Orthopedic Association (JOA) score proposed by JOA, the treatment outcome of the patient was evaluated at the first visit, after LSG and after TKA. JOA score is a judgment criteria that consists of 4 items (100 point maximum); “Pain on walking”, “Pain on ascending or descending stairs”, “Range of motion”, and “Joint effusion”⁹⁾.

Scores were 45/100 points at the first visit, 55/100 points 10 month after LSG and 90/100 points after both-side TKA, indicating his joint symptoms were markedly improved. The state in detail at the first visit seemed as follows: He was capable of walking for 100 m to 500 m distance with pain; He was capable of going up and down stairs, slowly step by step, depending on a handrail with pain; The range of motion of the knee joint was more than 110 degree; Joint punctures were often needed.

After LSG and before TKA, his condition improved; He was capable of going up and down stairs without assistance

but with pain; He was free from pain while going up and down stairs with the use of a handrail; Joint punctures were only sometimes necessary. These findings indicated that joint disorders induced by excess BW could be efficiently ameliorated to some extent only by performing LSG.

After both-side TKA, his condition improved markedly; He was capable to walk more than 1 km distance; He was capable of going up and down stairs without pain; His range of motion in the knee joint widened and he was capable of sitting sideways and in cross-legged position; Hydrarthrosis or swelling were not observed.

These findings indicated that joint disorders induced by excess BW could be efficiently ameliorated by performing LSG, although obesity treatment alone might also improve his state.

At one year and 5 months after LSG, his BW was 80 kg, a 62 kg reduction from the first visit, height 168.9 cm (taller than that at the first visit due to better posture), and BMI 28.0 kg/m². Blood examination showed that liver dysfunction was ameliorated (*Table 1*).

Visceral fat area of the patient markedly decreased to 53 cm² measured by HDS-2000. As shown in *Fig. 2*, visceral fat reduced markedly and waist circumference shortened. He became capable of walking without the assistance of a cane and no analgesics were necessary for knee joint pain. Blood pressure turned out to be normal without using anti-hypertensives.

Regarding to his sleep state, he was suspected to have severe SAS at the first visit with the Apnea Hypopnea Index (AHI): 54.7 evaluated by polysomnography but no abnormal findings were noted by otolaryngological examination. At this time, SAS was relieved by a weight reduction to AHI: 5.0 and he was free from sleep disorders: no medication necessary.

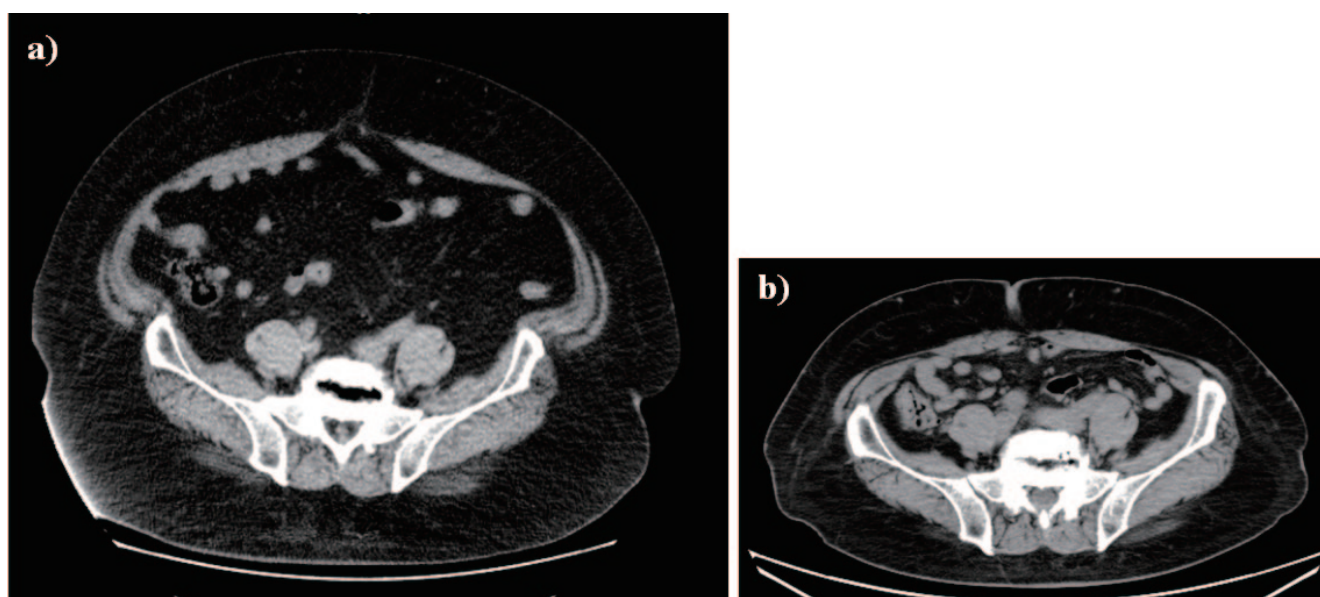


Fig. 2. Abdominal computed tomography.

a) On first visit. **b)** 17 months after laparoscopic sleeve gastrectomy. Remarkable decrease of visceral fat is found after surgery.

Discussion

Obesity is an exacerbation factor of knee OA. While knee pain causes difficulty in exercise therapy thus accelerating the obesity stage, the patients fall into the vicious cycles^{10,11}. In this case, which is very typical, he may go on the path of deterioration as it is, and could not avoid life in a wheel chair. TKA is an effective operation for knee OA in obese patients like a present case, however it is not easy to determine the optimal timing of the operation. Most obese patients are accompanied with obesity-related disorders, which are known to induce complications after TKA operations, *i.e.*, infection, delayed wound healing, deep vein thrombosis, and pulmonary thromboembolism¹²⁻¹⁷.

In obese patients, since insulin resistance or hyperglycemia inhibits the function of white blood cells, thus weakening immune function and vascular tissue, it is said that there are many complications related to surgical wounds¹⁸⁻²². Therefore, several reports²³⁻³⁰ recommend that patients perform TKA after weight reduction in cases of morbid obesity, resulting in less post-operative complications and improvement of the knee joint functions. However, there are some controversial reports³¹⁻³⁴.

For example, Li W *et al.*³³ reported that pain relief effects in patients without weight reduction is not different from patients who were operated on after weight reduction, although obese patients were often instructed to reduce BW. It is not easy to perform the exercise therapy for morbid obesity patients suffering from arthralgia, while, of course, weight reduction is better conducted as much as they possibly can. There may be a case whose joint conditions worsen while taking time for weight reduction therapy. It is said that, if patients can undergo the operation, he could expect early recovery of joint functions and continue to deal with obesity. It's possible to interpret, from this report, that obese patients can obtain the same level of pain relieving effects as patients with normal BW. However, we cannot conclude that pre-operative weight reduction is not necessary because obesity augments the inflammation risk after the joint replacement.

The risk of complications after TKA is more frequent in patients with high BMI¹²⁻¹⁷, and it is reported that, especially regarding super-obese patients (BMI > 50 kg/m²), the results of orthopedic surgery are better when the operations are performed after weight reduction^{16,17}. In this case with a BMI over 50 kg/m², the surgical procedure became less difficult because TKA was done after weight reduction. We expected less frequent post-operative complications and more marked improvement of joint functions. Actually, no complications were noted and the functions improved. However, there are still controversial points before conclusion about the significance of bariatric surgery before TKA. More prospective studies with higher levels of evidence are desired³⁵.

In Japan, the number of the bariatric surgery operations is fewer than in other countries, and also the definition of obesity is different compared with the world standard. There remain problems such as whether or not TKA should be performed after weight reduction by bariatric surgery, its surgical indication, or timing of surgery. However it takes a time to discuss these problems, considering our ethnicity, since it is necessary to accumulate the number of cases. In

order to establish the Japanese standard, it is desirable to conduct randomized controlled trials determining the degree of weight reduction necessary, before the knee joint operation in morbidly obese patients.

We often see cases in which the medical therapy, if given as an instruction against obesity, do not go well, or the therapy does not last long even though the patient obtains a transient weight reduction. In this case, a 20 kg weight reduction was once successfully noted, but the BW increased more than the previous value. The patient has achieved only 1 kg reduction after the re-trial therapy. On the other hand, we can say that bariatric surgery is a reliable method of weight reduction.

Motivation is important for obesity therapy. By aiming a clear purpose of the orthopedic surgery in this case, patient carried out the pre-operative weight reduction steadily and led to perform LSG. Even in the case of severe obese for whom exercise therapy was difficult to perform due to orthopedic diseases affecting activities of daily living and QOL, bariatric surgery was shown to efficiently improve the disorders induced by excess weight³⁶⁻³⁸. Furthermore, bariatric surgery has great benefits from the view point of healthcare economy since obesity-related complications can be improved and medication ceased^{39,40}. Insurance coverage of LSG in Japan applies to obese patients accompanied with one of the below disorders; T2DM, hypertension, dyslipidemia and SAS, and LSG may be effective on the severely obese with orthopedic diseases.

Conclusion

This case showed that the surgical operation by LSG can successfully reduce BW and improve the function of locomotor disorders even in the case of morbid obesity which was resistant to weight reduction by non-operative treatment, and possibly widened the range of orthopedic surgical indication so that we can expect a more radical treatment.

Conflict of interest

The authors have no conflict of interest in this study.

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