

Hypocalcemia and Vitamin D Deficiency in Patients Post-bariatric Surgery: A Systematic Review

¹Pallikonda S Madhulika, ²Juan U González-Tova

ABSTRACT

Introduction: Bariatric surgery is viewed as the best tool for the control and treatment of severe obesity; however, postsurgery, they have a greater risk of developing nutritional deficiencies as this procedure hinders the absorption of most of the nutrients.

Objective: To evaluate the effect of vitamin D insufficiency and that of calcium in bone in patients after Roux-en-Y gastric bypass (RYGB), and the mode of administration of calcium, its dosage, and efficacy.

Materials and methods: A precise survey was performed with articles identified that are associated with the subject of interest. Articles from 10 years back were looked up in PubMed, the US National Library of Medicine, the National Institutes of Health, Medline, Lilacs, Scielo, and Cochrane utilizing the headings “bariatric surgery,” “bone,” “obesity,” “vitamin D,” “calcium,” and “absorption.”

Results: Five articles were incorporated into this survey that have analyzed the facts that bariatric surgery can cause wholesome inadequacies of nutrition and poor assimilation of fats and fat-dissolvable vitamins and micronutrients, e.g., calcium.

Conclusion: Patients submitted to RYGB should make use of multivitamins and minerals, especially vitamin D and calcium to prevent bone fractures. Monitoring, treatment, and control of risk factors are essential to prevent complications after this operation.

Keywords: Bariatric surgery, Calcium deficiency, Vitamin D deficiency.

How to cite this article: Madhulika PS, González-Tova JU. Hypocalcemia and Vitamin D Deficiency in Patients Post-bariatric Surgery: A Systematic Review. *World J Lap Surg* 2017;10(3):108-111.

Source of support: Nil

Conflict of interest: None

¹Assistant Professor, ²Professor

¹Department of General Surgery, Shri Sathya Sai Medical College and Research Institute, Chennai, Tamil Nadu, India

²Department of Urology, Hospital Universitari de Vic, Barcelona Spain

Corresponding Author: Pallikonda S Madhulika, Assistant Professor, Department of General Surgery, Shri Sathya Sai Medical College and Research, Institute Chennai, Tamil Nadu India, e-mail: juan.uriagt@gmail.com

INTRODUCTION

Since the advent of bariatric surgery, numerous surgical techniques for the treatment of obesity have been proposed and further improvised over the decades. The RYGB is an operation, i.e., viewed as a gold standard of treatment for extreme obesity in light of the fact that it results in fewer serious side effects and complications than conventional malabsorption techniques, e.g., jejunioleal bypass.¹⁻³ The malabsorption methodologies have been perceived as a risk factor for diseases of bone⁴⁻⁸ because of the resulting alteration of calcium metabolism and decreased absorption.⁹⁻¹⁵ Some studies explored these deranged levels of calcium tentatively in patients with jejunioleal bypass, and demonstrated that assimilation diminishes by half after surgery.^{10,11,14} Insufficient calcium intake is common after gastric bypass,^{16,17} further increasing the bone loss. Comprehending the postoperative RYGB, diminishing of calcium absorption and supplements, and exploring the dosages, modes of administration, and the duration of medication treatment and its impacts on bone were the sole objectives of this review.

MATERIALS AND METHODS

The population, intervention, comparison, and outcome (PICO) strategy was adopted to expound the response to the question, “How is bone lost in patients who experience bariatric surgery and what supplements help to diminish this loss?” Obese patients who had bone loss and additionally BMI from 35 to 39.9 kg/m² with comorbidities and ≥ 40 kg/m² (population); patients submitted to RYGB by laparoscopy or laparotomy (intervention); eutrophic patients with BMI of 18.5 to 24.9 kg/m² (comparison); patients with insufficiency of vitamin D and calcium and conceivable nearness of fractures (outcome) were selected.

Qualification Criteria for Study Consideration

Inclusion Criteria

All studies; patients of age 15 to 70 years; BMI from 35 to 39.9 kg/m² with comorbidities and ≥ 40 kg/m²; ≥ 3 months postsurgery; and laparoscopic or laparotomic RYGB.

Exclusion Criteria

Pregnant women or, women in lactation; smoking or previous smoker; people treated with bisphosphonates; and animals.

Types of Outcome

Essential outcome was engaged in vitamin D and calcium inadequacy; nonetheless, conceivable bone fractures were investigated after bariatric surgery. As auxiliary outcomes, connection between the kind of supplement administration and the body's capability in engrossing the administered medication was looked at; and the dosages and their consequences for the maintenance or recuperation of bone resorption after bariatric surgery were observed.

Search Strategy

PubMed/Medline, Lilacs, Scielo, and Cochrane were utilized with the headings "bariatric surgery," "bone," "stoutness," "vitamin D," "calcium," "AND" "assimilation." Following the collection of data, examination of the title, perusing of the theoretical abstracts, the complete perusing of the articles was made.

RESULTS

Table 1 shows the methodological characteristics of the selected studies. Of the five articles, three corresponded to prospective cohort studies;¹⁸⁻²² two used the laparoscopic approach and one enrolled only women; there was one case report and one case series. All assessed the nutritional status and bone fractures, routes of administration, as well as the respective dosage of vitamin D and calcium; one article evaluated the parathyroid hormone and its influence on bone reabsorption in RYGB.

DISCUSSION

The results of this systematic review are based on five publications. The research did not identify bone fractures in patients undergoing bariatric surgery; nonetheless, there appeared high inadequacies in vitamin D and calcium in the bones. The studies demonstrated the diverse ways of administration and the results, noting the different answers regarding insufficiencies that emerge in the bone tissue because of dose and adequacy, as indicated by the route of administration. After bariatric surgery, all investigations pronounced outcomes with deficiency in the bones of patients, paying little heed to the kind of bariatric surgery. All studies specified administration of vitamin D and calcium by means of tablets or infusions in various doses.

None of them exhibited complete loss of bone calcium, yet demonstrated a critical distinction in bone resorption, fundamentally by parathyroid hormone. Parathyroid hormone increases the movement of osteoclasts, prompting the devastation of the cortical bone, indicating a likewise marked inadequacy of vitamin D,^{15,19}

finally debilitating the bones and then leading to the likelihood of fractures in the postoperative period. Avgerinos et al²¹ in their essential prospective cohort in people of the two sexual orientations for a period of 2 years have demonstrated the significance of vitamin D supplementation to prevent the decline of calcium in the bones.

Research investigated women in pre- and postmenopausal stages demonstrating that there was no critical difference between them in calcium absorption inadequacy and even the differences in relationship to the sort of surgery were not present.^{17,18,23}

As per this review, the sort of administration and dosage had no relationship or significance over time on drug treatment. Nonetheless, no direct connection to the postoperative bone loss was demonstrated. Vasconcelos et al¹⁸ considered the calcium intake in the eating routine of 600 mg and supplemented with 200 mg as tablet form during the 22 months in the operated group. Although the intake was fundamentally higher than in the nonoperated group, it was still lower than the prescribed levels for these patients, which ought to be between 1,000 and 1,800 mg/day.²⁴⁻²⁶

Intake of vitamin D (500 IU) was likewise beneath the prescribed levels. It can be deduced from the postoperative vitamin supplementation that it ought not just comprise multivitamins, since most do not contain the calcium and vitamin D required and prescribed to be taken each day. The above changes may increase the postoperative and preoperative screening; care ought to be taken to prevent the changes in bone metabolism. Reasonable supplementation of vitamins and minerals is basic to avoid or limit bone metabolic intricacies that can happen after RYGB.²⁷

Another important factor apart from vitamin D supplementation and calcium that may influence bone change in these patients is age, other than the differences in between women in premenopausal and postmenopausal women that need particular approach. There are different elements that can impact straightforwardly and add to bone resorption, which include lack of vitamin D, deficient calcium intake, and secondary hyperparathyroidism, present sometimes in the obese. The parathyroid hormone additionally increases the activity of osteoclasts, prompting bone cortical destruction to make up for the abatement of serum calcium.¹⁰

In connection with bone density and fracture prevalence, no significant differences in the studies were found. It is conceivable that the generally short follow-up contributed to the lack of identification of bone fracture. Future research is needed to better elucidate the bone complications in these patients.

Table 1: Articles reviewed

Reference (year)	Type of study	Study location	Period of follow-up	n	Type of surgery	Age (years)	Sex	Type of medication	Type of administration	Individual	Doses	Time of medical therapy	Conclusion
Vasconcelos et al ¹⁸	Case series	Brazil	From 7 to 22 months	n=29	RYGB	>18	F	Calcium and vitamin D	Tablets and diet	People	600 mg diet +200 mg tablet of Ca and 500 IU vitamin D (per day)	From 7 to 22 months	There were no significant differences between the average bone mass density and prevalence of vertebral fractures in both groups
Flores et al ¹⁹	Prospective cohort study	Espain	1 year	n=222	RYGBL	18-65	F and M	Calcium and vitamin D	Tablets	People	1,200 mg Ca and 800 IU vitamin D (per day)	4,8, and 12 months	The parathyroid hormone leads cortical bone destruction and improving serum Ca. 80% of patients have vitamin D deficiency but not bone fractures
Williams et al ²⁰	Case study	United States	2 years	n=1	RYGB	56	F	Calcium and vitamin D	Tablets	Person	500 mg Ca and 400 IU (per day)	2 years	After 2 years the patient showed no fracture or risk to bone fracture level
Avgerinos et al ²¹	Prospective cohort study	United States	2 years	n=444 (M=91 F=353)	RYGB	21-64	M and F	Calcium and vitamin D	Tablets	People	1,200 mg Ca and 800 IU vitamin D	1.8 years	Total calcium decreases in body-related mobilization of bone. Supplementation with vitamin D prevents the decrease in bone calcium
Riedt et al ²²	Prospective cohort study	United States	6 months	n=21	RYGB and RYGBL (5: open field and 16 laparoscopy)	29-62	F	Calcium and vitamin D	Tablets, diet, and injections	People	Diet, 1,000 mg of Ca, and 400 IU vitamin D	6 months	Low Ca absorption after surgery is considered a marker of bone resorption (60 to 200%). There was a higher bone resorption than bone formation

RYGBL: Roux-en-Y gastric bypass laparoscopy

CONCLUSION

Patients undergoing RYGB should make use of multivitamins and minerals, especially calcium and vitamin D to prevent bone fractures. Monitoring, treatment, and control of risk factors are essential to prevent these complications after the surgery.

REFERENCES

- Barrow CJ. Roux-en-Y gastric bypass for morbid obesity. *AORN J* 2002 Oct;76(4):590, 593-604.
- Jones KB Jr. Bariatric surgery—where do we go from here? *Int Surg* 2004 Jan;89(1):51-57.
- Weber M, Müller MK, Bucher T, Wildi S, Dindo D, Horber F, Hauser R, Clavien PA. Laparoscopic gastric bypass is superior to laparoscopic gastric banding for treatment of morbid obesity. *Ann Surg* 2004 Dec;240(6):975-982.
- Compston JE, Horton LW, Laker MF, Ayers AB, Woodhead JS, Bull HJ, Gazet JC, Pilkington TR. Bone disease after jejunoileal bypass for obesity. *Lancet* 1978 Jul;2(8079):1-4.
- Eddy RL. Metabolic bone disease after gastrectomy. *Am J Med* 1971 Apr;50(4):442-449.
- Halverson JD, Teitelbaum SL, Haddad JG, Murphy WA. Skeletal abnormalities after jejunoileal bypass. *Ann Surg* 1979 Jun;189(6):785-790.
- Parfitt AM, Miller MJ, Frame B, Villanueva AR, Oliver I, Thomson DL. Metabolic bone disease after intestinal bypass for treatment of obesity. *Ann Intern Med* 1978 Aug;89(2):193-199.
- Zittel TT, Zeeb B, Maier GW, Kaiser GW, Zwirner M, Liebich H, Starlinger M, Becker HD. High prevalence of bone disorders after gastrectomy. *Am J Surg* 1997 Oct;174(4):431-438.
- Charles P, Mosekilde L, Sondergard K, Jensen FT. Treatment with high-dose oral vitamin D2 in patients with jejuno-ileal bypass for morbid obesity. Effects on calcium and magnesium metabolism, vitamin D metabolites, and faecal lag time. *Scand J Gastroenterol* 1984 Nov;19(8):1031-1038.
- Danö P, Christiansen C. Calcium malabsorption and absence of bone decalcination following intestinal shunt operation for obesity. A comparison of two types of operation. *Scand J Gastroenterol* 1978;13(1):81-85.
- Hylander E, Jarnum S, Kempel K, Thale M. The absorption of oxalate, calcium, and fat after jejunoileal bypass. A prospective study. *Scand J Gastroenterol* 1980;15(3):343-348.
- Nunan TO, Compston JE, Tonge C. Intestinal calcium absorption in patients after jejuno-ileal bypass or small intestinal resection and the effect of vitamin D. *Digestion* 1986;34(1):9-14.
- Rannem T, Hylander E, Jarnum S, Ladefoged K, Schaadt O, Staun M, Thale M. Calcium absorption and bone mineral content in patients subjected to ileal bypass because of familial hypercholesterolaemia. *Scand J Gastroenterol* 1990 Sep;25(9):897-905.
- Sellin JH, Meredith SC, Kelly S, Schneir H, Rosenberg IH. Prospective evaluation of metabolic bone disease after jejunoileal bypass. *Gastroenterology* 1984 Jul;87(1):123-129.
- Silveira-Júnior S, de Albuquerque MM, do Nascimento RR, da Rosa LS, Hygidio DA, Zapelini RM. Nutritional repercussions in patients submitted to bariatric surgery. *Arq Bras Cir Dig* 2015;28(1):48-52.
- Alvarez-Leite JI. Nutrient deficiencies secondary to bariatric surgery. *Curr Opin Clin Nutr Metab Care* 2004 Sep;7(5):569-575.
- Santos TD, Burgos MG, de Lemos MC, Cabral PC. Clinical and nutritional aspects in obese women during the first year after roux-en-y gastric bypass. *Arq Bras Cir Dig* 2015 Dec;28(Suppl 1):56-60.
- Vasconcelos RS, Viégas M, Marques TF, Diniz ET, Lucena CS, Câmara Neto JB, Bandeira F. Factors associated with secondary hyperparathyroidism in premenopausal women undergoing Roux-en-Y gastric bypass for the treatment of obesity. *Arq Bras Endocrinol Metab* 2010 Mar;54(2):233-238.
- Flores L, Osaba MJ, Andreu A, Moizé V, Rodríguez L, Vidal J. Calcium and vitamin D supplementation after gastric bypass should be individualized to improve or avoid hyperparathyroidism. *Obes Surg* 2010 Jun;20(6):738-743.
- Williams SE, Cooper K, Richmond B, Schauer P. Perioperative management of bariatric surgery patients: focus on metabolic bone disease. *Cleve Clin J Med* 2008 May;75(5):333-334, 336, 338 passim.
- Avgerinos DV, Leitman IM, Martínez RE, Liao EP. Evaluation of markers for calcium homeostasis in a population of obese adults undergoing gastric bypass operations. *J Am Coll Surg* 2007 Aug;205(2):294-297.
- Riedt CS, Brolin RE, Sherrell RM, Field MP, Shapses SA. True fractional calcium absorption is decreased after Roux-en-Y gastric bypass surgery. *Obesity (Silver Spring)* 2006 Nov;14(11):1940-1948.
- Goldner WS, Stoner JA, Thompson J, Taylor K, Larson L, Erickson J, McBride C. Prevalence of vitamin D insufficiency and deficiency in morbidly obese patients: a comparison with non-obese controls. *Obes Surg* 2008 Feb;18(2):145-150.
- Hamoui N, Anthone G, Crookes PF. Calcium metabolism in the morbidly obese. *Obes Surg* 2004 Jan;14(1):9-12.
- Stein EM, Straint G, Sinha N, Ortiz D, Pomp A, McMahon DJ, Bockman R, Silverberg SJ. Vitamin D insufficiency prior to bariatric surgery: risk factors and a pilot treatment study. *Clin Endocrinol (Oxf)* 2009 Aug;71(2):176-183.
- Costa TM, Paganoto M, Radominski RB, Borba VZ. Impact of deficient nutrition in bone mass after bariatric surgery. *Arq Bras Cir Dig* 2016 Mar;29(1):38-42.
- Santos EF, Tsuboi KH, Palu BF, Araújo MR, Andreollo NA, Miyasaka CK. Partial gastrectomy associated to anterior truncal vagotomy: alterations in metabolism of the calcium. Experimental study in rats. *Arq Bras Cir Dig* 2009 Apr-Jun;22(2):105-109.