



XXXII CONGRESSO
NAZIONALE SICOB

23 - 25 MAGGIO 2024
GIARDINI
NAXOS

CHIRURGIA BARIATRICA E RISCHIO OSTEOPOROTICO

Dr.ssa Edda Cava

UOSD Dietologia E Nutrizione,

**Azienda Ospedaliera S. Camillo Forlanini ,
Roma**

Review

Postoperative Osteoporosis in Subjects with Morbid Obesity Undergoing Bariatric Surgery with Gastric Bypass or Sleeve Gastrectomy

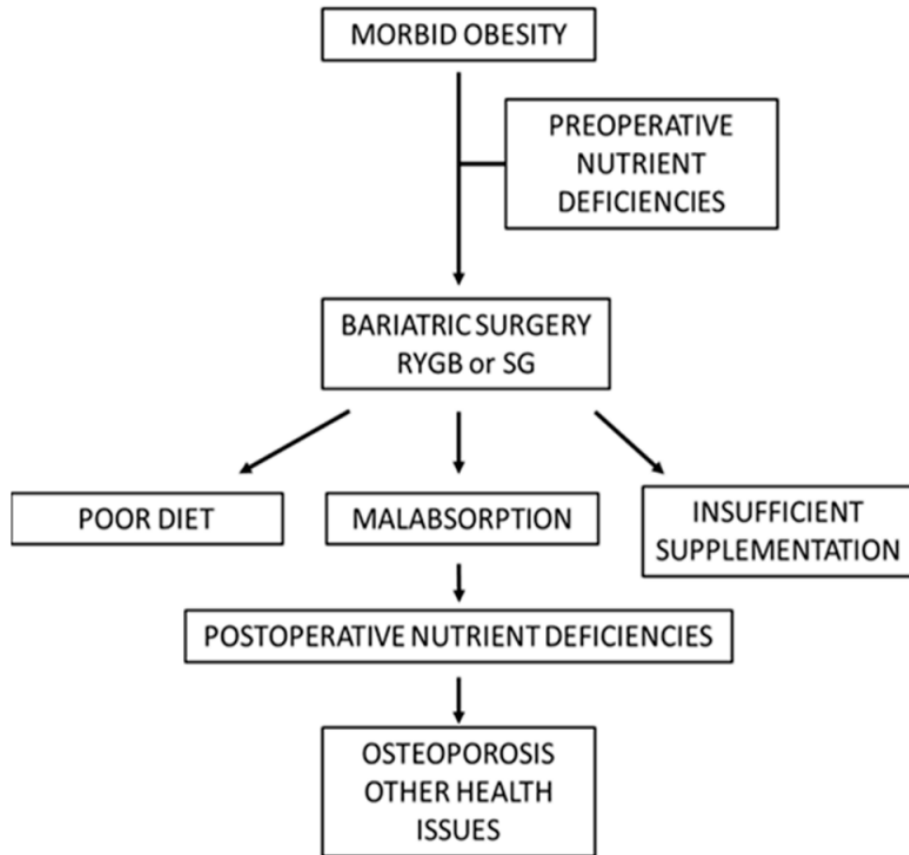


Figure 1. Postoperative development of nutrient deficiencies complicated with bone loss and/or other health issues (schematic). Among other health issues are anemia, fatigue, poor wound healing, hair loss, and neurological symptoms.

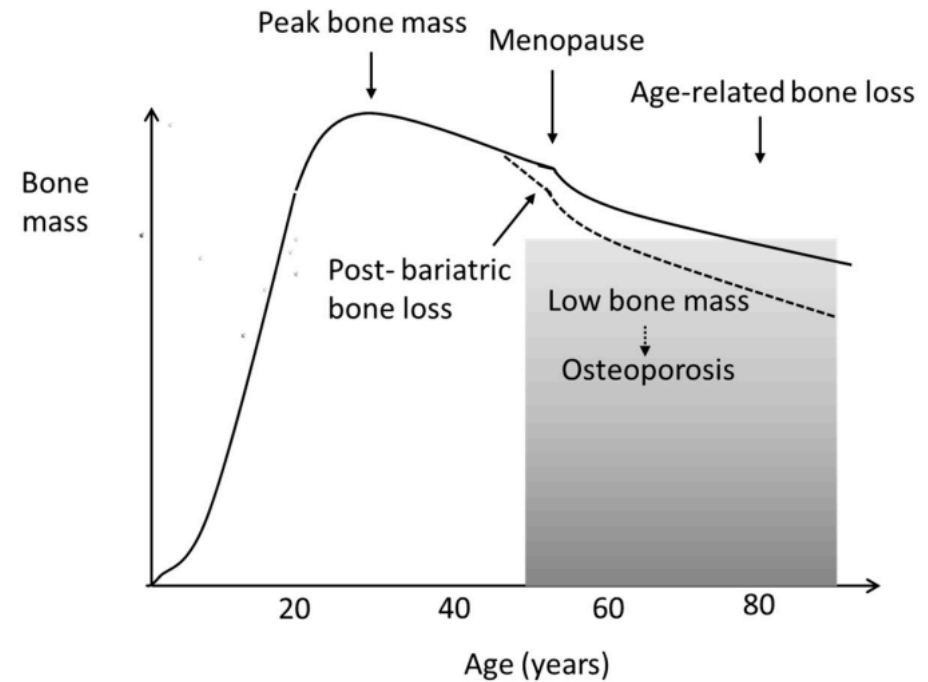



Figure 2. Age-related loss of bone mass in women (schematic). In both women and men, age-related bone loss can be accelerated by bariatric surgery.

REVIEW

Bariatric Surgery and Osteoporosis

Julien Paccou^{1,4}  · Robert Caiazzo² · Eric Lespessailles³ · Bernard Cortet¹

J. Paccou et al.

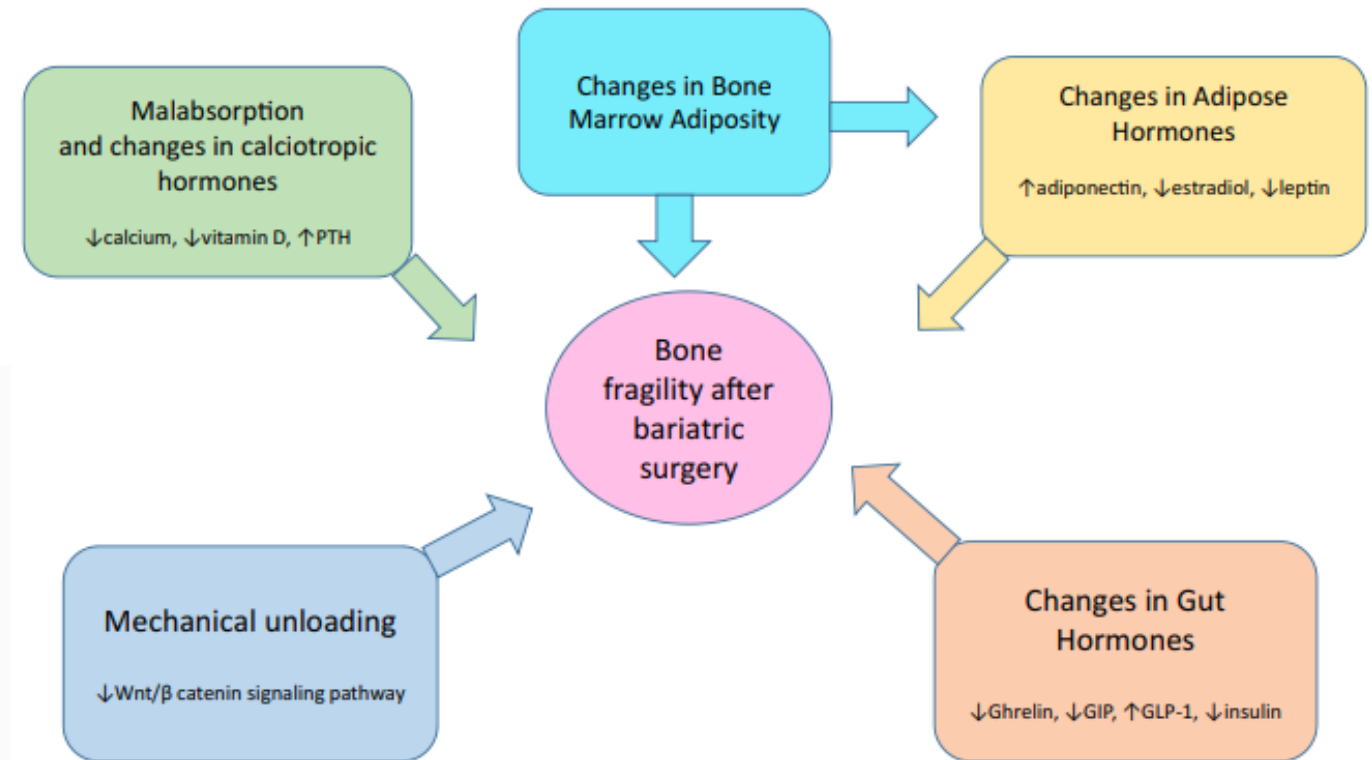
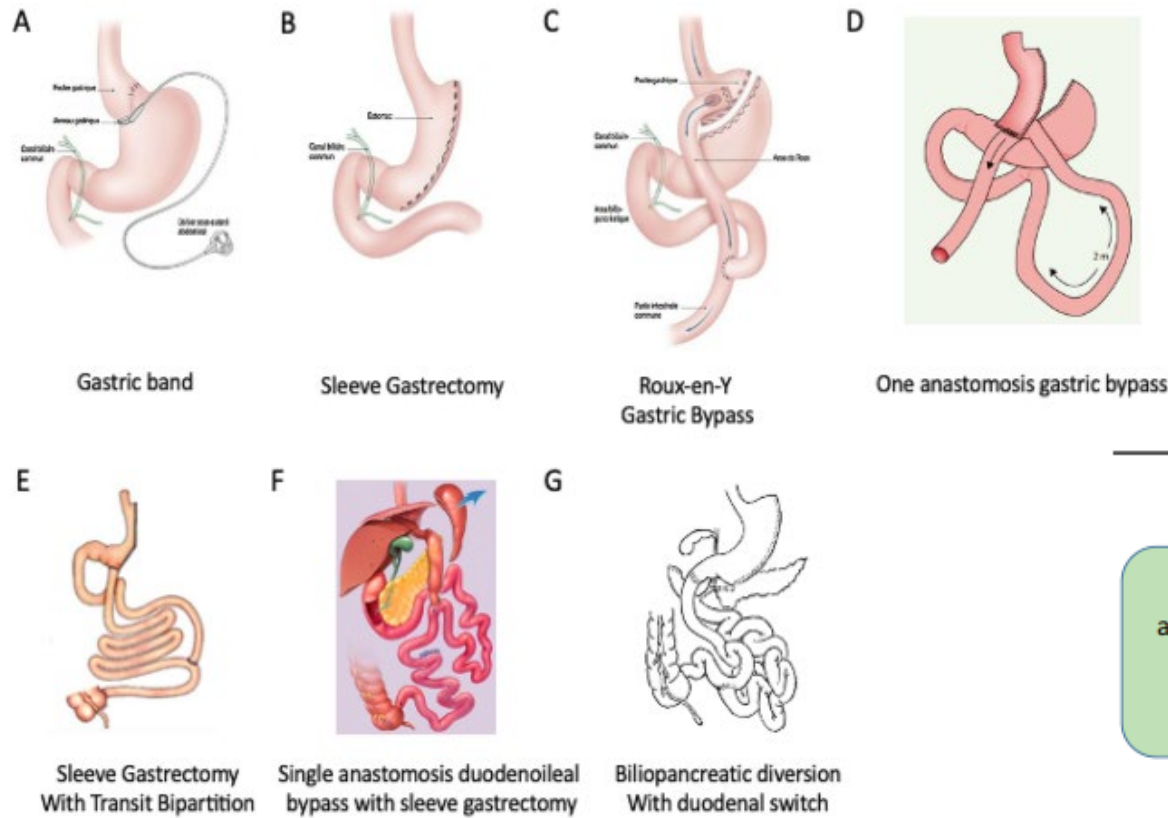


Fig. 2 Physiopathogenic hypotheses of bone fragility after bariatric surgery

Comparative risk of fracture for bariatric procedures in patients with obesity: A systematic review and Bayesian network meta-analysis



Qingyu Zhang, Jinlei Dong, Dongsheng Zhou, Fanxiao Liu* *International Journal of Surgery* 75 (2020) 13–23

Rischio relativo cumulativo [RR] **1,41** (95% CI 1,22-1,63) vs non-Chir.

Aumentato rischio postoperatorio di fratture

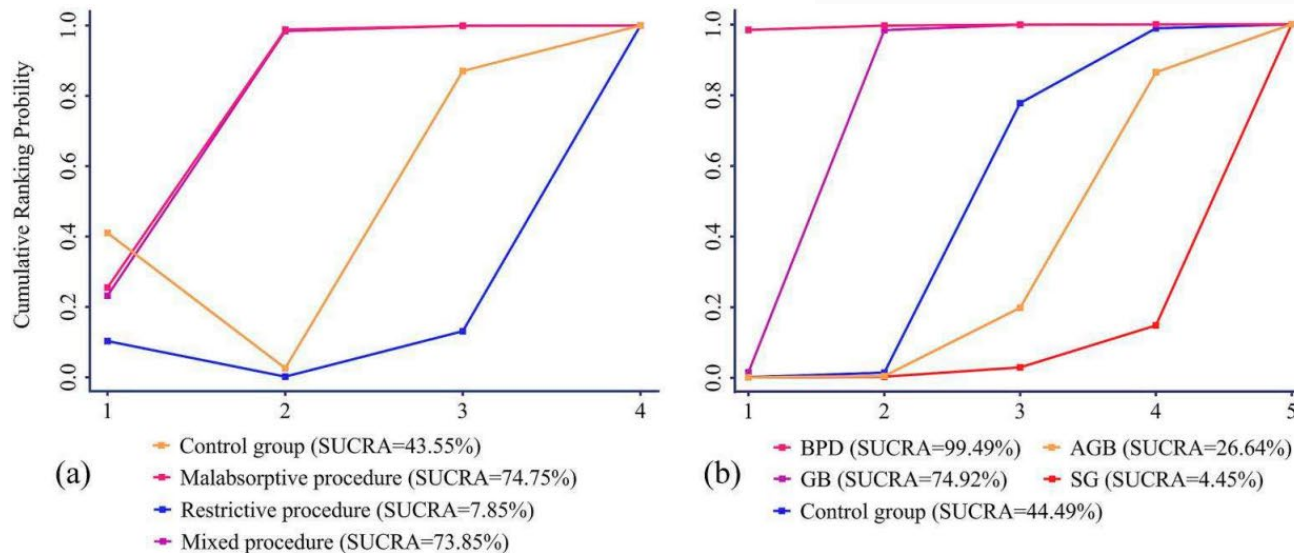


Fig. 6. The SUCRA Values of different bariatric procedures (a) and types (b) on the postoperative risk of fracture in patients with obesity.

- **BPD 99,49%**
- **RYGB 74,92 %**
- **Procedure Malassorbitive (pooled) 74,75%**
- **Procedure Miste (pooled) 73,85%**
- **Interventi non chirurgici (farmacologici, ecc) 44,49%**
- **Procedure restrittive (pooled) 7,85%**
- **AGB 26,64%**
- **SG 4,45%**

FU di medio: 2 anni- 8.2 anni
Rischio maggiore dopo 5aa dall'intervento

Per tutte le procedure eccetto le restrittive



Narrative Review of Effects of Glucagon-Like Peptide-1 Receptor Agonists on Bone Health in People Living with Obesity

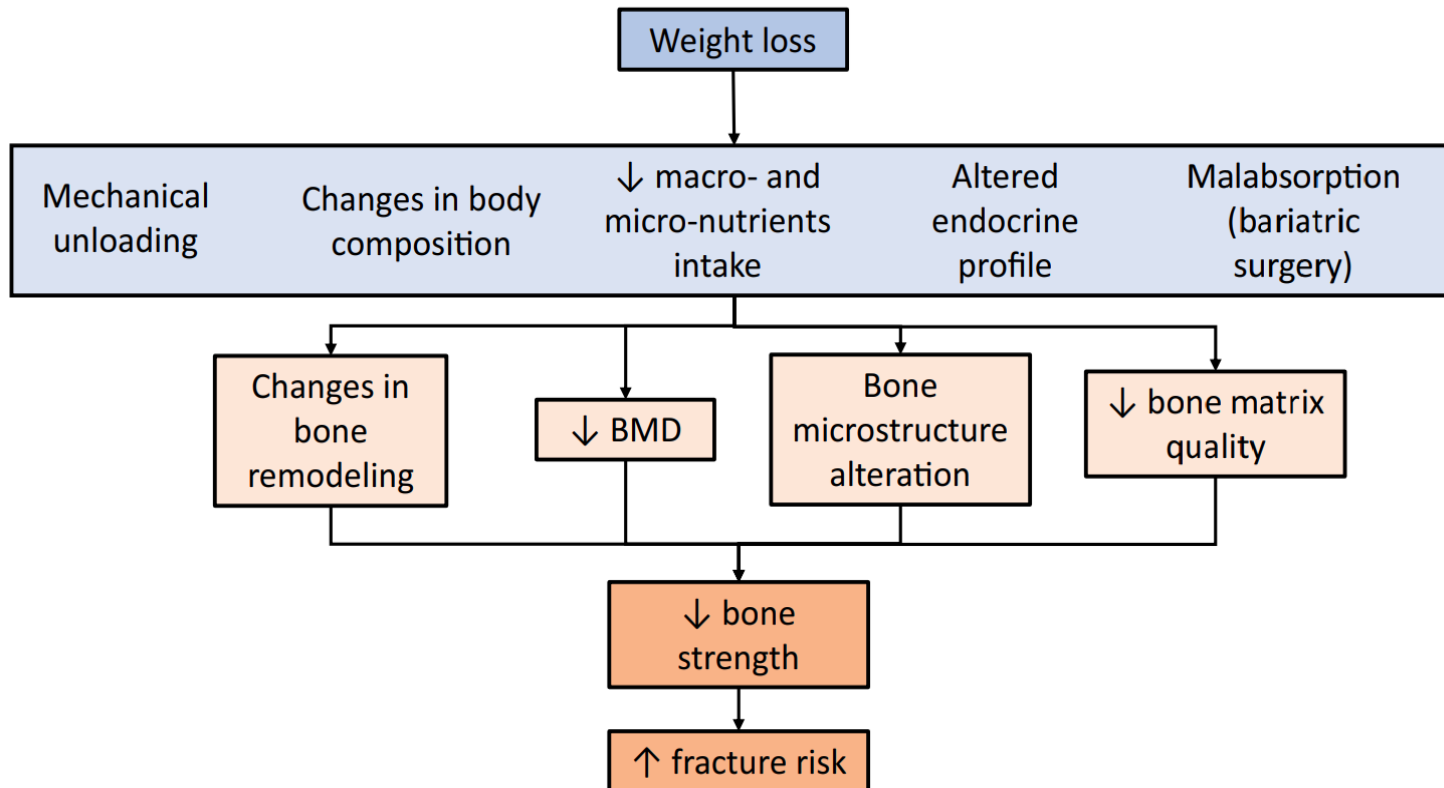
Julia Herrou¹ · Guillaume Mabileau² · Jean-Michel Lecerf³ · Thierry Thomas⁴ · Emmanuel Biver⁵ · Julien Paccou⁶

Bariatric surgery and skeletal health: A narrative review and position statement for management by the European Calcified Tissue Society (ECTS)


Julien Paccou^{a,*}, Elena Tsourdi^{b,c}, Christian Meier^d, Andrea Palermo^e, Jessica Pepe^f, Jean-Jacques Body^g, M. Carola Zillikens^h

Highlights

- Bariatric surgery is associated with a 21–44% higher risk of all fractures
- The high-turnover bone loss is associated with compromised microarchitecture
- Malabsorptive procedures have been associated with the highest risk of fracture
- RYGB is associated with greater bone alterations compared with Sleeve Gastrectomy
- There is a knowledge gap on osteoporosis treatment in patients undergoing bariatric surgery

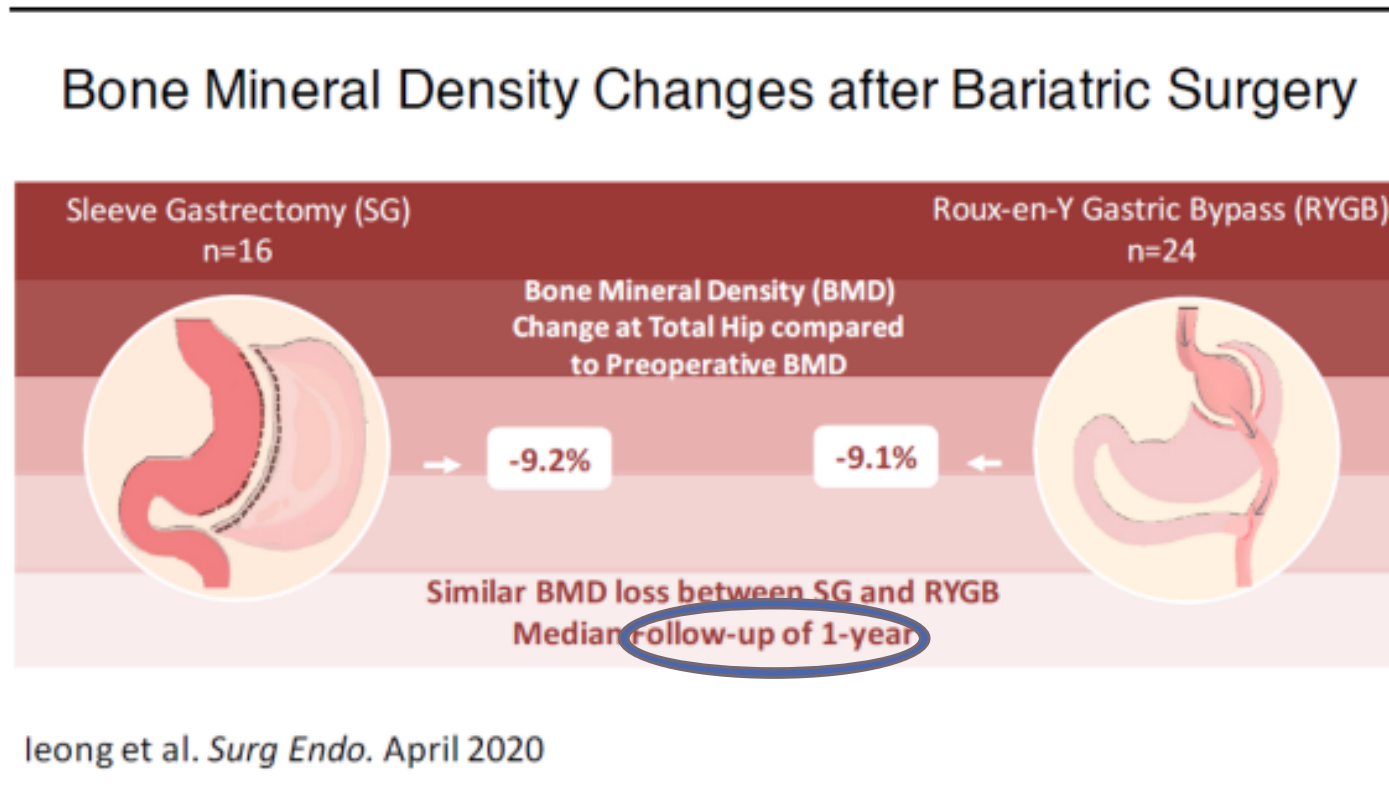


Bone mineral density changes after bariatric surgery

Kelly Jeong¹  · Jessica Ardila-Gatas¹ · Jie Yang² · Xiaoyue Zhang² · Stella To Tsui¹ · Konstantinos Spaniolas¹ · Aurora D. Pryor¹

Surgical Endoscopy

Graphic abstract



Bariatric surgery and skeletal health: A narrative review and position statement for management by the European Calcified Tissue Society (ECTS)

Julien Paccou^{a,*}, Elena Tsourdi^{b,c}, Christian Meier^d, Andrea Palermo^e, Jessica Pepe^f, Jean-Jacques Body^g, M. Carola Zillikens^h

J. Paccou et al.

Bone 154 (2022) 116236

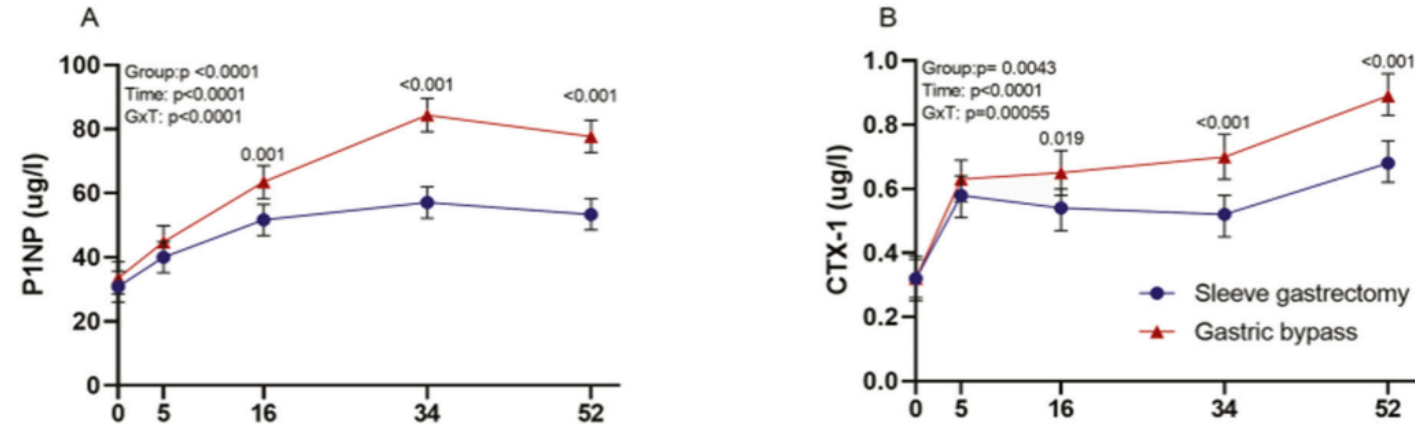


Fig. 1. Bone turnover markers after sleeve gastrectomy ($n = 48$) and gastric bypass ($n = 44$) during 1-year follow-up - Adapted from [34]. P-values were derived from linear mixed effects models for repeated measures. Bars indicate 95% confidence intervals. Abbreviations: CTX-1, C-telopeptide of type I collagen; P1NP, procollagen type 1 N-terminal propeptide.

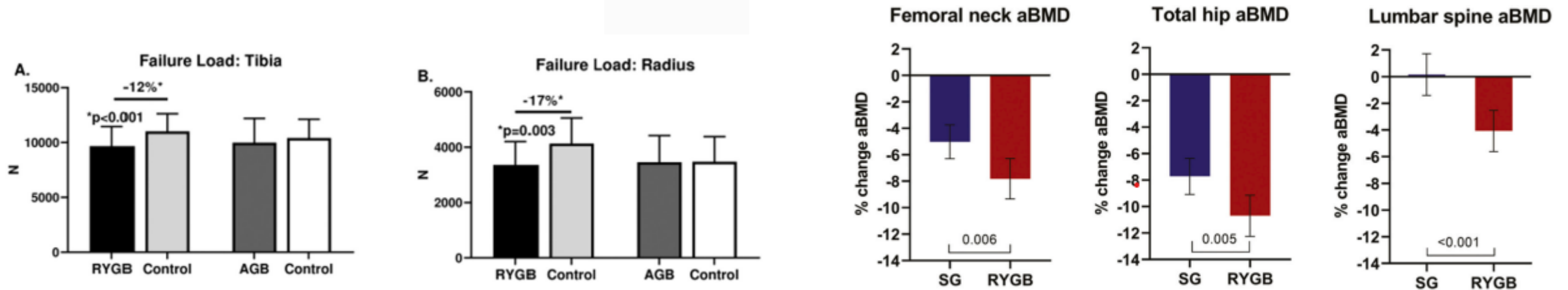


Fig. 2. Mean percent change in areal bone mineral density from baseline to 1 year after sleeve gastrectomy ($n = 48$) and Roux-en-Y gastric bypass ($n = 44$).

Association of Bariatric Surgery With Risk of Fracture in Patients With Severe Obesity

Syed I. Khalid, MD; Philip A. Omotosho, MD; Anna Spagnoli, MD; Alfonso Torquati, MD

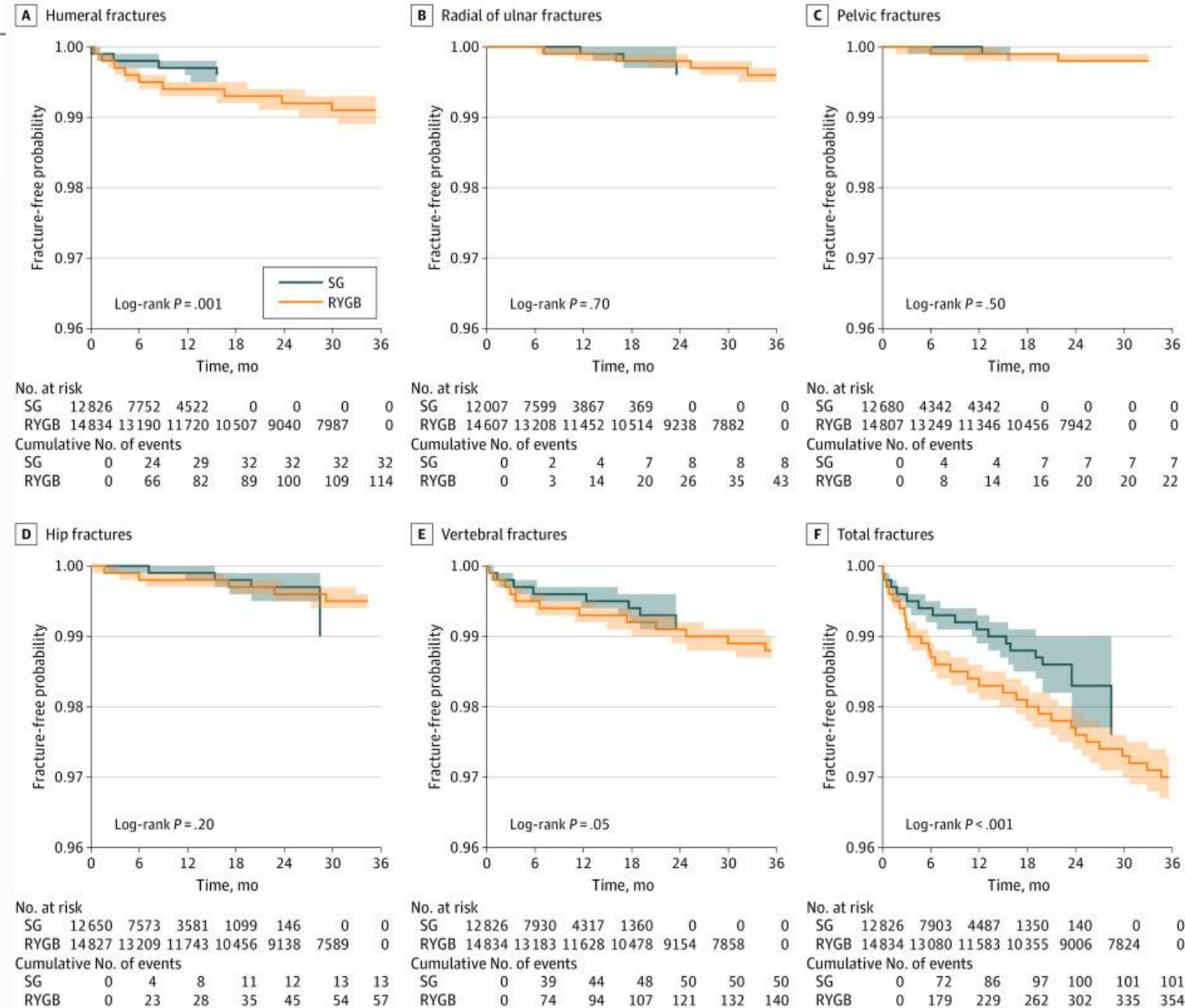
RYGB is associated with greater risk of:

- Total fractures (OR, 1.79; 95% CI, 1.55-2.06)

- Humerus fractures (OR, 1.60; 95% CI, 1.24-2.07)

compared with Sleeve Gastrectomy

There were no significant differences between RYGB and SG in the risk associated with developing fractures of the radius or ulna, pelvis, hip, or vertebrae

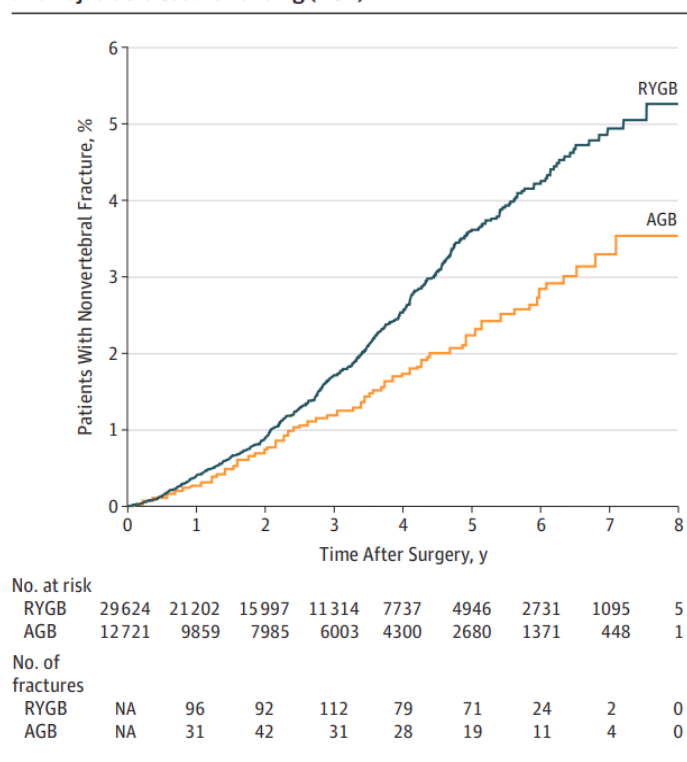


Fracture Risk After Roux-en-Y Gastric Bypass vs Adjustable Gastric Banding Among Medicare Beneficiaries

Elaine W. Yu, MD, MMSc; Seoyoung C. Kim, MD, ScD, MSCE; Daniel J. Sturgeon, MS; Katherine G. Lindeman, BA; Joel S. Weissman, PhD

- 73% di aumento del rischio di fratture non-vertebrali RYGB vs AGB, indipendente dall'età

Figure 2. Nonvertebral Fracture After Roux-en-Y Gastric Bypass (RYGB) and Adjustable Gastric Banding (AGB)



Kaplan-Meier curves illustrate time to fracture and corresponding patient populations in which the fractures occurred.

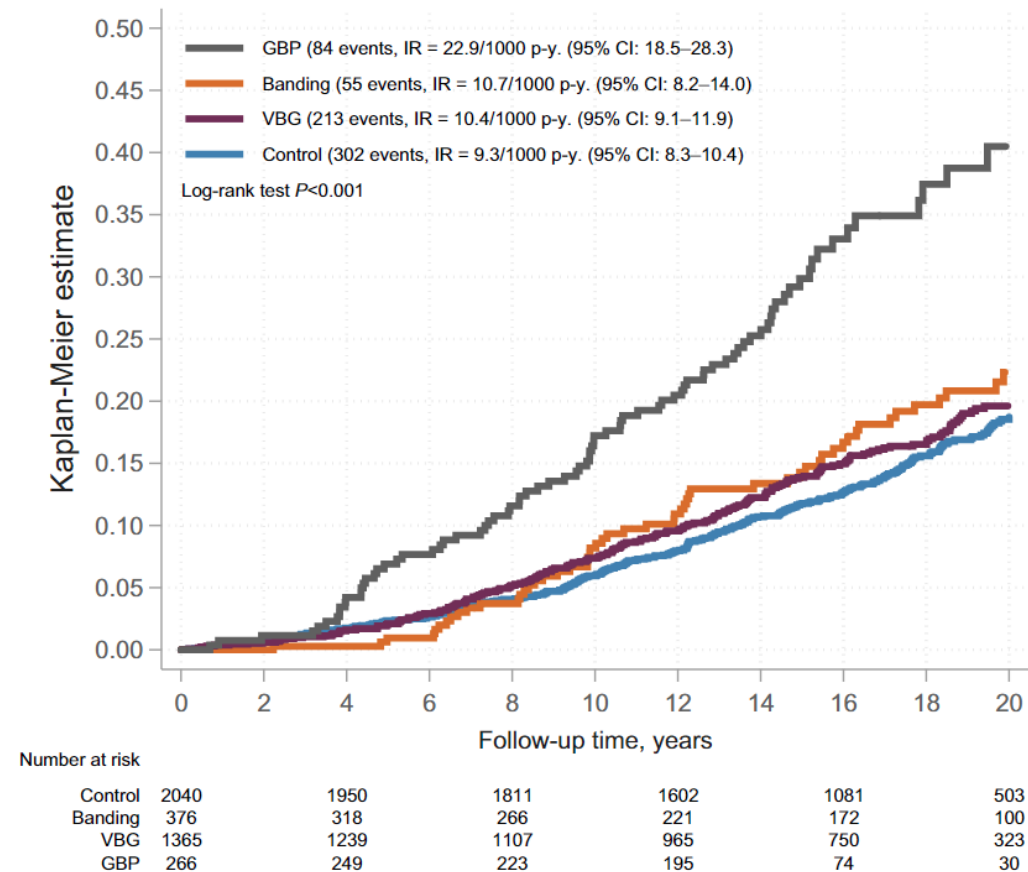
Table 3. Incidence Rates and HRs for Fracture in a Cohort Aged 65 Years and Older

Outcome	No. of Events	Person-Years	Incidence Rate/1000 Person-Years (95% CI)	HR (95% CI)		
				Unadjusted	Age, Sex-Adjusted	Fully Adjusted HR ^a
Any fracture						
RYGB	88	9132	9.9 (7.6-11.7)	1.86 (1.32-2.66)	1.93 (1.37-2.77)	1.75 (1.22-2.52)
AGB	49	9302	5.3 (3.8-6.7)	1 [Reference]	1 [Reference]	1 [Reference]
Wrist fracture						
RYGB	42	9132	4.6 (3.2-6.0)	1.66 (1.02-2.74)	1.70 (1.04-2.81)	1.65 (1.25-2.77)
AGB	26	9302	2.8 (1.7-3.9)	1 [Reference]	1 [Reference]	1 [Reference]
Hip fracture						
RYGB	30	9132	3.3 (2.1-4.5)	2.91 (1.50-6.09)	3.22 (1.65-6.77)	2.51 (1.25-5.93)
AGB	Censored ^b	Censored ^b	1.2 (0.5-1.9)	1 [Reference]	1 [Reference]	1 [Reference]
Humerus fracture						
RYGB	Censored ^b	Censored ^b	0.44 (0.01-0.87)	0.55 (0.14-1.83)	0.60 (0.16-2.0)	0.40 (0.09-1.64)
AGB	Censored ^b	Censored ^b	0.75 (0.20-1.31)	1 [Reference]	1 [Reference]	1 [Reference]
Pelvis fracture						
RYGB	33	9302	3.6 (2.4-4.8)	1.67 (0.87-3.33)	1.64 (0.85-3.29)	1.75 (0.89-3.56)
AGB	17	9132	1.9 (1.0-2.7)	1 [Reference]	1 [Reference]	1 [Reference]

Fracture risk after three bariatric surgery procedures in Swedish obese subjects: up to 26 years follow-up of a controlled intervention study

■ S. Ahlin^{1,2} , M. Peltonen³, K. Sjöholm¹, Å. Anveden^{1,4}, P. Jacobson¹, J. C. Andersson-Assarsson¹, M. Taube¹, I. Larsson^{1,5}, L. S. Lohmander⁶, I. Näslund⁷, P-A. Svensson^{1,8} & L. M. S. Carlsson¹

SOS Study





Long-Term Changes in Bone Density and Bone Metabolism After Gastric Bypass Surgery: a Retrospective Cohort Study

Luiza Ferreira Sperb¹ · Vanessa Bielefeldt Leotti² · Sandra Pinho Silveiro³ · Mirela Jobim de Azevedo³ · Luciana Verçoza Viana³

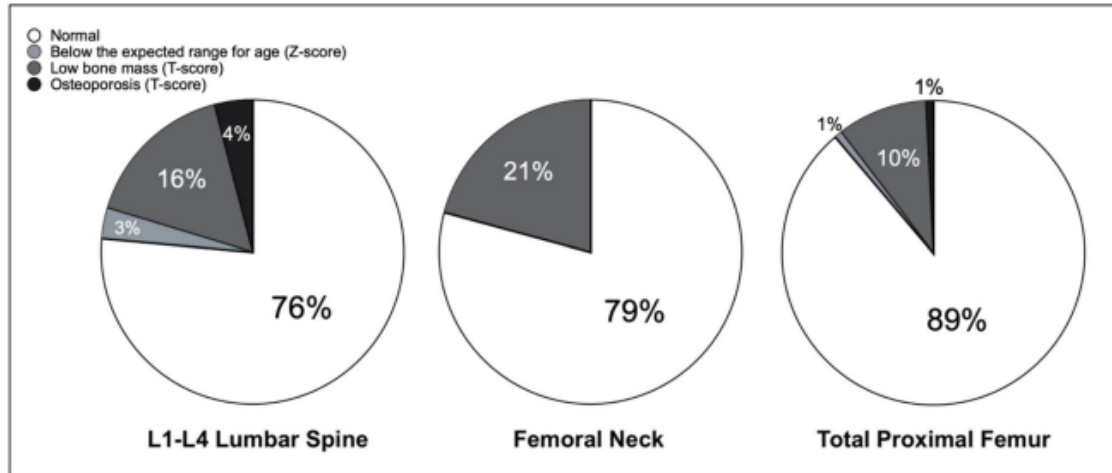


Fig. 1 First BMD evaluation post-RYGB from 127 participants after a mean of 2.5 years post-procedure, classified by T- and Z-scores for L1–L4 lumbar spine, femoral neck, and total proximal femur.

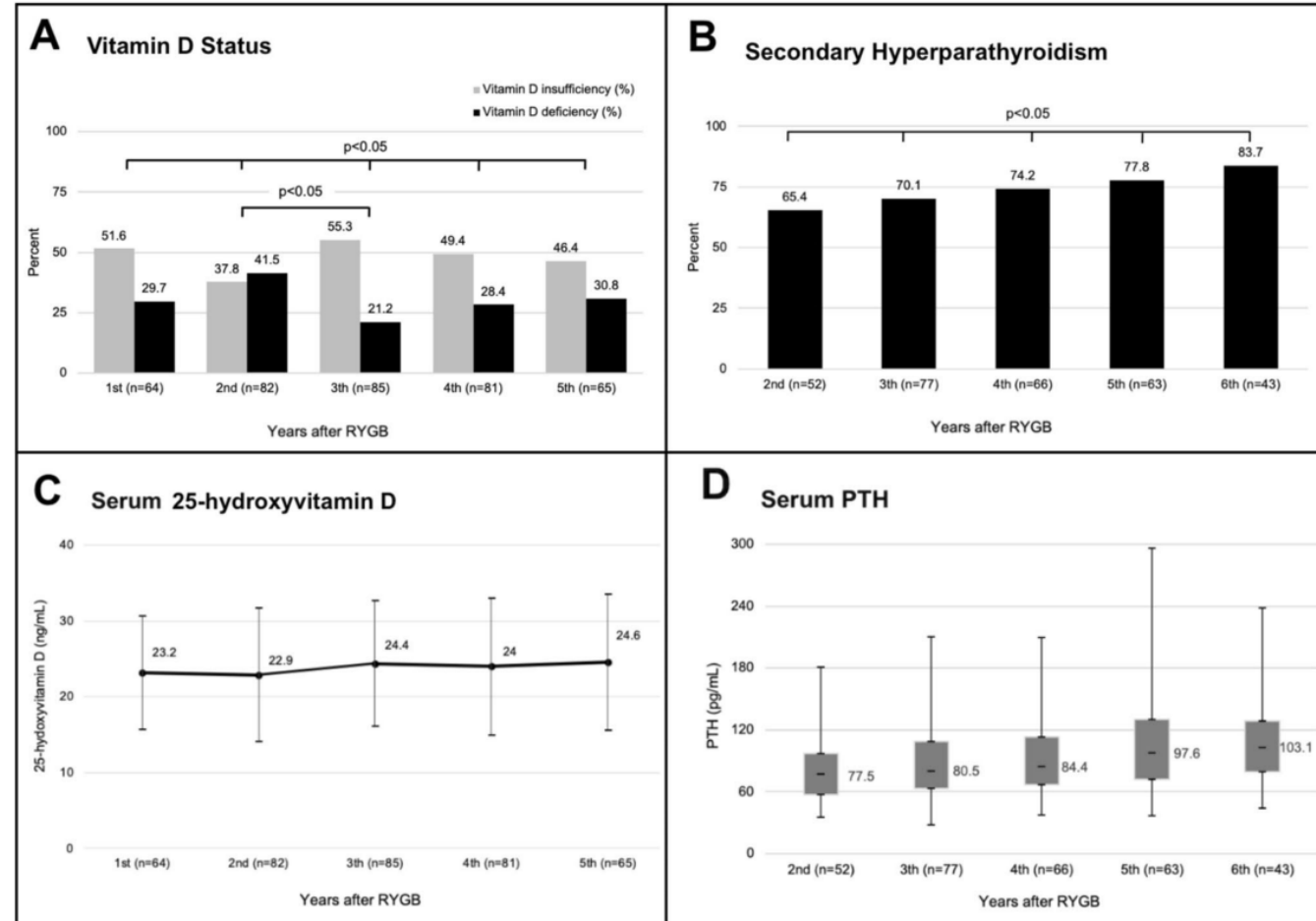


Fig. 2 Vitamin D status and parathyroid function over time post-RYGB. **A** shows vitamin D insufficiency and deficiency prevalence; **B** shows increasing secondary hyperparathyroidism (SHPT) prevalence; **C** shows mean \pm SD serum 25-hydroxyvitamin D; **D** shows serum PTH box plot.

Bone Metabolism in Adolescents Undergoing Bariatric Surgery

Madhusmita Misra^{1,2} and Miriam A. Bredella³

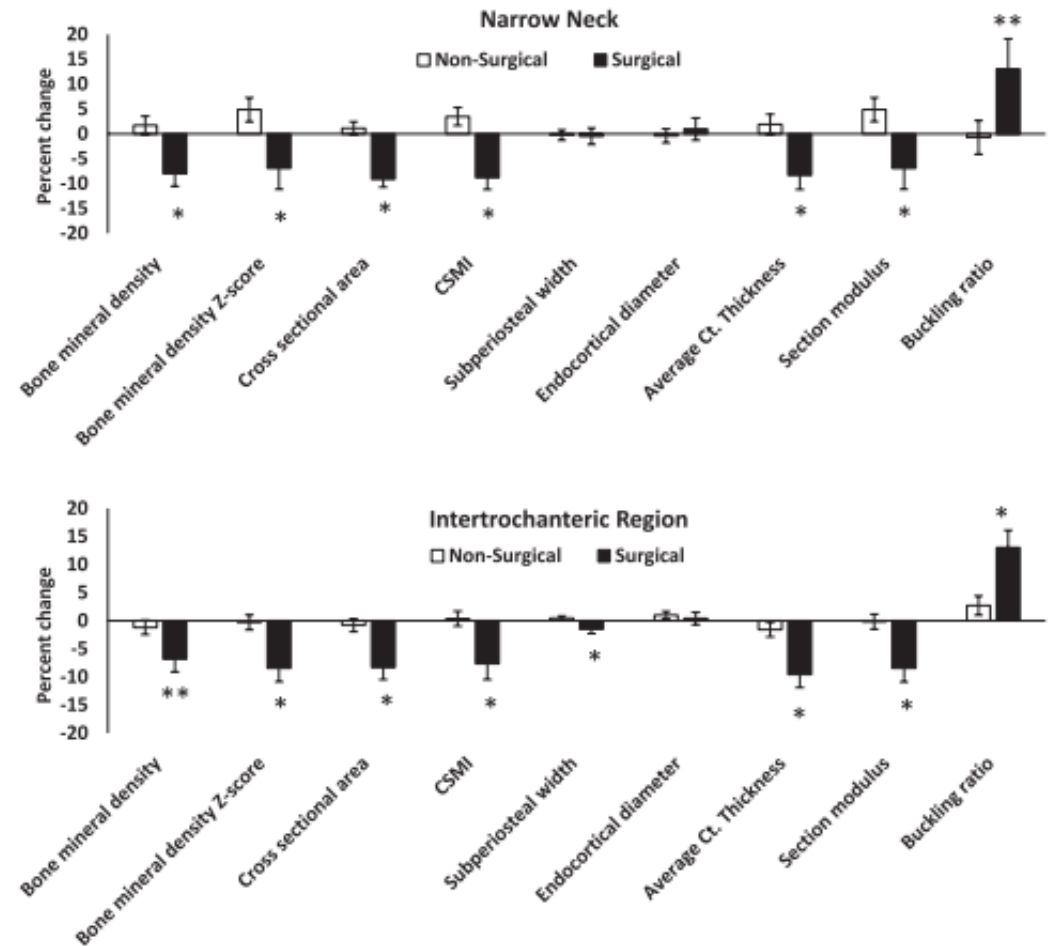
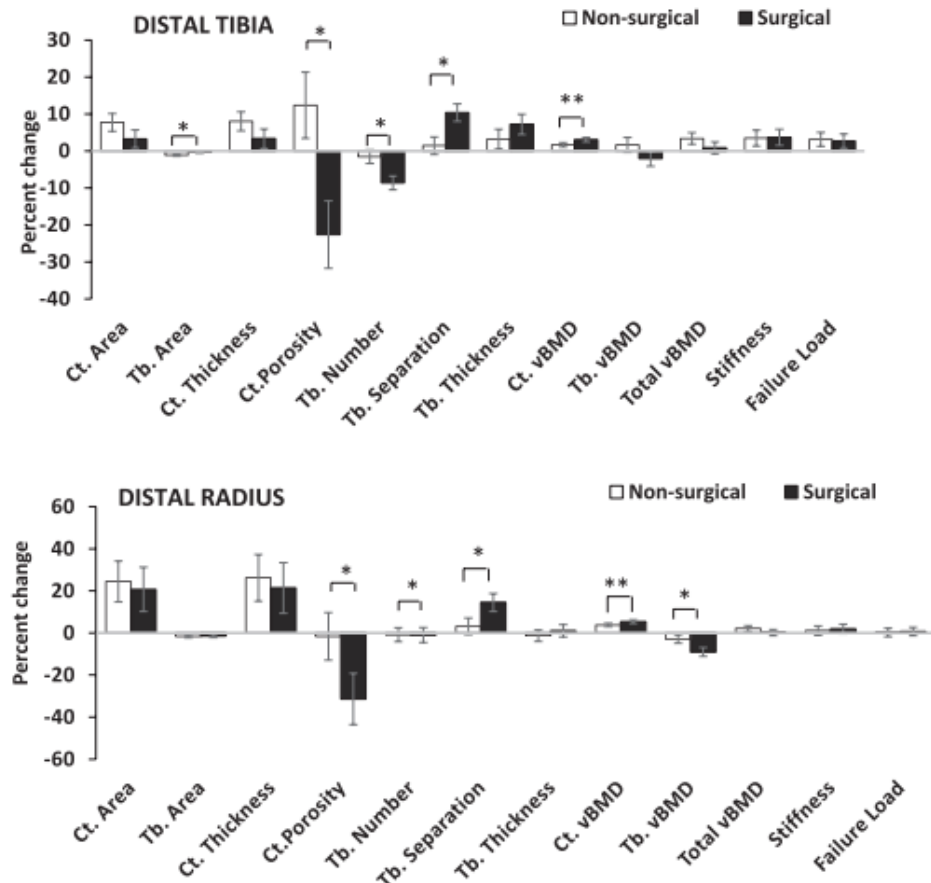


Figure 2. Percent change in HRpQCT measures at the distal tibia (top) and distal radius (bottom) in the nonsurgical and sleeve gastrectomy groups (after controlling for age, sex, and race). * $P < .05$, ** $P < .10$. Ct., cortical; Tb., trabecular; vBMD, volumetric bone mineral density. Reproduced with permission from Misra et al. Bone 2020.

ADOLESCENTI		Età media	BMI (kg/m ²)
CASI (n= 106)	RYGB (n=58)	26.8 ± 1.9	42.1 ± 9.9
	VSG (n=48)	25.1 ± 2.1	37.1 ± 8.4
CONTROLLI (n=91)		26.5 ± 2.7	40.2 ± 8.7

	RYGB	VSG
BMD (g/cm²)		
Anca	-10%	-6,3%
Collo Femore	-9,6%	-5,7%
Radio ultra-dist.	-7,9%	-7%
Radio	-30%	-15%
Tibia	-26%	-14%

- $\Delta\%$ BMI dal baseline o 1 anno dopo la MBS non era associato con le misure BMD ad una media di 9.3 anni post-MBS

- **BMD Z-scores** del Collo del **Femore** era inversamente associato al tempo trascorso da MBS ma non associato al $\Delta\%$ BMI

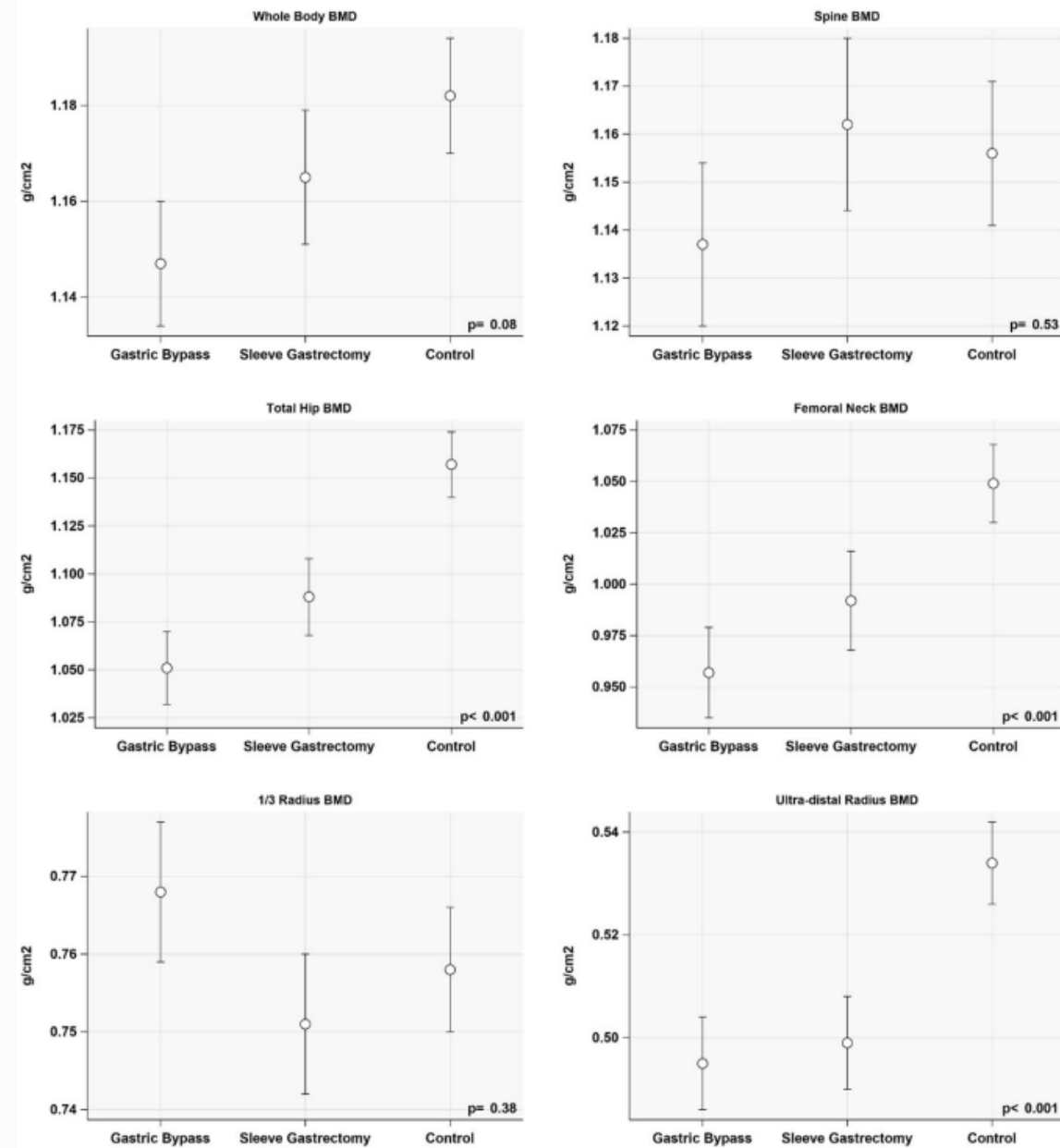


Fig. 1 Adjusted mean dual energy x-ray absorptiometry (DXA) outcomes for metabolic and bariatric surgery groups and matched

Joint Bone Spine

Volume 89, Issue 6, November 2022, 105443

Recommendations of metaanalyses

French recommendations on the prevention and treatment of osteoporosis secondary to bariatric surgery

Julien Paccou^{a,*}, Laurent Genser^b, Éric Lespessailles^c, Éric Bertin^d, Rose-Marie Javier^e, Martine Duclos^f, Anne-Sophie Joly^g, Yves Boirie^h, François Pattouⁱ, Jacques Delarue^j, Bernard Cortet^a

Assessment of fracture risk in patients with an indication for or who have already undergone bariatric surgery

General measures: For whom?

→ All patients

Normalise the intake of calcium (1000 mg/day after SG, and 1500 mg/day after RYGB) and protein (at least 60 g/day); attain a 25(OH) vitamin D concentration of at least 30 ng/mL; prevent the risk of falls and introduce a program of weight-bearing physical activity

Who to assess?

- ✓ **Regardless of age, in the case of RYGB and biliopancreatic diversion**
- ✓ **Regardless of age, for patients at high risk of fracture***
- ✓ **Menopausal women and men ≥ 50 years: for other bariatric surgery procedures and excluding patients at high risk of fracture***

How to assess?

- ✓ **Measurement of BMD by DXA**
- ✓ **Vertebral imaging (if necessary)**
- ✓ **Osteoporosis risk factors**

*Patients at high risk of fracture are:

- Those with a history of fragility fracture after the age of 40;
- Those presenting comorbidities that are frequently associated with osteoporosis, i.e. certain endocrinopathies, neurological disorders with neurosensory impairment, hepatic cirrhosis, chronic obstructive pulmonary disease > stage 1, and chronic inflammatory diseases);
- Those taking medications that are frequently associated with osteoporosis (corticosteroids, LH-RH antagonists, antiretroviral drugs, aromatase inhibitors, prolonged chemotherapy).

Who to treat?

Menopausal women and men ≥ 50 years:

- ✓ **If previous history of severe fractures**
- ✓ **If non-severe fracture and T-score ≤ -1**
- ✓ **If T-score ≤ -2 (in the absence of fractures)**

How to treat?

- ✓ **Zoledronic acid (cycle of 3 perfusions)**

Who to refer? (To a specialist in bone diseases)

- Non-menopausal women and men < 50 years old**
- ✓ **If previous history of bone fragility fractures**
 - ✓ **if Z-score ≤ -2 (in the absence of fractures)**

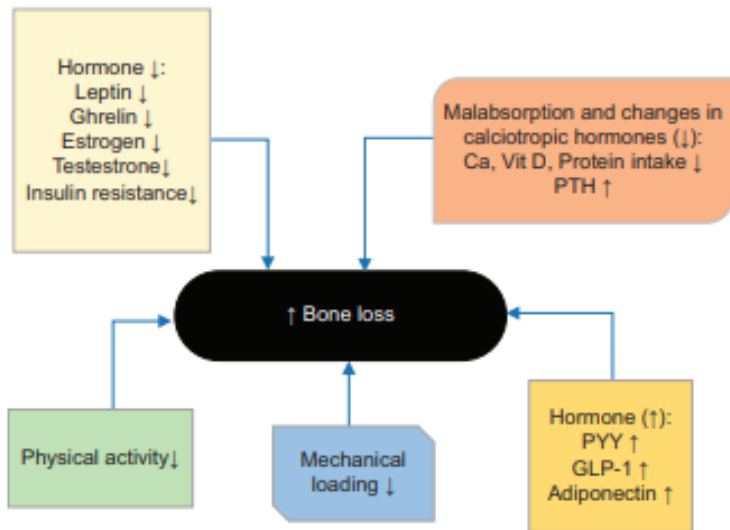


Figure 3: Numerous internal and external factors, including; diet, mechanical loading, hormones, and genetics, play a role in bone health sustainability⁽¹⁴⁹⁾

Table 4: Clinical evaluation and preventive strategies for bone health in bariatric surgery

Before surgery	Prevention	Follow up
Calcium		
Serum PTH	1200-1500 mg/day (after AGB, RYGB, and S.G.)	Every 6-12 month (S.G., RYGB, BPD/BPD-DS)
Serum calcium	1800-2400 mg/day (after BPD/BPD-DS) (food and supplements)**	Every 12 month (AGB)
Serum 25(OH) D		then annually
DXA at spine and hip (RYGB, BPD, BPD-DS; in higher-risk patients)*		DXA at spine and hip 2 years postoperatively (all patients)
Vitamin D		
Serum 25(OH) D	3000 IU D3/day (normal range 25(OH) D>30 ng/mL)***	Every 6-12 month (S.G., RYGB, BPD/BPD-DS)
Serum PTH		Every 12 month (AGB)
Protein		
Serum albumin	46 g/day - women 56 g/day - men	6-12 month
	Protein needs	Serum albumin (S.G., RYGB, BPD/BPD-DS)
	Should constitute:	12 month (AGB), then annually for all patients
	10%-35% of daily caloric intake	
	Weight maintenance: 0.8-1.2 g/kg body weight/day	
	Active weight loss: 1.2 g/kg body weight (BPD/DS may require 1.5-2.0 g/kg body weight/day)	

*Women aged ≥ 65 years, men aged ≥ 70 years, men above age 50-69; based on the risk factor profile, and men aged 50 and older who have had an adult age fracture. **Calcium citrate is preferable over calcium carbonate because it is independent of stomach acidity absorption. Calcium should be given in divided doses (single doses should not exceed 600 mg), separated by ≥ 2 -h intervals from iron-containing supplements. Calcium carbonate should be taken with meals, whereas calcium citrate can be taken with or without meals. ***D3 is recommended as more potent than D2, but both forms can be effective and dose-dependent. It is recommended that both D2 and D3 be taken with a meal containing fat to ensure maximum absorption. PTH: Parathyroid hormone, 25(OH) D: 25-hydroxyvitamin D, RYGB: Roux-en-Y gastric bypass, LAGB: Laparoscopic adjustable gastric band, BPD-DS: Biliopancreatic diversion with a duodenal switch, AGB: Adjustable gastric banding, DXA: Dual-energy X-ray absorptiometry, S.G.: Sleeve gastrectomy

The Skeletal Consequences of Bariatric Surgery

Alexandra N. Krez¹ · Emily M. Stein^{1,2}

Current Osteoporosis Reports

<https://doi.org/10.1007/s11914-020-00579-2>

Fig. 3 Recommendations for pre- and post-operative management of bariatric patients. Gastric banding (GB); sleeve gastrectomy (SG); Roux-en-Y gastric bypass (RYGB); biliopancreatic diversion with duodenal switch (BPD-DS)

Pre-Operative Management Recommendations		
Nutrition	Biochemical Evaluation	BMD Evaluation
<p>Calcium intake of 1000-1200 mg/day from combined diet and supplements</p> <p>Titrate 25OHD level to 30 ng/ml</p>	<p>Measure 25OHD and PTH levels and replete calcium and vitamin D</p>	<p>Baseline DXA performed on candidates with risk factors for osteoporosis</p>

Post-Operative Management Recommendations			
Nutrition	Biochemical Evaluation	BMD Evaluation	Exercise
<p>1200-1500 mg/day following GB,SG,RYGB and 1800-2400 mg/day following BPD-DS of calcium citrate</p> <p>Titrate 25OHD level to 30 ng/ml</p>	<p>Measure calcium, albumin, PTH, 25OHD levels initially and annually thereafter</p>	<p>Follow-up DXA measurements at 2 years</p>	<p>Moderate aerobic exercise for at least 150 minutes per week</p> <p>Incorporation of strength training 2-3 times per week</p>

Vitamin D status and supplementation before and after Bariatric Surgery: Recommendations based on a systematic review and meta-analysis

Reviews in Endocrine and Metabolic Disorders (2023) 24:1011–1029
<https://doi.org/10.1007/s11154-023-09831-3>

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TAKE HOME MESSAGES

FU nutrizionale, preoperatorio prima e successivamente post-operatorio, mirato a correggere TUTTE le deficienze nutrizionali per ridurre il rischio di Osteoporosi, Fratture, ma non solo.

- La chirurgia bariatrica è associata a rischio di fratture più elevato del 21–44%
- Rispetto alle altre procedure (SG e AGB) le procedure malassorbitive e il RYGB hanno rischio maggiore (73-79%)
- L'aumento del rischio è indipendente dall'età

TAKE HOME MESSAGES

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- L'aumento del rischio è indipendente dall'età

Nella prevenzione e nel trattamento post-operatorio dell'osteoporosi è importante attenzionare e/o supplementare:

- Microelementi: Ca, Mg, Zn, Cu, Mn
- Vitamina D (mantenimento livelli > 30ng/ml)
- Ca > 1000-1200 mg die, nel RYGB > 1500 mg, nella BPD > 1800-2400 mg
- Richiedere PTH e DXA come da linee-guida

Attività fisica (carico e stimolo) da includere nelle raccomandazioni



XXXII CONGRESSO
NAZIONALE SICOB

23 - 25 MAGGIO 2024
G I A R D I N I
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Grazie

Dr.ssa Edda Cava

UOSD Dietologia e Nutrizione

Azienda Ospedaliera S. Camillo Forlanini , Roma