

# Bariatric Surgery and Bone Loss: Novel Mechanisms and Comparison of Different Modalities

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## Introduction

- Obesity rates have increased in recent decades
- Bariatric surgery remains the most effective therapy for weight loss.
- The skeletal consequences of obesity surgery are not clear.

## Aims

- To determine:
- Bone loss in obese subjects following weight loss surgery.
  - Changes in gut hormones and adipokines:
    - following weight loss.
    - impact on BMD

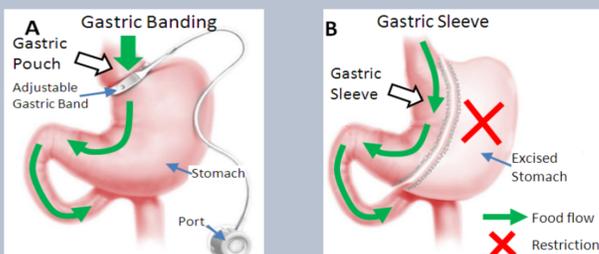
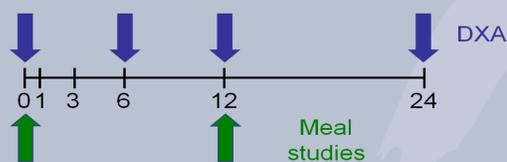
## Methods

Nonrandomized, prospective study of obese patients undergoing weight loss through 3 interventions

- Diet and exercise program (Diet)- followed for 1 year
- Gastric Banding (GB)- followed for 1 year
- Gastric Sleeve (GS)- followed over 2 years

Measurements at all visits:

- Anthropometry, biochemistry, gut hormones, adipokines
- Ca<sup>++</sup> and vit D supplements



## Baseline Characteristics

	Diet	Gastric Band (GB)	Gastric Sleeve (GS)	Anova, P value
Number	18	12	22	
Age	57 (10)	46 (13)*	52 (12)	0.02
Females (%)	15 (83)	10 (83)	12 (55)	0.09
Weight (kg)	110 (28)	105 (16)	127 (19)^	0.006
BMI	38 (7)	38 (5)	43 (6)^	0.006
Ca intake(mg/d)	924 (344)	937 (516)	951 (496)	0.72
25(OH) D nM	67 (27)	56 (12)	57(12)	0.11
iPTH (pM)	5.3 (2.5)	4.4 (1.3)	5.8 (2.9)	0.86
Body Fat (kg)	48 (9.7)	52 (8.8)	56 (8.6)	0.09
Lean BM (kg)	52 (11)	49 (8.2)	60 (9.0)	0.09
TH BMD(g/cm <sup>2</sup> )	1.1(0.13)	1.1(0.2)	1.2 (0.1)^	0.049
% PYY Δ (+90min)	38 (114)	57 (84)	58 (137)	0.85
Adiponectin (ng/ml)	7788 (3516)	6863 (2346)	6987 (4708)	0.99

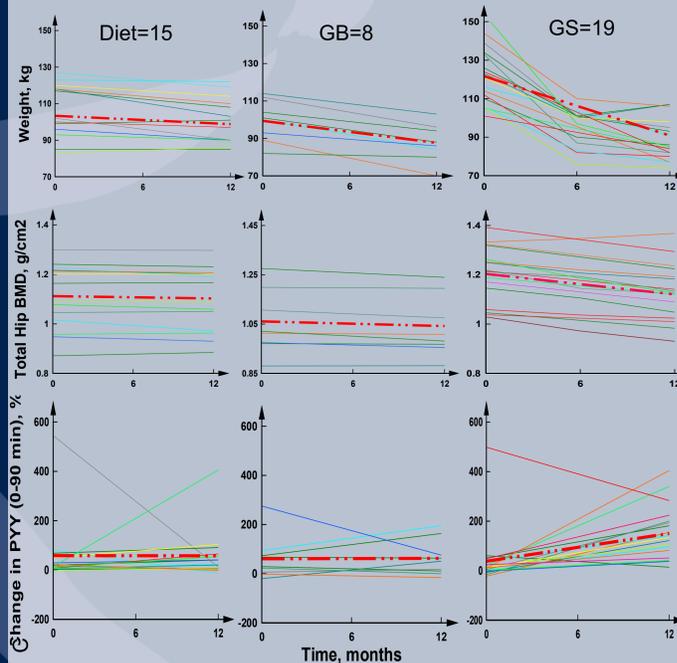
\* P<0.05 diet vs.GB, # P<0.05 diet vs GS, ^ P<0.05 GB vs GS

## Comparison of study procedures at 12 months

	Diet& exercise (Diet)	Gastric Band (GB)	Gastric Sleeve (GS)	Anova, P - value
% wt loss	↓ 4.5 (5)	↓ 12 (6)	↓ 26 (8)	<0.0001
% bone loss	↓ 0.83 (1.6)	↓ 1.6 (1.5)	↓ 6.1 (2.9)	<0.0001
% PYY Δ (+90min)	↑ 58 (102)	↑ 70 (74)	↑ 150 (106)	<0.008
% Adiponectin Δ	↑ 4 (22)	↑ 21 (19)	↑ 75 (62)	0.0022
% GLP1 Δ	↑ 34 (56)	↑ 11 (24)	↑ 79 (5)	0.43
% Osteocalcin Δ	↓ 16 (42)	↑ 22 (42)	↑ 110 (89)	0.0004
% u NTX Δ	↑ 36 (67)	↑ 42 (57)	↑ 89 (83)	0.0222
% iPTH Δ	↓ 0 (26)	↓ 14 (42)	↓ 15 (33)	0.38
% 25 (OH) vit D	↑ 8 (61)	↑ 34 (49)	↑ 53 (76)	0.04

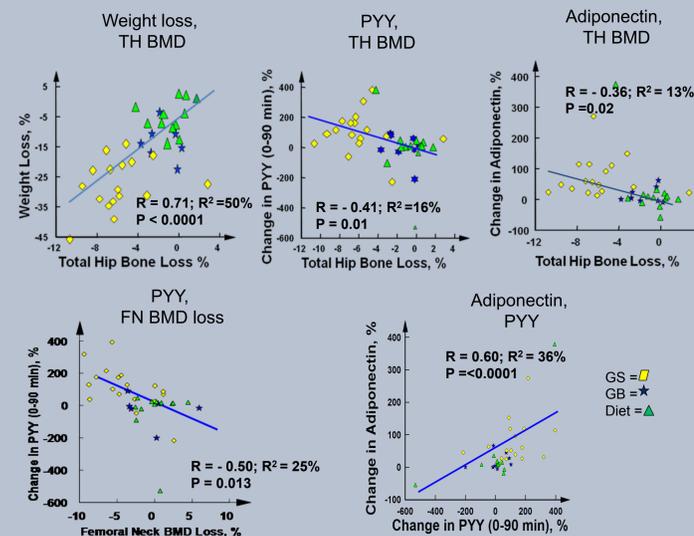
- Significant differences in weight loss between 3 groups.
- In GS, continuous bone loss; 3.5% by 6 mths and 6.1% by 12 mths
- In GS, ↑ % PYY (+90min) increment and ↑ adiponectin level.
- In GS, BTM increased significantly
- In GB or Diet no significant changes in gut hormones or adiponectin
- In all groups, Ca and 25-OHD remained within normal range through the study

## Comparison of study procedures at 12m



- GS was the most efficient weight loss modality.
- Diet produces modest weight loss.
- Bone loss was significant only in GS.
- The postprandial PYY response 12 months post- GS was significantly higher compared with Diet or GB group.

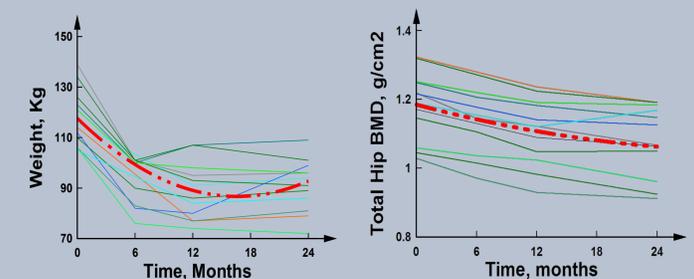
## Correlations between weight loss, bone loss, adiponectin and PYY for all patients



### PREDICTORS OF TH BMD LOSS OVER 12 MONTHS TIME

Variable	Unit of Change	Estimate	R <sup>2</sup>	P-value
Baseline Weight (Kg)	- 5	0.45	0.28	0.0017
Baseline TH BMD (g/cm <sup>2</sup> )	- 0.14	1.17	0.11	0.0405
(%) Weight loss	+ 1	19	0.50	< 0.0001
(%) Adiponectin change	- 1	1.6	0.13	0.024
% (+90 min) PYY change	- 1	0.87	0.55	0.0102

## GS: Continuous bone loss over 24months after early weight loss



### For 12 GS patients with 24 months data

- Maximum weight loss occurred during the first 6 months
- Bone loss was continuous across the 24 month period
- These patients experienced a further BMD loss, totalling 9 (3)%
- There was a ↓ in mean TH T-score from +1.0 to 0.2, p=0.04
- There was a continuous lean mass loss of 13.5%

## Conclusion

- GS is the most effective weight loss modality.
- Bone loss was the highest in GS patients.
- Bone loss at 12 months was significantly correlated with weight loss, change in PYY and adiponectin.
- In the multivariate analysis weight loss and postprandial PYY response explained 56% of TH BMD loss (P<0.0001).
- The bone loss and lean mass loss in GS group were continuous (24 months), while weight loss only occurred during first 6 months.
- Calcium and 25-OHD were normal throughout this study

These findings have significant clinical implications for people undergoing bariatric surgery

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