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Dynamic Shifts in Vitamin D Status Following Liposuction: Implications for Patient Monitoring and Health

Liposuction Sonrası D Vitamini Durumundaki Dinamik Değişimler: Hasta İzleme ve Sağlık Açısından Etkileri

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ABSTRACT

Aim: Liposuction, a prevalent plastic surgery procedure, has gained a significant popularity in recent years. Vitamin D, a crucial fat-soluble vitamin, plays a vital role in numerous metabolic pathways, with emerging importance beyond skeletal health. This study aims to assess vitamin D status before and after liposuction surgery and examine the impact of removed adipose tissue on serum 25(OH)D levels.

Material and Method: This cross-sectional study included patients undergoing liposuction between January 2022 and February 2023. Criteria for inclusion and evaluation of vitamin D status followed established guidelines. Vitamin D status and serum 25(OH)D levels were assessed and measured on the follow-up points.

Results: Participants (n=21) exhibited a significant decrease in BMI postoperatively. Serum 25(OH)D levels showed a decline, reaching the lowest in the 1st month post-surgery. The distribution of vitamin D status shifted postoperatively, with an increased incidence of deficiency.

Conclusion: The study underscores the dynamic relationship between BMI, adipose tissue, and vitamin D levels following liposuction. Research has associated vitamin D deficiency with adverse surgical outcomes and emphasizes the need for monitoring this parameter in elective surgeries. Findings suggest a dynamic shift in vitamin D status post-liposuction, advocating for continuous monitoring and potential supplementation.

Key Words: Liposuction, Vitamin D, 25(OH)D, BMI, Adipose tissue, Surgical outcomes

ÖZ

Amaç: Yaygın bir plastik cerrahi işlemi olan liposuction son yıllarda önemli bir popülarite kazanmıştır. Yağda çözünen önemli bir vitamin olan D vitamini, iskelet sağlığının ötesinde önemi ortaya çıkan çok sayıda metabolik yolda hayati bir rol oynar. Bu çalışma, liposuction ameliyatı öncesi ve sonrası D vitamini durumunu değerlendirmeyi ve alınan yağ dokusunun serum 25(OH)D düzeyleri üzerindeki etkisini incelemeyi amaçlamaktadır.

Gereç ve Yöntem: Bu kesitsel çalışmaya Ocak 2022 ile Şubat 2023 arasında liposuction uygulanan hastalar dahil edildi. D vitamini durumunun değerlendirilmesine ilişkin kriterler, yerleşik yönergelere uygun olarak yapıldı. Takip zamanlarında D vitamini durumu ve serum 25(OH)D düzeyleri değerlendirilip ölçüldü.

Bulgular: Katılımcıların (n=21) ameliyat sonrası vücut kitle indeksinde anlamlı bir azalma olduğu görüldü. Serum 25(OH)D düzeyleri düşüş göstererek ameliyat sonrası 1. ayda en düşük seviyesine ulaştı. D vitamini durumunun dağılımı postoperatif dönemde değişti ve eksiklik gözlenen bireylerin insidansı arttı.

Sonuç: Çalışma, liposuction sonrası vücut kitle indeksi, yağ dokusu ve D vitamini düzeyleri arasındaki dinamik ilişkinin altını çizmektedir. Araştırmalar, D vitamini eksikliğini olumsuz cerrahi sonuçlarla ilişkilendirmiştir ve elektif ameliyatlarda bu parametrenin izlenmesi ihtiyacını vurgulamaktadır. Bulgular, liposuction sonrası D vitamini durumunda dinamik bir değişim olduğunu ve sürekli takip ve ihtiyaç durumunda takviye gereksinimini desteklemektedir.

Anahtar Kelimeler: Liposuction, Vitamin D, 25(OH)D, VKİ, Adipoz doku, Cerrahi sonuçlar

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Introduction

Liposuction is the most frequently performed plastic surgery procedure, corresponding to 22% of operations, with a 21.1% increase in 2022 compared to the preceding year (1). The procedure involves extracting adipose tissue using a suction-assisted technique with cannulas. Over time, various methods have been introduced to minimize complications and enhance the comfort and satisfaction of patients.

Vitamin D, classified as a fat-soluble vitamin and recognized as a steroid hormone, plays a crucial role in over 300 metabolic pathways, with recent data, highlighting its increasing importance in extra-skeletal tissues (2).

While Vitamin D can be acquired through the diet, its primary source is endogenous photo-production in the skin from 7-dehydrocholesterol upon exposure to UV-B radiation through the sunlight. Specialized binding proteins facilitate the transportation of vitamin D to the liver parenchymal cells. Within these cells, the vitamin undergoes conversion by the vitamin D-25-hydroxylase enzyme, resulting in the formation of 25-hydroxycholecalciferol (25(OH)D). 25(OH)D is the major circulating form of vitamin D, and, given its relatively longer half-life, the analysis of serum 25(OH)D levels is a common method for assessing the overall vitamin D status in the organism (3, 4).

Vitamin D deficiency /insufficiency is a global health issue, affecting approximately 1 billion people worldwide with an increasing prevalence, while 50% of the population has vitamin D insufficiency (5, 6). Numerous studies and meta-analyses have established a connection between suboptimal levels of 25(OH) D and various conditions, including chronic diseases, cancer, increased mortality rates, and autoimmune diseases (7, 8). It has been reported that body adipose tissue mass is inversely related to serum 25(OH)D levels, stronger than its association with body mass index (BMI) and weight (9).

To the best of our knowledge, there are a limited number of studies that evaluate the 25(OH)D levels following liposuction. Therefore, the aim of this study was to evaluate the vitamin D status before and after liposuction surgery and examine the impact of removed adipose tissue on serum 25(OH)D levels.

Material and Method

Study design and study population

This is a cross-sectional study of patients that was conducted at a single plastic surgery clinic. Patients with 25(OH) vitamin D level testing during the preoperative period and follow-up points between the periods of January 2022 and February 2023 were included. Ethical approval was obtained from the institutional review board (Date: 10.05.2023; No: E-22686390-050.99-27247).

Inclusion criteria were as follows: aged 18 years or older, willing for the testing of 25(OH) vitamin D on the study checkpoints, and patients who underwent a primary liposuction procedure. The patients with a metabolic disease, chronic disease, and patients who underwent a previous bariatric surgery procedure were excluded.

The widely used global criteria determined by the Endocrine Society was employed for the evaluation of 25(OH)D status, and insufficiency is defined as a 25(OH)D of 21–29 ng/ml, whereas individuals with a 25(OH)D of less than 20 ng/ml were regarded in the deficiency group. The adequate levels of 25(OH)D were determined within the range of 30–100 ng/ml (10). Study variables were age, gender, serum vitamin D level, BMI, and the follow-up points.

Informed consent was obtained, and the study was conducted in accordance with the Declaration of Helsinki.

Statistical analysis

Categorical variables were presented as frequency and percentages, while numerical variables were presented as mean ±standard deviation and minimum and maximum values. A paired Student's t-test was used for the comparison of variables between time points. Analysis was performed using the IBM SPSS software version 17.0 (IBM Corp., Armonk, NY. A p value <0.05 was determined for the statistical significance.

Results

Table 1 presents the demographic and clinical characteristics of the study participants undergoing liposuction. The mean age of the participants was 34.71 years, with a range of 28 to 43 years. There were 18 females and 3 males in the study. The average body mass index (BMI) was 27.42 kg/m^2, ranging from 21.72 to 35.98 kg/m^2.

Table 1. Demographic data of the study group.

Variables	Mean ±SD	Min-Max
Age (years)	34.71±4.906	28-43
Female/Male	18/3	
BMI (kg/m^2)	27.42±4.074	21.72-35.98
25(OH)Vitamin D (ng/mL)		
Preoperative	27.70±36.616	2.32-110
Postoperative	15.196±20.54	1.96-69.6
Postoperative 1st month	11.476±4.556	4.28-19.8
Postoperative 3rd month	14.16±7.024	7.76-28.24
Postoperative 6th month	19.8±14.9	9.48-36.88

The mean serum 25(OH)D levels were 27.70 ng/mL preoperatively, 15.196 ng/mL postoperatively, 11.476 ng/mL in the 1st month, 14.16 ng/mL in the 3rd month, and 19.8 ng/mL in the 6th month. Table 2 shows a comparison of BMI and serum 25(OH)D levels at various time points before and after liposuction surgery.

Table 2. Comparison of variables in the study group.

Variables	Mean ±SD	p value*	p value**
BMI (kg/m^2)			
Preoperative	27.42±4.07		
Postoperative	25.76±2.99	<0.001	
Postoperative 1st month	25.82±2.34	<0.001	0.1057
Postoperative 3rd month	25.71±2.69	<0.001	0.1182
Postoperative 6th month	25.44±2.87	<0.001	0.1374
25(OH)Vitamin D (ng/mL)			
Preoperative	27.70±36.616		
Postoperative	15.196±20.54	<0.05	
Postoperative 1st month	11.476±4.556	<0.05	
Postoperative 3rd month	14.16±7.024	<0.05	0.3302
Postoperative 6th month	19.8±14.9	0.068	0.1446
			<0.05

*Difference with preop; **Difference with previous measurement.

Preoperative BMI was 27.42±4.07 kg/m^2, which significantly decreased to 25.76±2.99 kg/m^2 postoperatively ($p < 0.001$). BMI continued to show a significant difference from the preoperative levels for all time points ($p < 0.001$ for all). The changes in BMI levels were not statistically significant when comparing postoperative periods with the previous measurement.

There was a significant decrease in postoperative 25(OH) D levels (15.196±20.54 ng/mL) compared to the preoperative measures (27.70±36.616 ng/mL; $p < 0.05$). The 1st-month, 3rd-month, and 6th-month levels of serum 25(OH)D were also significantly lower than the preoperative levels. Also, there was a significant difference between the postoperative months 3 and 6 ($p<0.05$) (Figure 1). Table 3 illustrates the distribution of 25-hydroxy vitamin D status at various time points after the liposuction surgery.

Table 3. Vitamin D status of the study group on different time-points.

Time points	25(OH) Vitamin D status			
	Deficiency (<20 ng/ml)	Insufficiency (21-29 ng/ml)	Adequacy (30 -100 ng/ml)	Potential advers effects (>100 ng/ml)
Preoperative	9	8	4	0
Postoperative	15	3	3	0
Postoperative 1st month	4	5	12	0
Postoperative 3rd month	3	9	9	0
Postoperative 6th month	6	6	9	0

Before the procedure, 9 cases were vitamin D deficient, followed by those with insufficiency (8 cases) and adequacy (4 cases). Postoperatively, the deficiency increased to 15 cases, while cases of insufficiency and adequacy decreased to 3 each. In the first month after surgery, adequacy surged to 12 cases, contributing to a decline in deficiency (4 cases) and insufficiency (5 cases). In the third and sixth months postoperatively, a balanced distribution was observed among deficiency, insufficiency, and adequacy. None of the cases had serum 25(OH)D levels > 100 ng/ml that might cause potential adverse effects.

Discussion

In the context of this study, 25(OH)D levels were measured at different time points: preoperative, postoperative, postoperative 1st month, postoperative 3rd month, and postoperative 6th month. We observed significant variations during the follow-up period in terms of 25(OH)D levels, possibly as a result of decreased adipose tissue content, which serves as the main site for vitamin D storage. Furthermore, we observed increased rates of Vitamin D deficiency following the surgery, indicating the necessity of a closer follow-up of this parameter in the patient group.

The dynamic relationship between BMI and vitamin D has been documented in several studies. While our study observed a reduction in 25(OH)D levels within the participant group, aligning with the decline in BMI, research by Vimaleswaran et al. indicated that for every additional unit of kg/m^2 in BMI, there was a corresponding 1.15% decrease in serum 25(OH)D concentration. They concluded that the increased volume of adipose tissue might be a contributing factor to reduced vitamin D bioavailability due to the sequestration of the fat-soluble vitamin (11).

Despite its small sample size, a study by Beckman et al. reported that visceral adipose tissue contained 21% more vitamin D compared with subcutaneous fat, confirming the concept that vitamin D is sequestered in visceral fat in obesity (12).

The definitions of both Vitamin D deficiency and insufficiency were based on the effect of its status on bone health. However, Vitamin D gained importance recently due to accumulating data regarding the relationship between its status and the risk and/or severity of nonskeletal conditions including death due to cardiovascular disease, cancer, COVID-19, and other causes (13-16). Additionally, studies have pointed out that individuals deficient in Vitamin D face elevated risks of adverse outcomes following surgery and anesthesia (2).

In a randomized placebo-controlled trial, conducted by Lotfi-Dizaji et al., it was discovered that a 12-week intervention involving a weekly bolus of 50,000 IU vitamin D supplementation, coupled with a weight loss diet program, led to a decrease in circulating levels of the chemokine monocyte chemoattractant protein-1(MCP-1). However, no significant impact was observed on interleukin-1β (IL-1β) and Toll-like receptor 4 (TLR-4) levels. This implies that the combination of weight loss and vitamin D supplementation may collaboratively reduce MCP-1 levels and inflammation related to excessive weight and obesity through distinct mechanisms (17).

Research by Bandstein et al. evaluated the correlation between vitamin D and weight loss assessed the FTO genotype status of patients who underwent a bariatric surgery procedure, and reported that individuals with preoperative vitamin D deficiency experienced differential weight loss following the procedure, suggesting an interaction between the response to the operation and FTO alleles (18). To date, most research on Vitamin D status following a surgical procedure has been done on bariatric and metabolic surgery procedures. However, all types of these surgeries involve the redirection, resection, or bypassing of different parts of the gastrointestinal tract, which would certainly affect the absorption and metabolization of Vitamin D and its precursors. Despite the increase in the recommended dietary allowance (RDA) for vitamin D from 400 to 600 IU daily for healthy adults in 2010, there remains a lack of consensus regarding the regulation of RDAs concerning weight loss through bariatric surgery and liposuction procedures (19). Also, individuals who are overweight or with obesity may require higher exogenous Vitamin D dosages. Also, the dosages should be adjusted depending on seasons, climates, personal clothing outgoing preferences, and nutritional habits. It is worth noting that patients with excessive weight also experience decreased sunlight exposure due to body image insecurities, and limited physical activity after the liposuction surgery.

It is required that well-designed guidelines on this specific patient group are required in order to provide adequate levels of Vitamin D and reduce the costs of analysis, healthcare, and physician consultations for continuous monitoring of this parameter. With a plasma half-life of 3 weeks and approximately 80%-90% of the molecule bound to Vitamin D binding protein, it has been proposed that assessing vitamin D status in the preoperative period should ideally take place 2 weeks prior to the surgery (20). Despite this, the measurement of 25(OH)D levels, determination of Vitamin D status, and supplementation when necessary are not commonly practiced in the context of elective surgeries. The presented data underscores the importance of evaluating Vitamin D status to uphold the highest standards of patient safety and public health.

This study has several limitations, including a limited

number of participants and a relatively short follow-up duration. Additionally, seasonal variations may impact the comparability of results. Nevertheless, the study comprises a homogeneous group of patients who underwent a similar procedure, and all participants were consistently included in the follow-up assessments throughout the study.

Conclusion

The findings of our study suggest a dynamic shift in vitamin D status following liposuction, emphasizing the need for ongoing monitoring and potential supplementation to address deficiencies. Also, further studies with longer follow-up durations are required to determine the prevalence of osteoporosis and osteomalacia in patients who have undergone liposuction procedures.

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