



Original Article



Prevalence of Skin Changes and Their Management After Bariatric Surgery: A Prospective Study at International Metabolic and Bariatric Center

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ABSTRACT

Numerous skin disorders, including ulcerated necrobiosis lipoidica diabetorum, hidradenitis suppurativa, intertrigo, and psoriasis, have shown improvement post-bariatric surgery. On the other hand, there have been reports of the occurrence of unfavourable skin disorders, most of which are related to nutritional deficiencies, such as those of iron, folic acid, vitamins, and trace elements. **Objectives:** To determine the prevalence of skin changes and diseases following bariatric surgery at our centre and their management strategies. **Methods:** This longitudinal study was carried out from April 2021 to March 2023. Patients were eligible for inclusion if they were aged 18 years or older, and had undergone one of the following bariatric procedures: sleeve gastrectomy, Roux-en-Y gastric bypass, or mini gastric bypass. Baseline clinical and demographic information was documented, At frequent follow-up intervals postoperative data were collected to record any new onset or changes in skin problems. **Results:** A total of 1656 patients who had undergone bariatric surgery were included. During the 12-month follow-up period, 1292 (78%) of patients experienced skin changes. Excess skin was the most prevalent type of skin alteration, affecting 1026 (62%) of patients, especially in the arms 745 (45%) and abdomen 1159 (70%). **Conclusions:** It was concluded that significant dermatological challenges are faced by patients post bariatric surgery and a holistic and multidisciplinary approach should be incorporated in managing these issues. By addressing both aesthetic and functional concerns, healthcare providers can enhance patients' overall satisfaction and quality of life.

INTRODUCTION

The most effective and widely used treatment for morbid obesity is bariatric surgery, which significantly improves several comorbid illnesses linked to obesity [1]. The literature on the side effects of bariatric surgery is extensive. Among the often reported ones are nutritional deficiencies, haemorrhage, infections, stomach leaks, , gastrointestinal leaks, strictures, and wound hematomas [2]. The effects of obesity on the skin are well-known. It is linked to changes in the composition and structure of collagen, increased transepidermal water loss, arise in skin infections, and inadequate wound healing. In addition, the majority of obese patients experience hirsutism, acne, and occasionally androgenetic alopecia as a result of increased androgen production brought on by elevated insulin levels [3]. Furthermore, there are advantages and disadvantages

to bariatric surgery for the skin. Numerous skin disorders, including ulcerated necrobiosis lipoidica diabetorum, hidradenitis suppurativa, intertrigo, and psoriasis [4], have shown improvement. On the other hand, there have been reports of the occurrence of unfavourable skin disorders, most of which are related to nutritional deficiencies, such as those of iron, folic acid, vitamins, and trace elements [5]. Moreover, severe weight reduction also causes skin laxity [6]. Due to the significant amount of superfluous skin, the majority of the patients are likely to exhibit adverse consequences after undergoing bariatric surgery and experiencing significant weight loss [7]. Due to the extra skin and tissue after weight loss, fungal infections, dermatitis, pruritus, excessive sweating, and hygiene problems are common post-bariatric surgery [8].



Furthermore, anomalies in the extracellular matrix and skin of post-bariatric patients are common compared to normal skin tissue, the extracellular matrix in the patients' cases is loose. The tissue collected from striae and normal-appearing skin showed signs of elastin deterioration, collagen resorption, inflammation, and scarring [9]. Different skin conditions post-bariatric surgery also include Bowel-associated dermatosis–arthritis syndrome (BADAS), psoriasis, nutritional deficiency dermatoses and alopecia [10]. Prevention and management of these skin abnormalities are of paramount importance and need a multidisciplinary approach. An important factor in post-bariatric patients' care is nutrition. To identify any nutritional deficits, a thorough nutritional study should be carried out during the preoperative tests, and a suitable intervention should be planned. Additionally, patients undergoing significant weight reduction and body contouring should consider the possibility of "induced malnutrition," which can impact surgical recovery, scar quality, and the likelihood of complications [11]. All patients must have a clinical investigation for indications of nutritional inadequacies to prevent and/or manage the skin conditions associated with bariatric surgery [12]. Although alterations in the post-bariatric skin are acquiring attention worldwide, there is relatively little evidence from Pakistan regarding these changes and treatment. The different kinds and extents of skin issues following weight loss surgery may also vary with each region's special genetic susceptibility to these changes along with dietary and healthcare accessibility patterns. Most of the current research focuses on Western populations, which leaves a question of how well the results can be applied to patients in Pakistan.

Despite increasing global evidence on post-bariatric dermatological complications, there is limited region-specific data from Pakistan describing the prevalence, pattern, and management outcomes of skin changes following bariatric surgery. Most available literature is derived from Western populations, making its applicability to South Asian patients uncertain due to differences in genetics, nutrition, and healthcare access. Therefore, this study aimed to determine the prevalence of post-bariatric skin changes and evaluate their management strategies in a Pakistani tertiary care setting to provide local evidence for clinical practice.

METHODS

This longitudinal study was carried out at the International Metabolic and Bariatric Center in Peshawar, from April 2021 to March 2023. The Institutional Review Board (IRB) granted ethical approval (reference no 103/DME/AMC), and each subject provided informed consent. A total of 1656 patients who underwent bariatric surgery at the centre were included in the study utilizing non-probability convenience

sampling calculated through open epi software. Patients were eligible for inclusion if they were aged 18 years or older, had undergone one of the following bariatric procedures: sleeve gastrectomy, Roux-en-Y gastric bypass, or mini gastric bypass, and were willing to participate in follow-up assessments for a minimum of 12 months post-surgery. Exclusion criteria included patients with pre-existing dermatological conditions, previous bariatric surgery, or any history of significant comorbidities that could affect skin integrity. Patient medical records, in-person physical examinations, and patient-reported results were all used to gather data. Baseline clinical and demographic information was documented, including age, sex, BMI, kind of bariatric surgery, and skin condition before surgery. Data were collected throughout the follow-up period of one year, postoperative data were collected to record any new onset or changes in skin problems, such as the appearance of striae, rashes, infections, or excess skin. At every follow-up visit, skilled medical personnel conducted physical examinations. The existence and severity of skin changes which were divided into groups including excess skin, striae distensae, intertriginous dermatitis, and surgical scars were evaluated using standardized methods. With the consent of the patient, photos were taken utilizing a standard setup to guarantee consistency and record any evident skin modifications. Patients presenting with skin changes were offered a variety of management options based on the severity and type of changes observed. Treatment modalities included topical applications, oral medications, lifestyle modifications, and, in some cases, referral for plastic or reconstructive surgery. The choice of treatment was determined collaboratively by the attending bariatric surgeon, a dermatologist, and the patient. All treatments and patient adherence were documented. The frequency of various skin alterations following bariatric surgery and the efficacy of the management techniques used were the main end measures. A validated patient satisfaction survey was used to measure the secondary outcomes, which included patient satisfaction with the appearance and functional results of their skin following surgery. Data analysis was performed using statistical software SPSS version 26. Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. The prevalence of skin changes was calculated as a proportion of the total number of patients. Comparative analyses were conducted to evaluate differences in the occurrence of skin changes based on variables such as age, sex, BMI, and type of surgery. The effectiveness of different management strategies was assessed using appropriate statistical tests, with a p-value of <0.05 considered statistically significant.

RESULTS

In all, 1656 patients who had undergone bariatric surgery at the International Metabolic and Bariatric Center between April 2021 and March 2023 were included in this study. 530 (32%) of the patients were female and 1126 (68%) were male, with a mean age of 42 years (range: 18–65 years). The majority of patients 775 (47%) had mini gastric bypass followed by sleeve gastrectomy 529 (32%) and 352 (21%) Roux-en-Y gastric bypass (RYGB). The mean preoperative BMI was 42 kg/m² (range: 35–38 kg/m²). At 12 months postoperatively, the average percentage of excess weight loss was 65% (Table 1).

Table 1: Demographic and Clinical Characteristics

Characteristics	Values
Total Patients	1656
Mean Age (Years)	42
Gender Distribution	
Female	530 (32%)
Male	1126 (68%)
Bariatric Procedures	
Mini Gastric Bypass	775 (47%)
Sleeve Gastrectomy	529 (32%)
RYGB	352 (21%)
BMI	
Mean Preoperative BMI	42 kg/m ²
Percentage of Weight Loss	65%

During the 12-month follow-up period, 1292 (78%) of patients experienced skin changes. Excessive skin was the most prevalent type of skin alteration, affecting 1026 (62%) of patients, especially in the arms 745 (45%) and abdomen 1159 (70%). In 662 (40%) of cases, there were striae distensae, and in 464 (28%) of cases, intertriginous dermatitis was observed, mostly in regions where skin folds were present. 911 (55%) of patients had surgical scars, which were a common postoperative observation. However, at one year, the majority of scars were reported to be small and well-healed. Alopecia was reported in 596 (36%) of the patients. A total of 47% of patients suffering from psoriasis pre-surgery reported improvements in their symptoms (Table 2).

Table 2: Prevalence and Types of Skin Changes

Types of Skin Change	n (%)
Excess Skin	1026 (62%)
Striae Distensae	662 (40%)
Intertriginous Dermatitis	464 (28%)
Surgical Scars	911 (55%)
Alopecia	596 (36%)

794 (48%) of the patients who presented with alterations in their skin were treated non-surgically using topical lotions and lifestyle changes. In 662 (40%) instances, topical therapies were utilized, mostly for the management of

striae and intertriginous dermatitis. These treatments included moisturizers and anti-inflammatory creams. 199 (12%) of patients received prescriptions for oral drugs, primarily for the management of infections in cases of dermatitis. A referral for plastic or reconstructive surgery was necessary for 323 (25%) of the patients, and in 129 (10%) of those situations, operations like abdominoplasty were carried out. 1408 (85%) of patients reported regular topical application use and compliance with lifestyle modifications, indicating a high level of patient adherence to the prescribed therapy. Most patients said they were happy with how their treatments had worked out. According to the Body-Q questionnaire, 1159 (72%) of patients were happy with how their skin looked and worked after surgery, whereas 497 (28%) were not, mostly because of residual extra skin or the presence of scars (Table 3).

Table 3: Management of Skin Changes and Patient Satisfaction

Treatment Modality	n (%)
Topical Applications	662 (40%)
Oral Medications	199 (12%)
Plastic/Reconstructive Surgery	129 (10%)
Patient Satisfaction	1159 (72%)
Dissatisfied	497 (28%)

A comparative analysis showed that individuals with a higher preoperative BMI had a considerably greater prevalence of extra skin ($p=0.01$), whereas younger patients had a higher prevalence of striae distensae ($p=0.03$). The severity of skin problems was successfully reduced by non-surgical treatments, especially topical applications; after six months of treatment, 994 (60%) of patients reported improvement ($p=0.04$). A large percentage of patients 1411 (85%) expressed satisfaction with the results of surgical procedures for extra skin ($p=0.01$) (Table 4).

Table 4: Association among Different Variables

Findings	Subgroups	Prevalence n (%)	Statistical Significance (p-value)
Prevalence of Excess Skin by BMI	Higher Preoperative BMI	1026 (62%)	$p=0.01$
Prevalence of Striae Distensae by Age	Younger Patients	662 (40%)	$p=0.03$
Effectiveness of Non-Surgical Treatments	Improvement After 6 Months	994 (60%)	$p=0.04$
Satisfaction with Surgical Interventions	Post-Surgery Satisfaction	1411 (85%)	$p=0.01$

DISCUSSION

This study investigated the prevalence and types of skin changes in patients following bariatric surgery at the International Metabolic and Bariatric Center, along with various management strategies and their effectiveness. Literature has reported that skin changes after bariatric surgery are mainly due to rapid weight loss, which can exceed the skin's ability to retract, resulting in loose or

sagging skin, especially on the abdomen, arms, and thighs. Nutritional deficiencies in protein, vitamin C, and zinc, common post-surgery, further weaken skin structure and delay healing, contributing to stretch marks and dermatitis. These factors highlight the need for ongoing skin and nutrition management to support patient recovery and satisfaction [13]. Our findings reveal that 78% of patients experienced skin-related issues within 12 months post-surgery, with excess skin (62%), striae distensae (40%), and intertriginous dermatitis (28%), alopecia 298 (18%) being the most common. Additionally, 55% reported postoperative scars, underscoring the impact of rapid weight loss on skin health and patient satisfaction. The findings of our study are consistent with another study which highlights the high prevalence of excess skin, particularly in areas like the arms and abdomen, following rapid weight loss. This excess skin, more common in patients with higher preoperative BMIs ($p=0.01$), can create functional issues in hygiene and cause discomfort. The study also reported that patients achieving at least 50% excess body weight loss (EBWL) showed improved skin conditions, with a reduced prevalence of acanthosis nigricans, keratosis pilaris (aOR=0.21, $p=0.02$), and pebble fingers (aOR=0.09, $p=0.04$). However, a higher incidence of alopecia was noted, suggesting post-surgical nutritional challenges [6]. The findings of our study showed that striae distensae 662 (40%) and intertriginous dermatitis 464 (28%) were also common post-surgery, with a higher prevalence of striae in younger patients ($p=0.03$). These findings are from a study which reported the increased prevalence of acquired perforating dermatosis [14]. Another study supported our findings and showed an even greater prevalence of stria in 30 (97%) of the patients along with acanthosis nigricans in 29 (93%) patients [15]. Alopecia was reported in 596 (36%) of the patients in our study. The literature has reported the rates of alopecia post-bariatric surgery as between 12 to 93%. Reports of telogen effluvium linked to iron and zinc nutritional deficiencies typically start six months following surgery [16]. These skin issues can impact patients' quality of life, emphasizing the need for regular dermatological monitoring after bariatric surgery. In comparison Razvigor et al. Showed that Striae distensae (stretch marks) and intertriginous dermatitis are prevalent concerns in obese patients, exacerbated by rapid weight fluctuations and the unique skin physiology associated with obesity. Striae arise due to the mechanical stretching of the dermal layer, leading to collagen disruption and subsequent scar tissue formation, commonly seen in areas like the abdomen, thighs, and arms. Intertriginous dermatitis, frequently observed in skin fold areas (e.g., underarms and groin), results from friction, moisture accumulation, and poor ventilation, which create an environment conducive to bacterial or fungal growth. These skin conditions, typical in

the post-bariatric population, significantly impact the patient's quality of life, emphasizing the necessity for dermatological monitoring and preventive care in weight management programs [17]. Different pre-existing skin conditions have shown improvements following bariatric surgery including Hidradenitis suppurativa and Psoriasis. The results of a retrospective analysis showed that 35 patients with HS symptoms underwent bariatric surgery out of which 24 patients (69%) showed improvements, 7 patients (20%) showed no change, and 4 individuals (11%) saw their HS symptoms increase [18]. Similarly in another retrospective survey, following bariatric surgery, 62% of respondents reported improvements in their psoriasis, 26% reported no change, and 12% reported deterioration [19]. However, in our study, the data of only psoriasis patients pre-surgery was collected according to which 47% of the patients showed improvements post bariatric surgery. We found that management strategies for skin changes including non-surgical treatments like topical applications and lifestyle adjustments, benefited many patients. For severe excess skin, surgical interventions, such as abdominoplasty, were performed in 129 (10%) of cases, with 85% of these patients reporting satisfaction ($p=0.01$). These findings suggest that non-surgical options suit milder cases, while surgical intervention is vital for more severe skin issues [20]. Another study which examined the strategies for bariatric patients experiencing skin-related changes showed that multidisciplinary approaches are an essential part of management. Their findings showed that approximately 30% of patients benefited from dietary adjustments and targeted supplementation, with significant improvement in vitamin levels over six months ($p=0.05$). For cases with severe skin complications, surgical interventions, such as abdominoplasty and other reconstructive procedures, were undertaken for 20% of patients as compared to 10% in our study, resulting in an 80% satisfaction rate reported postoperatively ($p=0.02$). These findings highlight that while non-surgical measures can adequately support mild cases, surgical options are often critical for managing more extensive skin-related challenges in post-bariatric surgery patients [21]. Another study was findings of the high prevalence of excess skin following bariatric surgery and its associated impacts. Findings indicated that in comparison to the reference group (1.5 ± 3.5), excessive skin scores were significantly higher for obese adults (10.5 ± 8.5) and even higher for adults and adolescents (12.3 ± 8.1 versus 14.4 ± 7.7) following obesity surgery [22]. Another study reported that redundant skin following significant weight loss is a common occurrence affecting up to 96% of patients who undergo bariatric surgery [23].

This study is limited by its single-center design, which may restrict the generalizability of findings to broader populations across Pakistan and other regions. The follow-

up period of 12 months may not fully capture long-term dermatological outcomes or late-onset complications after bariatric surgery. Additionally, reliance on observational data without a control group may introduce bias in assessing treatment effectiveness. Future studies should include multicenter cohorts with longer follow-up durations and standardized dermatological assessment tools to improve external validity and strengthen evidence-based management guidelines.

CONCLUSIONS

It was concluded that significant dermatological challenges are faced by patients post bariatric surgery and a holistic and multidisciplinary approach should be incorporated in managing these issues. By addressing both aesthetic and functional concerns, healthcare providers can enhance patients' overall satisfaction and quality of life. Further research is encouraged to explore long-term outcomes and to develop optimized treatment plans that cater to the specific dermatological needs of post-bariatric patients.

Authors' Contribution

Conceptualization: MA¹

Methodology: MA¹, MA², WA

Formal analysis: MA², WA

Writing and Drafting: MA¹, MNDK, AHS

Review and Editing: MA¹, MNDK, AHS

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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REFERENCES

- [1] Arterburn DE, Telem DA, Kushner RF, Courcoulas AP. Benefits and Risks of Bariatric Surgery in Adults: A Review. *Journal of American and Medical Association*. 2020 Sep; 324(9): 879-87. doi: 10.1001/jama.2020.12567.
- [2] Gulinac M, Miteva DG, Peshevska-Sekulovska M, Novakov IP, Antovic S, Peruhova M et al. Long-Term Effectiveness, Outcomes and Complications of Bariatric Surgery. *World Journal of Clinical Cases*. 2023 Jul; 11(19): 4504. doi: 10.12998/wjcc.v11.i19.4504.
- [3] Hany M, Zidan A, Ghozlan NA, Ghozlan MN, Abouelnasr AA, Sheta E et al. Comparison of Histological Skin Changes After Massive Weight Loss in Post-Bariatric and Non-Bariatric Patients. *Obesity Surgery*. 2024 Mar; 34(3): 855-65. doi: 10.1007/s11695-024-07066-y.
- [4] Bundela M, Bhatia K, Bhandari K, Namdeo C, Gupta S. Cutaneous Changes in Obese Patients Before and After Bariatric Surgery. *International Journal of Research in Dermatology*. 2023; 9(4): 182-188. doi: 10.18203/issn.2455-4529.IntJResDermatol20231825.
- [5] Rosen J, Darwin E, Tuchayi SM, Garibyan L, Yosipovitch G. Skin Changes and Manifestations Associated with the Treatment of Obesity. *Journal of the American Academy of Dermatology*. 2019 Nov; 81(5): 1059-69. doi: 10.1016/j.jaad.2018.10.081.
- [6] Itthipanichpong Y, Damkerngsuntorn W, Tangkijngamvong N, Udomsawaengsup S, Boonchayaanant P, Kumtornrut C et al. Skin Manifestations After Bariatric Surgery. *BioMed Central Dermatology*. 2020 Dec; 20: 1-8. doi: 10.1186/s12895-020-00120-z.
- [7] Derderian SC, Dewberry LC, Patten L, Sitzman TJ, Kaizer AM, Jenkins TM et al. Excess Skin Problems Among Adolescents After Bariatric Surgery. *Surgery for Obesity and Related Diseases*. 2020 Aug; 16(8): 993-8. doi: 10.1016/j.soard.2020.04.020.
- [8] Butt M, Khesroh E, Simmers J, Rogers AM, Helm MF, Rigby A. Evaluating the Need for Dermatological Care in A Postsurgical Bariatric Sample. *Surgery for Obesity and Related Diseases*. 2021 Jul; 17(7): 1302-9. doi: 10.1016/j.soard.2021.03.021.
- [9] Toninello P, Montanari A, Bassetto F, Vindigni V, Paoli A. Nutritional Support for Bariatric Surgery Patients: The Skin Beyond the Fat. *Nutrients*. 2021 May; 13(5): 1565. doi: 10.3390/nu13051565.
- [10] Richarz NA, Bielsa I, Morillas V, Enguita V, Fumagalli C. Bowel-Associated Dermatitis-Arthritis Syndrome (BADAS). *Australasian Journal of Dermatology*. 2021 May; 62(2). doi: 10.1111/ajd.13516.
- [11] Bramante C, Wise E, Chaudhry Z. Care of the patient After Metabolic and Bariatric Surgery. *Annals of Internal Medicine*. 2022 May; 175(5): ITC65-80. doi: 10.7326/AITC202205170.
- [12] Vieira de Sousa JP, Santos-Sousa H, Vieira S, Nunes R, Nogueiro J, Pereira A, Resende F, Costa-Pinho A, Preto J, Sousa-Pinto B, Carneiro S. Assessing Nutritional Deficiencies in Bariatric Surgery Patients: A Comparative Study of Roux-En-Y Gastric Bypass Versus Sleeve Gastrectomy. *Journal of Personalized Medicine*. 2024 Jun; 14(6): 650. doi: 10.3390/jpm14060650.
- [13] Gasmi A, Bjørklund G, Mujawdiya PK, Semenova Y, Peana M, Dosa A et al. Micronutrient Deficiencies in Patients After Bariatric Surgery. *European Journal of Nutrition*. 2022 Feb; 61(1): 55-67. doi: 10.1007/s00394-021-02619-8.
- [14] Silva AC, Kazmarek LM, Souza EM, Cintra ML, Teixeira F. Dermatological Manifestations Relating to

- Nutritional Deficiencies After Bariatric Surgery: Case Report and Integrative Literature Review. *Sao Paulo Medical Journal*. 2022 Aug; 140(5): 723-33. doi: 10.1590/1516-3180.2021.0616.r1.17022022.
- [15] Triwatcharikorn J, Itthipanichpong Y, Washrawirul C, Chuenboonngarm N, Chongpison Y, Udomsawaengsup S et al. Skin Manifestations and Biophysical Changes Following Weight Reduction Induced by Bariatric Surgery: A 2-Year Prospective Study. *The Journal of Dermatology*. 2023 Dec; 50(12): 1635-9. doi: 10.1111/1346-8138.16951.
- [16] Lie C, Liew CF, Oon HH. Alopecia and the Metabolic Syndrome. *Clinics in Dermatology*. 2018 Jan; 36(1): 54-61. doi: 10.1016/j.clindermatol.2017.09.009.
- [17] Darlenski R, Mihaylova V, Handjieva-Darlenska T. The Link Between Obesity and the Skin. *Frontiers in Nutrition*. 2022 Mar; 9:855573. doi: 10.3389/fnut.2022.855573.
- [18] Golbari NM, Porter ML, Kimball AB. Response to: Remission of Hidradenitis Suppurativa After Bariatric Surgery. *Journal of the American Academy of Dermatology Case Reports*. 2018 Apr; 4(3): 278-9. doi: 10.1016/j.jdc.2017.11.024.
- [19] Hossler EW, Wood GC, Still CD, Mowad CM, Maroon MS. The Effect of Weight Loss Surgery On the Severity of Psoriasis. *British Journal of Dermatology*. 2013 Mar; 168(3): 660-1. doi: 10.1111/j.1365-2133.2012.11211.x.
- [20] Schlosshauer T, Kiehlmann M, Jung D, Sader R, Rieger UM. Post-Bariatric Abdominoplasty: Analysis of 406 Cases with Focus On Risk Factors and Complications. *Aesthetic Surgery Journal*. 2021 Jan; 41(1): 59-71. doi: 10.1093/asj/sjaa067.
- [21] Herman CK, Hoschander AS, Wong A. Post-Bariatric Body Contouring. *Aesthetic Surgery Journal*. 2015 Aug; 35(6): 672-87. doi: 10.1093/asj/sjv008.
- [22] Elander A, Björserud C, Staalesen T, Ockell J, Olsén MF. Aspects of Excess Skin in Obesity, After Weight Loss, After Body Contouring Surgery and in A Reference Population. *Surgery for Obesity and Related Diseases*. 2019 Feb; 15(2): 305-11. doi: 10.1016/j.soard.2018.10.032.
- [23] Sadeghi P, Duarte-Bateman D, Ma W, Khalaf R, Fodor RA, Pieretti G et al. Post-Bariatric Plastic Surgery: Abdominoplasty, The State of the Art in Body Contouring. *Journal of Clinical Medicine*. 2022 Jul; 11(15): 4315. doi: 10.3390/jcm11154315.