GEORGIAN MEDICAL NEWS

ISSN 1512-0112

NO 11 (332) ноябрь 2022

ТБИЛИСИ - NEW YORK

ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

Monthly Georgia-US joint scientific journal published both in electronic and paper formats of the Agency of Medical Information of the Georgian Association of Business Press. Published since 1994. Distributed in NIS, EU and USA.

GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

GEORGIAN MEDICAL NEWS
No 11 (332) 2022

Содержание:

UPPER ARM CONTOURING – A NARRATIVE REVIEW

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Abstract.

Disfigurement of upper arms is a common esthetic problem. All soft tissues contribute with skin and subcutaneous adipose tissue as the major targets of medical intervention. This narrative review describes the complex pathogenesis of upper arm ptosis and its classification. Surgical and non-surgical methods to improve upper arm contour are discussed. With the broad spectrum of available treatments, a tailored approach is possible to address the individual patient's needs.

Key words. Upper arm ptosis, sagging, flaccidity, treatment, surgery, laser, radiofrequency, filler.

Introduction.

Disfigurement of the upper arms is common and become more frequent with increasing age. Several factors contribute to the process. The major tissue components are the bony structures, musculature, connective and adipose tissue, and the overlying skin.

Certain genetic disorders predispose to loose and sagging skin with diminished resilience and elasticity. The most common are autosomal dominant and autosomal recessive cutis laxa and the various subtypes of Ehlers-Danlos syndrome [1,2].

Cutis laxa can also occur in an acquired form in adults showing flaccid skin [3]. Wrinkling of the upper arms can be a symptom of mid-dermal elastosis in adult Caucasian females [4].

Adipose tissue hypertrophy can lead to upper arm disfigurement. Examples are severe obesity, symmetrical lipomatosis, and lipedema [5,6]. Bariatric surgery improves malignant obesity but leads to upper arm ptosis [7,8].

Skeletal muscle atrophy is seen after temporary immobilization. Sarcopenia is a senile syndrome with muscle volume loss, loss of muscle strength, and metabolic alterations [9].

Upper arm contouring can be classified into three major targets: (a) skin redundancy, (b) lipodystrophy, or (c) a combination of both. Surgical and minimally invasive techniques allow a tailored treatment. Severity of ptosis has been classified by various authors. The classification of El Khatib (2007) is shown in Table 1 [10].

Table 1. *Classification of upper arm ptosis according to El Khatib 2007 [10].*

Stage	Remarks
stage 1	minimal fat deposit and no ptosis
stage 2a	moderate fat deposit and grade 1 ptosis
stage 2b	severe fat deposit and grade 2 ptosis
stage 3	severe fat deposit and grade 3 ptosis
stage 4	minimal or no fat deposit and grade 3 ptosis

Brachioplasty to correct the esthetic problem has gained increasing popularity. Different techniques have been developed to copy with volume changes and skin flaccidity [11,12].

Brachioplasty.

The surgical technique has been developed in the 1920ies [13]. Various modifications of the original surgical procedure evolved during the last 100 year with elliptical, S- and L-shaped excisions, fish incision, sinusoidal, double-ellipse and T-type brachioplasty (Figure 1) [14]. While the surgical technique is capable to remove excess adipose tissue and skin, adverse events are more common than with the other techniques described in this review (Table 2).

Figure 1. *Brachioplasty. Upper line – before treatment, lower line – after surgery. (a) 37-year-old woman with stage 2a ptosis. Before and 2 weeks after brachioplasty. (b) and (c) 55-year-old woman with stage IV ptosis. Before and 3 weeks after surgery.*

Table 2. *Typical adverse events in classical brachioplasty (Modified from Sisti et al. 2017) [14].*

Adverse event	Complication rate (%)
Hypertrophic scars	11
Seroma and secondary lymphedema	7
Wound dehiscence and delayed wound closure	6
Wound infection	3
Nerve damage	2
Hematoma formation	1

Circumferential lipobrachioplasty is used to remove excessive adipose tissue and/ or skin of upper arms. In an open trial 62 patients (49 women, 13 men) were treated by simultaneous circumferential liposuction followed by brachioplasty. The minimal follow-up was six months. The average reduction of mid upper arm circumference was 9 cm. About 95% of patients were highly satisfied. Adverse events included minor wound dehiscence (3.2%) and hypertrophic scarring (1.6%). By this technique excess adipose tissue and ptosis could be addressed [15].

Brachioplasty has been the gold standard for decades. A drawback of this method is the long scars, which may become hypertrophic in some patients. There is some downtime after surgery. But in the hands of an experienced surgeon a high satisfaction rate of patients is achievable.

Figure 2. *Short scar brachioplasty in a 53-year-orld woman, 2 months after surgery.*

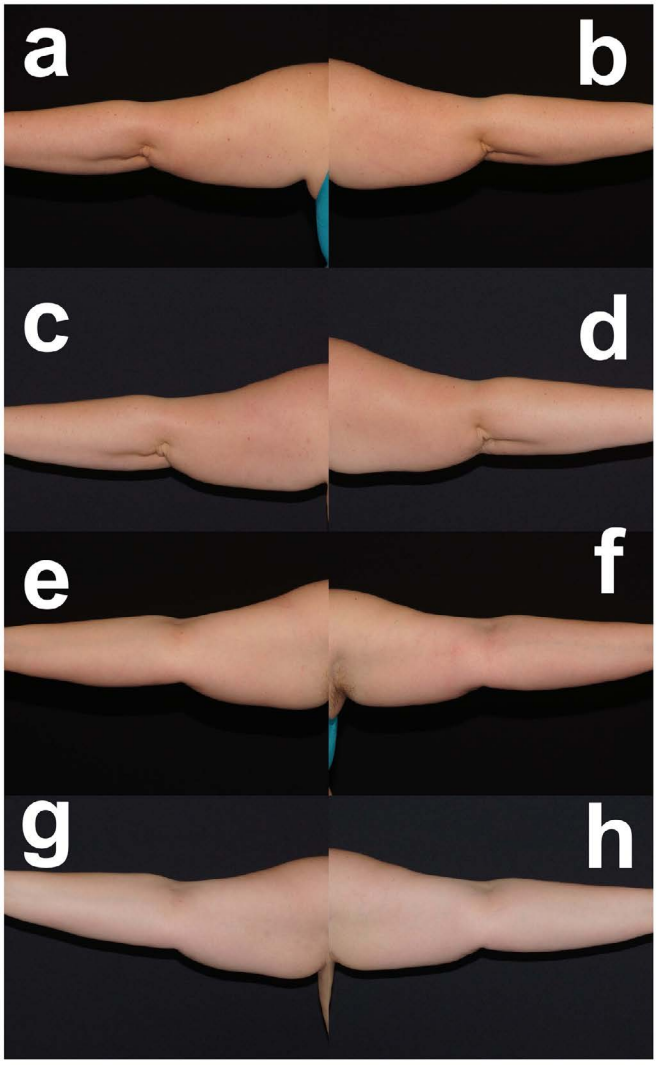

Figure 3. *Lipedema grade I in a 27-year-old woman. Mild to moderate upper arm ptosis (stage 2b). (a) and (b): Before treatment. (c) to (f): After classical liposuction. Despite reduction of upper arm circumference by 5 cm, ptosis was only mildly improved.*

Liposuction.

In classical liposuction of upper arms, the procedure focused on the postero-lateral region (Figures 3 and 4). This can lead to a disharmonic contour [16]. Multi-positional circumferential arm liposuction (MCAL) has been developed to improve the outcome. The arm was positioned in 90-degree abduction, 180 degrees lifting and 45-degree abduction. Liposuction was performed in tumescent anesthesia. Patients were evaluated by Artec EVA 3D® scanner (Artec, Santa Clara/CA, USA) before and 2 to 3 months after the procedure. Thirty-four female patients (mean age 27.3 years) with a BMI < 28 underwent MCAL for the arms, 10 for upper arms. The upper arm deformity was classified in three classes (I-III). The volume reduction was 10.8% for class I, 17.3% for class II, and 22.8% for class III. Transient limb edema was the most common adverse event [17].

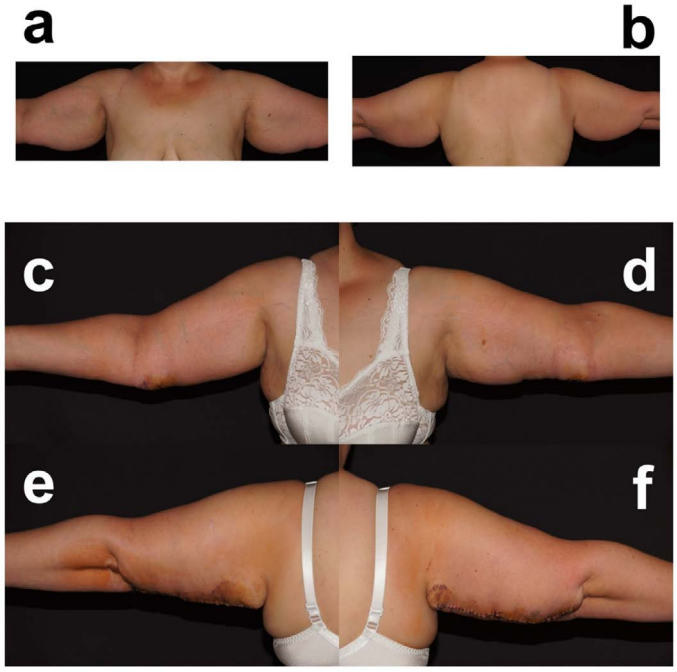

Figure 4. *Lipedema grade II in a 45-year-old woman. Moderate arm ptosis stage 3. Upper two lines: Before treatment. Lower two lines: After liposuction followed by upper arm lift with an ellipsoid excision (10 days after surgery).*

A prospective study enrolled 95 patients (mean age 39 years, mean BMI 28) for power-assisted liposuction in combination with lipotransfer and lipofilling in the bicipital triangle of the medial upper arm. Patients had mild to moderate brachial ptosis. Mean liposuction volume was 240 mL and mean lipofilling volume was 110 mL per arm. Average follow-up was 24 months. Results were stable over time and extensive surgical procedure could be avoided [18].

Liposuction-assisted short scar brachioplasty aims to reduce to long scar after traditional surgery (Figure 2) [19].

Liposuction is less invasive than brachioplasty by surgery. It shows good results with minor adverse events. Scars are small. The limitation of this method is that it does not improve loose skin.

Laser-assisted liposuction.

In an open trial 28 women (mean age 42.3 years) with a smooth to moderate skin laxity of the upper arms were included.

Standardized circumferential measurements and photographs were used before and after follow-up of 3 months to assess the effect. A pulsed neodym-YAG-laser (1,064 nm) connected to the tip of the liposuction cannula was combined with microcannular liposuction in tumescent anesthesia. The control group was treated by liposuction only. The range and mean of liposuction volume was comparable between the 2 groups. Laser-assisted liposuction resulted in a mean skin tightening of 11.4% compared to 8.7% in the liposuction only group. No adverse events were observed [20]. Dermal remodeling, collagen shrinkage, and neocollagenesis are the underlying mechanisms of the laser effect [21].

In another open trial 45 patients with upper arm ptosis Teimourian grades I and II got a single session of laser-assisted liposuction using a 1,470 nm diode laser (15 W). Circumferences decreased between 4.7 and 5.5 cm. Skin tightening was assessed by skin caliper measurements for all subgroups. Prolonged arm edema was noted in 11 patients [22]. The same schedule was used in 22 patients with Teimourian grades III and IV. Here the mean decrease of circumferences was 4.9 to 5.5 cm [23].

An open trial compared laser-assisted liposuction with open suction-assisted brachioplasty (Pascal & Leouarn technique). In each study arm 30 patients with grade 2b arm ptosis (El Khatib classification) were included. Patient satisfaction was statistically significant better in the laser-assisted liposuction group. These patients also reported less pain and earlier return to work [24]. Examples of clinical outcome are shown in Figures 5 and 6.

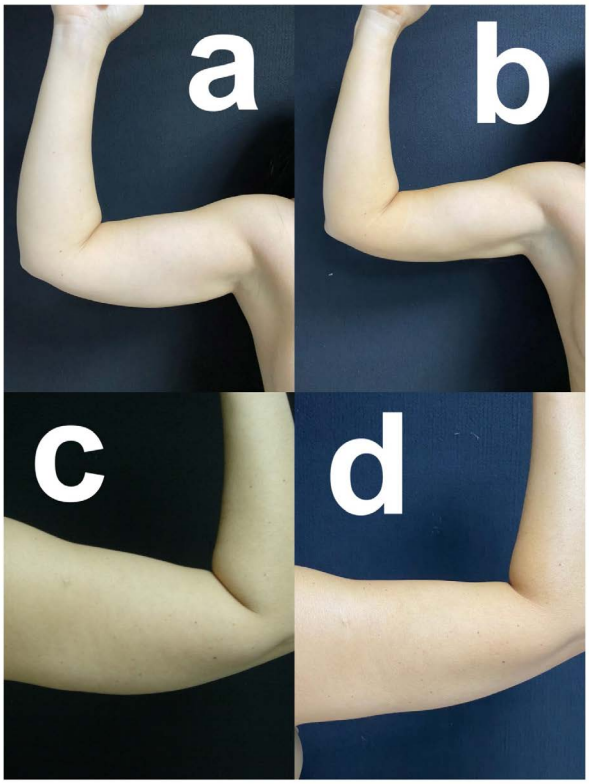

Figure 5. *A 37-year-old woman with localized adiposity (stage 2a). (a) and (c) before treatment. (b) and (d) 8 months after laser-assisted liposuction with improved contour and skin tightening.*

Figure 6. *57-year-old woman with skin flaccidity (stage 1). (a) before treatment. (b) 3 months after laser-assisted liposuction Improved contour and skin tightening.*

Laser-assisted liposuction combines the benefits of a classical liposuction with improvement of skin flaccidity. Major unwanted side effect is possible skin burns. With tumescent anesthesia and control of skin temperature laser burns can be avoided.

Radiofrequency-assisted liposuction (RAFL).

One man and 39 women were included in an open trial (mean age 40 years) for upper arm contouring. All of them had a body mass index (BMI) < 35. For RFAL the bipolar BodyTie® platform (Invasix, Yokneam, Israel) had been used with a power of 35 W followed by microcannular liposuction. Target temperature was 38 to 40 degrees Celsius during radiofrequency treatment (RF). The procedure was performed in tumescent anesthesia. After a single treatment patient were re-evaluated for up to 52 weeks. More minor to moderate discomfort had been reported during RF compared to liposuction. Six months after treatment 95% of patients were satisfied to extremely satisfied with the outcome. Third party plastic surgeons reported that 80% of patients achieved a good to excellent improvement of the upper arm shape after one year follow-up. One patient had a full-thickness burn, another one developed a seroma [25].

Power-assisted VASER liposuction followed by BodyTite® RF (InMode Corporation, Toronto, Canada) therapy (n=53) or Renuvion® (Apyx Medical, Clearwater/FL, USA) helium plasma subdermal coagulation (n=66) was compared in an open trial with VASER® (Solta Medical, Bothell/WA, USA) liposuction alone (n=57). The mean age of patients was 32 years (153 females and 23 males). Patients were treated for skin laxity of upper arms once and followed for another 6 months before re-evaluation by third party plastic surgeons. After 6 months 80.6% of all patients reported satisfaction with the techniques. Third party surgeons considered the outcome good to excellent in 81.5% of patients [26]. It is important to spare the bicipital groove where the vessels and nerves lie [25]. RAFL is an option mainly for moderate skin laxity.

There are several devices for RAFL available. The approach is minimally invasive. It is best used in younger, non-obese patients who wanted some improvement of skin laxity. Burns and seroma formation are uncommon adverse events.

Monopolar radiofrequency (RF).

Monopolar RF with a TECAR (Transferencia Eléctrica CApacitva Resistiva) device (Capenergy C 200®, Capenergy, Barcelona, Spain) was used in young women to improve body

contour in a half side trial. The average decrease in upper arm circumference was 2.9 cm [27].

Thermistor-controlled monopolar subsurface radiofrequency was investigated in a prospective, open clinical trial for a single treatment of 24 arms. Follow-up was 90 days. Significant improvement of skin laxity was noted on days 30 and 90. Firmness and skin texture were also improved. Adverse events noted on day 7 after treatment included erythema, irregularities of the contour and bruising. These adverse events were temporary, mild, and completely disappeared until day 30 [28].

Monopolar RF is a minimally invasive technique for young, non-obese patients. The most common, but temporary adverse event is erythema.

Microfocused ultrasound.

Microfocused ultrasound (MFU) can be used in either single-plane or dual-plane mode. Both techniques have been compared in a randomized, single-blinded, controlled trial for upper arm skin laxity in 30 patients in a side-by-side study. Single-plane MFU (4 MHz/4.5 mm transducer) and dual-plane MFU (4 MHz/4.5 mm transducer and 7 MHz/3.0 mm transducer) resulted in a comparable improvement after 1, 3, and 6 months. Median pain-scores were slightly higher for single-plane MFU. No other adverse events were recorded [29].

MFU is a relatively new technology in esthetic medicine. While more often used in face and neck region, published results for upper arm contouring are limited. The available data suggest a beneficial effect in non-obese patients. Treatment associated pain is the most common adverse event.

Cryolipolysis.

In a retrospective study 4,122 patients who underwent a treatment with CoolSculpting® (Allergan Aethetics, Irvine/CA, USA) have been evaluated. The average age was 34.7 years. There was a female predominance of 96.3%. Twenty-seven patients received treatments for upper arms. Reduction of upper arm circumference was on average 1.3 cm. Possible adverse events of cryolipolysis include paradoxical lipohypertrophy, frostbites, post-inflammatory hyperpigmentation, skin necrosis, and persistent erythema [30].

In another study 15 patients with a mean age of 51 years and a mean BMI of 26.8 were treated by cryolipolysis with two treatment cycles (-11 degree Celsius for 35 min each) for upper arms. Re-evaluation – both clinically and with diagnostic ultrasound – was performed 12 weeks later. The mean adipose tissue layer reduction was 2.5 mm. Eighty-seven percent of patients were satisfied with the procedure. Mild edema, erythema and transient numbness were the major adverse events that fully resolved within the 12-weeks follow-up [31].

Another study on 30 women with a mean age of 46 years used a CoolCup applicator (Zeltiq Aesthetics; Pleasanton/CA, USA) for bilateral treatment of upper arms. Thirty-two female patients were enrolled and 30 completed the study. The mean BMI was 28.2. Follow-up was 12 weeks. Ultrasound detected a mean adipose tissue layer reduction of 3.2 mm. The pain score during treatment was 1. Prolonged numbness and bilateral erythema were reported as possible adverse events [32]. Other rare adverse events are prolonged neuropathy, either sensory or motoric, and paradoxical adipose tissue growth [33,34].

Cryolipolysis is commonly used on the trunk. There are some trials for upper arm contouring. Multiple treatments in young, non-obese patients are capable to reduce adipose tissue. Numbness and erythema are common adverse events. Paradoxical lipohypertrohpy is a rare but unpredictable unwanted side effect.

Injection lipolysis.

Phosphatidylcholine (RC) and deoxycholic acid (DA) were used for injection lipolysis. In a retrospective study 169 patients were evaluated with upper arm contouring. The authors used a cocktail of PC and DA on average 4 times every month. Outcome was assessed two months after the last injection.

All female patients were satisfied but the two male patients included were not. The ideal situation is a limited excess of subcutaneous adipose tissue. The injection causes a temporary panniculitis with lipolysis and skin tightening [35]. To avoid accidental intramuscular injection pinch technique has been recommended [36].

Injection lipolysis has its domain in reduction of smaller areas of adipose tissue hypertrophy. Multiple treatments are necessary. Commonly encountered temporary adverse events are injection pain, edema, and erythema.

Calcium hydroxyl apatite (CaHA) filler.

CaHA filler Radiesse® (Merz, Frankfurt/Main, Germany) is composed of CaHA microspheres embedded in a hyaluronic acid matrix. It is used or facial and hand rejuvenation. This filler is characterized by a high viscosity and elastic modulus G' [37]. It exerts no cytotoxicity to keratinocytes and fibroblasts [38]. Clinical trials have demonstrated long-lasting effects of contouring (12-18 months) and volumizing with an excellent safety profile [39,40].

Radiesse® has been used to improve upper arm contour and induce skin tightening. In an open trial, 30 middle-aged women have been included for esthetic improvement of upper arm appearance (mean age 55.6 years). Skin flaccidity and arm volume have been classified using a visual analogue scale (VAS), where "0" was very bad and "10" was very good. The majority of participants had a type III or IV VAS upper arm. Radiesse® 1.5 mL was mixed with 0.5 mL 2% lidocaine and injected per arm twice – injections one month apart. Injections were performed using a 27 Gauge needle 1 to 2 cm apart in the deep dermis. Follow-up was 4 months after the second injection. Improvement of flaccidity and volume reached significance at visit 2 and 3 compared with the pre-treatment findings. While all participants achieved some improvement, 43.3% assessed the effect as a "great improvement". No adverse events were recorded [41].

In another case series, 10 women were included. CaHA was diluted 1:2 with 2% lidocaine solution and injected in the subdermis with a linear-threading technique. Skin elasticity was measured with a Cutometer before, 1 and 3 months after injection. The skin elasticity increased from 72 U at baseline to 85 U at month 3 after a single filler treatment. The procedure was well tolerated [42].

A consensus conference on the use of hyperdiluted CaHA (Radiesse®) suggested the use of retroinjection with a fanning technique. The preferred dilution ranges from 1:2 to 1:4 [43].

The skin tightening effect is possibly achieved by dermal remodeling and production of precollagen type I and collagen type III [44,45]. Furthermore, induction of pre-adipocytes by dermal fillers has been suggested [46].

Hyperdiluted CaHA is a minimally invasive treatment mainly for milder skin flaccidity. It does not reduce adipose tissue at all. Injection is associated with temporary pain, edema, and redness.

Stem cells and cell-free treatments.

Mesenchymal stem cells (MSC) are capable to differentiate towards adipocytes, osteoblasts and chondroblasts. They are involved in tissue homeostasis and regeneration. MSC show anti-inflammatory and anti-oxidative activity. It has been demonstrated that antioxidants like lactoferrin, N-acetyl-cysteine or ascorbic acid can reverse MSC senescence [47].

Transplantation of MSC may reduce skin laxity by formation of new adipose tissue and improved tissue repair. The latter includes neoangiogenesis, synthesis of dermal matrix elements. The combination of MSC with a hyaluronic acid scaffold may improve the efficacy of cell-based therapies [48].

Cell-free therapies include the application of exosomes and microvesicles secreted by MSC. Senescence of dermal fibroblast can be prevented by conditioned medium from MSC. Adipose tissue derived exosomes promote proliferation and migration of fibroblasts, prevent photoaging, and increase production of dermal matrix components [49,50].

Table 3. *Techniques and targets for upper arm contouring.*

	Targets			
Technique	**Flaccidity**	**Adipose tissue**	**Skin texture**	**Adverse events**
Brachioplasty	+	++	-	Hypertrophic scars, wound dehiscence, seroma, hematoma, wound infection
Liposuction	(+)	++	-	Irregularities, seroma, fibrosis
Laser-assisted liposuction	++	++	+	Burns, seroma, irregularities
Radiofrequency-assisted liposuction	++	++	+	Burns, seroma, irregularities,
Monopolar radiofrequency	+	(+)	+	Erythema, edema, burns, irregularities
Microfocused ultrasound	+	(+)	(+)	Irregularities, pain, edema
Cryolipolysis	+	+	-	Irregularities, edema, pain, numbness, lipohypertrophy
Injection lipolysis	+	+	-	Pain, edema, fibrosis, irregularities
Calcium hydroxyl apatite filler	+	-	+	Pain, irregularities, granuloma formation

Conclusions and future perspectives.

Upper arm contouring has become increasingly requested. It is a common procedure after bariatric surgery but also for esthetic reasons in non-obese patients. A variety of different techniques is available. This allows to tailor the approach to the individual needs of the patients. Table 3 summarizes techniques and targets such as flaccidity, adipose tissue, and skin texture. Age, BMI, and comorbidities need to be considered as well. In obese patients, surgical techniques are preferable. Medical devices with RF focus on flaccidity, while cryolipolysis and injection lipolysis reduce subcutaneous adipose tissue. Combined and sequential treatments may achieve an even better outcome. Unrealistic expectations and body dysmorphic disorders are a contraindication.

New developments are on the horizon to scope with upper arm ptosis. These include mesenchymal and pluripotent stem cells. Cell-free treatment with stem cell exosomes or extracellular vesicles may become available in the future [47]. By these methods, muscular rejuvenation might also be realistic.

Conflict of interest.

The author declares that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

Author contributions.

Uwe Wollina, Alberto Goldman contributed equally to the publication.

Data availability statement.

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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