DOI: 10.56871/RBR.2023.30.97.001
UDC 616-08-031.84

POSSIBILITIES OF APPLYING PHYSIOTHERAPEUTIC TREATMENT METHODS FOR THE PURPOSE OF PREVENTION OF RESTRICTIONAL DISORDERS OF EXTERNAL RESPIRATORY IN PATIENTS AFTER BREAST ENDOPROSTHETICS

© Odiljon O. Ismati[1], Evgeniy V. Zinoviev[2, 3], Denis V. Kostyakov[2, 4], Evgenia V. Ermilova[2], Tamara Z. Gogokhiya[2], Vladimir O. Sidelnikov von Essen[2], Anna V. Kostyakova[2], Anastasia G. Vasilyeva[3]

[1] Samarkand State Medical University. Amir Timur st., 18, Samarkand, Uzbekistan, 140100
[2] Saint-Petersburg I.I. Dzhanelidze research institute of emergency medicine. Budapestskaya st., 3, lit. A, Saint Petersburg, Russian Federation, 192242
[3] Saint Petersburg State Pediatric Medical University. Lithuania 2, Saint Petersburg, Russian Federation, 194100
[4] Saint Petersburg State University. Universitetskaya embankment, 7-9, Saint Petersburg, Russian Federation, 199034

Contact information: Denis V. Kostyakov — Candidate of Medical Sciences, Leading Researcher in the Department of thermal injuries Saint-Petersburg I.I. Dzhanelidze research institute of emergency medicine. E-mail: kosdv@list.ru ORCID ID: 0000-0001-5687-7168 SPIN: 9966-5821

For citation: Ismati OO, Zinoviev EV, Kostyakov DV, Ermilova EV, Gogokhiya TZ, Sidelnikov von Essen VO, Kostyakova AV, Vasilyeva AG. Possibilities of applying physiotherapeutic treatment methods for the purpose of prevention of restrictional disorders of external respiratory in patients after breast endoprosthetics // Russian biomedical research (St. Petersburg). 2023;8(4):4-11. DOI: https://doi.org/10.56871/RBR.2023.30.97.001

Received: 06.09.2023 **Revised: 02.11.2023** **Accepted: 20.12.2023**

Abstract. ***Introduction.*** Implantation of foreign silicone implants during breast replacement is accompanied by structural and functional changes in the surrounding tissues. Developing chronic inflammation, fibrosis, severe pain and the compression effect of the implant lead to severe restrictive disorders of external respiration functions, reducing the patient's quality of life in the postoperative period. One of the possible ways to solve this problem is to use an electromagnetic field with a frequency of 448 kHz. ***Purpose of the study:*** to evaluate the effectiveness of physiotherapeutic methods of influence as methods for the prevention of restrictive disorders of external respiration in patients after breast replacement. ***Materials and methods.*** The study is based on the results of a survey of 89 females who underwent breast replacement with silicone implants. All women were divided into 4 groups, taking into account the approach to the use of physiotherapy. The study assessed respiratory rate, vital capacity, forced vital capacity, formed expiratory volume in the first second, and peak expiratory volumetric flow rate. ***Results.*** It was found that all patients in the early postoperative period had impairment of external respiratory function by an average of 30% of the reference values. The combined use of electrophysiological effects and botulinum toxin made it possible to reduce the frequency of identified respiratory system disorders. By the 7th day of treatment, the frequency of shortness of breath, as well as the magnitude of the deviation from the norm of vital capacity of the lungs, forced vital capacity of the lungs and forced expiratory volume were less, respectively, by 12.3 times, 6.4 times, 8.7 times. 8.1 times compared to control. ***Conclusion.*** A set of preventive measures, including electrophysiological therapy, can significantly increase the efficiency of restoration of external respiratory functions in patients after breast replacement in the first week after surgery.

Key words: breast replacement; external respiration disorders; spirometry; botulinum toxin; electrophysiological effects.

ВОЗМОЖНОСТИ ПРИМЕНЕНИЯ ФИЗИОТЕРАПЕВТИЧЕСКИХ МЕТОДИК ЛЕЧЕНИЯ С ЦЕЛЬЮ ПРОФИЛАКТИКИ РЕСТРИКТИВНЫХ НАРУШЕНИЙ ВНЕШНЕГО ДЫХАНИЯ У ПАЦИЕНТОК ПОСЛЕ ЭНДОПРОТЕЗИРОВАНИЯ МОЛОЧНЫХ ЖЕЛЕЗ

© Одилжон Обидович Исмати[1], Евгений Владимирович Зиновьев[2, 3], Денис Валерьевич Костяков[2, 4], Евгения Валерьевна Ермилова[2], Тамара Зауровна Гогохия[2], Владимир Олегович Сидельников фон Ессен[2], Анна Витальевна Костякова[2], Анастасия Григорьевна Васильева[3]

[1] Самаркандский медицинский университет. 140100, Республика Узбекистан, г. Самарканд, ул. Амира Тимура, 18
[2] Санкт-Петербургский научно-исследовательский институт скорой помощи имени И.И. Джанелидзе.
192242, Российская Федерация, г. Санкт-Петербург, Будапештская ул., 3, лит. А
[3] Санкт-Петербургский государственный педиатрический медицинский университет.
194100, Российская Федерация, г. Санкт-Петербург, ул. Литовская, 2
[4] Санкт-Петербургский государственный университет. 199034, Российская Федерация, г. Санкт-Петербург, Университетская наб., 7–9

Контактная информация: Денис Валерьевич Костяков — к.м.н., ведущий научный сотрудник отдела термических поражений ГБУ СПб НИИ СП им. И.И. Джанелидзе. E-mail: kosdv@list.ru ORCID ID: 0000-0001-5687-7168 SPIN: 9966-5821

Для цитирования: Исмати О.О., Зиновьев Е.В., Костяков Д.В., Ермилова Е.В., Гогохия Т.З., Сидельников фон Ессен В.О., Костякова А.В., Васильева А.Г. Возможности применения физиотерапевтических методик лечения с целью профилактики рестриктивных нарушений внешнего дыхания у пациенток после эндопротезирования молочных желез // Российские биомедицинские исследования. 2023. Т. 8. № 4. С. 4–11. DOI: https://doi.org/10.56871/RBR.2023.30.97.001

Поступила: 06.09.2023 **Одобрена: 02.11.2023** **Принята к печати: 20.12.2023**

Резюме. ***Введение.*** Имплантация инородных силиконовых имплантов во время эндопротезирования молочных желез сопровождается структурными и функциональными изменениями окружающих тканей. Развивающееся хроническое воспаление, фиброз, выраженный болевой синдром и компрессионное воздействие импланта приводит к выраженным рестриктивным нарушениям функций внешнего дыхания, снижающим качество жизни пациентки в послеоперационном периоде. Одним из возможных путей решения данной проблемы является применение электромагнитного поля с частотой 448 кГЦ. ***Цель исследования*** — оценить эффективность физиотерапевтических методик воздействия в качестве методов профилактики рестриктивных нарушений внешнего дыхания у пациенток после эндопротезирования молочных желез. ***Материалы и методы.*** Исследование основано на результатах обследования 89 лиц женского пола, перенесших эндопротезирование молочных желез силиконовыми имплантами. Все женщины были разделены на 4 группы с учетом подхода к использованию физиотерапевтического метода воздействия. В ходе исследования оценивалась частота дыхания, жизненная емкость легких, форсированная жизненная емкость легких, объем форсированного выдоха за первую секунду, пиковая объемная скорость выдоха. ***Результаты.*** Установлено, что у всех пациенток в раннем послеоперационном периоде отмечалось нарушение функций внешнего дыхания в среднем на 30% от референсных значений. Комбинированное использование электрофизиологического воздействия и ботулотоксина позволило снизить частоту выявленных нарушений дыхательной системы. К седьмым суткам лечения частота одышки, а также величина отклонения от нормы жизненной емкости легких, форсированной жизненной емкости легких и объема форсированного выдоха оказались меньше, соответственно, в 12,3 раза, в 6,4 раза, в 8,7 раза и в 8,1 раза по сравнению с контролем. ***Заключение.*** Комплекс профилактических мероприятий, включающий электрофизиологическую терапию, позволяет достоверно повысить эффективность восстановления функций внешнего дыхания у пациенток после эндопротезирования молочных желез в первую неделю после операции.

Ключевые слова: эндопротезирование молочных желез; нарушения внешнего дыхания; спирометрия; ботулотоксин; электрофизиологическое воздействие.

INTRODUCTION

At present, breast replacement is one of the most demanded surgical interventions in aesthetic medicine [6]. Annually, no less than 100.000 surgeries with silicone implant use are performed in plastic surgery clinics not only in Russia but abroad as well, and these data do not tend to decline but steadily grow [4].

Breast enlargement and change of its structure is gained by the use of implant mostly on the hydro-gel silicone basis [8]. Installation of the latter in the chest results in a number of possible physiological and functional changes often leading to pathological conditions, e.g. pneumonitis. V.S. Paredes et.al have demonstrated by their study (2010) that approximately in one third of all women who underwent breast replacement with silicone implants infiltrates in the parenchymatous tissue of the lung were identified within the 1st week after the surgery [10]. At the same time, there was a chronic inflammatory process in the tissues surrounding the foreign implant,

which was a normal body response. This provides silicone fibrous encapsulation and pulmonary tissue fibrosis with participation of macrophages, T-cells as well as active B-lymphocytes [1, 7].

Pain syndrome, an expected surgical intervention effect, is one of the most significant problems in mammary gland endoprosthetics. Trauma of anatomical structures, as well as excessive overstretching of tissues cause constant pain impulsation development which may persist for several years following the surgery [11]. This results in emotional health deterioration and lowed satisfaction from breast implantation.

Abnormal changes of the soft tissues surrounding silicone implant as well as of the lung parenchyma combined with surgical interventions in the region of the thorax lead to marked restrictive impairment of external respiration functions [9]. Moreover, compressing effect of a foreign body in the region of the chest initiates these changes leading to new chains of pathogenesis developing with the latter joining to vicious circles. Numerous findings of spirographic studies of females after breast implantation show significant reduction in all available external respiration data [3]. Absence of possibility to ventilate the lungs properly lowers quality of life in both the early and the late postoperative period [2].

One of the possible ways of accelerated arresting of tissue inflammatory changes and pain syndrome following the mammary gland endoprosthetics is the use of an electromagnetic field with a frequency of 448 kHz that activates ion exchange due to which natural cell regeneration processes are effected more efficiently. Such physiotherapeutic equipment makes electric potential of the cell membrane restored in the postoperative period, activates collagen production; improves microcirculation and tissue trophicity, produces antiedematous effect, promotes hematoma reorganization and stem cells proliferation as well [5]. Noted properties are of particular interest considering their use to prevent restrictive impairment of external respiration in patients after breast endoprosthetics.

OBJECTIVE OF THE STUDY

To evaluate the effectiveness of physiotherapeutic methods of influence as methods for the prevention of restrictive disorders of external respiration in female patients following breast replacement.

MATERIALS AND METHODS

An open, randomized, mono-centered and prospective study has been carried out to evaluate the possibility of the use of physiotherapeutic methods as preventive measures of external respiration restrictive impairment after mammary gland endoprosthetics. The work is based on the findings of 89 implantations with the silicone implants use performed in the Plastic Surgery Unit of the “Relax Med Service” clinic in Samarkand, the republic of Uzbekistan for the period of 2021–2023.

Female patients were involved into the study according to the following criteria: aged 25–50, the presence of clinically meaningful hypomastia, asymmetry of the mammary glands, no earlier surgeries in the regions of the chest and breast, patient’s voluntary consent to be involved in the study on the assessment of postoperative rehabilitation measures effectiveness.

Female patients were not involved under the following conditions: the age under 25 and over 50 years, some chronic diseases as well as their acute stage, CAD, obstructive lung disease, respiratory failure of any degree, skin infectious and non-infectious diseases in the region of the chest, hyper and hypocoagulation, HIV, previous hepatitis B, C, tuberculosis, any gestational age, lactation, cardiac pacemaker, thrombophlebitis, refusal to be involved in the study on the assessment of postoperative rehabilitation measures effectiveness.

All the patients were divided into four groups considering pre- and postoperative management: botulinum toxin type A injection into the *musculus pectoralis major* 14 days before endoprosthetics (n=23), botulinum toxin type A injectioon into the *musculus pectoralis major* 14 days before endoprosthetics with the postoperative 1 week physiotherapeutic treatment with the help of the INDIBA apparatus (n=24), 0.9% saline solution injection into the *musculus pectoralis major* 14 days before endoprosthetics with the postoperative 1 week physiotherapeutic treatment with the INDIBA apparatus (n=22), 0.9% saline solution injection into the *musculus pectoralis major* 14 days before endoprosthetics (control, n=20).

The botulinum toxin type A “Botox” in the dose of 100 units was injected bilaterally in concentration 1 to 25 in 10 symbolic muscular sectors presented in Figure 1. The amount of the preparation administered into one spot did not exceed 2.5 ml, 0.9% saline solution was injected similarly.

Electrophysiological therapy of the chest region was conducted by means of the INDIBA active 801 apparatus (Spain). The procedure of radiofrequency cellular electrotherapy was performed with a frequency of 448 kHz in capacity regime within 15 minutes daily during the 1st weak after the surgery.

The assessment of external respiration was carried out by determining spirometry findings a day before breast endoprosthetics and on the 1st and the 7th day following the

operation. Instrumental investigation was conducted with the help of microprocessor portable spirograph SMP-21/01-R-D (Scientific and Production Enterprise "Monitor", Russia). Registration and analysis of dynamic findings of the vital capacity of the lung (VCL), forced vital lung capacity (FVLC), forced expiratory volume in the 1st second (FEV_1), peak expiratory flow rate (PEFR) were performed according to recommendations of the Russian Respiratory Society.

Statistic processing of the study data used common methods of variation statistics. To assess the significance of differences student's t-test was used. The belonging of the samples to the normal distribution was determined using the Kolmogorov–Smirnov criterion. An alternative hypothesis was accepted at $p < 0.05$.

STUDY RESULTS AND THEIR DISCUSSION

While analyzing parameters of external respiration and spirograms of 89 females it was identified that mammary gland endoprosthetics with silicone implants caused tachypnea developing in 59.5% of observed cases in the first day after the trauma. By the second day, the analyzed parameter reduced in up to 40.4% of cases (32 patients) and reached its minimum by the end of the week in 9 patients or 10.1% of observed cases.

Analysis of VCL, FVLC, FEV_1 and PEFR parameters in all patients on the 1st day after breast implantation showed their significant reduction, correspondently by 26.8, 31.1, 29.2 and 25.3% ($p < 0.05$). During the next week, follow-up disorders became less prominent. Assessed parameters reduced only by 8.9, 11.2, 7.4, and 13.2% ($p > 0.05$) (Table 1).

In-depth analysis of the presented in Table 1 data makes it possible to conclude that decrease of respiratory volume and external respiration parameters taken within the first 24 hours after breast replacement is due to restrictive disorders characterized by severe pain syndrome and limited chest excursion because of the silicone implant.

The findings of assessment of external respiration and spirogram parameters in four patients' groups divided according to the way of arresting pathological conditions progressing following breast endoprosthetics are given in Table 2.

Examination findings presented in Table 2 testify that within first 24 hours after the surgery on aesthetic mammary gland endoprosthetics in the group of patients who were preliminary administered botulinum toxin type A dyspnea was recorded in 31.2% of cases. At the same time VLC, FVLC, FEV_1 and PEFR reduced by minimum 30% compared to their values before the surgery in 34.1, 22.8, 33.2 and 12.1% of observed cases. By the 7th day of follow up the noted parameters were found to be restored compared to the first day of postoperative period by 150–200% ($p < 0.05$).

When a combination of botulinum toxin type A with a course of physiotherapeutic treatment INDIBA is

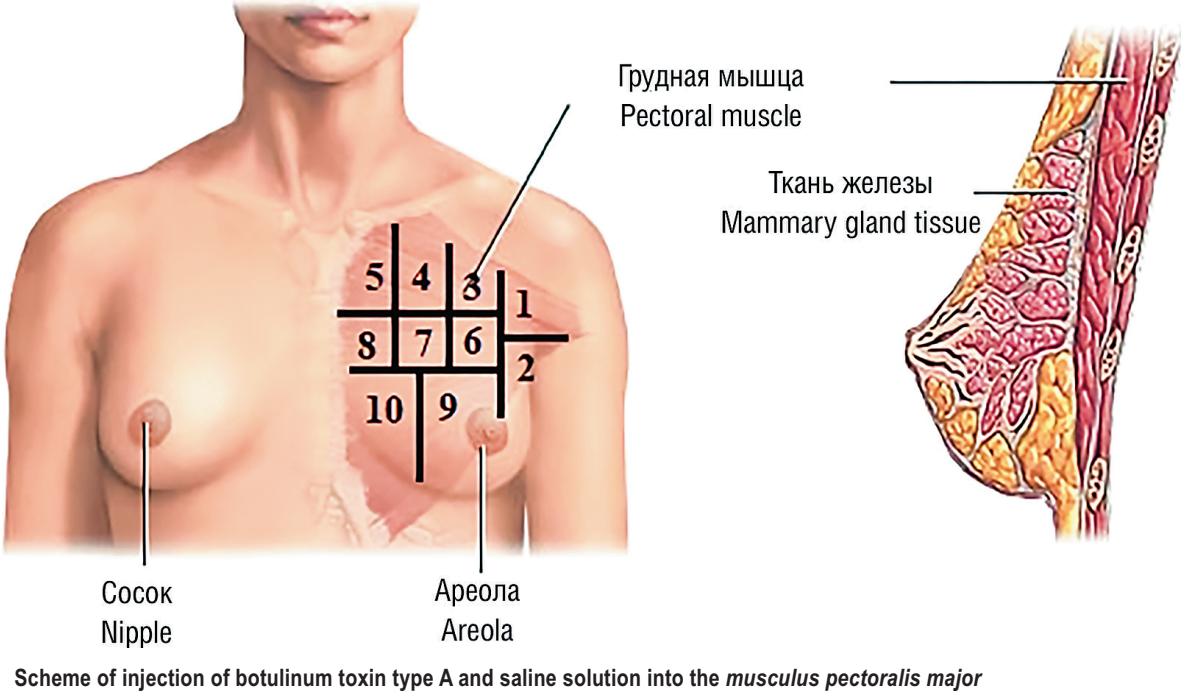

Fig. 1. Scheme of injection of botulinum toxin type A and saline solution into the *musculus pectoralis major*
Рис. 1. Схема инъекционного введения ботулотоксина типа А и 0,9% натрия хлорида в *musculus pectoralis major*

Table 1

Spirometry parameters in the first week after breast replacement

Таблица 1

Параметры спирометрии в первую неделю после эндопротезирования молочных желез

Анализируемые параметры / Studied parameters	Величина анализируемых параметров в группе / The value of the analyzed parameters in the group			
	срок, сут / duration, days	среднее, M±m / average, M±m	число наблюдений (%) / number of observations (%)	
			в норме / normal	вне нормы / not normal
Частота дыхания, л / Respiration rate, l	1	23,3±2,4	36 (40,5)	53 (59,5)
	7	18,4±2,5	80 (89,9)	9 (10,1)
Жизненная емкость легких, л / Vital capacity of the lungs, l	1	74,2±6,2	37 (41,6)	52 (58,4)
	7	83,1±7,8	64 (72,0)	25 (28,0)
Форсированная жизненная емкость легких, л / Forced life lung capacity, l	1	79,4±6,6	35 (39,3)	54 (60,7)
	7	85,1±7,3	66 (74,1)	25,9 (3,5)
Объем форсированного выдоха, л / Forced volume exhalation, l	1	65,1±5,1	40 (44,9)	49 (55,1)
	7	71,4±6,3	72 (80,8)	17 (19,2)
Пиковая объемная форсированная скорость выдоха, л/с / Peak volumetric forced expiratory flow, l/s	1	76,8±8,2	70 (78,7)	19 (21,3)
	7	80,2±6,3	81 (91,1)	8 (8,9)

Table 2

Respiratory system examination results after breast replacement

Таблица 2

Результаты обследования дыхательной системы после эндопротезирования молочных желез

Срок, сут / Duration, days	Подгруппа / Subgroup	Частота выявления нарушений, % / Frequency of detection of violations, %				
		одышки / dyspnea	жизненной емкости легких / vital capacity of the lungs	форсированной жизненной емкости легких / forced vital capacity	объема форсированного выдоха / forced expiratory volume	пиковой объемной форсированной скорости выдоха / peak forced expiratory volumetric flow rate
1	1	31,2	34,1	22,8	33,2	12,1
	2	35,4	32,2	24,5	31,2	13,6
	3	43,3	47,1	46,4	37,5	24,8
	4	96,4	98,1	96,1	100	34,5
7	1	18,4	16,8	18,4	21,1	0
	2	1,5	2,6	2,1	2,6	0
	3	23,1	26,3	21,5	19,4	0
	4	54,3	43,8	41,4	37,5	0
p между 1 и 2 / *p* between 1 and 2	1-е сут	>0,05	>0,05	>0,05	>0,05	>0,05
	7-е сут	<0,01	<0,05	<0,01	<0,05	0
p между 1 и 4 / *p* between 1 and 2	1-е сут	<0,01	<0,01	<0,01	<0,01	>0,05
	7-е сут	<0,05	<0,05	<0,05	>0,05	0

used the prevalence of identified expiratory respiration function disorders differed from the value of the corresponding parameters in the first group not more than by 8–14% (p>0.05). By the end of the week the prevalence of dyspnea, VLC, FVLC, FEV_1 turned out to be less by 12.3 times (p <0.05), 6.4 times (p <0.05), 8.7 times (p <0.05), 8.1 times (p <0.05) correspondingly compared to the findings of the group where patients received only botulinum toxin type A.

In the control group at both points of examination in most clinical cases, impaired external respiration functions were marked. On the first day of the postoperative period the frequency of dyspnea as well as parameters of VLC, FVLC, FEV_1 and PEFR were minimum 30% below the normal level correspondingly in 96.4, 98.1, 96.1, 100 and 34.5% of cases. On the seventh day of the examination, the frequency of mentioned impairments decreased almost by half, but had significant statistical differences with the first and second study groups data where botulinum toxin type A was combined with physiotherapeutic treatment INDIBA.

External respiration and spirogram parameters findings in the third group that received isolated physiotherapeutic therapy with INDIBA apparatus were analyzed separately (Table 3).

Spirograms results given in Table 3 show that within the whole course of physiotherapy the respiration frequency tended to decrease till 19 per minute compared to 22 per minute recorded in the group where patients received placebo (p >0.05). After seven days of electrophysiological exposure VLC, FEV_1 and PEFR parameters turned out to be higher than control only by 5, 4 and 5% respectively (p >0.05). Considering data received on the basis of a profound calculation with the use of student's t-test none statistically significant differences in spirogram parameter values in the postoperative period after endoprosthetics of the breast taking into consideration electrophysiological effect were revealed. One may conclude about the absence of a proven effect of the isolated use of INDIBA apparatus on external respiration function in the postoperative period in our follow-up groups.

CONCLUSIONS

1. Breast endoprosthetics is accompanied by marked restrictive disorders of patients' external respiratory functions such as reduction of vital lung capacity, forced vital lung capacity, forced expiratory volume in the 1st second and peak expiratory flow rate. The above mentioned spirometry parameters changes reached their peak in the first week following the aesthetic surgery.

2. Isolated physiotherapeutic treatment with INDIBA apparatus did not produce any significant effect on the rate of expiratory respiration functions restoration in female patients after mammary gland replacement.

3. A set of preventive measures based on the botulinum toxin type A administration in the large pectoral muscle before the operation as well as a course of anti-inflammatory electrophysiological therapy make it reliably possible

Table 3

Respiratory system examination results after a week after endoprosthetics of mammary glands, taking into account electrophysiological effects

Таблица 3

Результаты обследования дыхательной системы через неделю после эндопротезирования молочных желез с учетом электрофизиологического воздействия

Анализируемые параметры / Analyzed parameters	Средняя величина параметров при воздействии INDIBA / Average parameter values when exposed to INDIBA		Разность средних / Difference average	*p*
	есть yes	нет no		
Частота дыхания, л / Respiration rate, l	$_{18}19_{21}$	$_{20}22_{23}$	$_{-0,5}-1,0_{0,5}$	0,05
Жизненная емкость легких, л / Vital capacity of the lungs, l	$_{79}81_{82}$	$_{76}77_{79}$	$_{-0,7}-0,6_{0,8}$	0,61
Объем форсированного выдоха, л / Forced volume exhalation, l	$_{77}78_{79}$	$_{74}75_{77}$	$_{-0,1}-0,2_{0,6}$	0,06
Пиковая объемная форсированная скорость выдоха, л/с / Peak volumetric forced expiratory flow, l/sec	$_{82}83_{85}$	$_{77}79_{80}$	$_{-0,3}-0,2_{0,7}$	0,07

Примечание: границы 95% доверительных интервалов для медианы подстрочно.
Note: limits of 95% confidence intervals for the median line by line.

to increase the rate of expiratory respiration functions restoration in patients following breast endoprosthetics in the first week after the surgery.

4. Combination of botulinum toxin and one of the physiotherapeutic methods provided both the complete *musculus pectoralis major* denervation and effective anti-inflammatory and metabolic effect on the injured by the surgery tissues, which resulted in marked analgesic effect development. In the absence of pain, no impaired external respiration parameters resulted from, with respiratory volume being normal and breast excursions being painless in the early postoperative period. Combined use of physiotherapy and botulinum toxin proved to be more effective than their isolated application.

ADDITIONAL INFORMATION

Author contribution. Thereby, all authors made a substantial contribution to the conception of the study, acquisition, analysis, interpretation of data for the work, drafting and revising the article, final approval of the version to be published and agree to be accountable for all aspects of the study.

Competing interests. The authors declare that they have no competing interests.

Funding source. This study was not supported by any external sources of funding.

Consent for publication. Written consent was obtained from the patient for publication of relevant medical information within the manuscript.

ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

Вклад авторов. Все авторы внесли существенный вклад в разработку концепции, проведение исследования и подготовку статьи, прочли и одобрили финальную версию перед публикацией.

Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

Источник финансирования. Авторы заявляют об отсутствии внешнего финансирования при проведении исследования.

Информированное согласие на публикацию. Авторы получили письменное согласие пациентов на публикацию медицинских данных.

REFERENCES

1. Ali A., Picado O., Mathew P.J. et al. Risk Factors for Capsular Contracture in Alloplastic Reconstructive and Augmentation Mammaplasty: Analysis of the National Surgical Quality Improvement Program (NSQIP) Database. Aesthetic plastic surgery. 2022; 1-5: 198–206.
2. Castillo J.P., Robledo A.M., Torres-Canchala L., Roa-Saldarriaga L. Gigantomastia as a Cause of Pulmonary Hypertension. Archives of Plastic Surgery. 2022; 49(03): 369–72.
3. Guliyeva G., Cheung J.Y., Avila F.R. et al. Effect of Reduction Mammoplasty on Pulmonary Function Tests: A Systematic Review. Annals of Plastic Surgery. 2021; 87(6): 694–8.
4. He J., Wang T., Dong J. Classification and management of polyacrylamide gel migration after injection augmentation mammaplasty: a preliminary report. Aesthetic Plastic Surgery. 2020; 44: 1516–21.
5. Hernández-Bule M.L., Paíno C.L., Trillo M.Á., Úbed A. Electric stimulation at 448 kHz promotes proliferation of human mesenchymal stem cells. Cell Physiol. Biochem. 2014; 34(5): 1741–55.
6. Hong P., Kim S.S., Jeong C. et al. Four-year interim results of the safety of augmentation mammaplasty using the motiva Ergonomix™ round silksurface: a multicenter, retrospective study. Aesthetic Plastic Surgery. 2022; 45: 895–903.
7. Juan A.N., Li Y.U. Advancement of Complications Related to Augmentation Mammoplasty using Silicone Gel Prosthesis. Chinese Journal of Plastic and Reconstructive Surgery. 2020; 2(1): 51–8.
8. Lupon E., Chaput B., Meresse T. Augmentation mammaplasty by superolateral thoracic flap: a case report. Journal of Medical Case Reports. 2021; 15(1): 1–7.
9. Nadeem M., Sahu A. Ultrasound guided surgery under Dilutional Local Anaesthesia and no sedation in breast cancer patients. The Surgeon. 2022; 18(2): 91–4.
10. Paredes V.S., Barcala F.G., Suarez A.J. Pneumonitis caused by silicone gel following breast implant rupture. Irish J Med. Science. 2010; 179(1): 141–5.
11. Williams D.C., Seifman M.A., Hunter-Smith D.J. Patient related outcome measures for breast augmentation mammoplasty: a systematic review. Gland Surgery. 2019; 8(4): 425.

ЛИТЕРАТУРА

1. Ali A., Picado O., Mathew P.J. et al. Risk Factors for Capsular Contracture in Alloplastic Reconstructive and Augmentation Mammaplasty: Analysis of the National Surgical Quality Improvement Program (NSQIP) Database. Aesthetic plastic surgery. 2022; 1-5: 198–206.
2. Castillo J.P., Robledo A.M., Torres-Canchala L., Roa-Saldarriaga L. Gigantomastia as a Cause of Pulmonary Hypertension. Archives of Plastic Surgery. 2022; 49(03): 369–72.
3. Guliyeva G., Cheung J.Y., Avila F.R. et al. Effect of Reduction Mammoplasty on Pulmonary Function Tests: A Systematic Review. Annals of Plastic Surgery. 2021; 87(6): 694–8.
4. He J., Wang T., Dong J. Classification and management of polyacrylamide gel migration after injection augmentation mammaplasty: a preliminary report. Aesthetic Plastic Surgery. 2020; 44: 1516–21.

5. Hernández-Bule M.L., Paíno C.L., Trillo M.Á., Úbed A. Electric stimulation at 448 kHz promotes proliferation of human mesenchymal stem cells. Cell Physiol. Biochem. 2014; 34(5): 1741–55.
6. Hong P., Kim S.S., Jeong C. et al. Four-year interim results of the safety of augmentation mammaplasty using the motiva Ergonomix™ round silksurface: a multicenter, retrospective study. Aesthetic Plastic Surgery. 2022; 45: 895–903.
7. Juan A.N., Li Y.U. Advancement of Complications Related to Augmentation Mammoplasty using Silicone Gel Prosthesis. Chinese Journal of Plastic and Reconstructive Surgery. 2020; 2(1): 51–8.
8. Lupon E., Chaput B., Meresse T. Augmentation mammaplasty by superolateral thoracic flap: a case report. Journal of Medical Case Reports. 2021; 15(1): 1–7.
9. Nadeem M., Sahu A. Ultrasound guided surgery under Dilutional Local Anaesthesia and no sedation in breast cancer patients. The Surgeon. 2022; 18(2): 91–4.
10. Paredes V.S., Barcala F.G., Suarez A.J. Pneumonitis caused by silicone gel following breast implant rupture. Irish J Med. Science. 2010; 179(1): 141–5.
11. Williams D.C., Seifman M.A., Hunter-Smith D.J. Patient related outcome measures for breast augmentation mammoplasty: a systematic review. Gland Surgery. 2019; 8(4): 425.