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Minimally Invasive Laser Procedures for Surgical Treatment of Pilonidal Cyst

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Abstract

Purpose. To study the postoperative results of minimally invasive laser operations in pilonidal cysts and conduct its comparative assessment with the results of traditional surgical treatments.

Materials and methods. The study included 106 patients with chronic and 60 patients with acute inflammation of pilonidal sinus who were blindly distributed – into two equal groups by simple randomization. Patients of group A underwent laser coagulation and curettage of the pilonidal sinus, in group B – sinus excision, in group C – laser coagulation through a wound, in group D – simple incision of the abscess. Laser radiation of a diode apparatus with a wavelength of 1.56 microns with a power of 10–15 W was used.

Results. The recurrence rate of the disease 1 year follow-up after laser coagulation and curettage of the pilonidal sinus is 5.67%. Significant advantages over the method of sinus excision were revealed by indicators of the level of pain syndrome, the frequency of wound infection, the duration of treatment, the timing of postoperative wounds healing ($p < 0.05$, Mann – Whitney U-test, Chi-Square). During ultrasound, a year after minimally invasive operations, infiltrative changes of tissues in the postoperative zone were significantly less common, as well as scar deformities of the intergluteal area (Chi-Square ($df=1$) $p=0.00001$, $p=0.0062$).

Median wound healing times in groups C and D were comparable ($p=0.8054$, $z=-0.3458$ Mann – Whitney U-test). In 10% of patients in group D, a secondary fistula was detected after a month, which later required a sinus excision. The benefits of laser coagulation through a wound by disease remission rate 1 year after start of treatment ($p=0.0122$, Yates corrected Chi-square) were identified. In dimension measurement, ultrasound after a year, the presence of infiltrate without fluid structures and inflammation in group C was detected in 6.67% of patients, in group D – in 22.5%.



Conclusion. The laser coagulation with pilonidal sinus curettage method and laser coagulation through a wound has a number of advantages over the traditional operations. The methods can become one of the alternative options for treating chronic and acute pilonidal sinus in regimen of "one-day surgery".

Keywords: laser coagulation, curettage, pilonidal sinus, ultrasound

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Малоинвазивные лазерные вмешательства в хирургическом лечении пилонидальной кисты

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Резюме

Цель. Изучить послеоперационные результаты малоинвазивных лазерных операций при пилонидальных кистах и провести их сравнительную оценку с результатами традиционных хирургических методов лечения.

Материалы и методы. В исследование вошли 106 пациентов с хроническим и 60 пациентов с острым воспалением пилонидальной кисты, которые были слепо распределены – по две равные группы методом простой рандомизации. Пациентам группы А выполняли лазерную коагуляцию и кюретаж пилонидальной кисты, в группе В – иссечение кисты, в группе С – чрезнаревую лазерную коагуляцию, в группе D – простую санацию абсцесса. Применялось лазерное излучение диодного аппарата с длиной волны 1,56 мкм, мощностью 10–15 Вт.

Результаты. Вероятность рецидива заболевания через 1 год после лазерной коагуляции и кюретажа пилонидальной кисты – 5,67%. Достоверные преимущества перед методом иссечения кисты были выявлены по показателям уровня болевого синдрома, частоты раневой инфекции, длительности лечения, срокам эпителизации послеоперационных ран ($p < 0,05$, Mann – Whitney U-test, Chi-Square). При эхоскопии через год после малоинвазивных операций достоверно реже наблюдались

инфильтративные изменения мягких тканей в зоне послеоперационного рубца, а также рубцовые деформации межъягодичной складки (Chi-Square (df=1) $p=0,00001$, $p=0,0062$).

Средние сроки заживления ран в группах С и D оказались сопоставимы ($p=0,8054$, $z=-0,3458$ Mann – Whitney U-test). У 10% пациентов в группе D через месяц выявлен вторичный свищ, что позднее потребовало иссечения кисты. Выявлены преимущества чрезрассековой лазерной коагуляции по частоте ремиссии заболевания через 1 год после начала лечения ($p=0,0122$, Chi-square с поправкой Yates). При морфометрии, экоскопии через год наличие инфильтрата без жидкостных структур и воспаления в группе С было выявлено в 6,67% наблюдений, в группе D – в 22,5%.

Заключение. Методы лазерной коагуляции с кюретажем пилонидальной кисты и чрезрассековой лазерной коагуляции обладают рядом преимуществ по сравнению с традиционными вмешательствами. Они могут стать альтернативными вариантами лечения хронического и острого воспаления пилонидальной кисты в условиях «хирургии одного дня».

Ключевые слова: лазерная коагуляция, кюретаж, пилонидальная киста, ультразвуковое исследование

■ INTRODUCTION

Despite a great number of clinical researches, which aim at the surgical treatment of pilonidal sinus (PS) or pilonidal cyst (PC), there are still a lot of contradictions and disputes concerning the efficiency of minimally invasive methods of treatment in comparison with traditional operations [1–5]. The methods of flap dissection of PS with wound suturing by different methods are accompanied by a high rate of complications and disease recurrence (according to different data from 2 to 60%), long periods of epithelialization of postoperative wounds: from 2–3 weeks at primary adhesion to several months or even at "mid-open" and "open" management of such wounds [3, 5–7].

There are still contradictions and disputes concerning the issues of treatment in case of the acute inflammation of PS. In this case, the simplest and the most commonly used treatment method – incision and drainage of abscess, according to a number of investigations, don't always lead to full recovery and requires a second stage of surgical treatment – radical operation [2, 7]. The data about the possibility of the repeated abscess formation (recurrence rate) in various publications are very contradictory. Some authors report 60–80% recurrence [8, 9]. Another point of view is that after the adequate opening of abscess, radical surgical intervention is not always indicated, as more than 60% of patients don't have any manifestations of the disease, and accordingly, there are not any indications for the recurrent operation [3, 10]. Some specialists offer simple opening of abscess without affecting the cyst itself at the period of acute inflammation. Others offer also to incise a cyst, scraping its walls with a small curet [5]. In modern publications from the developed countries of Europe and America, more and more often, instead of urgent "abscessectomy" (a conditional term), the authors propose the methods of local thermal treatment of the abscess cavity with devitalization of the epithelial lining of the cyst [6, 11–15]. Thus, there have been formed a steady tendency to the minimization



of indications for excisional surgical intervention by the selection of patients and their differentiation according to the results of echoscopy of sacrococcygeal area, and also implementation of minimally invasive operations. The following methods have become the most widespread ones – the methods of treatment of abscessing pilonidal cyst, based on the mechanic transwound destruction (transwound curettage under local anesthesia: "LOCULA" – "Laying Open and Curettage under Local Anesthesia") or thermal (laser, electric) coagulation of cyst epithelium without its dissection (laser coagulation of pilonidal cyst and fistulous tract, for example "SiLaC" – "Sinus Laser-assisted Closure"), sinusectomy, phenolization of cyst (introduction of phenol solution into the cavity of PS), scraping and draining of cyst with lateral plasty according to J. Bascom (1980), endoscopic treatment method ("EPSiT" – "Endoscopic Pilonidal Sinus Treatment") and etc. [3, 5, 6, 11–16]. According to the conclusions from the analyzed literature, such interventions can be successfully applied in patients with a small expansion of pilonidal cysts, in case of the absence of multiple lateral fistula branches, leaks in the areas of buttock or perineum [5, 6, 11, 12, 14, 15]. Minimally invasive operations are performed under local anesthesia and can be successfully used in ambulatory conditions or hospital conditions with a short-stay of patients ("one-day surgery"). It seems very promising to use laser technologies for this purpose. Application of flexible diffusing fiber with radial extension of laser beam helps to carry out thermal coagulation of internal lining of coccygeal passages with their further obliteration [5]. The absence of excision of massive flaps along the midline of the sacrum and the associated open wounds has a potentially beneficial effect on the course of the postoperative period.

■ PURPOSE OF THE STUDY

To study postoperative results of minimally invasive laser operations at pilonidal cysts and to carry out comparative evaluation with the results of traditional surgical treatment methods.

■ MATERIALS AND METHODS

The clinical investigation was carried out at the Department of Emergency Surgery in accordance with the scientific planning schedule of Belarusian Medical Academy of Postgraduate Education and in the frameworks of the tasks of the State Program of Scientific Investigations "Fundamental and applied medicine and pharmaceuticals": "To develop the method of minimally invasive treatment of patients with malignant malformations of soft tissues and the organs superficially located with the application of semiconductor lasers under ultrasound control" (code number 3.38, № State Registration 20160943, deadlines. From January, 2015 to January, 2020, there had been conducted non-urgent operations on 116 patients with chronic inflammation of PS; and 211 operations of incision and drainage of abscess at acute PS had been carried out. The criteria for inclusion of patients into the research on the study of the results of planned minimally invasive laser surgeries ("planned cohort") have become the following ones: chronic inflammation of PS at the stages of infiltration, residual abscess and stages of purulent fistula (according to the classification of the State Scientific Center for Coloproctology (1988); location of the site of infection (fistula, infiltrate) in the typical region – along the midline or with deviation from the midline (laterally) not more than 5 sm (with the absence of multiple lateral purulent leakages on the buttock, lumbar region, multiple lateral fistulas with convoluted path,

branching paths like "clusters of grapes"); absence of previous operations on incision of coccygeal branches.

The criteria for inclusion of patients into the research on the study of the results of treatment of abscessed PS ("emergency cohort") have become the following ones: acute inflammation of PC at the stage of purulent abscess; location of abscess in the typical region – along the midline or with deviation from the midline (laterally) not more than 4 cm laterally (with the absence of lateral purulent leakages on the buttock); absence of rough postoperative scars, which deform sacral region and intergluteal cleft.

The criteria for exclusion from the study: severe common diseases, which potentially lead to the violation of regeneration of postoperative wounds: pancreatic mellitus, systemic diseases of connective tissue (collagenoses), secondary immunodeficiency, chronic skin diseases, trophic disorders at atherosclerosis and etc.

According to these criteria, the study included 106 patients from "planned cohort", who had been blindly divided into two groups (53 patients in each) by simple randomization – assigning each of the 106 patients a number that is an arbitrary number from a table of random numbers, ranking these numbers in ascending order. Every second patient in the ranked series was included in the main group A, the remaining patients were assigned to control group B. Stratification according to the total duration of the disease was not performed.

The research on the study of the treatment results of abscessed PS from "emergency cohort" also included 60 patients, who had been blindly divided into two groups (the groups C and D, 30 patients in each) by simple randomization.

The operations were performed by the agreement of patients from inpatient and outpatient healthcare establishments with short-term stay of patients ("one-day hospital") at multidisciplinary treatment and advisory medical center.

There had been used the following devices for ultrasound investigations: "LOGIC C5" (China/USA), and also portable ultrasound scanner "Sonon 300L" (South Korea) with a linear sensor (frequency 3,5 MHz, depth to 20 cm, visual field angle 58,2°). Scanning of the tissues of sacrococcygeal region in 2D regime had been carried out in the sagittal and frontal axes. In 2D regime, it was evaluated the presence or absence of the residual cavity of cyst, infiltrative changes of soft tissues, rough scars. During the research in the regime of Colour Doppler Imaging (CDI), it had been evaluated the intensity of vascular response in adjacent tissues, the presence of (absence) residual fluid cavities.

The patients of the group A (53 patients) had been performed minimally invasive surgeries under local infiltration anesthesia – laser coagulation and curettage of PS and recurrent fistulous tracts (if there were such). The method is described in the instruction, approved by the Ministry of Health of the Republic of Belarus "Method of Surgical Treatment of Pilonidal Cyst" (№ 107-1120, authors – S. Shakhrai, Y. Gain, M. Gain). The amount and character of anesthesia made the laser operation painless for a patient, providing a comfort for him. The anesthesia was consisted of the solutions – novocaine 1%, lidocaine 1–2% in combination with adrenaline in a ratio of 1:100.000. Fine needles (27G) 35–38 mm long were used. The main stages of this operation include the following: intraoperative ultrasound control; performing of local infiltration anesthesia; cannulation of the secondary fistula; dissection and mechanical debridement of primary and secondary mouths of fistula with the help of sharp-pointed scalpel or special tapan-ring-knife – "Punches" or «Trephines» ("Moshe Gips procedure") (wounds with the dimensions



of 0,5–1 sm appeared) [17]; curettage of the cavity of the pilonidal cyst and secondary fistula by the small curet, removal of detritus, epithelial lining, hair (if there is); introduction of 3% hydrogen peroxide solution into cavity of treated coccygeal passages and sinus; connection of a diode-fiber laser medical device in continuous or pulsed modes (pulse length and period between pulses – from 0,5 to 2 sec). Power – from 10 to 15 W. Wave-length is 1560 nm; laser coagulation of treated primary fistulous openings and cyst cavity in the midline; laser coagulation of treated secondary fistulous openings and cavities of the secondary fistula; hemostasis and its control.

Laser action is being produced continuously aiming at thermal coagulation of the remains of epithelial lining of cyst, detritus, and also decontamination and additional hemostasis. The final aim of the operation is a full obliteration of pilonidal cyst, residual passages and fistula.

Laser exposure was carried with the help of the surgical diode device "Mediola compact" (CJSC "FOTEK", the Republic of Belarus). There had been used disposable optical tips with the fiber length of 7.5 and 15 sm for the multiple-use holder "Mediola Colibri". The radial type of optical fiber tip, small diameter of the light conductor, and also its flexibility – these all help to cannulate and to carefully debride narrow areas of the pilonidal cyst.

Patients of the group B (53 patients) had been performed traditional surgery intervention – flap excision of PC and abnor abnormal foci within healthy tissues in a single block with suturing the edges of the wound to the bottom the wound (sacral fascia) in a checkerboard pattern (the method was first described by W. McFee in 1942). This method, which is considered to be semi-open, has become widespread due to the possibility of preserving the outflow of wound discharge, and also dynamic control of the state of the wound during dressings, which is important in conditions of chronic tissue inflammation [3, 18]. The interventions over the patients of the group B were carried out under spinal anesthesia. In the postoperative period, special attention was paid to the prevention of secondary infection of the postoperative wound: extensive treatment of the skin around the wound with an iodine-containing solution, the use of gauze turundas moistened with antiseptic solutions.

The treatment was complied with the clinical protocol for the diagnosis and treatment of patients with benign diseases of the rectum, pararectal and coccygeal region on an outpatient basis and in surgical (proctological) departments with a short stay (Appendix to the Decree of the Ministry of Health of the Republic of Belarus dated April 28, 2014 No. 31). Patients of both study groups underwent daily staged dressings using a 3% hydrogen peroxide solution, a 0.05% solution of chlorhexidine bichluconate, a solution of potassium permanganate 1: 10,000, a hydrophilic-based ointment containing chloramphenicol and dioxomethyltetrahydropyrimidine (Mekol-Borimed). In some cases, in patients from group B, ointments accelerating repair (methyluracil) were applied topically. If the wound healed by primary intention, the sutures in patients in group B were removed on the 12th day after the operation. Control examinations of patients were carried out every week until complete healing of the wound. The control points for recording the results of treatment were the terms of 1 and 12 months after the operation. In a year after the operation, the patients underwent ultrasound investigation of the sacrococcygeal region. To compare the study groups, the following indicators were evaluated: the frequency of recurrence, the frequency of postoperative complications, the timing of complete healing of the postoperative wound, the timing of temporary disability in an outpatient setting.

The patients with acute inflammation of the PC (groups C and D) under local infiltration anesthesia (Sol. Novocaini 0.5% – 100 ml) underwent opening and drainage of the PC abscess using an incision along the length corresponding to the size of the purulent cavity. After the removal of pus, necrotic detritus or hair (if any), the abscess cavity was sanitized with a 3% hydrogen peroxide solution. The wound was drained with gauze turunda with hypertonic 10% NaCl solution for 7–10 hours (until the next dressing).

On the 3rd day after the primary operation, patients of group C (30 patients) underwent an additional intervention under local infiltration anesthesia – transcutaneous laser coagulation of the abscess cavity and PC. The method was described in the instructions approved by the Ministry of Health of the Republic of Belarus "Method of surgical treatment of abscessed pilonidal cyst" (No. 106–1120, authors – S. Shakhrai, Y. Gain, M. Gain). The criterion for the readiness of the postoperative wound and the choice of this period of re-intervention was a decrease in the acute inflammatory process in the surrounding tissues, the absence of severe contact bleeding of the wound, which allows for its thorough revision and surgical treatment. The main stages of trans-wound laser coagulation: wound revision; additional skin incision connecting all primary fistulous openings (if necessary); curettage of the abscess cavity (with a Volkmann spoon, a surgical brush, removal of areas of the epithelial lining, remnants of purulent detritus, hair (if any); laser coagulation of the abscess cavity and PC throughout its entire length in a continuous mode of emission of laser radiation with a wavelength of 1560 nm and a power of 10–15 W (laser exposure mode is similar to that in chronic inflammation of the PC). The impact was made fan-shaped, sectorally with a deviation to the side up to 2 mm from each point of impact. In the focus of exposure, a focus of thermal coagulation of soft tissues (subcutaneous adipose tissue and remnants of the epithelial lining of the cyst) was formed without disturbing other anatomical structures of the sacrococcygeal region.

Patients of group D (30 people) did not undergo laser treatment of the postoperative wound. In addition to recommendations for careful hygiene, patients with increased hair growth on the skin of the intergluteal folds, the sacrum area were recommended to shave regularly, followed by treatment of the skin around the wound with alcohol solutions. After discharge from the hospital, control examinations of patients were carried out every week until the wound was completely healed. The control points for recording intermediate and long-term results of treatment were also the terms of 1 and 12 months. The ultrasonic criterion for inflammation in soft tissues was the presence of hypoechoic areas or a zone of compacted tissues (infiltrate) with anechoic softening foci against the background of a homogeneous structure of the subcutaneous tissue, a pronounced vascular pattern due to tissue plethora in the infiltrate zone. In the study in the mode of color Doppler mapping (CDC), the severity of the vascular reaction in the adjacent tissues, the presence (absence) of a residual cavity with serous-purulent contents were assessed. The comparison groups in the studies were homogeneous by sex and age (Table 1).

Statistical processing of the study results was performed using the software "Statistica" (Version 7.0, StatSoft Inc.) and Microsoft Excel 2010 (version 14.0.6129.5000 for Windows 7). Nonparametric methods were used to compare the groups: Mann – Whitney U-test, to analyze relative values and test the statistical hypothesis, a chi-square test was used: Chi-Square analysis 2 × 2 Tables Chi-Square test. Differences between the groups were considered significant at $p < 0.05$. Study design: clinical, controlled, prospective, single-blind (at the stage of randomization), randomized, single-center, parallel.



Table 1
Patient comparison groups by sex and age

Groups to compare	Sex		Age, years (Me [25%–75%])
	Male	Female	
Group A (n=53)	25 (47.2%)	28 (52.8%)	24 [23–27]
Group B (n=53)	30 (56.6%)	23 (43.4%)	25 [22–27]
Group C (n=30)	15 (50%)	15 (50%)	23 [20–27]
Group D (n=30)	16 (53.3%)	14 (46.7%)	23.5 [21–27]
Mann – Whitney U-test _{A-B}	–		p=0.714007, z=–0.3665
Chi-square (df=1) _{A-B}	p=0.3311		–
Mann – Whitney U-test _{C-D}	–		p=0.482517, z=–0.7023
Chi-square (df=1) _{C-D}	p=0.7961		–

■ RESULTS

The average (median) duration of minimally invasive surgery for chronic inflammation of the pilonidal cyst (Me [25%–75%]) in group A was 16 [15–19] min, in the control group B – 32 [23–39] min. ($p=0.0000714$, $z=-3.86418$, Mann – Whitney U-test). In both groups of patients (A and B), moderate blood soaked bandage was observed on the 1st day after the intervention. In contrast to patients in group B, whose interventions were performed under spinal anesthesia and there was a need for bed regime during the first 12–24 hours after surgery, patients in group A had an inclination to early physical activity almost immediately after surgery. A day after the surgery, all patients in group A due to the absence of pain syndrome were completely canceled non-steroidal anti-inflammatory drugs. 24 hours after the surgery 39 (73.58%) patients in group B noted the persistence of moderate pain and discomfort, that required further use of non-narcotic analgesics (Chi-square, $p<0.00001$). Complete cancellation of analgesics in all patients of group B was carried out only on the 5th day of hospital stay.

Despite the active wound infection prevention, 11 (20.75%) patients from group B during the period of outpatient observation (from 6 to 17 days after the surgery) showed inflammatory changes in the area of postoperative wounds, that required complete removal of sutures and open wound management. Thus, the comparison of the early results of the surgery of chronic inflammation of the pilonidal cyst according to the frequency of wound infection revealed the advantages of laser coagulation and coccygeal passages curettage (Chi-Square (df=1), $p=0.0062$; $p=0.0005$).

Follow-up of patients after elective surgeries for 1 year revealed long-term complications in the form of recurrence of abscess of the pilonidal cyst in 3 patients (5.66%) in group A (during the follow-up period at 4, 8, 12 months after surgery), which didn't reveal statistically significant differences when compared with group B (relapses were not revealed after a year) (Chi-Square (df=1), $p=0.0789$). 7 (13.21%) patients in group B continued to have complaints of moderate discomfort in the area of the intergluteal fold. On examination, the patients were found to have scars in the area of the postoperative wound, deforming the intergluteal fold. Patients with recurrence of epithelial coccygeal passages in the form of an abscess were performed opening and drainage of the abscess, followed by transcutaneous laser coagulation under local anesthesia.

Features of the post-operation wound process affected the overall wound healing time (Fig. 1) and outpatient treatment.

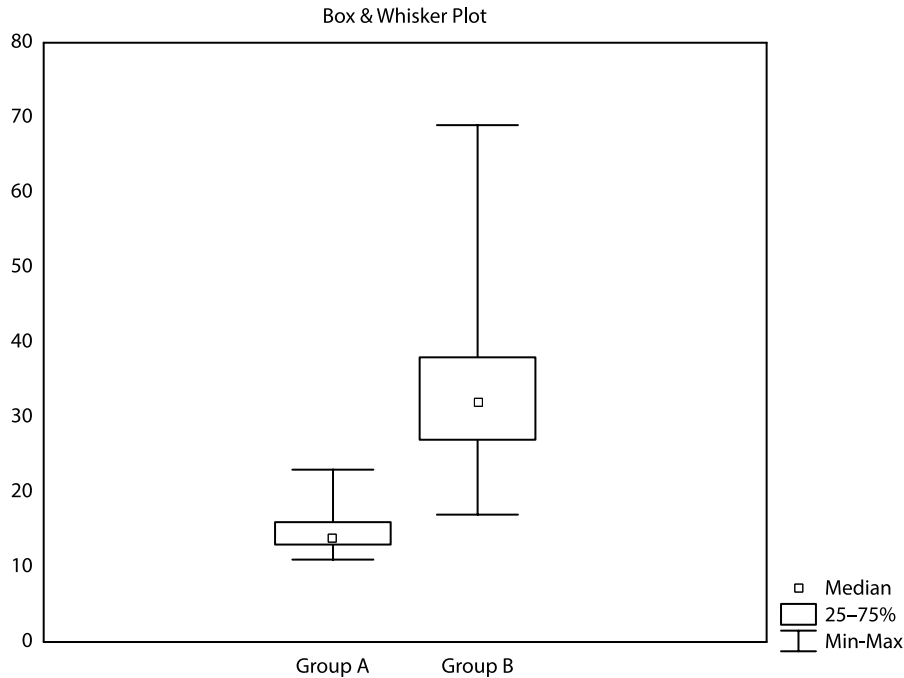


Fig. 1. Median time for complete healing of postoperative wounds in study groups

Patients who underwent minimally invasive surgery (group A) were discharged from the hospital on average on the second day, which made it possible to apply to them all the principles of short-term hospital stay surgery. The traditional surgery for excision of the pilonidal cyst with suturing the wound in a semi-open technique (group B) required significantly longer periods of stay in the hospital, associated primarily with the peculiarities of the course of the wound process and the need for observation, performing dressings in a medical center ($p=0.0000113$, $z=-4.33446$, Mann – Whitney U-test).

The results of a clinical examination of patients in groups A and B, which included ultrasound examination of the sacrococcygeal region within 12 months after surgery, are presented in Table 2.

Thus, in patients who underwent laser coagulation and curettage of the coccygeal passages (group A), compared with patients from group B, after 1 year, echoscopy showed significantly less infiltrative changes in the soft tissues in the area of the postoperative scar, as well as cicatricial deformities of exposed area.

The criterion for healing was stable agglutination of the wound edges (during healing by primary intention) or comparison (contraction) of the edges with the absence of discharge and the beginning of scar formation (during healing by secondary intention). Statistically significant differences in the comparison groups are due to the extremely small size of the wounds during curettage with laser coagulation of the coccygeal passages (0.5–1 cm), the actual absence of divergence of the edges of these skin wounds with their healing by primary intention.



Table 2
Data obtained during clinical examination of patients in groups A and B 1 year after surgery

Treatment outcome	Follow-up period	
	1 year	
	Group A (n=53)	Group B (n=53)
Absence of clinical manifestations of epithelial coccygeal passages (remission)	50 (94.34%)	53 (100%)
Chi-Square (df=1)	p=0.0789	
The presence of a scar in the area of the postoperative wound that deforms the sacrococcygeal region and the intergluteal fold	0 (0%)	7 (13.21%)
Chi-Square (df=1)	p=0.062	
The presence of infiltrative changes in soft tissues in the area of the postoperative scar without liquid structures and signs of inflammation according to echoscopy	6 (11.32%)	34 (64.15%)
Chi-Square (df=1)	p=0.00001	
The presence of residual fluid cavity / pilonidal cyst without signs of inflammation according to echoscopy	4 (7.55%)	5 (9.43%)
Chi-Square (df=1)	p=0.9776	

Statistically significant differences were found in groups A and B in the average terms of healing (epithelialization) of wounds ($p=0.0000318$, Mann – Whitney U-test), which indicates the advantages of a minimally invasive method of treatment compared to traditional surgery. In addition, in 6 patients of group B (11.32%), due to the open method of wound management and its healing by secondary intention, complete healing was more than 1.5 months.

In the study of abscessed pilonidal cyst in both patient groups (groups C and D), similar local changes were observed on the 1st day after surgery: after opening and draining the abscess, the local inflammatory process began to actively resolve, pain and swelling decreased. Non-steroidal anti-inflammatory drugs were cancelled for all patients in groups C and D on the 3rd day. An additional skin incision, connecting all previously unidentified primary fistula openings, as one of the stages of the operation of percutaneous laser coagulation, was required in 19 (63.33%) patients of group C.

Despite the fact that the average wound length in patients of the main group (C) was 73.4% higher than that in the control group (D), the healing time in the comparison groups was comparable (Fig. 2).

The criterion for primary healing was the agglutination of the edges of the wound, the complete absence of discharge and the beginning of scar formation. The absence of a statistically significant effect of the linear length of the wound on the rate of regeneration is due to the actual absence of wound separation with their healing by primary intention ($p=0.8054$, $z=-0.3458$ Mann – Whitney U-test).

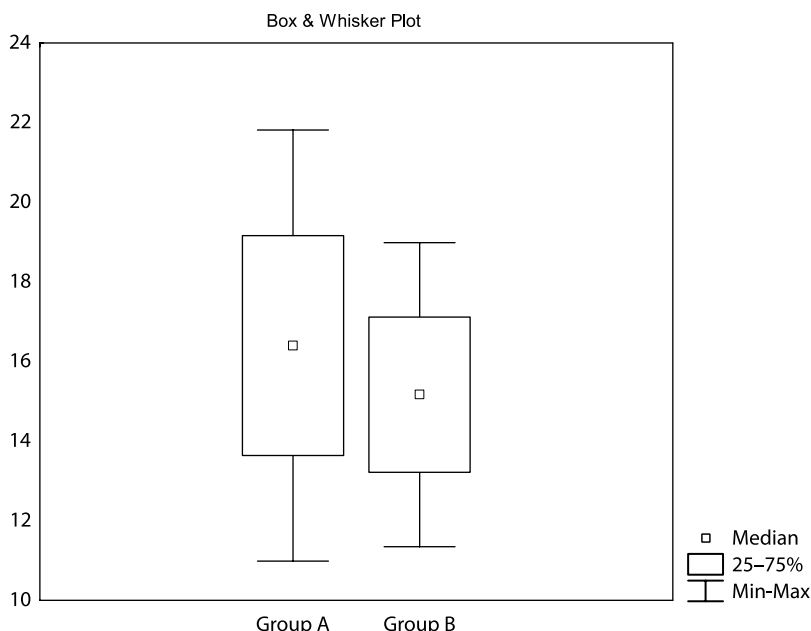


Fig. 2. Median post-operative wound healing in groups C and D

The results of a clinical examination of patients, which included echoscopy of the sacrococcygeal region at 1 and 12 months after the primary surgery, are presented in Table 3.

In patients who, on the 2nd day after drainage of the abscess, underwent percutaneous laser coagulation of the abscess cavity and pilonidal cyst (group A), compared with patients

Table 3
Data obtained during physical and echoscopic examination of patients in study groups 1 and 12 months after primary surgery

Treatment outcome	Follow-up period			
	1 month		1 year	
	Group C (n=30)	Group D (n=30)	Group C (n=30)	Group D (n=30)
Absence of clinical manifestations of epithelial coccygeal passages (remission)	25 (83.3%)	14 (46.7%)	28 (93.3%)	19 (63.3%)
Chi-square with Yates' correction	p=0.0068		p=0.0122	
The presence of infiltrate in the area of the postoperative scar without liquid structures	4 (13.3%)	8 (26.7%)	2 (6.67%)	8 (26.7%)
Chi-square with Yates' correction	p=0.3329		p=0.0377	
Presence of residual fluid cavity/pilonidal cyst without signs of inflammation	1 (3.3%)	6 (20%)	0 (0%)	2 (6.67%)
Chi-square with Yates' correction	p=0.0444		p=0.4720	
The presence of a primary / secondary fistulous tract with signs of inflammation	0 (0%)	3 (10%)	0 (0%)	–(3) (elective surgery)
Chi-square with Yates' correction	p=0.2361		–	

from group B at 1 month and 1 year, signs of remission of the disease were statistically significantly more often detected during echoscopy with the absence of liquid formations, infiltrates, fistulas and signs of inflammation in the area of surgical intervention ($p=0.0009$, $p=0.001$).

■ DISCUSSION

Randomization of patients, strict observance of the conditions for inclusion and exclusion from the study, make it possible to eliminate the bias of the researcher regarding one of the methods of treatment, unify the initial severity and form of the disease, create equal conditions for patients from comparison groups when evaluating minimally invasive laser methods, obtain new clinical data, and also additional information about the structure and frequency of early and late (in a year) postoperative complications.

Statistically significant differences in the groups in terms of the median duration of the operation (laser intervention was performed on average 2 times faster) were due to a significant reduction in the time spent on flap excision of the cyst, coagulation hemostasis, and suturing the postoperative wound. The use of minimally invasive laser surgery under local anesthesia did not significantly worsen the general condition and well-being of patients, but, on the contrary, contributed to a decrease in pain after surgery, as evidenced by the absence of the need for drug analgesia after 1 day in all patients of the main group A. The same low level of pain syndrome is noted, according to the literature, after performing similar minimally invasive interventions ("SiLaC", "SiLaT", "pit-picking", etc.): complete cancellation of analgesics is acceptable after 0–3 days [11–14].

Comparison of the rate of wound infection in the early postoperative period revealed significant advantages of laser coagulation and curettage of the coccygeal passages over the traditional operation of excision of the pilonidal cyst (Chi-Square ($df=1$), $p=0.0143$). Chance of disease recurrence 1 year after minimally invasive surgery (5.66%) was comparable or even lower than in a number of similar studies on minimally invasive surgeries for ECC: 14.9% after "SiLaC" [14], 8% after "pit-picking" [12].

Statistically significant differences in the comparison groups in terms of the duration of treatment on an outpatient basis, as well as in assessing the timing of epithelialization of postoperative wounds, indicate the advantages of the method of laser coagulation and curettage of the pilonidal cyst. The absence of a flap wound along the midline of the sacrococcygeal region, the presence of which is associated with a long healing period, the relatively low likelihood of wound infection – all this contributed to a reduction in the treatment time for patients on an outpatient basis.

Ultrasound examination one year after minimally invasive laser coagulation showed significantly less infiltrative changes in soft tissues in the area of the postoperative scar, as well as gross cicatricial deformities of the intergluteal fold and the sacrum (Chi-Square ($df=1$) $p=0.0317$, $p=0.0029$).

The use of therapeutic tactics with repeated revision of the postoperative wound on the 3rd day after the initial opening and drainage of the abscess of the epithelial coccygeal passage under local anesthesia made it possible to establish the feasibility of an additional skin incision along the cyst, with the involvement and sanitation of all previously unidentified primary fistulous openings in more than half of the operated patients of the main study group (67.5%), which affected the results of postoperative wound morphometry (an increase in the linear length of the wound by 54.4%). This fact is

probably due to the difficulty of detecting multiple primary fistula openings in the acute period of the disease accompanied by severe edema, skin hyperemia, purulent outflow and increased tissue bleeding with shielding of the surgical field. The use of delayed curettage with transcutaneous laser coagulation of the abscess cavity and the pilonidal cyst did not negatively affect the wound healing process, as indicated by the absence of statistically significant differences in the comparison groups in terms of the duration of temporary disability in outpatient conditions, as well as in assessing the timing of epithelialization of postoperative wounds.

Only in 3 patients of the control group D (10%) one month after the primary surgery, signs of chronic inflammation of the pilonidal cyst with the presence of secondary fistulous tracts were revealed, that required the implementation of the 2nd stage of surgical treatment – excision of the pilonidal cyst in a planned manner 1.5 months after the primary abscess opening. In other cases (90% of observations among patients of the control group D and 100% of observations in the main group C), 1 month and 1 year after the primary surgery, no visual pathological changes were detected during a clinical examination, except for the presence of a postoperative scar on the skin. According to P.M. Lavreshina et al. (2011), in 60% of patients after the initial opening of the abscess and evacuation of pus in the long-term period, there are no signs of the disease and indications for elective surgery [10]. According to current research, at a distant time (7–10 years after the primary surgery), about 70% of patients do not need the flap surgery for pilonidal cyst, and when such interventions are performed, all patients with acute inflammation (abscess formation) of the pilonidal cyst have a number of negative phenomena: prolongation of wound healing and, accordingly, an increase in the overall duration of treatment and rehabilitation, an increase in incidence of surgical infection, an increase in disease recurrence rate, etc. [1, 3]. Comparison of patient health outcomes in the study groups revealed significant advantages of the therapeutic approach used in the main group of patients (trans-invasive laser coagulation) in terms of the frequency of remission of the disease (both one month and one year after the start of treatment – Chi-square with Yates correction, $p=0.0068$, $p=0.00122$). During echoscopy the presence of an infiltrate in the area of the postoperative scar without fluid structures and signs of inflammation in the main group was detected only in 2 cases (6.67%), in the control group – in 8 cases (26.7%) a year later. Residual liquid cavity or pilonidal cyst without signs of inflammation wasn't found in the main group, that indicates the radical nature of the developed laser treatment method, while in the control group, according to the results of echoscopy, 2 such patients (6.67%) were identified a year later. The asymptomatic course of the disease at the time of examination in these patients does not exclude the possibility of recurrence of the pilonidal cyst in the future, requiring dynamic observation by the surgeon. A rather low incidence of pathological changes in the ultrasound examination of the sacrococcygeal region indicates the need for further study of the long-term results of primary surgery for abscessing pilonidal cysts.

■ CONCLUSION

Despite a large number of studies devoted to the study of radical methods of surgical treatment of PC, the methods based on excision of the pathological focus with a wide flap within healthy tissues, although they are a kind of "gold standard" for the treatment of patients, their results still can not fully satisfy either specialists, or patients, primarily due



to the rather high incidence of postoperative complications and long periods of wound healing [5–7, 15].

The developed minimally invasive method of laser coagulation and curettage of the coccygeal passages under local anesthesia is simple to perform, easily reproducible, it can be successfully used in a one-day surgical hospital or an outpatient center with a daycare ward. Due to the absence of a flap wound in the sacrococcygeal region, the method has no defects and is characterized by a low level of pain, short periods of outpatient treatment and a period of disability.

The consequences of surgical treatment of patients with acute inflammation of PC, as well as the results of ultrasound examination of the sacrococcygeal region a month and a year after the primary surgery in the clinical study, reveal a low probability (0% in the main study group and 10% in the control group) of chronic inflammation of PC with the need for the second stage of surgical treatment (elective surgery for excision of PC), provided that the abscess is adequately opened, drained, a wide incision is formed involving all primary fistulous openings, as well as delayed curettage with laser coagulation of the abscess cavity and residual epithelial lining of PC. The results of an ultrasound study on the detection of the residual fluid cavity of the cyst and infiltrative formations in the sacrococcygeal region a year after the primary intervention (2% in the main group and 26.7% in the control group) also inspire certain optimism regarding the prospects for one-stage radical treatment of abscessed PC. In addition, certain advantages of minimally invasive laser intervention were revealed in terms of the frequency of remission and the asymptomatic course of the disease one year after the treatment.

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