

## RESULTS OF USING LASER THERAPY IN SURGERY FOR STOMACH AND DUODENAL ULCERS

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**Abstract.** *In the given article the authors analyze various degrees of physiological anastomosis in 131 patients, and conclude that for the treatment of late anastomosis after surgical interventions on the stomach and duodenum, it is recommended to include laser exposure of the anastomosis zone with two types of low-energy lasers in a comprehensive program. The authors argue that the integrated use of low-energy laser exposure through endoscopic and percutaneous irradiation will improve the effectiveness of treatment of late anastomosis.*

**Keywords:** *laser therapy, endoscopy, excision, probe, resection, anastomosis, ulcer, stomach, duodenum.*

**Relevance.** Despite the progress in the development of drug and endoscopic treatment methods, surgery for ulcerative disease in its complicated course remains a subject of interest in terms of developing or improving various options for surgical approaches, the essence of which is aimed at reducing the incidence of various postoperative complications [2,5,7,14]. This applies to both resection technologies, among which the Billroth-I or II resection options are constantly being modified, and organ-preserving interventions - excision of ulcers, suturing of perforations, etc. [3,8,10,12,]. In this regard, the frequency and range of complications certainly depend on both the surgical technique and other factors: the type of suture material, the initial condition of the patients and others [6,11].

Factors associated with pathology include pathological features (size and location of the ulcer, presence of perforation, local tissue inflammation, suspicion of malignancy, peritonitis and sepsis) [4,9]. Patient-related factors include age, gender, and comorbidities, while health-related factors include the availability of medical facilities and skilled surgeon [1]. Each factor itself and their relationship, reflecting the surgical extent, are important when deciding on the choice of surgical strategy [13].

As a rule, postoperative anastomosis is considered as a physiological process and develops in all patients as a result of the intervention. However, it is considered physiological only in the next 5-7 days after surgery, while according to morphological criteria, the anastomosis should be catarrhal. With the development of clinical signs of anastomosis and its duration of more than 7 days, the rehabilitation process will be lengthened, since in these cases such a complication is no longer physiological and requires additional therapeutic measures.

**Target.** To improve the results of surgical treatment of patients with duodenal ulcer by introducing laser technology.

**Materials and methods of research.** The satisfactory course of the early postoperative period was characterized by only mild general clinical manifestations, which generally correspond to the severity of the operation. The intra- and postoperative measures proposed against the background of standard recommendations made it possible to increase in the main group the frequency of postoperative “physiological” anastomosis within 6-7 days after surgery from 68.5% (in 50 patients in the comparison group) to 89.7% (in 52 out of 58 patients;  $\chi^2=9.202$ ;

p=0.011). The average severity of anastomosis was verified in 19 (26%) and 6 (10.3%) patients, respectively, while the severe degree developed only in the comparison group in 4 (5.5%) patients (Table 1).

**Table 1**

**Distribution of patients according to clinical severity of postoperative “physiological” anastomosis**

Severity	Comparison group		Main group	
	Abs	%	abs.	%
<b>Light</b>	50	68,5%	52	89,7%
<b>Average</b>	19	26,0%	6	10,3%
<b>Heavy</b>	4	5,5%	0	0,0%
<b>Total</b>	73	100,0%	58	100,0%
$\chi^2$	9,202; df=2; p=0,011			

Accordingly, a lower frequency of clinical manifestations was noted. Thus, symptoms of nausea were noted by 8 (11%) patients in the comparison group, while in the main group only 3 (5.2%). Periodic vomiting occurred in 5 (6.8%) and 1 (1.7%) patients, respectively. Pain symptoms persisted by day 7 in 12.3% (9) in the comparison group and in 3.4% (2) in the main group (Table 2).

**Table 2**

**Frequency of various manifestations of anastomosis on the 7th day after surgery**

*Abs % abs. %*  
**Nausea 8 11.0% 3 5.2%**  
**Vomiting 5 6.8% 1 1.7%**  
**Belching 13 17.8% 4 6.9%**  
**6 8.2% 2 3.4%**  
**Pain or heaviness in the epigastrium 9 12.3% 2 3.4%**  
**Decreased appetite 19 26.0% 6 10.3%**

Complaints	Comparison group		Main group	
	Abs.	%	Abs.	%
<b>Nausea</b>	8	11,0%	3	5,2%
<b>Vomiting</b>	5	6,8%	1	1,7%
<b>Belching</b>	13	17,8%	4	6,9%
<b>Heartburn</b>	6	8,2%	2	3,4%
<b>Pain or heaviness in the epigastrium</b>	9	12,3%	2	3,4%
<b>Decreased appetite</b>	19	26,0%	6	10,3%

Control endoscopy on days 7-8 due to the development of clinically significant anastomosis was performed on 37 patients in the comparison group and only 8 patients in the main group (Fig. 1).



*Fig. 1. Verified form of early prolonged postoperative anastomosis according to endoscopy*

**Results and their discussions.** The most frequently verified form of inflammation severity was catarrhal-edematous degree - 28 (75.7%) in the comparison group and 7 (87.5%) in the main group. In 8 (21.6%) and 1 (12.5%) cases, respectively, the erosive-fibrinous form was determined. The ulcerative-necrotic form was detected in 1 (2.7%) patient in the comparison group. Endoscopically, first degree anastomotic stenosis was determined in 11 (29.7%) patients in the comparison group and 1 (12.5%) in the main group; second degree in 2 (5.4%) patients in the comparison group, normal patency of the anastomosis was in 24 (64.9%) and 7 (87.5%) patients. Already in the early postoperative period, in 6 (16.2% of patients in the comparison group,

ligatures were identified in the area of inflammatory infiltrate, which during this period were not subject to excision due to the risk of subsequent failure of the sutures.

In general, 6 (8.2%) patients in the comparison group (after gastric cancer according to B-I - 3; gastric cancer according to B-II - 1 and ulcer excision - 2) and only 1 (1.7%) in the main group (after GC according to B-I), clinically and endoscopically, the development of clinically significant anastomosis was noted in the immediate period (Table 3).

**Table 3**

***Frequency of development of clinically significant anastomosis in the near future***

Type of operation	Comparison group		Main group	
	Abs	%	Abs.	%
<b>RJ according to B-I</b>	3	11,5%	1	5,3%
<b>RJ according to B-II</b>	1	7,7%	0	0,0%
<b>Excision of ulcer</b>	2	5,9%	0	0,0%
<b>Total</b>	6	8,2%	1	1,7%

All these patients underwent a radiocontrast study with a barium suspension. During dynamic examination, normal evacuation (45-60 minutes) after GC according to B-I was determined in 3 (18.8%) cases in the comparison group and 2 (50%) in the main group, accelerated evacuation (less than 45 minutes) in 4 (25%) and 1 (25%) patients, slow (more than 60 minutes) in 9 (56.3%) and 1 (25%) patients (Table 4). After GC according to B-II, the norm was determined in 2 (28.6%) cases in the comparison group and 1 (50%) in the main group, accelerated evacuation in 5 (71.4%) and 1 (50%) patients. After excision of the ulcer, normal evacuation was in 5 (35.7%) in the comparison group and 1 (50%) in the main group, accelerated evacuation in 1 (7.1%) patient in the comparison group, slow in 8 (57.1%) ) and 1 (50%) patients.

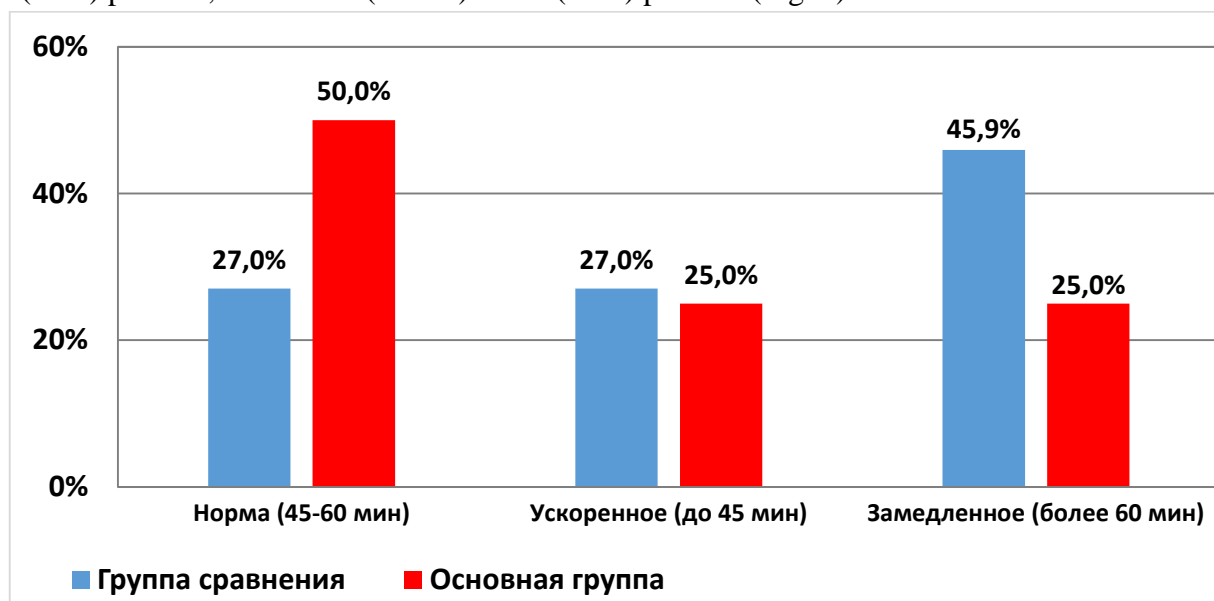
**Table 4**

***Distribution of patients according to contrast evacuation time  
(X-ray contrast study)***

vacuation time	Comparison group		Main group	
	Abs	%	Abs.	%
<b>RJ according to B-I</b>				
Norm (45-60 min)	3	18,8%	2	50,0%
Accelerated (up to 45 min)	4	25,0%	1	25,0%
Slow (more than 60 minutes)	9	56,3%	1	25,0%
Total	16	100,0%	4	100,0%
<b>RJ according to B-I</b>				
Norm (45-60 min)	2	28,6%	1	50,0%
Accelerated (up to 45 min)	5	71,4%	1	50,0%
Slow (more than 60 minutes)	0	0,0%	0	0,0%
Total	7	100,0%	2	100,0%

Ulcer excision				
Norm (45-60 min)	5	35,7%	1	50,0%
Accelerated (up 45 min)	1	7,1%	0	0,0%
Slow (more than 60 min)	8	57,1%	1	50,0%
Total	14	100,0%	2	100,0%

In general, for all types of operations, normal evacuation was determined in 10 (27%) cases in the comparison group and 4 (50%) in the main group, accelerated evacuation in 10 (27%) and 2 (25%) patients, slow in 17 (45.9%) and 2 (25%) patients (Fig. 2).



**Fig. 2. Summary distribution of patients by contrast evacuation time**  
*(X-ray contrast study)*

The quality of postoperative rehabilitation also varied over time. Thus, within up to 7 days after surgery, the clinical manifestations of anastomosis were stopped after GC according to B-I in 10 of 26 patients (38.5%) in the comparison group and 15 (78.9%) of 19 patients in the main group.

In the period of 7-10 days, regression of anastomosis was verified in 13 (50%) and 3 (15.8%) patients, and in periods of more than 10 days in 3 (11.5%) and only 1 (5.3%) patient in main group ( $\chi^2=7.339$ ;  $df=2$ ;  $p=0.026$ ) (Table 5).

After GC according to B-II, by 7 days the anastomosis was stopped in 6 of 13 patients (46.2%) in the comparison group and 9 (81.8%) of 11 patients in the main group.

In the period of 7-10 days, regression of anastomosis was verified in 6 (46.2%) and 2 (18.2%) patients, and in periods of more than 10 days in 1 (7.7%) patient in the comparison group ( $\chi^2 = 3.457$ ;  $df=2$ ;  $p=0.178$ ; the difference was not significant).

After excision of the ulcer, by 7 days the anastomosis was relieved in 20 of 34 patients (58.8%) in the comparison group and 26 (92.9%) of 28 patients in the main group.

In the period of 7-10 days, regression of anastomosis was verified in 12 (35.3%) and 2 (7.1%) patients, and in periods of more than 10 days in 2 (5.9%) patients in the comparison group ( $\chi^2 = 9.433$ ;  $df=2$ ;  $p=0.009$ ).

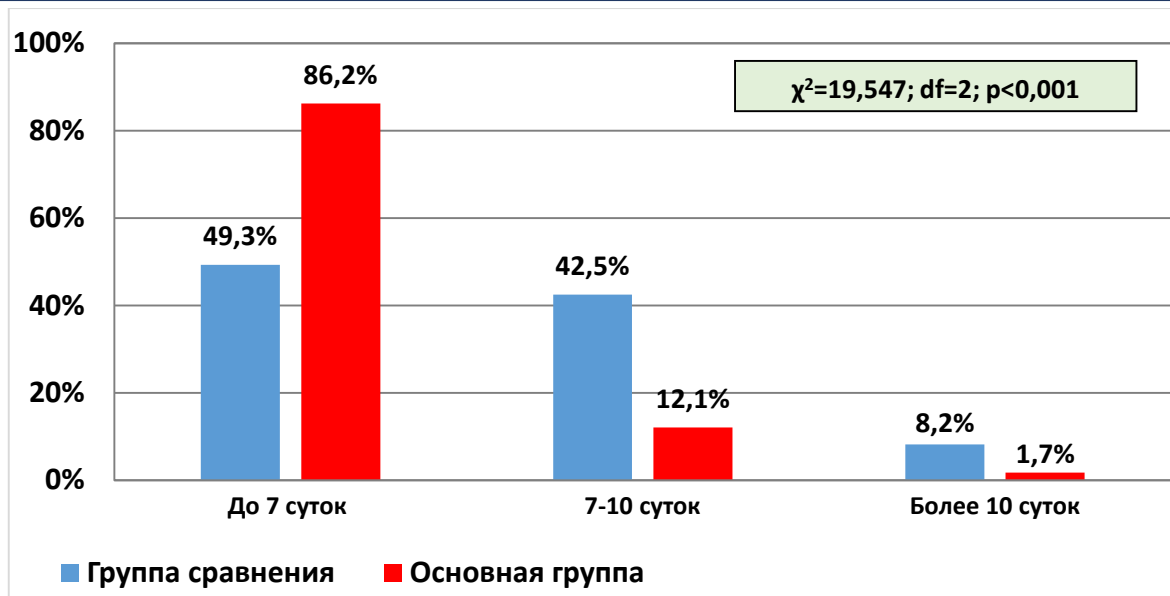
*Table 5*

*Distribution of patients according to the timing of relief of clinical manifestations of anastomosis*

Evacuation time	Comparison group		Main group	
	Abs	%	abs.	%
<b>RJ according to B-I</b>				
Up to 7 days	10	38,5%	15	78,9%
7-10 days	13	50,0%	3	15,8%
More than 10 days	3	11,5%	1	5,3%
<b>Total</b>	<b>26</b>	<b>100,0%</b>	<b>19</b>	<b>100,0%</b>
$\chi^2$	7,339; df=2; p=0,026			
<b>RJ according to B-II</b>				
Up to 7 days	6	46,2%	9	81,8%
7-10 days	6	46,2%	2	18,2%
More than 10 days	1	7,7%	0	0,0%
<b>Total</b>	<b>13</b>	<b>100,0%</b>	<b>11</b>	<b>100,0%</b>
$\chi^2$	3,457; df=2; p=0,178			
<b>Ulcer excision</b>				
Up to 7 days	20	58,8%	26	92,9%
7-10 days	12	35,3%	2	7,1%
More than 10 days	2	5,9%	0	0,0%
<b>Total</b>	<b>34</b>	<b>100,0%</b>	<b>28</b>	<b>100,0%</b>
$\chi^2$	9,433; df=2; p=0,009			

In general, for all operations, within 7 days after the interventions, the clinical manifestations of anastomosis were relieved in 36 of 73 patients (49.3%) in the comparison group and 50 (86.2%) of 58 patients in the main group.

In the period of 7-10 days, regression of anastomosis was verified in 31 (42.5%) and 7 (12.1%) patients, and in periods of more than 10 days in 6 (8.2%) and 1 (1.7%) patient in the main group ( $\chi^2= 19.547$ ;  $df=2$ ;  $p<0.001$ ) (Fig. 3).



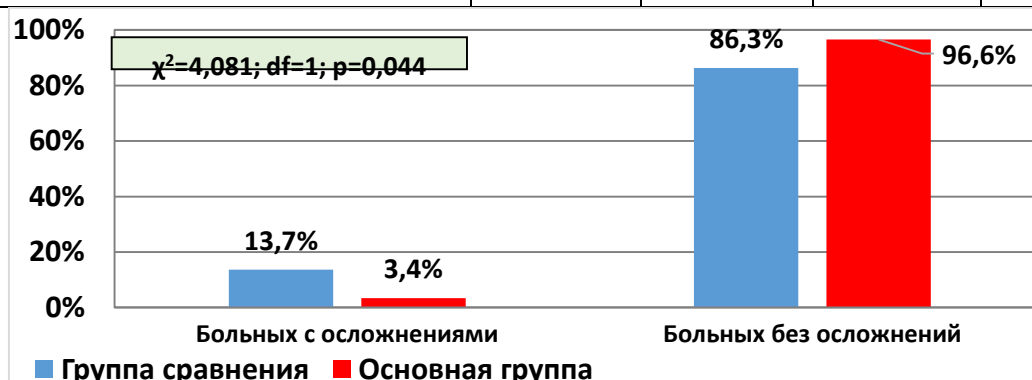
**Fig. 3. Summary distribution of patients according to the timing of relief of clinical manifestations of anastomosis**

In the structure of postoperative complications, in addition to erosive anastomosis in 9 (12.3%) patients in the comparison group and 2 (3.4%) patients in the main group, leakage of anastomotic sutures after GC using the first Billroth method developed in 1 (1.4%) patient in the comparison group. The phenomena of gastrostasis were generally observed in 3 (4.1%) and 1 (1.7%) patients (Table 6).

**Table 6**

**Frequency of various early postoperative complications in the compared groups**

Complications	Comparison Group		Main Group	
	abs.	%	abs.	%
Leakage of anastomotic sutures	1	1,4%	0	0,0%
Anastomosis (erosive process)	9	12,3%	2	3,4%
Gastrostasis	3	4,1%	1	1,7%
Bleeding	1	1,4%	0	0,0%
Acute pancreatitis	1	1,4%	0	0,0%



**Fig. 4. Cumulative incidence of complications after surgery**

Bleeding and acute pancreatitis were noted in 1 case (1.4%) in the comparison group. In general, in the comparison group there were 10 (13.7%) patients with various complications and 63 (86.3%) were discharged without complications. In the main group there were 2 (3.4%) patients with complications and 56 (96.6%) without complications ( $\chi^2=4.081$ ;  $df=1$ ;  $p=0.044$ ) (Fig. 4).

It should be noted that in the control group there were 2 (2.7%) with severe complications. In the case of suture failure, repeated intervention was required with suturing of the area of suture failure, and in the case of bleeding due to anastomosis, endoscopic hemostasis was required.

According to clinical characteristics, the beginning of regression of anastomosis manifestations in the comparison group after GC according to B-I was noted on  $8.2 \pm 2.6$  days after surgery, in the main group on  $6.3 \pm 1.3$  days ( $t=2.74$ ;  $p < 0.05$ ). After GC according to B-II, this indicator was  $8.1 \pm 2.2$  versus  $6.1 \pm 1.3$  days ( $t=2.36$ ;  $p < 0.05$ ), after excision  $7.5 \pm 2.2$  versus  $6.1 \pm 1.3$  days ( $t=3.11$ ;  $p < 0.05$ ) (Table 7).

The duration of the entire hospital period after GC according to B-I was  $13.0 \pm 3.0$  days in the comparison group, in the main group  $10.5 \pm 1.9$  days ( $t=3.45$ ;  $p < 0.05$ ). After GC according to B-II, this indicator was  $12.8 \pm 2.1$  versus  $10.6 \pm 1.5$  days ( $t=2.90$ ;  $p < 0.05$ ), after excision of the ulcer –  $11.6 \pm 2.2$  versus  $9.9 \pm 1.5$  days ( $t=3.71$ ;  $p < 0.05$ ).

**Table 7**

***Duration of various stages of the hospital period (days)***

Period	Comparison group			Main group			T	
	n	M	$\delta$	n	M	$\Delta$	Value	P
<b>Beginning of regression of anastomosis manifestations (day p.o.)</b>								
<b>RJ according to B-I</b>	26	8,19	2,56	19	6,32	2,03	- 2,74	<0,05
<b>RJ according to B-II</b>	13	8,08	2,22	11	6,36	1,29	- 2,36	<0,05
<b>Excision of ulcer</b>	34	7,47	2,22	28	6,07	1,27	- 3,11	<0,05
<b>Duration of hospital p/o period (day p/o)</b>								
<b>RJ according to B-I</b>	26	11,04	2,54	19	8,53	1,58	- 4,08	<0,05
<b>RJ according to B-II</b>	13	10,92	2,36	11	8,82	1,08	- 2,88	<0,05
<b>Excision of ulcer</b>	34	10,29	2,29	28	8,64	1,45	- 3,45	<0,05
<b>Duration of hospital stay (days per day)</b>								
<b>RJ according to B-I</b>	26	1,92	0,80	19	1,95	0,71	0,11	>0,05
<b>RJ according to B-II</b>	13	1,85	0,80	11	1,82	0,75	- 0,09	>0,05
<b>Excision of ulcer</b>	34	1,32	0,53	28	1,21	0,42	- 0,90	>0,05



<b>Duration of the entire hospital period (daily days)</b>								
<b>RJ according to B-I</b>	26	12,96	2,96	19	10,47	1,87	- 3,45	<0,05
<b>RJ according to B-II</b>	13	12,77	2,09	11	10,64	1,50	- 2,90	<0,05
<b>Excision of ulcer</b>	34	11,62	2,23	28	9,86	1,48	- 3,71	<0,05

In general, for all interventions, the duration of the period before surgery in both groups was  $1.6 \pm 0.7$  days. The beginning of regression of anastomosis manifestations in the comparison group was noted on  $7.8 \pm 2.4$  days after surgery, in the main group on  $6.2 \pm 1.6$  days ( $t=4.64$ ;  $p<0.05$ ). The duration of the postoperative period was  $10.63 \pm 2.4$  versus  $8.9 \pm 1.7$  days ( $t=4.88$ ;  $p<0.05$ ). The duration of the entire hospital period was  $12.3 \pm 2.5$  days in the comparison group, in the main group  $10.5 \pm 1.9$  days ( $t=4.64$ ;  $p<0.05$ ) (Table 8).

**Table 8**

**Cumulative duration of various stages of the hospital period**

Periods	Comparison Group		Main Group		t	
	M	$\delta$	M	$\delta$	Value	P
Beginning of regression of anastomosis manifestations (day p.o.)	7,81	2,35	6,22	1,55	- 4,64	<0,05
Duration of hospital p/o period (day p/o)	10,63	2,39	8,88	1,71	- 4,88	<0,05
Duration of hospital stay (days per day)	1,63	0,74	1,57	0,68	- 0,49	<0,05
Duration of the entire hospital period (daily days)	12,26	2,53	10,45	1,94	- 4,64	<0,05

**Conclusion.** Thus, the inclusion of the proposed laser technique in a comprehensive program of early rehabilitation after surgical treatment of complicated duodenal ulcer made it possible to reduce the incidence of clinically significant anastomosis from 8.2% (in 6 patients in the comparison group) to 1.7% (in 1 patient in the main group). group) and in general specific complications that required additional measures from 13.7% (in 10 patients) to 3.4% (in 2 patients;  $\chi^2 = 4.081$ ;  $df = 1$ ;  $p = 0.044$ ), increase the proportion of the physiological course of the postoperative period already by 7 days from 49.3% (36 patients) to 86.2% (50 patients;  $\chi^2=19.547$ ;  $df=2$ ;  $p<0.001$ ), and also reduce the duration of the hospital period from  $12.3 \pm 2, 5$  to  $10.5 \pm 2.0$  days ( $t=4.64$ ;  $p<0.05$ ).

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