

## Research Article

# The Impact of Surgeon Experience, Surgical Techniques and Types of Suture Materials on the Occurrence of Dehiscence after Laparotomy

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## Abstract

The finish line of this study was to determine the influence of surgeon experience, surgical techniques and types of suture materials on the occurrence of dehiscence laparotomy. The choice of surgical materials, surgical techniques of sewing, and a choice of incision and assessment of tension on the wound edges are variables that depend on the subjective choice of surgeon, based on his experience (years of surgical experience), knowledge and ability.

The prospective study included 964 operated patients in the Clinic for General Surgery in Nis from January 1, 2018 to March 30, 2019. The investigated patients were divided into two groups: a group of patients who had complications-dehiscence of laparotomy with 40 patients and a control group (patients who did not have dehiscence of laparotomy) with 924 patients.

Surgeons who operated patients with dehiscence laparotomy were significantly younger (they had surgical experience smaller from 20 years) than surgeons who operated patients without dehiscence laparotomy (they had surgical experience longer from 20 years). In our study was a statistically highly significant correlation between laparotomy dehiscence and continuous seam closure. There was a statistically very significant association between dehiscence laparotomy and used nylon like a suture material. Good preoperative preparation reduces postoperative wound complications.

**Keywords:** Dehiscence of laparotomy; Surgeon experience; Surgical technique; Suture materials; Wound; Reintervention

## Introduction

Dehiscence of laparotomy is a disorder of wound healing. There is dehiscence or disorder of the superficial layers of the wound (skin and subcutaneous tissue) while the deep layers healing in a satisfactory manner and the release or dehiscence of all layers of one part or the entire operative wound. Dehiscence is one of the most significant complications of laparotomy with partial or complete opening or tearing laparotomy wound sewinged, with the evisceration of the abdominal organs, which requires urgent reintervention. Although it can start at any time, the dehiscence of the laparotomy wound usually begins on the 7<sup>th</sup> postoperative day. It occurs in 0.5% to 3% of operated patients [1]. Dehiscence of laparotomy is accompanied by high morbidity and mortality that ranges up to 40%.

The healing process of the wound is an extremely complex and dynamic set of cellular, biochemical and immunological processes. General condition of the patient, nutritional status, the presence of chronic diseases and malignant disease, immunocompromising conditions, age, obesity, wound infection and the extent of surgical operation are well-known factors that influence the process of healing

of laparotomy, but for most of these factors, the surgeon has very little influence or overall can not affect [2-4].

A type of surgical material, surgical sewing techniques, as well as the selection of an operative cut and evaluation of tension on the edges are variables that depend on the subjective selection of a surgeon based on his experience (years of surgical experience), knowledge and skill. These subjective factors-the factors dependent on the surgeon, are a constant subject of the study of numerous clinical and experimental studies. So far, the ideal way of closing the abdominal wall has not yet been defined. Surgical tradition and school, habits, simplicity of procedure and current surgical trends determine the way of closure of laparotomy, rather than scientifically proven in a large number of patients in the study [5,6].

The aponeurotic-muscular layer of the abdominal wall can in principle be sewn with single or continuous seams, non absorbable or absorbable suture material. The classical division of surgical material divides it into two groups: absorbable (ketgut) and non absorbable material (flax, silk, wire). Non absorbable suture material has far greater mechanical strength and tensional power, which is necessary to support facial healing to establish complete integrity of the anterior abdominal wall (up to 12 months). The disadvantages of this group of suture materials are primarily in the induction of the reaction by type of foreign body, with increased incidence of sinus, fistula and granuloma, as well as difficult manipulation (binding of nodes). Consequently, the standard way of closing laparotomy by the middle of the seventies gave priority to seams with non absorbable suture material [7]. The development of new technologies has introduced into the surgical practice a new type of surgical thread - a slow-absorbing material that combines the benefits of both groups of suture materials, that is, induces a far weaker immune response while retaining good tensional characteristics up to the time of definitive healing of the

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abdominal wall. A significant subjective factor, from which the process of healing of laparotomy depends, is the applied surgical technique in closing the abdominal wall, i.e. the choice of single or extended surgical seam [8]. The advantages of individual seams are as follows: the area of ischemia of the operative wound caused by the sealing of the seams is far less than in the case of continuous sewing, the release of one seam will not lead to dehiscence of the entire laparotomy as in the case of delaying the extension seam. An extended seam is more economical, faster, and in the event of an increase in tension at the edges of the operative wound, an equal sealing of the seam (spring effect) results in an increase in its efficiency in adapting the edges of the wound. Numerous retrospective and prospective clinical studies that compared the results of applied surgical techniques and suture materials have quite opposite results. Most authors in large clinical series do not find statistically significant differences in the process of healing of laparotomy after analyzing surgical technique and applied suture material [9,10-14]. However, in a series of 1491 patients, statistically demonstrates the advantage of non absorbable suture material, but without significant differences in relation to the applied surgical technique [15]. Similar results refer to Lewis [16] and Bucknall [17].

Biochemical analysis involves the quantitative determination of the concentration of collagen in the tissues, on the basis of which level the efficacy of the fibroplasia process can be determined, which, in case of healing of the aponeurotic structures of the abdominal wall, plays a crucial role [3,18]. The biomechanical properties of the wound, i.e. the measurement of the tensional strength of the early samples of the anterior abdominal wall on which the sutures are made, is a precise parameter that speaks of the definitive goal of the surgical abdominal closure, that is, of the integrity of the abdominal wall, which is at a satisfactory level after 15 days of surgery, and the definite level reaches from the 4<sup>th</sup> month to the year after surgery [3,5,18-20].

## Methods

The research was organized by type of prospective study that had analyzed the following data as risk factors: the presence of surgeon experience, surgical techniques (continuous and individual seam closure) and types of suture materials (nylon and polypropylene) on the occurrence of dehiscence of laparotomy of 964 operated patients at the Clinic for General Surgery in Nis from January 1, 2018 to March 30, 2019. Investigated patients were divided into two groups: a group of patients who had complications-dehiscence of laparotomy with 40 patients and a control group (patients who did not have dehiscence of laparotomy) with 924 patients.

Statistical sample size is determined by the statistical methodology to meet the basic principle of representativeness. Was used to determine the optimal nomogram sample.

Out of 964 respondents, 561 are male and 403 are female.

In this paper, results are presented graphically. The statistical analysis using the methods of descriptive statistics (mean, standard deviation), parametric tests (Student's t-test) and nonparametric Chi-square test. For statistical analysis we used the software package SPSS 14.0, and the imaging table and a Microsoft Office Word 2003.

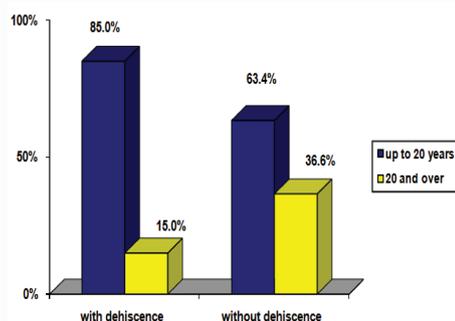
## Results

Dehiscence of laparotomy occurred in 4.1% of respondents or 40 patients out of a total of 964 subjects. In our study from 40 patients with dehiscence of laparotomy, 26 patients were a male gender and 14 females.

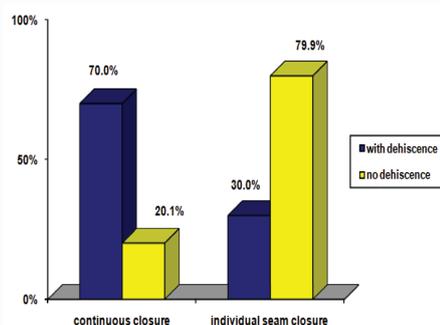
Of the total 40 patients with dehiscence of laparotomy, 34 or 85% patients operated younger surgeons (they had surgical experience smaller from 20 years) and only 6 patients or 15% patients with dehiscence of laparotomy operated older surgeons (they had surgical experience longer from 20 years). There is a statistically significant relationship between dehiscence of laparotomy and surgeon experience ( $\chi^2=18.625$ ;  $p<0.05$ ). Of the patients who did not have a dehiscence of laparotomy 63.4% or 586 patients operated surgeons with surgical experience smaller from 20 years and 36.6% or 338 patients without dehiscence of laparotomy operated surgeons with surgical experience longer from 20 years (Figure 1).

There is statistically very significant correlation between dehiscence of laparotomy and continuous closure of laparotomy ( $\chi^2=68.372$ ;  $p<0.01$ ). In group of patients with dehiscence of laparotomy in 70% patients or in 28 patients abdominal wall was closed with individual seams and in 12 patients or in 30% of them abdominal wall was closed with continuous closure. In 20.1% or in 186 patients without dehiscence of laparotomy abdominal wall was closed with individual seams and in 79.9% or in 738 patients who did not have a dehiscence of laparotomy abdominal wall was closed with continuous closure (Figure 2).

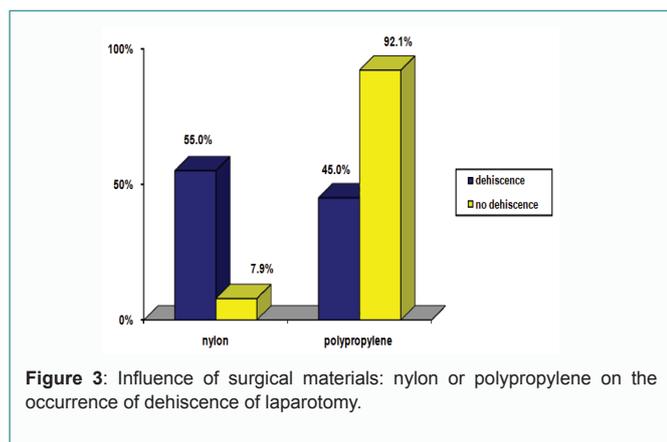
There is statistically very significant correlation between dehiscence of laparotomy and nylon like a suture material ( $\chi^2=64.796$ ;  $p<0.01$ ). In 22 patients or in 55% of them with dehiscence of laparotomy and in 73 patients without dehiscence of laparotomy used nylon. In 18 or in 45% of patients with dehiscence of laparotomy and in 851 or in 92.1% of patients without dehiscence of laparotomy used polypropylene like a suture material (Figure 3).



**Figure 1:** Occurrence of dehiscence of laparotomy in relation to surgeon experience, surgeons with experience up to 20 years and surgeons with experience 20 years and over.



**Figure 2:** Effect of surgical techniques of sewing, continuous closure or individual seam closure on the occurrence of dehiscence of laparotomy.



## Discussion

Despite great shifts in the understanding of the physiology of the wound healing process, surgical technique and the application of modern technologies and materials in surgery, the percentage of difficulty healing of laparotomy is still high. Dehiscence of laparotomy occurs in up to 3% of patients. In a retrospective study by Rodriguez-Hermosa et al. [21] from Spain, in 57 patients or 0.45% of the total 12,622 patients who had undergone laparotomy occurred in dehiscence of laparotomy. In that study were 45 male patients and 12 female patients. The Cracow study Konig et al. [22] with dehiscence of laparotomy occurred in 56 patients or 2.9% of their patients. In India's study from Rajindra Hospital in Patiala male predominance (37/50) was observed, with ratio of male to female being 2.84:1 [23]. The results of our study show that dehiscence of laparotomy occurred in 4.1% of patients or 40 patients of the total of 964 respondents. In relation with gender from 40 patients with dehiscence of laparotomy, 26 patients were a male gender and 14 females. Our study does not show a statistically significant difference between genders.

Preoperative preparation is an important stage in the treatment of surgical patients and the adequacy of preoperative depends on result of the operation, the incidence of complications and mortality of patients. It is necessary that all the general condition of the patients preoperatively stabilized and carry a minimum of anesthesia and surgical preoperative whenever the patient's condition allows [24].

The suture material, the surgical technique, the choice of laparotomy and the tension on the seams are parameters that depend on the surgeon. These subjective factors-factors dependent on the surgeon, are the subject of discussion and examination of numerous clinical and experimental studies. However, the ideal way of closing the abdominal wall is still not defined.

Clinical studies that compare the results of the closure of the abdominal wall compared to the choice of laprotomy, suture material and sewing techniques, address only some of the parameters that indicate the effectiveness of healing of the operative wound. These studies can only record clinically evident complications such as infection, dehiscence, and hernia [3,25-33]. One of the main objections to clinical studies from an earlier period is the use of materials that are completely abandoned today, such as silk, linen and Dexon.

Patients we examined and who reported dehiscence of laparotomy operated surgeons with statistically significant shorter surgical experience compared to surgeons who operated patients without dehiscence of laparotomy ( $\chi^2=18.625$ ;  $p<0.05$ ). The average length of

the surgical experience of the surgeons who operated patients with laparotomy dehiscence was 13.6 years, and the average length of the surgical experience of surgeons who operated patients who did not report dehiscence of laparotomy was 20.8 years. If the patients who have been analyzed in our study are divided into two groups (those operated by surgeons with up to 20 years of surgical experience and those who have operated surgeons with over 20 years of surgical experience), we also get the highest number of patients with dehiscence was operated by surgeons with up to 20 years of surgical experience, 34 or 85%, while only 6 or 15% of patients who reported dehiscence of laparotomy, operated surgeons with and above 20 years of surgical experience. In the study by Irwin et al. [34], exist a statistically significant relationship between the dehiscence of laparotomy and operations by young surgeons who are on the training. Another, very important subjective factor, on which the process of healing of laparotomy depends, is the applied surgical technique in closing the abdominal wall, i.e. the choice of single or extended surgical seam [8].

According to Rodeheaver et al. [35], during the early stage of healing of the wound, before achieving mechanical strength, the life and health of the patient depend on the seams that closed the abdominal wall.

In the study of Richards et al. [36], 2.0% (5/244) of patients in whom sewing technique was applied by the sewing machine for closing laparotomy showed dehiscence, while using the sewing technique with a single seam closure, dehiscence occurred in 0.9% (2/229) patients. In this study there was no statistically significant relationship between dehiscence of laparotomy and surgical sewing technique with prolonged seam or individual seam.

In our study a statistically very significant relationship was established between the dehiscence of laparotomy and the surgical sewing technique with continuous seams ( $\chi=68.372$ ;  $p<0.01$ ). In people using sewing techniques with an extension seam for closing laparotomy, dehiscence of laparotomy is statistically significantly higher in relation to patients in whom sewing techniques are used by individual sewing wound seams. Dehiscence occurred in 28 or 70% of patients in whom the sewing technique was applied by the continuous seam for closing laparotomy, while dehiscence occurred in 12 patients or 30% with the use of a sewing technique with a single wound closure seam.

By analyzing the results of 16 prospective clinical studies published by 2010, it has been shown that:

1. An extended seam of non-corrosive material has the smallest percentage of postoperative hernias, which agrees with Hodgson's and associates [5];
2. In most cases this claim has no statistical significance [14,25,37-46];
3. The statistical confirmation of the superiority of the prolonged non-resorptive seam is found in only 3 controlled studies [16-18].

In groups of patients after the closure of the abdominal wall with individual seams, the percentage of hernias and dehiscences is the highest in the case of using non absorbable suture material ( $p>0.05$ ). The percentage of wound infection is somewhat higher in the groups of patients using resorptive material, but without a statistically significant difference [44-55]. In groups of patients with prolonged seams, the percentage of hernias is higher in the case of using absorbable suture material, while infections and dehiscences are more

frequent after the closure of the abdominal wall with non absorbable material [56]. Accordingly, in the case of a prolonged seam, the advantage is given to the non absorbable suture material, while the absorbable suture material is superior in the case of individual seams recommended for the wounds in which the infection is expected [56].

In our study is statistically very significant association between dehiscence of laparotomy and nylon application as wound closure material ( $\chi^2=64.796$ ;  $p<0.01$ ). Dehiscence of laparotomy is statistically significantly more prevalent in patients using nylon as a sewing material for closing laparotomy compared to patients in whom polypropylene is used as a wound closure material. In patients using nylon as a wound closure material, there were 22 patients with dehiscence or 55% and 73 patients without dehiscence of laparotomy or 7.9%. In patients in whom polypropylene was used as a sewing material for closing the wound with dehiscence, there were 18 patients or 45% of patients, i.e. 851 patients without dehiscence of laparotomy or 92.1%.

In the study of Israel's and Jonsson [10], the dehiscence of laparotomy occurred in 6 patients or 0.6% of the total of 813 patients in whom nylon and polydioxanone were used as sewing materials for closing laparotomy. In this study was no statistically significant association between dehiscence of laparotomy and the use of nylon or polydioxanone as a wound closure material.

Both studies confirm same conclusions.

Comparing the results of world studies with the results of our observational prospective study, we conclude that our results are not worse than the results of the world's healthcare institutions.

## Conclusion

Dehiscence of laparotomy occurs in less than 5% of patients. In operated patients by surgeons who had surgical experience smaller from 20 years dehiscence of laparotomy is a common occurrence. In our study in patients whose abdominal wall was closed with continuous seams and when surgeons used nylon like a suture material dehiscence of laparotomy occurrence very common.

By analyzing risk factors, a surgeon can identify high-risk patients and take all measures of prophylaxis at his disposal.

If is possibly high-risk patients is the best to operate surgeons with longer surgical experience from 20 years.

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