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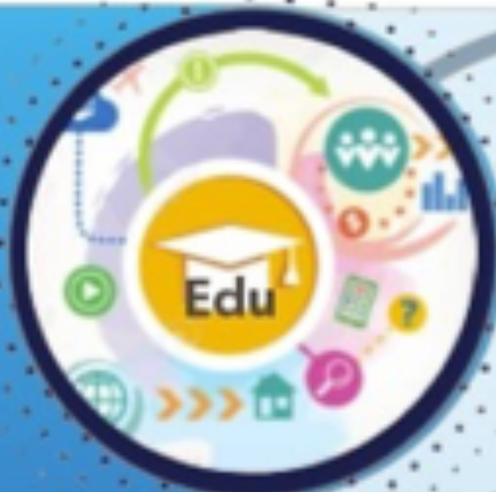

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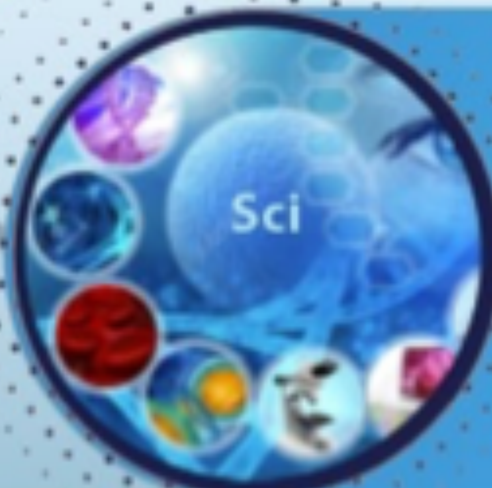

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The Role Stereometry In Medicine

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ABSTRACT

The review summarizes literature data on the use of stereometry in medicine. The results obtained after using stereometry are also analyzed and discussed. It was concluded that the optimal placement of instrumental trocars is the key to success in performing surgical interventions.

Key words: stereometry, trocar, laparoscopic instruments.

INTRODUCTION

One of the important conditions for effective surgical intervention is the justification of optimal surgical access [1, 2].

As is known, the choice of access in surgery is determined by its topographical advantages, operational characteristics that determine the effectiveness of manipulations and, as a result, the immediate and long-term results of treatment of patients [7].

For the first time, standardization of operational access assessment criteria was carried out by A. Y. Sozon-Yaroshevichin 1954. [7], who proposed basic terms that allow evaluating access for open surgical interventions, combining maximum accessibility with minimal trauma.

However, these criteria in their classical form could not be applied to endoscopic interventions and required further development. Currently, a number of studies have been carried out on the development of criteria for evaluating surgical approaches in video endosurgery, and the creation of optimal endoscopic access. Thus, A. A. Bondarev et al. proposed objective criteria for evaluating surgical approaches in endosurgery on the example of laparoscopic cholecystectomy, having modernized the criteria of A. Yu. Sozon-Yaroshevich's surgical approaches used in open surgery [1].

O. G. Ustinov et al. In our work, we evaluated various options for possible mutual positioning of manipulation instruments in an artificially created cavity and proposed optimal geometric parameters for the mutual positioning of optics and instruments in the surgical area [7]. A. N. Tarasov developed a set of variables necessary for evaluating the operating space, clarified the criteria for evaluating endosurgical accesses, and proposed principles for forming optimal endosurgical access [6].

The concepts typical for traditional operations change somewhat when using endovideosurgical (EVC) technology. In this case, the possibility of performing an operative technique directly depends on the insertion points of the laparoscope and manipulators, respectively, on the viewing angle and angles formed during operation, both between the tools themselves and between the tool and the working surface[1-3, 5].

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THE CONCEPT OF STEREOMETRY

Stereometry is a branch of geometry that studies spatial shapes and their properties. This area of mathematics has a wide range of applications in various scientific, technical, and practical disciplines, such as architecture, engineering, astronomy, geography, and many others.

Stereometry helps to develop spatial thinking and imagination, which is extremely important in the professional activities of architects and designers, in the field of engineering, astronomy, and is also widely used in geography and cartography, where it helps to create accurate three-dimensional models of landscapes, mountain systems, and other natural objects. Thus, stereometry as a branch of geometry is of great practical importance, providing an effective solution to many applied problems in various fields of science and technology.

Stereometric methods are also used in medicine. The use of stereometry allows you to create three-dimensional models of organs and tissues of the human body, which is used in diagnostics, planning surgical interventions and training medical specialists.

In general, stereometry is a powerful tool in the hands of specialists in various fields, providing opportunities for analyzing, modeling and visualizing spatial objects and phenomena with a high degree of accuracy and realism.

Qualitative assessment of the position of the organ in three-dimensional space is carried out according to the following criteria:

1. Holotopy-determining the position of an object in relation to the human body as a whole.

2. Skeletotopy - using the most accessible bone landmarks as reference points to describe the topography of an anatomical object.

3. Syntopy-determining the position of the object to neighboring anatomical elements (blood vessels, muscles, fascia).

When making a qualitative assessment of the spatial position of the organ, the following conditions must be met:

1. Considering a person in a "standard" position:

* standing with closed heels and spread feet;

* The arms are lowered along the torso and the palms are facing forward.

2. Using strictly defined directions to describe coordinates:

* "top to bottom" - from head to heels;

* "front to back" - from the sternum to the spine;

* in the sagittal plane "outwards "(laterally), " inwards "(medially).

These directions remain the same when changing the position of the human body in space. In particular, when a person is in a horizontal position in a dental chair or on an operating table, the "top - down" direction corresponds to the axis drawn from the head to the heels. To quantify spatial relationships, a technique similar to a geographical coordinate system with parallels and meridians is used.

Individual regions are taken as an "ellipsoid of rotation", in which the central axis is formed by intersecting sagittal and frontal planes.

• For the head, neck and torso, the vertical axis is drawn from the crown to the center of the perineum.

* The median sagittal plane drawn through the vertical axis forms the initial ("zero") meridian, similar to the Greenwich meridian.

• Similarly, a frontal plane is drawn through the axis of rotation. The combination of the frontal and sagittal planes makes it possible to distinguish the anterior and posterior "quadrants", supplemented by meridians drawn every 30

Within each region, the resulting geometric structure is supplemented by a horizontal ("equatorial") plane, which is drawn as follows::

* in the head area through the lower edge of the eye socket and the external ear canal;

* in the neck area - at the level of the cricoid cartilage.

The geometric parameters used for the study are not generally accepted, and we integrated them as a result of analyzing the literature devoted to the criteria for optimal laparoscopic access, so we describe them [1, 8, 9]. Operating action plane (SUB) - a plane perpendicular to the surgeon's position near the operating table and drawn through the operation object. Instrumental vector (IV) - the direction of the instrument and the distance between the points of its insertion into the cavity and its intersection with another instrumental vector or plane of surgical action. Instrument axis (OI) - an axis running along the center of the instrument [3], drawn from the point of its insertion on the body surface to the object of surgical intervention [1]. Wound depth (GR) - the distance from the cavity wall to the intersection with the surgical object, measured along the instrumental axis. The depth (wound) of the surgical action of the instrument (GDI) located in the trocar characterizes the point of maximum removal, which preserves the accessibility of the intervention object (the distance between the insertion site of the trocar sleeve and the operating field) [1]. Tool Plane Tilt angle (UNI) - the angle formed by the operational action plane and the tool plane. Operational action angle (UOD) - determine between the axes of the main and auxiliary tools directed to the operation object [1] (the angle between the tools). The lifting angle (UPOD) is determined by the slope of the OI relative to the intervention plane (between the tools and the horizontal plane) [1]. The viewing angle is formed by the angle of inclination of the eyepiece to the plane of the intervention or the operating table [8]. "Freedom of manoeuvre in the wound" - the ability to move tools in and out of the free cavity [1].

Laparoscopic surgery provides patients with a less painful operation but is more demanding for the surgeon. Increased technological complexity and sometimes poorly adapted equipment have led to increased complaints from surgeons about fatigue and discomfort during laparoscopic operations. Ergonomic integration and a suitable environment in the laparoscopic operating room are essential for improving the efficiency, safety and comfort of the operating team. Understanding ergonomics can not only make a surgeon's life more comfortable in the operating room, but also reduce the physical strain on the surgeon.

In 1901, when Kelling G.[22] first used an imaging device to study the peritoneum of a dog, this was an important milestone in the history of surgery. However, it took another eight decades for advanced laparoscopic techniques to be introduced, the Mouret P. [25] first performed a successful laparoscopic cholecystectomy in 1987.

After all the achievements, there are also disadvantages. Laparoscopy is no exception. The disadvantages are mostly twofold. In the first scenario, the surgeon experiences the negative consequences of the operation, and in the second, the patient becomes the victim. At first glance, this statement may seem superficial and unreflective, but it answers a much deeper question. There have been numerous reports of carpal tunnel syndrome, visual strain, and cervical spondylosis among unsuspecting surgeons performing numerous laparoscopic procedures in high-volume instrument centers [29].

It was found that in the first decade after the introduction of laparoscopy, patients also experienced many inconveniences associated with increased postoperative pain at the port sites and, in some cases, due to other complications of the procedure. Mistakes that lead to such poor results seem to be completely avoided by simply applying an understanding of the physics and functioning of the entire event.

The operating room environment has traditionally been inconvenient for the user, but recently it has become even more complicated due to the addition of complex machines and complex interfaces between the patient and the surgeon[11, 13].

ERGONOMICS

The term "ergonomics" comes from the Greek words "ergon", meaning work, and" nomos", meaning natural laws or device. Ergonomics is "the scientific study of people at work in terms of equipment design, workplace layout, work environment, safety, productivity, and training." Ergonomics is based on anatomy, physiology, psychology and technology combined in a systematic approach. Simply put, it is the science of how best to adapt the employee to their work or make the conditions and environment favorable for the laparoscopic surgeon. This term was officially defined in 1949 and has brought benefits and safety to many areas of human activity [23]. The importance of ergonomics in laparoscopy cannot be overemphasized. Research has shown that proper ergonomics can reduce the time required for suturing. [19, 20] Chronic pressure-related pain in surgeons is relieved by using ergonomically designed products [30].

THE HOTHORN EFFECT

It is well known that anyone performs their skills better and with more care when they know that they are being watched and evaluated. This tends to skew the results towards more positive grades than would otherwise be possible if the student were unaware of the assessment being conducted. This represents the "Hawthorne effect", which has been recognized as applicable to most scientific assessments of human function, and therefore full knowledge of this aspect is necessary for ergonomic purposes [17]. Laparoscopy, which is a surgical skill performed by a person's dexterity and coordination, can be evaluated with an ergonomic scale. Such assessments, although they must be conducted in secret to avoid bias caused by the Hothorn effect, will raise many ethical and analytical issues.

ERGONOMIC PROBLEMS DURING LAPAROSCOPY

First, it is useful to identify potential problem areas in the practice of minimal access surgery that create unique ergonomic difficulties that non-laparoscopic surgeons do not face.

The differences between open and laparoscopic surgery are as follows. Open surgery has a high degree of freedom, and surgeons work according to the visual axis. There is three-dimensional direct vision and direct haptic feedback. During laparoscopic surgery, two-dimensional vision and, to some extent, loss of depth perception are observed. There is a support effect with increased tremor. There are only 4 degrees of freedom. The main limitation is that the view is not under the control of the surgeon.

The main factor not related to skills that affects the surgeon's effectiveness is the decoupling of the visual and motor axes. There is also a loss of tactile feedback due to the replacement of instruments with the surgeon's hands. Visual orientation changes with loss of depth perception due to indirect visual impact, as well as with loss of peripheral vision caused by the limited range of vision offered. The laparoscopic surgeon also assumes a relatively static posture during most of the procedure, which ergonomically reduces efficiency.

One of the most significant cognitive tasks for a general surgeon in his transformation into a laparoscopic surgeon is to overcome the spatial separation of the visual axis and the axis of the physical aspect of the procedure. The surgeon does not have the ability to simultaneously look directly at the instruments or his hands, as well as at the field of surgery. It will have to learn to adapt to the difficulties of combining two functions in the same channel approach in order to deftly manipulate tissues without direct contact. Studies have shown that working in separate coordinate systems reduces productivity, which leads to a higher level of errors in the procedure [31].

By learning the skills associated with open surgical procedures, we residents learn to "see" not only with our eyes, but also with our hands. We train our hands to do this double work, trying to reach the level of dexterity required for competence. This represents tactile feedback, which is clearly lacking in the transition from open procedures to laparoscopic operations. Long grippers moved through trocars replace the surgeon's hands, which definitely reduces the efficiency and increases the dissection time[27].

Performing complex laparoscopic operations requires great concentration and skill. Thus, it was observed that the operating surgeon takes a more static position during laparoscopic procedures compared to the previous open access. These static postures have been shown to be more disabling and harmful than dynamic postures, since muscles and tendons accumulate lactic acid and toxins when they are held in the same positions for a long time [10,12, 21, 26].

Sensory ergonomics (manipulation and visualization) increase accuracy, agility, and confidence, while physical ergonomics provide comfort for the surgeon. Together, these two ergonomic elements increase safety, improve results, and reduce stress [28].

GENERAL PRINCIPLES OF INTRODUCTION OF MANIPULATIVE TROCARS

Monitor position from an ergonomic point of view, the best view for laparoscopy is when the image on the monitor is at the optimal 25 degrees below or within the horizontal plane of the eye [16, 24]. According to available research, this leads to the least tension in the neck. For best results, you can use standard LCD monitors placed on a low trolley separate from the operating room equipment. It is not recommended that the surgeon should be positioned "chin up" [16]. For operations where surgeons change ports and positions, a second monitor is necessary, such as total colectomy. A second monitor for assistants reduces the strain on their necks.

The location of trocars may differ from the "standard" schemes, but the necessary conditions must be observed. Do not install trocars in the immediate vicinity of the costal arch and xiphoid process of the sternum, pelvic bones - this limits their mobility. The proximity of trocars to each other interferes with the movement of tools. The angle between the two main manipulators when they approach each other in the operating area should be as small as possible. The introduction of trocars must be visually monitored from the abdominal cavity (the location of internal organs, the presence of splices of the parietal peritoneum, the course of the largest vessels determined by diaphanoscopy are taken into account). Strictly radial installation of trocars in relation to the operated organ greatly facilitates and accelerates the operation [2].

When arranging ports, you must also adhere to certain requirements. The distance between the insertion point of the sleeves and the operating field should be approximately half the length of the tool used (about 15 cm). This allows you to avoid a large range of movements with the handle (accidental violation of sterility) or the working end (danger of uncontrolled movements in the abdominal cavity), and also balances the tool. Tools should not be placed too close to each other (at least 5 cm) and parallel, as well as close to the back. There is a simple rule in endosurgery: the distance between two active trocars is equal to half the length of the instruments used. The video monitor should be positioned across the axis of the optical tube facing the operation area. Instruments should enter the operating field in the direction of the video monitor, not away from it [5].

The shortest time for forming an intracorporeal seam and the highest quality of execution is observed when the combination of the manipulation angle (the angle between tools) of 60 degrees with the lifting angle (between tools and the horizontal plane) of about 60 degrees. In this case, it is possible to fluctuate the value of the ascent angle with an equivalent azimuth angle in the range of 45-75 degrees. If the manipulation angle increases, then the lifting angle should also increase accordingly [16].

For practical implementation of the intracorporeal suture, an isosceles triangle between the instruments is recommended as the optimal geometry. At the same time, the angle between the tools should be 45 degrees, and the lifting angle 55 degrees [5, 15].

Regardless of the spatial location of the surgeon in the operating room, the main monitor should be in line with the operating surgeon. The insertion vector of the laparoscope and other instruments is directed towards the site of manipulation [4].

K. V. Puchkov et al. (2008), developed an algorithm for calculating the optimal placement of manipulation trocars during laparoscopic operations on retroperitoneal organs. During the period 2005-2006, the Department of Urology performed 43 laparoscopic operations on retroperitoneal organs with preoperative calculation of optimal placement of manipulative trocars (based on the algorithm). The developed method for calculating the optimal port placement places allows us to model possible variants of intraoperative geometry individually for each patient before surgery and choose the most optimal variant of placement of manipulative trocars. The calculation method is simple and requires no additional equipment. Evaluating the results, the proposed algorithm for optimal placement of manipulative trocars during laparoscopic operations on retroperitoneal organs allows the correct introduction of basic endosurgical materials and instruments, and reduces the duration of the operation. Preoperative modeling of endoscopic access also reduces the number of conversions and intraoperative complications.

Based on the research of K. V. Puchkov et al. methods for determining the optimal placement of trocars during laparoscopic operations on retroperitoneal organs, A. A. Vorobyev (2018) et al. a method for determining the optimal placement of trocars during laparoscopic operations on the adrenal glands was developed. The study was conducted on the basis of computed tomography results of 42 patients with various adrenal pathology and constitutional body type. The main geometrical parameters of laparoscopic access were measured. As a result of the study, a method for determining the optimal placement of trocars during laparoscopic operations on the adrenal glands was developed, the possibility of its use was determined based on preoperative computed tomography, a comparative analysis of measurements of geometric parameters of endoscopic access under standard trocar insertion points and calculated using the developed method, which revealed the advantages of the developed method.

D. V. Moiseev (2016) et al. We evaluated the stereometric parameters of various laparoscopic approaches to the abdominal aorta. A morphometric study was performed on 8 male and female corpses of the second maturity period (35-60 years) and the elderly (61-75 years). Based on the conducted experimental study, it should be noted that the optimal laparoscopic approaches to the abdominal aorta, from the point of view of stereometric parameters, are transperitoneal post-colon access (TPOD), transperitoneal post-renal access (TPPD). Thus, when using insertion points of video optics and instruments, at which their axes form optimal angles, conditions are created for ergonomic actions of the surgeon, which is especially important for such long and precise manipulations as applying a vascular anastomosis. The duration of surgical intervention can be reduced if optimal angles of surgical action are used, and it will improve the results of surgical treatment of patients with widespread occlusal damage to the aorto-iliac segment and abdominal aortic aneurysms.

CONCLUSION

The development of criteria for optimal placement of instrumental trocars is the key to success for improving the technique of performing the intervention and the ergonomics of the surgeon's hands, as well as the accuracy of the installation of ports is one of the factors determining the success of endoscopic surgery. An insufficiently developed technique for providing endoscopic access is considered as the reason for its conversion to open access, as well as intraoperative complications.

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REFERENCES:

1. Bondarev A. A., Myasnikov A.D., Rabotskiy I. A. Criteria for evaluating surgical approaches in endosurgery // Endoscope. hir. -2003. - No. 4. - pp. 47-53.

2. Borisov A. E. Videoendoscopic interventions on the organs of the abdomen, chest and retroperitoneal space. Spb. Enterprise EFA Yanus 2002; 416.

3. Vorob'ev A. A., Tarba A. A., Mikhin I. V. Algorithms of operational accesses. 2nd ed. Saint Petersburg: ELBI-SPb Publ., 2015.

4. Ospanov O. B. Algorithm of laparoscopic access for performing bypass biliodigestive anastomoses. Endoscope. hir. 2003.

5. Puchkov K. V., Rodichenko D. S. Manual suture in endoscopic surgery. MFA Medpraktika 2004.

6. Rozin D. Minimally invasive surgery, translated from English, Moscow: Meditsina Publ., 1998, 275 p.

7. Sozon-Yaroshevich A. Yu. Anatomical and clinical justification of surgical approaches to internal organs. -L.: Medgiz, 1954. -123 p.

8. Tarasov A. N. Stereometry of endoscopic access. Endoscopic surgery. 2005;6:30-36.

9. Ustinov O. G., Zakhmatov Yu. M., Vladimirov V. G. Kriterii otsenki endoskopicheskikh podkhodov [Criteria for evaluating endoscopic approaches].

10. Ernazarov, Kh. I., & Ergashev, U. Yu. (2022). Effect of the drug "reomannisol" on wound healing in an experimental model of diabetic foot. Published by the decision of the Editorial and Publishing Council of the KSMU Ministry of Health of the Russian,52.

11. Ernazarov, Kh. I., & Ergashev, U. Yu. (2022). Elimination of endogenous intoxication using the domestic drug "reomannisol" in the experimental model of diabetic foot. Published by the decision of the Editorial and Publishing Council of KSMU, Ministry of Health of the Russian,55.

12. Berguer R, Rab GT, Abu-Ghaida H, Alarcon A, Chung J. A comparison of surgeons' posture during laparoscopic and open surgical procedures. Surg Endosc. 1997;11:139-42.

13. Curtis P, Bournas N, Magos A. Simple equipment to facilitate operative laparoscopic surgery (or how to avoid a spaghetti junction) Br J Obstet Gynaecol. 1995;102:495-7.

14. De U. Ergonomics and Laparoscopy. Indian J Surg. 2005;67:164-6.

15. Frede T., Stock C., Renner C. et al. Geometry of laparoscopic suturing and knotting techniques. J Endourol 1999; 13 (3): 191-198.

16. Hanna GB, Shimi SM, Cuschieri A. Task performance in endoscopic surgery is influenced by location of the image display. Ann Surg. 1998;227:481-4.

17. Hanson DL. Evaluation of the Hawthorne effect on physical education research. Res Q. 1967;38:723-4.

18. Hemal AK, Srinivas M, Charles AR. Ergonomic Problems Associated with laparoscopy. J Endourol. 2001;15:499-503.

19. Irsaliyevich, E. K. (2023). Impact of the drug reomannisol in the model of an experimental diabetic foot. International Journal of Medical Sciences And Clinical Research, 3(11), 65-88.

20. Joice P, Hanna GB, Cuschieri A. Ergonomic evaluation of laparoscopic bowel suturing. Am J Surg. 1998;176:373-8.

21. Kant IJ, de Jong LC, van Rijssen-Moll M, Borm PJ. A survey of static and dynamic work postures of operating room staff. Int Arch Occup Environ Health. 1992;63:423-8.

22. Kelling G. Uber oesophagoskopie, gastroskopie, koelioskopy. Munich Med J. 1901;49:21.

23. Kilbom A. Measurement and assessment of dynamic work. In: Wilson EC Jr, editor. Evaluation of human work: A practical ergonomics methodology. London: Taylor and Francis; 1990. pp. 641-61.

24. Menozzi M, von Buol A, Krueger H, Miege C. Direction of gaze and comfort: Discovering the relation for the ergonomic optimization of visual tasks. Ophthalmic Physiol Opt. 1994;14:393-9.

25. Mouret P. From the laparoscopic cholecystectomy to the frontiers of laparoscopic surgery: The prospective future. Dig Surg. 1991;8:124.

26. Nguyen NT, Ho HS, Smith WD, Philipps C, Lewis C, De Vera RM, et al. An ergonomic evaluation of surgeons' axial skeletal and upper extremity movements during laparoscopic and open surgery. Am J Surg. 2001;182:720-4.

27. Patkin M, Isabel L. Ergonomics, engineering and surgery of endosurgical dissection. J Royal Coll Surg Edinburgh. 1995;40:120-32.

28. Stylopoulos N, Rattner D. Robotics and ergonomics. SCNA. 2003;83:1321-37.

29. Uchal M, Brogger J, Rukas R, Karlsen B, Bergamaschi R. In-line versus pistol-grip handles in a laparoscopic simulators. A randomized controlled crossover trial. Surg Endosc. 2002;16:1771-3.

30. Van Veelen MA, Meiier DW. Ergnomics and design of laparoscopic instruments: results of a survey among laparoscopic surgeons. J Laparoendosc Adv Surg Tech A. 1999;9:481-9.

31. Wang Y, MacKenzie CL. Human-Computer Interaction INTERACT '99. Edinburgh, Scotland: IOS Press; 1999. Effects of orientation disparity between haptic and graphic displays of objects in virtual environments.

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TIBBIYOTDA STEREOMETRIYATNING O‘RNI

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Toshkent tibbiyot akademiyasi

ABSTRAKT

Ushbu maqola stereometriyaning tibbiyotda foydalanishi bo‘yicha adabiyot ma'lumotlarini umumlashtiradi. Stereometriyadan foydalangandan keyingi natijalar tahlil va muhokama qilingan. Xulosa shuki, instrumental troakarlarni optimal joylashtirish jarrohlik aralashuvlarni amalga oshirishda muvaffaqiyat kalitidir.

Kalit so'zlar: stereometriya, troakar, laparoskopik asboblar.

СТЕРЕОМЕТРИЯ В МЕДИЦИНЕ

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АБСТРАКТ

В обзоре обобщены данные литературы о применении стереометрии в медицине. Также проанализированы и обсуждены полученные результаты после использование стереометрии. Сделано заключение, что оптимальная расстановка инструментальных троакаров является ключом успеха для выполнения оперативных вмешательства.

Ключевые слова: стереометрия, троакар, лапароскопические инструменты.