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COMPARATIVE CHARACTERISTICS OF MODERN SUTURE MATERIAL (REVIEW)

Authors performed an updated and thorough review of the literature regarding modern suture material.A comprehensive literature review was conducted through the search in the databases Pubmed, Google Scholar, Cochrane Library, using the keywords suture, suture techniques, suture material.Were described data on the qualities ofthe ideal suture, general classification, comparative characteristics of different types of suture materials.It was possible to synthesize the current knowledge about present suture material and present their peculiarities according to examined laboratory findings.
Keywords: *suture, suture material, regeneration*

Introduction.

Each surgical operation requires the application of adequate suture material, taking into account the general condition and age of the patient, the presence of infection and inflammatory process, a high risk of thrombosis and etc. Thus, one of the problems, defining the further progress of modern medicine is the creation of suture materials, most rational in this or that surgical situation.

For the first time, the suture thread was used for closing wounds 3.500 years before Christ in Egypt. [1] In the past centuries, there have been many stitching matters, for instance, animal tendons, horsehair, leather strips, clod fibres, and human hair. [2] In 1806, Philip SyngPhysick developed a firm absorbable suture made from buckskin, [2] basically developing the current suture technique. Still, nowadays, there is a search for an ideal suture material.

Ideal suture material should:

1. Have stable handling properties; 2. Not provoke tissue response; 3. Enable solid knots; 4. Have satisfying tensile force; 5. Not perforate into tissue; 6. Be sterile; 7. Be nonelectrolytic; 8. Be non-allergenic; 9. Cheap. [3]

Materials and methods.

A comprehensive literature review was conducted through the search in the databases Pubmed, Google Scholar, Cochrane Library, using the keywords suture, suture techniques, suture material.

Totally were found 1132 articles (60 from PubMed, 574 from Google Scholar, 498 from Cochrane Library). From them we have chosen 29 articles, which were relevant for our theme.

Discussion and Results.

A comprehensive assortment of stitching materials is available to surgeons today.

Suture materials can be broadly categorised on natural and synthetic. [4]

Table 1 [5] - Classification of suture material.

Suturematerials			
Absorbable		**Non-absorbable**	
Natural	**Synthetic**	**Natural**	**Synthetic**
Catgut-plain or chromic	Polyglactin (vicryl), polyglycolic acid (dexon)	Silk, linen	Polyamide (nylon), polyester (dacron), polypropylene (prolene)

Besides, they can be monofilament or multifilament (braided), dyed or undyed, coated or uncoated. Various parameters, including suture strength, flexibility, capillarity and thread memory represent a physical characteristic of sutures. [6] Advantages of braided sutures include ease of administration, weak memory and increased knot security. However, bacteria can invade the spaces between fibres, potentially leading to suture infection, granulomas and sinuses. [7] By contrast, a monofilament suture is a single material. These seams have limited tendency of infection, ease of the passage within tissue and simple removal. Their disadvantages are considerable preservation of package shape, difficult applying, knot insecurity, and perforating the tissue. [8] Generally, braided sutures potentiate more contaminations as opposed to non-braided sutures. When sealing wounds by a braided Vicryl™ suture there is a 100% rate of infection. By contrast, injuries connected by non-braided sutures exhibited a significantly diminished rate of wound infection. [9]

Many surgeons prefer non-absorbable monofilament sutures, while others tend to choose absorbable ones more. [10] The main limitation of non-absorbable sutures is the necessity for their removal within 5 and 10 days next to installation. This requires an extra doctor visit, what is not so beneficial for many patients. As LaBagnara has

mentioned in his review of absorbable suture materials, used in head and neck surgery, absorbable sutures are simple to manipulate, have low reactivity and good tensile strength, and cost less than non-absorbable sutures. [11] Luck et al., came with no clinically notable variations in cosmetic appearance between absorbable and non-absorbable sutures after 3 months. [12] Likewise, Karounis et al. did not discover any difference in cosmetic scores between plain catgut versus nylon sutures in paediatric lacerations after 4-5 months. [13] When compared to absorbable sutures, monofilament nylon ones lessen the risk of hypertrophic scarring mainly in sternotomy scars. [14]

Vicryl is a type of synthetic absorbable suture and formed of a polymer of glycolide and lactide coated with a mixture of glycolide, lactide and calcium stearate. [15] There is a new formulation of Vicryl called VicrylRapide, which consists of smaller molecules of the same components as Vicryl. [16] VicrylRapide is produced by gamma irradiation of polyglactin 910, which absorbs quickly than Vicryl. [16] Its tensile strength is reduced by 50% after 5 days, in comparison to Vicryl; furthermore, there is no traction left after 14 days. [16] VicrylRapide is fully absorbed after 42 days, whereas Vicryl takes around 56-70 days. Thus, irradiated polyglactin 910 is proper for the closure of scars where fast suture absorption is required, especially for bruises in the scalp, scrotum, and perineum and is an ideal material for mucocutaneous anastomosis at stoma surgery. Loss of suture strength is so accelerated that suture removal is unnecessary, eliminating the necessity for further medical or paramedical care.[17]

The features of irradiated polyglactin 910 do it ideal for full-thickness skin grafts. Linberg observed a similar efficiency of Vicryl and nylon stitches in inhibiting scar dehiscence in an in vivo rat model of oculoplastic surgery. [18]

Polydioxanone (PDS) is a monofilament absorbable thread produced from the polymerization of paradioxanone. The study performed by anastomosis and micro anastomosis with polidioxanone had shown that this type of material has provoked little inflammatory reaction when compared with other materials of suture [19, 20]. Additionaly, nowadays polydioxanone becomes very popular in Facial Rejuvenation procedure. Samira Yaraket. al. in their study reported a series of cases using polydioxanone absorbable monofilament synthetic threads called Mint Lift™. According to results, Mint Lift™ is an alternative for reconstruction and facial rejuvenation in patients with mild to moderate skin flaccidity, admitted to be minimally invasive and can be performed in a shorter time and under local anaesthesia. It has a definite recommendation in patients who do not want to undergo the routine surgical procedure, do not have free time for recovery, or that do have a contraindication to procedure due to anaesthetic sedation. The procedure has proven to be safe, and a significant improvement was visible in the postoperative period. [21]

Poliglecaprone (Monocril) is an absorbable, monofilament, a copolymer of epsilon-caprolactone and glycoside. Laboratory findings have shown good ease of handling, minimal resistance during crossing in the tissues and tension resistance. The time of total absorption between 90 and 120 days after installation into the tissues, with minimal tissue reaction [22]. Moreover, according to LaBagnara study, where he applied Monocryl in 80 cases, suggest that it has multiple superior characteristics including the comfort of handling, mild tissue reactions, higher tensile strength, and lower cost. [11]

Poliglecaprone-25 (Monocril) and polyglactin-910 (Vicryl Rapid) are two of the most commonly applied absorbable stitches in cutaneous surgery. The study, closure of the deep part of Mohs defects, performed by Thomas Regan and Naomi Lawrence had shown that Poliglecaprone-25 resulted in significantly less projected sutures than did polyglactin-910, although both presented in the same degree of lumpiness and similar-appearing scars at 1 week and 3 months. [23]

Cotton, linen and silk aremultifilamentary non-absorbable sutures of natural fibers. They have high resistance, are comfortable to manage and provide a secure mechanical connection. Their benefit is the low cost, reason by which still today are widely used in many hospitals. Nevertheless, they induce the infection more than monofilamentares wires nonabsorbable sutures. Thus, these materials should be avoided in wound suture that show bacterial contamination. Silk, in particular, exerts a significant inhibitory effect on the functions of macrophages, harming mostly the adhesion of these cells [24].

Polytetrafluoroethylene (PTFE) is a non-absorbable monofilament wire, examined with good results in plastic surgery. According to a comparative study with 10 other sutures, it was established that the PTFE induces lesser tissue reaction, making it admitted the material of choice for facial plastic surgery, where the functional and aesthetic results are crucial. [25]

One of the modern world trends in surgery is the use of synthetic non-absorbable sutures for the application of surface removable seams. Within the framework of this direction, new kinds of materials with improved characteristics are developed and introduced into surgical practice [26].

A decade ago, V.E. Günther et al. Discussed the possibility of using a thread based on titanium nickelide as a suture [27, 28].

Today this suture material has already been introduced into medical practice. Titanium nickelide provides implants with a new set of properties: shape memory with temperature change, superelasticity at body temperature, corrosion resistance under conditions of prolonged alternating deformation. D.N. Kornilov et al. in

the experiment, studied the features of scar formation and its quality when using suture material based on titanium nickelide. As a result, it has been established that a titanium nickelide-based filament induces the development of a fibrous clutch in the shortest possible time [29].

The literature contains only fragmentary data on the interaction of suture materials based on titanium nickelide with biological tissue. This is not enough for the wide use of new medical products, it is necessary to continue research.

Conclusion.

In conclusion, the existing knowledge of sutures and their characteristics contribute to the surgeons decide the proper surgical material for the use, leading to best postoperative results, bypassing rejections, infections and other difficulties inherent to the operative procedure, promoting a quick recovery of the patient.

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ҚАЗІРГІ ЗАМАН МАТЕРИАЛДАРЫНЫҢ САЛЫСТЫРМАЛЫ СИПАТТАМАЛАРЫ (ӘДЕБИ ШОЛУ)

Түйін: Әрбір хирургиялық операция толыққанды материалды емделушінің жалпы жағдайы және жасына байланысты қолдануға, инфекциялар мен қабыну процесстерінің жоқтығын, жоғарғы тромбоз қатері және тағы басқа аурулардың болмайтындығын талап етеді. Осыған орай, ең басты мәселе, заманауи медицинаның алға басуын анықтайтын, барлық салада қолданылатын жаңа тігу материалдарын ойлап табу. Бұл мақалада авторлар қазіргі заман тігіс материалдарының әдеби салыстырмалы нұсқасын жасады, Pubmed, Google Scholar, Cochrane Library секілді онлайн кітапханаларын қолдана отырып. Тұжырымдамада авторлар қарастырған тігіс материалдардың өзіндік қасиеттері мен жетіспеушіліктері бар, және әрбір материалға тұжырым , хирургтардың операция түрімен қандай тінге өзіндік материал қолдануын шеше алады.
Түйінді сөздер: тігіс, тігіс материалдары, регенерация

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СРАВНИТЕЛЬНАЯ ХАРАКТЕРИСТИКА СОВРЕМЕННОГО ШОВНОГО МАТЕРИАЛА (ОБЗОР ЛИТЕРАТУРЫ)

Резюме: Каждая хирургическая операция требует использования адекватного шовного материала с учетом общего состояния и возраста пациента, наличия инфекции и воспалительного процесса, высокого риска тромбоза и так далее. Таким образом, одной из проблем, определяющих дальнейший

прогресс современной медицины, является создание шовных материалов, наиболее рациональных в той или иной хирургической ситуации. В данной статье авторы выполнили обширный обзор литературы по современным шовным материалам, используя онлайн библиотеки, такие как Pubmed, Google Scholar, Cochrane Library.В заключение авторы отметили, что рассмотренные шовные материалы имеют свои преимущества и недостатки, и существующие знания об их характеристиках способствуют тому, что хирурги могут выбрать подходящий материал в зависимости от типа ткани и вида операции.
Ключевые слова: шов, шовный материал, регенерация