

Research Results on the Effect of Tissue Dressings on Wound Healing

Bafaev Jamshid Turabovich

Bukhara State Medical Institute, Bukhara, Republic of Uzbekistan

Akhmedova Dilafruz Bakhadirovna

Tashkent Medical Academy, Tashkent, Republic of Uzbekistan

Abstract: Wound healing is a complex biological process that includes several stages, from inflammation to tissue remodeling. One of the key elements of this process is tissue ligaments, which play an important role in repairing damaged tissues due to their structure consisting of collagen and elastin.

The purpose of this study was to evaluate the effect of dressings made from different compositions (including cotton and fibroin materials) on the wound healing process in laboratory animals.

The experiment involved 24 rats with skin injuries that remained open throughout the observation period. Dressings of various compositions (100% cotton, 50% cotton and 50% silk, 70% silk and 30% cotton, 100% silk) were applied to the wounds, after which healing parameters were analyzed at different intervals (4, 7, 13, 16, and 19 days). Results showed that silk fibroin dressings significantly accelerated the healing process compared to the control group, providing faster wound closure, especially when using 100% silk material. This is confirmed by improved wound closure indicators, such as wound bed area and inflammation degree, during the first 10 days.

Thus, the use of silk dressings as a wound treatment material demonstrated improved healing and reduced recovery time compared to traditional cotton dressings. The research results may contribute to developing more effective wound rehabilitation methods and improving medical care quality.

Keywords: wound healing, tissue ligaments, collagen, elastin, inflammatory phase, proliferative phase, remodeling phase, dressings, silk fibroin, cotton dressings, tissue regeneration, biological mechanisms, experiment, skin wounds, tissue restoration, wound healing, laboratory animals, tissues, tissue material, accelerated healing.

Relevance: Wound healing is a complex and multi-stage biological process that involves an extensive range of factors and mechanisms [1, 2]. One of the key components of this process is tissue ligaments. Tissue ligaments, or ligamentous structures, are fibrous connective tissues that play a critical role in maintaining the body's structural integrity.

The composition of these ligaments includes collagen fibers and elastin. Collagen is a protein that provides strength and resistance to stretching, while elastin provides the necessary tissue flexibility. These two components work in tandem, allowing ligaments to not only withstand loads but also return to their original state after deformation [3].

It should be noted that wound healing is not just the restoration of damaged skin or tissues. This process includes several phases: inflammatory, proliferative, and remodeling. The inflammatory phase begins immediately after injury [4-7]. At this stage, there is an increase in blood flow and migration of immune cells to the injury site, which is necessary to prevent infection. The proliferative phase is characterized by the formation of new tissue, where tissue ligaments play a significant role in forming

the new structure. During this time, collagen and other components necessary for damaged tissue repair are synthesized [8, 9].

The remodeling phase can continue for months or even years. During this period, collagen fibers undergo restructuring, which ultimately leads to strengthening and improved functionality of the healed tissue [10]. It's important to emphasize that wound healing speed and quality are influenced by various factors, such as age, general health condition, presence of chronic diseases, and proper care of the damaged area.

Thus, understanding the role of tissue ligaments in wound healing can help develop more effective treatment and rehabilitation methods. The characteristics of these tissues and their interaction with other cellular structures are important aspects that must be considered in medicine and biology [11, 12].

Research Objective: To study the effect of dressings of various compositions on the wound healing process.

Materials and Methods: The experiment studied the healing effect of cotton dressings on skin wounds in male and female rats weighing 200-220g. The study involved 24 rats divided into four groups. The skin wound dressing model was created using general anesthesia with a urethane dose of 1.0 g/kg. The first group of animals received cotton dressings, then the experimental group received 100% cotton dressings, the second group received a mixture of 50% cotton and 50% cotton dressings, and the third group received 30% cotton and 70% cotton dressings. Dressings were applied to the dorsal area of skin wounds under general anesthesia with a urethane dose of 1 g/kg. Skin patches measuring 15 mm by 15 mm were obtained from the back, and skin flaps were created. The skin injuries remained open throughout the observation period. The healing wounds were completely closed, the wound surface was treated, and the study was successfully completed.

Results and Conclusions: The study results showed that the wound bed area on day 4 post-surgery in control group animals averaged 128.2 ± 9.7 mm², with a wound closure rate of 9.8%. Objective examination showed increased inflammatory reaction - edema, hyperemia, infiltration of atrophic tissues. By day 7, the treatment area was 32.4% of the initial wound size. By day 13, the wound bed area continued to steadily decrease. At this time, inflammation signs like edema, hyperemia, and infiltration of atrophic tissues were observed only until day 15. By day 17, the healing site showed slightly elevated atrophic tissue content and pronounced granulation tissue formation due to intensive blood vessel growth. The highest hyperemia of atrophied tissues was observed and maintained. The observation group achieved complete treatment in 19 days, reaching a 99.9% success rate.

In the experimental group of animals, decreased inflammation was noted starting from the application of connective tissue material. Initial wound closure percentages at days 4, 7, and 10 showed a comparable trend of 34.4%, 61.6%, and 70.4% respectively compared to 100% silk fibroin material. Results for 50% silk fibroin material showed percentages of 23.7%, 41.4%, and 74.6% at the same intervals, while 70% silk material showed percentages of 37%, 46.4%, and 75.5% compared to initial values.

In later stages of the experiment, the healing process in animals receiving 100% silk fibroin dressing showed wound closure rates of 92.3% and 95.7% on days 13 and 16 respectively. In the group receiving 50% silk fibroin dressing, results showed closure rates of 94.6% and 96.1%. Among the group receiving 70% support dressing, results showed closure rates of 89.1% and 98.6% respectively.

Based on the obtained results, silk fibroin dressings showed a positive effect on skin wound healing times. Particularly, when discussing monitoring results during the first 10 days of observation, significant positive changes in the healing index were noted in wound treatment. When comparing the

effectiveness of 100% silk dressings with other dressings, wound healing was significantly accelerated, leading to complete wound closure 3 days earlier compared to the control group.

Thus, the therapeutic properties of tissue material obtained from silk fibroin proved effective in accelerating wound treatment when used in flap design. The positive effect on wound healing and faster recovery is explained by the 100% silk content in the fabric, which showed the best results among these types of materials.

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