Skin Morphology at the Site of Postoperative Cicatrix Formed after the Use of Different Surgical Cutting Instruments

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Experimental morphological study of the postoperative cicatrix forming after the use of scalpel made from a crystal material was carried out. The skin healed much sooner and the resultant cicatrix was more fine in comparison with the wound inflicted by a common metal scalpel.

Key Words: *scalpel; postoperative skin cicatrix; rats; morphology*

By the present time, a series of cutting instruments from artificial crystal material have been developed by Russian scientists and engineers. By their characteristics these instruments are superior to those made from metal or other materials. The scalpel described in this paper has no analogs in the world practice and opens new vistas in medical technologies.

One of the first instruments of this type was a medical surgical scalpel made from Zyttria crystal material. It is used in common, plastic, vascular surgery, neurosurgery, *etc.* (Registration Certificate No. 292/0699/97-9-12 of June 23, 1999, issued by Committee for New Medical Technology, Ministry of Health of Russia). Scalpels from crystal material have obvious advantages over those made from steel, ceramics, and diamond [2,3] due to high quality of the postoperative cicatrix, the morphology of which remains not studied.

We studied the wound process in the skin after intervention with a scalpel made from crystal material.

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MATERIALS AND METHODS

Experiments were carried out on 20 male and female Wistar rats (150-200 g). After removal of hairs on the posterior surface of the caudal part of the trunk, two skin incisions 3 cm long were inflicted under sterile conditions: by a scalpel made from crystal material (experiment) on the right and by a common metal scalpel (control) on the left. The wound was carefully sutured. During the postoperative period, the wounds were treated with common antiseptics. On days 14 and 30 postoperation skin fragments with the postoperative cicatrices (experimental and control samples) were dissected with the underlying tissues for histological study.

Tissue fragments were fixed in 10% formalin buffered after Lilly, dehydrated in ascending ethanols, and embedded in paraffin by the common method. Histological sections (3-5 μ) were deparaffinated, stained with hematoxylin and eosin and with picrofuchsin after van Gieson.

RESULTS

Morphological analysis of the skin of experimental animals showed clear-cut differences in healing of operation wounds inflicted by the crystal scalpel in

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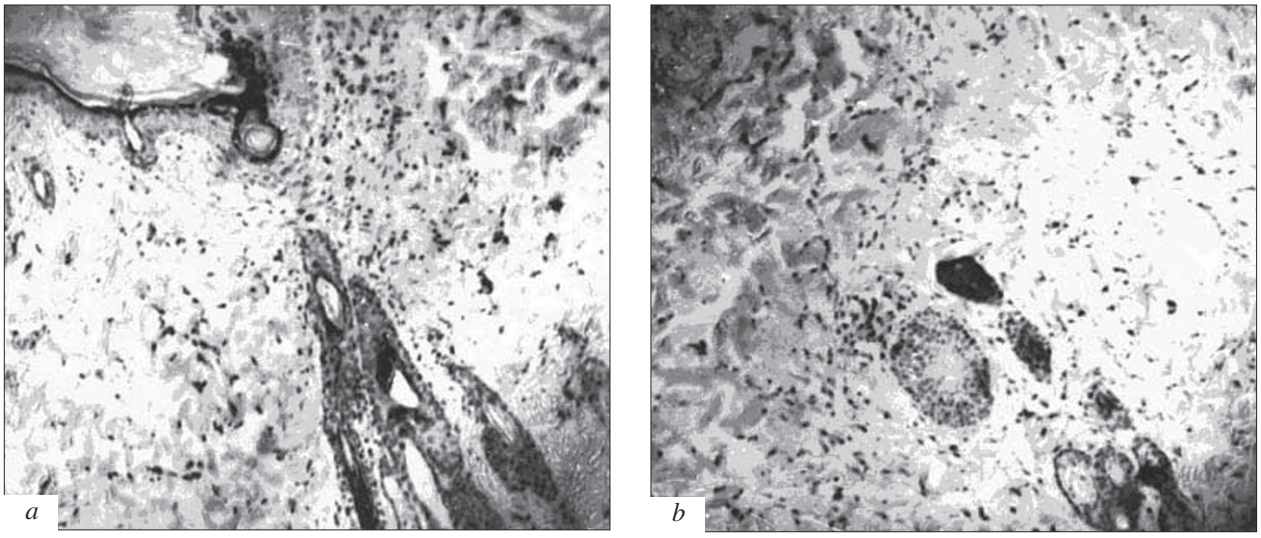

Fig. 1. Pathohistological changes in the skin at the site of postoperative cicatrix formed after healing of a wound inflicted by a scalpel made from Zyttria crystal material. *a*) epithelialized fine cicatrix with slight proliferation of macrophages and fibroblasts, ×100; *b*) appendages of the skin in the subepidermal part of the derma, ×200. Hematoxylin and eosin staining.

comparison with the wound inflicted by a common metal scalpel. Macroscopically, a fine almost invisible cicatrix was seen on day 14 postoperation in the former case; on day 30 it was virtually unseen. In the latter case, a compact cicatrix formed, sometimes with granulations, which was clearly seen until the end of the observation period. This cicatrix was 2-3-fold wider in comparison with the cicatrix formed after the use of the crystal scalpel.

Microscopy of 13 experimental specimens showed healing of the postoperative wound by first intention in all cases. On day 14 postoperation, an epithelialized linear cicatrix slightly widening towards the skin surface was seen (Fig. 1, *a*). Few fine, often devastated vessels, and slight cellular reaction with macrophages and fibroblasts were seen in the cicatricial area (Fig. 2). Polymorphonuclear leukocytes were just solitary in all cases. Fibrous connective tissue structures were scanty. The epithelium covering the surface of the cicatrix had signs of hornification.

On day 30 after surgery, a linear cicatrix was hardly discernible on the skin; the morphological structure of the derma was restored, including the appendages of the skin (hairy follicles and skin glands) (Fig. 1, *b*).

Histological study of 7 control samples showed healing of the postoperative wound by first intention in 3 cases and by second intention in 4 cases [1]. Healing by first intention in the control (wounds inflicted by metal scalpel) differed from that in experimental group by thicker epithelialized cicatrix with polymorphic cells, proliferation of fibroblasts, and collagen fibers (Fig. 2, *a*). On day 30, primordial appendages of the skin were seen in dermal areas adjacent to the cicatrix.

A substantial portion of granulation tissue with an epidermis defect was seen between the wound edges in 4 control samples healed by second intention (Fig. 2, *b*). Numerous fine-wall vessels, some of them with erythrocytes in the lumen, were discernible in the granulation tissue. Extensive diapedetic hemorrhages, inflammatory reaction with an appreciable admixture of polymorphonuclear leukocytes and cell degradation were seen in 2 of these samples. Epitheliocyte proliferation in the depth of the Malpighian layer of the skin was seen in the wound edges; necrotic changes were seen. A connective tissue cicatrix with partial epithelialization (epidermization) of skin surface formed during the period of observation (30 days).

Hence, the skin wound after dissection with a crystal scalpel healed by first intention with the formation of apparently invisible fine cicatrix with complete and rapid epithelialization of the skin, minimum development of fibrous connective tissue, and regeneration of the appendages of the skin. The wound inflammatory process was minor without clear-cut reaction of polymorphonuclear leukocytes. The reparative process after metal scalpel was more manifest with the formation of a thick connective tissue cicatrix. In some cases, the wound healed and cicatrices formed by second intention with the development of granulation and then fibrous connective tissue, sometimes with suppuration and delayed epithelialization of the wound.

On the whole, the morphogenesis of reparation changes in the skin at the site of the postoperative

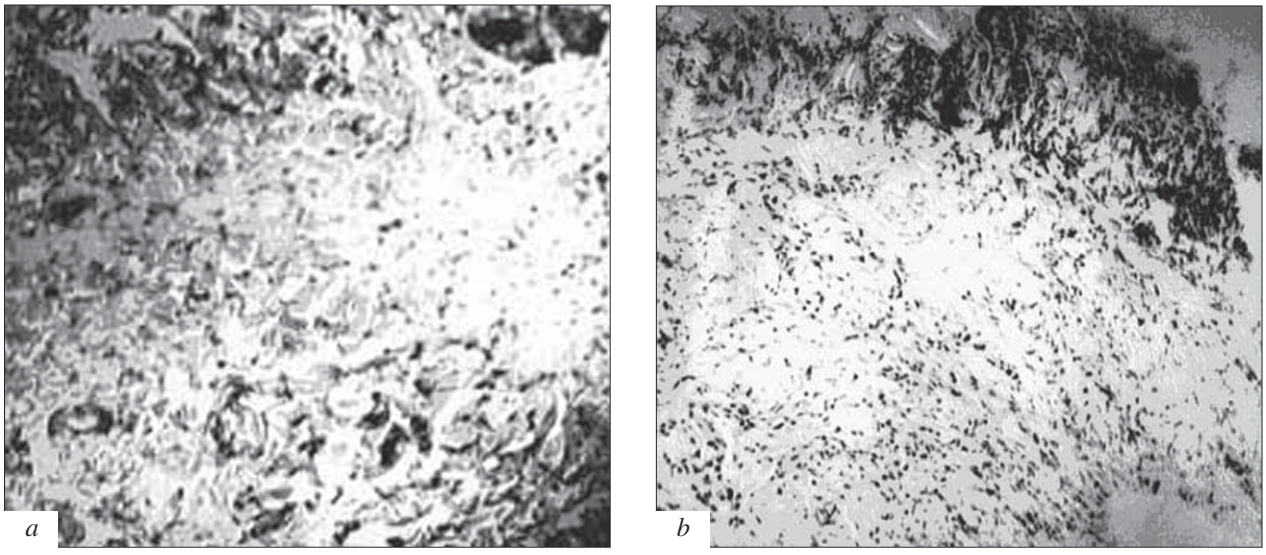

Fig. 2. Pathohistological changes in the skin at the site of the postoperative cicatrix formed after the use of metal scalpel. *a*) healing by first intention with formation of a thick cicatrix, polymorphonuclear reaction with numerous fibroblasts, ×200; *b*) healing by second intention, granulation tissue with epidermis defect, pronounced polymorphocellular infiltration, ×100. Hematoxylin and eosin staining.

cicatrix after crystal scalpel use is characterized by a phase-wise pattern, similar to that during healing of a wound dissected with a metal scalpel. However, the results of comparative morphological study indicate less pronounced destructive effect of the crystal scalpel in comparison with common metal scalpel. The healing was associated with less pronounced vascularization and granulation changes in the operation wound. This creates favorable anatomic physiological conditions in the wound focus, generally accelerating the reparation process in the skin. Structural elements of the skin were virtually completely restored with the formation of a very fine skin cicatrix.

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