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PATHOMORPHOLOGICAL CHANGES ASSOCIATED WITH XENOTRANSPLANTATION IN FACIAL SOFT TISSUE DEFORMITIES

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Abstract: *The incorporation of xenotransplantation materials into recipient tissues represents a complex biological process characterized by successive inflammatory, regenerative, and remodeling responses. Morphological assessment of the implantation site provides important information regarding tissue compatibility, the intensity of the local inflammatory reaction, and the progression of reparative processes. In the present experimental study, the tissue response to xenotransplant materials of different animal origins was evaluated using a morphological approach. Particular attention was given to the temporal development of inflammatory changes, connective tissue formation, vascularization, cellular proliferation, and maturation of the extracellular matrix. The obtained findings demonstrated a gradual transition from an acute inflammatory response during the early postoperative period to active tissue regeneration and subsequent structural remodeling. The nature and intensity of these changes varied according to the biological origin of the xenotransplant material.*

Keywords: *xenotransplantation, facial soft tissue reconstruction, pathomorphology, tissue regeneration, inflammatory response, angiogenesis, connective tissue remodeling.*

Aim of the study

The aim of the study was to evaluate the effectiveness of xenotransplant materials for soft tissue reconstruction by means of a comparative morphological assessment of tissue repair and integration at different stages following implantation.

Materials and Methods

The experimental study involved 60 laboratory rabbits in which a soft tissue defect was experimentally created, followed by implantation of a xenotransplant material. This model was designed to reproduce conditions relevant to reconstructive procedures and to investigate the interaction between the implanted biological matrix and the surrounding recipient tissues.

For assessment of the dynamics of tissue repair, the experimental animals were examined at different postoperative intervals: 3, 7, 14, 21, and 35 days after implantation. Pericardial xenotransplant materials obtained from cattle, pigs, and sheep were evaluated.



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Histological examination was performed to characterize the morphological response of the tissues surrounding the implanted material and to determine the successive stages of inflammation, regeneration, angiogenesis, connective tissue formation, and remodeling.

Results

Histological examination demonstrated a clearly defined temporal pattern of morphological changes within the implantation zone. The observed tissue response corresponded to successive stages of the reparative process, including acute inflammation, formation of granulation tissue, active regeneration, and maturation of the connective tissue matrix.

On day 3, the implantation site demonstrated a pronounced acute inflammatory response. The connective tissue showed structural disorganization, marked edema, and substantial cellular infiltration, predominantly consisting of neutrophils. Numerous polymorphonuclear leukocytes were observed around blood vessels and within the intercellular spaces. These findings were consistent with an early inflammatory response to surgical trauma and implantation of the biological material.

Comparative evaluation of xenotransplants of different animal origins revealed differences in the intensity of the early inflammatory reaction. The sheep-derived pericardial matrix was associated with a comparatively milder inflammatory response. Neutrophilic infiltration was less prominent, while the implanted material retained a more distinct and organized fibrous structure. These morphological characteristics suggest more favorable tissue compatibility and adaptation of the sheep pericardial matrix within the recipient tissue environment compared with the bovine and porcine materials.

At this stage, the connective tissue surrounding the implant consisted mainly of loose fibrous structures with a limited amount of mature collagen. The collagen fibers were irregularly arranged and formed a relatively loose extracellular matrix, corresponding to the early phase of tissue repair.

By day 7, the acute inflammatory reaction had considerably diminished. Morphological findings indicated a transition toward active tissue regeneration, accompanied by granulation tissue development, increased cellular proliferation, and the onset of pronounced angiogenesis. Although the general pattern of the tissue response was comparable among the examined biological matrices, the intensity of regenerative changes differed according to the xenotransplant's animal origin.

On day 14, regenerative activity reached its highest level. This period was characterized by intensive cellular proliferation and angiogenesis, accompanied by active formation of young connective tissue and progressive incorporation of the xenotransplant into the surrounding tissues. The newly formed connective tissue remained relatively loose and contained a considerable proportion of type III collagen fibers, which are characteristic of immature connective tissue. These fibers were predominantly irregularly arranged and contributed to the formation of a temporary extracellular framework.

The most pronounced reparative response at this stage was observed with the sheep-derived pericardial xenotransplant, which demonstrated prominent vascularization, active proliferation of connective tissue cells, and intensive extracellular matrix formation.



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By day 21, the reparative process entered a more advanced stage characterized by progressive maturation of the connective tissue. The previously active proliferative phase gradually shifted toward structural organization and remodeling of the extracellular matrix. Mature connective tissue structures became increasingly evident, accompanied by stabilization of the tissue architecture within the implantation zone.

Conclusions

The morphological findings demonstrated that xenotransplantation was followed by a consistent sequence of tissue responses involving early inflammation, active regeneration, angiogenesis, connective tissue formation, and subsequent matrix maturation and remodeling. Although these processes followed a common biological pattern, their intensity and rate varied depending on the animal origin of the xenotransplant material. Among the evaluated biological matrices, the sheep-derived pericardial xenotransplant demonstrated the most favorable morphological characteristics. It was associated with a less pronounced early inflammatory response and more active subsequent reparative changes, including angiogenesis, cellular proliferation, and connective tissue formation. At later stages, a greater degree of structural organization of the mature connective tissue matrix was observed. Overall, the findings indicate that the biological origin of a xenotransplant material can influence the morphological characteristics and dynamics of tissue integration. The observed progression toward organized connective tissue formation suggests the development of a stable tissue framework within the implantation area.

