



MORPHOLOGICAL CHARACTERISTICS OF SPLEEN REMODELING IN  
RATS FOLLOWING MILD SPINAL CORD INJURY.

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**Relevance:** *It is well known that the organs of the immune system provide adaptive immunity and maintain the cellular and humoral homeostasis of the organism. Experimental studies have demonstrated the high sensitivity of the spleen to various external and internal influences, as well as its ability to respond among the first with adaptive morphological changes.*

**Aim of the study:** *To determine morphological changes in the spleen of 3-month-old outbred white rats during the early period following a mild spinal cord contusion.*

**Materials and Methods:** *A total of 144 outbred white rats of both sexes were used in the study. The animals were maintained under standard vivarium conditions for three months. Morphometric changes in the spleen tissue of 3-month-old outbred white rats were studied during the early period after mild spinal cord contusion at the T4–T12 vertebral level at 7, 14, and 21 days post-injury.*

The following parameters were measured: the total cross-sectional area of the organ, the relative areas of the white and red pulp, the area of lymphoid follicles, the diameter and number of periarterial lymphoid sheaths (PALS), and the density of cellular elements in the lymphoid tissue.

**Results and Discussion:** The study of the dynamics of morphological and morphometric changes in the spleen after mild spinal cord contusion allows for identification of patterns in the immune organ's response to systemic stress. In this series of observations, analyses were performed on tissue from 3-month-old outbred white rats. Sections were stained with hematoxylin and eosin and subjected to digital processing with morphometric analysis. The results are considered at sequential time points—days 7, 14, and 21.

On day 7 after mild spinal cord contusion, moderate congestion of the red pulp with dilation of the venous sinuses is noticeable; in some areas, they appear gaping, indicating impaired venous outflow and stasis. Hemolysis in the perisinusoidal zones is focal. At this stage, the white pulp already demonstrates a noticeable reduction in volume, and its architecture becomes less distinct.

The periarterial lymphoid sheaths (PALS) are thinned, and their lymphocytic composition is depleted, indicating early loss of mature T-lymphocytes. Digital analysis shows that T-lymphocytes (marked in red) decreased to 163 cells, one-third lower than the control values. B-lymphocytes (blue) totaled 118 cells, with a more pronounced decrease of 40%. Against this background, the number of blast elements (yellow)



increased to 54 cells, representing 19% of the pool. The white pulp occupied only 36.7% of the field of view ( $1.03 \times 10^6 \text{ px}^2$ ), while the red pulp expanded to 63.3% ( $1.78 \times 10^6 \text{ px}^2$ ).

By the second week (day 14) after mild spinal cord contusion, the changes in the spleen became more pronounced. The morphological picture is characterized by further reduction of the white pulp. Follicle architecture is blurred, contours lose regularity, and PALS zones are uneven and in some areas nearly indistinguishable. The mantle and marginal zones are markedly reduced. The red pulp is congested with multiple foci of hemolysis; signs of splenocyte destruction are evident, reflecting the severity of the changes.

Morphometric analysis confirms these observations: the white pulp area decreased to  $0.84 \times 10^6 \text{ px}^2$  (30.4%), while the red pulp occupied 69.6% of the field ( $1.92 \times 10^6 \text{ px}^2$ ). T-lymphocytes decreased to 104 cells, 57% lower than controls, and B-lymphocytes to 73 cells (-63%). Blast lymphocytes maintained a relative increase of 49 cells (22% of the pool).

If residual structural organization of the white pulp was still observed on day 7, by day 14 the stage of pronounced atrophy with critical reduction of the mature lymphocytic component became evident. The increased proportion of blast cells may be interpreted as a compensatory response, though it does not prevent structural degradation of the organ. At this time point, the red pulp shows signs of chronic hyperemia and increasing stromal changes, indicating the onset of organ remodeling.

Conclusions:

Overall, the identified changes indicate a staged development of pronounced morphological and immune disturbances in the spleen following mild spinal cord injury. By day 21, maximal destructive changes are formed, reflecting moderate suppression of the spleen's immune function.