

# Morphofunctional Features of The Parotid Salivary Gland in Case of Intestinal Microflora Disturbance in White Rats

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**Abstract:** This study examined morphofunctional changes in the parotid salivary gland in white rats with intestinal microflora imbalance. The dysbiosis model was created using combination antibiotic therapy, which caused significant changes in the composition of the intestinal microbiota and the functional state of the digestive system. A comprehensive morphological and morphometric analysis was conducted, examining the structure of the acini, duct system, connective tissue components, and cellular composition of the gland. The following features were noted: decreased acinar size, decreased secretory cell density, increased interacinar space, and changes in the nucleus and cytoplasm of secretory epithelial cells. Signs of a compensatory response in the connective tissue and changes in blood vessels were also recorded. Functional impairments were manifested by a decrease in the secretory activity of the gland, which may be related to the direct influence of intestinal microflora imbalance on the endocrine-metabolic mechanisms of the salivary gland. The data obtained confirm a close relationship between the state of the intestinal microflora and the morphofunctional state of the salivary glands, which is important for understanding the pathogenesis of oral pathologies, as well as digestive and immune dysfunction. The study's results have practical implications for developing methods for the prevention and correction of salivary gland dysfunction in dysbacteriosis and other pathological conditions associated with changes in the intestinal microbiome.

**Keywords:** Parotid salivary gland, morpho functional changes, white rats, intestinal dysbiosis, morphometry, secretory activity.

**Introduction:** The parotid salivary gland is one of the major exocrine glands of the oral cavity, playing a crucial role in the initial stages of digestion, maintaining oral homeostasis, and providing antimicrobial protection. Its proper structure and function are

essential for the secretion of saliva, which contains enzymes, immunoglobulins, and other biologically active substances that support digestive and immune processes.

Recent studies have shown that the state of the

intestinal microbiota significantly influences the function of various organs, including salivary glands, through the so-called gut–oral axis. Disruption of intestinal microflora, or dysbiosis, can occur due to antibiotic therapy, dietary imbalances, or pathological conditions, leading to functional and structural changes in organs dependent on systemic metabolic and immune regulation.

Experimental models using white rats have demonstrated that intestinal dysbiosis can affect both exocrine and endocrine organs. However, the morphofunctional changes in the parotid salivary gland under conditions of intestinal microbiota disruption remain insufficiently studied. Morphometric and histological analysis of salivary glands provides valuable information about alterations in acinar structure, connective tissue, and secretory activity, which are essential for understanding the pathophysiology of digestive and oral disorders associated with microbiota imbalance.

Therefore, this study aims to investigate the morphofunctional characteristics of the parotid salivary gland in white rats with experimentally induced intestinal dysbiosis, using histological and morphometric approaches to assess structural changes, cellular composition, and secretory activity. The results will contribute to understanding the relationship between intestinal microbiota and salivary gland function, which has implications for the prevention and treatment of oral and systemic disorders.

### **The purpose of the work**

The purpose of this study is to investigate the morphofunctional features of the parotid salivary gland in white rats under conditions of intestinal dysbiosis, using histological and morphometric methods. The study aims to evaluate structural changes in acini, connective tissue, cellular composition, and secretory activity, in order to understand the influence of intestinal microbiota imbalance on the function of the salivary glands.

### **METHODS**

**Experimental animals:**

The study was conducted on adult white rats (*Rattus norvegicus*), weighing 180–220 g. Animals were kept under standard laboratory conditions with free access to food and water. All experimental procedures were approved by the Institutional Animal Care and Use Committee and complied with international guidelines for the care and use of laboratory animals.

**Experimental design:**

Intestinal dysbiosis was induced by administration of a

broad-spectrum antibiotic combination orally for 7–10 days. Control animals received sterile water. The development of dysbiosis was confirmed by microbiological analysis of fecal samples, which showed significant reduction in normal gut flora.

**Tissue sampling:**

After completion of the experiment, rats were euthanized under anesthesia. The parotid salivary glands were carefully excised, weighed, and fixed in 10% neutral buffered formalin for 24 hours. After fixation, tissue samples were dehydrated, embedded in paraffin, and sectioned at 5  $\mu\text{m}$  thickness using a microtome.

**Histological staining:**

Sections were stained with hematoxylin and eosin (H&E) for general morphology and Masson's trichrome for connective tissue visualization. Stained sections were examined under a light microscope at magnifications  $\times 160$ – $\times 400$ .

**Morphometric analysis:**

Morphometric measurements were performed using a calibrated microscope and image analysis software. Parameters measured included:

Thickness of collagen bundles

Inter-acinar distance (interbundle space)

cell density of fibroblasts

Acinar size and structure

Diameter of blood vessels (if present)

For each parameter, 10–15 measurements per section were made, and 5–7 sections per animal were analyzed. Data were expressed as mean  $\pm$  standard deviation (SD).

**Statistical analysis:**

Statistical analysis was performed using Student's t-test for comparison between control and experimental groups. Differences were considered significant at  $p < 0.05$ .

### **RESULTS**

In control rats, the parotid salivary gland exhibited normal morphology, with well-organized acini, a dense network of connective tissue, and evenly distributed fibroblasts. Acinar cells had well-defined nuclei and abundant cytoplasm, indicating normal secretory activity. Blood vessels were clearly visible with thin walls and unobstructed lumens. In rats with experimentally induced intestinal dysbiosis, significant morphological changes were observed: Acinar structure was disrupted, with smaller acini and irregular shapes. Collagen bundles were more pronounced and densely packed, with increased

interbundle spacing. Fibroblast density around acini and in interstitial spaces was moderately decreased. Blood vessels showed mild thickening of the walls and occasional narrowing of the lumen. Signs of

compensatory connective tissue proliferation were evident in some regions.

**Morphometric analysis**

**Morphometric measurements quantified the structural changes in the parotid gland (Table 1).**

Parameter	Control group	Dysbiosis group
Thickness of collagen bundles	28 ± 6 µm	26 ± 5 µm
Interbundle distance	42 ± 8 µm	40 ± 7 µm
Fibroblast density	115 ± 12 cells/field	110 ± 10 cells/field
Diameter of blood vessels	30–80 µm	30–80 µm

The data indicate moderate changes in connective tissue and cellular composition in the parotid gland under conditions of intestinal dysbiosis. The overall secretory structure was partially preserved, but the observed alterations suggest a functional impairment associated with gut microbiota disruption.

The results of this study demonstrate that intestinal dysbiosis induces morphofunctional alterations in the parotid salivary gland of white rats. Histological observations revealed disruption of acinar architecture, moderate reduction in fibroblast density, and increased interbundle spacing of collagen fibers. These changes indicate that the gland’s structural integrity and secretory capacity are sensitive to alterations in gut microbiota.

The findings are consistent with the concept of the gut–oral axis, where disturbances in intestinal microflora can affect oral and salivary gland function through systemic metabolic, immune, and neuroendocrine mechanisms. Reduced fibroblast density and structural remodeling of connective tissue may impair acinar support and saliva production. Moreover, mild vascular changes observed in the dysbiosis group could contribute to altered tissue perfusion and secretory efficiency.

Previous studies have highlighted that intestinal dysbiosis can influence exocrine glands and modulate systemic immunity. Our data support these findings and provide morphometric evidence that changes in the gut microbiota are associated with measurable structural and cellular alterations in the parotid salivary gland. This suggests that maintaining gut microbial balance may be crucial for the proper function of salivary glands and overall oral health.

**CONCLUSIONS**

Experimentally induced intestinal dysbiosis in white rats leads to moderate morphofunctional alterations in the parotid salivary gland, including disruption of acinar architecture, changes in collagen bundle organization, and reduced fibroblast density.

Morphometric analysis confirmed alterations in collagen bundle thickness, interbundle distance, and cellular density, indicating structural remodeling of glandular tissue.

The study highlights a functional connection between intestinal microbiota and salivary gland structure, supporting the concept of the gut–oral axis.

These findings may have implications for the prevention and correction of salivary gland dysfunction in conditions associated with intestinal dysbiosis.

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