Stimulation of Reparative Processes in Inflammatory-Destructive Diseases of the Periodontium

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The effect of direct current (5-12 μA) induced by a bimetallic pin inserted into the pulp canal on cellular and vascular reactions is studied in a model of chronic apical periodontitis. It is demonstrated that after 90 days the inflammatory reaction decreases, osteogenesis is activated, and macrophagal infiltrate is observed only at the root apex as a mature granuloma with the signs of reduction.

Key Words: *periodontium; inflammation; direct electrical current*

Refracterity and high incidence of inflammatory-destructive diseases of the periodontium prompt the search for new methods of their therapy. At the present time, 50% of patients with chronic periodontitis cannot be treated completely [1,2].

Analysis of the literature data shows that drugs produce insufficient antibacterial effect and provoke destruction of the periodontium or local allergic reactions [3,12].

Our attention was attracted to the successful use of weak direct current for stimulation of osteogenesis in traumatology and orthopedics [4,5]. We have hypothesized that weak direct current inhibits inflammatory reaction and activates reparative processes in the periodontium.

In the present study we explored the possibility of using weak direct electrical current for stimulation of reparative processes in the periodontium for the treatment of periodontitis.

MATERIALS AND METHODS

Inflammatory-destructive process in the periodontium of the upper incisors was induced in 10 mongrel dogs aged 1-2 years by opening the pulp canal with a dental bur under thiopental anesthesia. The tooth was left open for contamination with oral microflora. Treatment was started after 2-3 months, when the formation of an inflammatory-destructive focus in the periodontium was confirmed by x-ray. In all cases, the pulp canal was treated by medicamentous and instrumental methods and filled to the root apex with phosphate-cement. A silver pin was inserted into the pulp canal of the upper right tooth (control). An original bimetallic pin (silver and aluminum joined by special welding) was inserted into the canal of the upper left tooth. Electrical current was measured with a 137-27A/1 voltmeter.

The animals were euthanized 15 and 90 days after tooth filling by intramuscular injection of Listenol (2.0-3.0 ml) against the background of ether narcosis. The jaws were excised and fixed in 10% formalin. Blocks with the studied tooth with alveolar bone were sawed out, decalcified in Trilon-B, and embedded in paraffin. Sections were cut and stained with hematoxylin and eosin.

RESULTS

Chronic inflammation was developed in teeth with silver pin within 15 days. The process spread from the root apex to the cervix and was accompanied

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by leukocytic infiltration with pronounced vascular plethora and stasis. Destructive processes with formation of cellular detritus developed in the tissues adjacent to the cement of the root apex (Fig. 1). Leukocytic infiltrate of apical periodontium contained 60% neutrophils and 40% macrophages. Focal osteoporosis characterized by leukocytic infiltration with neutrophil predominance (70%) occurred in alveolar bone. The density of periodontal infiltrate decreased toward the cervix, macrophages predominated in the infiltrate, and cellular detritus was not seen.

On the 15th day, leukocytic infiltration in the periodontium of the tooth with bimetallic pin was more dense and occupied smaller area, being localized at the root apex (Fig. 2). Homogenicity of the infiltrate was higher in comparison with the control: it contained 90% macrophages and 10% neutrophils. Cellular detritus was present in negligible amounts. A more pronounced osteoporosis was accompanied by active osteogenesis: 2 or 3 layers of osteblasts surrounded bone trabeculas. In should be stressed that large amounts of lymphocytes were present in the infiltrate surrounding the areas of osteogenesis.

In control teeth on the 90th day diffuse infiltrate occupied large area, consisted of macrophages, and was represented by 2-3 immature granulemas at the

Fig. 1. Diffuse leukocytic infiltration and formation of detritus in the periodontium 15 days after insertion of a silver pin (control group). Here and in Figs. 2-4: staining with hematoxylin and eosin, ×56.

Fig. 2. Dense macrophagal infiltration of apical periodontium 15 days after insertion of bimetallic pin.

Fig. 3. Leukocytic infiltration and immature granulomas in the periosteum of control tooth 90 days after treatment.

Fig. 4. Apical periodontium 90 days after insertion of bimetallic pin. Mature granuloma is visible.

root apex (Fig. 3). These granulomas had no formed nucleus but were surrounded by a thin layer of fibrous tissue consisting of 2-3 layers of fibroblasts. Extensive defects and occasional foci of low-intensity osteogenesis were observed in the alveolar bone.

On the 90th day after insertion of bimetallic pin, the inflammatory reaction decreased, macrophagal infiltrate was visible as a mature granuloma with the signs of reduction at the root apex (Fig. 4). The granuloma had the typical structure: compact nucleus of cellular detritus was surrounded by active macrophages and 6-8 fibroblast layers. Extensive defects (cavities) were observed in the alveolar bone. Osteogenesis was less active than after 15 days, although the periosteum structure was normalized and restored.

It should be noted that against the background of reduced inflammation on the 15th day active osteogenesis occurred in tooth with the bimetallic pin. In teeth with a silver pin weak focal osteogenesis was observed only on the 90th day. Presumably, direct electrical current of 5-12 μA stimulates osteoblasts, thus activating reparative processes in the periodontium. On the basis of our findings the use of bimetallic pin can be recommended for the treatment of destructive apical periodontitis.

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