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Intensity of Approximal Contacts as a Factor Which Conditions Direction of Seepage of Biologic Fluid in a Periodontal Area.

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ABSTRACT

It is known that all general pathologic processes are initiated, are a result of or are supported by a trophism disorder. Biologic fluids seepage direction determines a possibility of securing trophism in organs and tissues and depends on a wide range of factors, but the most important one is a difference of pressures in carrying and deferent areas of a tissue region. The article presents a possibility of change of the direction of a biologic fluid flow, in the periodontal area, which is a result of approximal contacts intensity loss.
Keywords: approximal contact, periodontium, biologic fluid, pressure, seepage, atrophy.

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INTRODUCTION

Volume and direction of seepage of biologic fluids in an interstitial space, as a rule, is regulated within fairly narrow limits, hydrostatical and colloidal osmotic pressure is automatically readjusted in response to agitation of blood and lymphatic vessels [1, 2, 3, 4]. Bone tissue, as distinct from soft tissues, is a complex pore system, where seepage direction depends on the hierarchy of pore diameters, composing the system, and difference in pressure of carrying and deferent areas of the system [5, 6, 7].

From the viewpoint of hemodynamics, a cortical plate of an alveolar bone is an open pore system. Talking about biologic fluids flow, we mean seepage of extravasal fluid which has left the vascular bed in a pore space of a mandibular bone. Heart, generating some pressure, creates conditions for the direct seepage of the pore fluid into different anatomic volumes. The pore fluid being there changes its and tissue's characteristics as appropriate. At this time fluids seeping through anatomic volumes are defined with the help of corresponding terms:

- Fluid locating in the volume of alveolar bone pore space is considered to be a pore fluid after leaving vascular bed before seepage from nutrient canal into periodontal fissure volume;
- Fluid seeping from nutrient canal, locating in the periodontal fissure volume, is considered to be a crevicular fluid before entering mouth cavity and contamination at mixing with mouth fluid;
- Mouth fluid, which in a normal state is located outside the periodontal fissure volume, in case of inverse seepage contaminates deep sections of periodontium.

Fluid's direct seepage from the alveolar bone area, through periodontal ligament fibres, is caused by the difference of atmosphere pressure and pressure in systemic circulation peripheral section which is several times higher than the atmospheric one. This law corresponds to formula 1 and is true under evident approximal contacts of dental arch.

$$P_{atmosphere} + P_{tooth\ root} < P_{crevicular\ fluid} \leq \sigma + P_{capillary\ pressure} \quad (1)$$

Where σ is a surface energy density (surface tension coefficient).

Pressure decrease in the system's carrying area or pressure increase in the deferent area leads to change of rate and direction of biologic fluids flow and subsequently to trophism disorder.

Possible progress of atrophy is conditioned by a variable $P_{tooth\ root}$. In turn, value and duration of tooth root's pressure on the cortical plate, more precisely – on throats of pores opening into periodontal fissure gap, depend on approximal contacts intensity. Evident approximal contacts, under non-axial loading of teeth, condition translational dosplacement of a tooth root. If there are no evident approximal contacts, non-axial loadings lead to rotational displacement of a tooth. In this case direct seepage of biologic fluids in some moments of obturation can turn into the indirect one. Change of seepage direction is possible under pressure gradients correspondence to formula 2.

$$P_{atmosphere} + P_{tooth\ root} = P_{mouth\ fluid} > \sigma + P_{capillary\ pressure} \quad (2)$$

Increase of pressure in the periodontal fissure volume, during the process of mastication load, may be regarded as a sequence of hydraulic surges which lead to decrease of linear and volumetric blood flow. At initial stages of periodontitis these facts are a background of emerging of periodont atrophy, at later stages – of its manifestations.

METHODS

To confirm or confute the possibility of the inverse seepage of a biologic fluid in the periodontal fissure volume and of the progress of atrophy conditioned by this process, the research involved 170 patients with dental arches defects of the III grade according to Kennedy. The research was carried out using an orthopantomograph with 3D-graphics function Toshiba PaX – Reve 3D, under anode voltage 88 kVp and tube current 5.0 mA.

At the first stage, all participants of the research passed through a professional tooth brushing. Accepting degree of movableness of a tooth, which distally limits the defect of dental arch wholeness, as a qualifying indicant, we have set three groups. The first group included 54 patients, whose dental arch defect was limited by a tooth with physiologic movableness. The second group included 63 persons whose dental arch defect was limited by a tooth of the I degree of movableness. Teeth, which distally limited the defect of dental arch wholeness, of 53 patients of the third group were characterized by movableness of the II degree (table 1).

Table 1: Quantitative description of groups of patients (n=170) passed through the research

	Men		Women		
Age / Movableness	under 35	36-45	under 35	36-45	total
Physiologic 1 group	17	8	14	15	54
The first degree II group	15	16	18	14	63
The second degree III group	14	11	11	17	53
Total	46	35	43	46	170

Into a patient's gingival pocket, from the mesial side of the tooth, which limited the dental arch defect, we inserted a loose cotton swab saturated with radiopaque substance "Ultravist". Immediately after intake of the radiopaque substance we performed imaging examination. In the image, using the "area" tool, we estimated the blackening area of the inserted swab with the radiopaque substance.

Then research persons chewed a stick of gum for 20 minutes. According to the research requirements, chewing was unilateral, with loading of teeth limiting the dental arch defect. Thereafter we carried out the second imaging examination and estimated the blackening area. Comparing blackening areas in the first and the second image, we judged seepage processes ongoing in the periodontal fissure gap. If the blackening area in the second image was larger for over 10% than the first image area, we assumed that there were the inverse seepage in the loaded tooth area.

MAIN PART

The research we carried out showed that under the mastication load's influence the fluid in the periodontal fissure gap may seep both in coronary and apical directions. Ratio of images with inverse seepage in groups of persons with different degrees of teeth movableness is shown in table 2.

Table 2: Relationship speaking for the fluid inverse seepage in groups of persons with different degrees of teeth movableness

	Physiologic movableness	Movableness of the 1 degree	Movableness of the II degree	Total
Amount of initial images	54	63*	53**	170
Amount of second images with blackening area increased 10%	0	7	13	20
Ratio %	0	11.1%	24.5%	11.8%

*The first group distinction from the second group is statistically significant if the error level is not more than 5% [P<=0.05].
** The second group distinction from the first group is statistically significant if the error level is not more than 5% [P<=0.05].

In case of the first group of patients, in the second images the blackening area after mastication load did not differ or differed less than 10% of the first images blackening area. In case of the second group, in 7 second images, which is 11.1%, the blackening area after mastication load differed more than 10% of the first images blackening area. In case of the third group, in 13 second images, which is 24.5%, the blackening area after mastication load differed more than 10% of the first images blackening area. Only in 20 cases from 170 cases of the studied repeated imaging examinations we observed increase of blackening area due to radiopaque substance intake after mastication load, and this amounted to 11.8%.

CONCLUSION

From the biophysical viewpoint, obtained data can be interpreted as follows. In the sample under research 54 teeth, which limit the dental arch defect (31.8%), move in a translational way under the influence of occlusal load. In 116 cases (68.2%) teeth, limiting the dental arch defect, of different degrees of pathologic movableness, rotate circumferentially, with different amplitudes corresponding to rotation centre location. If patients do not ask for orthopedic aid, then the rigid interaction "tooth-bone", which is not cut short by remedial measures within a long period of time, causes elastic deformations conversion into irreversible ones. Thus, as the atrophy develops, the tooth's rotation centre moves in apical direction.

The revealed principle's pathophysiological aspect is observed in the fact that transition from the tooth's physiologic movableness to other movableness degrees can be regarded as a failure of compensatory mechanisms which are caused by tissue damage inlficted by occlusal load (2). In this case, the group with the physiologic movableness of teeth distally limiting the dental arch defect can be considered as a control group (n=54). And it is logical to unite persons with the decompensated periodontium (n=116) into a study group (table 3).

Table 3: Possibility of the fluid inverse seepage in periodontium of teeth with pathologic movableness

	Control group	Study group
Amount of initial images	54	116
Amount of second images with blackening increase more than 10%	0	20
Ratio (%)*	0	17,2

* The control group distinction from the study group statistically is significant if the error level is not more than 5% [P<=0.05].

The process's hydrodynamic component is interesting from the viewpoint of atrophy progress. In case of teeth pathologic movableness augmentation, in 17.2% of cases occlusal load leads to transition from the ratio of hydrodynamic variables conditioning biologic fluids direct seepage, which are described in formula (1), to those which correspond to formula (2). With resorption augmentation and movableness degree increase we observe increasing of possibility of the tooth rotational displacement, which is accompanied by emerging of the mouth fluid inverse seepage in the periodontal fissure gap. The process is accompanied by hydropreparing of periodontium tissues and their contamination, which without appropriate treatment invariably leads to atrophy progress [8, 9, 10].

RESUME

Mastication loading of periodontium of teeth with physiologic movableness does not cause change of a pressure gradient in the periodontal fissure volume and does not change biologic fluids flow direction.

Mastication loading of teeth with pathologic movableness in 17.2% of cases creates conditions for inverse seepage of fluids in the periodontal fissure volume, and that can pathogenetically aggravate or initiate hydropreparing and contamination of deeper sections of periodontium.

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