Morphoclinical aspects of the human paraprosthetic gingival mucosa

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Abstract
The multiple and various changes that the human gingival mucosa undergoes when coming into contact with a denture, require a histopathological study correlated with that of clinical manifestations. The highlighting of the histological lesions of the prosthetic field’s mucosa is extremely important in the study concerning the tolerance of the oral cavity tissues towards the materials of dentures, because it has been observed that different materials can cause the same type of clinical changes. The clinical research has been carried out having as a basis a group of patients, carriers of fixed dentures made of different materials, the study method consisting in their clinical evaluation. The investigation of microscopic preparations, obtained through drawing mucosa from those patients under study, has been made by using both usual colorations for an overall examination of the tissue architecture, as well as special colorations for pointing out certain structures. The results of the investigation have made clear the fact that the clinical changes of the prosthetic field’s mucosa can be adaptable to the denture or can react pathologically to the various possibilities of denture aggression. The histopathological picture of the paraprosthetic mucosa lesions is polymorphous due to the morphofunctional complexity as well as to the reacting capacity of the oral mucosa when interfering with a fixed denture.

Keywords: paraprosthetic gingival mucosa, fixed dentures, metal alloy, morphoclinical changes.

Introduction
The human paraprosthetic gingival mucosa represents a structure of a complex morphofunctionality, being integrated in the stomatognathic system. The morphological and functional reability of this system, with the help of dentures, perturbs the existing equilibrium characterizing the elements of the oral biotope. The introduction of a gnathoprosthetic apparatus into the oral cavity has multiple effects upon the oral mucosa, because the prosthetic piece represents both a physical-mechanical material as well as a chemical mixture. Recent investigations show that effects of the dentures on the oral mucosa are influenced by the oral medium and are assigned to its pathology.

According to some authors, every mucosa practically reacts to the contact with a denture. (Ursache Maria, 1999)

The hypotheses concerning the mechanisms, by means of which the denture apparatus influence the histophysiology of the oral mucosa have improved throughout the years, so that investigations performed in this field have led to different opinions. However, most studies describe the role played by the local factors of irritation, since the general factors only diminish the strength of the mucosa to the action of the local factors.

There are authors who make up a classification of the etiopathogenical factors, corroborating the general etiology with the local one, characterizing the prosthetic acrylic dentures as a real sponge for the oral microbial flora (Monsenego P, 1981).

On the contrary, other researchers relate the action of the local factors to the general state of the body, considering that this state influences the paraprosthetic stomatopathy through the configuration of the general bioclinical indices (Burlui V, 1989).

The dentures exercise several aggressive actions upon the oral mucosa leading to a reaction or even to a pathological response of the mucosa. The mechanisms through which a denture has a negative influence upon the encountered mucosa are multiple. (Nikawa H et al., 1991; van Loon LA et al., 1992).

The main types of the dentures’ aggression upon the prosthetic field’s mucosa are mechanical, thermal, toxic-chemical, electrochemical, immunological and microbial.

The survey regarding the clinical changes of the prosthetic field’s mucosa are of a special interest because it has been noticed that in many cases the clinical aspect of the lesions of the human paraprosthetic gingival mucosa is similar, although the aetiopathogenical mechanisms and the prosthetic materials coming into contact with the mucosa are different.

On the other hand, the factors that characterize the patients, i.e. their age, sex, health, oral hygiene, and on
the other hand, the type and the physical-chemical properties of the denture material are of a distinct importance in the appearance and evolution of these lesions.

In some cases, the changes of the gingival mucosa adjacent to the denture have been characterized by adaptation, disappearing after this period.

On other occasions, no clinical manifestations with an inflammatory character have been revealed, but the existence of varied morphopathological lesions has been observed.

Material and method

The clinical investigation was carried out on a number of 151 patients, carriers of fixed dentures with a metallic component of copper-chrome-nickel alloy. Those selected were patients of the Prosthetic Denture Clinic during 2001–2005. The patients studied, of both sexes, aged 28–73, did not present any affections of the oral mucosa, were non-smokers and did not work in a toxic environment.

The study method consisted in the clinical evaluation of the patients according to a medical care record, especially elaborated, out of which I extracted details referring to the patients’ age, sex and origin, the maxillary with denture, that section of the dental arch with a fixed denture, the type of material in the fixed denture, the modeling of the occlusal surface of the denture, the clinical signs of the alteration of the paraprosthetic mucosa.

The morphopathological study was carried out on a number of 21 fragments of human gingival mucosa taken from patients, which are carriers of fixed dentures. The taken fragments had a length of 3–4 mm and a width of 2–3 mm.

The method of the morphopathological study unfolded in two stages:

- a stage of drawing the fragments of paraprosthetic gingival mucosa through surgical techniques;
- a stage of processing the gathered fragments through histological techniques.

The fragments were taken from patients by extracting the supporting teeth of the fixed denture. There were excised fragments of gingival mucosa in excess, which had an inadequate resilience, in order to regularize the wound borders after the extraction and to prevent any possible complications.

The fragments were washed in saline solution and kept in different fixing liquids according to the structure to be distinguished: Lillie liquid, Backer liquid, saline formol. The fixed and washed pieces were submitted to the technique of inclusion in the liquid paraffin.

The blocks were selected with the help of the paraffin microtome, the dimensions of the sections being of 5 µm. The seriated sections were numbered in a consecutive order.

The blades were colored differently, taking into consideration the morphological substrate highlighted: Haematoxyllin–Eosine, Giemsa, Goldner–Szeckelly, Van Gieson, Gömöri silver impregnation, Schiff Hotckinss Mc. Manus periodic acid coloration.

Results

The changes of the human paraprosthetic gingival mucosa have led to a detailed histopathological study, which, in correlation with the clinical manifestations and the physico-chemical characteristics of the materials of the dentures (copper and chrome-nickel alloys), have provided important data regarding the tolerance of the oral cavity tissues to the materials used in the making of the dentures.

Because of the clinical evaluation, the patients were divided into two groups according to the material of the dentures (Table 1).

<table>
<thead>
<tr>
<th>The type of prosthetic material used</th>
<th>No. of patients</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper alloy</td>
<td>127</td>
<td>84.1</td>
</tr>
<tr>
<td>Chrome-nickel alloy</td>
<td>24</td>
<td>15.9</td>
</tr>
<tr>
<td>Total</td>
<td>151</td>
<td>100</td>
</tr>
</tbody>
</table>

The distribution of the two categories of patients according to their age is different (Table 2).

<table>
<thead>
<tr>
<th>The age group (years)</th>
<th>Patients with copper alloy dentures</th>
<th>Patients with chrome-nickel alloy dentures</th>
</tr>
</thead>
<tbody>
<tr>
<td>20–30</td>
<td>9</td>
<td>–</td>
</tr>
<tr>
<td>30–40</td>
<td>19</td>
<td>1</td>
</tr>
<tr>
<td>40–50</td>
<td>45</td>
<td>3</td>
</tr>
<tr>
<td>50–60</td>
<td>37</td>
<td>13</td>
</tr>
<tr>
<td>60–75</td>
<td>17</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>127</td>
<td>24</td>
</tr>
</tbody>
</table>

The number of the patients of the two age groups is reduced while the number of the patients in the third and fourth age groups is increased.

The period of time in which the denture is used represents another factor that influences the appearance of a paraprosthetic stomatopathy.

The distribution of the patients based on the period of denture usage is given in Table 3.

<table>
<thead>
<tr>
<th>The denture usage period (years)</th>
<th>No. of patients with copper alloy dentures</th>
<th>No. of patients with chrome-nickel alloy dentures</th>
</tr>
</thead>
<tbody>
<tr>
<td>3–5</td>
<td>17</td>
<td>–</td>
</tr>
<tr>
<td>5–10</td>
<td>57</td>
<td>1</td>
</tr>
<tr>
<td>10–15</td>
<td>42</td>
<td>8</td>
</tr>
<tr>
<td>15–20</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>127</td>
<td>24</td>
</tr>
</tbody>
</table>

Most of the patients with copper alloy dentures carried these for 10 or 15 years because the appearance of dental or mucosal affections or of denture biodegradation required the ablation of gnathoprosthetic fixed apparatus. 59 patients out of 127 from this category presented signs of clinical inflammation of the paraprosthetic gingival mucosa.

The subjective clinical signs detected at these patients are presented in Table 4.
As far as the objective clinical signs of stomatopathies caused by the copper alloys of the denture are concerned, we distinguished the most varied lesions of the paraprosthetic mucosa (Table 5).

Table 5 – The distribution of patients with copper alloys dentures based on the clinical modifications of the paraprosthetic mucosa

<table>
<thead>
<tr>
<th>Subjective clinical signs</th>
<th>No. of patients</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>erythema</td>
<td>14</td>
<td>23.7</td>
</tr>
<tr>
<td>cyanosis</td>
<td>4</td>
<td>6.7</td>
</tr>
<tr>
<td>tumefaction</td>
<td>14</td>
<td>23.7</td>
</tr>
<tr>
<td>pigmentation having the aspect of a tattoo</td>
<td>1</td>
<td>1.6</td>
</tr>
<tr>
<td>bleeding when being touched</td>
<td>11</td>
<td>18.8</td>
</tr>
<tr>
<td>ulceration</td>
<td>2</td>
<td>3.4</td>
</tr>
<tr>
<td>associated clinical sings</td>
<td>13</td>
<td>22.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>59</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

The macroscopic aspect of the lesions of the paraprosthetic mucosa was different, starting from simple changes of the color with a linear aspect up to ulcerated lesions. Different deteriorations were frequently encountered at the level of the gingival papillae, such as reddish cyanotic coloration, turgescent aspect and fragmentized relief (Figure 1).

At the level of the edentulous crest ulcerations associated with tumefactions of the free gingival margins of the supporting teeth and even reddish impregnations of the tooth stumps were noticed (Figure 2).

From a microscopical point of view, in the analysis of histological products, obtained by the preparation in the lab of fragments of human paraprosthetic gingival mucosa, we observed the existence of polymorphous lesions, depending on the type of material used in the construction of the dentures.

During the investigation of the fragments of human paraprosthetic gingival mucosa, taken from carriers of fixed dentures with metal wplia component, by means of photonical microscopy, lesions of the papilla were predominantly encountered, although macroscopically no inflammatory lesions were noticed.

At the analysis with different microscopical objectives as a goal, we noticed a pavimentos epithelium stratified with acanthosis, the accentuation of conjunctive papillae and pronounced parakeratosis (Figure 3).

There were cases of lesions of epithelium-lamina propria junction. In other situations, we noticed thick fascicles of collagen and intense picrofuxynophile in the lamina propria adjacent to the lesion, areas of hyaline dystrophy being observed locally.

The examination of the colorated Gomori sections pointed out the existence, in some cases, of an acute inflammatory process characterized by the predominance of neutrophils polymorphonucelars, of phenomena of leukocyth margination as well as of angiogenesis, even with vessels of neo-formation grouped in a nodular way (Figure 4).

Areas of necrobiosis were observed at the level of the same sections. Going on to the microscopic investigation of histological preparations obtained from fragments of human gingival mucosa drawn from patients carriers of dentures with a metal component of cooper alloys, condylomatous lesions were remarked.

A stratified pavimentos epithelium with acanthosis and discreet parakeratosis was revealed on the preparations examined through the magnifying glass. In other cases, areas with intense lesions of necrobiosis at the level of lamina propria were observed in the Giemsa colored sections.

Moreover, fibersclerosed areas with hiperplasious collagen, with a disposition of filament meshwork were noticed on the preparations, which were histochemically coloured Goldner–Szeckelly (Figure 5).

The examination of other sections revealed the disposition of a follicular type of the mononuclear inflammatory cellular elements in the gingival lamina propria.

There was observed a multitude of nervous elements in the lamina propria of the fragments of gingival mucosa studied, elements that appear tumefied, separated by interstitial oedema, phenomena of reacting neuritis being observed.

When examining the Gomori sections, which were colored immunohistochemically, there was observed the presence of koiocytes, which cover the entire surface of the epithelium and of the mitoses specific to profound strata.

At the level of the junction epithelium-lamina propria there are both koiocytes, with a perinuclear luminous area and hyperchromic nucleus, as well as a subjacent conjunctive tissue with pronounced lax oedema and rare inflammatory elements (Figure 6).

Discussions

The clinical changes suffered by the oral mucosa when encountering a denture represent one of the highly tackled themes by the scientific literature.

Recent studies mention the results of several authors that have described the modifications of the oral mucosa at the contact with the dentures made out of metal alloys with a different composition from that of the metal alloys studied in this paper.

According to the clinical data, we have observed the fact that most of the patients under study had fixed dentures with a metal component based on copper. This is the result of the dental prosthesis, which they suffered five years before resorting to our clinical service.

Throughout the last years there has been observed a tendency to replace copper alloys with chrome-nickel alloys in the course of therapy of mass dentures.
Figure 1 – Reddish-cyanotic, turgescent papillas with a fragmentized aspect

Figure 2 – Ulcerated paraprosthetic mucosa. Reddish impregnation at the level of 2.4

Figure 3 – Papilloma of paraprosthetic gingival mucosa (Goldner–Szeckelly staining, ×100)

Figure 4 – Paraprosthetic gingival mucosa. Lamina propria with an acute inflammatory process and phenomena of angiogenesis (HE staining, ×100)

Figure 5 – Gingival mucosa with fibbersclerosed areas at the level of lamina propia (Goldner–Szeckelly staining, ×100)

Figure 6 – Paraprosthetic gingival mucosa. The junction between epithelium–lamina propria and oedematous conjunctive tissue (Gömöri staining, ×200)
As far as the distribution according to age groups is concerned, the present study highlights the fact that the patients with the age between 20–30 years and 30–40 years presented forms of reduced partial edentation, which required prosthesis for the first time. Consequently, they had to be followed-up in order to detect the appearance of a paraprosthetic stomatopathy.

The number of patients in the next age groups is increased, because these suffered several dental afflictions in the passing of years and were applied various treatments, including repeated dentures. Most of the patients carriers of wipla chrome-nickel alloy dentures belong to the last two age groups, because they benefited from prosthetic therapy in the period when this metal alloy was frequently used. Nowadays, the use of this alloy in the denture therapy is very rare.

Although most of the patients carriers of dentures with a metal component of wipla chrome-nickel alloy used dentures for over 15 years, there were detected no subjective or objective clinical signs of inflammation of the paraprosthetic mucosa. Recent scientific literature mentions the presence of clinical manifestations in the form of allergies at patients with chrome-nickel alloy dentures. (Garau V, 2005; Mehliluc M, 2005)

As far as their subjective clinical signs of stomatopathies induced by copper alloys are concerned, the studies in this field mention that the feelings of metal or foul taste, of itches or of burns are caused by the phenomenon of galvanic polarizing in the oral cavity (Panait, 1998, Costin G et al., 1998). This phenomenon is based on electrochemical reactions between metal alloys and oral fluids, as it is known that every dental material applied in the oral cavity presents a certain level of solubility in the saliva (Bratu D et al., 2001).

Other investigations show the persistence of subjective accusations with a lower intensity, sometimes months after the removal of the fixed denture. It was elaborated another hypothesis about the existence of a correlation between the relatively high frequency of galvanic disorder and the number of dentures (Bodnar V et al., 1998).

The results of other studies point out that the area of subjective signs of paraprosthetic stomatopathies caused by copper alloys is relatively limited, the appearance of pain located in the labial, jugal or lingual zone, as well as the decrease of gustative sensiveness up to ageusia being specified as subjective signs (Stelea O et al., 2000).

The results of our study regarding the objective clinical signs of stomatopathies induced by copper alloys point out the existence of a specific lesional polymorphism. Other studies show the fact that the macroscopic lesions of the type “periodontal gingival inflammations, with hyperemia, oedema and bleeding and which have been amended after the removal of fixed dentures”, might be the result of oral galvanic microcurrents, but the assumption of local anaphylactic reactions, based on the interaction of metal ions or the products of corrosion of the prosthetic material with the oral medium is not excluded (Costin G et al., 1998).

Other investigations mention the existence of leucoplasia lesions of the paraprosthetic mucosa, as well as metal impregnations having the aspect of a tattoo at the level of the marginal periodontium (Bratu D et al., 1998).

The latter were observed at the level of the marginal periodontium of the crown stumps reconstituted with silver amalgam, covered with metal crowns. Regarding the histological changes of the paraprosthetic mucosa, caused by dentures made out of modern chrome-nickel alloys, our study highlights the existence of the papilloma.

Other investigations point out the existence of unspecific inflammatory reactions. These were characterized by the presence of an epithelium with parakeratosis, pronounced acanthosis and spongiosis, and mononuclear inflammatory infiltration and dilatation of the vessels were noticed at the level of the subjacent conjunctive tissue (Jörgensen RB, 1983).

The current research emphasizes the existence of lesions of the type of acuminate condylomata as a result of the anatomico-pathological examination of the fragments of mucosa drawn from patients with copper alloy dentures. The results of other investigations show subacute or chronic inflammatory modifications (Costin G et al., 1998).

The chronic inflammatory processes were characterized by the presence of a hypertrophic mucosa with parakeratosical epithelium and high conjunctive papillae. Blood vessels dilated with abundant perivascular infiltrate of lymphocytes and plasmocytes, as well as granules of haemosiderin were detected in lamina propria.

From a morpho-pathological point of view, the acute or chronic gingival processes highlighted an atrophic epithelium, with thickened epithelial crests and easily distinguished conjunctive papillae without any ramifications.

The acute inflammatory infiltrate characterized by the predominance of neutrophyle polymorphonuclears, but also subacute infiltrate of lymphocytes and plasmocytes and vessels ectasised with oedem and perivascular and intravascular inflammatory infiltrate with phenomena of leukocytic margination were noticed in the lamina propria.

As far as the appearance of condylomatous lesions of the paraprosthetic gingival mucosa, presented in this study, is concerned, recent investigations reveal the role Human Papillomaviruses (H.P.V.) play in the appearance of these lesions in the oral sphere and not only (Stânceanu Fl, 2001).

The role of Human Papillomaviruses in the appearance of nuclear lesions of the host cells is indefinite (Rihet S et al., 2000).

The viral proteins of oncogenical H.P.V. can either bind or hold back functionally the genes of proteins of tumorous suppression as p53. These phenomena can lead to disorder of the cellular cycle and have as their consequence the instability of the cellular genome which host the oncogenous H.P.V.

This mechanism cannot explain, however, the association between the presence of the D.N.A.- aneuploidy in the acuminate condylom and the presence of non-oncogenous H.P.V. in the same type of lesion.
Our study has not determined the correlation between the aggression possibilities of fixed dentures with a metal component of copper alloys and the presence of acuminate condylomata at the level of paraprosthetic gingival mucosa.

Conclusions

1. The morphofunctional complexity of the human paraprosthetic gingival mucosa confers it the ability of reacting to the contact with a fixed denture having a metal component.

2. The histologic reactivity of the paraprosthetic gingival mucosa can have an aspect of adaptation to the denture or can lead to the appearance of various mucosal lesions, because of diversified aggressions of the dentures.

3. The human paraprosthetic gingival mucosa, which is in contact with fixed dentures having a metal component of copper, alloys presented clinical inflammatory lesions as well as morphopathological ones of the type of acuminate condylomata.

4. The picture of morphopathological lesions of the human paraprosthetic gingival mucosa, being in contact with wipla chrome-nickel alloy dentures revealed papillomatous lesions.

References


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Received: April 20th, 2006
Accepted: May 10th, 2006