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PhD THESIS

CONTRIBUTIONS TO THE STUDY OF MARGINAL PERIODONTIUM MODIFICATIONS IN OCCLUSAL TRAUMA

ABSTRACT

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KEY WORDS

Occlusal trauma, marginal periodontium, morphology

CURRENT KNOWLEDGE

The dental organ is a complex of differently structured tissues but morphologically and functionally harmonized in order to buffer and transmit the masticatory pressures [Boboc 1996, Bratu 1991; Costin 1999].

The dental organ or “odontium” has 2 componets: the odontium or the masticatory component and the periodontium or the support component.

The periodontium has two components: the support periodontium and the coating periodontium. The support periodontium is represented by the cement, alveolar bone and periodontium, while the coating periodontium is represented by the gum tissue.

All of the components of the periodontium are biologically interdependent because an aggression with disfunctional consequences on one of the components has repercussions on all of the others [Lindhe 1986; Löe 1993; Machado & al. 2009].

The gingival mucosa is part of the masticatory fibro-mucosa that covers the alveolar processes and surrounds the cervical region of the teeth. Together with the supraalveolar ligaments form the coating periodontium.

Anatomically, the gingival mucosa presents several parts: the free or marginal gum tissue, the interdental gum tissue and the adherent gum tissue.

The free gum tissue covers the tooth parcel on the vestibular and oral face, continuing on the proximal faces with the interdental gum. It stretches between the free edge of the gum and the bottom of the gingival purse, being 0,5-1,5 mm wide. On a section it has a triangular shape, having an oral or vestibular side and a dental side which forms the soft wall of the gingival sulcus [Craițoiu Ș. and Crăițoiu M. 1995; Narayanan and Page 1983; Niță 1992; Armitage 1999].

Understanding the morphophisiology of the periodontium is necessary to identify the abnormal modifications of the histio-cito-enzimological substrate in the pathology of the periodontium as well as clinical situations that underline the presence of occlusal trauma.

The gingival mucosa is formed from a stratified malpighian epithelium and a dense and unsorted connective tissue, separated and outlined by a basal membrane. Starting from the basal membrane and going to the surface, the epithelium presents three layers of overlaying cells: The basal layer, The plyhedric cell layer (mucosal layer of Malpighi, the spine cell layer) and The superficial layer [Mogoantă 2004 Carranza 2002].

The superficial layer of the epithelium varies according to its progressive keratinization or the lack thereof. If the epithelium is keratinised, the spine cell layer is covered by a granulous layer whose cells contain keratohyalin granules and Odland bodies within the cytoplasm. If the layer is parakeratinised, even if the cells are very flattened they keep their nucleus, which is picnotic and sticks to the cell wall [Calandriello & al,1996].

The gingival line is formed from fibrous connective tissue. On the marginal gum it receives the desmodontal ligament, participating on the interdental and gingivo-alveolo-dental anchorage. In the periradicular region, the mucosal lining is fixed on the external cortical of the alveolar bone, ensuring the cohesion between the gum and the bony part of the fixed gum tissue. Histologically, the gingival line contains cells, fibers, nerves and ground substance. Vascularity ensures the functionality of the lining through its blood and lymph components and rich innervation [Bogdan 1989; Crăițoiu Ș., Crăițoiu M. 1995; Mogoantă 2004].

Dental occlusion can be considered as the sum of inter-arching reports in both static and dynamic contact [Dawson 1992, Ash 1993; Burlui 2000]. The morphology

of the occlusion surface of the two dental arches is very similar in both mandible and maxilary, having though some differential aspects.

Occlusion is considered as one of the three determinants of the mandibular dynamics. In its own, occlusion presents an anterior and a posterior determinant. Between the two determinants of the occlusion there is a mutual protection, that acts in both dynamic and static phases of occlusion [Burlui 2000].

Any oscillation of the level of normal occlusion or any inadequate occlusal interference has the possibility to trigger pathological modifications in any of the elements described above.

The Romanian school of dentristry considers five criteria of a functional occlusion [Costa, et al. 1975, Popescu 2008].

Occlusal disorder appear as a consequence of abnormalities in dental numbers, volume, position, of coronary odontal lesions, dental migrations, edentation, modifications in occlusal parameters, but also secondary to musculo-articular dysfunctions.

Periodontal occlusal trauma is a degenerative lesion that appears when occlusal forces outweigh the adapting capacity of support tissues. When the dental-dental gear is of cusp-fissure type, the vectoring of efforts is done along the axis of the teeth.

Due to the functionally differential structure of periodontal tissues and the topography of the two components (coating and supporting), the defense and resistance systems against aggressive risk factors, both direct and indirect, is very special being conditioned by their character.

Widespread pathological abrasion – is the type of abrasion that is inconsistent with the biological age. Widespread pathological abrasion is a major sign of occlusal dysfunction.

Occlusal trauma can determine a progressive denudation of dental roots, characterized by the displacement of the gum towards the apex of the tooth. There are two categories of gingival retraction: one that can be detected on a clinical examination, and another that is hidden, part of the root being covered by the inflamed wall of a periodontal purse. Occlusal trauma causes and aggravates gingical retraction, thus accelerating the initial epithelial proliferation by a local rash, a clinical form known as McCall's festoons or garlands.

Periodontal sacks appear in secondary trauma, on an already affected periodontium in the presence of infectious and irritating local factors. Relative gingival sacks are actually gingival hypertrophy without destructive events of the subjacent periodontal tissues, on which the gingivo-dental fissures are deepend due to the fact that gum volume is increased. Absolute periodontal sacks located above the bone are characterized by the fact that their terminal end is coronary with respect to the subjacent alveolar bone, while for those that are intraosseous the terminal end is apical [Scannapieco 1998;Taylor 2008; Wolf & al. 2005].

PERSONAL CONTRIBUTION

MATERIAL AND METHODS

The basis of this study is represented by a group of 51 patients with occlusal trauma from which marginal periodontium was recovered and investigated.

The study material was represented by two categories of data sources: the medical documents of the patients from the dentistry and the biological material

consisting of fragments from marginal periodontium obtained from patients that were treated for occlusal trauma.

The study was a complex prospective one, and was split into two main directions: the clinical study and the morphological study of the marginal periodontium.

The investigated parameters were the following: Clinical parameters (Gender, Age, Environment of origin, Smoking, Alcohol, Oral hygene and Presence and extent of dental plaque) and Morphological Parameters (Affected tooth, Location of the tooth on the dental arch, Location of the tooth on the mediosagital plane, Dental migration, Edentation, Presence of abrasion, Presence of gingival retraction, Presence of decay, and Morphological status of the marginal periodontium comprised of: Superficial gingival epithelium, The papillary epithelium/superficial epithelium ratio, Leukoplakia, The percentage of papillary and deep interstitial fibrosis, the deep fibrosis.papillary fibrosis ratio, Deep and papillary vascular density, The deep vascular density/papillary vascular density ratio).

Preliminary data regarding the assessed clinical and morphological parameters has been entered in Microsoft Excel tables from the Microsoft Office 2010 software suite.

The morphopathological study had two components: Macroscopic evaluation of the dental and periodontal lesions and Microscopic evaluation of gum tissue which consisted of histological examination of periodontum fragments on slides stained with H-E, trichrome Masson and antiCD34 antibody immune staining.

Aquisition, processing and morphometric determinations were done usinf specialised software analySIS Pro, ACDSee 4.0, Aperio ImageScope [v12.3.2.8013] and a morphometry module designed in the MATLAB (Mathworks) programme.

Preliminary data from the selected cases that was introduced in Excel tabels was processed with the same Microsof Excel module of the Microsoft Office 2010 Professional software. The Data Analysis module of the Microsoft Excel programme was used to process the data, along with the XLSTAT add-in programme for MS Excel. The algorithm for statistical analyisis contained (for numerical parameters): determination of the minimum and maximum value, the mean value, the standard deviation and variation, Lilliefors, Pearson, Student, Kolmogorov-Smirnov, Kruskal-Wallis and ”χ2" tests. Diagrams (graphs) illustrating evolution tendencies of different assessed parameters as well as statistical comparisons betwen them have been done with the help of the „Graph” instrument from „Word” and „Excel” from the Microsoft Office 2010 Professional software suite and the XLSTAT 2009 add-on for the Excel module.

CLINICAL STUDY

The patients included in the study were mostly males, mature adults, with a mean age of 40, coming from an urban socio-economical environment, more frequently declared as non alcohol-consuming but without the habit of smoking. with poor oral hygene and plaque.

Reviewing the results of the assessement on possible influences of the clinical parameters, some of them being risk factors, on the profile of lesions caused by occlusal trauma, we noticed several interesting aspects.

An initial observation is that the only topographic criterion where we identified correlations with some of the established clinical parameters was a local one and that is the type of affected tooth.

Thus, the frontal group was affected by lesioms caused by occlusal trauma only in mature adults, after 45 years while the lateral groups and especially the molars were affected more often in young adults and teenagers before 45 years.

Lesions caused by occlusal trauma affected only the lateral groups and especially the molars in woemn while in men the lesions affected al three types of teeth in an equal manner

Lesions determined by occlusal trauma located in the frontal group and the lateral group were found only in patients with poor oral hygene while lesions located in the lateral group of the molars were encountered also in patients with a good oral hygene.

In the setting where alcohol consumption was only assumed by a third of number of patients, it was more frequently associated with lesions caused by occlusal trauma located in the lateral group of premolars and most rarely with lesions that were located in the frontal group on incisives.

Paradoxally, smoking and plaque or the socio-economic environment of origin did not have an infuence on the layout of lesions determined by occlusal trauma within the studied groups of teeth

Regarding the influence of clinical parameters on the topography of lesions caused by occlusal trauma of the arch or half-arch, the only statistically validated observations were the significant presence of alcohol consumption in patients with lesions caused by occlusal trauma located on the mandible and the location of lesions caused by occlusal trauma mostly on the left hemi-arch in smokers and on the right hemi-arch in non-smokers

Secondly, for the rest of the assessed correlations between clinical parameters and the topography of the lesions caused by occlusal trauma, be it local or located on one of the arches or one of the hemi-arches, on one side and the other of the medio-sagital line, the statistic tests that were used did not reveal any sort of correlation and influence of external factors on occlusal trauma.

MORPHOLOGICAL STUDY

Reviewing the results of the analysis on the possible influence of morphological parameters, some of them being direct consequences of the pathological event that is occlusal trauma, on the profile of occlusal trauma lesions revealed some aspects that are worth taking into consideration.

A first general observation is in completing the profile for the group of studied patients that had their macroscopic morphological side identified on oral cavity exam.

Thus the profile of lesions caused by occlusal trauma met in patients enrolled in the study looks like this:

Lesions caused by occlusal trauma were more frequently met on molars, on the lower dental arch, without a certain propensity for the hemi-arches placed on each side of medio-sagital plane under the circumstances that the studied group did not contain any patient with lesions caused by occlusal trauma of the canines. Then, patients with lesions caused by occlusal trauma generally presented dental migration, and especiallyvestibulation, unbraced edentations, slight pathological abrasion and often gingival retraction, without untreated decay.

A second observation is that the only topographic criteria where we identified correlations with some of the established morphological parameters was also in the case of morphological modifications, the local topographic criterion that is the type of affected tooth. For the rest, the location of lesions caused by occlusal trauma in one of the dental arches or one of the hemi-arches, on one side and another of the

medio-sagital line did not reveal any influence on the morphological modifications associated with the process of occlusal trauma.

From the wide range of migration phenomenons associated with lesions caused by occlusal trauma only two stood out and presented a very clear polarization with regard to the location of teeth with occlusal trauma

Firstly, we underlined the vetibulation phenomenon that was associated with almost all lesions caused by occlusal trauma located on the incisives and had a propensity for their location on the upper dental arch. This was followed by the mesialisation process which was associated exclusively with lesions caused by occlusal trauma located on the molars and encountered in the vast majority of cases on the lower dental arch. It is also worth mentioning the distalization process which was associated almost entirely with lesions caused by occlusal trauma in the premolars and was encountered only in affected teeth located on the mandible.

Decay, although rarely encountered, had a propensity for incisives and was encountered only on the lower dental arch.

Finally, pathological abrasion was the apostle of incisives, being encountered at thise site only in moderate forms. It did not skip the molars however and to a lesser extent the premolars, presenting lighter forms in both situations.

Edentation and gingival retraction associated with lesions caused by occlusal trauma did not show a particular distribution with repsect to the types of location for the teeth affected by occlusal trauma

The leucoplastic lesion, and important lesion for its premalignant nature, showed a higher degree of association with lesions caused by occlusal trauma located in the lateral groups and even an increase of severity from the lateral or frontal groups. Its presence did not correlate however with the position of affected teeth on the arches or hemi-arches.

The epithelium of the gingival mucosa taken as a whole presented modifications of the thickness with respect to the type of affected tooth, having a thickness between 400 and 500 μ on the mucosa around the affected incisives and over 400 and even above 500 μ in the lateral groups. The epithelium of the gingival mucosa around the affected teeth did not however present significant variations with respect to the arch or hemi-arch on which the affected teeth were located.

The outer layer of the gingival mucosa epithelium around the affected teeth had a different behavior, presenting a tendency to thicken from the frontal towards the lateral groups of teeth

The papillarey compartment of the epithelium, however, did not present siginifcant variation with respect to the affected tooth or the hemi-arch on which the tooth was located, but with respect to the dental arch on which the affected tooth was located, showing the tendency of the mandible to thicken in comparison with the maxillary.

For the rest, fibrosis and vascular density did not present significant variation with respect to the layout of the affected teeth by lesions caused by occlusal trauma, neither in the superficial papillary compartment or the deep compartment of the gingival mucosal line around the affected teeth.

The leucoplastic pathological process appears to be influenced as a whole by the thickness of the gingival mucosal epithelium, especially due to its outer compartment

The leucoplastic lesion has a reduced thickness and it may even disappear as the amount of fibrosis within the papillary lining increases.

The epithelium of the gingival mucosa tends to be thicker especially if the fibrosis from the papillary lining is lower and vascular density of the deep lining is smaller.

The epithelial compartment tends to be thicker if the fibrosis from the papillary lining is smaller and the vascular density is smaller.

In the papillary epithelial compartment, the same tendencies of inverse correlation as the ones described on the total thickness of the epithelium were observed, even more pronounced in the papillary epitheliar compartment/papillary fibrosis and the papillary epitheliar compartment/papillary vascular density relations.

As the fibrosis percentage increases the vascular density decreases, a process which seems logical at first sight. The tendency was more obvious in the superficial compartment located in aposition with the epithelium.

Finally it is worth mentioning that, although there were tendencies, generally of inverse correlation between the studied morphological parameters, these were not statistically validated with one exception, that is the case of fibrosis that influences the presence and extent of the leucoplastic layer.

CONCLUSIONS

Our study came to the following conclusions:

1. The clinical profile of patients that comprised oru study group is the following:
mature adults, with a mean age of 40, coming from an urban socio-economical environment, more frequently declared as non alcohol-consuming but without the habit of smoking. with poor oral hygene and plaque.
2. The local topographic criterion (tyoe of affected tooth) was the only with which most of the clinical parameters orrelated. Thus:
   - Lesions determined by occlusal trauma of the frontal group were mostly encountered in men, after 45 years, with poor oral hygene and rare alcohol consumption.
   - Lesions determined by occlusal trauma of the lateral group of premolars were mostly encountered in women, before 45 years, with poor oral hygene and alcohol consumption.
   - Lesions determined by occlusal trauma of the lateral group of molars were also mostly encountered in women, before 45 years, with good oral hygene of the dental cavity.

   femei, înainte de 45 de ani și la pacienți cu igienă bună a cavității orale.
3. Alcohol consumption was more frequently associated with lesions determined by occlusal trauma located on the lower dental arch where someking was associated especially with lesions determined by occlusal located ont the left hemi-arches.
4. A particularity of the studied group was the absence of patients with lesions determined by occlusal trauma located on the canines. Thus, lesions determined by occlusal trauma were mostly encountered on the molars, more frequently on the lower dental arch, without a certain propensity for the left or right hemi-arches.
5. The morphological profile of patients who comprised the study group consisted in the constant presence of the dental migration phenomenon, especially vestibulation of the unbraced edentations, pathological abrasion and, often, the gingival retraction process but with the absence of untreated decay.
6. .The identified correlations between the macroscopic morphological modifications and the layout of teeth with lesions determined by occlusal trauma were:

- Vestibulation was associated with most of the lesions determined by occlusal trauma located on the incisives and was often encountered on the upper dental arch.
- Mesialisation was exclusively associated with lesions determined by occlusal trauma located on molars and was encountered in most of the cases on the lower dental arch.
- Decay had a propensity for the incisives and was encountered only on the lower dental arch
- Pathological abrasion was encountered especially on the incisives but it was also present on the lateral groups

7. The shear size of the superficial keratinized acellular layer showed an increase of severity from the frontal group towards the lateral groups and was in direct correlation with the evolution of the size of the gingival mucosal epithelium as a whole and its superficial compartment and in an inverse correlation with the evolution of the quantity of mature collagen fibers from the papillary compartment of the gingival mucosal lining and not with that of the deep compartment of the gingival mucosal lining.
8. . The thickness of the gingival mucosa and its superficial compartment had a tendency to increase from the frontal group towatds the lateral groups of teeth and the modifications to the thickness of the epithelium and to its layers showed an obvious inverse correlation with the quantitative modifications of fibrosis from both compartments of the gingival mucosal lining.
9. Modifications of the density of the vascular network from the gingival mucosal lining sketched and inverse correlation with the modifications of the thickness of the gingival mucosal epithelium and those of its superficial layer but not with those deep papillaru epithelial layer.
10. Quantitative modifications of the fibrosis process sketched a logical report of inverse correlation with the modifications of the vascular density in both compartments of the gingival mucosal lining.
11. Unfortunately, the correlations sgown above were only sugested by diagrams of the utilized tests, but were not however statistically validated, the explanation being the small size of the studied group.
12. Finally, one can sustain that the morphological modifications that take place in the different compartments of the gingival mucosa are influenced to a certain extent bay the occlusal trauma lesions and their topography

În final, se poate afirma că modificările morfologice care se produc la nivelul diferitelor componente ale mucoasei gingivale sunt influențate într-o măsură semnificativă de leziunile de traumă ocluzală și de topografia lor.

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