UNIVERSITY OF MEDICINE AND PHARMACY
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PhD THESIS

CONTRIBUTIONS TO THE STUDY OF DENTAL PULP MODIFICATIONS IN OCCLUSAL TRAUMA

ABSTRACT

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KEY WORDS

Occlusal trauma, pulp cavity, morphology

CURRENT KNOWLEDGE

The dento-maxillary apparatus represents and extremely complex morphofunctional entity, being comprised of structurally, filogenetically, and ontogenetically various components.

As the teeth are dependent of their support tissues which maintain them in the alveoli of the maxillary bones, so is the periodontal complex dependent on the activity of the dental arches, the normal occlusal function producing a morphofunctional mechanic stimulation which drives the biological mechanisms that are responsible for the integrity of the periodontium [Costa, & al. 1975, Bratu, Românu 1999; Burlui 2002].

The analysis of the functional occlusion must be used as a basis for all conservative dental, periodontal, prosthetic, surgical and orthodontical therapeutic procedures.

By “odontium” one understands a complex of differently structured tissues but morphologically and functionally harmonized in order to buffer the masticatory pressures [Bratu 1997].

The odontium or the plain tooth, is an appendage of the mouth mucosa and represents the structural unit of the dento-alveolar arches.

On the inside of the tooth lies the pulp cavity, which contains the pulp of the tooth.

The dental pulp is a loose connective tissue, which derives from the mesenchimal papilla, located in the central region of the tooth, in a cavity which is called the pulp cavity or dental cavity (Cavum dentis). Its surface is outlined by the mineralized dentine, from which is separated by the dentinogenetic area.

Histologically, the pulp is made of tissue that holds many of the morphological traits of the embryonic mesenchyme. The young dental pulp has a very rich cellularity whilst the older pulp has a smaller number of cells and shows an enriched fibrilary component.

In order to evaluate the condition of the dento-maxillary apparatus, the following positions are considered as determinant in both clinical and paraclinical investigations: the position of the mandible, the centric relation, the dental occlusion [Bratu, 1991; Dale 2003; Dawson 1992; Ash 1993; Burlui 2000].

Occlusion is one of the determinant factors in the dynamics of the mandible [Burlui 2000].

The occlusion stabilizes the mandible in its positions against the skull, intervening as an important part both in static occlusion and dynamic occlusion, participating in the fulfillment of several roles of the somatognathic system like: phonation, mastication, deglutition, physical function [Burlui 2000; Popescu 2008].

Occlusal trauma is of two types: Primary occlusal trauma = Atypical force + Healthy periodontium and Secondary occlusal trauma = Normal or atypical force + Affected periodontium.

Three stages of occlusal trauma are described: the aggression stage, the repair stage and the periodontal adaptation stage.

Traumatic factors can induce within the pulp an inflammatory cellular infiltration. Inflammatory cells, through the substances they secrete, modifiy the metabolic action of the pulp cells.

High or long term aggressions act on the entirety of the vascular bed, causing irreversible alterations of the pulp tissue. When stimuli of physical, chemical or electrical nature pass a certain threshold, they determine a pain reaction whose intensity is based on the number of nerve endings.

Aging of the pulp is accompanied by involutive and degenerative processes and also hyperplastic processes, in which cases the pulp has a reduced defense capacity [Andreescu 1996; Mogoantă 2004].

The dental pulp reacts to these harmful stimuli, which also include occlusal trauma, by mobilizing a large number of defense cells like: macrophages, lymphocites, polymorphonuclear cells, triggering inflammatory and immune responses, as well as the forming new lairs of dentine [Avery 1994; Bender 1978; Bhascar 1995].

The presence of fibrosis and calcifications indicate a regression of pulp tissue, appearing as astructural microscopical areas of different sizes, with a tendency to converge. Calcium deposits can be linked with both aging of the pulp and with some chronic inflammatory processes.

PERSONAL CONTRIBUTION

MATERIALS AND METHODS

The basis of this study is represented by a group of 45 patients with occlusal trauma from which dental pulp 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 dental pulp 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.

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, Presence of abrasion, Presence of decay, Presence of gingival retraction, Edentation and Morphological status of the dental pulp comprised of: Thickness of the basal layer described by Weil, Thickness of the cell-rich layer/area, Total thickness of the peripheral pulp area (without odontoblasts), Presence and extent of intrapulping calcifications, Percentage of interstitial fibrosis within the dental pulp, Vascular density of the capillary network inside the dental pulp).

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

The morphopathological study had two components: Macroscopic evaluation of the dental lesions and Microscopic evaluation of pulp tissue which consisted of histological examination of dental pulp 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 45, coming from an urban socio-economical environment, more frequently declared as alcohol consuming but without the habit of smoking. Generally, oral hygene was poor and plaque was a frequent occurence.

Generally the statistical correlation test did not validate any of the small differences that occured in the topography of the teeth affected by occlusal trauma in relation to the studied clinical parameters, with two sole exceptions.

The statistical analyisis identified just two possible correlations: lesions caused by occlusal trauma have been located more frequently on the maxillary for smoking patients and those with poor denal hygene and more frequently on the mandible for non-smoking patients and those with good oral hygene.

MORPHOLOGICAL STUDY

A brief review of the macroscopic morphological traits thwt were identified on the examinatoin of the oral cavity sugests that, within the studied group, the tooth with the most affections caused by occlusal trauma was the canine, while lesions determined by occlusal trauma more often favored the maxillary and the left half-arches.

Practically all patients (with one or twe isolated exceptions) carried unbraced, usually intertwined edentations and presented gingival retraction around the teeth that were affected by lesions caused by occlusal trauma.

The profile is completed by one last set of particular traits, consisting in the absence, in large percentages, of dental migration, pathological abrasion and untreated decay.

Morphological macroscopic modifications associated with occlusal trauma that were introduced in the study revealed that, in general, there is no statistically sustained relationship with the layout of the affected teeth, be it individual or in relation to the dental arches or half-arches.

There were, however, a few isolated exceptions. Thus, the migration phenomenon revealed a somewhat particular pattern in the sense that for every type of tooth there was a propensity for for a certain type of migration: for the incisives, vestibulation; for canines, the lack of migration or, when there was the case, distalisation and finally, mesialisation for the molars. For premolars, like a corollary, all three types of migration were encounered for the other tooth types.

Pathological abrasion developed a relationship with teeth affected by occlusal trauma on the dental arches, proving to be a phenomenon more frequently associated with lesions by occlusal trauma of the dental arches.

Finally, the edentation process, which in the vast majority of the studied cases was unbraced, developed a relationship with the layout of the teeth that had lesions determined by occlusal trauma on the dental arches.

Thus, if for the superior maxillary the unbraced edentation panel was strongly dominated by zonal or lateral intertwined edentations along with unilateral uniterminal

edentations, at the mandibular level the tandem was comprised of intertwined edentations, but this time, going along with bilateral biterminal edentations.

The two components of the peripheral area as well as the area taken as a whole have a tendency to grow in the same sense, or, in other words, when the size of the components or the entire area grows, so does the size of the other components or the entire area.

As the percentage of pathological calcium deposits within the mass of the pulp grows, the peripheral area has a tendency to reduce its size as a whole but also by separate components.

As the mass of mature collagen fibers from the pulp grows, the peripheral area as a whole, and lesser by components, has a tendency to reduce its size.

As the density of the intrapulping capillary network increases, the peripheral area as a whole, lesser its individual components, tends to decrease in size.

When the amount of fibrosis increases an expansion of the vascular bed takes place. The phenomenon seesm rather unusual because it is a well known fact that the development of an increasingly dense collagen tissue is accompanied by a decrease of both the stromal cell population and the vascular network. This phnemenon can be explained by the reemergence of some chronic inflammatory processes within the pulp cavity.

The evaluation of correlations between the studied microscopic morphological aspects (peripheral area of the pulp, pathological calcifications, intrapulping fibrosis, and intrapulping vascular density) and topographic classification criteria of lesions determined by occlusal trauma did not reveal any sort of influence that can be sustained by the statistical tests, fact supported by the synopsis of ”p” values calculated for the $\chi 2$ correlation test by means of which this assessement has been done.

CONCLUSIONS

Our study came to the following conclusions

The clinical profile of patients who comprised the studygroup is: mostly males, with a mean age of 45, coming from an urban socio-economical environment, more frequently declared as alcohol consuming but non-smoking, poor oral hygene and plaque frequent as a occurence.

Lesions determined by occlusal trauma were more frequently located on the superior dental arch in smoking patients and with poor oral hygene and on the inferior dental arch in non-smoking patients and with good oral hygene.

A particularity of the studied group was the predominance of the canine location of lesions caused by occlusal trauma.

The morphological profile of patients who formed the study group was: constant presence of unbraced edentation phenomenon, mostly intertwined, and gingival retraction due to significant absence of migration and pathological abrasion and presence of untrated decay.

The links identified between the macroscopic morphological modifications and layout of the teeth presenting lesions caused by occlusal trauma were: the propensity of a certain type of migration for a certain type of tooth, the propensity for the association between pathological abrasion with affected teeth located on the lower arch and the preponderance of the pairs intertwined edentations – unilateral uniterminal edentations on the upper arch and intertwined edentations – bilateral biterminal edentations.

The size of the peripheral area of the dental pulp and that of its components evolved in the same sense, whether it was growth or decrease.

The quantitative modifications to the processes of intrapulping fibrosis, intrapulping calcification and the intrapulping vascular network revealed an inverted correlation with the modifications to the size of the peripheral pulp area and its components, in the sense that the decrease of the peripheral area was associated with an increase of collagen fiber density, calcium deposits and density of the capillary network.

The direct correlation between the amount of collagen fibers and vascular density seems somewhat paradoxal but it can be explained by the reemergence of chronic inflammatory events located in the dental pulp.

The correlations described above, sugested by the diagrams of the tests we used, were not, however, statistically validated, fact which imposes a deeper study on larger groups and the introduction of inflammatory cell population studies.

The morphological modifications that take place in the pulp are influenced by some of the lesions caused by occlusal trauma and their layout to a greater extent and by others to a lesser extent.

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