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Original Research Article

Orthopantomogram (OPG) diagnosis of trauma from occlussion, condylar displacement and the role of dental restorations

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ABSTRACT

Introduction: The periodontal ligament faces even greater occlusal forces, presenting with occlusal trauma radiographic changes locally to the tooth where it operates. The effects of excessive continuous occlusal forces are closely related to temporo-mandibular articulation (TMA) disorders appearing radiographically with condyle displacement in relation to articular eminence. A definitive diagnosis of occlusal trauma would be completed with the clinical assessment of occlusion.
Aims: Distinguish radiographic signs of occlusal trauma in OPGs, tooth pathological migration evident in radiography that are related to trauma, the role of dentists in the initiation of occlusal trauma.
Materials and Methods: 100 randomly digital Orthopantomograms (OPG) of previous patients at the clinic of Albanian University, were selected and were grouped according to the number of teeth in oral cavity and the presence or absence of occlusion. Each of them was analyzed and categorized on basis of radiographic signs of occlusal trauma at the level of periodontal structures, and the symmetry of the condylar heads. The teeth presenting the characteristic signs of trauma were determined if they were treated with fix prosthodontics crowns or in operative dentistry. The radiographs were screened for the presence of tooth pathologic migration associated with trauma signs.
Results: 36% are the group of patients with less than 20 teeth in oral cavity with or without occlusion. 64% are patients with a minimum of 20 teeth, but with occlusion due to prosthetic or implant replacements. The criterion of bone trabeculae parallelism and the local thickening of the periodontal ligament are noticed in the value of 22%, followed by thickening of lamina dura at 20%. The asymmetry of articular heads is found on 25% of radiographs. Pathological migration to the mesial direction was observed in 13% of teeth that were subjected to occlusal trauma. 32% of teeth presenting trauma signs were restored with dental fillings and 23% of them with crowns.
Conclusions: Radiographic signs of occlusion trauma are evident at the level of the lamina dura, the density of the alveolar bone, the width of the PDL space. Pathologic migration and asymmetric condylar heads are associated mostly with trauma. Dentists play an important role in preventing occlusal trauma after dental replacements.

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1. Introduction

Occlusion trauma is described as damage to the constituent structures of the periodontal, preceded by the application of an occlusal force that exceeds the adaptive capacity of the periodontal ligament.[1–3] Occlusion trauma may not have the same clinical signs as gingival or periodontal inflammation, as the bacteria are not responsible for its cause.[1–6] Consequently, there is no attempt to find clinical signs of pocket presence or loss of attachment, similarly for both clinical cases.[2] From 1901 to 1960, there has been a stabilization of theoretical-practical ideas regarding the exact definition and expression of what we call occlusion trauma, clinically and radiographically, as distinguished.[6]

Divergence, convergence of tooth roots predetermine the size of the bony area where these forces from occlusal

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trauma exert a significant oppressive effect according to or in opposition to the longitudinal axis of the tooth. Short, conical, slender, or fused roots rather than divergent roots are more predisposed to occlusal traumatism.[1,7]

The suppression of periodontal structures is associated with the compression of the arteries, resulting in the lack of oxygen and glucose that these vessels mechanically transport through the blood to the relevant periodontal tissues.[6] This is where the first stage of occlusion trauma begins, which is the injury.Radiographically the ligamentous space appears unequally widened mostly under apex and furcation, when referring to teeth that are not affected by periodontitis. Typical for this stage is the parallelism of the bony trabeculae in the interdental bone which indicates for thinning and bone weakening. Bone under the tooth in some cases also may appear somewhat radiolucent compared to the bone density of the entire jaw. Bone resorption is the primary sign of injury that is subsequently followed by the reparative stage to new conditions, under the effect of forces applied to the tooth.[1] Often this stage is observed in teeth with healthy periodontal structure.[1,4,8] The trabecular parallelism that indicated bone loss now disappears on radiography, and the bone becomes more radiopaque. In a tooth with a normal periodontium, the lamina dura is presented as a continuous radiating line along the perimeter of the root, whereas at this stage the line becomes thicker.[7,9]

If the periodontium fails in the repair stage, then begins the last stage of tissue changes that is adaptive remodeling characterized by the funnel shape of supporting bone.[1] Otherwise if the damage forces were diminished in the first stage, then the repair phase would occur immediately and the supporting tissue would return to normal.[1,2]

Chronic occlusal trauma can be distinguished in the positions of the condylar heads versus the fossa and the articular eminence through the asymmetry of condyles.[6,9,10] An imaginary or computerized horizontal line can also be added at the level of one of the articular heads, and if the other side of the articular head is not found in this line, this indicatesthe asymmetry and effect of occlusal trauma on the articulations.

Occlusal trauma injuries are expressed at the balance between the maxillary and mandibular occlusal plane, inducing alteration of intercuspal distance between the two sides.[6,10]

According to M W Parker, the optimum hinge position of the mandible is centric relation, the most anterosuperior position of the condyles in the glenoid fossae, articulating against the eminences, with the disks properly interposed.[8]

Among the most common causes of occlusal trauma are bruxism and other parafunctional actions, loss of bone support due to periodontitis, teeth loss, and iatrogenic malocclusion.[1,7,11]

The correlation between operative and fixed prosthetic dentistry with the prevention of occlusal trauma lies in the accurate restoration of the occlusal anatomy and the correct contacts between antagonists.[8,11]

Persistent occlusal interferences over long periods of time reflect their effects on neuromuscular and articular disorders. Clinically these disorders are presentedin deviation during mandibular opening. The patient tends to avoid the central relation position in order to achieve the maximum possible interdental contact.[9]

Clinical diagnosis of trauma from occlusion includes an occlusal examination using articulation papers, and the fremitus test.[1–3] The latter is performed by putting and positioning the index finger on labial surfaces of anterior maxillary teeth and the dentist perceived the mobility of the teeth while patient taps the teeth together in the maximum ICP and grind in the lateral, protrusive movements.[1]

Pathological migration is the inclination of the teeth and their displacement in the direction of the edentulous areas. Often, since these teeth have no lateral contact, they need to support alone the occlusal loading from the opposite jaw.[1]

The purpose of this study is to evaluate the occlusal trauma radiographic signs and other radiographically distinct disorders at OPG's of patients with periodontal changes. Also to discuss the role of dentists in causing occlusal trauma, failing to restore the occlusion.[6,8]

2. Materials and Methods

The study was conducted on the radiographic evaluation of occlusion trauma signs on 100 randomly selected electronic panoramic graphs of patients with periodontal problems in the university clinic „Albanian University." The OPG's were grouped and categorized as below.

Group 1: The presence of all teeth in the oral cavity. No presence of fixed-implant prosthetic replacements (full number of teeth in mouth).

Group 2: Presence of all teeth in oral cavity - extractions of up to 5 teeth. Presence of implants with fixed prosthetics - implant (complete number of teeth in mouth).

Group 3: Extracted teeth within the range of 6-12 teeth. Presence of occlusion in at least 2 sets of teeth, triple contact of the teeth.

Group 4: Maximum 20 teeth in oral cavity. Presence of occlusion in at least 2 sets of teeth, triple contact of the teeth.

Group 5: Maximum 20 teeth in oral cavity. Absence of occlusion.

Group 6: Less than 20 teeth in oral cavity. Absence or not of occlusion.

Radiographic signs of occlusion trauma evaluated in this study (criterion 1) were:

1. Parallelism of the bony trabeculae at the level of the alveolar ridges,

2. Periodontal ligament of different widths along the surface of the tooth roots,
3. Thickening of the periodontal ligament.
4. Angular bone loss
5. Root resorption

Another categorization of radiographs was performed on basis of analyzing the positioning of the constituent structures of the temporomandibular articulation.[6,10] At this point radiographs were categorized (criterion 2):

1. Symmetric position of articular heads
2. Asymmetric position of articular heads

The radiographs were screened for the presence of tooth pathologic migration (criterion3):

1. Mesial migration
2. Axial migration
3. Absence of migration

All the teeth that presented radiographic signs were grouped on basis of dental treatment to whom they have been subjected. Restorative dental treatment or endodontic treatments were grouped in the category of „Dental fillings" since the occlusion is established in similar conditions. The second category was abutment teeth treated with fix prosthodontics.[9] (criterion 4)

1. Dental filling
2. Crown

3. Results

The data collected from this study are summarized in the tables below.

36% are the radiographs of patients with less than 20 teeth, the presence or not of occlusion.

64% are the patients with more than 20 teeth with occlusal contacts, presence of implants with fixed prosthetics, and fillings.

Trabecular parallelism and the enlargement of ligamentous space are the most frequent criterion on radiographs at 22%.

Thickened lamina dura is evidenced in 20% of radiograph cases.Figure 1 The adaptive capacity is shown with the angular bone loss at 17%, and more rarely with the root resorption 8%. 11% of the OPG's did not show any radiologic signs that indicate trauma.

The graphs were evaluated for the positioning of articular heads versus the articular eminence. The data from Table 3 and Table 4 were summarized in a chart showing clearer the association of occlusal trauma signs and articular disorders.

25% of patients were subjected to TMJ disorders, and 22% of them were present at graphs with occlusal trauma signs. Trabecular parallelism, Width of PDL, and thickened

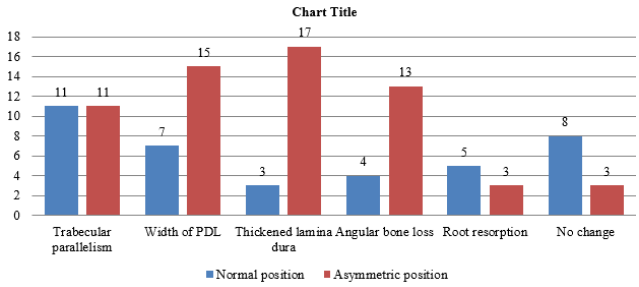

Fig. 1: Correlation of occlusal trauma and articular disorders

lamina dura are most associated with asymmetric position of condylar heads.Figure 2

The purpose of Tables 5 and 6, and Figure 2 is to show the role of dentists in restoring the occlusion, related to initiation of occlusal trauma.

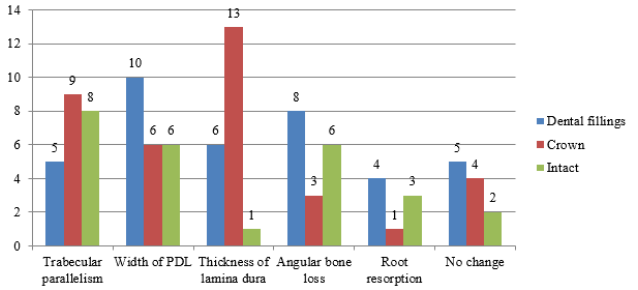

Fig. 2: Correlation between trauma signs and dental treatments

71% of teeth were subjected to treatments, and 53% of them had trauma signs.

30% of teeth with trauma signs were treated in operative dentistry or endodontics, and 32% with fix prosthodontics comprehending single crowns or tooth abutment of a bridge. 9% are radiographs showing treated teeth with crown or therapeutically, but an absence of occlusal trauma signs.

The categorization of pathologic migration was performed to portray the association of the latter with trauma from occlusion. The 6 groups were sub-grouped again in „Normal" referring to teeth with normal periodontium with no radiologic changes, and „Trauma" - teeth with radiographic signs indicating occlusal trauma.

Mesial migration was noticed in 28% of the graphs, and the extrusion at 21%. Pathologic migration combined with trauma signs was noticed in 17% of radiographs, 11% of which were in mesial direction, and 5% axially (extrusion). 12% represents the radiographs showing periodontal changes from trauma but an absence of migration.

4. Discussions

Trabecular parallelism typical for the injury stage is the most frequent criterion on radiographs of patients with

Table 1: This table presents radiograph cases grouped by the number of teeth in oral cavity and the presence or absence of occlusion

	Group 1	**%**	**Group 2**	**%**	**Group 3**	**%**	**Total**
No. graph	11	11%	18	18%	19	19%	48%
	Group 4	%	Group 5	%	Group 6	%	
No. graph	16	16%	19	19%	17	17%	52%
Total	27	27%	37	37%	36	36%	100%

Table 2: Data on 6 groups of radiographs divided by clinical signs of occlusion trauma.

Criteria	**Group 1**	**Group 2**	**Group 3**	**Total**	**Group 4**	**Group 5**	**Group 6**	**Total**	**Total**
Trabecular parallelism	5%	6%	4%	15%	2%	2%	3%	7%	22%
Widened PDL space	0	3%	5%	8%	5%	5%	4%	14%	22%
Thickened lamina dura	2%	4%	4%	10%	3%	4%	3%	10%	20%
Angular bone loss	1%	2%	3%	6%	3%	3%	5%	11%	17%
Root resorption	0	1%	2%	3%	2%	2%	1%	5%	8%
Absence of changes	3%	2%	1%	6%	1%	3%	1%	5%	11%
Total	11%	18%	19%	48%	16%	19%	17%	52%	100%

Table 3: Data on the first 3 groups of radiographs divided by articular head position.

Criteria	**Group 1**		**Group 2**		**Group 3**		**Total**
	Normal position of articular heads	**Asymmetric position**	**Normal position of articular heads**	**Asymmetric position**	**Normal position of articular heads**	**Asymmetric position**	
Parallelism of trabeculae	4%	1%	1%	5%	3%	1%	15%
Width of ligament	0	0	2%	1%	0%	5%	8%
Thickness of lamina dura	0	2%	0%	4%	1%	3%	10%
Angular bone loss	0	1%	1	1%	0%	3%	6%
Root resorption	0	0	1%	0	1%	1%	3%
No change	2%	1%	2%	0	1%	0	6%
Total	11		18		19		48%

Table 4: Data on the second 3 groups of radiographs divided by articular head position.

Criteria	**Group 4**		**Group 5**		**Group 6**		**Total**
	Normal position of articular heads	**Asymmetric position**	**Normal position of articular heads**	**Asymmetric position**	**Normal position of articular heads**	**Asymmetric position**	
Parallelism of trabeculae	0%	2%	1%	1%	2%	1%	7%
Width of ligament	3%	2%	1%	4%	1%	3%	14%
Thickness of lamina dura	0%	3%	1%	3%	1%	2%	10%
Angular bone loss	1%	2%	1%	2%	1%	4%	11%
Root resorption	1%	1%	2%	0	0	1%	5%
No change	1%	0	1%	2%	1%	0	5%
Total	16		19		17		52%

Table 5: The data of the first 3 groups of patients. The categorization is made based on radiographic signs and dental treatment.

Criteria	Group 1			Group 2			Group 3			Total
	Dental filling	Treated with crown	Intact teeth	Dental filling	Treated with crown	Intact teeth	Dental filling	Treated with crown	Intact teeth	
Parallelism of trabeculae	1%	2%	2%	2%	1%	3%	2%	2%	0%	15%
Width of ligament	0	0	0	2%	0	1%	4%	0	1%	8%
Thickness of lamina dura	1%	1%	0%	1%	3%	0%	1%	3%	0%	10%
Angular bone loss	1%	0	0	1%	0	1%	2%	0	1%	6%
Root resorption	0	0	0	1%	0	0	0%	1%	1%	3%
No change	1%	1%	1%	1%	1%	0	1%	0	0	6%
Total		11			18			19		48%

Table 6: The data of the second 3 groups of patients. The categorization is made based on radiographic signs and dental treatment.

Criteria	Group 4			Group 5			Group 6			Total
	Dental filling	Treated with crown	Intact teeth	Dental filling	Treated with crown	Intact teeth	Dental filling	Treated with crown	Intact teeth	
Parallelism of trabeculae	0	1%	1%	0	1%	1%	0%	2%	1%	7%
Width of ligament	1%	2%	2%	2%	2%	1%	1%	2%	1%	14%
Thickness of lamina dura	0%	2%	1%	2%	2%	0%	1%	2%	0%	10%
Angular bone loss	0	1%	2%	1%	1%	1%	3%	1%	1%	11%
Root resorption	2%	0	0	1%	0	1%	0	0	1%	5%
No change	1%	0	0	0	2%	1%	1%	0	0	5%
Total		16			19			17		52%

Table 7: Data showing the association of trauma radiographic signs and the pathologic migration of teeth.

	Group 1		Group 2		Group 3			Group 4		Group 5		Group 6		
	Normal	Trauma	Normal	Trauma	Normal	Trauma	Total	Normal	Trauma	Normal	Trauma	Normal	Trauma	Total
Mesial migration	0	0	2	2	1	3	8%	4	2	5	2	5	2	20%
Axial migration	0	0	2	0	3	2	7%	2	1	2	1	6	2	14%
Absence of migration	7	4	9	3	9	1	33%	5	2	8	1	1	1	18%
Total	7%	4%	13%	5%	13%	6%	48%	11%	5%	15%	4%	12%	5%	52%
	11%		18%		19%			16%		19%		17%		

periodontal changes at 22%. With the same percentage is encountered the enlargement of radiolucent ligamentous space. This indicates that the stage of tissue injury evidenced radiographically, is the most common sign on the OPGs collected by a random selection.

Thickened continuos radiopaque line of lamina dura is evidenced in 20% of radiograph cases. Consequently, the buttressing bone formation and the periodontal tissue effort to repair the resorbed bone is surveyed less in these patients, but not significantly.

The adaptive capacity is shown with sclerotic lamina dura at 20%, angular bone defect at 17% and more rarely with the root resorption 8%. This part represents the cases of reparative failure.

OPGs presenting signs of changes in condylar symmetry are mostly associated with sclerotic lamina dura. The study provides a new insight into the relationship betweenthe chronicity of occlusal trauma and TMA disorders. Width of PDL space and trabecular parallelism are less associated with the assymetry of condylar heads.The data contributes a clearer understanding of TMA manifestation of chronic occlusal trauma.[10]

The correlation of these 2 pathologies is that one may be the cause of the other. The asymmetric position of articular heads may have been present because of previous TMJ disorders, which may have resulted in discrepancies causing the traumatic radiographic signs. Or, the chronicity of trauma persisting for a long period has manifested in

TMA adaption with the new occlusal conditions.

The data show that mesial migration is more often associated with signs of trauma. Extraction of a tooth brings overload to the neighboring tooth which becomes subject to trauma by antagonistic jaw forces. Mesial migration of tooth is more often associated with trauma, than the extrusion, showing mostly radiological signs of trauma along the mesial surface of the root.

Fix prosthetic replacements, based on data on the number of patients of the study, show an increased application of the respective protocols.[6]

In terms of PDL enlargement and trabecular parallelism there are no distinct differences in the presence of these signs between groups of restored and intact teeth. The most common radiological sign in restored teeth is the thickening of the lamina dura. This analysis supports the theory that the value of radiographic follow-up of subjects following prosthetic treatment is emphasized.[(8)]These treatments enhance possibilities of occlusion trauma, based on the data of this study.

The findings of this study have to be seen in light of some limitations.The primary limitation to the generalization of these results is radiological diagnosis of trauma fro occlussion. A definitive diagnosis of occlusal trauma would be completed with the clinical assessment of occlusion. The deviation on mouth opening, tenderness to palpation of TMA, and slide from retrusion to intercuspidationexplain TMA disorder.[9]The second limitation concerns the OPG radiograph interpretation of TMA condition. Lateral TMJ radiographs provides resolution and detail to evaluate the condylar position in the fossa.[10]

5. Conclusions

Occlusal trauma injuries are expressed at the level of scaling of the bone trabeculae, at the level of expansion of the periodontal ligament, thickening of lamina dura, root resorption and angular bone loss. Chronic occlusal trauma induces condylar displacement in glenoid fossae radiologically. Mesial tooth migration is a phenomenon associated significantly with occlusal trauma signs. As fix prosthetic replacements and therapeutic fillings increase the chances of occlusal trauma, the role of the dentist becomes more important in balancing the occlusion after each procedure.

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7. Conflicts of Interest

All contributing authors declare no conflicts of interest.

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