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11th UBT ANNUAL INTERNATIONAL
CONFERENCE

INTERNATIONAL CONFERENCE ON
DENTAL SCIENCE

29-30
OCTOBER

UBT Innovation
Campus



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Editor Speech of IC - BTI

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Congratulation!

Edmond

Hajrizi, Rector of UBT and Chair of IC - BTI

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THE EFFECT OF NEW INTERNAL FERRULE DESIGN PREPARATION ON THE FRACTURE RESISTANCE OF ENDODONTICALLY TREATED CENTRAL INCISORS

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Statement of problem. Many studies concerning that the amount of remaining coronal tooth structure may have a significant effect on fracture resistance of endodontically treated teeth.

Purpose. This study investigated the fracture resistance of endodontically treated anterior central incisors prepared with internal ferrule preparation design.

Material and methods. A total of 120 extracted human maxillary central incisor were endodontically treated and divided into 10 groups of 12. From Group A1 to E1 and A2 to E2 represented teeth were prepared without (0mm), 0.5mm, 1mm, 1.5mm, and 2mm internal ferrule preparation. As material for our experiments, we used Ø1.4 - 1.6mm Y-TZP ceramics posts with retention forms in the coronary part of the post, upgraded with IPS E-MAX, Ivoclar, Vivadent. The experimental samples were cemented (Multilink Automix, Ivoclar), embedded in acrylic resin blocks (ProBase Polymer/Monomer, Ivoclar) and loaded at an angle of 45° degrees in an Instron Testing Machine 4301 (Instron Corp., USA) at a crosshead speed of 1mm/min until fracture. Fracture loads (N) and modes (repairable or catastrophic) were recorded. Two-way analysis of variance was used for statistical analysis with the level of significance set $p < 0.05$. Failure patterns were analyzed in the optical microscope Stereo Discovery V.8 (Carl Zeiss, Germany).

Results. The mean values (\pm SD) for fracture loads were measured (Newtons) for the first two groups without internal ferrule (0mm) = A1: 1.4mm - 405.04N (\pm 100.04); and A2: 1.6mm - 503.09N (\pm 109.01); for next two groups with 0.5mm = B1: 1.4mm - 401.07N (\pm 75.02) and B2: 1.6mm - 507.13N (\pm 101.08), for next two groups with 1mm = C1: 1.4mm - 479.01N (\pm 109.12) and C2: 1.6mm - 567.06N (\pm 134.37), for next two groups with 1.5mm = D1: 1.4mm - 601.73N (\pm 103.52) and D2: 1.6mm - 675.79N (\pm 171.09), and for last two groups with 2mm = E1: 1.4mm - 719.99N (\pm 220.02) and E2: 1.6mm - 861.06N (\pm 237.15).

Failure patterns within those 1.4 - 1.6mm Y-TZP posts - E-MAX cores groups revealed non catastrophic failure in groups (0mm) A1-A2 = 100% - 100%, groups (0.5mm) B1-B2 = 100% - 100%; groups (1mm) C1-C2 = 91.7% - 91.7%, groups (1.5mm) D1-D2 = 91.7% -

75%; and for 2mm (internal ferrule preparation design) were 66.7% -58.3% in both of groups E1-E2.

Conclusion. With the limitations of this study, the teeth prepared without (0mm), with 0.5mm and 1mm internal ferrule preparation design demonstrated significantly lower failure loads than those with 1.5 and 2mm IF. The results showed that zirconium posts with retentive coronal part and 1.5mm - 2mm internal ferrule preparation which contribute to increasing the fracture resistance of the restored root-coronary dental complex, show significance higher fracture resistance. No-significant results were determined in all of experimental groups restored with different diameter (\varnothing 1.4 - 1.6mm) of zirconia posts.

Keywords: endodontically treated teeth, zirconia post, ferrule

Introduction

Many studies concerning that the amount of remaining coronal tooth structure may have an effect on the fracture resistance of endodontically treated teeth to provide ferrule effect.^{1,2,3,4,5}

Several authors,^{6,7,16,17,19,21} have suggested that it is very important to provide ferrule effect from the post, the core and the crown, but they extend their researches only on the effect of the dentin and crown ferrule. Only few studies investigate the effect of internal ferrule preparation on fracture resistance of endodontically treated teeth restored with different post and core. Jovanovski⁸

Faria et al⁹ tested different designs of tooth preparation. They researched the influence of the remaining coronal tooth structure location on the fracture resistance and concluded that palatal walls were more resistant to fractures than labial.

In most of the studies^{10,11,12,13,14,15,16,19,23} only external ferrule effect between external prepared dentin and crown was researched, not taking into account the influence of internal ferrule effect. Therefore, we decided to investigate the effect of post-core design and internal ferrule preparation design on the fracture resistance of endodontically treated teeth restored with zirconia posts. ^{8,17,18,20,21,24,25,26,27}

Material and methods

A total of 120 extracted human maxillary central incisors without fractures and with similar dimensions were stored in 0.1% thymol solution after extraction. The root canals were endodontically treated, prepared with K3TMXF, Dentsply (Starter kit), obturated with AH plus[®] and gutta-percha points (Dentsply, DeTrey, Germany). The anatomic crowns of all teeth were sectioned horizontal to the long axis (2 mm incisal to the cement-enamel junction) with water cooled diamond-coated disc, IsoMet[®] 1000 Precision Saw BUEHLER.

All experimental teeth were divided into 10 groups of 12. Group A1 to E1 (A1 / B1 / C1 / D1 / E1) and E2 to E2 (A2 / B2 / C2 / D2 / E2) represented teeth prepared without (0mm), 0.5mm, 1mm, 1.5mm, and 2mm internal ferrule preparation. As material for our experiments, we used \varnothing 1.4 - 1.6mm Y-TZP ceramics posts (IJS-MF) Slovenia with retention forms in the coronary part of the post, upgraded with IPS E-MAX, Ivoclar, Vivadent. Circumferential shoulder preparation of the cervical part of the root canal were prepared (excluding the first two groups) with an apical extended 0.5mm/1mm/1.5mm and 2mm long internal dentin ferrule preparation. 360° parallel internal dentin wall was extended coronal from the preparation shoulder of the root canal. The vertical length of the internal surface of the dentin wall was defined as the length of internal ferrule preparation. (Fig. 1.) Post spaces were prepared in all groups with the special preparation drills (IJS-MF, Slovenia) leaving at least 4 mm gutta-percha apical seal.



Fig. 1. Internal Dentin Ferrule Preparation and Y-TZP Post with retentive rings in the coronal part (IJS-MF), Slovenia

Groups A1 / B1 / C1 / D1 / E1, were restored with \varnothing 1.4mm, length 17.5/11mm, and groups A2 / B2 / C2 / D2 / E2 with \varnothing 1.6mm, length 15/8.5mm, Y-TZP Post (IJS-MF), Slovenia. The root part of the zirconia experimental post had a cylindrical-conical line. The coronary design of the zirconia posts included retention forms with three retentive rings. The first (apical) retention element is a full ring, and upper two half-rings providing sufficient space for core build up material. The experimental posts were build-up with e-max core material (E-MAX, Ivoclar, Vivadent, Liechtenstein) and cemented with resin cement (Multilink Automix, Ivoclar). All simples with uniform core buildup were with dimensions 6 x 5 x 5 mm (base diameter x height x upper surface) and with 45° degrees on the palato-incisal surface made with indirect press method.



Fig 2. Instron Testing Machine 4301.

Root surfaces of the experimental teeth were marked at the CEJ and covered with Durapore adhesive tape. That cemented post/teeth experimental samples were embedded in acrylic resin blocks (ProBase Polymer/Monomer, Ivoclar) with fixator (Bego). (Fig. 1.)

In the next steps Durapore spacers were removed from the root surfaces and impression material (Xantopren plus, HeraeusKulzer, GmbHGermany) was injected into acrylic resin modle. The experimental teeth were reinserted into acrylic cylinders with standardized silicone 0.1-0.2mm thin layers (simulated periodontal ligament).

Test specimens (unloaded) were then placed at an angle of 45° to the long axis into a special jig and retention tests were performed by Instron Testing Machine 4301 (Instron Corp., USA) with crosshead speed of 1mm/min until fracture. The load was applied in the middle of the lingual surface, 2 mm below the incisal margin. (Fig. 2)

Fracture loads (N) and modes (favorable/repair or catastrophic/non restorable) were recorded, thereby considering that reparable fractures are those that occur above the level of the alveolar bone, and catastrophic are those that occur below the level of the alveolar bone. Two-way analysis of variance (ANOVA) was used for statistical analysis with the level of significance seat $p < 0.05$. Failure patterns were analyzed in the optical microscope (Fig. 3.).



Fig. 3. Optical microscope Stereo Discovery V.8 (Carl Zeiss, Germany).

Results

The mean and standard deviations for failure loads are shown in Table 6.1 and 6.2. The mean values for fracture loads measured in Newton's were for the following groups:

Table 1. 1 Fracture loads (N)

POST / CORE	Y-TZP POSTS / E-MAX CORES					
GROUP A(1-2) / B(1-2) / C(1-2)	INTERNAL FERRULE PREPARATION					
	A(1-2) = 0 mm		B(1-2) = 0,5mm		C(1-2) = 1 mm	
Ø (mm)	1.4	1.6	1.4	1.6	1.4	1.6
CONTROL GROUP						
Mean (N)	405.04	503.09	401.07	507.13	479.01	567.06
Stand. Deviation	± 100.04	± 109.01	± 75.02	± 101.08	± 109.12	± 134.37

Table 1. 2 Fracture loads (N)

POST / CORE	Y-TZP POSTS / E-MAX CORES					
GROUP A(1-2) / D(1-2) / E(1-2)	INTERNAL FERRULE PREPARATION					
	A(1-2) = 0 mm CONTROL GROUP		D(1-2) = 1,5mm		E(1-2) = 2 mm	
Ø (mm)	1.4	1.6	1.4	1.6	1.4	1.6
Mean (N)	405.04	503.09	601.73	675.79	719.99	861.06
Stand. Deviation	± 100.04	± 109.61	± 103.52	± 171.08	± 220.02	± 237.15

For fracture resistance, two-way ANOVA revealed a significant difference ($p < 0.05$) in groups with 1.5 mm and 2 mm, compared to groups without (0mm), with 0.5mm and 1 mm internal ferrule. No significant difference ($p > 0.05$) was evaluated between the teeth in groups without (0mm), with 0.5mm and 1 mm and between the teeth with 1.5 and 2mm internal ferrule preparation.

Table 2. 1. No-Significant Difference ($p > 0.05$)

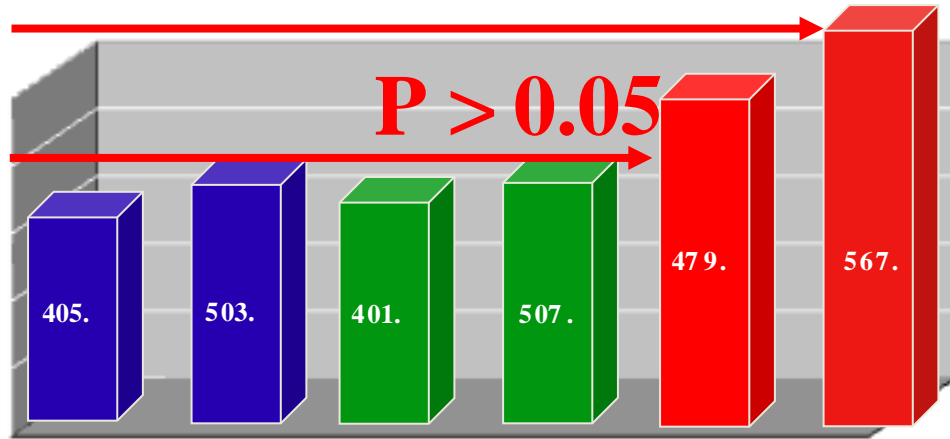
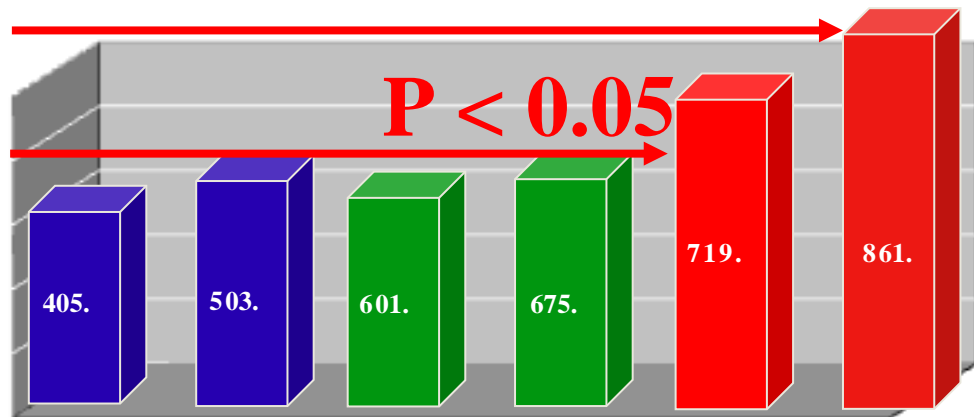


Table 2. 2. Significant Difference ($p < 0.05$)



There were no significant differences among the groups with Ø 1.4 mm / 1.6 mm posts, regardless to the prepared internal ferrule (Table 2. 1/2).

Failure patterns within those groups revealed non-catastrophic failure in group A = 100% - 100% for 0mm; group B = 100% - 100% for 0.5mm; group C – 91.7% - 91.7% for 1mm; group D = 91.7% - 75% for 1.5mm; and 66.7% - 58.3% for 2mm (internal ferrule preparation design) in both of groups E (Table. 3. 1/2)

Table. 3.1. Types of Failure / Number / (%) of Teeth.

TABLE A: FRACTURES		INTERNAL FERRUE PREPARATION (IF)		
Y-TZP POST/ E-MAX CORE FRACTURES	%	<u>Control A</u>	<u>B</u>	<u>C</u>
		(0mm) %	(0.5mm) %	(1mm) %
REPARABLE	1.4	12 (100)	12 (100)	
	11 (91.7)			
NON-REPARABLE	1.6	12 (100)	121 (90.7)	
	1.4	0 (0,0)	0(0,0)	
	1 (8,3)			
	1.6	0 (0,0)	0(0,0)	
	1 (8,3)			

Table. 3.2. Types of Failure / Number / (%) of Teeth.

TABLE B: FRACTURES		INTERNAL FERRUE PREPARATION (IF)		
	%			

Y-TZP POST/ E-MAX CORE FRACTURES		<u>Control A</u> (0mm) %	<u>D</u> (1.5mm) %	<u>E</u> (2mm) %
	Ø			
	1.4	12 (100)	11 (91.7)	
	8 (66.7)			
	REPARABLE			
	1.6		9 (75)	7
(58.3)		12 (100)		
	NON- 4 (33,3)	1.4	0 (0,0)	1 (8.3)
	REPARABLE	1.6	0 (0,0)	<u>3 (25,0)</u>
	5 (41,7)			

Discussion

In this in vitro experimental study natural teeth were used for preparation and all roots received endodontic treatment and were subjected to a post and core build up. The authors⁸ of the present study investigated and described the new design preparation. They concluded that different preparation length has different influence on the fracture resistance. However, adequately prepared dentin for zirconia posts with retentive rings in the coronal part result in reparable fractures when subjected to compressive loads directly applied to the inclined surfaces of the cores. As in similar previous studies^{28,29,30,31,32,33,34,35} in this study, the post and cores did not restore with crowns. We used fracture testing as a method for evaluation of the fracture resistance. The testing apparatus did not differentiate between the different modes of failure (Fig 3. Instron Testing Machine 4301).

The results showed that the fracture resistance of the post-core restorations with 0.5mm and 1mm prepared internal part of the dentin was not significantly different from the fracture resistance of the restored teeth without (0mm). On the other hand, the teeth prepared with 1.5mm and 2mm prepared internal part of coronal dentin showed significantly increased fracture resistance. Therefore, it is not only important to use the remaining internal part of dentine in order to improve the fracture resistance of the tooth, but it is crucial to provide the sufficient length of internal preparation.

From many authors^{21,23,24,25,26,27,36,37} it is generally accepted that for a restoration extending at least 2mm apical to the junction of the external core surface will protect the endodontically treated tooth. On the other hand, Nothdurft²² stated noticeably lower values for the fracture resistance which were not significantly different for 1mm and for 2mm ferrule. Stankiewicz and Wilson (2008)²³, and numerous other authors^{24,25,26,27,28,39}, concluded that a ferrule with 1mm of vertical height has been shown to double the resistance to fracture

versus teeth restored without a ferrule preparation design. The results from our study confirm that not only the external ferrule, but also the internal ferrule should be at least 1.5 and 2mm long in order to provide the desired protective effect.⁸

In our present study cylindrical-conical posts with retentive coronal part were used for restoration of experimentally endodontically treated teeth. It is known that cylindrical posts exhibit better retention than conical posts. However, the cylindrical shape does not correspond to root anatomy and excessive preparation in the apical portion of the tooth might weaken the root.²¹

Fracture strength values from others reviewers^{23,25,26,27,28} is not comparable with the results of the present study because of differences in research design. Namely, in present study the ferrule lengths are presented from the internal part of dentin, unlike other studies which analyze only core-crown ferrule.^{2,3,4,5,6,10,11,13,30,31,32,36,37,39} The internal preparation part of dentin circumferentially provides a cylindrical space for the first retentive ring of the zirconia post in the coronal part of the root. Therefore, it provides physiological stress distribution through the dentin walls.

Other than that, in most of the studies on this matter, the composite core was built up on experimental posts that had no retention elements in their coronal part,^{15,28,36} while in our study we used posts with retention elements and press core build up.

Ottl et al³³ in artificial root canals stated lower fracture strength of zirconia posts in respect to results from our study. Similarly, Asmussen et al³⁴ found lower fracture strength for Biopost and CeraPost. In both of these studies, zirconia posts without retention forms were used. With artificial roots lower fracture strength values were obtained because they reduced the effect of structural differences between natural teeth and the posts.^{19,30}

Oblak et al¹⁹ used zirconia posts with retention elements, and stated values for load to fracture similar to ours (without internal ferrule), but their experiments were also conducted on posts mounted in artificial root canals, instead of natural teeth.

They concluded that load to fracture of zirconia posts depends primarily on post diameter but they had not taken into account the effect of dentin preparation. From our results, it is evident that the post diameter is less influential than the internal dentin preparation length for the improvement of the fracture resistance.

Akkayan and Guelmez²⁸ stated catastrophic fractures of zirconia posts. However, this study was performed with zirconia posts without retentive coronal forms. Similar to this study, Ozkurt et al³⁵ stated that the high rigidity of the zirconia posts is a predisposing factor for vertical root fractures. Dilmener³¹ and Asmussen³⁴ assumed that the use of a zirconia post with an elastic modulus closer to that of dentin would be mechanically more advantageous for the preservation of recipient roots. Many other studies^{24,25,26} have shown maximum beneficial effects from a ferrule with 1.5 to 2mm of vertical tooth structure. The fracture patterns were more favorable when a ferrule was present. The majority of the fractures in the teeth without a ferrule were nonrestorable.^{27,28} Hazaimah and Gutteridge³⁶ concluded that the fracture patterns were more favorable when an external ferrule was present.

In our experimental study we excluded the external ferrule in order to research only the influence of the internal ferrule preparation length on the fracture resistance of endodontically treated teeth. The results showed increased percentage of reparable fractures in all groups. In the present study, the teeth prepared with and without internal preparation dentin showed similar fracture modes, all in favor of the reparable fractures. However, we

should not forget the fact that the same zirconia posts with retentive coronal elements were used for restoration of the teeth in all the groups. Therefore, it is evident that the retentive coronal form of the zirconia post contributes to the more favorable outcome of fractures.

The results from the all mentioned studies, compared with ours, confirm that preparation ferrule design and posts design with retentive coronal elements additionally increase the fracture resistance and produced more favorable modes of fracture.

Conclusion

Within the limitations of this in vitro study, the following conclusions were drawn:

1. The teeth without and with 0.5 and 1 mm internal ferrule preparation design were fractured at significantly lower loading than teeth restored with an apical extended 1.5 and 2mm long internal ferrule preparation.
2. The minimum internal ferrule length that provides increased fracture resistance is 1.5 to 2mm.
3. Load to fracture of the post-core restored endodontically treated teeth depends primarily on the length of the internal ferrule preparation, regardless to the post diameter.
4. The fracture patterns of the post-core restored teeth were restorable in 60 to 100% in all of the groups and significantly higher % of reparable fractures was determined in all of experimental groups.

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The influence of systemic drugs affecting the process of osseointegration of dental implants A review

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Abstract:

The process of osteointegration of dental implants is a biological process in which systemic therapy can interfere, which affects the anabolic and catabolic processes of the bone and consequently leads to the failure of the implant.

The purpose of the literature review has to do with certain groups of systemic drugs that have a direct impact on this process.

Some of the systemic drugs that have a direct impact on the osteointegration processes of dental implants are:

selective serotonin reuptake inhibitors, bisphosphonates, non-steroidal anti-inflammatory drugs, proton pump inhibitors, glucocorticoid drug.

SSRIs - cause bone loss by inhibiting bone remodeling processes.

Bisphosphonates - associated osteonecrosis occurs after dental implant surgery.

Non-Steroidal anti-inflammatory drugs - Non-steroidal anti-inflammatory drugs and their impact before implant placement has to do with the inhibition of cyclooxygenase COX-enzymes and consequently inhibits the inflammatory mediators Prostaglandins, which play the main role in bone metabolism.

Proton pump inhibitors- negatively affect the process of osteointegration of dental implants in such a way that they affect the absorption of Calcium as well as the activity of osteoclast.

Glucocorticoid drug- Increasing the humane serum levels of glucocorticoids in vitro to supraphysiological doses decreases the ability of osteoblasts to differentiate.

Keyword :

Osteointegration; Bisphosphonates; Drug related; Non-steroidal anti-inflammatory drug; SSRIs, Proton pump inhibitors, Dental failure.

Introduction

In these last three decades, due to endotulism in patients, we have a continuous increase in requests for placement of dental implants in patients who have lost teeth, and with this method, the lost teeth are replaced and the function is immediately restored, as well as aesthetics.

However, dental implants are not a suitable method for every patient. Knowing that the dental implant must be integrated into the jawbone, then as a clinician we must clearly evaluate systemic diseases as well as medications for the treatment of these diseases, but which can affect the process of osseointegration of dental implants.

Based on the data on the incidence of drug use in the USA, an increase in the use of different therapies was found from 2000 to 2008, where the percentage of Americans who in 2000 had taken one, two or five prescription medications was increases significantly until 2008 by one percentage, from 44%-48% for one medication administered, from 25%-31% for two tablets administered and from 6%-11% for five medications administered by the patient. (1)

Therefore, to avoid the possible failures of dental implants as well as the impact these medications have on the process of osseointegration itself, a careful pre-operative assessment is needed.

Osteointegration

The process of osteointegration of dental implants is a biological process that results in a direct connection between the jawbone and the surface of the implant without the incorporation of connective tissue. (2)

The process of osteointegration goes through certain stages such as hemostasis, inflammatory, proliferative and remodeling. Crucial for this process to succeed is to eliminate iatrogenic or systemic biological factors that would have a direct impact on the bone-implant connection.

Certain systemic drugs that we have analyzed that have an impact on the process of osseointegration of dental implants are:

Selective serotonin reuptake inhibitors (SSRIs)

Bisphosphonates

Nonsteroidal anti-inflammatory drugs (NSAIDs)

Glucocorticoids

Proton pump inhibitors

Bisphosphonates

These are drugs that are taken by patients for the treatment of bone pathologies such as osteoporosis, multiple myeloma, Paget's disease, but also for the treatment of bone metastases.

The interference between these drugs and the process of osseointegration of the implants itself is high because the biological process is affected, namely the cellular level during bone metabolism, where its action is expressed in the inhibition of the osteoclast cell cycle, thus preventing bone resorption, which is also known as initial stage for the creation of new bone. (3)

The method of administration is for os and intravenously, the characteristic of this therapy is that it has a long time of action since it remains inside the bone, as we have the case of Alendronate, which lasts up to 10 years.

Although it is one of the main drugs in bone pathology, the main complication in cases of oral surgical interventions, whether it is the placement of implants or even an extraction, is that it can lead to osteonecrosis of the jaw.

This is proven in cases where the patient has undergone oral surgery, but healing has not occurred even after 8 weeks with a bony exposure of the jaw and the patient has not been exposed to radiotherapy in the maxillofacial region. (4)

The treatment protocol in such cases must be done individually in each case, even though it is very challenging, but if we follow the preventive procedures that include taking antibiotics, local irrigation with antimicrobial solutions, local cleaning of the wound, application of plasma rich in platelets and hyperbaric oxygen, then the complications regarding a possible osteonecrosis will be reduced.

Based on the review of the literature, the patient should have routine examinations in the oral cavity, the least invasive procedures should be performed, when placing the implants, the therapy should be stopped 3 months before and 3 months after the intervention, but also a temporary prosthesis should be applied for to prevent any possible injury to the postoperative wound.

Based on the Maxillofacial and Oral Surgical Association, dental implants are contraindicated in patients who are being treated with Intravenous Bisphosphonate therapy.

While patients who are under oral administration and have just started therapy or have now been under bisphosphonate therapy for 3 years are not a contraindication for placing implants, while patients who have been receiving therapy for 10 years then the incidence of bone osteonecrosis is evident. (5)

Also, as a preventive measure, prophylactic antibiotic therapy should be administered. Penicillin or metronidazole in combination with quinolone (broad-spectrum antibiotic). Likewise, mouthwash, Chlorhexidine 0.12% 2 times a day for 2 weeks is necessary.

Since, as we emphasized above, Bisphosphonate therapy stays in the bone for a long time, then we should focus on the level of Type 1 collagen Carboxy-terminal telopeptide in the blood, because precisely under the influence of this therapy, this telopeptide is detached from the molecule of collagen, and the high level forces us to take preventive measures. (6)

It is very important for the surgeon to have knowledge of these drugs from the pharmacological, pharmacodynamic, pharmacokinetic and mechanistic aspects of the action of these drugs.

Based on the scientific studies from which we have analyzed by the authors Freitas and his collaborators in 2016 where out of 15 studies, 8 were retrospective, 1 prospective and 6 other cases, where a total of 1339 patients were analyzed, with 3748 implants placed, 152 implants failed and 78 cases called osteonecrosis.

So we understood that patients who were under intravenous administration and are an indication for invasive oral surgical interventions, including dental implants, should not be performed, unlike patients who are under oral administration, we must know the period of time that they are under oral administration these drugs and that we take preventive measures for a possible osteonecrosis before oral surgical interventions.

Nonsteroidal anti-inflammatory drugs

Non-steroidal anti-inflammatory drugs are a group of drugs with anti-inflammatory, analgesic and antipyretic effects.

In oral surgical interventions, it is mainly used for the management of postoperative pain.

The mechanism of their action is based on the inhibition of cyclooxygenase enzymes (COX1, COX2, COX3 and these interfere directly in the synthesis of prostaglandins and thromboxane. Prostaglandins are actually inflammatory mediators that have an influence on bone metabolism and its non-synthesis therefore leads in the disorder of the repair mechanisms of bone tissue. (7)

Based on a long-term study by the authors Marquez-Lara, who analyzed the effects of peri-operative non-steroidal anti-inflammatory therapy, the osseointegration failures of dental implants appear, where out of 197 implants that failed over a long period of time, 44% of the cases of failure occurred. were the patients who received NSAID therapy before the operation, while 38% of the failures had not received any nonsteroidal anti-inflammatory.

Furthermore, the group under NSAID therapy had a bone loss 3.2 times more and with a loss of <30% of the total bone height. (8)

Proton pump inhibitor drugs

Proton pump inhibitor drugs are taken for treatment and prevention in pathological cases of the gastrointestinal tract, such as peptic ulcer, gastroesophageal reflux, Helicobacter pylori, etc. The mechanism of drugs such as Omeprazole, Pantoprazole, Esomeprazole is based on the suppression of the acidity of the stomach by inhibiting the function of the proton pump (H⁺/K⁺ ATPase), which in fact, in addition to the gastrointestinal tract, also exists in the bones of the body. (9)

These drugs, through their indirect action, affect the activity of osteoclasts as well as by regulating calcium homeostasis, so the level of its absorption decreases and this leads to a reduction in bone density, which in turn interferes with the process of osseointegration of the dental implant. (10)

During the review of the literature, we have analyzed several scientific works on patients under PPI therapy administration, such as the author Wu, where from a study with 1773 dental implants placed in 799 (where from 133 implants to 58 PPI users and 1640 to 741 non-users), (11)

Implant failure was 6.8% in PPI users compared to 3.2% in non-PPI users.

In another study by the author Ursomanno, which studied the loss of bone level from 1480 implants in 635 patients, a loss of 1.60 mm was verified in PPI users compared to 1.01 mm. (12)

Also in another study by Charcovic, from the total number of dental implants 3559 in 999 patients, 178 were reported to have failed. Of this number, 12.0% (30/250) for PPI users failed compared to 4.5% (148/3,309) for non users. (13)

Based on these analyzes of these studies, it is found that cases of failures in osseointegration of dental implants are relatively evident in patients using PPI, but this does not mean that they are a contraindication for the placement of dental implants.

Glucocorticoid drugs

The mechanism of glucocorticoid drugs has to do with the inhibition of inflammatory processes caused by any specific autoimmune disease, usually the role of these drugs should be expressed in cases where the natural steroids produced by the body do not work effectively to fight autoimmune diseases .

In addition to their anti-inflammatory function, they also play a role in the body's response to stress as well as in the metabolism of carbohydrates and lipids. From the group of drugs that are used most often are: Cortisone, Prednisone. Dexamethasone, Methylprednisolone, etc.

The high supraphysiological level of this therapy, which is administered for a long period of time, directly affects the process of differentiation of osteoblasts, and this can then regulate the cascade of the osteointegration process itself. From the group of corticosteroid drugs, drugs such as Prednisone and Prednisolone have a more negative effect compared to Dexamethasone. (14)

Excess corticosteroids reduce the differentiation of osteoblasts through the blockade of B-Catenin/Wingless (it is a growth factor that participates in the regulation of osteogenic differentiation at the mesenchymal level of Stem Cells) which results in an increase in the level of reactive oxygen species as well as increases the production of the Activating Receptor of the binding factor kappa-B (which is the main mediator in the process of resorption through the stimulation of osteoclasts) - which is associated with preosteoclasts, which together build a complex where an osteoclast differentiates and then develops into a mature osteoclast which is ready for bone resorption. (15)

Also, the osteoblast decreases the secretion of Osteoprotegerin, making it less available for a connection with the RANKL-receptors, which further increases the degree of bone resorption, also the apoptosis of osteocytes is very evident, which results in a poor bone quality. and knowing that the process of osseointegration of implants results in defects in the creation of adequate bone, all this lies in less formed bone (decrease in the amount of osteoblasts, osteocytes, OPG osteoprotegerin) and more bone resorption (increase in osteoclast function), reduction of vascular endothelial factor (VEGF) resulting in osteoporosis or osteonecrosis of bone architecture. (16)

Conclusion

Clinicians considering implant therapy should be aware of possible medication-related implant failures.

The present systematic review showed an association of PPIs, NSAIDs, SSRIs, Glucocorticoids and Bisphosphonates with an increased implant failure rate.

The effect of these medications should be further investigated in future studies as potential confounders for implant outcomes.

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CEPHALEA FROM OROFACIAL ORIGIN - CONTEMPORARY DENTAL PROSTHETIC TREATMENT

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INTRODUCTION

Cephalgia from orofacial origin can be manifested with diffuse, mild to moderate pain and as patients describe it, it can cause painful bandage around the head. Cephalgia from orofacial origin can be constant, persistent and uninterrupted headache.⁽¹⁾ There is a difference in the manifestation with comparison to sinusoidal, temporal, migrainous and other types of headaches.⁽²⁾ Patients experience pain as tightening around the head and describe its presence as bilateral.⁽³⁾ Cephalgia from orofacial origin can have different time interval of duration, in periods from several days to several weeks.⁽⁴⁾ It is significant that the subjective patient findings are compared with the objective clinical findings and evidence. Martin et al. have described pain from orofacial origin as a general term for pain experienced in the mouth, jaws and the face.⁽⁵⁾ More than 95% of cases of pain from orofacial origin result from dental reasons (pulpitis or abscess).⁽⁶⁾ The second most common cause of pain from orofacial origin is temporomandibular dysfunction (TMD).⁽⁷⁾ Leandro Lauriti et al. have deduced that the TMD has a multifactorial etiology.⁽⁸⁾ Improperly designed prosthetic devices can cause the patients to develop occlusion problems.⁽⁹⁾ Masticatory muscles are tense, overloaded which can have an input on the cephalgia from orofacial origin.⁽¹⁰⁾ Day and night bruxism are parafunctions, that represent direct etiological causes for the development of cephalgia from orofacial origin.^(11,12) Loss of occlusal support is also considered to be the main etiological cause for the development of cephalgia from orofacial origin.⁽¹⁾ The therapy of cephalgia from orofacial origin is often associated with TMD therapy. Studies reveal the reduction of severity and frequency of headaches by using occlusal splints, occlusal adjustments or physiotherapy.⁽¹³⁾ Kapusevska has noticed acute reduction of symptoms of recurrent cephalgia from orofacial origin, companion of occlusal parafunctions and TMD by using the butterfly deprogrammer.⁽⁴⁾

PURPOSE

The purpose of this study is to represent the contemporary dental prosthetic treatment on cephalgia from orofacial origin.

MATERIAL AND METHODS

For the purpose of this study the patients that were material for the examination consisted a total of 120 patients.

They were divided into two groups, each group consisted of 60 patients. The first group of patients was divided into three subgroups of 20 patients:

- 20 patients with traumatic occlusion from improperly designed fixed prosthetic devices;
- 20 patients with horizontal and vertical bruxism;
- 20 patients with loss of occlusal support (Kennedy Class I, Kennedy Class II, Kennedy Class III).

The second group was the control group also consisted of 60 patients without etiological causes and patients were not being treated, they were monitored.

Before the start of work each patient received a consent form for the procedure and interventions.

For this research a consent was given consent the Ethics Commission at the Faculty of Dentistry in Skopje, University "St. Cyril and Methodius". The examinations were performed at the department of Dental Rehabilitation in the private Dental Polyclinic "Kavaja", in Pristina, also at the PHI University Dental Clinical Center "St. Panteleimon"- Skopje at the Clinic for dental prosthetics.

The following methods were used:

1. Questionnaire was prepared for all patients, for the occurrence of cephalgia from orofacial origin;
2. Questionnaire was given with using the Helkimo anamnestic dysfunctional index (Ai);
3. Clinical examination was performed with the help of the Helkimo clinical dysfunctional index (Di) that evaluates five different symptoms;
4. Intraoral inspection was conducted for evaluation of the condition of the teeth, tongue and cheek mucosa;
5. Cephalgia from orofacial origin in patients with traumatic occlusion caused by improperly designed prosthetic devices (picture 1 a,b) was diagnosed and treated ;

a b

Picture 1a Intraoral view of improper prosthetic device

Picture 1b Panoramix radiograph of the same patient

6. Cephalgia from orofacial origin in patients with bruxism (picture 2a,b) was diagnosed and treated;

a b

Picture 2a Patient with bruxism - intraoral view

Picture 2b Bruxchecker for diagnosis of bruxism

7. Cephalgia from orofacial origin, in patients with loss of occlusal support (Kennedy class I, Kennedy class II, Kennedy class III (picture 3a,b) was also diagnosed and treated;

a b

Picture 3 a Intraoral view of patient with loss of occlusal support

Picture 3b Radiographic lateral view of the same patient

8. Prevention was implemented of the occurrence of cephalgia from orofacial origin;
9. Prevention was conducted of the damage to teeth, masticatory muscles, TMJ and removal of pain;
10. Contemporary prosthetic adjuvant clinical approach was applied at patients with cephalgia from orofacial origin in the three subgroups of examinees;
11. Educating patients about the need for rehabilitation of the dental system and motivation on how to eliminate the appearance of cephalgia from orofacial origin was practiced;
12. Pharmacotherapy, physiotherapy and psychotherapy were introduced;
13. The designs, effects on the butterfly deprogrammer and stabilization splint at the control examinations were displayed;
14. Control radiography before and after treatments were taken;
15. Education of patients on the usage of butterfly deprogrammer and stabilization splint was monitored;
16. All changes were well documented in patients' records;
17. Statistical data processing was conducted using the statistical program STATISTICA 8.0 and SPSS Statistics 23.0.

RESULTS AND THEIR ANALYSIS

From all of the analysis followed many results that were analyzed and compared with literature data.

Graph 1. Correlation between Helkimo anamnestic (Ai) and clinical (Di) dysfunctional index at the first subgroup of examinees – with traumatic occlusion

For $R = 0.50$ and $(p > 0.05)$ a medium strong positive insignificant correlation was established, with the obtained result leading to a positive association (confirming the statement of the patients with the clinical examination by the therapist).

Table 1. Control of the first subgroup of examinees – with traumatic occlusion

Cephalgia from orofacial origin on control after one week showed 12 (60.00%) patients, after one month - 8 (40.00%) patients, after three months - 6 (30.00%) patients. After 6 months, cephalgia from orofacial origin has not been reported in patients. For Cochran Q Test = 43.78 and $p < 0.001$ ($p = 0.000$) during the control in the stated relation there is a significant reduction of cephalgia from orofacial origin.

Table 2. Control of the first subgroup of examinees – with traumatic occlusion, after use of first aid, initial therapy, long term therapy (anterior deprogrammer)

Cephalgia from orofacial origin after application of first aid was reported in 17 (85.00%) patients, after application of initial therapy in 10 (50.00%) patients. After long-term therapy (anterior deprogrammer), cephalgia from orofacial origin has not been reported in patients. For Cochran Q Test = 25.76 and $p < 0.001$ ($p = 0.000$) after first aid, initial therapy, and long-term therapy (anterior deprogrammer) there is a significant difference in the presence of cephalgia from orofacial origin.

Graph 2. Correlation between Helkimo anamnestic (Ai) and clinical (Di) dysfunctional index in the second subgroup of examinees - with present bruxism

For $R = 0.19$ and ($p > 0.05$) a moderately weak positive insignificant correlation was found thus, the result confirms the statement of the patients with the clinical examination (there is a positive association). Restrepo C. et al. reported that bruxism causes symptoms such as stiff neck, facial pain and cephalgia, which is seen in our research and treatment is inevitable.^(9,10)

Table 3. Control of the second subgroup of examinees – with present bruxism

Cephalgia from orofacial origin of control after one week was seen in 16 (80.00%) patients, after one month in 12 (60.00%) patients, after three months in 9 (45.00%) patients, after six months in 2 (10.00%) patients, after twelve months only in 1 (5.00%) patient. After 18 months, cephalgia from orofacial origin has not been reported in patients. For Cochran Q Test = 54.83 and $p < 0.001$ ($p = 0.000$) during the control in the stated relation there is a significant reduction of cephalgia from orofacial origin.

Table 4. Control of the second subgroup of examinees - with present bruxism, after the application of first aid, initial therapy, long-term therapy (anterior deprogrammer, stabilization splint)

Cephalgia from orofacial origin after application of first aid was reported in 19 (95.00%) patients, after application of initial therapy in 17 (85.00%) patients, after application of long-term therapy (anterior deprogrammer) in 2 (10.00%) patients. After long-term therapy (using stabilization splint), cephalgia from orofacial origin has not been reported in patients. For Cochran Q Test = 48.83 and $p < 0.001$ ($p = 0.000$) after first aid, initial therapy, long-term therapy (anterior deprogrammer) and long-term therapy (stabilization splint) there is a significant difference in the presence of cephalgia from orofacial origin.

Graph 3. Correlation between Helkimo anamnestic (Ai) and clinical (Di) dysfunction index in the third subgroup of examinees - with loss of occlusal support

For $R = 0.87$ and ($p > 0.05$) a very strong positive insignificant correlation was established and the obtained result confirms the statement of the patients with the clinical examination by the therapist (there is a positive association). Salazar L. V. et al. have discovered that the loss of occlusal support induces Godonov's phenomenon, TMD which results in cephalgia from orofacial origin, also seen in our research.⁽¹¹⁾ Tsai C-M. described that the excessive strength of the masticatory muscles of the dental system is a trigger factor in the appearance of cephalgia from orofacial origin.⁽¹²⁾

Table 5. Control of third subgroup of examinees - with loss of occlusal support

Cephalgia from orofacial origin of control after one week was seen in 11 (55.00%) patients, after one month in 7 (35.00%) patients, after three months in 5 (25.00%) patients. After 6 months, cephalgia from orofacial origin has not been reported in patients. For Cochran Q Test =

39.57 and $p < 0.001$ ($p = 0.000$) during the control in the stated relation there is a significant reduction of cephalgia from orofacial origin.

Table 6. Control of third subgroup of examinees - with loss of occlusal support after use of first aid, initial therapy, long term therapy (anterior deprogrammer)

Cephalgia from orofacial origin after application of first aid is seen in 15 (75.00%) patients, after application of initial therapy in 10 (50.00%) patients. After long-term therapy (anterior deprogrammer), cephalgia from orofacial origin has not been reported in patients. For Cochran Q Test = 23.33 and $p < 0.001$ ($p = 0.000$) after first aid, initial therapy, long-term therapy (anterior deprogrammer) there is a significant difference in the presence of cephalgia from orofacial origin. Cephalgia from orofacial origin after application of first aid was seen in 15 (75.00%) patients, after application of initial therapy in 10 (50.00%) patients. After long-term therapy (anterior deprogrammer), cephalgia from orofacial origin has not been reported in patients. For Cochran Q Test = 23.33 and $p < 0.001$ ($p = 0.000$) after first aid, initial therapy, long-term therapy (anterior deprogrammer) there is a significant difference in the presence of cephalgia from orofacial origin

DISCUSSION

Aspects of rehabilitation of patients with cephalgia from orofacial origin with different etiological causes analyzed by dr. George Ghidrai expose that the vital element is adaptation to the bite.⁽¹⁶⁾

The dysfunctional environment at improperly designed fixed structures causes occlusal trauma, toothaches and muscle fatigue. Occlusal discrepancies are a direct cause for cephalgia from orofacial origin. The same was proved in our examinations and in multiple literature studies. Review of the scientific literature elaborates five key factors related to TMD and Okeson divides them as: Occlusal Conditions, Trauma, Emotional Stress, Deep Pain Input, and Parafunctional Activities.⁽¹⁷⁾

Our study, studies of Gazit et al., Takai et al. and Hellsing remind of the great importance of restorative procedures, observed and achieved during the dentition reconstruction.^(18,19,20)

Patients with bruxism experience headache and pulsation after waking up in the morning. In our examinations cephalgia from orofacial origin is present in patients with diagnosed bruxism.

De Luca Canto et al. discovered that individuals with bruxism are three times more likely to develop a tense type of headache in a state of bruxism.⁽²¹⁾

Mechanisms of central sensitization, released by trigger points are located in the craniofacial muscles.⁽²²⁾

Bruxism has been the hardest for treatment, which was discovered in our examinations.

Butterfly deprogrammer, in a group of patients with bruxism and stabilization splint introduce great improvement in the symptomatology of these patients.

Schulman et al. have seen that patient that have loss of occlusal support also develop occurrence of headaches which suggests the need for an intraoral device that would reduce pain, also proven in this study.⁽²³⁾ There is a connection of the tooth loss, overload of a group of teeth, muscle strain and TMD, leading to cephalgia from orofacial origin.

After reduction of headaches with the help of intraoral apparatus a contemporary prosthetic rehabilitation of patients is proceeded.

Patients with traumatic occlusion, bruxism and loss of occlusal support that reported cephalgia from orofacial origin have great contribution with the usage of anterior deprogrammer and stabilization splint. The preventive and therapeutic function of the butterfly deprogrammer and stabilization splint are far the most proven.

The three therapeutical modalities that we used - first aid, initial therapy and long-term therapy lead to complete elimination of cephalgia from orofacial origin. This research needs to be implemented in more detail in the everyday clinical practice. There is also a confirmed effectiveness of the prosthetic adjuvant clinical approach of cephalgia from orofacial origin in the everyday clinical practice with the contemporary prosthetic treatment.

Special emphasis should be applied in the process of manufacturing butterfly deprogrammer, and stabilization splint as a new contemporary method, because of the different possibilities for designs. This is another reason why they should be implemented in the everyday dental clinical practice.

With the first aid patients would get rid of the occurrence of cephalgia at the first visit to the dentist with pharmacotherapy, radiation therapy (solux lamp) and anesthetics. The initial therapy using pharmacotherapy, physiotherapy, psychotherapy and prosthetic therapy is a continuation of the first aid. It induces improvement of the oral health that leads to prevention of the damage to all structures of the stomatognathic system. The long term therapy consisting of manufacturing and appliance of butterfly deprogrammer and stabilization splint leads to elimination of the objective and subjective symptomatology, thus confirming justification for their usage.

The therapist independently in the office has an opportunity for a short period of time to create a butterfly deprogrammer and stabilization splint.

The individualization in approach shows improved patient quality of life on the increased satisfaction of the patient and the entire dental prosthetic team.

CONCLUSION

The application of first aid, initial therapy and long - term therapy on cephalgia from orofacial origin lead to elimination of objective and subjective symptomatology of patients. Statistically confirmed correlation between Helkimo Ai and Di, concludes the reduced pain from cephalgia, symptom of TMD. Usage of butterfly deprogrammer and stabilization splint completes the reduction of subjective and objective symptomatology of TMJ which concludes that their application is absolutely justified. The contemporary prosthetic clinical restoration which follows then completely enables functional - aesthetic rehabilitation of patients with continuation of the elimination on cephalgia from orofacial origin.

The overall oral and systemic health in the patients with traumatic occlusion from improperly designed prosthetic devices, bruxism and loss of occlusal support is generally improved which is satisfactory for all patients and the entire dental team.

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The Influence of Estrogen on Pregnant Women during the Three Trimesters of Pregnancy

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Abstract. Oral hygiene during pregnancy is an important but often neglected system. Oral health plays pivotal role in the outcomes of a pregnancy; but many pregnant women are unaware for this fact or accord less attention. We have made search in different data bases to find a paper when are described different protocols for oral health and influence of hormones such as estrogen during first and second trimester in pregnant women.

Keywords: Estrogen, Progesterone, Oral Hygiene, Pregnant Women

1 Introduction

The prevalence of oral diseases which are shown during the pregnant periods are about 44.2% [1,2]. Many studies shows increase prevalence and severity of oral inflammation during the pregnancy which occurred more in the 2nd and 3rd trimester [3,4]. The gingivitis is the most common oral diseases which attack the women during the pregnancy and the prevalence is 60-70% and will usually resolve spontaneously after delivery [1,2,5]. The pregnancy is associated with a variety of hormone, physiologic and biochemical change which occurring in the body women including alimentary canal [6,7]. There many physiological condition which occur at gingivitis and these include change in salivary volume and composition, microorganism flora, connective tissue and so on [7,8]. Many of oral diseases are prevented by health education, oral hygiene and oral health care; thus came to reduce the opposite outcomes which may be associated [2,9]. Additionally the health care and dental check after postnatal period may also play pivotal role in the prevention of early childhood caries [10]. In some regions in the world the services

where the services is available many of the pregnant women are unaware of it. The studies by Hullah et al. demonstrated good oral health practices, poor oral health services and each of third women were not aware of availability of free dental health service in pregnancy [11].

The aim of this paper is to make literature evaluation for oral health of the pregnant women in the three trimesters.

1.1 Gingivitis

Gingivitis in pregnant women is known to be modified by physiological alternation in endocrine system, such as puberty, menstruation and pregnancy [12]. The inflammation of gingiva will be increased during the pregnancy period, and it is associated with increase of female sex hormone level [8,13,14]. First investigation shows that hormones such as estradiol and progesterone are nutrients for *Prevotella intermedia* (*P. intermedia*) are correlated with gingivitis, but last results from different research groups show that subgingival microbiota is affected by gingival inflammation [15] (see figure 1, 2, 3, 4, 5, 6). The *Porphyromonas gingivalis* (*P. gingivalis*) have a great contribution in gingival diseases during the pregnancy [8]. Both *Porphyromonas gingivalis* and *Aggregatibacter actinomycetemcomitans* (*A. actinomycetemcomitans*) are associated with higher risk for oral disorders such as gingivitis and preterm birth [16,17]. Although abnormal pregnancy or pregnant gingivitis may be associated with different pathologies which are caused by different pathogens, and which are unclear till today. The correlation between GI (gingiva index) and the value of *Lactobacillus* in pregnant women in the first and third trimester showed a weak negative insignificant correlation [18].

Fig. 1. The influence of estrogen on periodontal tissues

The saliva is a biological fluid which is secreted from saliva gland into oral cavity, and are found different bacteria shed from microbial community and sustain different intraoral surface such as tooth surface, gingival cervix, tongue and buccal mucosa. Saliva collection is very easy, non-invasive and will take some minutes.

1.2 Symptoms of gingivitis

The main symptoms of gingivitis are swollen gums, bright red or purple gums, bleeding gums or bleeding after brushing, and bad breath. The complication which can associated gingivitis are periodontitis, different infection of gingiva or jaw bones, swollen lymph node etc.

Fig. 2. Healthy gingiva

Fig. 3. Gingivitis at 2 months of pregnancy

Fig. 4. Gingivitis at 6 months of pregnancy

Fig. 5. Gingivitis at 8 months of pregnancy

1.3 Diagnosis of gingivitis

Currently many researchers have shown different activity of enzymes in saliva samples such as aspartate aminotransferase (AST), alanine aminotransferase (ALT), gamma glutamyl

transferase (GGT), alkaline phosphatase (ALP), and acid phosphatase (ACP). These enzyme biomarkers may help in diagnosis and treatment of gingivitis.

2 Classification of gingivitis

The first classification of gingivitis are made in World Workshop in Clinical Periodontics, there are two main categories, which are divided at several subgroups:

Dental plaque –induce gingival diseases with four subgroups:

- Gingivitis associated with plaque only
- Gingival diseases modified by systemic factors
- Gingival diseases modified by medications
- Gingival diseases modified by malnutrition

Non-plaque-induced gingival lesions

- Gingival diseases of specific bacterial origin
- Gingival diseases of viral origin
- Gingival diseases of fungal origin
- Gingival diseases of genetic origin
- Gingival manifestations of systemic conditions

Traumatic lesions

Foreign body reactions

Not otherwise specified [19].

2.1 Influence of estrogen and progesterone in pregnant women

Estrogen is known to give a huge contribution to epithelial keratinization, new blood formation, proliferation of fibroblast in gingiva connection tissue [23]. The progesterone also have shown to play pivotal role on prostaglandin production and it is important for bone resorption rate [12,24]. During the pregnancy the level of both hormones at the end of third trimester are 10-30 times of amount observed during menstrual cycle, respectively [25]. But in case of pregnant tumor or granuloblastoma it is possible to see during pregnancy [26]. During the pregnancy gingivitis occur up to 36-100% of pregnant women [14], and clinical symptoms mention early are prevalent with no relationship with the amount of dental plaque [27]. The periodontal therapy need to be increased during the pregnancy, indicating the importance of periodontal care during this period [28]. Similar changes are found at women who are taking oral contraceptive (OCPs) [29]. Woman may have a changes in oral mucosa during menopause, when the level of hormone is decreased, which caused taste can change, xerostomia or gingivostomatitis [14,27,30,31].

The treatment of gingivitis is suggested to make by triclosan, chlorhexidine digluconate, and combination of thymol, menthol, eucalyptol, and methyl salicylate [20]. Based on mouthwashes with oils may also be useful, as they contain ingredients with anti-inflammatory properties, such as thymol, menthol and eucalyptol [21]. The bacteria that causes gingivitis can be controlled by using antibiotic such as amoxicillin, cephalixin, or minocycline in 500 grams of a non-alcoholic fluoride mouthwash is an effective mixture [22] (<https://www.webmd.com/oral-health/guide/gingivitis-periodontal-disease>).

3 Conclusion

This paper demonstrates the importance of prevalence of severe gingivitis among pregnant women, these findings highlight the need to address the importance of oral health care who is need during reproductive age women. Advances who are made in the field of salivary and gingiva tissue biomarkers as a potential therapeutic targets for treatment of oral diseases including gingivitis, oral inflammation, and immunological diseases in gingiva could lead to early diagnosis and treatment of this kind of diseases.

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How often medical errors are reported by health care providers at the Emergency Center in Pristina

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Abstract

Purpose: Safety is a fundamental principle in patient care, as well as a key component of quality management of healthcare services. Improving patient safety requires continuous energy, including all persons who have direct or indirect contact with the patient. This means changing the approach to the patient, to the workplace, improving workers' performance, as well as redesigning systems, with the aim of reducing patient risk.

With this approach, almost all disciplines and actors are involved, therefore a complex and multidisciplinary approach is required in the identification of deficiencies initially, the drafting of policies by the responsible institutions, as well as the implementation of policies by health care providers.

Research method: For this research, two questionnaires were compiled: One was compiled in order to address patients who sought health services at the Emergency Center. The second questionnaire is designed for the Emergency Center personnel, in order to identify the relationships between the workers, the managerial staff, the problems of reporting errors, and similar.

For this purpose as support were engaged a nurse and a specialist of the Emergency Center who worked in shifts, with the aim of surveying patients, in different parts of the day during the 24 hours.

Results: The results of this study show that the majority of patients who come to the Emergency Center are transported either by family members or by a passerby. These patients can suffer many unintentional injuries from inadequate and unprofessional transport. Also, the many patients come directly from the accident site or from respective homes: They are signs that there are problems in the referral system from the levels of Primary Health Care (PHC). Multiple injuries in the head region indicate a need for treatment by a dentist specializing in head and neck.

Conclusions: It is noticeable the need to reorganize the working hours for the workers of the Emergency Center. Raising the capacities of the primary care level would reduce the load of the Emergency Center from interventions, which can be handled without a problem at the lower levels.

Continuous professional trainings, as well as trainings focused on stress management, working under time pressure and relationships between health service providers, would significantly improve the level of patient safety in the Emergency Center.

Keywords: Patient Safety, Emergency Center, Research (study and analysis), Questionnaire, Medical errors, Adverse events, Safe procedures, Non-punitive reporting.

Introduction

The role of the Emergency Center in the provision of health services

The Emergency Center deals with the treatment of life-threatening emergencies such as injuries, poisonings, severe allergic reactions and patients whose lives are in danger and need urgent medical attention overall. The activity of the Emergency Center is performed by the services within the University Clinical Center of Kosovo (UCCK) which deals with:

- Triage
- Monitoring
- Examination
- Observation
- Laboratory and Radiological diagnosis

What does the Emergency Center offer?

The Emergency Center offers emergency professional medical assistance to the sick, injured and poisoned (accidental situations), whose life is in danger.

Given the dynamics of life often occur injuries at work, traffic accidents, homicides, injuries, shocks with cold tools, falls from high floors of buildings, electric current injuries, drownings, head, spine, abdomen and limb injuries, multiple incidents, injuries from physical, chemical and biological means, heart attacks and other emergency situations.

The Emergency Center must implement the basic principles of providing emergency medical aid and consider it as a humane and legal obligation to all those whose lives are in danger at the given moment (SHSKUK, n.d.).

The research question

How often medical errors are reported by health care providers at the Emergency Center in Pristina?

The purpose of the research (study)

The main reason of this research precisely in relation to the issue of "Patient Safety in the Emergency Center" lies in the fact that this research is about patients admitted for treatment at the Emergency Center, in a state of health which often due to the importance and emergency of the health treatment, prevents them (patients) from making informed decisions to choose the treatment of offered and preferred by the health personnel engaged in the Emergency. Different methods of treatment, application of drugs and the like, thus causing basic issues of patient safety to remain completely negligible.

Expected Project Completion

Recommendations regarding Patient Safety in the Emergency Center in Pristina, which will be developed in accordance with the goals and International Patient Safety Standards, will present the main result and output provided at the end of the research.

These recommendations are intended to contribute to reducing the rate of medical errors, creating a system of reporting medical errors, thus opening the possibility of learning from the previous lesson. The creation of a fair error reporting system would affect the improvement of the quality

of Patient Safety, and would affect the reduction of the frequency of repetition of the same and repeated eventual medical errors and failures.

Methodology and working material

The Emergency Center at the University Clinical Center of Kosovo in Pristina was chosen for research. The research was carried out through two questionnaires, the prospective method was used.

Before the start of the research, the written request was addressed to the Director of UCCK - Prishtina, specifying the goals of the research, the time-duration, and the research methods. Each of the respondents was informed about the purpose of the research and how to complete the questionnaire.

Purpose

The purpose of this work is to find the degree and the mass of patient danger that are treated at emergency center in Pristina. The results of this research will contribute to a better understanding of the Patient Safety Issues.

Objectives

Creating a focused report on the approach to the patient, which should be on the centre of attention all the time to the health service providers.

Determining the activities that in a potential way can cause unwanted and unintentional damages to the patients health.

Improvement of relations between health personnel, based on professional and human support, again always on the patients in common interest.

Reduction of intra-hospital infections preventing possible and various falls, caused by carelessness and negligence based on research data, appropriate recommendations will be developed by proposing possible solutions to the problems identified in the field of Patient Safety, always based on the Patient Safety International Standards.

Results

The research in the Emergency Center in Pristina was designed to evaluate the opinions of the working staff on issues related to patient safety, errors during the provision of health services, procedures for reporting errors that could harm the patient during the provision of health services. For this purpose, two questionnaires were compiled: One for evaluating the opinion of the employees of the Emergency Center, while the other for recording the opinions of those who sought health services at this center. The questionnaire for the staff had 35 questions collected of similar interest, while the second questionnaire had 33 questions which focused more on identifying the frequency of interventions by the staff, the type of interventions, the hygiene of the staff and the premises of the Emergency Center.

In the question of how often errors of health service providers are reported?! The results are alarming! Most of the respondents state that unintentional errors are not reported, which are identified either before they reach the patient, or errors that reach the patient and did not cause harm to the patient. Most of the respondents stated that errors that occur and have the potential to harm the patient are rarely reported.

Table 1. How often are the following errors reported in the unit where you work?

	Always	Often	Not often	Rarely	Never	In total
How often is it reported if an error occurs but is identified before reaching the patient?	5 16%	8 25%	7 22%	11 34%	1 3%	32 100%
How often is it reported when an error occurs that has caused no harm to the patient?	4 13%	9 28%	6 19%	10 31%	3 9%	32 100%
How often is it reported when an error occurs that has the potential to cause harm to the patient?	6 19%	3 9%	8 25%	12 38%	3 9%	32 100%

In the question of how often a case is reported if an error occurs (Wolf, 2008), but it is identified before it reaches the patient?!... We have these results: 16% of respondents are convinced that this type of error is always reported, while 25% partially agree with such a thing.

The portion of 22% was not declared at all, while 34% think that the errors that occur are not reported, but are identified before they reach the patient. Only 3% are convinced that these errors are not reported at all.

Actual reporting of medical errors by doctors in hospitals is underreporting compared to doctors' views on whether they should report such errors (Doctors Under-Reporting Medical Errors To Hospitals, Science Daily)

In the question of how often a case is reported if the error occurs which did not cause any harm to the patient, 13% of respondents are convinced that this type of error is always reported, while 28% partially agree with this. The portion of 19% was not declared at all, while 31% think that errors that occur and that did not cause any harm to the patient are not reported. Of the total number of health service providers, 9% are convinced that these errors are not reported at all. The reporting of medication administration errors and the factors that may prevent it continue to receive a lot of attention in those entities seeking to increase patient safety: Fear of negative

consequences, whether disciplinary or legal action, has been identified as a major deterrent to reporting errors (Medication Error Reporting: CQI Programs Offer Avenue to Vital Follow-Up).

Analysis of error data has enabled researchers to identify strategies for reducing medication errors in hospital settings, and studies have shown that some tools are effective (Medication Error Reporting: CQI Programs Offer Avenue to Vital Follow-Up).

In the question of how often it is reported in the event of an error that could have caused harm to the patient, 19% of respondents are convinced that this type of error is always reported, while 9% partially agree with this. The 25% part did not declare at all, while 38% think that the errors that occur and that can cause damage of any nature to the patient, who was seeking health services at the Emergency Center, are not reported. Of the total number of health service providers, 9% are convinced that these errors are not reported at all.

Patient care is not as safe as it should be. The occurrence of adverse events due to unsafe care is likely to be one of the top 10 causes of death and disability in the world (WHO, 2019). A significant number of Americans have been harmed as a result of medical malpractice. Preventable adverse events are a leading cause of death in the United States of America, generally when an error is identified the initial reaction is the tendency to find and blame someone. However, isolated events or errors appear to be more often due to the convergence of multiple contributing factors. Blaming an individual does not change these factors and the same mistake is likely to be repeated. Preventing errors and improving patient safety requires a new approach to systems in order to modify the conditions that contribute to the occurrence of errors. People who work in healthcare are the most educated and dedicated workforce. The problem is not with people not wanting to contribute to the flaws of this system, but the problem is that this system needs to be made more secure (TO ERR IS HUMAN: BUILDING A SAFER HEALTH SYSTEM (Linda T. Kohn, Janet M. Corrigan & Molla S. Donaldson eds., 1999)).

Not many cases of errors are reported to the Emergency Center. According to health service providers, 38% stated that during the past year no case was reported, 40% stated that 1-2 cases were reported, 16% stated that 3-5 cases were reported, while none of the respondents, did not state that 6 - 10 cases were presented and 6% are convinced that more than 21 cases were reported. Developing a skilled workforce requires continued investment in employee knowledge and skills. Day-to-day management of employee performance is key to an effective performance management system. Goals must be set, making sure expectations are clear, always drawing on the experience of existing staff.

Most workers want to be part of a compelling future in the organization. They want to know what is most important in their workplace. To be meaningful and effective objectives in motivating employees, they must be linked to the larger ambitions of the organization (20 tips to improve employee engagement and performance).

Discussion

Patient Safety is a health care discipline that emerged with the evolving complexity in health care systems and the resulting rise of patient harm in health care facilities. It aims to prevent and reduce risks, errors and harm that occur to patients during provision of health care. A cornerstone of the discipline is continuous improvement based on learning from errors and adverse events. (WHO, 2019)

Patient safety is a global public health concern. It is a health care discipline with ever evolving advancement and complexity resulting in consequential rise in patient harm. Since the pandemic, patient safety has been threatened even more by laying bare the inadequacies of health systems. (Gregory Domer, 2021)

The World Health Organization (WHO) defines patient safety as “the prevention of errors and adverse effects to patients associated with health care” and “to do no harm to patients” (World Health Organization, 2009)

Patient Safety in the Emergency Centre shows a help indicator, useful and necessary, which provides information for patients opinion regarding fulfillment of their needs and expectations from the health institution in relation to the professionalism health service providers.

There are millions of patients globally who suffer disabilities, injuries or death each year due to unsafe medical practices. (Sorra J, 2003)

Researches for patients safety enables healthcare workers to monitor the performance and implement quality improvement measures, two needed elements to provide a good healthcare.

The traditional approach to medical errors has been to blame the provider who delivers care directly to the patient, acting at what is sometimes called the “sharp end” of care: the doctor performing the transplant operation or diagnosing the patient's chest pain, the nurse hanging the intravenous medication bag, or the pharmacist preparing the chemotherapy. Over the last decade, we have recognized that this approach overlooks the fact that most errors are committed by hardworking, well-trained individuals, and such errors are unlikely to be prevented by admonishing people to be more careful, or by shaming, firing, or suing them. (Hill, 2023)

The level of risk of patients treated by the health personnel in the Emergency Centre in Pristina is a summary and interweaving of the patients experiences on this emergency center with the techniques of health service providers.

In the past years there has been a need to measure and manage patients experiences on health institutions, focusing if the patients are on the center of the healthcare or not. A patients satisfaction is an important factor of the staff satisfaction and more for.

The most worrying part is that from 31 of the respondents, or 14% who have been disappointed by the services on this Emergency Centre.

This can be explained by the fact that the work of health service providers in the Emergency Centre is more difficult in comparison with other clinics, and safety needed, speed, accuracy and bigger service considering that some of the patients are on heavy condition and unable to move.

Conclusions

- Lack of freedom to communicate errors during therapy administration
- Low frequency of error reporting
- The need for management/staff awareness raising on patient safety
- Support non-punitive system for reporting errors
- Continuous institutional education and continuous professional development
- Inadequate working hours of workers
- Poor team performance
- Poor performance among teams

Recommendation

- Encouraging patient safety education for all health care providers, including administrative, managerial and other staff.
- Promotion of the non-punitive system for reported errors that could harm the patient or have harmed the patient.
- Production, distribution and discussion of various information on international patient safety standards, patient safety indicators.
- Cooperation with Organizations, Colleges, Universities involved in the education of health workers for the introduction of Patient Safety in the teaching curricula of their Institutions.
- The permanent engagement of the emergency dentist for the treatment of injuries in the head region.
- Encouraging health service providers for their active role in patient safety.
- Management of existing resources (personnel, equipment or supplies) in order to increase the performance of all actors of the Emergency Center.

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GROWTH INDICATORS AND THEIR RELATION IN INDIVIDUALS WITH DIFFERENT SKELETAL MALOCCLUSIONS

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Abstract:

Introduction: Growth and development variations among individuals with the same chronological age have led to necessities of assessing individual biologic maturity. Knowledge and understanding of facial growth and development is fundamental to determine the optimal timing for orthodontic, and dental orthopedic treatment planning. Treatment timing during these favorable growth processes can contribute significantly to the efficient and effective improvement of skeletal problems in the individual patient.

Aim: To study the correlation between cervical vertebral maturity index (CVMI) according to Baccetti and dental calcification index (DI) according to Demirjian method, in individuals with Class I, II and III skeletal relationships.

Methods: Panoramic and lateral cephalometric radiographs of 140 subjects were evaluated, with age range from 6-19 years. Skeletal maturation stages according to Baccetti method were determined in lateral cephalometric radiographs. DI of upper canines (UC) and lower second molars (LSM) with Demirjian method were evaluated in panoramic x-ray. Digital lateral cephalograms and panoramic radiographs were performed by Vatech and they were analyzed and saved in DICOM format using dedicated software (Easydent version 4.1). Statistical analysis Chi square with $p=0.05$ and Pearson's correlation coefficient were performed in IBM SPSS version 26 to assess the correlation between CVMI and DI for intergroup comparison.

Results: There is a strong positive correlation between chronological age, cervical vertebral maturation index and Demirjian index for lower second molars, with $p < 0.000$, Pearson correlation coefficient was from $r = .744$ to $r = .922$. Pubertal growth spurt (CS3–CS4) was longer in Class III subjects than in subjects with normal skeletal relationships. Males show an younger dental calcification stage compared to females in the corresponding skeletal maturation stage.

Conclusion: There is a strong correlation between cervical vertebral maturation index and Demirjian index for upper canines and lower second molars. The correlation is not affected by intermaxillary sagittal relationship, however in class II patients we have a shorter pubertal peak period and in class III there is a longer period of pubertal peak.

Keywords: *skeletal maturation, cervical vertebral maturation, dental maturation.*

INTRODUCTION

When planning orthodontic and dental orthopedic treatment with the aim to alter or modify skeletal growth, knowledge of individual growth pattern is essential. Growth and development variations among individuals with the same chronologic age have led to necessities of assessing individual biologic maturity. Knowledge and understanding of facial growth and development is fundamental to determine the optimal timing for orthodontic, and dental orthopedic treatment planning. In dentofacial orthopedics, the issue of optimal timing is linked intimately to the identification of periods of favorable growth in structures such as the mandibular condyles or the circummaxillary sutures. Treatment timing during these favorable growth processes can contribute significantly to the efficient and effective improvement of skeletal problems in the individual patient¹⁻².

Cervical vertebral maturation method was first proposed by Lamparski³ in 1972. This method is beneficiary because the evaluation of individual skeletal growth or cervical vertebral maturation is performed in lateral cephalometric radiograph, which is already used in orthodontic diagnosis.

The method used in this study is the modified one by Bacetti⁴ et al in 2005, where there are six stages corresponding to six different maturational phases in the cervical vertebrae. These stages are as follows:

CVMI I – Initiation – The lower borders of the second, third and fourth cervical vertebrae (C2, C3 and C4) are flat. The bodies of C3 and C4 are trapezoid in shape and the superior vertebral borders are tapered from posterior to anterior.

CVMI II – Acceleration – Concavities develop on inferior borders of C2 and C3, and inferior border of C4 is flat. The bodies of C3 and C4 are nearly rectangular in shape.

CVMI III – Transition – Distinct concavities develop on inferior borders of C2 and C3, and concavity begins to develop on inferior border of C4. The bodies of C3 and C4 are rectangular.

CVMI IV – Deceleration – Distinct concavities are seen on inferior borders of C2, C3 and C4. The vertebral bodies are becoming square in shape.

CVMI V – Maturation – More accentuated concavities are seen on inferior borders of C2, C3 and C4. The bodies of C3 and C4 are nearly square in shape.

CVMI VI – Completion – Deep concavities are seen on inferior borders of C2, C3 and C4. The bodies of C3 and C4 are square or greater in vertical dimension than in horizontal dimension

A widely used dental age assessment method was described by Demirjian in 1973. Demirjian et al⁵ and Demirjian and Goldstein⁶ based their dental maturity scores on objective criteria rather than on absolute lengths. Foreshortened or elongated projections of developing teeth do not affect determinations. Since its introduction 4 decades ago the Demirjian method of age estimation has emerged as the most widely researched and applied technique in dental age estimation of children and adolescents. According to Demirjian et al there are eight stages of calcification for molars and premolars and 6 stages for canines and incisors. These stages are labelled with letters A-H for molars and premolars and C-H for canines and incisors

The purpose of the study is to assess the correlation between chronological age, cervical vertebral maturation index (CVMI) and Demirjian index of the upper canines (DIUC) and

Demirjian index of lower second molars (DILSM). Is this correlation affected by gender and intermaxillary sagittal malocclusions and are the data reliable to predict skeletal individual growth and thus plan the orthodontic and dental orthopedic treatment.

MATERIAL AND METHOD

The study group is consisted of 140 subjects, 85 females and 55 males. All subjects analyzed are from "Ars Medica" polyclinic, Prishtine, Kosovo. The age range is 6-19 years old. All our patients were divided into three groups according to their sagittal skeletal relationship, in class I, II and III. The selection criteria were:

- Subjects with chronological age from 6 to 19 years
- Good quality pre-treatment digital panoramic and lateral cephalometric radiographs, performed by "Vatech", taken at the same day
- No congenital anomalies or syndromes

The study was approved by the Ethics Committee of the Dental Chamber of Kosovo, N0.24, 19.01.2022.

Digital lateral cephalometric and panoramic radiographs were analyzed and saved in Digital Imaging and Communication in Medicine (DICOM) format using dedicated software (Easydent version 4.1).

Lateral cephalometric analysis was performed to determine skeletal relationship; Steiner's analysis complemented with Holdaway's ratio and Wits appraisal.

The cervical vertebral maturation index (CVMI) according to *Baccetti et al* of C2 (odontoid process), C3 and C4 were evaluated on lateral cephalometric radiograph where two sets of variables were examined:

- The presence or absence of concavity along the inferior border.
- Differences in the morphological shapes of the vertebral bodies (trapezoidal, rectangular horizontal, square, and rectangular vertical).

The *Demirjian* Index (DI) of upper canine (UC) and lower second molar (LSM) was evaluated on panoramic radiograph. Dental calcification stages corresponding eight maturational stages are labelled with letters A-H form lower second molars and C-H for upper canines. In order in to perform statistical analysis they were marked with numbers ranging from 1-8 for lower second molars and 3-8 for upper canines.

The data derived were subjected to appropriate statistical analysis in IBM SPSS version 26. To avoid errors in evaluation of the cervical vertebrae and the stage of mineralization of the upper canines and lower second molars an interrater reliability analysis using the Kappa statistic was performed to determine consistency among raters.

Descriptive statistics with mean, standard deviation and the number of subjects for variables were performed.

Chi-square test and Pearson's correlation coefficient were performed to analyze correlation between variables and intergroup comparison.

Frequency and distribution of DIUC and DILSM through different stages of CVMI and intergroup comparison was performed (gender and intermaxillary sagittal skeletal relation).

RESULTS

Mean chronological age of our subjects was 12,6653. Their mean skeletal age was between CVMI 3 and CVMI 4 and their mean dental age for upper canines was stage G and stage F for lower second molars as shown on Table 1.

Table 1: Descriptive statistics of age, CVMI, DIUC and DILSM

The interrater reliability for the raters was found to be Kappa = 0.982 for CVMI, Kappa = 0.980 for DIUC and Kappa = 0.973 for DILSM ($p < .001$), 95% CI, Table 2.1, 2.2 and 2.3

Table 2.1: Cervical vertebral maturation index * Cervical vertebral maturation index observer 2 Crosstabulation

Table 2.2: Demirjian index for upper canines * Demirjian index for upper canines observer 2 Crosstabulation

Table 2.3: Demirjian index for lower second molars * Demirjian index for lower second molars observer 2 Crosstabulation

At a significance level of 0.05, and $DF=20$ the association between the variables is statistically significant with a level of significance $< .000$ as shown in Table 3.1 and 3.2.

Table 3.1 Chi-squared test of independence for CVMI and DIUC

Table 3.2. Chi-squared test of independence for CVMI and DILSM

Pearson's correlation coefficient is significant $<.000$ with standard α value $.05$. We have a strong positive correlation between variables, the strongest being between DIUC and DILSM $r=.922$ as shown in Table 4.

Table 4: Pearson's correlation between age, CVMI, DIUC and DILSM

In **Figures 1 and 2** the scatterplot of Pearsons correlation coefficient and the regression line show positive strong correlation. They are not affected by gender and intermaxillary skeletal relation.

Figure 1.1 Scatterplot and regression line between age and CVMI by gender sagittal relation

Figure 1.2 Scatterplot and regression line between age and CVMI by intermaxillary sagittal relation

Figure 1.3 Scatterplot and regression line between age and DIUC by gender sagittal relation

Figure 1.4 Scatterplot and regression line between age and DIUC by intermaxillary sagittal relation

Figure 1.5 Scatterplot and regression line between age and DILSM by gender sagittal relation

Figure 1.6 Scatterplot and regression line between age and DILSM by intermaxillary sagittal relation

Figure 2.1 Scatterplot and regression line between CVMI and DIUC by gender sagittal relation

Figure 2.2 Scatterplot and regression line between CVMI and DIUC by intermaxillary sagittal relation

Figure 2.3 Scatterplot and regression line between CVMI and DILSM by gender sagittal relation

Figure 2.4 Scatterplot and regression line between CVMI and DILSM by intermaxillary sagittal relation

For stage 2 or acceleration stage of CVMI the distribution and frequency for upper canines is stage G and stage E and F for lower second molars. In stage 3, transition stage of CVMI, the distribution and frequency for upper canines is stage H and stage F and G for lower second molars. And for stage 4 of CVMI, deceleration, the distribution and frequency for upper canines is stage H and stage G for lower second molars, Table 5 and 6.

Table 5 Distribution and frequency for DIUC through CVMI

Table 6 Distribution and frequency of DILSM through CVMI

The onset of the peak of pubertal growth spurt in class II patients, especially females, happens earlier compared with class I and class III patients. In the corresponding CVMI stage 3 and 4 in class II we found earlier stages of DIUC and DILSM.

DISCUSSION

Statistically significant results while evaluating the correlation between CVMI and DI gives us perspective even in circumstances when we are limited with diagnostic materials. According to *Valizadeh S et al* a single panoramic radiograph which is of routine use may be suggested as an alternative diagnostic material⁷. Demirjian index includes details of the tooth and the crown-to-root ratio, not just observing and measuring the root length of the tooth. As a result, shortening or extending the teeth in radiography does not affect the accuracy of the measurements *Krailassiri S et al*⁸.

Growth modification is often limited by the amount of the growth potential. The purpose of this study is not to exclude one diagnostic material for another in this case the Cephalometric x-ray over panoramic x-ray, but to use as much data available from the panoramic and cephalometric x-ray to predict growth, plan and execute orthodontic and dental orthopedic treatment. Dental maturation stages of the mandibular teeth show satisfactory diagnostic performance only for the identification of the prepubertal and postpubertal growth phases, with no reliable indications for the onset of the pubertal growth spurt *Surendran S et al*⁹.

According to *Trakinienė G et al* indicator of pre-peak of pubertal growth spurt could be the opened apical end of the maxillary canine root. While the opened apical ends of the mandibular second molar roots could match with the peak of pubertal growth spurt¹⁰.

Angeliari et al noted that pre-pubertal CVM stages of CS1, CS2, and CS3 are equal to midpalatal maturational stages of A, B, and C. The best performance for rapid palatal expansion is achieved at CS2 which corresponds to upper canine stage F and lower second molar stage E in females, and upper canines stage G and lower second molars stage F for males¹¹.

In class II patients there is an earlier onset of the peak of pubertal growth spurt. On the other hand according to *Kuc-Michalska M and Baccetti T*¹² growth interval corresponding to the pubertal growth spurt (CS3–CS4) was longer in Class III subjects than in subjects with normal skeletal relationships.

CONCLUSION

There is a strong correlation between CVMI and DIUC and DILSM. The data are reliable and reproducible and they can be used in diagnosis and treatment planning in orthodontic and dental orthopedics.

The correlation itself is not affected by gender or inetrmaxillary class relationship, however in class II patients we have an earlier pubertal peak period and in class III there is a longer period of pubertal peak which corresponds to CVMI stage 3 and 4.

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