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The role of the IDJ is to inform its readers of ideas, opinions, developments and key issues in dentistry - clinical, practical and scientific - stimulating interest, debate and discussion amongst dentists of all disciplines. All papers published in the IDJ are subjected to rigorous peer review.

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Amoxicillin vs Levofloxacin in Treatment of Chronic Periodontitis: Review

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ABSTRACT

Background: Antibiotics Resistance can be the main problem faced by the specialists in the medical fields. The main reason of such resistance is the improper prescribing of antibiotics. In dentistry this problem must be in concern for 2 reasons, first, limited and outdated knowledge of many dentist in Iraq with recent modalities in the field of therapeutics, so they keep prescribing penicillins, for every odontogenic infection (rationale prescribing), second, the patient who keeps prescribing the same drug for himself every time (i.e. dealing with antibiotic as over-the-counter drug).

Aim of the study: This review will clarifies the use of amoxicillin (most prescribed drug in Iraqi dental clinics) vs the use of third generation quinolones (levofloxacin) in an important field of dental practice which is periodontology, with focusing on levofloxacin as it took a privileged position in medical researches.

Conclusion: levofloxacin was superior to amoxicillin since it is applied once daily, few nonhazardous side effects, nearly 100 % bio-availability in spite of different rout of administration, and can be applied topically as gels and intra- pocket films. Perhaps this can change a lot among practitioners' and non- practitioners' prescribing (habits).

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INTRODUCTION

Infection is a major category of human illness and skillful managing of antimicrobial drugs is of the first rank [1]. The challenge is made more difficult by the problem of emerging resistances and socio-economic status that is on decline [2].

Dental infections are polymicrobial involving a combination of gram positive, gram negative, facultative anaerobes, and strict anaerobic bacteria [3]. While there are many antibiotic preparations offered for the treatment of localized and systemic infections, comparatively few antibiotic preparations are routinely engaged in dentistry [4].

Dentists prescribe medications for the management of a number of oral conditions, mainly orofacial infections [5]. The prescribing of antibiotics by dental practitioners has become an important aspect of dental practice. For this reason, antibiotics account for the bulk of medicines prescribed by dentists [6].

The accidental discovery of a mould called "Penicillium Notatum" which had the potential of inhibiting Staphylococcus colonies by Alexander Flemming in 1928 paved the way for the miracle drug "Penicillin" which saved millions of lives and opened a new era of curative medicine [7].

Penicillins can be classified into four broad categories, each covering a different spectrum of activity. The natural penicillins (penicillin G and penicillin V) have activity against many gram-positive organisms, gram-negative cocci, and some other gram-negative organisms. The aminopenicillins (ampicillin, amoxicilline, bacampicillin, and pivampicillin) have activity against penicillin-sensitive gram positive bacteria, as well as Escherchia coli, Proteus mirabilis, Salmonella sp., Shigella sp. and Haemophilus influenza. The antistaphylococcal penicillins (cloxacillin, dicloxacillin, etc) are also active against beta - lactamase - producing staphylococci. The antipseudomonal penicillins have less activity against gram positive organisms than the natural penicillins or aminopenicillins [8]. The penicillins are nontoxic and remarkably safe drug. The hypersensitivity reaction leading to anaphylaxis is the only major problem which is seen in approximately 5 to 10% of the patients taking penicillin. The minor adverse effects include nausea, vomiting, pain and inflammation at the site of injection after intramuscular administration has been reported [9].

Fluoroquinolones a class of man-made antibiotics. Over 10,000 fluoroquinolone analogs have been synthesized, including several with wide clinical presentations.

Fluoroquinolones in use nowadays typically offer greater efficacy, a broader spectrum of antimicrobial activity, and a better safety profile than their forerunners[1].

Levofloxacin (trade names: Levaquin, Advaquin, Tavanic, Levomed, Novotic which is widely spread in Iraqi market); Is a broad-spectrum antibiotic of

the fluoroquinolone drug class (third generation of quinolones) [10]. Its spectrum of activity includes most strains of bacterial pathogens responsible for respiratory, urinary tract, gastrointestinal, and abdominal infections, including Gram negative (Escherichia coli, Haemophilus influenzae, Klebsiella pneumoniae, Legionella pneumophila, Moraxella catarrhalis, Proteus mirabilis, and Pseudomonas aeruginosa), Gram positive (methicillin-sensitive but not methicillinresistant Staphylococcus aureus, Streptococcus pneumoniae, Staphylococcus epidermidis, Enterococcus faecalis, and Streptococcus pyogenes), and atypical bacterial pathogens (Chlamydophila pneumoniae and Mycoplasma pneumoniae).

Compared to earlier classes such as ciprofloxacin, levofloxacin exhibits greater activity towards Gram-positive bacteria [11].

Most adverse reactions are mild to moderate; yet, sometimes serious adverse effects occur. There is some disagreement in the medical literature regarding whether and to what extent levofloxacin and other fluoroquinolones produce serious adverse effects more frequently than other broad spectrum antibacterial drugs [12, 13,14].

This review shed the light over the use of both penicillins and levofloxacin in an important field of dental practice which is periodontology.

Amoxicillin

In 2003 martin Addy reported that chronic inflammatory periodontal conditions are not indicated for antibiotics; systemic antimicrobials should only be used in acute periodontal conditions where drainage or debridement is impossible, where there is local spread of the infection or where systemic upset has occurred. The disadvantages of systemic antimicrobials can be grouped under the headings of allergic reactions, superinfection, toxicity, drug interactions, and patient compliance and, perhaps of most widespread importance, bacterial resistance [15].

In 2006 N. J. Lopez et al reported that the effect of metronidazole plus amoxicillin as the sole therapy, on the sub gingival microbiota of chronic periodontitis. This was confirmed in a study held with twenty-two patients with untreated chronic periodontitis were randomly assigned to a group that received a combination of amoxicillin plus metronidazole for 7 days, and a group receiving scaling and root planning and two placebos [16].

In 2013 Anna K. Szkaradkiewicz and Tomasz M. Karpiński described Periodontitis as a chronic oral infection that lead to rapid destruction of periodontal tissues. On the development of the disease have an impact many bacteria, in particular anaerobic bacteria which act on fibroblasts, epithelial and endothelial cells and extracellular matrix components [17]. This leads to the conclusion that amoxicillin have no effect in managing chronic periodontitis comparing with metronidazole which affects anaerobic cocci, and anaerobic gram-negative bacilli [1].

Levofloxacin

In 1998 H. M. Wexler et al reported an important paper that compared the effect of levofloxacin with ofloxacin, ciprofloxacin, ampicillin, sulbactam , cefoxitin, and metronidazole for a selected group of anaerobes isolated from skin and soft tissue infections, and the final conclusion was that Levofloxacin has good activity against certain groups of anaerobic isolates (non-B. fragilis Bacteroides species, Veillonella species, Prevotella species, and Porphyromonas species)[18].

In 2003 Stein G. E. , Goldstein EJ. In a review confirmed that in clinical efficacy trials, levofloxacin has been effective in the treatment of patients with gynecologic, skin and skin-structure, and bone infections involving anaerobic pathogens [19].

In 2014 Avani R. Pradeep et al held a study on sixty five patients with chronic periodontitis randomly divided into test and control group in which the test group was treated with oral levofloxacin 500 mg once daily. Results showed that Patients receiving levofloxacin showed statistically-significant improvements in mean probing depth and clinical attachment level. The conclusion was confirmed at last that levofloxacin has significantly improved the clinical and microbiological parameters of chronic periodontitis [20].

In 2013 B. M. Borole et al formulated a levofloxacin hemihydrate in - situ oral gel to be applied without incision. This was developed by using various concentrations of plaxomer which exhibit sol- to- gel phase transition converting to gel at body temperature 37C° from liquid at room temperature 25 C°, each formulation was evaluated with various parameters such as physiochemical properties, viscosity, gelation properties, gelation temperature, spreadability, in vitro release and stability. The results were satisfactory for all formulations but they recommended to use polymers instead for more bioavailability [21].

Later in 2014 Neha Bisht et al directed their efforts to formulate and evaluate in situ oral topical gels of levofloxacin. In-situ gel were prepared by using carbopol 934P and using sodium carboxy-methyl cellulose along with hydroxyl-propylmethyl-

cellulose was used to prolong the release of levofloxacin. Formulations were evaluated for gelling capacity, viscosity, gel strength, bio-adhesive force, spreadability, microbiological studies and in vitro release. Levofloxacin from the muco-adhesive system in simulated salivary fluid was influenced significantly by the properties and concentration of carbapol 934 and sodium CMC showed to enhance bioavailability through its longer oral residence time and ability to sustain the release of the drug. The gels which was prepared by using the technique thermo reverse gelation with Levofloxacin shown good antimicrobial activity. The In situ systems showed increased residence time and prolonged drug release for over 8 hrs.

Conventional oral formulations like solution, suspension, and ointments have many disadvantages which result into poor bioavailability of drug.[22].

As intra pocket medication; In 2010 Prabushankar GL, Gopalkrishna B, Manjunatha KM, Girisha CH has formulated and evaluated Levofloxacin dental films for Periodontitis. Films were prepared by solvent casting technique.

Periodontal films containing Levofloxacin were prepared. In vitro characterization studies revealed that Levofloxacin can be integrated in a slow release device for the treatment of periodontitis. Ageing studies shows that the drug remained intact and stable in the periodontal films during storage. Spectroscopic data shows there is no significant chemical interaction between the drug and polymers. Further, detailed investigation is required to establish in vivo efficiency of these films[23].

CONCLUSION

It is observable that levofloxacin is not only preferred over penicillins it is also preferred even over newer (4th) generation quinolones this is due to its broad spectrum of activity.

Antibiotic spectrum:

Levofloxacin has excellent activity against G- negative bacilli. Amoxicillin is a wide-spectrum antibiotic but it is not effective against gram negative bacilli so metronidazole is added in many therapeutic regimens [16].

Bioavailability and dosage forms:

Levofloxacin is available in the market as a conventional dosage forms such as tablets, capsules, and parenteral for the treatment of bacterial infections [23]. It is rapidly and completely absorbed after oral administration, with a plasma concentration profile equal to that obtained from intravenous administration of the same amount (bioavailability 100% compared with 60- 70% for oral penicillins), oral fluoroquinolones should be taken 2 hours before or 4 hours after antacids[24] .

This is definitely preferred by patient instead if confusing multi- application of amoxicillin (3time) during the day. Most of the penicillins are incompletely absorbed after oral administration, and they reach the intestine in sufficient amounts to affect the composition of the intestinal flora. Food decreases the absorption of all the penicillins because as gastric emptying time increases, the drugs are destroyed by stomach acid. Therefore, they should be taken on an empty stomach [25].

Topical forms of levofloxacin (gels and intra-pocket films) revealed chemical stability during preparation, storage and application; yet no topical penicillins are seen.

Side-effects:

In general, levofloxacin is well tolerated; but like most antibiotics, the most common adverse effects of fluoroquinolones are nausea, vomiting, and diarrhea.

Headache and dizziness or light- headedness may occur, should be avoided in pregnancy and in nursing mothers, and in children under 18 years of age, because of articular cartilage erosion (arthropathy and tendinitis), should not be used in patients who are predisposed to arrhythmias or are taking antiarrhythmic medications. Still penicillins are among the safest drugs.. However neurotoxic, nephrotoxic, cation toxicity (hypokalemia) is likely to occur among susceptible patients [1, 13, 14, 25].

Combination:

The antibiotics prescribed most commonly by dentists either amoxicillin alone or in addition to metronidazole. [26, 27] while levofloxacin prescribed alone.

Allergy:

Among the most important problems in penicillins is allergy. Allergic reactions include anaphylactic shock (0.05% of recipients); serum sickness-type reactions (urticaria, fever, joint swelling, angioneurotic edema, intense pruritus, and respiratory compromise occurring 7 –12 days after exposure); and a variety of skin rashes [24]. Levofloxacin could be the safer among first-, second- or fourth-generation quinolones in cases of allergic reaction [28].

Resistance:

Resistance to any drug obtained due to:

1. Repetitive prescription by practitioners and / or non- practitioners (volume of drug use).
2. Exposure of bacteria to low concentration of

antibiotic.

3.Absence of knowledge of cross- resistance [29].

Resistance to penicillins and other β-lactams is due to one of the following mechanisms: (1) inactivation of antibiotic by β-lactamase, (2) modification of target penicillin- binding proteins, (3) impaired penetration of drug to target penicillin binding proteins.

Beta-lactamase production is the most common mechanism of resistance (24). In quinolones, resistant organisms emerge only due to one or more point mutations in the quinolone binding region of the target enzyme or to a change in the permeability of the organism, (28), this limited the resistance only in streptococcus pneumonia, which is not related to oral conditions [30] .

RECOMMENDATIONS

After reviewing this article we recommend that:-

1.Dentists must be routinely updated with advances in field of therapeutics.

2.Proper diagnoses and analysis will definitely lead to proper drug prescribing.

3.Antibiotics should not be consumed as OTC (over the counter drugs). This can be limited in Iraq by using the system of bar code so the patient will be prevented from re- dispensing the prescription once again (rationale use).

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Comparing Shear Bond Strength Of Auto-polymerized Soft Lining Materials to Acrylic Denture Base Using Different Surface Treatment and Denture Base Materials.

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ABSTRACT:

Background: Denture bearing tissue condition may be highly affected by stress applied from the occlusal force during function of mastication therefore the need for denture soft lining material application is necessary and testing the bond strength of this material to acrylic denture base is of some point of interest and need to be improved. The aim of the study is to test the shear bond strength of soft lining materials to the denture base after surface modifications and using different denture base materials.
Materials and Methods: 120 samples included in the study to test the shear bond strength, sample grouped according to surface treatment of acrylic resin (Control without surface treatment, monomer surface treatment, Nd-Yag laser surface treatment (10 Hz and 20 Watt) and Nd-Yag laser surface treatment (10 Hz and 40 Watt)) with different denture base materials used (High impact acrylic, Heat cured acrylic and light cured acrylic), the shear bond strength test was made by using universal testing machine with cross head speed 40 mm/ min the force required for soft lining material complete separation from the acrylic resin materials calculated. Statistical analysis made by SPSS software analysis using ANOVA Table with LSD multiple Comparison.
Results: the highest value of shear bond strength found in group with high impact acrylic and 2nd dose of laser treatment applied, while the lowest one found In a group of light cured acrylic when 1st dose of laser treatment used. the comparison among groups made by using ANOVA Table with LSD which revealed that there was a highly significant difference between all groups with different surface treatments except heat cured and light cured groups. A highly significant difference also found between 2nd dose of laser treatment and control, monomer and 1st dose of laser surface treatment when different materials used.
Conclusion: 2nd dose of laser surface treatment when 10 Hz and 40 Watt of Nd-Yag Laser applied Show the highest value of shear bond strength in high impact acrylic group, while the lowest value was recorded in light cured acrylic with 1st does laser treatment.

KEYWORDS:

Soft lining materials, denture base, Laser, Monomer. High impact acrylic, light cured acrylic.

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مقارنة قوة القص السطحي لالتصاق البطانة اللينة مع مادة قاعدة أطقم الاسنان بعد معالجة سطحها بمواد مختلفة

لتحسين التصاق مادة بطانة أطقم الاسنان مع قاعدة الطقم تم استخدام عدة طرق لمعالجة سطح مادة أطقم الاسنان قبل وضع البطانة المرنة واستخدمت ١٢٠ عينه لهذا الغرض توزعت حسب المادة المستعملة في معاملة أسطح مادة طقم الاسنان الاكريليكية وتم ايضا استخدام مواد مختلفة من مادة أطقم الاسنان وتبين بعد الفحص بواسطة قوة القص السطحي ان معاملة السطح بال Nd-YAG ليزر (١٠Hz و٤٠ watt) نتجت عنها اعلى قوة التصاق عند استخدام الأكريليك الحراري المقاوم للصدمة، بينما كانت اقل قوة التصاق في المجموعة التي عوملت بال Nd-YAG ليزر (١٠ Hz، ٢٠watt) باستخدام الأكريليك المتصلب بالضوء

INTRODUCTION:

Although soft lining material was first used in 1961 widely in partial and complete dentures [1], and should fulfill a list of requirements, but above of all it should bond in a satisfactory way with acrylic denture base; otherwise problems will arise like plaque accumulation, bacterial growth..etc [2-4].

So many researchers suggested different methods for improving bond between soft liners and acrylic denture base like mechanical roughening by laser, monomer, or by sandblasting [5-7].

Laser is an intense beam of light energy, it was first developed by Mainman in 1960, in its early invention laser was a technical breakthrough, but was a technology rather than purpose [8].

Laser gets the approval from the FDA and was introduced to dentistry about 35 years ago, and since that, researches continues to expand in this field [9], it becomes more common for caries removal, root canal treatment, remove periodontal disease, bleaching, disinfecting.

Laser light has the advantage of interacting with biological tissue because of its particular properties: (1) monochromaticity i.e. one color (2) coherence like waves have identical amplitude and frequency (3) collimation like laser rays are parallel and don't diverge (4) brightness [10].

There are many types of lasers such as ruby laser, He-Ne laser, Nd-YAG laser, Co2 laser, and Er-YAG laser, in this study Nd-YAG laser used, it was first used in 1990, and it is near the infrared wavelength of 1064 nm. It works on contact and non-contact way, which both can be used depending on performed procedure [11].

Because laser have the capacity to alter surface of material in a relatively easy and safe way [12], it can be used to increase bonding between materials and make benefit to solve the drawback of soft liner and denture base.

The use of laser in these studies are still limited so the present study try to make a comparison between monomer and laser application using different denture base materials and find out what will come with best result to overcome the dilemma of soft liner detachment from acrylic denture base.

MATERIALS AND METHODS:

Sample Grouping:

120 samples were constructed, divided according to materials' used: (high impact/ Vertex), (heat cure, Triplex) and (light cure, Vertex LC), each group was further subdivided according to surface treatments; so that the total number of groups included in the study were twelve groups and they were summarized as follows:

a. Control without surface treatments (Heat Cured Acrylic)
b. Control without surface treatments (High impact Acrylic)
c. Control without surface treatments (Light Cured Acrylic)
d. Monomer surface treatment (Heat Cured Acrylic)
e. Monomer surface treatment (High impact Acrylic)
f. Monomer surface treatment (Light Cured Acrylic)
g. Laser surface treatment 10 Hz 20 Watt (Heat Cured Acrylic)
h. Laser surface treatment 10 Hz 20 Watt (High impact Acrylic)
i. Laser surface treatment 10 Hz 20 Watt (Light Cured Acrylic)
j. Laser surface treatment 10 Hz 40 Watt (Heat Cured Acrylic)
k. Laser surface treatment 10 Hz 40 Watt (High impact Acrylic)
l. Laser surface treatment 10 Hz 40 Watt (Light Cured Acrylic)

Sample preparation:

High impact and heat cured acrylic samples:-

A metal mold used for shear bond strength sample construction, it measured (75mm, 25mm, 5mm) length, width and height respectively, with 3mm depth and handle thickness of 13mm [13] to have a maximum clamping of samples with instron machine (Fig. 1).

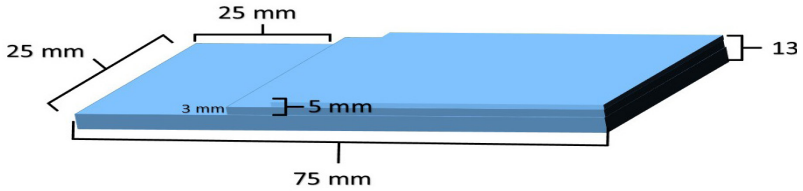

Fig. 1. Shear Bond Strength Specimen.

The samples constructions for high impact acrylic denture base materials were done by mixing of powder and liquid according to manufacturer's instruction (P/L ratio 21g/10ml) then a layer of separating media applied to the stone mold made from the metal templates and the dough acrylic mixture adapted to the stone mold, cured in water bath at 70 °C for 90 minutes, followed by 100 °C for 30 min. according to manufacturer's instructions, then allowed for bench cooling. The same procedure undertaken for heat cured except curing cycle which run under 70 °C for half an hour followed by 100 °C for one hour according to manufacturer's instructions.

Light cure samples:

The material was packed in stone mold after application of separating media, pressed with fingers, then cured by light curing unit (Vertex Ecoligth box/ Holland) initially for 5 min and removed from the mold and cured again for 5 min. The excess materials removed with sharp wax knife before curing.

Surface treatment:

a. Monomer Surface treatment: Samples were swabbed with a cotton dipped in monomer for 180 sec before soft liner application.
b. Laser surface treatment: Nd-Yag laser was used to treat the surface of the acrylic which will bond to soft liner materials, the wavelength fixed to (1064 nm), and the frequency fixed to 10 Hz., while the power set to 20 and to 40 watt. The surface of the acrylic block divided into four lines, the distance between line and the other fixed to 6.35 mm, each line divided into five parts equally and the laser

strokes applied to these five points on each line, so that the total strokes applied to each specimen will be 20 strokes. The exposure time for each point will be set to 4 sec. The distance between the head of the laser device and the surface of the specimen fixed to 12 mm by using plastic cable tie [16].

Application of soft liner material to the samples:

The soft lining material (mollosil/ chair side / Germany) was applied in the space between the two blocks of shear bond strength, one over the other in a space dimension of 25mm, 25mm, 3mm (length, width and depth respectively); the reline material mixture applied by using spatula, the excess material was removed by sharp wax knife then samples placed under 200 g of load until complete set of material.

Testing the samples:

Testing was done by using Instron testing machine, the cross head speed 40 mm/ min. and the soft lining material was separated from the acrylic plates [18]. The force required for this separation was calculated, the shear bond strength value of each sample was calculated by applying the following equation:

Shear Bond strength=F(N)/A (mm^2) [19].

F=force of failure (N).

A= surface area of cross section (mm^2).

The data was analyzed by SPSS v. 21 statistical analysis software using ANOVA Table with LSD multiple comparison test.

RESULTS

As shown in Table 1, the highest mean of shear bond strength found in the group of high impact acrylic and when 2nd dose of laser surface treatment applied, while the lowest value found in the group of light cured when 1st dose of laser surface treatment applied.

Table 1: Descriptive Statistics for all groups.

	N	Control		Monomer Surface Treatment		1st Dose of Laser Treatment		2nd Dose of Laser treatment	
		Mean (N/mm^2)	SD	Mean (N/mm^2)	SD	Mean (N/mm^2)	SD	Mean (N/mm^2)	SD
Heat Cured	10	0.747	0.029	0.756	0.018	0.746	0.037	0.838	0.023
High impact	10	0.863	0.024	0.840	0.041	0.849	0.032	0.921	0.015
Light Cured	10	0.745	0.036	0.765	0.012	0.740	0.037	0.856	0.019

Inferential statistical analysis done by using ANOVA Table with LSD to compare both materials used in the study and different surface treatment of these materials, the results revealed that when comparing materials used in the study there is highly significance among all groups except when comparing heat cured and light cured materials using different surface treatments as shown in Table 2 and 3.

When comparing surface treatment of different materials used in the study, the results show that there are highly significant difference between Control group and 2nd dose, Monomer and 2nd dose, and 1st dose and 2nd dose of laser surface treatment, while other groups comparisons show no significant differences as shown in table 4 and 5.

Table 2: ANOVA Table comparison for groups categorized according to method used for surface treatments.

		Sum of Squares	df	Mean Square	F	Sig.
Control (Without Surface Treatment)	Between Groups	0.091	2	0.045	49.234	H.S.
	Within Groups	0.025	27	0.001		
	Total	0.116	29			
Monomer Surface Treatment	Between Groups	0.042	2	0.021	28.379	H.S.
	Within Groups	0.020	27	0.001		
	Total	0.062	29			
1st Dose of Laser Treatment	Between Groups	0.074	2	0.037	28.857	H.S.
	Within Groups	0.035	27	0.001		
	Total	0.109	29			
2nd Dose of Laser treatment	Between Groups	0.038	2	0.019	47.732	H.S.
	Within Groups	0.011	27	0.000		
	Total	0.049	29			

Table 3: Multiple comparison Post hoc LSD test according to method used for surface treatments.

	Control		Monomer		1st Dose		2nd Dose	
	Mean Difference (I-J)	Sig.	Mean Difference (I-J)	Sig.	Mean Difference (I-J)	Sig.	Mean Difference (I-J)	Sig
High impact- Heat Cured	0.1158	H.S.	0.0838	H.S.	0.1023	H.S.	0.0829	H.S.
High Impact-Light Cured	0.1175	H.S.	0.0744	H.S.	0.1086	H.S.	0.0651	H.S.
Heat Cured – Light Cured	0.0017	0.901	-0.0094	.447	0.0063	0.698	-0.0178	.057

Table 4: ANOVA Table comparison for groups categorized according to material used

		Sum of Squares	df	Mean Square	F	Sig.
High Impact	Between Groups	0.040	3	0.013	14.685	H.S.
	Within Groups	0.033	36	0.001		
	Total	0.073	39			
Heat Cured	Between Groups	0.059	3	0.020	24.973	H.S.
	Within Groups	0.028	36	0.001		
	Total	0.088	39			
Light Cured	Between Groups	0.087	3	0.029	35.903	H.S.
	Within Groups	0.029	36	0.001		
	Total	0.117	39			

Table 5: Multiple comparison Post hoc LSD test according to material included in the study

	High Impact		Heat Cured		Light Cured	
	Mean Difference (I-J)	Sig.	Mean Difference (I-J)	Sig.	Mean Difference (I-J)	Sig.
Control- Monomer	0.0232	0.094	-0.0199	0.127	-0.008	0.488
Control= 1st Dose	0.0142	0.300	0.0053	0.680	0.0007	0.956
Control- 2nd Dose	-0.0582	H.S.	-0.1106	H.S.	-0.0911	H.S.
Monomer- 1st Dose	-0.009	0.509	0.0252	0.056	0.0095	0.455
Monomer- 2nd Dose	-0.0814	H.S.	-0.0907	H.S.	-0.0823	H.S.
1st Dose- 2nd Dose	-0.0724	H.S.	-0.1159	H.S.	-0.0918	H.S.

DISCUSSION

An appropriate bond between denture base and soft lining material is a required demand, but unfortunately, all materials available are considered temporary compared to hard denture base, because it is associated with low physical and mechanical properties, it leads to bacterial and fungal aggregation, and poor bond to denture base material [20].

Many researchers have been studied different methods and test to increase this bond, but there was a controversy about the effectiveness of surface treatment like monomer application, acetone, laser, aluminum oxide, making holes through acrylic, etc.… [2,3,12], and the majority agreed with the fact that treating surface with abraded particles will decrease the bond [21].

Fowler [22] and Cantor et al [23] pointed out that, tensile failure was not only due to tensile forces but also caused by shear forces occurred because of the high Poisson's ratio of silicone soft liner. So that

testing the soft liner using shear bond test is believed to be a useful way to measure bond strength because of close simulation to clinical situations [24].

There is a limited published papers studied the effect of laser on shear bond strength of different denture base and soft lining material; this study compare the effect of laser and monomer on three different types of denture base to improve bond with soft lining material.

The present study showed that the highest mean value of shear bond strength was for high impact denture base acrylic material when compared to heat cured and light cured denture base acrylic materials, this significant difference could be explained due to the fast raising in temperature during curing as a short curing cycle used, causing the production of many new radicals leading to more growing polymer chain, and more branching and cross linking [25].

In this study, the effects of surface treatment with monomer on shear bond strength between soft liner and both heat cured and light cured acrylic were not significant despite the mean differences found, this is in agreement with Memarian and Shayestehmajd [26] who found that MMA alter the surface morphology without improving the shear bond strength, while the results disagree with Kulkarni and Parkhedkar [21] and with Sarac et al [27] who found that surface treatment of acrylic denture base with monomer increase the bond to soft lining material, this disagreements may be due to the differences in methodology of surface treatment used and materials.

The altering of surface material when exposed to laser energy is due to ablation which is removing of surface material because of energy absorption, and since the material exposed in this study is polymer so a photochemical ablation took place creating ablated regions, carrying away liquid and solid clusters of material substrate [28] .

Regarding surface treatment with Nd-Yag laser, the second dose of laser had the highest mean value compared to first dose; this may be due to the different absorption capacity of resin material [29]. Also Suke et al [30] explain a chemical change may occur on acrylic surface when exposed to laser energy which cause shortening of chain length then increasing the chain cross linking, and this is believed to ameliorate the bond between denture base material and soft lining material.

Laser energy cause more irregularities than methyl methacrylate monomer, this explains the high significant values compared to monomer and control groups; the rough surface creates a larger contact area in denture base and improve the micromechanical interlocking [31] this will affect the bond strength of denture base with soft liner in a good way [32]. this comes in agreement with Jacobson et al [33] who stated that soft lining material has the ability to penetrate to denture base irregularities which improve the adhesion, it also agrees with Al-Noori and Al-Kateb [34] who found that laser treatment is superior to monomer.

Although it is an in vitro study and does not mimic the in vivo conditions but still can give a possible estimation of clinical outcome.

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Studying the coating of Alumina and Hydroxy Apatite on Tapered Dental Implant (In Vivo and In Vitro Study)

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ABSTRACT

Background: In clinical trial studies, the success of dental implant depends on excellent biocompatibility, mechanical strength and characteristic of material such as surface properties of material.

The Objective of this study was to evaluate the effects of coating implants with two materials (Al2O3 &HA) .And this was in mixture form or in two layers form. Then their effect on the bond strength at the bone/implant interface with cell compatibility was evaluated.

Materials and methods: Electrophoretic deposition technique (EPD) was used to obtain a uniform coating for each one of two types of coated layers on the screws (mixture of 50%HA and 50% Alumina and two layers). For examination of the changes occurred on the surface, structural ,elemental analysis and morphological investigations were carried out on the modified surfaces of the Ti-6Al-7Nb alloy using different techniques, namely X-ray diffraction (XRD), and Energy Dispersive X-ray Fluorescence (EDXRF). The in vivo study was done by the implantation of tapered screw–shaped uncoated and coated implants of 3mm diameter, 8 mm length (the threaded part is 5 mm and the smooth part is 3 mm) and 0.5mm pitch height.The tibia of white New Zealand rabbits were chosen as implantation sites. The right tibia of rabbit received two screws, (one uncoated and coated) while the left tibia of a rabbit received coated screws of two layers. To understand the bone-implant interface, biomechanical test was performed after 2, 6 and 18 weeks healing periods. 15 rabbits were sacrificed for each period. A removal torque was done for ten animals in each group, whereas the other five ones were used for histological testing with optical microscope.

Results: The results indicates that there was a rapid reaction of bone towards coated Ti-6Al-7Nb alloy implants as compared with the uncoated one and more mature bone was observed after 6 weeks of implantation in screws coated with a mixture of Alumina and HA. The biomechanical test revealed that there was an increase in the torque mean value at bone-implant interface with time, with the highest mean values of bond strength in implants coated with a mixture of 50% HA and 50%Alumina. Also the bond strength of two layers coating was more than that of uncoated.

The results of histological examination revealed a well tissue response with the formation of a lamellate and haversian type of osteon tissue after 18 weeks.

Conclusion: this study concludes that coating by electrophoresis proved to be a valuable process to coat metallic implants with an osteoconductive material, and to form a uniform biocomposite and multiple layer coating. The biomechanical and biological properties of the bone-implant interface associated with the coated implants were improved comparing to the uncoated ones they have better mechanical properties and excellent biocompatibility through the improved performance of bone at the site of a bone implant contact area than the uncoated implants.

KEY WORDS : EPD, Alumina, Hydroxyapatite, implant

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المستخلص

المقدمة : ان تحقق نجاح عملية زراعة الاسنان سريريا ليس بسبب المتانة الميكانيكية أو الإنسجام الحيوي المتميز لمادة الزراعة وحسب بل بسبب صفات أخرى لمادة الزراعة مثل خواص السطح.

الهدف من الدراسه تقيم تاثير طلاء الزرعات بمادتين الالومينا والهيدروكسي ابيتايت وهذة اما على شكل خليط او طبقتين .بعد ذلك دراسة تقيم تاثير طلاء الزرعة على قوة الترابط بين العظم والزرعة مع تطابق الخلايا .

المواد والعمل:-استعمل طريق الترسيب الكهربائي للحصول على طلاء متجانس لكل طبقه من طلاء الزرعات (بخليط من 50%الومينا و50%هيدروكسي ابيتاي اوطبقتين) . نفذت الفحوصات للسطح لفحص تغير السطح و تحليل الهيكلي وتحليل العناصر المكونه للسطوح المطليه باستعمال تقنيات مختلفه مثل حيود الاشعة السينية و الاستشعاع بالاشعة السينية

ال دراسه داخل الجسم الحي تمت ع باستعمال زرعات ذات شكل لولبي مخروطي مطلية وغير مطلية قطرها 3 ملم وطولها 8 ملم خمسة مليمات منها ملولب وثلاث مليمات ملساء.أختير عظم الساق لارانب النيوزلندية البيضاء مكانا للزراعة,استلمت الساق اليمنى من كل ارنب 2 ملولبات (مطلي وغير مطلي) والساق اليسرى استلمت ملولب مطلي بطبقتين .ولفهم السطح البيني للعظم و الغرسة اجري الفحص الاحيامكانيكي بعد 2 , 6 و18 اسبوعا من مدة الشفاء . تم التضحية بخمسة عشر أرنب لكل فترة ، عشرة منها لإجراء الفحص الميكانيكي بواسطة فحص عزم التدوير بينما استخدم خمس منها لأغراض إختبار الأنسجة بالمجهر الضوئي.

النتائج:النتائج تظهر استجابة سريعه للعظم باتجاة الزرعة المطلية مقارنة بالغير مطلية واكثر العظم الناضج لوحظ بالفترة 18 شهر . كما أن الأختبار الأحيامكانيكي ,كشف النقاب عن زيادة في القوة الميكانيكية (قيمة العزم) للسطح البيني للعظم و الغرسة مع الوقت ,اعلى زيادة لقوة الربط وجدت للغرسات المطلية بخليط الالومينا50% و الهايدروكسي ابيتايت 50%. كما ان القوة الربط للغرسات المطلية بطلاء ثنائي الطبقة(الالومينا والهايدروكسي ابيتايت) وجدت اعلى من نظيرتها الغير مطليه .نتائج الفحص النسيجي اظهر استجابة جيده مع تكون عظم ناضج مع وجود قنوات هافرشين بعد 18 اسبوع.

الاستنتاج :اثبت ان عملية الطلاء بالترسيب الكهربائي عمليه قيمه لطلاء الزرعات المعدنية بمواد محفزة للعظم و المكونه من مركب بايولوجي ومتعدد الطبقات .الخواص البايوميكانيكيه والبايولوجية لها علاقه بتحسين الزرعات المطليه مقارنة بالغير مطلية .وايضا لها خواص ميكانيكيه احسن وملائمه الخلايا ممتازة وذلك من خلال تحسين انجاز العظم في منطقة ارتباط العظم بالزرعه مقارنة بالغير مطلية

INTRODUCTION

The ultimate goal of using implants is the prosthetic rehabilitation of patients with lost dentition, for both the functional and esthetic levels [1].Surface modification of dental implant is still a very active area of research. And a definite interest exists in surface treatment that can induce normal healing phenomena and restoring implants sooner than that was previously believed possible [2, 3] .One reason is the fact that the physical or chemical and biochemical properties of the implant surface control the performance of relevant processes such as protein adsorption and cell surface interaction at the interface between the biomaterial and the body [4].The development of coating system was driven by combining the mechanical properties of metallic implant material with the bioactivity of ceramics material[5]. Ceramic materials used in surgery can either be bioinert or bioactive .Alumina is an excellent biomaterial with good biocompatibility, high wear resistance, high strength and high corrosion resistance.it was used in hip prostheses and dental implant. If the bioactivity to alumina is imparted, the range of its application as biomaterial will be largely extended [6].

Hydroxyapatite, (HA), Ca_{10} $(PO4)_6(OH)_2$ is a natural mineral found in human enamel and bone [7]. Bioactive HA is deposited onto implants surfaces to promote bone formation and enhance bone - implant adhesion. While bone compatibility is provided by the HA the underlying metal possesses good strength and ductility. HA coatings has been achieved by a number of methods, including ion implantation, plasma spraying, , sputtering, sol-gel coating, bioimmic methods, and electrophoretic deposition methods[8].

Electrophoretic deposition (EPD) is considered as a colloidal forming technique. In this technique, and in a stable suspension, the charged colloidal particles are deposited on a positively charged substrate after the application of an electric field. EPD technique gained a great attention in processing of ceramic materials and coatings. This is because of its cost-effectiveness and requires simple apparatus, alsoits can be deposited on complex geometry [9].

The development of coating system by forming a two layers coating (bioinert ceramic inner layer and bioactive outer shell) and by mixing of bioactive with bioinert ceramic materials so as to improve its biocompatibility and mechanical properties, beside the induction of osseointegration should be evaluated.

In this study, invivo investigation of ceramics films using cathodic electrophoretic deposition on Ti-6Al-7Nb was performed to evaluate the behavior of this modified alloy by this technique histologically and mechanically

MATERIALS AND METHODS

Electrophoretic deposition process includes:-

A-Suspension preparation:

1st Suspension preparation used for coating a mixture of hydroxyapatite HA (Particles size 3.8µm, Merck, Darmstadt, Germany).and Al_2O_3 (Particles size (8.7 µm), Riedel-de Haën AG in Seelze Hannover, Germany) was prepare as follow:- Adding 50 % HA +50 % Al_2O_3 powders to the solvent (ethanol) (l00g/1 liter) in a container over a stirrer for 10 minutes. After that phosphate ester (3.5g/l liter) as dispersant agent was added. After stirring for 10 minutes. Polyvinylbutyral was added as a binder (3g/l liter). The stirring was continued until a colloidal suspension was obtained.2nd suspension was used for Alumina coating. The suspension was prepared by adding alumina powder to solvent (ethanol) (l00g/ 1 liter) in a container over a stirrer for 10 min. dispersant agent was added, this was the phosphate ester (3.5g/l liter). After stirring the polyvinylbutyral was added as a binder (3g/1 liter).The stirring continued until a colloidal suspension was obtained [10].

B- Coating process: The Ti-6Al-7Nb specimen was placed on the cathode and anode electrode. The distance between two electrodes was 10 mm. Then both electrodes were connected to the power supply and a meter. In order to understand the effects of time on the coating thickness, the power supply was used with (60 V) for coating the Al_2O_3 and a mixture of HA and Al_2O_3 , the coating procedure was repeated for a periods of time 2, 3, 4, 5,6 and 7 min. while (10 V) was used for coating the HA in the same procedure which was repeated for periods of time5,10,15,20,25&30 min. [10] .

Another pilot study has been done to understand the effect of applied voltage on the coating thickness, the power supply was used with different applied voltage (10, 20, 30, 40, 50 & 60 V) for 5 min for coating the alumina and a mixture of hydroxyapatite and alumina. Also the same procedure was repeated with different applied voltage (5, 10, 15, 20, 25 & 30V) for 5 min for coating the hydroxyapatite**.** After evaluation of the results of the coating of Al_2O_3 and HA with different applied voltage and time periods, the specimens were coated with Al_2O_3 (5 min, 60V) as first inner layer and then coated with HA (5 min, 10 V) as second outer shell layer.

After complete coating, Sintering was carried out using Tubed furnace (Carbolite Type MTF 12/38A.

BAMFORD England). The treatment temperature is 850 °C for specimens coated with a mixture of HA and alumina powder, whereas 800 °C for two hours is given to those coated with two layers [11, 8]

After complete sintering of specimens, examination of coated layer is performed using the following:-

A Thickness measurement:

For all samples, measurements of coating layer thickness was performed using microprocess coating thickness gauge (ERICHSEN MINI test 3000).

B. Microscopical examination:

Examination of the coated layer was performed using optical microscope (Nikon Type 120, Japan) provided with a digital camera type DXM 1200 F. The micrographs were analyzed through Nikon ACT- version 2.62, 2000 software. This procedure is applied for coated sample at different times and different applied voltage.

C. X-Ray phase analysis XRD

Phase analysis is employed on Ti-6Al-7Nb alloy specimen before and after coating. Phase analysis was studied using 3121 powders X-ray Diffractometer using Cu Ka radiation. The 2Θangles were swept from 20- 60° in step of one degree. The peak indexing was carried out based on the JCPDS (joint committee on powder diffraction standards).

D.X-Ray Fluorescence (XRF)

it is an elemental analysis technique .And it is used in determinations of the major elements Also it can make a broad elemental survey of the sample composition without standards. Energy dispersive XRF (EDXRF) was performed to determine the composition of the coated layer as well as the matrix elements.

E. Microhardness measurement:

Vickers Micro Hardness Tester (Micro met ADOLPH 1. BUEHLER INC.Optical and metallogrical instrument 2120 Gr/USA).Measurement of the microhardness was performed for samples coated with a mixture of 50% Hydroxyapatite and 50%Alumina, b. two coating layers (Alumina layer and HA layer) c. Uncoated samples.

Implant preparation:

Ti-6Al-7Nb alloy rod machined into tapered screw–shaped implants using a Lathe machine. The rod was 6mm in diameter (ASTM F1295, Straumann Company, Switzerland). The diameter of each screw 3.0mm and the length about 8mm (5mm is the threaded part and 3mm is the smooth part) with pitch height was 0.5mm. Tapering angle is 6º. The head of the implant had a slit to fit the torque meter during insertion and mechanical testing. After that all implants cleaned with ethanol for 15 minutes in an ultrasonic cleaning device. Then specimens were dried at 100°C. The screws were divided into three groups each group consist of forty five screws.

The 1st group was coated with a mixture of HA and alumina for 5min with 60V following the same procedure of EPD that was performed on the Ti6Al7Nb alloy specimens. 2nd group was coated with two layers (inner layer alumina for 5min with 60 V &outer layer HA for 5min with 5 V). The last3rd group uncoated screws were passivated in 28% nitric acid for one hour and then rinsed with an ultrasonic cleaning device for 5 minutes.

Sterilization of implants

"The screws were sterilized according to the usual irradiation dose recommended for sterilization of surgical instrument and materials." [12]

Sample grouping

Implants were categorized according to the type of test into:

1. Mechanical test (torque measurements)

a. Control group (30 uncoated implants): This group includes 10 implants for each healing interval (2, 6 and 18 weeks).

b. Experimental group :-(60coated implants): in which the screws were divided according to the type of material that was used in the coating process into:

i. Coated with a mixture of HA& alumina powder: 10 screws for each healing interval.

ii. Coated with two layers (inner layer alumina &outer layer HA): 10 screws for each healing interval.

2. Histological test

1.*Control group (15 uncoated screws)*: include 5 screws for each healing interval or period (2, 6, and 18 weeks).2.Coated with mixture of HA& alumina powder: 5 screws for each healing period.iv - Coated with two layers (inner layer alumina &outer layer HA): 5 screws for each healing period.

Surgical Method for implantation Procedure

Adult white male New Zealand rabbits weighing 2-3 kg were used. The age of the animals was from 10-12 months. Intramuscular Ivome injection was given to the animals. Also an antibiotic cover with oxytetracycline 20% (0.7ml/kg) intramuscular injection was given.

A total of forty five animals were divided into 3 groups according to healing interval (2, 6 and 18 weeks).Each healing intervals consist of 15 animals, 5 rabbit for histological study, and 10 for mechanical test by torque removal test .Three implants (one uncoated, two coated [one coated with the mixture

of alumina &HA and the other one coated with two layer (inner layer alumina &outer layer HA)] were implanted in the left tibia

"All towels and instruments were autoclaved at 121 C° and 15 bars for 30 minutes. The rabbit was anesthetized by" intra-muscular injection of ketamine hydrochloride 50 mg (1ml/kg body weight) and xylocaine 10% (1ml/ kg body weight). Then both tibia were shaved with a shaving spray, and the skin was cleaned with a mixture of ethanol and iodine. After that tibia was exposed. The distance between holes was 10 mm between them. Bone penetration was performed at a rotary speed of 1500 rpm with irrigation "[11] .Then implant was screwed with a torque meter. Implantation of 1 screws was done in the right tibia and 2 screws in the left tibia. After suturing, local antibiotic (oxytetracycline spray) and systemic antibiotic oxytetracycline 20% (0.7 ml/1kg) was given to the rabbit. Post-operative antibiotic (local and systemic) was given for 5 days. Then the animals were followed for 2, 6 and 18 weeks

Mechanical testing

For each healing interval (2, 6 &18 week), before mechanical test, an X-ray was taken to the implantation site. Then anesthesia given to the animals as in implantation procedure. Then surgical procedure was performed to expose the implant head. A torque meter (STURTEVANT RICHMONT TORQUE PRODUCT, MODEL F 80-1-0. USA.) used to determine the maximum torque requires to unscrew the implant from its site

Histology test

In this test, a bone- implant block was prepared by cutting of the bone around the implant 5 mm away from the head of the implant. Then immediately, Bone implant blocks were placed in 10% of fresh formalin for 3 days for fixation. After that, specimens were left in a solution of 10%formic acid and sodium citrate . Decalcification takes from two to three weeks. Then specimens was tested for complete decalcification by methods used by Baker et al 2009 [13]

Statistical methods

The suitable statistical methods were used. These include: - a. Descriptive statistics and b. Inferential statistics a. testing equality of means value by analysis of variance (ANOVA). In all multiple comparisons significant p-value was at ($p< 0.05$).b. Least Significant Difference (LSD) after the analysis of variance.

RESULTS

a. In vivo test: Figure (1) shows series of micrographs for the microstructure of **a**. 1st layer of Al_2O_3 at60V for 5min 60V b. mixture of Al_2O_3 &HA for 2min at60 V **c** 2 layers Al2O3&HA.

The XRD pattern of coated specimens are presented in figure (3.2), (3.3).And the average Hardness Vickers (HV) numbers are listed in Table (1).

b. In invivo test: Clinical observation revealed that all animals moved normally and good health within one week. At sacrifice, no negative clinical observations were found around implant. Also, there were no peri-implant defects at the coronal aspect of implant after 2, 6 and 18 weeks of healing periods. And this was observed through radiographic examination. In which, there were no radiolucency between the implant and adjacent cortical bone.as shown in figure(4)

1 Mechanical testing:-

In Table (2) the highest torque mean value was observed after 18 weeks of implantation .And the results of ANOVA test revealed a highly significance difference among all groups of modified implant surfaces at each time interval. In LSD test results, Table (3) revealed a highly significance difference between uncoated implant and coated implant with two layer and mixture of Al2O3 &HA .and this was for all time interval.

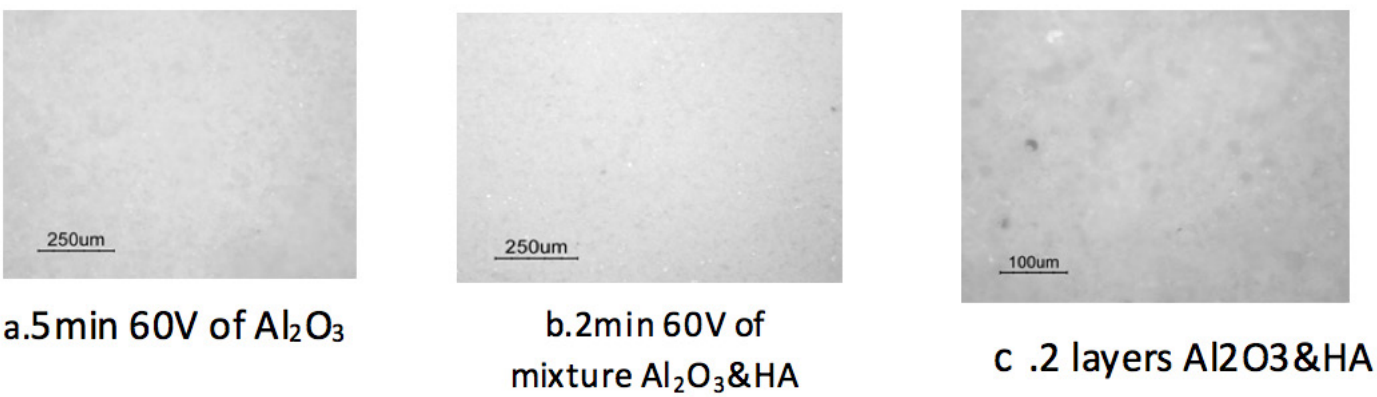


Fig (1) Optical micrograph views of different coating surface

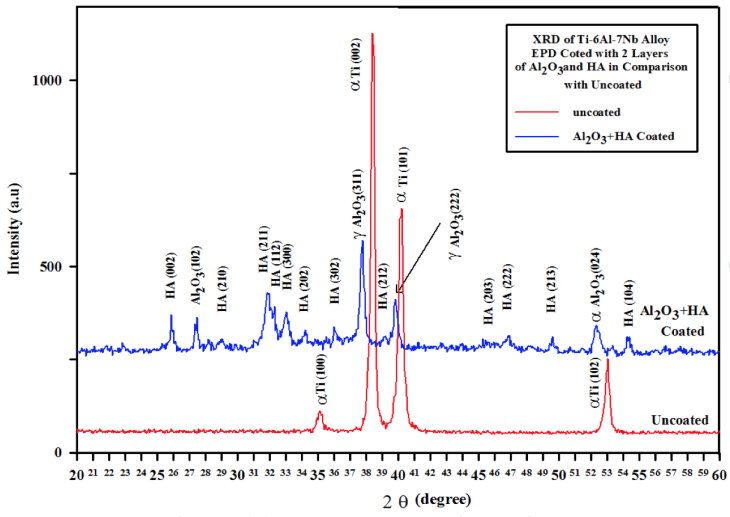


Figure (3)XRD patterns of specimen coated with two layers (Al2O3 and HA)

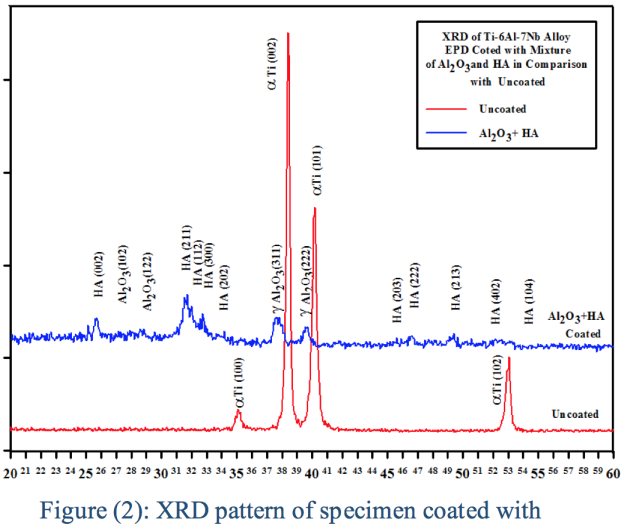
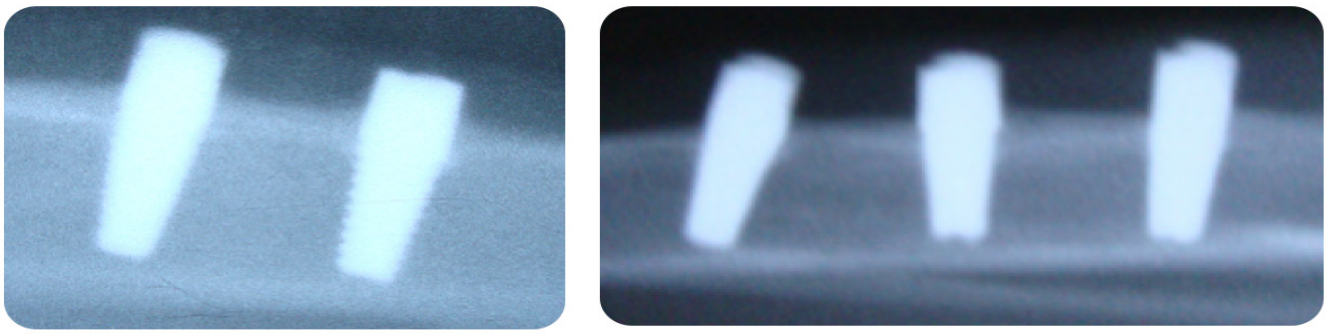


Figure (2): XRD pattern of specimen coated with mixture of 50% HA and 50% Al2O3



Fig(4) radiographic examination after 18 weeks

Table (1): Average microhardness of the three tested groups of Ti-6Al-7Nb.

groups	*Uncoated Bulk Mat.*	*(Al_2O_3&HA) coated layer*	*Two layer (Al_2O_3&HA)*
Average	404.5	283.3	126.5

Table(2) The removal torque mean value of different groups after 2, 6 & 18 weeks interval s of implantation and ANO-VA test

Groups	*N*	*2 weeks*		*6 weeks*		*18 weeks*	
		Mean N/cm	*St. d*	*Mean N/cm*	*St.D*	*Mean N/cm*	*St.D*
uncoated implant	10	8.63	0.70	14.51	0.80	29.61	1.81
coated implant (Al_2O_3&A)	10	12.42	1.34	24.25	2.48	48.11	1.59
Two layer (Al_2O_3&HA)	10	12.10	1.02	23.54	2.39	46.33	1.88
ANOVA test	F-test	22.262		47.714		155.705	
	P value	0.000 (HS)		0.000	(HS)	0.000	(HS)

Table (3) Multiple Comparison (LSD) among all pairs of implant groups along each period of time independently

Groups	*Groups*	*Healing periods*					
		2W.	*Sig.*	*6W.*	*Sig.*	*18W.*	*Sig*
uncoated screw	Coated implant(Al_2O_3&HA)	0.000	HS	0.000	HS	0.000	HS
	Two layer (Al_2O_3&HA)	0.000	HS	0.000	HS	0.000	HS
Coated implant (HA&$Al_2O_{3)}$	two layer (HA&Al_2O_3)	0.512	NS	0.409	NS	0.042	S

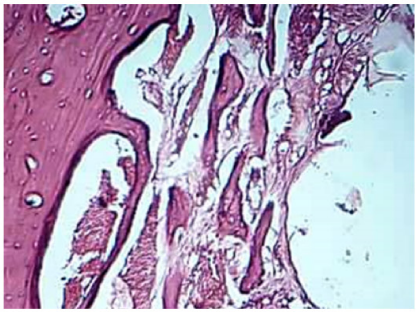


Fig (5)Microphotograph of coated implant with mixture Al_2O_3after 2 weeks H&E X100

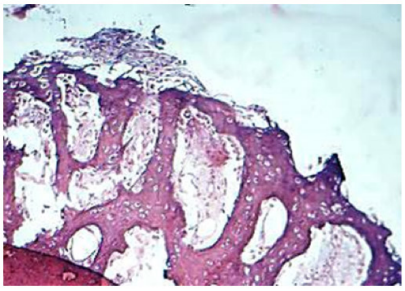
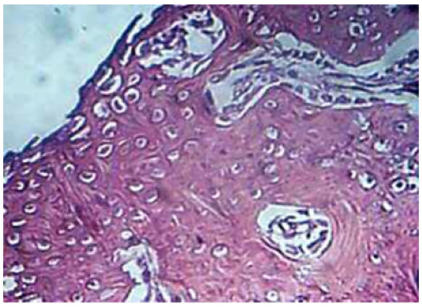
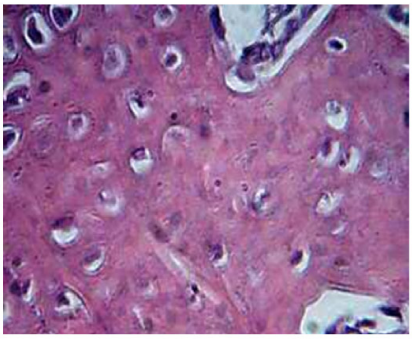


Fig (6)Microphotograph Of coated implant with two layers (Al2O3) after 2week

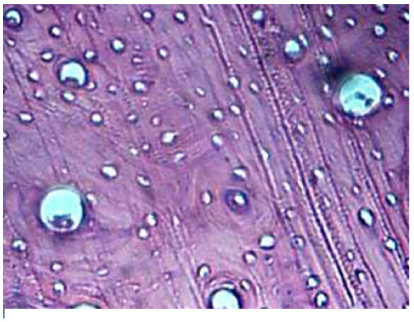


Fig(7)Micrographic view for implant coated with two layers (Al_2O_3&HA) after 6 weeks duration H&E X200



Fig(3)Micrographic view for implant coated with a mixture of (Al2O3) after 6 weeks of implantation H&E X200

Fig (9)Microphotograph view implant coated with mixture of alumina and hydroxyapatite after 18 weeks of implantation



Fig(10)Microphotograph view implant coated with 2 layer of(Al2O3&HA) after 18 weeks of implantation H&E X200

Histological test

Figure (5) illustrates the histological feature of implant coated with mixture of alumina and HA at two weeks. This figure Shows the formation of new bone trabeculae (arrow).while infig(6) view there is a bone trabeculae formed with an implant coated with two layers (alumina and HA) for two week duration . Also huge number of osteocyte cell (OCC). In(fig7) Micrographic view shows a new bone formation with huge number of osteocyte cell (OCC), osteon canal (OC) in implant coated with two layers (alumina and hydroxyapatite) after 6 weeks. Micrographic view in fig (8) shows a new bone formation in rabbit tibia for implant coated with a mixture of alumina and hydroxyapatite after 6 weeks of implantation, with a higher number of osteocyte (OCC).

Microphotograph view for thread Ti-6Al-7Nb alloy implant coated with a mixture of alumina and hydroxyapatite after 18 weeks of implantation shows well developed mature osteon (arrows). H&E X200as in fig(9)..In higher magnification view, fig(10) shows lamellated and haversian type osteon (arrow), lamella bone (arrow head). H&E X400.2layers 18 weeks.

DISCUSSIONS

In microscopic examination, Cracks were not observed across the 1st layer of Al_2O_3 coating and mixture of Al_2O_3 and HA which is probably due to the relatively lower thermal expansion coefficient of alumina (Al_2O_3=8.3×10^{-6}/K) and when alumina mixed with the HA it will decreases the differences in thermal expansion coefficient of titanium alloy substrate and overcome problems caused by firing shrinkage during sintering that's may leads to the formation of cracks and improve the bond with the substrate[15,9] . In the surface morphology of the coated samples weather in the mixture of Al_2O3 and HA coating or two layers coating (alumina and HA), there was a fairly uniform distribution of particles and microporous coating layer. In the coating, No cracks was observed suggesting that there was no shrinkage in the coated surface. These findings agreed with Ghiban et al in 2006, [15] who found different appearances, from very smooth and small pored aspects to rough and island-like one. These differences are mainly due to the different deposition conditions of the samples. Also it might be due to differences in particle size of the powder used, HA powder have a very small particle size (8 µm) with a narrow size range.(0.5-35 µm , 75%D=7.11 µm) while alumina had about (8.7 µm) with very wide size range (0.3-153µm, 75%D=42.17 µm).

The result of the study shows that the Vickers

microhardness value of two layer coating Al_2O_3 &HA (126.5 HV) while the Vickers microhardness number of the composite of HA and alumina (283.3 HV) was higher than two layers coating .Both studied groups gain less hardness values than control, this may be due to differences in the surface topography of them. The increase in porosity was related to decrease in hardness as found by Gurusamy and Akira, (2005)[16]

Structural and elemental analysis (XRD)

The high incidence of HA revealed from the XRD of Ti-6Al-7Nb specimen coated with 50% HA powder and 50% alumina may be due to the particle size difference between the two powders (HA and alumina), The HA particle size (3.8µm) was smaller than that for the alumina powder (8.7µm) and this may give more opportunity to the HA particles for charging during the electrophoretic deposition, so that the alumina contribution in the coated layer is much lesser than HA.

The XRD patterns of Ti-6Al-7Nb alloy specimen coated with two layers of alumina and HA shows a crystalline structure of coating layer with domination of the alumina which represent the thick inner layer directly coated the Ti-6Al-7Nb alloy specimen, while the HA represent the outer thin layer of the coating.

In vivo experiments

In this study, rabbit was selected as an animal model. This is due to the rapid healing of bone as compared with other model [17]

Passivation of uncoated implants was performed in this study using HNO3. This was according to the ASTM-F86 .Nitric acid protocol was used with the intention of reducing their surface reactivity, and consequently the corrosion potential, in the highly corrosive biologic milieu [18]

Clinical tests

The radiographic examination in this study, demonstrated a seemingly direct contact between bone and implant, there was no radiolucent zones adjacent to the implanted screw. However, the lack of such zones is not evidence for osseointegration. [19].

Mechanical test

The removal torque was used for mechanical property of bone implant interface, This technique was present in several experimental and clinical studies [20].“Torque is the twisting or movement exerted by a force acting at a distance on a body equal to the force multiplied by the perpendicular distance between the line of action of the force and the center of rotation at which it is exerted” [21]

In this study it has been shown that a significant difference in the removal torque mean values between different time periods was present. This agreed with the study Hammad, 2007.[11] “this increase depends on an increasing bone-metal contact with time as a result of a progressive bone formation and remodeling around the implant during healing, which substantially improved the mechanical capacity.”

In the results of the present study, all groups shows a minimum torque mean value after 2 weeks of implantation. And maximum torque mean value after 18 weeks of implantation. Also the maximum increase in torque mean value was observed between 6 and 18 weeks. This increase in torque mean values between 6 & 18 weeks may be due to the maturation of woven bone to lamellar bone. And in rabbit, it takes 6 weeks as Sennerby et al in 1992[22].

The highest mean torque value was recorded for the Ti-6Al-7Nb screws coated with a mixture of alumina & HA which was 48.11 N.cm after 18 weeks of implantation, this value indicated that composite formed by mixing of bioinert (alumina) and bioactive (HA) ceramic materials increased the activity of EPD coated layer which improved the bone maturation in bone-implant interface. This result was in agreement with finding of Juna et al, 2003.[23]

In the present study, two layer coated implants (inner Al_2O_3 and outer HA) result in a highly significant increase in the removal torque mean values as compared with the uncoated specimens within different time periods. This may explain the bioactivity of HA shell and porous bioinert alumina that allow the growth of bone, advance bony integration, and enhance mechanical interlocking with bone.

From the mechanical testing data obtained there was a non-significant difference among two layers(alumina and HA) and mixture of alumina and HA at two and six weeks of healing periods while a significant results appear at 18 weeks this might be due to the continuous maturation and remodeling of the bone around implants so there is no difference in the bioactivity, biomechanical effect of HA, two layers (alumina and HA) and mixture of alumina and HA during maturation of bone, while after 18 weeks the ”maturated bone appear to be affected by the type of material on its surface and so that the screw coated with the mixture of alumina and HA required greater removal torque value and a significant difference was revealed between these groups, and this agreed with Clokie and Bell , 2003.[24]

Histological test

From histological results of this study, the evidence of bone formation on uncoated Ti-6Al-7Nb alloy implant suggests that the woven bone formation

began in the second weeks after placement. The bone marrow showed active blood vessels, which indicate the beginning of new bone formation. These findings are supported by the work of Shukur in 2015 [25]

The histological features of coated Ti- 6Al-7Nb implants after 2 weeks of implantation revealed numerous bone spicules, active bone trabeculae formation when compared to the uncoated implant. Osteoblast cell surround trabeculae like beads and osteocyte cell embedded in trabeculae, numerous new blood vessels and bone trabeculae with a huge number of osteocyte cells particularly for that coated with a mixture of alumina and HA and that coated with two layers(alumina and HA) this indicate osteoinductivity of these coatings. And this result was in agreement with the study Habibovic et al in 2005.

After six weeks of implantation, the microscopical observation of uncoated Ti-6Al-7Nb implants showed more bone trabeculae formation, osteocyte cell irregular arranged with osteon canal. While that coated with alumina shows a new bone formation with primitive osteons, and that coated with HA shows an active bone trabeculae and osteon with osteocyte cell irregularly surround it. The mixture of alumina and HA and two layers coated implants shows active process of bone development, indicated by the very active and huge numbers of osteocyte cells , preosteocyte and osteoblast which arranged like a beads. These results were in agreement with Suh et al, 2007[27], which reported that six weeks after implantation, all implants were histologically in direct contact with the surrounding bone with no sign of inflammation with either newly formed bone or marrow tissue.

The Microscopical observation of uncoated Ti-6Al-7Nb implants after 18 weeks of implantation showed a late stage in the development of a future compact bone, osteon . While the coated implants shows a well-developed mature bone following the shape of the screw characterized by a mature osteons and active periosteium with an obvious reversal lines between old and new bone. These results agreed with the findings of Veis et al, 2007 [28] who confirmed a new cortical layer was formed and a dense connective tissue similar to periosteum was present at bone implant interface after five months

According to the results of this study, one might suggest that the rapid bone formation response to the electrophoretically coated implants with two layers and the mixture of bioinnert gamma Alumina and bioactive Hydroxyapatite are dependent on surface topography and better biocompatibility of the material which greatly effects the biomechanical and histological properties of the interface.

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Buccally Malposed Maxillary Canines in Intermediate Schools Students of Sammawa City

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ABSTRACT

Background: Canines are unique teeth because they have certain characteristics and responsibilities. They are located in the corner of the mouth, assist the incisors in cutting and tearing food, help the posterior teeth by guiding the mandible during the action of mastication. This survey aimed to determine the prevalence and gender difference of buccally malposed maxillary canines and to study the relation of this problem with the sagittal occlusion, crowding, retard deciduous canine and lack of space in the dental arch in a sample of intermediate schools students from Sammawa city.

Materials and methods: A total of 3200 students (1600 males and 1600 females) aged 13-14 years old from Sammawa city were examined to detect the buccally malposed maxillary canines. For each diagnosed case, the sagittal occlusion, the sides affected on the maxillary arch, angulation of the canines, presence of crowding, retard deciduous canine and space lacking were determined. Z-score test was used to detect the gender difference, while Chi square test was applied to correlate the canine malposition with other factors.

Results : In general 311(9.72%) of total sample have buccally malposed maxillary canines. Of them, 163(10.19%) were males and 148(9.25%) were females. This problem appeared to be higher in class I than other sagittal relations. Mesially angulated canine was more prevalent than distally one and in right more than left with non-significant gender difference. The prevalence of buccally malposed maxillary canines with the presence of crowding and retard primary canines was higher in males than females with non-significant gender difference. There was high significant association between buccally malposed canine and lacking of space.

Conclusions: Regular visits of the children to the general practitioners and /or orthodontists are mandatory trying to preserve the deciduous teeth and to educate the parents about the importance of these teeth. In addition to that, the age between 9 to 10 years is important to detect the bulging of canines trying to minimize the possibility of ectopic canine eruption.

KEY WORDS

Prevalence, canines, Sammawa city.

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ملخص

خلفية: الأنياب هي أسنان فريدة من نوعها لامتلاكها بعض الخصائص والمسؤوليات. تقع هذه الاسنان في زاوية الفم، وتساعد القواطع في تقطيع وتمزيق الغذاء من جهة، وتساعد الأسنان الخلفية من خلال توجيه الفك السفلي أثناء المضغ من جهة اخرى. تهدف هذه الدراسة إلى تحديد نسبة انتشار الأنياب العلوية سيئة الوضع شدقيا لكلا الجنسين ودراسة علاقة هذه المشكلة مع الاطباق السهمي وازدحام الاسنان وتأخر الانياب اللبنية وعدم وجود مساحة في القوس السني في عينة من طلاب المرحلة المتوسطة من مدينة السماوة.

المواد والطرق: تم فحص ما مجموعه 3200 طالبا (1600 ذكور و 1600 إناث) الذين تتراوح أعمارهم بين 13-14 عاما من مدينة السماوة للكشف عن الأنياب العلوية سيئة الوضع شدقيا. لكل حالة تم تشخيصها، تم فحص الاطباق السهمي، موقع الناب في قوس الفك العلوي، تزوي الأنياب، ووجود الزحام، تأخر الانياب اللبنية و عدم وجود مساحة في القوس السني. تم استخدام اختبار Z-score للكشف عن الفرق بين الجنسين، في حين تم تطبيق اختبار مربع كاي لربط سوء وضع الانياب مع العوامل أخرى.

النتائج :بشكل عام كان عدد الحالات المتأثرة 311 (9.72٪) من إجمالي العينة. منهم 163 (10.19٪) من الذكور و 148 (9.25٪) من الإناث. كانت هذه المشكلة أعلى في الصنف الأول من العلاقات السهمية. كانت الانياب المائلة انسيا أكثر انتشارا وفي جهة اليسار اكثر من اليمين مع وجود فرق غير معنوي بين الجنسين. كان انتشار الأنياب العلوية سيئة الوضع شدقيا مع وجود الازدحام وتأخر ألانياب الابتدائية أعلى في الذكور منه في الإناث مع وجود فرق غير معنوي بين الجنسين. كان هناك ارتباط معنوي بين الانياب سيئة الوضع شدقيا مع عدم وجود مساحة في القوس السني.

الاستنتاجات: الزيارات المنتظمة من قبل الأطفال إلى اطباء الاسنان الممارسين أو اختصاصي تقويم الأسنان إلزامية في محاولة للحفاظ على الأسنان اللبنية وتثقيف الآباء والأمهات حول أهمية هذه الأسنان . بالإضافة إلى ذلك، من المهم فحص الفئة العمرية بين 9-10 عاما للكشف عن انتفاخ الأنياب في محاولة للحد من إمكانية ظهور الانياب بشكل منحرف.

الكلمات الرئيسية: نسبة الانتشار، ألانياب، مدينة السماوة.

INTRODUCTION

Human beings have four pointed teeth one on each side of the dental arch called canine or cuspid. Each canine represents the third tooth from the median line after the central and lateral incisors forming the key stone or the corner stone of the dental arch [(1)].

The maxillary canines possess crowns that are as long as the crowns of the central incisors with single root longer than that of any tooth. The shape and position of the canines contributed to the guidance of the teeth into the inter-cuspal position by "canine guidance." [(2)]

Several characteristics of the functional form of canine crowns had a clear similarity to that of incisor and premolar. Due to possessing crowns with single pointed cusps and long roots in addition to their location in the corner of the mouth, canines resemble the prehensile teeth of the carnivore, hence the name

come. Generally, the labio-lingual thickness of the crown and the root of the canine and its anchorage in the alveolar process make this tooth the most stable one in the mouth. The shape of the crown promotes the self-cleaning property, so it is the last tooth to be lost.

The bony ridge over the labial portion of the canine's root in addition to the form and position of the canine give it more cosmetic importance [3].

Due to these characteristics, it plays a great role in keeping up the contour and shape of the dental arch, occlusion and facial expression, in addition to its role in mastication, appearance and prosthetic treatment [4].

From developmental point of view, Dewel [5] stressed on the maxillary canine as it had the longest period of development from the deepest area (below the orbit) and it had the most tortuous path of eruption from the point of origin till full occlusion. These factors made maxillary canines more susceptible to favorable or unfavorable environmental influences.

The calcification process of maxillary permanent canine crown begins at 4 months of age and completed at 6-7 years of age. It erupts in the oral cavity at 11-12 years old and its roots completed at 13-15 years old [6].

Sachan and Chaturvedi [7] summarized the etiological factors of ectopic canines as followed:

1. Early loss of deciduous teeth
2. Crowding of the permanent successor
3. Tooth size and overall arch length
4. High developmental position and long path of eruption and tortuous movement
5. Prolonged retention of the deciduous tooth
6. Failure of primary canine root resorption
7. Small or congenital missing permanent lateral incisor
8. Reduced in the length of the adjacent lateral incisor root
9. Ankylosis of permanent canine
10. Alveolar cleft
11. Malposed tooth germ
12. Hereditary factors
13. Endocrine deficiency
14. Febrile diseases.

Many studies [8-22] have been conducted in Iraq to study the problems of canines. Some of them concern with canine specifically and the other took the maxillary canine as a part from the survey.

This survey was conducted to study the prevalence of buccally malposed maxillary canines in Sammawa city and to find out the gender and sides' difference of this type of malocclusion in addition to the relation with the presence of crowding, retard deciduous canine and lacking of space.

MATERIALS AND METHODS

Sample

This study was conducted from 5 October 2014 to 29 April 2015 on a sample consisted of 3200 students (1600 males and 1600 females) attending intermediate schools in Sammawa city (280 km to the south of Baghdad).

Age was considered according to the last birthday giving an age range from 13 years 0 months to 14 years 11 months [23].

Permission was acquired from the Al-Muthanna directorate of education. The schools` authorities were contacted and the purpose of the study was explained to them to ensure full cooperation.

Criteria of the sample selection

1. All subjects are Iraqis Arabs in origin.
2. No history of orthodontic treatment.
3. Any gross facial asymmetry was excluded
4. No history of systemic disease or regular drug used for chronic disease that affecting the growth of the body.
5. Cases of cleft lip and palate were excluded.

Methods

The following instruments and equipment were used: disposable dental mirrors, kidney dish, millimeter graded vernier (INOX, Zurcher Modell, Asset plant and machinery Pty. Ltd., China), plastic ruler with 15º angle cut, medical cotton, medical gloves, cheek retractor, disinfected solution (Desident Cavicide, Spofadental, Czech), portable torch light and case sheet to register the information obtained.

The examination was carried out in rooms that were available in host school. The subjects were seated on ordinary chairs with their heads supported in an upright position and the examiner stood in front of the chair to get direct view of both sides of the mouth [24] and determined the following parameters:

Angulation of the buccally malposed maxillary canines

Mesial or distal tipping or angulation of fully erupted permanent maxillary canine was recorded when it exceeded 15º using modified plastic ruler [25].

Sagittal occlusion

Depending on Angle's classification [26], the sagittal occlusion was determined by examining the

1st permanent molar relationship:

a. Normal molar occlusion (class I): It is registered when the mesio-buccal cusp of the upper first permanent molar occludes with the anterior buccal groove of the lower first permanent molar.

b. Distal molar occlusion (class II): It is observed when the relative position of mandibular molar has shifted distally by half cusp width or more.

c. Mesial molar occlusion (class III): The relative position of the mandibular molar had shifted mesially by half a cusp width or more.

Presence of crowding

The dental arch was divided into three segments; one incisal and two lateral segments (right and left). The incisal segment was demarcated by the distal contact points of the two lateral incisors, while the lateral segments were limited by these points and the mesial contact points of the first molars [25].

Crowding (a shortage of 2 mm or more of space preventing the correct alignment of all teeth in that segment) was recorded for each segment with the aid of vernier [24].

Presence of retard deciduous tooth

Retard deciduous tooth (a tooth remained in the mouth beyond its normal time of shedding) was denoted as persistent when, owing to aplasia or anomalous eruption of the equivalent permanent teeth [25].

Lack of space

Present due to premature extraction of primary teeth causing mesial shifting of the permanent teeth and block the space of canine.

Statistical Analysis

The data were processed and analyzed by using SPSS program version 21. The statistical analyses included descriptive statistics (frequency and percentages) and inferential statistics (Z score test for comparison between both genders and Chi square test to detect the association between the determined parameters and malposed canines).

The following levels of significance are used:

Non-significant	NS	$P > 0.05$
Significant	S	$0.05 \geq P > 0.01$
Highly significant	HS	$P \leq 0.01$

RESULTS

Prevalence of the buccally malposed maxillary canines according to genders

The total sample consisted of 3200 students (1600 males and 1600 females). From this total sample, only 311(9.72%) were found to have buccally malposed maxillary canine, of them 163(10.19%) males and 148(9.25%) females (Table 1).

Table 1: Distribution of buccally malposed maxillary canines according to genders

State	*Total*		*Males*		*Females*	
	No.	*%*	*No.*	*%*	*No.*	*%*
Affected	311	9.72	163	10.19	148	9.25
Not affected	2889	90.28	1437	89.81	1452	90.75
Total	3200	100	1600	100	1600	100

Distribution of the buccally malposed maxillary canines according to the side of the problem

As shown in table 2, unilateral buccally malposed canine was more prevalent than bilateral malposition and in males more than females with a non-significant gender difference.

Table 2: Distribution of the buccally malposed maxillary canines according to state of malocclusion in both genders

State of malposition	*Total*		*Males*		*Females*		*Gender difference*	
	No.	*%*	*No.*	*%*	*No.*	*%*	*Z-test*	*p-value*
Unilateral	211	67.85	110	67.48	101	68.24	-0.143	0.889 (NS)
Bilateral	100	32.15	53	32.52	47	31.76	0.143	0.889 (NS)
Total	311	100	163	100	148	100		

Buccally malposed maxillary canines showed high frequency in the right side than the left with a non-significant gender difference (Table 3). Buccal maxillary canine malposition on both side appeared in 100 cases; 53 in males and 47 in female with a non-significant gender difference. The association between the side of canine malposition and genders was non-significant.

Table 3: Distribution of buccally malposed maxillary canines according to the sides' maxillary arch

Side of problem	*Total*		*Males*		*Females*		*Genders difference*	
	No.	*%*	*No.*	*%*	*No.*	*%*	*Z-test*	*p-value*
Right side	133	42.77	68	41.72	65	43.92	-0.392	0.697 (NS)
Left side	78	25.08	42	25.77	36	24.32	0.293	0.772 (NS)
Both sides	100	32.15	53	32.52	47	31.76	0.143	0.889 (NS)
Total	311	100	163	100	148	100		

X^2= 0.166, d.f. =2, p-value= 0.920 (NS)

Buccally malposed maxillary canines in relation to the sagittal occlusion

Distribution of buccally malposed maxillary canines in relation to sagittal occlusion in both genders was demonstrated in table 4.

Generally the highest number of cases was presented in class I cases followed by class II and the least in class III. Z-test revealed non-significant gender difference. Chi-square test disclosed non-significant association between the sagittal occlusal relation and genders.

Table 4: Distribution of buccally malposed maxillary canine in relation to sagittal occlusion

Sagittal occlusion	Total		Males		Females		Genders difference	
	No.	%	No.	%	No.	%	Z-test	p-value
Class I	**222**	**71.38**	**113**	**69.32**	**109**	**73.65**	**-0.843**	**0.401 (NS)**
Class II	**63**	**20.26**	**37**	**22.70**	**26**	**17.57**	**1.125**	**0.263 (NS)**
Class III	**26**	**8.36**	**13**	**7.98**	**13**	**8.78**	**-0.257**	**0.795 (NS)**
Total	**311**	**100**	**163**	**100**	**148**	**100**		

X^2= 1.272, d.f. =2, p-value= 0.529 (NS)

Angulations of buccally malposed maxillary canines

Table 5 demonstrated distribution of the buccally malposed maxillary canine according to its angulation. Mesially angulated maxillary canine was presented in 281 cases while in 30 cases, the canine angulated distally. Generally, both of the types of angulations were higher in the right side that of the left. Chi-square tests revealed a non-significant association between the angulation of canine malposition and the side of occurrence in the maxillary arch.

Table 5: Distribution of buccally malposed maxillary canines according to its angulation on the sides of maxillary arch

Side of problem	*Total*		*Mesially*		*Distally*	
	No.	*%*	*No.*	*%*	*No.*	*%*
Right side	133	42.77	121	43.06	12	40
Left side	78	25.08	71	25.27	7	23.33
Both sides	100	32.15	89	31.67	11	36.67
Total	311	100	281	100	30	100

X^2= 0.31, d.f. =2, p-value= 0.856 (NS)

The frequency of mesially angulated buccally malposed canines were presented in males more than females in each side and in both side cases with a non-significant genders difference. Non-significant association was found between the genders and the side of malposition (Table 6).

Table 6: Distribution of mesially angulated buccally malposed canine according to the sides' maxillary arch

Side of problem	Total		Males		Females		Genders difference	
	No.	%	No.	%	No.	%	Z-test	p-value
Right side	121	43.06	62	42.18	59	44.03	-0.313	0.757 (NS)
Left side	71	25.27	38	25.85	33	24.63	0.236	0.810 (NS)
Both sides	89	31.67	47	31.97	42	31.34	0.113	0.912 (NS)
Total	281	100	147	100	134	100		

X^2= 0.106, d.f. =2, p-value= 0.948 (NS)

The distally angulated buccally malposed canines were presented in 16 males and 14 females with nearly equal distribution on each side of the arch and in both sides with a non-significant gender difference. Again, no significant association was found between the gender and the side of the problem (Table 7).

Table 7: Distribution of distally angulated buccally malposed canine according to the sides' maxillary arch

Side of problem	Total		Males		Females		Genders difference	
	No.	%	No.	%	No.	%	Z-test	p-value
Right side	12	40	6	37.5	6	42.86	-0.299	0.764 (NS)
Left side	7	23.33	4	25	3	21.43	0.231	0.818 (NS)
Both sides	11	36.67	6	37.5	5	35.71	0.101	0.920 (NS)
Total	30	100	16	100	14	100		

X^2= 0.101, d.f. =2, p-value= 0.950 (NS)

Buccally malposed maxillary canine in relation to crowding

Table 8 showed the distribution of buccally malposed canines in relation to crowding on the sides of the maxillary arch in both gender. The crowding appeared in 206 cases (107 cases in males and 99 cases in females). There was non-significant gender difference in each side and in both side, also no significant association existed between the gender and the side of crowding.

Table 8: Distribution of buccally malposed maxillary canines on sides of the maxillary arch associated with crowding

Side of problem	Total		Males		Females		Genders difference	
	No.	%	No.	%	No.	%	Z-test	p-value
Right side	84	40.78	44	41.12	40	40.40	0.105	0.920 (NS)
Left side	55	26.70	29	27.10	26	26.26	0.136	0.889 (NS)
Both sides	67	32.52	34	31.78	33	33.33	-0.238	0.810 (NS)
Total	206	100	107	100	99	100		

X^2= 0.058, d.f. =2, p-value= 0.971 (NS)

Buccally malposed maxillary canine in relation to retard deciduous canine

The retard deciduous canine with buccally malposed canines were presented in 69 cases; 37 cases in males and 32 cases in females. No significant gender difference or association between the retard deciduous canine and buccally malposed maxillary canine were recorded (Table 9).

Table 9: Distribution of buccally malposed maxillary canines on sides of the maxillary arch associated with retard deciduous canine

Retard deciduous canine	Total		Males		Females		Genders difference	
	No.	%	No.	%	No.	%	Z-test	p-value
Right side	27	39.13	13	35.14	14	43.75	-0.731	0.465 (NS)
Left side	18	26.09	10	27.03	8	25	0.191	0.849 (NS)
Both sides	24	34.78	14	37.84	10	31.25	0.573	0.567 (NS)
Total	69	100	37	100	32	100		

X^2= 0.567, d.f. =2, p-value= 0.753 (NS)

Buccally malposed maxillary canine in relation to space lacking

The space lacking for buccally malposed canines were presented in 205 cases, 121 cases of them in males and 84 in females with a high significant gender difference in cases of both sides and non-significant gender difference in each side separately.

Chi-square test revealed a highly significant association between the lack of space and buccal canine malposition with regard to genders (Table 10).

Table 10: Distribution of buccally malposed maxillary canines on sides of the maxillary arch associated with lack of space

Space lacking	*Total*		*Males*		*Females*		*Genders difference*	
	No.	*%*	*No.*	*%*	*No.*	*%*	*Z-test*	*p-value*
Right side	98	47.80	51	42.15	47	55.95	-1.946	0.051 (NS)
Left side	57	27.80	30	24.79	27	32.14	-1.155	0.246 (NS)
Both sides	50	24.39	40	33.06	10	11.90	3.468	0.000 (HS)
Total	205	100	121	100	84	100		

X^2= 12.035, d.f. =2, p-value= 0.002 (HS)

DISCUSSION

Prevalence of buccally malposed canines in Sammawa city

The prevalence of buccally malposed maxillary canine in this study was 9.72%, this was higher than Ghaib [11] (8.36%), Al-Huwaizi [14] (6.5%), Al-Chalabi [22] (4.6%), and lower than Al-Fahdawi [16] (42.35%) and Aziz [18] (10.8%); this is due to the difference in sample size and selection.

This problem affected males more than females due to the smaller dental arch of females.

Prevalence of buccally malposed canines on sides of the maxillary arch

High frequency of buccally malposed canines was reported at one side and in the right side more than the left with a non-significant gender difference. Ghaib [11] reported high prevalence of unilateral buccally malposed canines.

Al-Fahdawi [16] and Al-Chalabi [22] found high frequency of buccally malposed canines on the right side in reverse to Al-Huwaizi [14] and Aziz [18].

Buccally malposed canines in relation to the sagittal occlusal relationship

High frequency of buccally malposed maxillary canines was found in class I sagittal occlusion more than other classes; because the dominance type of occlusion is class I, so it is reasonable to find a higher percentage of canine problems in class I sagittal occlusion.

Bass [27] reported lower percentage of Class II cases affected with displaced canines as greater amount of space will be available in such cases due to proclined incisors that reduced the opportunity of an early canine deflection whether buccally or palatally and gave this tooth a high chance to carry on its correct path of eruption.

All classes showed non-significant gender difference. This comes in agreement with Ghaib [11], Al-Fahdawi [16] and Aziz [18].

Angulation of buccally malposed canines

High frequency of mesially angulated buccally malposed canines than distally angulated one had been reported in this study in addition no significant gender difference between prevalence of mesially and distally angulated buccally malposed canines. This is due to its eruption path and this gives a real fact that the causative factors for the canine problems in males and females are similar mostly due to local factors in other word the canine problems outside the hormonal effect. These results are supported by Kinaan [9], Farah [10], Ghaib [11], Al-Fahdawi [16] and Aziz [19].

Buccally malposed canine and crowding

High frequency of buccally malposed canine associated with crowding was showed in this study with no significant gender difference. This may be due to lack of space and small arch.

Buccally malposed canine and retard deciduous canine

Non-significant gender difference for the prevalence of buccally malposed canine associated with retard deciduous canine was shown in this study. Retard deciduous canine cannot be considered as a causative factor for the buccally malposed canine since there is no tendency of matching the occurrence of cases of retard deciduous canine on the maxillary arch in the cases of buccally malposed canine (Chi

square revealed non-significant association). Early loss of deciduous canine may affect the permanent canine, whereas late loss (over 14 years old) of the deciduous canine may not have the same effect on the permanent canine.

Buccally malposed canine and space lacking

Highly significant association was found between prevalence of buccally malposed canine and space lacking. Buccally malposed canine has a significant tendency to be existed on the same side of the space lacking on the maxillary arch. Insufficient room in the dental arch and a vertical developmental position are often associated with buccal canine malposition [28]. This finding agrees with Al-Fahdawi [16].

CONCLUSIONS

Regular visits of the children to the general practitioners and /or orthodontists are mandatory trying to preserve the deciduous teeth and to educate the parents about the importance of these teeth. In addition to that, the age between 9 to 10 years is important to detect the bulging of canines trying to minimize the possibility of ectopic canine eruption.

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Evaluation of Interradicular Cortical Bone Thickness for Orthodontic Miniscrew Implant Placement Using Cone Beam Computed Tomography

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ABSTRACT

Background: Two factors, safety and stability that clinicians should consider during miniscrew implant placement. Safety is involved to MD distance and stability is involved to bone thickness. No Iraqi studies had been evaluated bone thickness and mesiodistal distance related to mini-implant placement for orthodontic anchorage at age 18 -35 years

The aim of study: This study aimed to assess the three dimensional interradicular areas and the cortical bone thickness in Iraqi patients wit h Class I skeletal pattern and to determine the safe and suitable sites for orthodontic miniscrew implant by use the CBCT.

Materials and Methods : The sample of the present study include a total of 20 Iraqi arabic patients aged 18-35 years of both sexes (10 males and 10 females) attending the Porceka Center at al Hilla city for CBCT scan for different CBCT diagnostic purposes from the period between November 2014 to May 2015.Measurements were made from the mesial aspect of the first premolar to the mesial aspect of the second molar of mandible, at 2, 4, 6, 8, and 10 mm heights from the alveolar bone crest in each interradicular area.

Results: In males, the greatest buccal cortical thickness, buccolingual alveolar process width and mesiodistal distance were between the first and second molar at 10-mm height (3.8 ± 0.92 mm, 15.7 ± 1.33 mm and 4.7± 1.01respectively). In females, the greatest buccal cortical thickness, buccolingual alveolar process width and mesiodistal distance were between the first and second molar at 10-mm height (2.7 ± 0.16 mm, 13.8 ± 1.59 mm and 6.1± 0.91respectively). There was statistically significant sex difference in buccal cortical thickness, buccolingual alveolar process width and mesiodistal distance which were larger with males.

Conclusion: Cone Beam Computed Tomography is a precise tool for evaluation the interradicular area and buccal cortical bone thickness to select the most suitable position of orthodontic miniscrew insertion.

KEYWORDS

Interradicular, Cortical Bone Thickness, Miniscrew Implant, CBCT.

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INTRODUCTION

Microscrew have many advantages, including effort less removal and placement, immediate cramming, minimize anatomical constraints due to their low and cost small size. Plenty reports have coped with various clinical cases, for example posterior or anterior teeth retraction, All teeth retraction, distalization , up righting or protraction of molars. [1,2].

Several sites had been proposed for the placement of miniscrews or microscrew implants. Most recommended sites were the midpalatine area; Interradicular spaces are generally the site of choice for mini implant placement for their ease of access, simplicity of procedure, and less traumatic placement [3]. The buccal interradicular area is commonly selected for miniscrew implant placement [4,5].

This area is not only easy for miniscrew implant placement, but also allows relatively simple orthodontic mechanics [3,6].

In craniofacial imaging the final advancing have made it possible to obtain (3D) acting with CBCT of the craniofacial structures.

CBCT was first enters to dentistry in the United States at the University of Loma Linda in 2000. [7].

The CBCT technique lets rapid data acquirement more than CT. Evolved software is found for all unit, letting measuring and processing for image. With a versatile range of uses in the dental purposes, CBCT applications for diagnosis and treatment planning. Orthodontics has many advantages from CBCT. ([8].

Compared with CT machines the advantages of CBCT are rather low cost and smaller size, 3D images of maxillofacial structures, easy of uses, rapid scans. Radiation dose levels achieved by CBCT is awarder to an all-mouth sequence, and less than (2 panoramic radiographs), adoption on the use setting. [9, 10].

The final accuracy studies include CBCT image have shown that 3D measurements they are close to reality and more accurate than 2D measurements. [11, 12].

Varied results of the accuracy of CBCT scan has been restudied on many machines. No statistically significant differences between anatomic truth and CBCT images found BY Some authors. [13].

Whereas others illustrated differences that, even though statistically different, were not considered clinically significant [14, 15].

CBCT which introduce clear 3D images with low voxel size. In recent years, has been broadly used in craniofacial diagnoses, orthodontics, and for accurate

surgical guidance for miniscrew placement. [16, 17].

In the present study, Cone Beam Computed Tomography was used as an aid in selection of precise position for miniscrew insertion.

MATERIALS AND METHODS

Prospective study of CBCT scans for (20) Iraqi patients, with equal number of each gender (10males and 10 females), age ranged from (18-35) yrs. were analyzed. The sample collected from patient attending Porceka center in Al-Hilla City CBCT scan for different diagnostic purposes from November 2014 to May 2015.

Criteria for the sample selection:

Full eruption of permanent dentition (except for third molars),no history of previous orthodontic treatment ,no missing teeth (exclude third molars),no severe craniofacial disorders, no severe periodontitis or periapical lesion, no large metal restoration, no severe crowding and spacing in posterior teeth and Class I skeletal pattern.

The examination was performed Cone Beam Computed tomography KODAK 9000C 3D machine (Trophy, France)

The patients were prepared for the exposure by asking them to remove any spectacles, jewelry, ear rings, and hearing aids.

Each patient was scanned on KODAK 9000C 3D machine (Trophy, France) which is in compliance with the requirements of the EEC (European Economic Community) and International Medical standards at 70kV and 10mA for 10.8 seconds for each quadrant of the jaw.

The CBCT images were formatted into standard DICOM and reconstructed into continuous slices at 1.0 mm thickness each. The CT image analysis for each image was conducted by Kodak 3D viewer, 2.2 version software, and oblique slicing images with sections of 1.0mm thickness were chosen for measurements.

The images were coincided in all the views (Cross-sectionl,Panoramic,and Axial) Figure(1).

Figure1:CBCT image (panoramic, axial,and cross-sectional)

Befor taking the linear measurment at various levels from the crest of alveolar bone.The cross-sectional images were perpendicular to the axial and panoramic planes.These images was used to measure mandibular Mesiodistal distance (MD), Buccolingual alveolar process width (BL) and Buccal cortical bone thickness (B-C).

Mesiodistal distance (MD): The distance between parallel lines tangent to the adjacent proximal root surfaces in the axial image Figure(2).

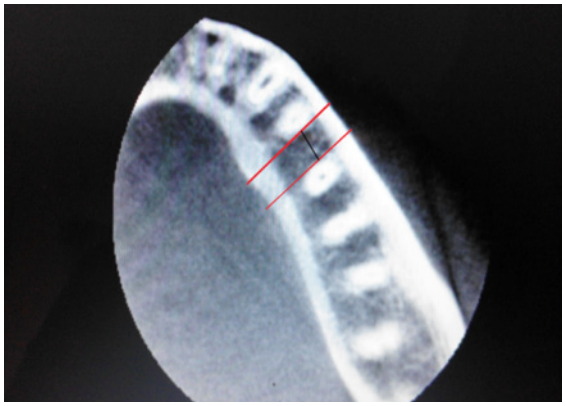

Figure2: Measurement of the interradicular distances

Buccolingual alveolar process width (BL): This width was measured at the center of the interradicular width between the tangent lines to the proximal root surfaces, from the outer most point on the buccal side to the outermost point on the lingual side Figure(3).

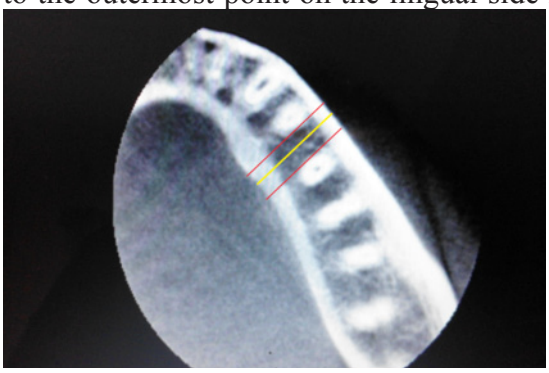

Figure 3: Measurement of the alveolar process width.

Buccal cortical bone thickness (B-C): The distance between the external and internal aspects of the buccal cortex midway between the tangent lines to the proximal root surfaces Figure(4).

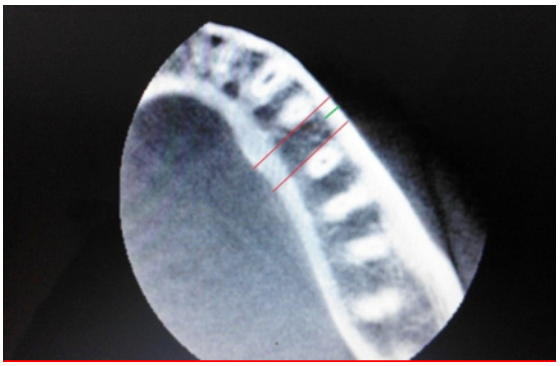

Figure 4: Measurement of the buccal cortical bone thickness

Procedure to measure CBT is as follows. Buccal CBT measurement was done at the interradicular space between 1st premolar-2nd premolar(4-5) and 2nd premolar-1st molar(5-6) and 1st molar-2nd molar(6-7) at 5 different levels, that is, (2,4,6,8,10) below the crest of alveolar bone. Each measurement was taken from the buccal alveolar plate. For this measurement, a reference horizontal line was drawn at the crest of alveolar bone parallel to CEJ and 5 horizontal measurements were taken parallel to this line at 5 different vertical levels.

To assess the safety of implant placement between these teeth, the mesiodistal interradicular distance and the alveolar process width (transverse distance from the buccal surface of the cortical bone to the lingual surface of the alveolar process) were measured.

For initial stability evaluation, cortical bone thickness was measured. First, sagittal images between the first premolar and the second premolar area that passed through the middle of the two teeth were constructed, then a horizontal line passing at the crest of alveolar bone of the two teeth was drawn and then a horizontal lines was drawn at 5 heights from this transverse line 2, 4, 6 , 8 and 10mm.Figure(5).

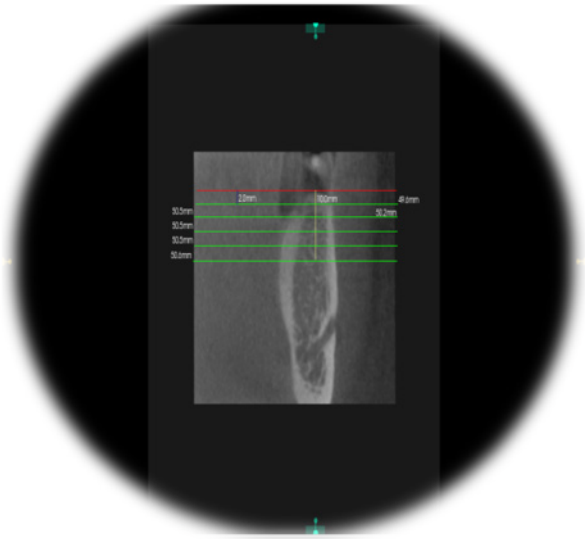

Figure 5: Sagittal images between the first premolar and the second premolar Sequential axial plane images at these 5 levels were constructed to measure the alveolar process width, mesiodistal distance (MD)and buccal cortical bone thickness at each axial plane at 2, 4, 6 ,8and 10 mm from the crest of alveolar bone.

For each patient, 45 measurements were measured and performed by one investigator.

Statistical Analysis:

Data were translated into a computerized database structure. An expert statistical advice was sought for. Statistical analyses were computer assisted using SPSS version 21 (Statistical Package for Social Sciences). Frequency distribution for selected variables was done first.

The outcome measurements were normally distributed variables as tested by Kolmogorov-Semirnov test. Such variables are described by mean, standard deviation (SD) and standard error (SE). The statistical significance of differences in mean of a normally distributed variable between males and females was assessed by independent samples t-test.

The statistical significance of differences in mean of a normally distributed outcome variable measured more than once in the same subject (different vertical and AP positions) requires paired significance testing in a repeated measure general linear model analysis.

Cohen's d is a standardized measure of effect size for difference between 2 means, which can be compared across different variables and studies, since it has no unit of measurement. Cohen's d = (mean1-mean2) / Pooled SD of the 2 groups. Cohen's d < 0.3 small effect, 0.3-0.7 (medium effect), while 0.8 and higher is a large effect.

A multiple linear regression model was used to study the net and independent effect of a set of explanatory variable on a quantitative outcome (dependent) variable.

RESULTS

Summary for the effect of sex, change in vertical level and change in (AP) position

Buccal cortical bone thickness

As shown in table (1), the net and independent effect of gender, vertical level and horizontal (AP) position were evaluated for their effect on buccal cortical bone thickness in a multiple linear regression model. The model was statistically significant and able to explain 0.74 of observed changes in the dependent (response or outcome) variable.

Being a male it is expected to significantly increase buccal cortical bone thickness by a mean of 0.47mm compared to female after adjusting (controlling) for vertical and horizontal level. For each 1mm increase in vertical level from the alveolar bon crest, the bucal cortical bone thickness is expected to significantly increase by a mean of 0.18mm after adjusting (controlling) for gender and horizontal level.

Compared to the most frontal position (4-5) after adjusting (controlling) for gender and vertical level, at the positions (5-6) and (6-7)is expected to significantly increase buccal cortical bone thickness by a mean of(0.24,1.02mm)respectively.

Buccolingual alveolar process width

As shown in table (2), the net and independent effect of gender , vertical level and horizontal (AP) position were evaluated for their effect on buccolingual alveolar process width in amultiple linear regression model. The model was statistically significant and able to explain 0.75 of observed changes in the dependent (response or outcome) variable.

Being a male is expected to significantly increase buccolingual alveolar process width by a mean of 2.08mm compared to female after adjusting (controlling) for vertical and horizontal level.

For each 1mm increase in vertical level from the alveolar bon crest, the buccolingual alveolar process width is expected to significantly increase by a mean of 0.48mmafter adjusting (controlling) for gender and horizontal level.

Compared to the most frontal position (4-5)after adjusting (controlling) for gender and vertical level, at the positions (5-6) and (6-7)is expected to significantly increase buccolingual alveolar process width by a mean of (1.07,3.27mm) respectively.

Mesiodistal (inter-radicular) distance (MD)

As shown in table (3), the net and independent effect of sex, vertical level and horizontal (AP) position were evaluated for their effect on mesiodistal (inter-radicular) distance (MD) in a multiple linear regression model. The model was statistically significant and able to explain (0.69) of observed changes in the dependent (response or outcome) variable.

Being a male is expected to significantly decrease mesiodistal (inter-radicular) distance (MD)by a mean of (-0.34)mm compared to female after adjusting (controlling) for vertical and horizontal level.

For each 1mm increase in vertical level from the alveolar bone crest, the mesiodistal (inter-radicular) distance (MD) is expected to significantly increase by a mean of (0.21) mm after adjusting (controlling) for gender and horizontal level.

Compared to the most frontal position (4-5)after adjusting (controlling) for sex and vertical level, at the positions (5-6) is expected to significantly decrease mesiodistal (inter-radicular) distance (MD)by a mean of (-0.41mm),and (6-7)is expected to significantly increase mesiodistal (inter-radicular) distance (MD) by a mean of (1.25)mm.

Table 1: Effect of gender, vertical and (AP) level on buccal cortical bone thickness

Cortical thickness (mm)	*Partial regression Coefficient*	*P*	*Standardized Coefficients*
(Constant)	0.09	0.21[NS]	
male compared to femal	0.47	<0.001	0.285
(5-6)compared to(4-5)	0.24	<0.001	0.136
(6-7)compared to(4-5)	1.02	<0.001	0.584
Level(distance from crest inmm)	0.18	<0.001	0.615

R2=0.74
P (Model) <0.001

Table 2: Effect of Sex, vertical and (AP) level on buccolingual alveolar process width

Buccolingual alveolar process width (mm)	*Partial regression Coefficient*	*P*	*Standardized Coefficients*
(Constant)	5.43	<0.001	
male compared to femal	2.08	<0.001	0.411
(5-6)compared to(4-5)	1.07	<0.001	0.200
(6-7)compared to(4-5)	3.27	<0.001	0.609
Level(distance from crest in mm)	0.48	<0.001	0.538

R2=0.75
P (Model) <0.001

Table 3: Effect of sex, vertical and (AP) level on mesiodistal (inter-radicular) distance (MD)

Mesio-distal (inter-radicular)distance in mm	*Partial regression Coefficient*	*P*	*Standardized Coefficients*
(Constant)	2.02	<0.001	
male compared tofemal	-0.34	<0.001	-0.149
(5-6)compared to(4-5)	-0.41	<0.001	-0.170
(6-7)compared to(4-5)	1.25	<0.001	0.521
Level (distance from crest in mm)	0.21	<0.001	0.529

R2=0.69
P (Model) <0.001

DISCUSSION

Computed Tomography permits the dental professional to visualize what the conventional radiographs never showed. The visualization of labial/buccal and lingual plates was not possible due to image superimposition of conventional radiographs[18]. CT gives accurate and reliable measurements of mandibular cortical bone thickness[19].

In the present study , CBCT was used since the effective dose of radiation for CBCT scans is much lower than for medical Computed Tomography scans and is restricted to maxillofacial area[20].

The interradicular spaces were the areas of interest in this study, since they were generally the site of choice for mini implant placement for their ease of access, simplicity of procedure, and less traumatic placement.

The choice of current study for the mandible as the sites for measuring cross-sectional bony thickness was made for practical and application based issues.

In the mandible, the space between the 2nd premolar and 1st molar is the preferred site for anterior tooth retraction, and the space between the 1st premolar and 2nd premolar is often used for the mesial movement of molars. In addition, the mandibular buccal molar areas can be used for an TAD to intrude the molars[21].

Therefore, determination of the cortical bone thickness of the mandibular molar region will be helpful for the selection of TAD placement sites.In the present study the side with full set of dentition was studied for measurements to exclude the effect of extraction on bone thickness. This was decided because that it was concluded that no significant difference existed in thickness of cortical bone between the sides of the mandible [19, 22].

Buccal cortical bone thickness

According to **Dalstra and Melsen(2004)**[23],a microimplant should have enough initial stability if peri-implant bone tissue has more than 1mm of cortical bone thickness. **Motoyoshi et al., (2007)** [24] stated that the mini-implant site should have a cortical bone thickness of at least 1.0 mm. In present study, more than1mm cortical bone thickness in all locations except at 2 mm from the crest of alveolar bone at the position between first and second premolars which is not a suggested area for mini-implant placement. Therefore, if all other factors of initial stability are satisfied, the range of mean cortical bone thickness in this study should provide sufficient initial stability. In this study a statistically significant difference between males and females in alveolar cortical bone thickness was found. The cortical bone thickness were greater in males than in females .These results is agreed with those found by **Kang et al,2007**, **Ono et al.,2008** and **Fayed et al.,2010**[25,26,5]who observed that the cortical bone thickness is more in males than in females.

The sex difference in cortical bone thickness recorded in the current study might be expected because males have larger bite forces and masticatory muscles than females [27, 28] .

Males have larger masticatory muscles and greater maximum biting forces than females [28, 29]. Although sex differences in diet have been reported maximum biting forces rarely occur in daily mastication [30, 31]. The forces required to masticate modern diets is far below the maximum biting force [32]. The similarity in cortical bone thickness indicates that the strains associated with daily masticatory forces are more important in determining group differences than maximum bite forces or muscle mass.

On the other hand, other studies reported no sex differences in cortical bone thickness which are inconsistent with the present study. This lack of sex difference in cortical bone thickness has been previously demonstrated **by Deguchi et al., 2006;Ono et al., 2008; Park et al., 2008; Choi et al., 2009; Farnsworth et al., 2011)**[33,26,34,35,6].

Another interesting finding was that gradual increase in the alveolar cortical bone thickness at different distances from the alveolar crest was found.

These results is agreed with those found by **Deguchi et al., 2006**[33] and **Ono et al., 2008**[26].who observed that the cortical bone thickness tends to be thicker at greater heights and thinner at shallow levels.

In a study conducted by **Park and Cho 2009**[34], the thickness of mandibular cortical bone, increasing from the CEJ toward the apex which are consistent with the present study.

Moslemzade et al., 2014[35]found similar results in their morphometric study; they reported buccal cortical bone increases in thickness as the distance of the measurement points from the alveolar crest increases.

However **Ono et al., 2008**[26] showed that the greater the height, the thicker the cortical bone tended to be which are consistent with the present study

In the current study , it was revealed that cortical bone thickness increased from anterior to posterior on the buccal side of the mandible, these findings are consistent with studies by **Farnsworth et al., (2011)**, **Horner et al., (2012)** and **Moslemzade et al., (2014)**[6,36,35].The pattern can be explained by masticatory force distribution within the mandible. The force developed during biting increases from anterior teeth to molars [37 ,38]. Therefore, bone in the molar areas is subjected to the higher levels of stress and strains, necessitating more bony adaptation than in the anterior region. The thicker cortical bone in the posterior mandible makes it well suited for MSI placement.

In a study by **Baumgaertel and Hans (2009)** [4], cortical bone thickness in the buccal area for the placement of mini-implants was evaluated on 30 dry skulls using CBCT technique. The results showed a higher cortical bone thickness in posterior areas and the thickness increased by moving away from the bone crest, consistent with the results of the present study.

These results are agreed with those found by **Baumgartel and Hans, 2009**[4] who found a buccal cortical bone thinnest in the anterior sextants of both jaws and a progressive increase toward the posterior region. **Farnsworth et al., 2011**[6] showed a cortical bone thickness decrease from posterior to anterior region. The current study suggests that the posterior area may contain denser and thicker cortical bone. This pattern might be explained by the higher functional demands placed on the posterior teeth [39, 40].

Buccolingual alveolar process width

Generally males are bigger than females in most dimensions[41],they have thicker alveolar ridge than females due to greater medullary bone in addition to larger teeth males have in comparison to females in all dimensions[42]. The difference in tooth size and body size may explain the differences in alveolar ridge width. **Swasty et al., 2011**[43] reported that males have thicker ridges than females only in the premolar and canine regions of the upper third of the mandible which are inconsistent with the present study. However, their study was based on a wide age-range (10-65 years old) and the number of males and females were not indicated.

The results of current study showed a consistent increase in the buccolingual thickness in most of the studied sites in the mandible when moving apically and posteriorly, **Fayed et al., (2010)** is in agreement with the results revealed by the present study.

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A Comparison of Time Needed for Instrumentation of Simulated Curved Canals by Using Different Files

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ABSTRACT

Background : A more flexible file was needed for instrumentation of curved canals using step back enlargement technique Ni-Ti files has been shown to be exceptionally elastic , having a lower bending moment and lower permanent set after torsion with similar gauge stainless steel files .

Aim of the study: is to compare the time needed to prepare curved resin simulated root canals with Ni-Ti, S.S., and SS K-Flex files using a step –back enlargement technique.

Materials and methods: 30 simulated root canals were constructed using size 20 silver points as a mold, then divided into 3 groups: group 1: Canals instrumented with SS K – files, group 2: Canals instrumented with stainless steel K- flex files. And group 3: Canals instrumented with Ni – Ti files.

Results: The comparison between the three groups using ANOVA and T- test, showed a significant difference in time needed to fully instrument the canals.

CONCLUSION: Ni- Ti files required more time to instrument the canals than other files.

KEYWORDS

instrumentation time, curved canals, files .

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INTRODUCTION

preparation of the root canals plays an important role in endodontic treatment, as the main objectives of the latter are to clean, disinfect and shape the root canals to enable easy and appropriate filling [1, 2].

New products, instruments and instrumentation techniques are appearing which claim to make endodontic instrumentation both faster and better than more conventional treatment [3].

Lim and Webber [4] speculated that a more flexible file would produce less, or perhaps no, apical transport. Nickel Titanium (Ni- Ti) alloy has been shown to be exceptionally elastic , having a lower bending moment and lower permanent set after torsion compared with similar gauge stainless steel (S.S.). Hand and rotary files fabricated from Ni-Ti alloy are now available which have expanded the therapeutic options available for root canal preparation and are claimed to be superior in curved canals [5].

MATERIALS AND METHODS

The time required to prepare curved artificial root canals in resin blocks was compared using 3 groups of root canal files.

30 simulated root canals were constructed using size 20 silver points as mold which were given a gentle " C" type curvature that is defined mathematically with an angle of approximately 30 degrees and a radius of 18 mm. The degree of curvature was approximated using Pruett et al modification of Schneider method [6].

The silver points were coated with a thin film of vegetable oil to prevent the resin from binding to the points. The mold was constructed from silicon rubber impression material and the resin was poured into it and when polymerized the material was clear.

The canals were divided into 3 groups:

- Group 1: canals instrumented with SS K – files.
- Group 2: canals instrumented with SS K- flex files.
- Group 3: canals instrumented with Ni-Ti files.

A standard step – back enlargement technique using simple in / out filing motion was used. The canals were instrumented to size 25 file to the full length. Followed by a step – back to size 45 in 1 mm increment, the canals were irrigated using 1.5 ml of distilled water after each instrument size to ensure that the canals were free of resin debris. The preparation time required for each canal was recorded in minutes. Timing was begun when size 15 file could be negotiated to the full working length. Timing ended when the canal was prepared to master apical file size 25, flared with step – back to size 45. The recorded time also covered irrigation and recapitulation.

RESULTS

The mean values of time taken to complete the preparation of canals are outlined in Table (1) and figure (1).

Table (1) Time taken to complete preparation of canals in minutes

	No.	Mean	SD	SE	Min	Max
Group1	10	13.6	3.660	1.160	10.00	16.00
Group2	10	15.40	3.098	0.980	10.00	20.00
Group3	10	18.20	2.440	0.772	13.00	20.00

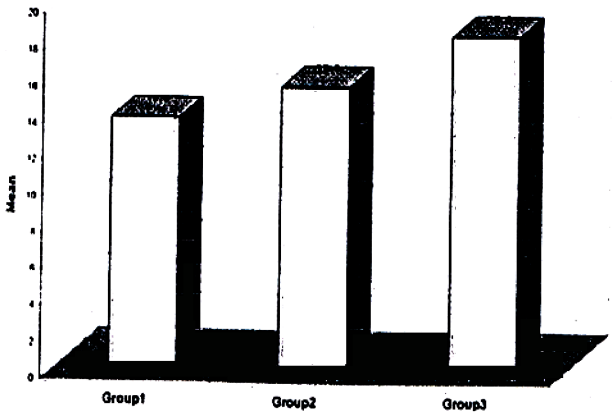

Fig (1): Mean values of time taken to complete the preparation

Using ANOVA test, there was a significant difference in time needed to fully instrument the canals. Group 1 (S.S. files) instrument the canals more quickly than group 2(K- Flex files) and group 3 (Ni-Ti files).

The comparison between the three groups using t-test showed a significant difference between group 1&3 and group 2&3, and no significant difference between group 1&2 (Table2).

Table (2).Comparison between the three groups using t-test

	t-test	P-value	Sig
Group1 &Group2	1.53	0.150	NS
Group1 &Group3	4.55	0.003	S
Group2 &Group3	2.240	0.038	S

**P>0.05 Non Significant, NS=non-significant.

DISCUSSION

Simulated canals were selected for root canal preparation in this study and other studies because the size , curvature and material characteristics are identical in all canals and good comparability of the results could be expected [5,7,8,9] .

The three instruments used; S.S, SSK- Flex and Ni-Ti files, were chosen because of the variability in their flexibility. Ni-Ti; files have 2-3 times the elastic flexibility of SS files because of the very low values of modulus of elasticity in tension and shear modulus of [10] , while flexibility of K- flex files is between them and the decrease of flexibility is more uniform with an increase in file size [11] .

Possible disadvantage of such flexibility of Ni-Ti files may be the decrease in the force that can be applied laterally to dentin to affect canal wall planning so cutting efficiency may be reduced as compared with SS due to the greater elasticity [11].

Instrumentation techniques have become widely studied particularly after the development of Ni-Ti alloy files, which allow faster and safer debridement of curved and flattened root [12].

Our results showed that Ni-Ti files required more time to instrument the canals and this is in agreement with Coleman and Svec [7] who found that time of instrumentation with Ni-Ti files in resin blocks was significantly greater than SS files. Coleman et al. [5] also found that time of instrumentation was greater for Ni-Ti files compared with SS in natural teeth, but the difference was not significant.

Our results disagree with Gambil et al. who showed that root canals prepared by Ni-Ti files using reaming technique required less instrumentation time than those prepared with SS K-Flex files used in a quarter turn / pull technique .

In this study, canals enlargement was time consuming and this may be due to the physical properties of the resin used in constructing the canals,

in addition to the complicated nature of the step-back technique with repeated measurements of files, recapitulation and constant irrigation.

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Detection of Second Canals in Mesial Root of Maxillary First Molars Using Different Evaluation Methods (In Vitro Study)

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ABSTRACT
Aim: The purpose of this study was to determine the number of canals treated in the mesio-buccal roots of the maxillary first molars in Iraqi population.
Materials and Methods: The examiners verified the number of canals in the teeth using different methods including: magnifying lens, bubble test and radio graphical method.
Results: In total, 200 maxillary first molars of which 148 teeth (74%) met the criterion of having two canals detected and treated in the mesio-buccal root of the maxillary first molars.
Discussion and conclusion: The fact that almost more than half the mesio-buccal roots of the maxillary first molars bear two canals is enough reason to assume always that two canals exist until careful examination proves otherwise. According to this study there was no difference in the prevalence of 2nd MB canal in maxillary 1st molar between males and females.

KEY WORDS : Second cananl, Mazillary first molars,mesial root

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INTRODUCTION
The aim of endodontic treatment is the chemomechanical cleansing of the root canal and its hermetic obturation with an inert material [1]. It is generally accepted that the major cause of the failure of root canal therapy is the clinician's inability to recognize and adequately treat all the canals of the root canal system [1-3]. A clear understanding of human root canal anatomy is a prerequisite for performing conventional endodontic procedures. The anatomic complexities of the root canal have been highlighted in the literature, and the need for clinicians to understand probable aberrations has been emphasized [4, 5].

The morphology of canal systems in maxillary molars fig.1 has been evaluated in many studies. In particular, the complexity of the mesiobuccal (MB) roots of the first and second maxillary molars, which was first noted by Hess and Zurcher [6], later became the focus of more detailed and repeated investigations after the publication of a study by Weine et al.[2] .

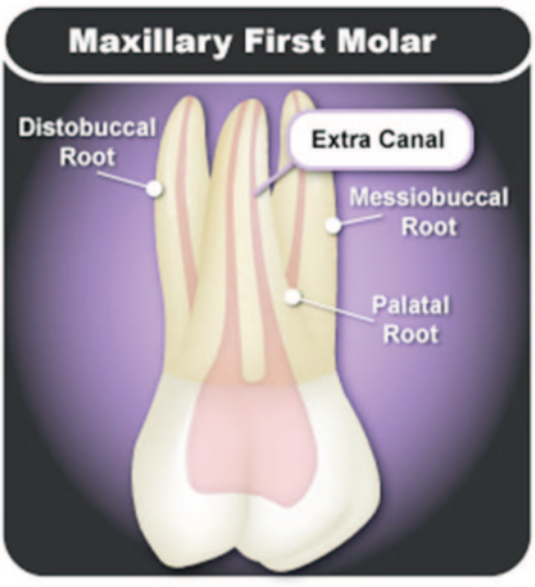

Fig.1 Morphology of maxillary 1st molar

These studies demonstrated that most maxillary first molars and a considerable percent of second molars have an additional MB root canal (MB2), which is also referred to as a mesiolingual canal or a mesiopalatal canal [7]. Since these studies, several more studies of the root canal anatomy of maxillary

molars have shown that the frequency of MB2s ranges from 10% to 95% [1, 3-5, 8, 9].

The prevalence of MB2s varies with the method used in the study i.e., the sectioning of extracted teeth, the injection of dye, the study of radiographs, the surgical techniques used, the use of light microscopy or scanning microscopy, microcomputed tomography, and whether the clinical study is retrospective or prospective [4,10,8].

A study by Pomeranz and Fishelberg [3] revealed a large discrepancy between clinical and laboratory results with regard to the incidence of MB2s. Although in vitro studies have also demonstrated that the incidence of MB2s is high, there is no consensus on the number of MB2s that are amenable to endodontic treatment [12, 16].

To categorize the root canal system in each root, Weine described four different configurations: type I (a single canal from the pulp chamber to the apex), type II (2 separate canals that leave the chamber but merge short of the apex to form a single canal), type III (2 separate canals that leave the chamber and exit the root in separate foramina), and type IV (1 canal that leaves the chamber but divides short of the apex into 2 separate and distinct canals with separate foramina). [2] Fig. 2

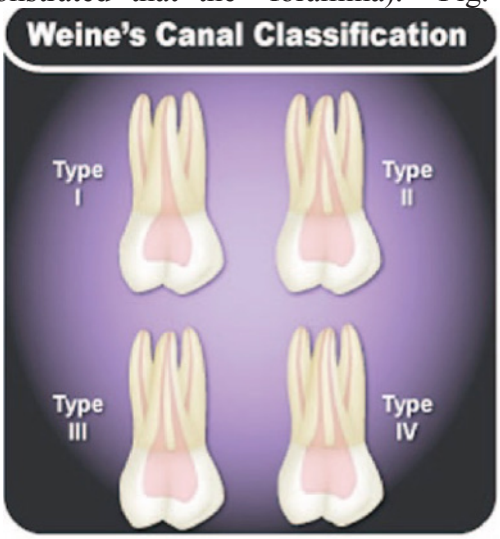

Fig .2 Weine canal classifications

Many authors have discussed different methods of locating extra canals like:

1. Additional off-angle radiographs (at least three radiographs at varying horizontal angles).
2. Use of computed tomography.
3. Use of magnification (loupes and dental operating microscopes).
4. Examining dentinal map minutely and useing DG 16 to explore the floorof the pulp chamber.
5. Looking for hemorrhagic spots (indicate the presence of extra canals).
6. Performing Champaign bubble test by flooding the pulp chamber with warm solution of 5% sodium hypochlorite, to visualize bubbles emanating from organic tissue indicating presence of canals.
7. Staining the pulp chamber with dye (e.g., 1% methylene blue).
8. Use of ultrasonic tips, special round burs, and thin tapering finishing burs to remove a small amount of tooth structure or calcification and trough the line angles of the pulp chamber will help.
9. Modifying the conventional outline form to include the extra canals.
10. Ensuring adequate straight-line access to improve visibility [8, 9, 10].

MATERIALS AND METHODS

A total of 200 extracted permanent maxillary first molar teeth of Iraqi patients (100 male and100 female) were collected from different health centers and private clinics.

After extraction, all teeth were sectioned at coronal orifice using A diamond disc mounted on straight hand-piece and under water coolant and then stored in 0.1% thymol solution at room temperature. The anatomic dark lines in the floor of the pulp chamber were examined with a DG16 endodontic explorer (Hu Freiday, Chicago, IL, USA) to identify the root canal orifice.

After locating the orifices, the teeth were placed in 0.5% sodium hypochlorite solution for 48 hours to dissolve debris and pulp remnants. All the specimens were then thoroughly washed in running water for 4 hours to clean the root canals of any debris.

Patency of each canal was established by passing a k-type file through the apical foramen and canal orifices, for calcified canal initial negotiation wad done using small stainless steel hand files, they are stiffer than equivalent size Nickel Titanium and can be

pushed through obstacles more easily. At first starting using loupes and magnifying glasses (x2.0 to x6.0) up to the operating microscope (x4.0 to x30.0) that aid in detection of number of root canals in mesiobuccal root, A Champaign bubble test was then carried out by flooding the pulp chamber with warm solution of 5% sodium hypochlorite, one could visualize bubbles emanating from organic tissue indicating presence of canals. We finally verified the number of canals radiographically using multiple straight and angled radiographs allows visualization of the presence of extra canals.

RESULTS

We collected a total of 200 maxillary first molars over 6 month's period. The results of the study showed that using magnifying glasses 42% of 2nd MB canals could be detected while 74% of canals could be detected using bubble tests and 59% of canals detected using radiographs (Table 1).

According to the results of the present study, there was no difference in the prevalence of 2nd MB canal in maxillary 1st molar between male and females.

Table 1 Percentage and number of root canals and apical foramina in the MB root of maxillary first molar using different method.

Method	*No. of teeth*	*Type I%*	*Type II%*	*Type III%*	*Calcified canal%*
magnifying glasses	200	58	19	23	0
bubble test	200	26	36	22	16
X-ray	200	41	22	19	18

MB, mesio-buccal.

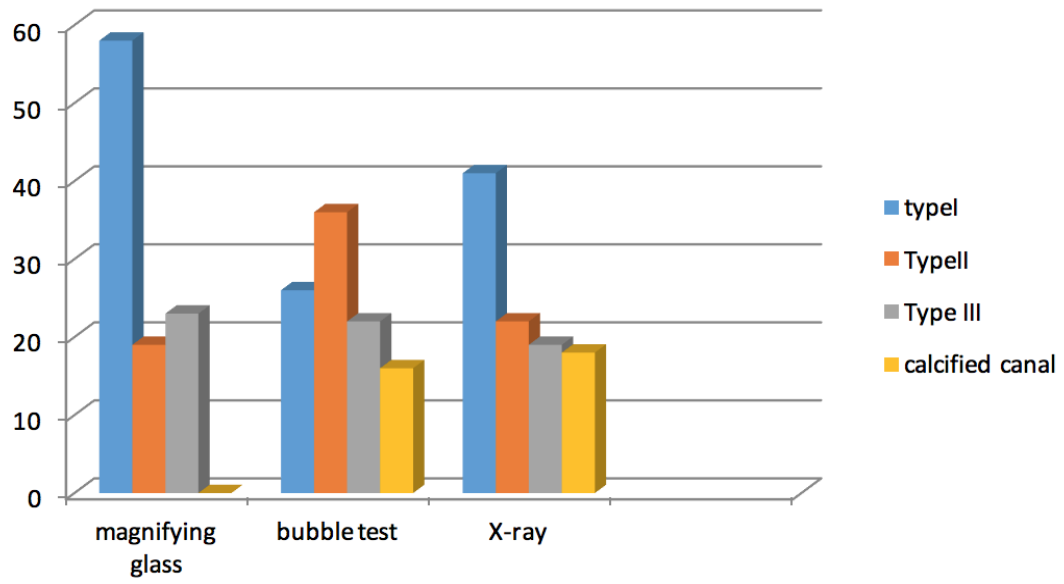

Fig.3 Bar chart for percentage and number of root canals and apicasl foramina in the MB root of maxillary first molar using different methods.

Table2 Association of gender with 2nd MB canal in maxillary 1st molar teeth

Gender	*No. of teeth*	*1*	*0*
Male	100	76	24
Female	100	72	28
Total	200	200	

1=presence of 2nd MB 0=absence of 2nd MB

DISCUSSION

The goal of this study was to report the percentage of the MB roots of maxillary first molars that contained at least two root canals. The results of this study showed a high prevalence of the MB2 canal in the MB root of maxillary first molars in Iraqi population.

This finding is in agreement with previous studies [11, 12, 16]. An examination of the floor of the pulp chamber offers clues to the type of canal configuration present. When there is only one canal, it is usually located rather easily in the center of the access preparation. If only one orifice is found and it is not in the center of the tooth, it is probable that another canal is present and the operator should search for it on the opposite side [13].

It is generally accepted that the maxillary first molar has three canals with an MB2 canal seen in 56.8%-80.9% of the cases similar findings were recorded in this study. The closer the orifices are to each other, the greater are the chances that the two canals join at some point within the body of the root [14, 15]. In this study magnifying lenses were used during the exploration of canal orifices, since magnification has been found to increase the detection rate of MB2 canals from 17.2% with the naked eye, to 62.5% with loupes and 71.1% using the surgical operating microscope [17] .

The use of radiograph to study the canal morphology might appear to have certain limitations, since it's a two dimensional image of a three dimensional object. However Weine[20] suggests that for the maxillary first molar, angulation from distal to mesial provides a profile type of view of the mesiobuccal root and greater possibility of detection of MB2 canal. In the present study more than 15% of the teeth presented with different amount of pulp chamber and/or calcified canals .

For easier access to canal openings a bubble test with sodium hypochlorite in the pulp chamber and chelating agents (EDTA) was occasionally used for removing the smear layer and softening calcifications. Ibarrola et al. [19] suggested the use of chelating agents and ultrasonic instrumentation to remove debris and anatomical irrigularities that interfere with negotiation of the MB and ML canals [18].

In this study different methods used for detection of 2nd canal in maxillary 1st molar but the bubble test showed the best results because it was found that When NaOCl is flooded into the access cavity, it dissociates into Na+ and Cl- ions and liberates free oxygen. A positive bubble reaction signifies that NaOCl is reacting with residual tissue within the instrumented or the missed canal or with the residual chelator present within the prepared canal.

There was no difference in the prevalence of 2nd MB canal in maxillary 1st molar between male and females in the present study and this was in agreement with Saad Al-Nazhan [12].

CONCLUSION

A thorough knowledge of the root canal anatomy, careful interpretation of the radiographs, proper modification of the conventional access cavity were the essentials for recognition and adequate treatment of these anatomical variations. Every tooth has to be treated as an exception and the pulp chamber explored for an additional canal.

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The Iraqi Method of Natural Liquorice as a Mouth Rinse and Its Effect in Patient with Chronic Periodontitis

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ABSTRACT

Background: Chronic periodontitis is an inflammatory disease that affects the supporting tissues of the teeth and it's a common chronic adult condition. Liquorice extract has been shown to effect the periodontium in decreasing its inflammation as a mouth wash.

Aim of the study: Comparative study the effect of liquorice as a mouth rinse in patient with chronic periodontitis.

Materials and Methods : In this study, 15 patients with chronic periodontists (study group) and 15 patient (control group) both received treatment in periodontal department of dentistry college by means of scaling and polishing, the study group in addition received the liquorice mouth rinse in order to study its effect and compare it with the control group. Plaque Index (PI) (sillness and loe 1964), Gingival Index (GI) (sillness and loe 1967) (1) were measured to assess the pattern of periodontal destruction for each patient.

Result and discussion: Liquorice mouth-rinse users demonstrated less amount of plaque (study group) than in the (control group), and less gingival inflammation in the study group than in the control group.

Conclusion: Liquorice extract as a mouth rinse has a an effect on the periodontal tissue health, by decreasing the amount of plaque and gingival inflammation without any side effect it can used for long time and as adjunct with scaling and polishing as treatment of periodontal disease.

CITE THIS ARTCLE

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INTRODUCTION

Periodontal diseases are bacterial infections of the gingiva, bone and attachment fibers that support the teeth and hold them in the jaw. The main cause of the diseases is bacterial plaque, a sticky, colorless microbial film that constantly forms on teeth (American Academy of Periodontology American Academy of Periodontology North Michigan Avenue Chicago, Illinois, (2004) [2].

Numerous epidemiological studies have reported a close association between the presence of bacterial plaque and periodontal disease which makes poor oral hygiene the primary etiologic agent in periodontal disease; [3]. Microbiological studies indicate that more than 500 distinct microbial species are found in dental plaque (1994) [4]. Non bacterial microorganisms that are found in plaque include mycoplasma species, yeasts, protozoa and virus (Newmann, M. G.; Takei, H. H.; Klokkevold. St Louis, Missouri: Saunders, Elsevier Inc. 2006. Vol. 33) [5].

Periodontitis is thought to account for 30–35% of all teeth extractions while caries and its sequelae for up to 50% [6].

Chronic periodontitis is generally a slowly progressing of periodontal disease that at any stage may undergo an exacerbation resulting in additional loss of attachment apparatus [6].

Effect of oil puling on plaque and gingivitis:

Dental caries and periodontal diseases can be effectively prevented and controlled by an effective plaque control method (-2006) [7].

The most wonderful part of oil puling is that it can be performed using any oil easily available at homes. Refined sunflower oil or any other cooking oil for that matter is a common house hold commodity in most of the Indian homes. hence the material for oil pulling is easily accessible to most of the Indian population right at their homes. This is a therapy that can be practiced right at home, without any expense and has a huge storehouse benefits [8].

Various oils like Refined Sunflower oil, Sesame oil, Olive oil etc can be used for Oil Pulling. Liquids from milk and water to extracts of Ghooseberries and mangoes have been used for oil pulling [9].

In the light of the present study it is concluded that Oil Pulling is having dental benefits and ii has resulted in a significant reduction in plaque and gingivitis scores. Hence it can he recommended as an Oral hygiene [10].

Herbal mouthwashes:

Recently, numerous studies have been conducted to verify the enormous wealth of medicinal plants. These herbal mouthwashes are gaining popularity as they contain naturally occurring ingredients called as Phytochemicals that achieve the desired antimicrobial and anti-inflammatory effects. Herbal formulations may be more appealing because they work without alcohol, artificial preservatives, flavors or colors [11].

Acacia catechu willd:

AC is used as mouthwash for mouth, gum and throat diseases like gingivitis, stomatitis.

The extracts of AC have been reported to have various pharmacological effects like antipyretic, anti-inflammatory, ant diarrhoeal, hypoglycemic, hepatoprotective, antioxidant and antimicrobial activities [12].

Alo Vera (AloeBarbadensis Miller):

Aloe vera, also known as the true or medicinal aloe, is a species of succulent plant in the genus. The species is frequently used in herbal medicine. Many scientific studies of the use of extracts of Aloevera have been undertaken (2000) [13].Aloe vera contains75 potentially active constituents: vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids and amino acid [14]. Aloe vera is found to possess good wound healing activity (Heggers J, kuckcelebi A, Listengarten D, StabenauJ, Ko F, Broemeling LD, etal, 1996) [15]**.** Aloe vera tooth gel demonstrated enhanced antibacterial effect against S. mitis (2009) [16].

Chamomile:

Throughout history, cultures around the world have made use of *chamomile's* medicinal benefits. With its anti-inflammatory and antibacterial properties, *chamomile* can help soothe inflammation from periodontitis and reduce the levels of Unhealthy bacteria in the mouth. *Chamomile* tea is taken to expose the gums to this herb, or mouthwashes and toothpastes that containing *chamomile* is a good remedy to overcome periodontal infections (1956) [17].

GlycyrrhizaGlabra(liquorice root) :

For centuries plants have been used throughout the world as drugs and remedies for various diseases.

Licorice (or liquorice) is a plant of ancient origin and steeped in history. It grows in subtropical climates inEurope, the Middle East, and Western Asia. Licorice extracts and its principle component, glycyrrhizin, have extensive use in foods, tobacco products, and snuff, and in traditional and herbal medicine. Licoriceor Liquorice (*Glycyrrhizaglabra*), is a perennial herb which possesses sweet taste [18].

Liquorice has extensive pharmacological effects for human being. The most common medical use liquorice is for treating upper respiratory ailments including coughs, hoarseness, sore throat and bronchitis [19]. Dried licorice root and herb sometimes used to treat sore throats, respiratory and digestive problems and other disorders—might be an effective agent to fight the bacteria that cause tooth decay and periodontal disease, according to a recent study two compounds found in dried licorice root are effective antibacterial substances that can prevent the growth several major bacteria connected with cavities and gum diseases. licoricidin and licorisoflavan A inhibited two of the major bacteria responsible for dental cavities and two of the bacteria that promote gum disease and licoricidin also inhibited a third gum disease bacterium [20]. Licorice root is often used in Chinese traditional medicine and alternative medicine as an additive that enhances the activity of other herbal ingredients. Outside the U.S., it is also being studied for use as an alternative therapy for Hepatitis C patients. Licorice root is also used as a breath freshening ingredient in some natural tooth pastes the licorice-flavored candies that consumers buy at the store, however, don't contain licorice root. These treats contain anise oil, which has a similar taste.

Licorice root should be used with caution after consulting with a health care professional, since it can have serious side effects and negative interactions with prescription medications [21]. Health hazard of Glycyrrhizic acid present in liquorice were evaluated by some researchers [22].

Antibacterial Activities of Phenethyl Isothiocyanate and Its Derivatives against Human Oral Pathogens:

Major oral health problems include dental caries periodontal diseases, gingival is inflammation and tooth loss [23]. These problems are caused by oral microorganisms. A sugar-rich diet together with smoking may cause increasing oral bacterial diseases [24]. The effective control of maiororai pathogens such as *Actinomyces*, *Actinobacilhis, Bacteroides, Streptococcus.* and *Porphvromonas* species that cause dental caries and periodontal diseases is thuse an important issue in Korean society [25], Although numerous chemicals and antibiotics have been widely used for the purposes of prevention and disease therapy against oral bacterial diseases, their excessive use can cause an increases in resistance in the target pathogens and serious side effects such as the development of bacterial vomiting, diarrhea and tolerance, teeth strain [26]. Studies designed to identify solutions to antibiotics resistance and undesirable side effects have often focused on novel agents against oral pathogens from diverse sources including edible plant extracts and the essential oils of herbal plant [27]

MATERIALS AND METHODS

This study was carried out during the period from the end of October 2014 till the end of March 2015.

Human sample:

Subjects included in the study were drawn from patients attending the Department of Periodontics in

the Collage of Dentistry, University of Baghdad. The study population included thirty subjects with chronic periodontitis with no history of any systemic diseases, the sample included both males and females having in consideration no pregnancy or any hormonal changes that may effect the later in our study. fifteen received liquorice mouth rinse (study group) and and the other fifteen were control group after scaling and polishing for all of them they were followed by two visit the interval between them is one week.

Design of the study:

All the individuals were informed the purposes of the investigation and consented to its protocol. The sample was divided into two groups:

1. (Chronic periodontitis / liquorice mouth rinse users (study group) (group 1) : fifteen patients with chronic periodontitis were assesed to examine there (Plaque Index (PI) (sillness and loe 1964) ,Gingival Index (GI) (sillness and loe 1967)) (1). And following scaling in the first visit they received the mouth rinse to use it two times daily and followed by a second visit one week later to asses their PI and GI again.
2. (Chronic periodontitis /control group) (group 2): fifteen patients with chronic periodontitis were assesed to examine there (Plaque Index (PI) (sillness and loe 1964), Gingival Index (GI) (sillness and loe 1967)) (1). After first visit of scaling the patients were followed by a second visit to asses the same measurement above.

Materials and instruments:

Instruments:

- Plane mouth-dental mirrors No.4.
- Marquis colour coded probe.
- Cotton, gloves, and masks.

Methods:

Clinical examination:

Oral examination was performed by the same examiner. The collected data include: -

Assessment of Plaque Index (PLI):

The four surfaces of each tooth except 3rd molar were examined and scored according to plaque index system (Silness&Loe, 1964) (1).This index was recorded after salivary sample collection.

The criteria for plaque index:

0: No plaque.

1: A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may be recognized only by running a probe across the tooth surface.

2: Moderate accumulation of soft deposits within the gingival pocket, on the gingival margin and/ or adjacent tooth surface, which can be seen by the naked eye.

3: Abundance of soft matter within the gingival pocket and/or on the tooth and the gingival margin.

Assessment of Gingival Index (GI):

The Gingival Index (Loe and Silness, 1967) (1) was created for the assessment of the gingival condition and records qualitative changes in the gingiva. It scores the marginal and inter proximal tissues separately on the basis of 0 to 3. The criteria are:

0= Normal gingiva;

1= Mild inflammation – slight change in color and slight edema but no bleeding on probing;

2= Moderate inflammation – redness, edema and glazing, bleeding on probing;

3= Severe inflammation – marked redness and edema, ulceration with tendency to spontaneous bleeding. The bleeding is assessed by probing gently along the wall of soft tissue of the gingival sulcus. The GI of the individual can be obtained by adding the values of the GI for each site on the tooth surface and dividing by the number of sites to be examined examined.

Liqourice mouth rinse preparation. After Through Washing of It, The Iraqi method in preparing the liqourice mouth rinse (ercksos) involve the disolvement of 5 g in 500 ml for 24 hours as shown the picture above. Then we Fulled it in a Clean water bottle of 330 ml.

So the concentration of (ercksos) is 10 % Ready To Be Used Twice Daily.

Statistical Analysis:

The data were processed and analyzed using the statistics package for social sciences (excel 2013). Both descriptive and inferential statistics were used.

1. Descriptive statistics

a. Statistical tables.

b. Mean

c. Standard deviation (SD).

2. Inferential statistics

Student (t-test).

RESULTS

Periodontal health results (clinical results).

Plaque index (PLI):-

The descriptive statistics for plaque index were described in Table (3-1), it was clearly shown that the means of plaque index were decreased in **(periodontitis/liquorice mouth rinse users) (study group)** = 1.15 as compared with **(periodontitis/ control group)** = 1.23.

Table 1: Descriptive statistics of plaque index in Group I and Group II periodontitis group.

Control group	*Study group*	*Characteristics*
1.23 ± 0.713988	1.15 ± 0.37295	Plaque Index

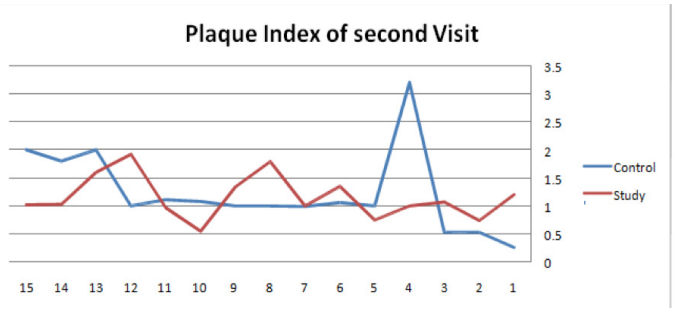

Figure 1: The relationship between plaque index in study group and control group patients (second visit only)

Table 2: Inter group Comparison of means of plaque index of study group and control group by using t-test

Plaque Index			
Sig	p-value	t-test	Group
NS	0.7071	-0.380	Group I – Group II

NS = No significant Inter group comparison for plaque index showed that there was a no significant difference between *Group I and Group II* where the p-value was 0.7.

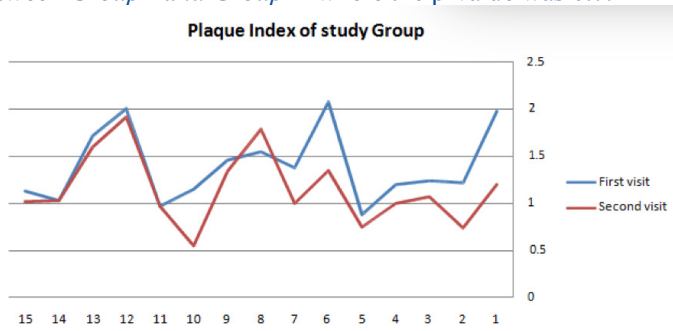

Figure 2: The relationship between plaque index in the first visit as compared with the second visit in study group .

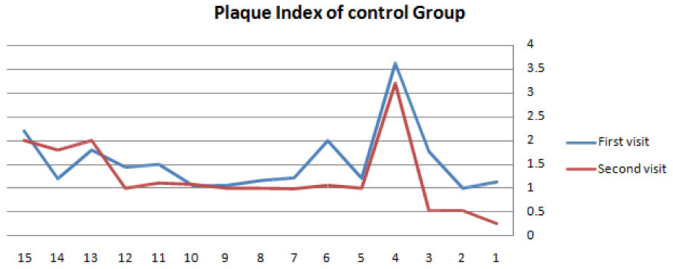

Figure 3: The relationship between plaque index in the first visit as compared with the second visit in the control group.

Gingival Index (GII):

The descriptive statistics for gingival index were described in the Table (3-4), it was clearly shown that the means of Gingival index were decreased in **(periodontitis/ liquorice mouth rinse users) (study group)** = 1.02 as compared with **(periodontitis/ control group)** = 1.1.

Table 3: Descriptive statistics of gingival index in Group I and Group II periodontitis groups

Characteristics	*Study group*	*Control*
Gingival Index	1.02 ± 0.130905	1.17 ± 0.7740

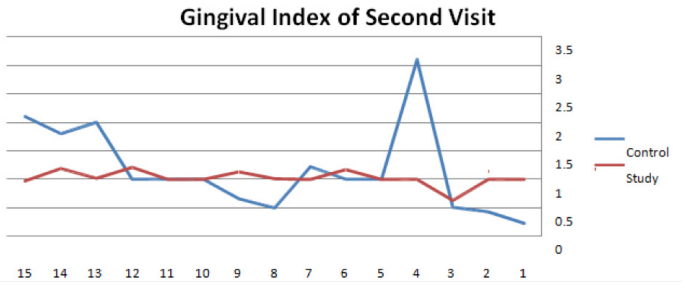

Figure 4: The relationship between gingival index in the first visit as compared with the second visit in the study group.

Table 4: Inter group Comparison of means of Gingival index of study group and control group by using t-test.

Gingival Index			
Sig	*p-value*	*t-test*	*Group*
HS	0.477	-0.729	Group I –Group II

NS= no significant

Inter group comparison for gingival index showed that there was a no *significant difference between* ***study group–control group*** *where the p-value was* 0.4.

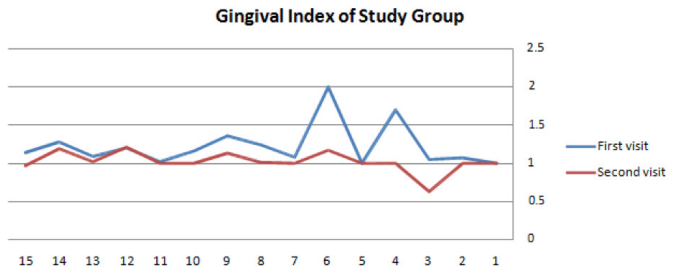

Figure 5: The relationship between gingival index in the first visit as compared with the second visit in the study group.

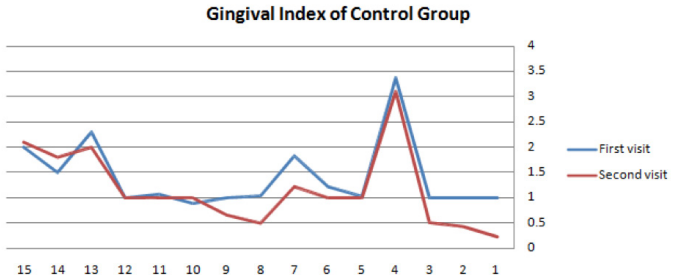

Figure 6: The relationship between gingival index in the first visit as compared with the second visit in the control group .

DISCUSSION

Considering the short time and the small human sample and the uncooperativeness from the patient part the noticeable reduction effect of plaque and gingival index in our study was of little significant as compared with the control group, so we suggest

a longer time and larger group for this study to be carried out. But it appear good result in gingival health and that agree with Zhu.j(2006).Though we should mention that in spite of the little reduction, liquorice mouth rinse is a safer and natural substitute to the Chlorhexidine when regarding the side effect, the taste and the safety.

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The Effect of Sulcular Injection of Fucose in The Treatment of Gingivitis. An Experimental Study On Rabbits

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ABSTRACT

Background: α-L- Fucose is one of the eight essential monosaccharides, which is a common component of many nitrogen and oxgyen linked glycans of glycoproteins and glycolipids produced by mammalian cells. The objective of this study is to evaluate the histopathological effect of local injection of 50µl of 150mM fucose into rabbits with gingivitis.

Materials and Methods: The existing study was carried out on 60 male rabbits. From the total number 5 rabbits with healthy gingiva had been taken and scarified , while an experimental gingivitis had been induced to the rest 55 rabbits and were divided randomly into 3 main groups ; first group consisted of 5 rabbits with gingival inflammation only and were not received any local injection and considered as a base line gingivitis non injected group ; second group consisted of 25 rabbits with gingival inflammation and were injected with 50 µl of normal saline into the bottom of gingival sulcus of mid-labial area of lower right central incisor and considered as gingivitis saline injected group ; third group consisted of 25 rabbits with gingival inflammation and were injected in the same area with 50µl of 150mM fucose solution and considered as gingivitis fucose injected group. Then periodontal tissue biopsy was collected from both saline and fucose injected subgroups at different time intervals of 1, 3 ,7 ,14, and 21 days after injection , from gingivitis non injected group, and from rabbits without gingival inflammation .

Results : The results showed that fucose injection resulted in rapid reepithelization , reduction of inflammatory reaction , and fibrous tissue regeneration in short duration of time after injection.

Conclusion: α-L- Fucose can be used as anti-inflammatory agent in the treatment of gingivitis (gingivitis induced by plaque).

KEY WORDS

α-L- Fucose, experimental gingivitis, periodontal biopsy, sulcular injection.

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تأ ثير حقن جيب اللثة بأ لفيوكوز في علاج ألتهاب اللثة
دراسه تجريبية على ألارانب

المستخلص

صممت الدراسه الحاليه لتقييم تاثيرالامراض النسيجيه للحقن الجيبى لجرعه واحده من الفيوكوز على علاج أمراض ألتهاب اللثة . أجريت الدراسه النسيجيه ألمرضيه على 60 أرنبا ذكرا , تم أخذ 5 من ألارانب مع اللثه ألمعاقاه ومن ثم تم أجرى ألتهاب اللثة المستحث بواسطة الصفيحه الجرثوميه لبا قي العدد المكون من 55 أرنبا والتى تم تقسيمها الى ثلاثة مجاميع رئيسيه وهي : مجموعه ألتهاب اللثة ألغير محقنه التى تتكون من 5 ارانب ومجموعة الحقن بالفيوكوز والتى تتكون من 25 ارنبا ومجموعة الحقن بالسلاين والتى تتكون من 25 ارنبا وتم تقسيم كل من مجموعة الحقن بالفيوكوز والمجموعة المحقنه بالسلا ين الى خمسة مجاميع فرعيه. تم زرق مجاميع ا لفيوكوز الفرعيه موضعيا بجرعه واحده من محلول الفيوكوز المذاب في السلاين بحجم 50مايكرو ليتر/كغم وزن الارنب وتركيز 150ملي مولاري في منتصف الجهه الاماميه لقعر جيب اللثه للسن القاطع السفلي الايمن بينما مجاميع حقن السلاين الفرعيه تم زرقها ب (50 مايكرو ليتر/كغم) من محلول السلاين)9.0 % كلوريد الصوديوم (تم اخذت عينات الانسجة بعد 1,3, 7,14,21 يوما من الحقن وأيضا اخذت عينات الانسجة بعد 10 أيام لمجموعه ألتهاب اللثة ألغير محقنه.

أظهرت النتائج النسيجيه المرضيه الخاصه بانسجه التهاب اللثه أنخفاض تدريجي في التفاعلات الالتهابيه وتعافي النسيج الرابط المتضرر للثه بعد زرق جيب اللثة بالفيوكوز وكذلك سرعة اعادة تكون الخلايا المرتبطة بجذور ألأسسنان في وقت قصير و سرعة اعادة التجديد في النسيج الرابط متمثله بكثره الخلايا الليفيه وكثرة تكون اليا ف الكولاجين مع تكون شعيرات دمويه جديده مقارنه بمجموعه حقن السلاين والتي لم يكن لديها اى تأثير على علاج التهاب اللثه .

من نتائج هذه الدراسه يمكن ان نلخص بان حقن جيب اللثه بالفيوكوز يمكن استخدامه كمادة مضا دة للالتهاب لعلاج امراض اللثه الناجمه عن الصفيحه الجرثوميه)المرض اللثوى المستحث بواسطة الصفيحه الجرثوميه,(وهذه تعتبر خطوة أولى فى الدراسه لتوضيح التأثير النافع للفيوكوز فى علاج ألتهاب انسجه اللثه بواسطة الصفيحه الجرثوميه .

INTRODUCTION

Periodontal disease is an infectious disease that affects the periodontium, it refers to two associated dental health problems, gingivitis and periodontitis [(1)].Gingivitis is a reversibly inflammatory reaction confined to the gingiva as a reaction to dental plaque biofilm, and it is characterized by an initial increase in blood flow, enhances vascular permeability , influx of inflammatory cell from the peripheral blood into the connective tissue, and the clinical soft tissue alteration during the state of gingivitis, this alteration includes redness, edema, bleeding and tenderness[(2)],while periodontitis is a destructive form of periodontal disease, it is an irreversible inflammatory state of the supporting structure[(3)].α-L-Fucose is a methyl pentose sugar similar to L-galactose except for the loss of alcohol group on carbon number six (C_6), with a general formula $C_6H_{12}O_5$ and a molecular weight of 164.16 g / mol [(4)]. Fucose is naturally found in D- and L-forms.The L-form is the only common form of the sugar , while the D-form is a synthetic galactose analogue [(5)],The L-form is found in mammalian tissues and fluids, while D- form is identified in plants.Purified L-Fucose is white powder and it melts at 153-155ċ [(6)],and L-fucose exist in two different forms α-L-fucose (29.5%)and ß-L-fucose (70.5%) [(7)] .

Studies showed the importance of serum, saliva and

gingival fluid fucose and its related parameters in the detection of oral disease, such as; gingivitis, periodontitis and oral cancers [8,9,10,11,12]. It was histologically showed, that fucose local injection into rabbit tongue muscle caused a reduction in the inflammatory process, 168 hours after injection, accompanied by regeneration in both oral mucosa and muscele layer[13]. Another study reported that sulcular injection of α-L-Fucose into healthy gingival tissue had no local side effect on the injected tissue and could be used as a suitable method for administration in treatment of gingival disease induced by mechanical trauma (non-plaque induced gingival disease) [14].

METHODS

This study was conducted from 10 th June 2013 to 10th December 2014. in Hawler Medical University, College of Dentistry, Department of Basic Science, and Clinical Biochemistry Laboratory, Baghdad University, College of Dentistry, Department of oral Diagnosis and Histology Laboratory. The study was carried out on (60) male rabbits of the same species and nearly the same age (10-12 months), with a weight range of (1-1.5 kg). These rabbits were allowed to acclimate at least 7 days prior to the experiment in well arrayed room to ensure the same type of food to be taken by these rabbits and the same condition of temperature (25-30 ˚c). From the total number, 5 rabbits had been chosen randomly and were sacrificed immediately (the rabbits were free from gingival inflammation and not receive any local injection) , while the rest 55 rabbits had gingival inflammation (gingivitis) and this was obtained by ; first the rabbits were weight , anesthetized with subcutaneous injection of xylazin (4 mg / kg) and ketamine (40mg/ kg) at the posterior part of the neck as a general anesthesia to facilitate handling of the animals cited by[15,16] ,then a notch (concavity area) was made in the cervical area at the mid- labial aspect of lower right central incisor adjacent to the gingival margin with # 8 round bur ,that attached to the portable hand piece .

The notch extended into the dentin and carried slightly adjacent to subgingival area (figure 1) modified of [17], after that the rabbits had been left for 10 days , during this period the notch area became site for subsequent plaque formation , and gingival inflammation (gingivitis) (figure 2) , which had been characterized by presence of clinical signs of inflammation ; as swelling , redness, loss of contour and bleeding of gingiva by probing. Finally the rabbits with gingivitis were divided randomly into three main groups:-

a. Gingivitis non injected group (G group) , consisted of 5 rabbits with gingival inflammation only and were not received any sulcular injection , periodontal tissue samples were collected immediately after 10 days of placing notch area and induction of gingival inflammation.

b. Gingivitis saline injected group (GSI group) , consisted of 25 rabbits. These 25 rabbits were divided randomly into 5 subgroups; GSI1, GSI2, GSI3, GSI4, and GSI5. Each subgroup consisted of 5 rabbits, these subgroups were received sulcular injection into the mid-labial area of the bottom of gingival sulcus of the lower right central incisor with a single dose of normal saline of 50 µl/ kg rabbit weight of normal saline solution (0.9%NaCl), then periodontal tissue samples were taken at different time intervals of 1day(GSI1) , 3day(GSI2), 7days (GSI3), 14 days (GSI4) ,and 21 days (GSI5) after normal saline injection. Then periodontal tissue samples were prepared for histopathological studies.

c. Gingivitis fucose injected group(GFI group), consisted of 25 rabbits and were divided randomly into 5 subgroups; GFI 1, GFI 2, GFI 3, GFI 4, and GFI 5 subgroups . Each subgroup consisted of 5 rabbits that received sulcular injection of a single dose of 50µl / kg rabbit weight of 150 mM of fucose dissolved in normal saline into the same area as in gingivitis saline injected subgroups, then these subgroups were sacrificed at the same time intervals of 1day (FGI1) , 3 days (FGI2) , 7days (FGI3) ,14days (FGI4) ,and 21 days (FGI5) after fucose injection respectively. Periodontal tissue samples were sent for histopathological studies.

1.Fucose solution preparation.

1.2312 g of α- L-fucose was dissolved in normal saline (0.9% Na Cl), and completed into 50ml by normal saline (150mM fucose) [14] .

1.2312 g of of α- L-fucose was obtained from the following equation:

weight of fucose(g)= mollarity (mol/L) × molecular weight ×volume1(ml)/l000

= 0.15(mol/L) ×164 .16 ×501000/

2-Sulcular injection technique and administration of L-fucose.

In this technique the needle was inserted from the gingival margin into thesulcular tissue at the bottom of the gingival sulcus18, In sulcular injection, the needle was inserted from the gingival margin approximately 5mm (The needle was painted at the level of 5mm distance from the tip and then stoper was placed over the painted area) into the sulcular tissue at the bottom of the gingival sulcus of the lower right central incisor, the solution was injected slowly and carefully throughout ten seconds[14].

2- Periodontal tissue sampling.

The head was separated from the rest of body, then the mandible was separated from the skull, muscles and the soft tissue covering the mandible were removed using a surgical

blade, then the lower right anterior region of the lower right jaw was excised and cut off with saw and preserved in formalin 10%, finally it was used for histopathological study (16,19) .

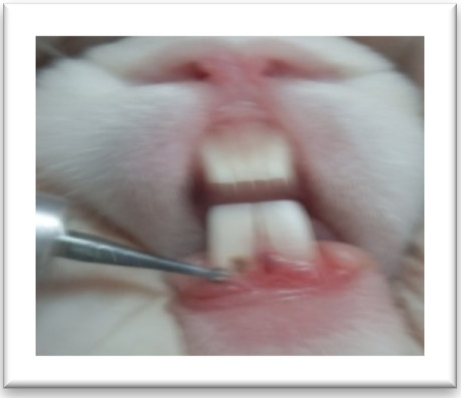

Figure1:Method of making notch incisor

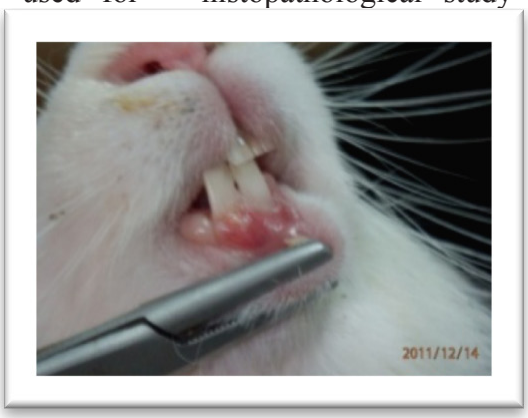

Figure 2:Ginigivitis in lower right central

3-Histopathological examination.

The histological sections analyzed at different magnification of (X100, X200, X400,and X600) under a digital biological light microscope. In comparison with gingivitis non injected group , the changes in gingival tissue of gingivitis fucose and gingivitis saline injected subgroups were recorded.

4-Histometric measurements.

The thickness of oral epithelia was measured from the crest of marginal gingiva, for each section by the use of calibrated eye piece micrometer[19] .

5-Evaluation of inflammation.

It was performed in accordance with the method proposed by a study [20].

The severity of inflammatory reaction was obtained by calculating the number of inflammatory cells within magnification power of x400 for control group, saline and fucose gingivitis injected subgroups according to the following scores:

1- Score 0, none or few inflammatory cells, from 0 to less than 5, no inflammatory reaction.

2- Score 1, the numbers of inflammatory cells are from 5 to less than 25, mild inflammatory reaction.

3- Score 2, the numbers of inflammatory cells are from 25 to less than 125 cells, moderate inflammatory reaction.

4- Score 3, the numbers of inflammatory cells are more or equal to 125 cells, sever inflammatory reaction

Statistical analysis

All data were expressed using descriptive statistic as mean ± standard deviation SD , and inferential statistics which include Paired T -test , statistical analysis were carried out by using statistical software (SPSS version 22),the results were considered significant if P value ≤0.05.

RESULTS

1-Histopathological results

Figure (1) shows the parakeratinized oral epithelial of normal rabbits without gingival inflammation with its normal oral epithelia thickness and presence of finger like projection of epithelia rete peges .The subepithelial connective tissue region showed well arranged bundles of collagen fibers , fibroblast cells , and few inflammatory cells infiltrated the area , and with well attachment of junctional epithelia into the root surface. Figure (2) shows the parakeratinized oral epithelial of rabbits with gingivitis non-injected group (G), which consisted of stratified squamous epithelia with its typical basal, spinosum, granulosum and cornium layers, the thickness of the oral epithelium is slightly increase with presence of vacuoles in the prickle cells layers and the epithelial rete peges are flatten in most of the region but remain pointed in other region, the lamina propria showed moderate inflammatory cells infiltration especially in the lower and sulcular part , destructed collagen fibers , and destructed blood vessels (sever hemorrhage). Then after 1day of fucose solution injection into rabbits with gingivitis figure(3) shows slight reduction in the oral epithelial thickness with remaining of vacuoles in some area of prickle cell layers , slightly appearance of epithelia rete pege in some areas of oral epithelia , deepening of gingival sulcus, and new attachment of junctional epithelia into the root tooth surface. The lamina propria below oral and sulcular epithelia still showed moderate inflammatory reaction , well arranged collagen fibers ,and beginning of new capillaries formation. The fibrous tissue appear especially in the sulcular part of lamina propria (more fibroblast cells with its more well formed collagen fibers formation) , while after 3 days of fucose injection figure (4) shows that the parakeratinized oral epithelia revealed more reduction in oral epithelia thickness ,

disappearance of the vacuole in the epithelial layers, presence of slightly widely epithelia rete peges, and great reduction in the depth of gingival sulcus. The lamina propria below oral and sulcular epithelia showed reduction in the inflammatory reaction (mild inflammatory reaction),more well arranged collagen fibers formation, more fibroblast cells, and more new blood vessels formation.Then after 7 days of fucose injection, the oral epithelia still parakeratinized and showed normal thickness with finger like projection of epithelia rete peges and the lamina propria below oral epithelia showed well fibrous tissue formation with no inflammatory reaction (few inflammatory cells infiltration) and in the sulcular part , more well arranged fibrous tissue can be seen (more fibroblast cells and more well collagen fibers formation) with no inflammatory cells infiltration figure (5), and after 14 and 21 days of fucose injection, the lamina propria below oral and sulcular epithelia appear normal (no inflammatory reaction with well formed fibrous tissue regeneration) as shown in figure (6). While 1 day after sulcular injection of saline; the parakeratinized oral epithelia showed an increase in oral epithelia thickness with tearing of base of gingival sulcus, and moderate inflammatory reaction in the lamina propria. This increase in oral epithelia thickness and moderate inflammatory reaction still present continued after 3,7,14,and 21 days from saline injection as shown in figure 7,8and 9.

2- Histometric measurments results:-

a- Thickness of oral epithelia.

Table (1), shows that the mean value thickness of oral epithelia in normal rabbits without gingival inflammation was (120 ± 2.98) and was increased with gingival inflammation in gingivitis non- injected group into (199.84.02±),then after fucose solution injection into rabbits with gingivitis, the mean value thickness of oral epithelia decreased significantly after1 day of fucose injection (191± 2.64) , and continued to decrease with significant differences with gingivitis non- injected group after different time intervals of 3,7,14,and 21 after fucose injection (170±2.73) ,(122.8± 2.13), (121.2±0.83), and (121.4 ±0.54) respectively .

Table (2) shows the mean value thickness of oral epithelia in gingivitis non- injected group was (199.84.02±), and after saline injection into rabbits with gingivitis , the results showed that the mean value thickness of oral epithelia was still increased with no significant difference with the gingivitis non injected group after different time intervals of 1,3,7,14, and 21 days after saline injection (198.6± 4.61), (198.6 ±2.38) ,(197.2 ± 4.21) ,(197.6 ± 1.30), and (196.2 ± 1.16) respectively.

b- Evaluation of inflammatory reaction:-

Table (3), shows that the inflammatory reaction was moderate (score 2) in rabbits with gingivitis-non injected group, and after 1 day of fucose solution injection the inflammatory reaction remain moderate , then reduced to mild inflammatory reaction (score 1) after 3 days of injection, and finally no inflammatory reaction (score 0) was observed after 7, 14, and 21 days of fucose injection. While after sulcular injection of saline into rabbits with gingivitis ,the inflammatory reaction remain moderate (score 2) after 1,3,7,14,and 21 days of saline injection .

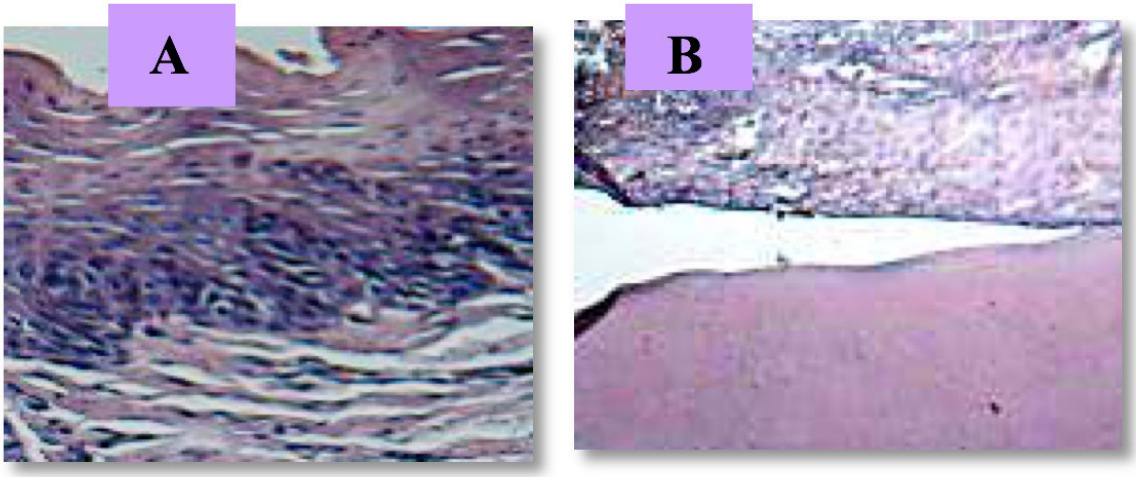

Figure1: Normal rabbit with healthy gingiva shows A- parakeratenized oral epithelia and underlying connective tissue with well arranged collagen fibers and no inflammatory reaction B- gingival sulcus with attachment of junctional epithelia into the root tooth surface(X200A,X100B).

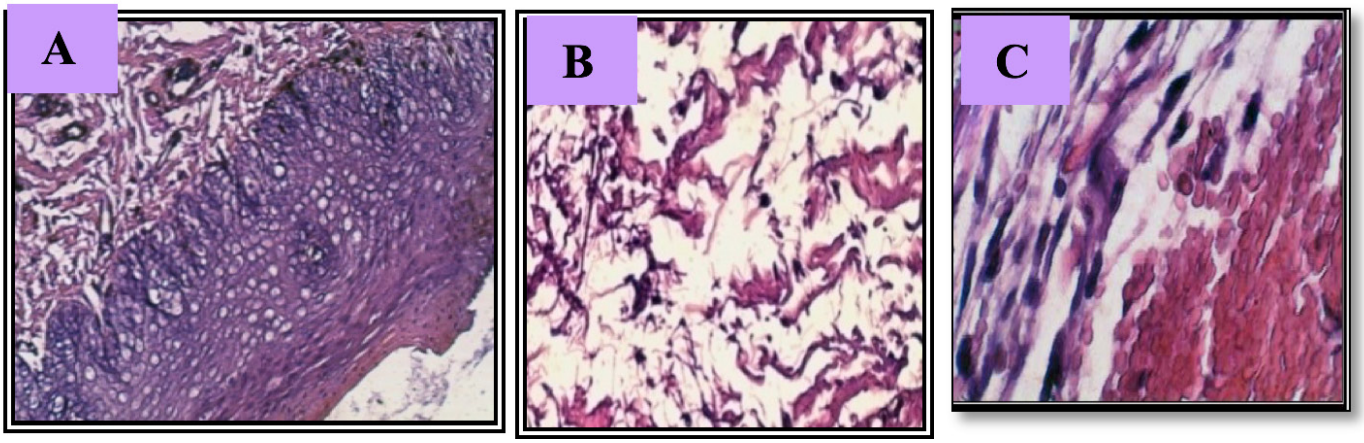

Figure2:Rabbit with gingivitis shows A- parakeratenized oral epithelia and connective tissue B-moderate inflammatory reaction in lower part of connective tissue C- moderate inflammatory reaction with destructed collagen fibers and blood vessels in sulcular area (X200A,X200B,X600C).

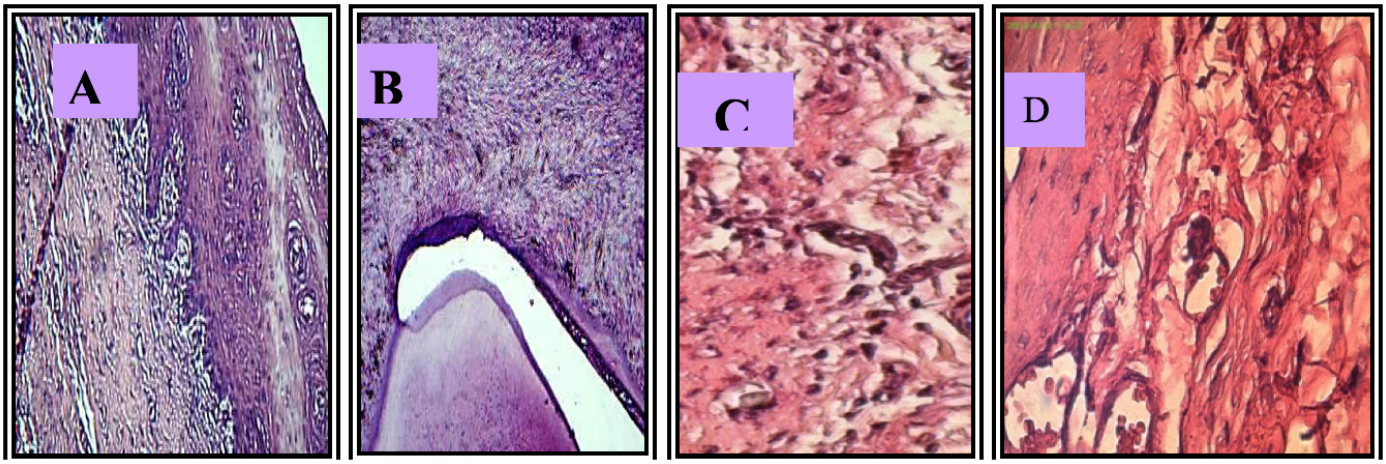

Figure3: Rabbits with gingivitis , 1 day after sulcular injection of fucose shows A-oral epithelia and connective tissue B-deepening of sulcus and new attachment of junctional epthelia to the root surface C-moderate inflammatory reaction in connective tissue D-sulcular area with well arranged collagen fibers and new blood vessels formation (X100A,X100B,X200 C, X600 D)

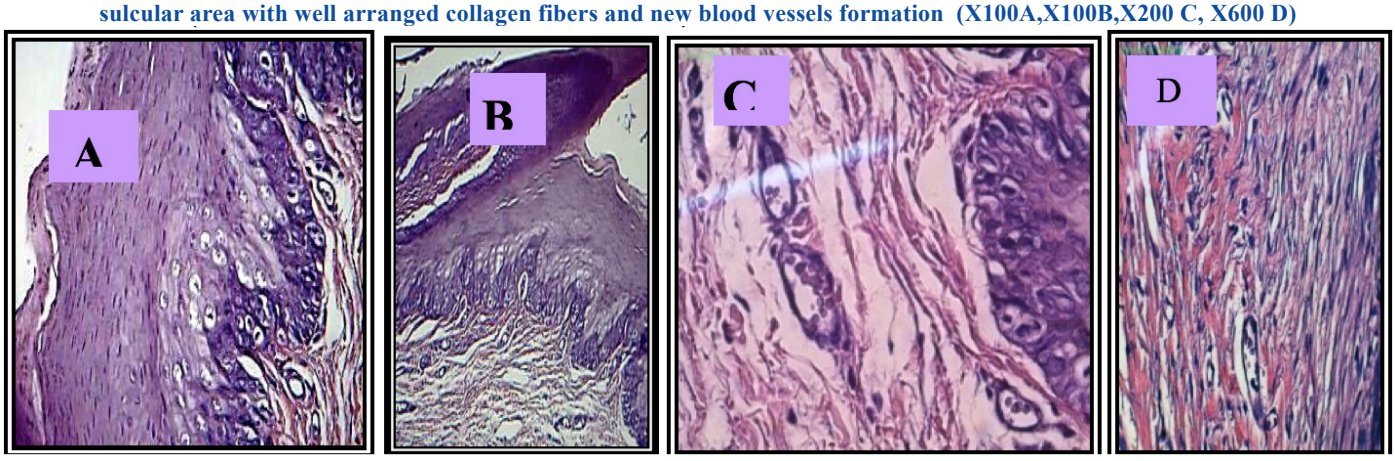

Figure 4: Rabbits with gingivitis , 3 days after sulcular injection of fucose show A- par keratinized oral epithelia and epithelia rete pege with prominent basal cell layer B- reduction in depth of gingival sulcus C- connective tissue with mild inflammatory reaction, well arranged collagen fibers and new blood vessels formation D- sulcular area with well arrangement of fibrous tissue (X200A,X100B,600C,X400 D).

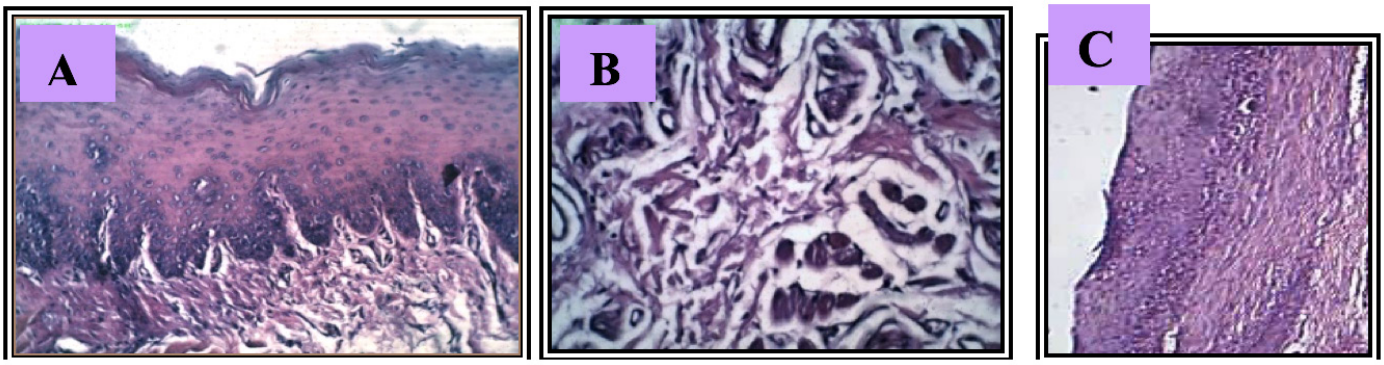

Figure 5: Rabbits after 7 day of sulcular injection of fucose show A-oral epithelia and finger like projection of epithelia retepeges B- connective tissue with no inflammatory reaction and well organized fibrous tissue C- sulcular epithelia and underlying well organized fibrous tissue(X200A,X400B,X200 C).

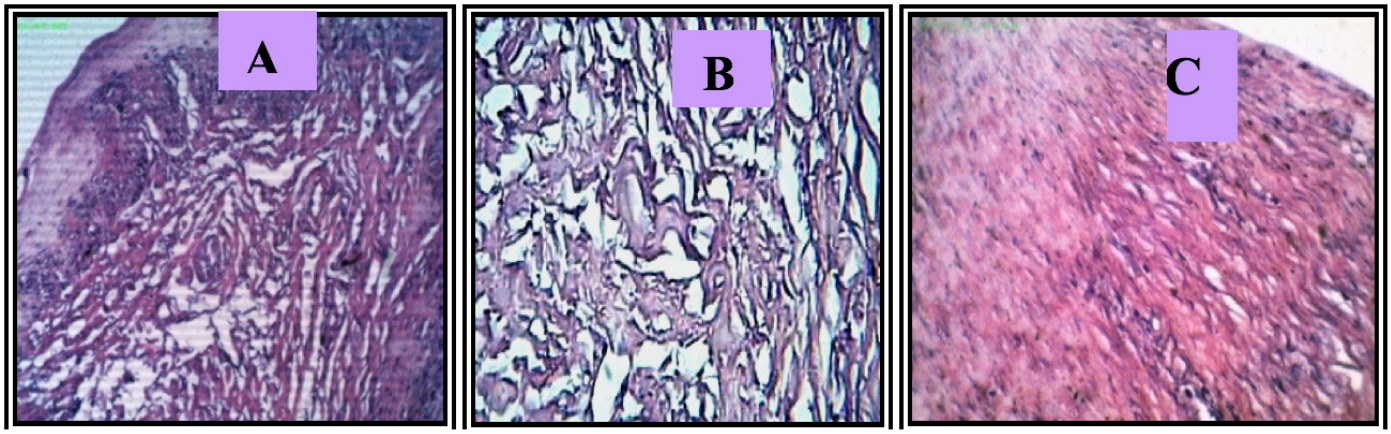

Figure 6: Rabbits after 14 day of sulcular injection of fucose show A- oral epithelia and underlying lamina propria B- lamina propria with no inflammatory reaction and more well organized fibrous tissue C- sulcular area with its well organized collagen fibers and fibroblast cells(X200A,X400B,X400 C).

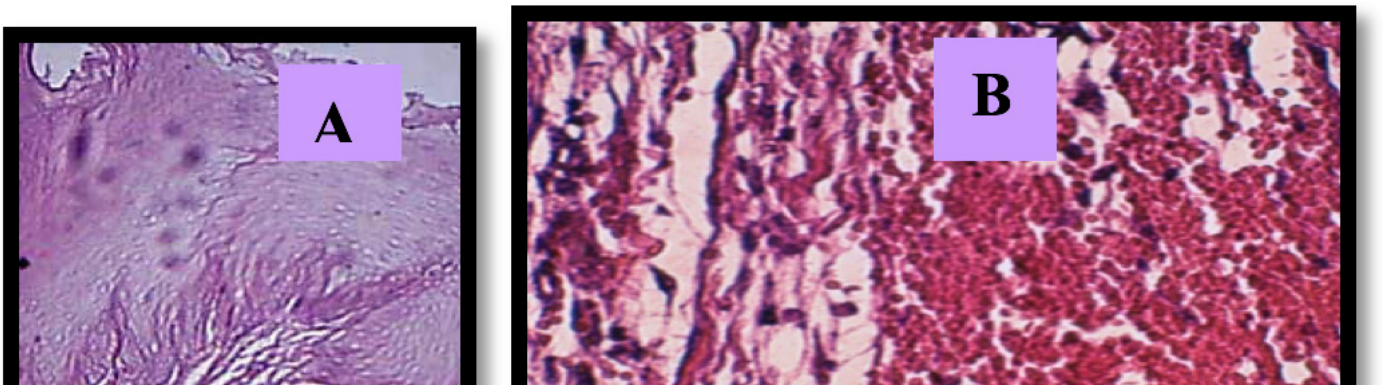

Figure 7: Rabbits with gingivitis ,1 day after sulcular injection of saline shows A-increase thickness of oral epithelia B- tearing of base of gingival sulcus C-lamina propria with moderate inflammatory cells infiltration, edema, and sever hemorrhage(destructed blood vessels) H&E(X200A,X100B,X400C).

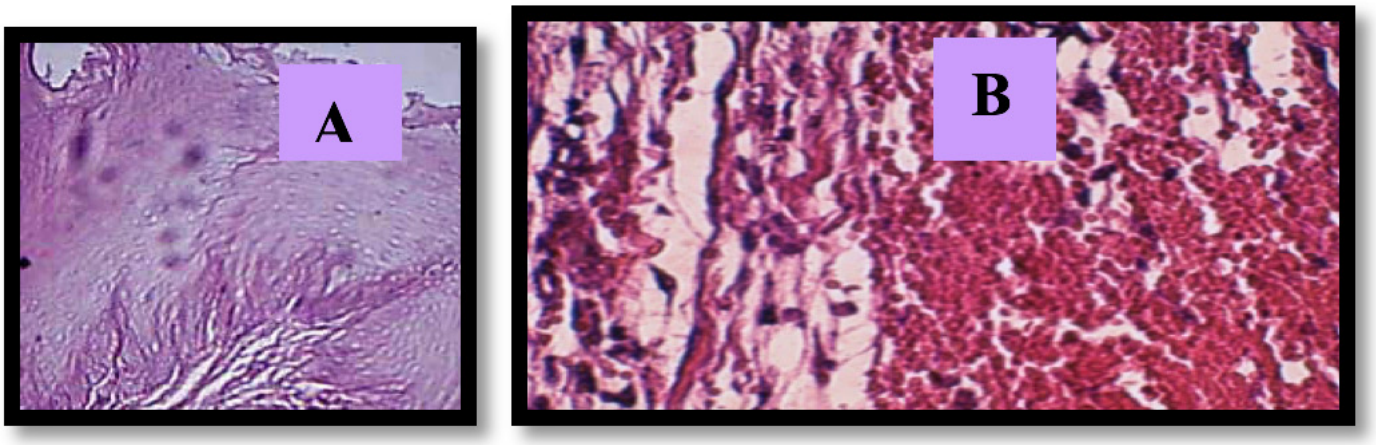

Figure 8: Rabbits with gingivitis ,3 days after sulcular injection of saline shows A-increase thickness of oral epithelia B- lamina propria with moderate inflammatory reaction, edema and destructed blood vessels (X100A , X400B) .

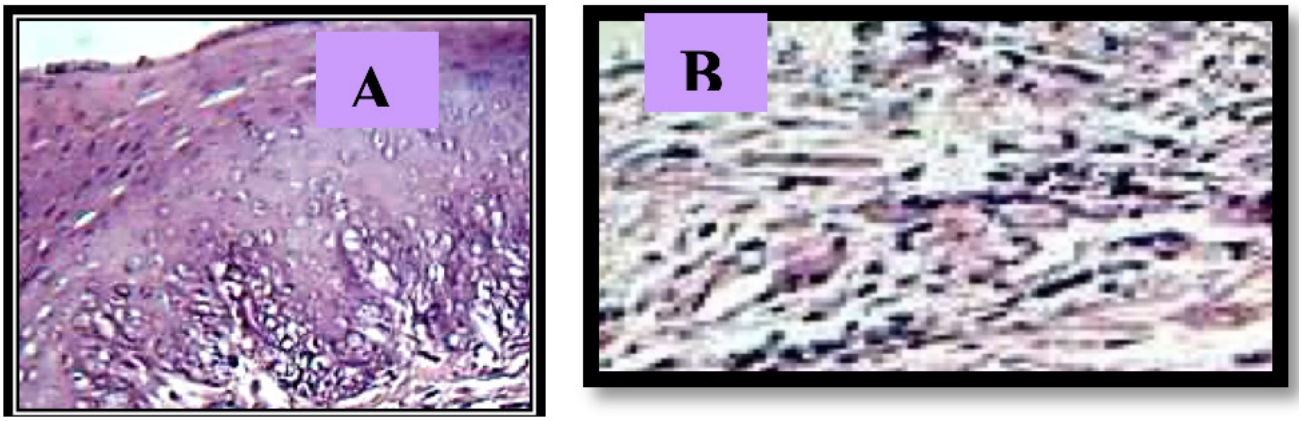

Figure 9: Rabbits with gingivitis ,21 days after sulcular injection of saline shows A-increase thickness of oral epithelia B- lamina propria with moderate inflammatory reaction(X200 A ,X200 B).

Table (1):-The mean ±standard deviation (SD) of oral epithelia thickness in gingivitis non-injected group (G) and fucose injected subgroups after different time intervals of sulcular injection with 50µl/kg of 150mM fucose solution ,P≤0.05= Significant .

Rabbits groups	*Time intervals (Days)*	*Mean±SD*	*P-value*	*Sig.*
Normal rabbits	-	120 ± 2.98		
G	gingivitis non-injected group	199.8±4.02		
GF1	1 day	191± 2.64	.037	S
GF2	3 days	170±2.73	.000	S
GF3	7 days	122.8 ±2.13	.000	S
GF4	14 days	121.2±0.83	.000	S
GF5	21 days	121.4 ±0.54	.000	S

Table (2):-The mean± standard deviation (SD) of oral epithelia thickness in gingivitis non-injected group (G) and saline injected subgroups after different time intervals of sulcular injection with 50µl/kg of saline solution,P≤0.05= Significant.

Rabbits groups	*Time intervals (Days)*	*Mean±SD*	*P-value*	*Sig.*
Normal rabbits	-	120 ± 2.98		
G	gingivitis non-injected group	199.8±4.02		
GS1	1day	198.6± 4.61	.587	NS
GS2	3 days	198.6 ±2.38	.395	NS
GS3	7days	197.2 ± 4.21	.360	NS
GS4	14 days	197.6 ± 1.30	.100	NS
GS5	21 days	196.2 ± 1.16	. 321	NS

Table (3): The score and number of inflammatory cells (N) in normal rabbit, gingivitis non injected group, gingivitis fucose injected group , and saline injected group after different time intervals of sulcular injection.

Time intervals (Days)	*Normal rabbits*		*Gingivitis -non injected group*		Gingivitis fucose injected subgroups		Gingivitis saline injected subgroups	
	Score	*N*	*Score*	*N*	*Score*	*N*	*Score*	*N*
	0	2	2	80				
1day					2	77	2	79
3 days					1	20	2	76
7days					0	3	2	79
14 days					0	0	2	76
21 days					0	0	2	75

Score (0) no inflammation Score (1) mild inflammation Score (2) moderate inflammation

DISCUSSION

To the best of our Knowledge, it's the first study to evaluate the effect of sulcular injection of fucose on the inflamed gingival tissue in case of gingivitis. The histopathological study revealed that after 1 day of fucose solution injection resulted in rapid reepithelization and new attachment of junctional epithelia into the root tooth surface that was tea red and injured normally by sulcular injection method with fibrous tissue and new capillaries formation in lamina propria , then reduction of inflammatory reaction was seen after 3 days of fucose injection, with well organized collagen fibers , and more new blood vessels formation and after different time intervals of 7days, 14,and 21 days the connective tissue was heal from any inflammatory reaction especially in the sulcular part with fibrous tissue and new blood vessels formation, while after saline injection, the moderate inflammatory reaction remain even after 21 days of saline injection.These results were nearly in the same line with a study conducted to evaluate the histopathological effect of local injection of fucose in normal saline into healthy gingival tissue and reported that fucose injection resulted in rapid reepitheliazation and new attachment of junctional epithelia into the tooth surface (3 days after injection) and that that the inflammatory reaction didn't continue for long time and the healing processes appeared at the examined site , 3days after injection[14]. The researcher also concluded that fucose can be used as anti-inflammatory agent in the treatment of gingival disease induced by mechanical trauma biochemically and immunologically, throughout its stimulatory effect in enhancement of endogenous secretion of vitamin C for long duration of time after injection (reached a peak in 3days after injection) which assist in healing of damaged gingival connective tissue and throughout its inhibitory effect in the decrease production of both proinflammatory cytokines IL-1 beta and TNF-alpha after fucose injection[14].

Another study coincide with our result, revealed that after local injection of fucose in normal saline into rabbit tongue muscle ,the inflammatory reaction didn't continue for long time and the healing processes appeared at the examined site , 168 hrs after injection . She concluded that after fucose injection; many signs of reduction in the inflammatory process in the lamina propria (LP) were seen accompanied by many signs of regeneration in lamina propria which was represented by the present of many active fibroblast and newly formed collagen fibers[13].

Another study conducted to reveal the effect of local application of 0.5 mg/ml L- fucose on corneal lesion in rabbit, and reported that L-fucose reduced significantly matrix metalloproteinase -9 (MMP-9) upregulation and activation (24 hrs after burn), and accelerated the recovery of the epithelial layer of the cornea. The researchers reported that there was relatively rapid regrowth of epithelium and the speed of this reepitheliaization was stimulated by the local application of fucose and they found at 48 hours after burn there was a difference between epithelia thickness of fucose-treated corneal lesion and epithelia thickness of control corneas (epithelial thickness was increased in fucose-treated corneas than the control corneas) [21]. In the same context the researchers studied the effect of fucose on normal corneas, which was added to rabbit as well as human cornea explant cultures, and the production and release of MMP-9 was determined by zymography. They found that fucose at a concentration of 0.5 mg/ml produced a 70% decrease of MMP-9 activity released in the medium by corneal explant cultures. From these results justify the use of fucose for the local treatment of corneal wounds[21]. These previous results were conincide with our result which showed that after 1 day of fucose injection , resulted in enhancement of regeneration of junctional epithelia cells and accelerated reepithelialization and new attachment of junctional epithelia into the root surface after tearing of the base of sulcus immediately by sulcular injection method [14]. This rapid reepithelialization and new epithelial attachment prevent the entrance of bacterial plaque and their product into the gingival connective tissue so can assist in healing of gingival disease induced by plaque (gingivitis) .

Researchers, measured the efficiency of fucose and fucose- rich polysaccharides to down regulate the elastase type endopeptidase activity by using skin explant cultures and fibroblast explant culture . In skin explant cultures, they

found that fucose and fucose rich preparation produced an inhibition of the activiation of the proform to active form of MMP-9 due to mono, and polysaccharides acting on elastin-laminin receptor / or on the fucose-mannose receptor which are efficient inhibitors of such enzymes by down regulating elastase – type endopeptidase activity, both at the level of the biosynthesis and at the level of the activiation of the pro-enzymes. They concluded that fucose and fucose-rich preparation were show to be efficient modulatory of MMP-2 and MMP-9 activity with potential therapeutic application for tissue loss in aging [22].

Similarly, in dermal fibroblast explant culture , the percutaneous application of an L-fucose-containing preparation penetrated in the dermis and produced an increase of skin thickness and a densification of collagen bundles due to favorable activities of L-fucose on the down regulation of matrix-degrading enzymes (MMP-2 and MMP-9) and increased fibroblast cells proliferation [23,24] , this result was nearly on the same line with our result which show that fucose injection stimulate cells proliferation,especially fibroblasts and collagen fibers production. Another study, revealed that the novel pharmacological properties of L-fucose and fucose-rich oligo- and polysaccharides (FROP-s) might be related to their accelerating effect of wound healing[25]. In another study, the researchers tested the cyto-protective effect of L-fucose and FROP-s and showed that relatively low concentrations of L-fucose could efficiently penetrate skin , protect fibroblasts from the ascorbate-induced cell-death by stimulate fibroblast cells proliferation to slow down skin aging [26].These results were similar to our results that show fucose sulcular injection stimulate fibroblast cells formation and collagen fibers production that induce healing of the gingival connective tissue.

Regarding to saline injection, the results showed that saline had no any effect on the healing of inflamed gingival tissue by plaque and the inflammatory reaction continued even after 21 days from saline injection, this result was nearly on the same line with another results which showed that sulcular injection of saline had no any effect on the healing of inflamed gingival tissue by mechanical trauma even after 21 days after injection[14].

So in the condition of gingivitis the study results indicated that fucose sulcular injection, can be used as therapeutic anti-inflammatory agent in the treatment of gingivitis .

CONCLUSION

Sulcular injection of fucose accelerated reepithelization and new attachment of junctional epithelia into the root tooth surface in short duration of time (1day after fucose injection) with new blood vessels and fibroblast cells formation and fibroblast proliferation to produce collagen fibers to form fibrous connective tissue (fibrous tissue regeneration) and also fucose injection resulted in reduction of the inflammatory reaction gradually (3 days after injection) which suggest the use of fucose as anti-inflammatory agent in the treatment of gingivitis (gingival inflammation induced by bacterial plaque), many studies need to support this conclusion, so we can be able to translate its anti-inflammatory effect from an experimental animals into human being.

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The Influence of Text Message Reminders on Oral Hygiene Compliance in Orthodontic Patients

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ABSTRACT

Objective: To determine if text message reminders regarding oral hygiene have an effect on maintaining good oral hygiene in orthodontic patients.

Materials and Methods: In this randomized, controlled clinical trial, 34 orthodontic patients were assigned to a text message or control group. Patients in the text message group received 2 reminder text messages each week for 4 weeks and one reminder text message for 8 weeks thereafter. Oral hygiene compliance was measured using bleeding index (BI), modified gingival index (MGI), and plaque index (PI) at baseline (T0), at 4 weeks after baseline (T1), and at 8 weeks after baseline (T2).

Results: Text message group had highly significant lower BI, MGI, and PI scores than control group at T2.

Conclusion: The use of text message reminders sent by the orthodontist was effective for improving oral hygiene compliance in orthodontic patients.

KEY WORDS

Oral hygiene; Text message; Orthodontics; Compliance.

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INTRODUCTION

Oral hygiene compliance is one of the most important factors controlled by the patient during orthodontic treatment. Gingival inflammation can lead to detrimental effects to the periodontium, including recession, pocket formation, hyperplasia, and subsequent periodontal disease.[1–9] Previous studies have shown a rapid decline in oral hygiene after the initial bonding, followed by an improvement by the fifth month of treatment.[10] However, other studies have also demonstrated that oral hygiene problems are highest at the end of orthodontic treatment, demonstrating the challenge in obtaining sustained and acceptable oral hygiene during orthodontic therapy.[11] Effective plaque removal and oral hygiene compliance have been important concerns for orthodontists. It is well known that oral hygiene compliance can be challenging with the orthodontic treatment population.[12–16] These undesired side effects can lead to unsatisfactory results of orthodontic therapy.[1])

In medicine and dentistry, Studies have shown text messaging to be an effective tool for behavioral change and disease prevention.[17,18] A 2009 systematic review of the influence of text messages on behavior changes in the medical field demonstrated positive behavior changes in 13 of the 14 studies that met the authors' inclusion criteria, including smoking cessation therapy, diabetes self-management, and anti-obesity behavior.[19] In dentistry, text message reminders, postal, , and automated telephone were effective in reducing appointment no-show rates.[20,21,22,23] Additionally, follow-up text message sent from an orthodontic office following initial appliance placement resulted in patient's lower levels of self-reported pain.[24] Another study showed that text message reminders to parents of orthodontic patients were shown to be an effective way to improve oral hygiene in these patients.[25] With the introduction of text messaging, it has become easier to communicate with the patient.

The aim of this study was to determine the effectiveness of reminding patients of maintaining good oral hygiene via text message reminders sent to them weekly encouraging them about oral hygiene compliance.

MATERIALS AND METHODS

This randomized controlled clinical trial was conducted on a convenience sample of 34 consecutively orthodontic patients. Subjects were required to be in active treatment with full fixed appliances in both arches, between the ages of 17 and 23, without any significant medical/dental history, have worn the appliance for at least 2 months and have at least 6 months of remaining orthodontic treatment and own a cellular telephone with text messaging services.

The text message group was composed of 10 girls and 7 boys, while the control group included 11 girls and 6 boys. The text message group receives two standardized text messages each week for the duration

of the study, while the control group did not receive any text messages. Subjects were blinded as to group status and were not made aware that text messages were part of the study.

At the start of treatment, all patients were given standardized oral hygiene instruction and checked to have an oral hygiene kit that included a toothbrush, interproximal brush, and mouthwash, and was given an oral hygiene instruction sheet. At time point (T0), baseline readings of the Ramfjord teeth (maxillary right first molar, maxillary left central incisor, maxillary left first premolar, mandibular left first molar, mandibular right central incisor, and mandibular right first premolar) were recorded for bleeding index (BI), modified gingival index (MGI), and plaque index (PI). Probing was done by the same examiner for all subjects to standardize periodontal probing, and cheek retractors were placed to properly measure BI.

The BI was scored as described by Saxton and van der Ouderaa[26] upon probing the mesio-buccal, direct buccal and disto-buccal aspects of the gingival sulci of the Ramfjord teeth. BI scoring is described in Table 1.[26] The MGI measurement of the buccal marginal gingiva for each Ramfjord tooth was scored as described in Table 2. The PI measurement was recorded for the buccal surface of each Ramfjord tooth according to the Turesky modification on the Quigley-Hein PI scoring system and is described in Table 3 [27].

The text message group received messages twice a week for 4 weeks (totaling 8 texts) as a reminder and encouragement to practice good oral hygiene. The standardized text message was: ‘‘Remember, your smile is the first thing people see, cleaning them after every meal for at least 2 minutes will keep them beautiful, healthy and bleeding free. See you soon”. The control group received no text messages. After the 4 weeks period, both groups were reevaluated. Following the first time point (T1), the text group received a text once a week for 8 weeks. After this second time period (T2), both groups were reevaluated again. Mean BI, MGI, and PI scores were compared between groups across three time points using paired samples t-test, within group scores were compared using one way analysis of variance (ANOVA). The significance level was set at $P < .5$ (significant) and $P < .001$ (highly significant). SPSS 22 software under windows 10 was used for all statistical analysis.

Table 1: Bleeding Index (BI) Measurements:

score	*presentation*
0	Absence of bleeding after 30 seconds
1	Bleeding observed after 30 seconds
2	Immediate bleeding

Table 2: Modified Gingival Index (MGI) Measurements:

score	*presentation*
0	Absence of inflammation
1	Mild inflammation (marginal or papillary unit)
2	Mild inflammation (entire marginal and papillary unit)
3	Moderate inflammation
4	Severe inflammation

Table 3: Plaque Index (PI) Measurements:

Score	*presentation*
0	No plaque
1	Discontinuous band of plaque at gingival margin
2	Up to 1-mm continuous band of plaque at gingival margin
3	Band of plaque wider than 1 mm but less than 1/3 of surface
4	Plaque covering between 1/3 and 2/3 of surface
5	Plaque covering 2/3 or more of surface

RESULTS

34 patients were randomly assigned to the text message or control group. There were 21 females and 13 males with a mean age of 20.2 years, ranging from 17 to 23 years old. Table 4 shows the descriptive statistics of BI, MGI, and PI for both groups at the three time points. As shown in table 5 there were no differences in scores between the groups at baseline ($P < .5$). At T1, there were no BI, MGI, or PI differences between the groups. At T2, the text message group had a highly significant lower BI ($P = .000$), MGI ($P = .000$), and PI ($P = .000$) scores. Within the groups,

BI, MGI, and PI highly improved over time in the text message group (P = .000). Within the control group, BI became worse over time (P = .001) while MGI, and PI did not change significantly. The changes across time points in BI, MGI, and PI are displayed in Figures 1–4, respectively.

Table 4: Descriptive statistics of BI, MGI, and PI for text message and control groups:

Time interval	*Text message group mean*	*Text message group SD*	*Control group mean*	*Control group SD*
		BI		
T0	1.47	.624	1.24	.664
T1	1.29	.470	1.53	.514
T2	.29	.470	2.00	.500
		MGI		
T0	3.12	.781	2.71	.920
T1	2.47	.624	2.82	.809
T2	.65	.702	3.35	.702
		PI		
T0	3.00	.866	2.71	.849
T1	2.59	.795	2.94	.659
T2	.59	.618	3.29	.588

Table 5: Paired samples t test:

Pairs	*Paired Differences*					*t*	*df*	*Sig. (2-tailed)*
	Mean	*Std. deviation*	*Std. error mean*	*95% confidence interval of the difference*				
				Lower	Upper			
BI T0	.235	.664	.161	-.106	.577	1.461	16	.163
BI T1	-.235	.562	.136	-.524	.054	-1.725	16	.104
BI T2	-1.706	.470	.114	-1.947	-1.464	-14.976	16	.000*
MGI T0	.412	1.004	.243	-.104	.928	1.692	16	.110
MGI T1	-.353	.786	.191	-.757	-.051	-1.852	16	.083
MGI T2	-2.706	.920	.223	-3.179	-2.233	-12.133	16	.000*
PI T0	.294	1.047	.254	-.244	.832	1.159	16	.264
PI T1	-.353	.862	.209	-.796	-.090	-1.689	16	.111
PI T2	-2.706	.470	.114	-2.947	-2.464	-23.754	16	.000*

*** P < .05**

DISCUSSION

This study examined the effect of text message reminder which was sent directly to patients on their oral hygiene compliance. Outcome was assessed using BI, MGI, and PI. We found that text messages reminding patients about their oral hygiene resulted in improved oral hygiene compliance over time. This finding is similar to that reported by Eppright et al.,[25] who found that sending text messages to the parents was effective for improving oral hygiene compliance

in orthodontic patients, and to that of Bowen et al.,[28] who found that text messages reminding and encouraging good oral hygiene resulted in a less measurable surface area of plaque over time. The text message group demonstrated a highly significant lower BI, MGI, and PI scores at T2, which was 12 weeks after baseline (T0). According to Lally et al.,[29] it takes an average time of 66 days to turn a behavior into an automatic habit. This lag time in habit formation may explain why differences in oral hygiene measures were not seen at T1, which was 4 weeks after baseline.

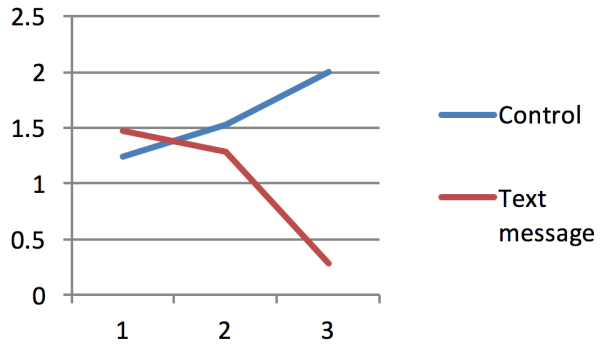

Figure 1: Treatment response for BI over time.

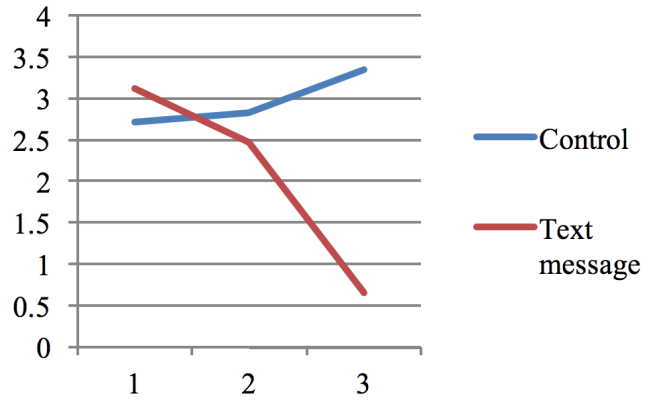

Figure 2: Treatment response for MGI over time.

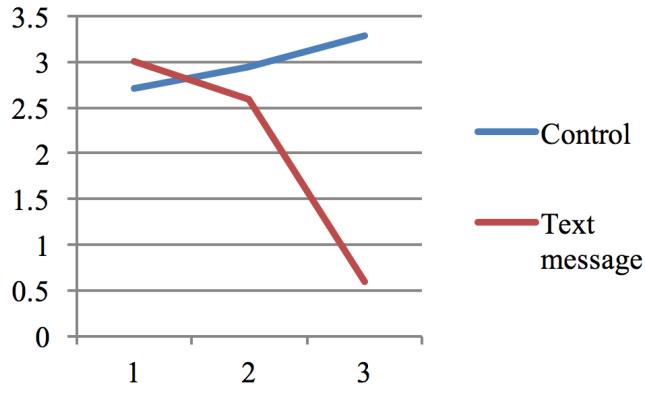

Figure 3: Treatment response for PI over time.

BI is a strong indicator of oral hygiene compliance, as it has been shown to have high sensitivity and specificity in periodontal health evaluation.[30,31] In addition, MGI has demonstrated high sensitivity for assessing resolution and progression of gingivitis.[32] Studies have indicated that MGI and BI correlate well and should produce comparable results when used together in a clinical trial.[32] Therefore, significantly lower BI and MGI scores in the text message group at T2 should be viewed as strong evidence of the effectiveness of the text messaging.

The results of this study suggest that a text message reminder improves oral hygiene compliance, but it is possible that its effectiveness was simply caused by the extra attention provided to the text message group, and the declined in the compliance for the control group may be simply because they were not being given any attention. Since this study looked at only a short time span, the question as to whether there would be any long-lasting effect from text messaging requires further investigation.

The use of text messaging is a very simple way of maintaining a good communication with the patient, especially between long span appointments which show that the orthodontist is still involved and concerned about the patient's well-being. This has been shown to be important in influencing patient satisfaction and promoting orthodontist-patient relationships [33] .

In recent years, many orthodontists used e-mail either as a replacement or adjunctive to cellular telephone calls as an appointment reminder for their patients. But thinking of that every cellular telephone has the ability to receive a text message, it is easy to realize that this is reasonably a preferred method to communicate. Furthermore, the number of individuals owning a cell phone is greater than the number of individuals owning a computer [34]. Direct text messaging of patients began as a way to remind patients of appointments but may now be used to remind them of brushing, elastic wear, wearing retainers, and so forth. Text message reminder system, as used in this study, is an effective means of improving oral hygiene compliance in orthodontic patients, beside, is a novel way to reach many patients with very little administrative time.

CONCLUSION

The sending of text messages directly to patients explaining and reminding them of the importance of oral hygiene is an effective way to improve oral hygiene compliance in orthodontic patients over a 3 months period.

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