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Clinical and histological study to evaluate the miniscrew penetration effect into dental root on dental pulp vitality during orthodontic treatment

D Eisa Wahbi
Hama Universitiy, Dentistry Faculty, Department of Endodontics, Syria

Abstract
The purpose of this study was to evaluate the clinical and histological effects after the miniscrew penetration into dental root on dental pulp vitality during orthodontic treatment**.** 63 patients who their ages between 13-23 years old with 95 first premolars to be extracted as part of their orthodontic treatment participated in the study.80 miniscrews were inserted into the root with the intention of penetration into dental root.the sample that the miniscrews were inserted into their root divided into 8 groups depended on the depth of miniscrew insertion (dentin –cementum), orthodontics movement presence and extract period (after a week – after 3 months). The clinical syndrome was evaluated directly from the first day of miniscrew insertion until tooth extraction. After the extraction histological sections were tacken to evaluate the effects caused by the miniscrews insertion. The pain was the only clinical syndrome obsperved. Pain Frequent increased in the group that the miniscrews were inserted into the dentin and associated with orthodontic movement. The pain was slight, impermanent and overwrought by biting. The reparative cementumregenerated in all groups that extracted after 3 months of miniscrew insertion and histological changes (vitrification- hyperemia- chronic inflammation) were observed in the pulp in all groups that the miniscrews were inserted into the dentin regardless of extraction period or the presence of orthodontic movement. Histological change degree was higher in the groups that the miniscrews were inserted into the dentin of the groups that the miniscrews were inserted into the cementum, and increased at the presence of orthodontic movemet, and decreased by the time. When miniscrews penetrate root that could causes light pain, impermanent and overwrought by biting. Reparativecementum regenerated at every injury site regardless of insertion depth or the presence of orthodontic movement, also the pulp associated with clear histological changes include: vitrification, hyperemia and chronic inflammation. Histological change degree increased at increase the insertion depth but the orthodontic movement had not clear effect on this changes and decreased by the time.

Keywords: miniscrews, reparativecementum, vitrification changes, pulphyperemia, pulp inflammation

Introduction
The dental undesired movement causes loss of the anchorage. Several years ago, some types of skeletal anchorage have appeared which do not relay on the patient's compliance such as the implants, the oplants and the miniscrews [1]. The miniscrews have been met with great welcomingas a simple tool to obtain the ultimate orthodontic anchorage to avoid the undesired dental movement, as it can be placed in several locations of the alveolar bone.

Types of the orthodontic dental movement
Vertical movement:
Intrusion movement.
Extrusion movement.
Horizonal movement:
Bending movement.
Physicalmovement.
Torque movement.
Axial movement:
Rotational movement.
Bending movement:

It is obtained by applying a force on the crown level which intern causes a bending movement of the crown towards that force and a root movement in the opposite direction.

The bending movement is divided into two types

a. Regimental bending: The rotation centre of this movement locate at the top of the root.
b. Unregimental bending: The rotation centre of this movement locate at the area between the resistance centre of the tooth and the top of the root, and it is produced by applying a singular horizontal force on the tooth crown which leads to a crown and root moving against each other [3].

Canomi 1997 is considered as the first man to publish reports aboat the usage of the miniscrews for orthodontic purposes [4].
The miniscrws failure has been widely studied, and this failure increased when they come close to the tooth roots [5].
Other factors also cooperate to the failure of these miniscrews such as placing them in the mandibular [5, 6, 7, 8], and placing them in the unpadded tissues [9].

Choosing miniscrws locations
- Avoiding the anatomical adjacements [10].
- Suitability principle [11].
- Hard tissue status [12].
- Soft tissue status: the attached gum is considered the favourite sites for the miniscrews [13].
- The patientcomfort [14].

The complications resulting from the miniscrews usage

- Soft tissue inflammation and its fester.
- The break of the miniscrews.
- Bleeding and numbness.
- The pain.
- Touching the root during dental movement.
- Injuring the dental root:

This damage ranges from a simple injury of the cementum surface to a severe injury t by the penetration the pulp or root fracture.

The simple injuries of the cementum are spontaneously recovered after the removal of the miniscrew, as the remaining injuries, their healing response varies and this point will represent the centre of our research.

There are many risks that should be taken into consideration when inserting the miniscrew between the dental roots [15].

Hwrman B & Cope A 2009 have studied the injury resulting from the self-drilling miniscrews penetration into the dental roots and found that the maximum depth of the miniscrew penetration of the dental root that can be tolerated was 0, 25 mm [18].

Helden 2008 constructed a laboratory study to evaluate the healing after the intentional root injury and concluded that extracted teeth after 40 days of inflecting surgical injury have shown cellular cementum on holes surfaces caused by the injury and the extracted teeth after 2-3 months have shown periodontal ligament fibers adjacent to the newly formed repaired cementum [19].

Andreasen AD 2008 conducted a histological study on the mice dental rootsafter exposing these roots to surgical injury and he found that the repairing of the cementum and ligaments happened after 14 days of the injury, and the repairing increases in time [20].

Asscherich *et al.* 2011 have published a study involves a histological tests of 3 damaged roots by miniscrews. The study have shown a primary repair to the periodontal structure during 12 weeks after the removal of the miniscrews with a near full recovery after 20 weeks [21].

Majumdar & Brook 2008 have published a report about a patient suffering a dental root injury to 3 premolars after placing fixing intra jaw screws. And have found that the teeth did not show response to the pulp vitality tests [22].

Rahul *et al.* 2009 have conducted a study to evaluate the histological response of the periodontal ligaments after the intentional inserting of the miniscrew into the experimental dogs dental roots.

In all cases, there were a clear repair to the cementum along the injured root surface expect the cases of a visible root injuries where there were crumbling and ankylosis (23).

Renjen R *et al.* 2009 have conducted a histological study on the experimental dogs, the miniscrew was intentionally inserted into the dental root in order to cause a root injury, and the dogs were put to sleep after12 weeks. The repairing cementum was found in all the injury sites. This study have concluded that the permanent injuries in the pulp and the surrounding tissue are inconclusive result where the miniscrew comes close or penetrates the ental root [24].

Cheng-Tsung Huang *et al.* 2012 have conducted a study on the experimental dogs in order to investigate the effect of the miniscrew coming in contact with the root when the root moved towards the miniscrew. It was noted that the roots which were in contact with the miniscrew during the orthodontic movement remained stable with the occurrence of certain injuries in the root in shape of small holes, it has been also noted some inflammatory cells in the periodontal ligament with external root resorption, and after the movement was stopped, no evidence remained on the dental resorption and the reparative cementum was formed in the injured sites and the ligament space remained in the same thickness [25]

Yang-Ku Lee *et al.* 2010 have conducted a study a boat the effects of inserting of the miniscrew into the dental root at the dogs and found that

- The injured periodontal tissues by the miniscrews have shown a clear inflammatory response
- Sometimes it was noted a dental resorption after 3 weeks of the inserting of the miniscrew even when the miniscrew was not in direct contact with the root.
- It was noted a repair to the root with the cementum formed by the cement oblast cells which were observed locating along the resorption surface after about 3 weeks of the miniscrew inserting [26].

Stephanie Shil-Hsuan Chen *et al.* 2012 conducted a study on 3 adult dogs, where the miniscrews were inserted invading the root in half of the specimens and placed so that they would not touch the root in the other cases, the dogs were put to sleep after 8 weeks and a histological study was conducted to the specimens and the result were:

- The failure range in the miniscrews inserted into the roots was 79, 2%.
- The failure range in the miniscrews which did not touch the root was 8, 3%. The injured roots were repaired moderately by cementum tissues with a normal periodontal ligaments followed by the healing, and the force applied had a mini effect on the miniscrew failure [27].

From the previous studies, we can conclude that the miniscrews have different effects on the dentin pulp complex when insert into the root, but these previous studies did not include the dentinal pulpal structure itself and did not clearly and widely mention the histological and clinical effects resulting from the inserting of the miniscrew into the pulp and the dentin, and most of these studies were performed on animals and for a short period of time mostly.

Aim of the study

Study of the effects resulting from the miniscrew inserting into the dental root on the cementum and dentin and health condition of the pulp during the orthodontic movement application.

Material and Methods

The specimen

1. The specimen consists of 63 patients, 38males and35 females, who have 95 premolar prepared for orthodontic extraction.
2. The ages of the patients range from 13-22 years, good health and without gingivitis or periodontal disease.
3. The premolar without any lesion or trauma occlusal

The tools

1. The orthodontic brackets and wires mad by American Orthodontic Company. The brackets MBT O, 22.
2. The required orthodontic wires: 0, 14-0, 16 Niti, and 0,

14 SS for making the required loops at the studied premolar level.
3. 63 orthodontic miniscrews from the Italian company LEADER, self-drilling, short headed specimen, the length is 8 m.m, the width is 1, 5 m.m. The miniscrews will be inserted into the premolar roots.

Method and Work

The miniscrews inserted vertically in the middle of the buccal suface of the first premolar roots, 13 m.m away from the top of the buccal cusp, the miniscrews were removed immediately after the insertion. The depth of inserting miniscrew varies and the amount of the inserting has been evaluated accurately whether in the cementum or the dentin or the pulp after taking histologicl sections at the place of the inserting.

The number of the premolars which the miniscrews have been inserted into their roots were 80 premolars, 40 of them were subjected to unregimental bending movement with the applying of a unified force in terms of intensity whereas non-of the remainging premolars were subjected to.

Half of the premolars have been extracted after 1 week from inserting the miniscrew, the other half has been extracted after 3 months.

The control specimen consisted of

- Five premolars with the same orthodontic movement and extracted after 1 week of exposing to the orthodontic movement of and without inserting any miniscrew into their roots.
- Five premolars with the same orthodontic movement and extracted after 3 months of exposing to the orthodontic movement of and without inserting any miniscrew into their roots.
- Five premolars without any orthodontic movement and without inserting any miniscrew into their roots.

The specimen was divided into 11 main groups according to the inserting depth of the miniscrew, the existence of the orthodontic movement and the studied time period

1. Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after *1* week (N=10).
2. Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after 3 months (N=10).
3. Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 1 week (N=10).
4. Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 3 month (N=10).
5. Group with inserting the miniscrew in the dentin, with orthodontic movement and extraction after 1 week (N=10).
6. Group with inserting the miniscrew in the dentin, with orthodontic movement and extraction after 3 months. (N=10)
7. Group with inserting the miniscrew in the dentin, without orthodontic movement and extraction after 1 week (N=10)
8. Group with inserting the miniscrew in the dentin, without orthodontic movement and extraction after 3 months (N=10)
9. Group without insertion the miniscrew, with orthodontic movement and extraction after 1 week (the first control group, N=5)
10. Group without insertion the miniscrew, with orthodontic movement and extraction after 3 months (the second control group, N=5)
11. Group without insertion the miniscrew, without orthodontic movement (the third control group, N=5).

Determining the time of the inserting:

After finishing the lining stage, an orthodontic wire of 0,14 S.S which had w loop was applied to obtain an unregimental bending movement at the studied premolar area with unified orthodontic force (this was applied on the premolars groups which were intended to insert the miniscrews into their roots with orthodontic movement)

Inserting the miniscrew: The miniscrews inserted vertically in the middle of the buccal suface of the first premolar roots, 13 m.m away from the top of the buccal cusp using the manual miniscrew carrier, and the twist was performed clockwise until the feeling of the root being reached, and then the miniscrew was inserted to different depths (cementum-dentin).Then it was removed using the same miniscrew carrier. After 1 week of inserting the miniscrew, half of the teeth were extracted and preserved in formalin liquid in order to perform the histological sections.

The remaining half teeth were extracted after 3 months with the same previous procedures.

The histological reflexes were divided according to the injury severity on the cementum and dentin pulp complex as in the below chart:

Table 1

Value degree	Degree of histological change
0	Non cementum or pulpal histological change
1	Normal pulp and cementum histological scar
2	non cementum histological scar and normal pulp
3	cementum histological scar and degenerative pulp changes
4	cementum histological scar and a hyperemia in the pulp
5	non cementum histological scar and a hyperemia in the pulp
6	cementum histological scar and an inflammated pulp
7	non cementum histological scar and an inflammated pulp

Results &Statistical Study

Table 2: The separation of the premolars in the research specimen according to the studied group

Percentage	Number of the premolars	The studied group
10.5	10	Group with inserting the miniscrew in the dentin, with orthodontic movement and extraction after 1 week
10.5	10	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after 3 months
10.5	10	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 1 week
10.5	10	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 3 month

10.5	10	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after 1 week
10.5	10	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after 3 months
10.5	10	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 1 week
10.5	10	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 3 month
5.3	5	Group without insertion the miniscrew, with orthodontic movement and extraction after 1 week
5.3	5	Group without insertion the miniscrew, with orthodontic movement and extraction after 3 months
5.3	5	Group without insertion the miniscrew, without orthodontic movement
100	95	total

The cementum scar study

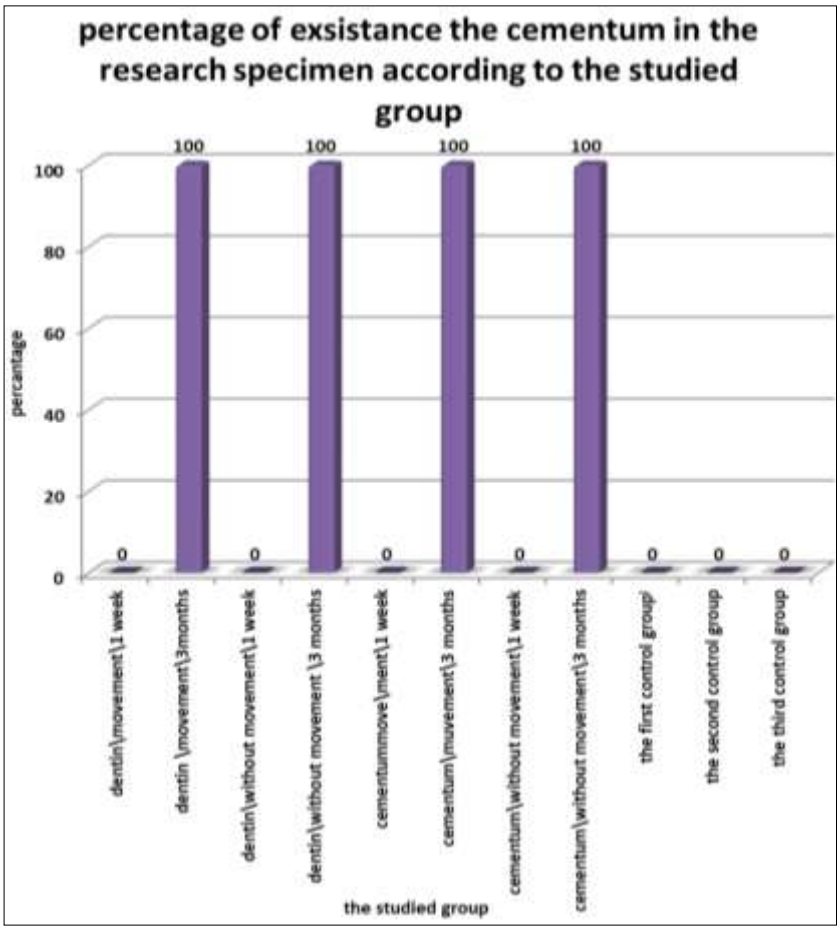
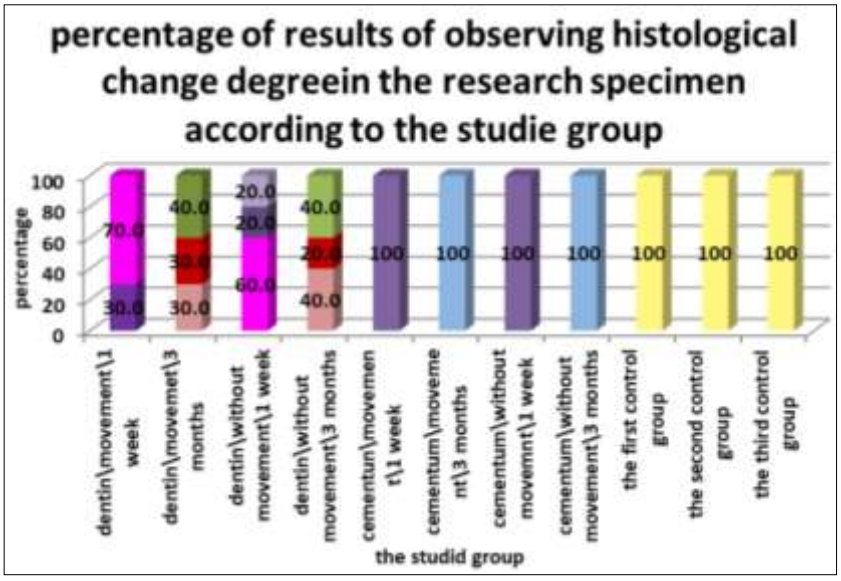


Fig 1

The study of the histological changes degree



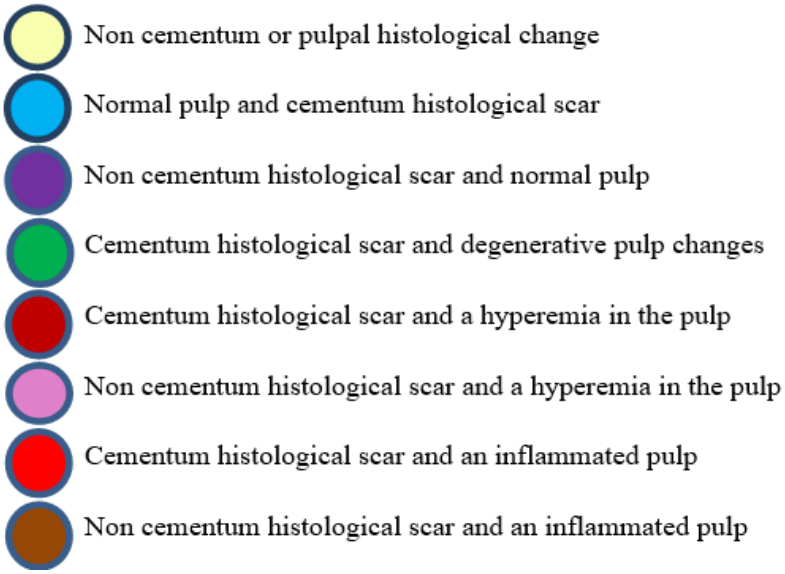


Fig 2

The study of the effect of the studied group in the histological changes degree

To study the effect of the binary differences in the repetitions of the the histological change degree between the 11 groups in the research specimen, the test of Mann-Whitney U was performed

Ranks Statistcs

Table 3: The chart (20-5) demonstrates the rank mean of the histological change degree in the research specimen according to the studied group

The studied variable = the histological change degree		
Mean rank	**Premolars number**	**The studied group**
83.20	10	Group with inserting the miniscrew in the dentin, with orthodontic movement and extraction after 1 week
71.70	10	- Group with inserting the miniscrew in the dentin, with orthodontic movement and extraction after 3 months
75.30	10	Group with inserting the miniscrew in the dentin, without orthodontic movement and extraction after 1 week ر
69.80	10	Group with inserting the miniscrew in the dentin, without orthodontic movement and extraction after 3 months
46.50	10	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after *1* week
25.50	10	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after 3 months
46.50	10	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 1 week
25.50	10	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 3 month
8.00	5	Group without insertion the miniscrew, with orthodontic movement and extraction after 1 week
8.00	5	Group without insertion the miniscrew, with orthodontic movement and extraction after 3 months

Table 4

The studied variable = the histological change degree				
Differences indication	**Indication level value**	**Value U**	**The group(b)**	**The group(a)**
exist	0.024	21.0	Group with inserting the miniscrew in the dentin, with orthodontic movement and extraction after 3 months ر	Group with inserting the miniscrew in the dentin, with orthodontic movement and extraction after 1 week
Does not exist	0.282	38.0	Group with inserting the miniscrew in the dentin, without orthodontic movement and extraction after 1 week	
Exist	0.005	14.0	Group with inserting the miniscrew in the dentin, without orthodontic movement and extraction after 3 months	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after *1* week	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after 3 months	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 1 week	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 3 month	
Exist	0.001	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 1 week	
Exist	0.001	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 3 months	
Exist	0.001	0	Group without insertion the miniscrew, without orthodontic movement	

Does not exist	0.354	38.0	Group with inserting the miniscrew in the dentin, without orthodontic movement and extraction after 1 week	Group with inserting the miniscrew in the dentin, with orthodontic movement and extraction after 3 months
Does not exist	0.809	47.0	Group with inserting the miniscrew in the dentin, without orthodontic movement and extraction after 3 months	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after *1* week	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after 3 months	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 1 week	
Exist	0.000	0	Group with inserting the miniscrew in the cementum,without orthodontic movement and extraction after 3 month	
Exist	0.002	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 1 week	
Exist	0.002	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 3 months	
Exist	0.002	0	Group without insertion the miniscrew, without orthodontic movement	
Exist	0.164	32.0	Group with inserting the miniscrew in the dentin, without orthodontic movement and extraction after 3 months	Group with inserting the miniscrew in the dentin, without orthodontic movement and extraction after 1 week
Exist	0.001	10.0	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after *1* week	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after 3 months	
Exist	0.001	10.0	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 1 week	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 3 month	
Exist	0.001	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 1 week	
Exist	0.001	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 3 months	
Exist	0.001	0	Group without insertion the miniscrew, without orthodontic movement	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after *1* week	Group with inserting the miniscrew in the dentin, without orthodontic movement and extraction after 3 months
Exist	0.000	0	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after 3 months	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 1 week	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 3 month	
Exist	0.001	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 1 week	
Exist	0.001	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 3 months	
Exist	0.001	0	Group without insertion the miniscrew, without orthodontic movement	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after 3 months	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after *1* week
Does not exist	1.000	50.0	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 1 week	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 3 month	
Exist	0.000	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 1 week	
Exist	0.000	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 3 months	
Exist	0.000	0	Group without insertion the miniscrew, without orthodontic movement	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 1 week	Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after 3 months
Does not exist	1.000	50.0	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 3 month	
Exist	0.000	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 1 week	
Exist	0.000	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 3 months	
Exist	0.000	0	Group without insertion the miniscrew, without orthodontic movement	
Exist	0.000	0	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 3 month	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 1 week
Exist	0.000	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 1 week	
Exist	0.000	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 3 months	
Exist	0.000	0	Group without insertion the miniscrew, without orthodontic movement	

Exist	0.000	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 1 week	Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 3 month
Exist	0.000	0	Group without insertion the miniscrew, with orthodontic movement and extraction after 3 months	
Exist	0.000	0	Group without insertion the miniscrew, without orthodontic movement	
Does not exist	1.000	12.5	Group without insertion the miniscrew, with orthodontic movement and extraction after 3 months	Group without insertion the miniscrew, with orthodontic movement and extraction after 1 week
Does not exist	1.000	12.5	Group without insertion the miniscrew, without orthodontic movement	
Does not exist	1.000	12.5	Group without insertion the miniscrew, without orthodontic movement	Group without insertion the miniscrew, with orthodontic movement and extraction after 3 months

The above chart demonstrates that the value of the indication level is smaller than 0, 05 when comparing within histological changes degree repetitions between the three control groups and each of the remaining groups. And when comparing the histological changes degree between the groups which the miniscrew were inserted into the dentin and the groups which the miniscrew were inserted to the cementum alone, and when comparing within histological changes degree repetitions between Group with inserting the miniscrew in the dentin, with orthodontic movement and extraction after 1 week and each of Group with inserting the miniscrew in the dentin, with orthodontic movement and extraction after 3 months and Group with inserting the miniscrew in the dentin, without orthodontic movement and extraction after 3 months alone, and when comparing within histological changes degree repetitions between each of Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after *1* week and Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 1 week and each of Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after 3 months and Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 3 month alone, so that at the trust level 95%there were binary differences statistically evidential in the repetitions of the histological changes degree between the mentioned groups in the research specimen and with the study of the mean rank values we conclude that the histological changes degree in each of the three control groups were less than in each of the 8 remaining groups alone, and we conclude that the histological changes degree in each of the groups of inserting the miniscrew into the dentin were higher than of the groups of inserting the miniscrew into the cementum alone, and we conclude that the histological changes degree in the groups of inserting the miniscrew into the dentin with movement and extraction after 1 week were higher than Group with inserting the miniscrew in the dentin, with orthodontic movement and extraction after 3 months and Group with inserting the miniscrew in the dentin, without orthodontic movement and extraction after 3 months alone, and we conclude that the histological changes degree in each of the Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after *1* week and Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 1 week were higher than Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after 3 months and Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 3 month alone.

Discussion

In this study we have intentionally inserted the mini screw into the buccal surface of the root with different depths and immediately removed, then half of the premolar was extracted after 1 week of inserting the miniscrew, and the other half after3 months.

The study variations in this study

- Inserting the miniscrew depth in the dental root. (Dentin- cementum).
- The presence or absence of the orthodontic movement.
- Observation period.

Histological study

The reparative cementum was formed in all specimens which were extracted after 3 months from inserting the miniscrew, that is explained to the availability of the enough time for the ligament cells to form the reparative cementum in the injured place, and no forming of the reparative cementum was seen in groups which were extracted after 1 week from inserting the miniscrew.

No histological changes were seen in the pulp in all groups which the miniscrews were inserted in the cementum whether with the presence or absence of the orthodontic movement and the difference of the observation period that is justified by not transporting the effects to the pulp because the dentin and dentinal tubes were not injured.

The histological changes degree in the groups in which the miniscrews were inserted into the root was higher than the control groups.

The histological changes degree in the groups in which the miniscrews were inserted into the Dentin was higher than the groups which the miniscrews were inserted into the cementum.

The histological changes degree in the Group with inserting the miniscrew in the cementum, with orthodontic movement and extraction after1 week were higher than each of the Group with inserting the miniscrew in the cementum,with orthodontic movement and extraction after 3 months and the Group with inserting the miniscrew in the cementum, without orthodontic movement and extraction after 3 month alone in the studied specimen.

- Our study results were partially corresponded with the study results done by Hellden 2008 where he conducted a study to evaluate the healing after the intentional root injury and concluded that extracted teeth after 40 days of inflecting surgical injury have shown cellular cementum on holes surfaces caused by the injury,but this study was on dogs and did not consider The histological changes on the pulp
- Our study results were partially corresponded with the study results of Andreasen AD 2008 where he conducted a histological study on the mice dental roots

after exposing these roots to surgical injury and he found that the repairing of the cementum and ligaments happened after 14 days of the injury, and the repairing increases in time but this study was on mice and did not consider The histological changes on the pulp.

- Our study results were partially corresponded with the study results of Fabroni *et al.* 2010 where they studied the injury of the tooth root resulting from inserting the miniscrew into, and found that off 63 teeth with radio evidence of tooth root injury, there were 6 teeth did not respond to vitality pulp tests.
- Our study results were partially corresponded with the study results of Rahul *et al.* 2009 where they conducted a study to evaluate the histological response of the periodontal ligaments and pulp after the intentional inserting of the miniscrew into the dog s dental roots, In all cases, there were a clear repair to the cementum along the injured root surface expect the cases of a visible root injuries where there were crumbling and ankylosis.
- Our study results were corresponded with the study results of Onur Kadioglu *et al.* 2008 where they conducted a clinical study to evaluate the effects of touching the miniscrew with the upper first premolar prepared for orthodontic extraction at 5 male patients and 5 female patients, the tooth root surface touching the miniscrew has shown rapid reparation and complete healing during few weeks after removing the miniscrew or the orthodontic force. But this study depended on 10 patients which means the number is not conclusive.
- Our study results were partially corresponded with the study results of Cheng-Tsung Huang *et al.* 2012 where they conducted a study on the dogs in order to investigate the effect of the miniscrew coming in contact with the root when the root moved towards the miniscrew, they noticed that after the movement was stopped, no evidence remained on the dental resorption and the reparative cementum was formed in the injured sites and the ligament space remained in the same thickness.
- Our study results were partially corresponded with the study results of Stephanie Shil-Hsuan Chen *et al.* 2012 where they conducted a study on 3 adult dogs, where the miniscrews were inserted invading the root in half of the specimens and placed so that they would not touch the root in the other cases, the orthodontic force was applied on the miniscrews immediately, and the dogs were put to sleep after 8 weeks and a histological study was conducted to the specimens. The study has concluded that The injured roots were repaired moderately by cementum tissues with a normal periodontal ligaments followed by the healing, and the force applied had a mini effect on the miniscrew failure
- Our study results were not corresponded with the study results of Renjen R *et al.* 2009 have conducted a histological study on the dogs to evaluate the pulp and periodontal ligament response after the intentional inserting of the miniscrew into the tooth root. This study have concluded that the permanent injuries in the pulp and the surrounding tissue are inconclusive result where the miniscrew comes close or penetrates the ental root.

Conclusion

The reparative cementum was founded in the site of inserting the miniscrew in the dental root in all groups which extracted after 3 months from inserting the miniscrew whether it was inserted into the dentin or touch the cementum, and regardless from the orthodontic movement

The inserting of the miniscrew into the tooth root corresponded with visible histological changes on the pulp include degenerative changes (vitrification-, pulp fibrosis and no calcareous degenerative was seen) and hyperemia changes and chronic pulpitis.

The histological change degrees were higher when the miniscrew was inserted into the dentin than when it was inserted to the cementum.

The histological change degrees were higher in the case of presence of the orthodontic movement.

Recommendation and prospects

Recommendation

- Knowledge the anatomy of the area in which the miniscrew will be implanted.
- Taking extra cautions when inserting the miniscrew between the dental roots.
- Using various methods which insured a safe insert of the miniscrew such as apical X-ray and the surgical guide such as the radical wire method and 3D surgical guide [28].
- When the miniscrew is inserted into the dental root,we recommend to remove it immediately and reinsert it in the correct place and observe the 2
- Not to haste performing the pulp treatment when inserting the miniscrew into the dental root.

Prospects

- Conducting more thorough clinical studies regarding determining the depth of the miniscrew inserting using the M.R scanning.
- Conducting clinical study to determine the timing of the start of the cementum reparation.
- Conducting clinical study involves all the different orthodontic movement.

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