

# Efficacy of MTA and CEM Cement with Collagen Membranes for Treatment of Class II Furcation Defects

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## Abstract

**Objectives:** This study aimed to compare the efficacy of MTA and CEM cement in Class II furcation defects in human mandibular molars.

**Materials and Methods:** Forty furcation defects were treated in 16 patients with chronic periodontitis. The clinical parameters of probing depth (PD), vertical and horizontal clinical attachment levels (VCAL and HCAL), open vertical and horizontal furcation depths (OVFD and OHFD), and gingival margin level (GML) were measured at baseline and at 3- and 6-month (re-entry surgery) postoperatively. Data were analyzed at a significance level of  $P < 0.05$ .

**Results:** Use of MTA and CEM caused significant decreases in PD, VCAL, HCAL, OVFD and OHFD at re-entry, with no statistically significant differences between the two treatment options in soft and hard tissue parameters.

**Conclusion:** Both treatment modalities caused significant gains in attachment levels and bone fills, proving efficacy for treatment of Class II furcation involvements.

**Key Words:** Regenerative therapy; Furcation defects; Bioabsorbable; Membrane; MTA; CEM cement

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## INTRODUCTION

Class II furcation involvement of molars poses a therapeutic challenge. Bacterial deposits are accumulated in the furcation area due to the anatomical complexities of the area, making periodontal debridement and personal oral hygiene practice difficult and challenging. Numerous studies have been undertaken in the recent years to evaluate the effectiveness of different techniques to manage Class II furcation involvements [1].

Based on the definition issued by the American Academy of Periodontology, periodontal regeneration entails the reproduction or reconstitution of lost or injured periodontal tissue [2]. A wide array of regenerative techniques are used to manage Class II furcation involvements; which include root surface biomodification with the use of root conditioning agents, coronally positioned flaps, placement of different bone grafts, and guided tissue regeneration (GTR) with the use of either non-

resorbable or bioabsorbable barrier membranes [3-6].

Mineral trioxide aggregate (MTA) was introduced to the dental market as a lateral perforation repair material in 1993 by Loma Linda University. The dental literature is replete with successful animal studies, case reports, and case series in relation to the use of MTA as a material to repair perforations [7-12].

MTA is a derivative of Type I Portland cement and is composed of dicalcium silicate, tricalcium silicate, tricalcium aluminate, and tetracalcium aluminoferrite. It has been demonstrated that MTA exhibits biocompatibility as an endodontic repair material; which is attributed to its capacity to form hydroxyapatite when exposed to simulated body fluid (SBF). MTA is not influenced by contamination with tissue fluids or blood and has low cytotoxicity and good antibacterial effects; in addition, it induces cementogenesis [13], promotes the overgrowth of cementum and regeneration of periodontal ligament and leads to bone formation [14]. Recently, a new endodontic cement, calcium-enriched mixture (CEM) cement was introduced to the field of endodontics. The principal constituents of CEM cement powder are 51.75 wt% CaO, 9.53 wt% SO<sub>3</sub>, 8.49 wt% P<sub>2</sub>O<sub>5</sub>, and 6.32 wt% SiO<sub>2</sub>; minor components include Al<sub>2</sub>O<sub>3</sub>>Na<sub>2</sub>O>MgO>Cl [15]. It has been shown in various studies that MTA induces complete and incomplete formation of hard tissue bridges [7-12] and CEM cement has been shown to exhibit effects similar to those of MTA [16-19].

Considering the results of the above-mentioned studies supporting the formation of bone and osteoconductive and osteoinductive properties of MTA and CEM, the present study was undertaken to evaluate and compare the efficacy of these materials for the repair of furcal perforations. This study was the first to use MTA and CEM cement for treatment of Class II furcation defects.

The aim of this controlled clinical trial was to evaluate and compare the use of MTA and

with collagen membranes for treatment of Class II furcation defects in mandibular molars.

## MATERIALS AND METHODS

Class II furcation defects of mandibular molars underwent treatment in this human study. According to the study by Sanata [20] and considering  $\alpha=99\%$ ,  $\beta=95\%$  and 20% drop out, the sample size was calculated to be 15 teeth. For greater accuracy, the sample size of each group was considered to be 20 teeth. The subjects consisted of patients with chronic periodontitis, referring to the Department of Periodontics at Mashhad Dental School, Iran, seeking treatment. Based on previous studies, a total of 16 systemically healthy patients (9 males and 7 females, 23-62 years of age), with 40 Class II furcation defects in mandibular molars, were selected for this study after obtaining written informed consents. Of 16 patients included in the study, 4 patients had two bilateral Class II furcation defects; the remaining 12 patients had one bilateral defect. The Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran, approved the study protocol and design, the patients' demographic data sheets, and the informed consent forms (Code=900075).

The study was thoroughly explained to patients and informed consents were obtained. Type of treatment for each tooth was determined using a table of random numbers. The preparation of MTA and CEM was carried out with an operator other than the surgeon. Thus, the study had a double blind design. The subjects were randomly assigned to one of the two groups: The subjects in group 1 were treated with MTA (Dentsply, Tulsa Dental, OK, USA) plus resorbable collagen membrane (BioGide Perios, Geistlich, Wolhusen, Switzerland); the subjects in group 2 received CEM (Yektazyst Dandan, Tehran, Iran) plus resorbable collagen membrane (BioGide Perios, Geistlich, Wolhusen, Switzerland). The subjects were followed for six months.

Before the study, intra-oral radiographs were requested to determine the status of the pulp and the periapical tissue in each tooth, maturation of the root, development of apex and the diagnosis of furcal defect.

The inclusion and exclusion criteria were as follows:

#### ***Inclusion criteria***

- (1) Evidence of facial or lingual CI II furcation defects in mandibular molars, confirmed by clinical and radiographic examinations ( $\geq 3$  mm horizontal probing depth)
- (2) Tooth vitality, confirmed by clinical tests and radiographic examinations
- (3) At least 2 mm of keratinized gingiva around the involved tooth
- (4) Signing the consent form for the re-entry surgery at 6-month post-operation

#### ***Exclusion criteria***

- (1) Any systemic disease affecting the periodontal tissues
- (2) Smoking more than two cigarettes per day
- (3) Teeth with previous endodontic treatment or endodontic and pulp pathologies
- (4) Poor oral hygiene
- (5) Pregnancy

The patients received full explanations about the treatment procedure and were fully informed about the necessity of re-entry surgery. Each patient signed an informed consent form. All subjects underwent initial phase periodontal treatment and received intensive oral hygiene instructions. Each patient received full-mouth scaling and root planing. Patients were included in the present study if they still suffered from a furcation lesion upon completion of the initial phase therapy. Traumatic occlusion was also ruled out.

#### ***Clinical measurements***

The defects were classified according to the method described by Hamp et al. [21] using a Nabers probe. Vertical and horizontal measurements were made using the same probe

with Williams markings (Hu-Friedy, Chicago, IL, USA). The measurements were rounded up to the nearest 0.5 mm.

All the clinical measurements were made by one operator to avoid inter-examiner variability.

#### ***Soft tissues***

Soft tissue baseline measurements of parameters were recorded. Measurements included: (1) probing depth (PD), measured from the gingival margin to the base of the pocket; (2) vertical clinical attachment level (VCAL), measured from the cemento-enamel junction (CEJ) or the margin of a restoration; (3) horizontal clinical attachment level (HCAL), measured in the furcation area horizontally using the buccal or lingual surface of the root as a fixed reference level; and (4) gingival recession (GR), measured from the CEJ to the gingival margin.

#### ***Hard tissues***

Measurements included: (1) open vertical furcation defect (OVFD): roof of the furcation to the base of the defect; and (2) open horizontal furcation depth (OHFD): horizontal extent of the defect at the level of the crestal bone.

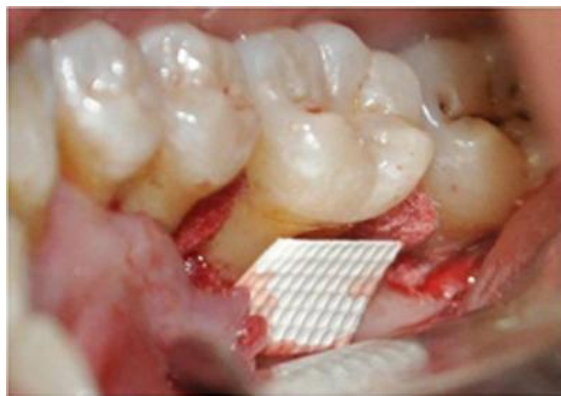
#### ***Surgical protocol***

The surgical procedure was carried out six weeks after phase I periodontal therapy. After induction of local anesthesia using 2% xylocaine with 1:200000 adrenaline, sulcular incisions were made and full-thickness flaps were elevated to expose the involved teeth.

Granulation tissue and visible calculi were removed with hand curettes (Gracey, Hu-Friedy) and ultrasonic devices (Cavitron, Dentsply, NY, USA). Subsequently, the bony defects were irrigated with sterile normal saline solution. At this stage, hard tissue measurements were made using the Williams probe. MTA and CEM cement powders were mixed with water according to the manufacturer's instructions.



**Fig 1.** Application of MTA to the class II furcation defect



**Fig 2.** The collagen membrane was prepared and placed on the defect



**Fig 3.** Primary closure using sutures

In group one, MTA was applied to the furcation defect using an amalgam carrier and condensed up to the level of a plane connecting the eminences of root surfaces near the furcation defect. MTA was well manipulated and condensed on a slab for a few minutes before placement. For better control of bleeding, interdental areas were condensed by two cotton pellets; which were removed after material application. Care was exercised not to overfill the defect beyond the reference plane mentioned above (Figure 1). Subsequently, the collagen membrane was placed and sealed the defect covering 3 mm of the adjacent alveolar bone to stabilize the graft material and maintained in situ with moderate pressure (Figure 2). No sutures or pins were used to fix and stabilize the membranes.

Finally, the flaps were repositioned for tension-free primary closure using modified mattress sutures (3-0 silk, Supa, Tehran, Iran) (Figure 3).

In group two, CEM cement was applied to the furcation defects using the method described above for MTA.

In both groups, a periodontal dressing (Coe-Pak™, GC America Inc, Alsip, IL, USA) was placed on the surgical site.

#### **Postoperative care**

All the surgical procedures were carried out by one operator. The patients received antibiotics for one week (3 × 500-mg amoxicillin capsules/day) and 400-mg ibuprofen tablets every six hours if necessary. The patients were instructed to use 0.2% chlorhexidine gluconate

mouthwash (Shahrdarou, Tehran, Iran) twice daily for two weeks. The sutures were removed at 10 days postoperatively. The patients did not practice any mechanical plaque control procedures for two weeks at the site of surgery. The patients were recalled every two weeks for two months after the surgical procedure. During these visits, the oral hygiene was reinforced and the teeth were cleaned supra-gingivally; no subgingival instrumentation was carried out during these sessions.

At 3 months postoperatively, soft tissue parameters were re-evaluated and recorded. At 6 months postoperatively, flaps were elevated for re-entry specially for cases with heavy plaque and for scaling and root planning if needed, during which hard and soft tissue measurements were repeated. Each furcation area was evaluated during the re-entry session by a non-treating, but calibrated, operator.

#### Data analysis

Statistical significance was defined at  $P < 0.05$ . SPSS 11.0 software was used for analysis of data (SPSS, Chicago, IL, USA).

Repeated measures ANOVA, Bonferroni's test, multivariate analysis, Friedman's test, Mann-Whitney test and Student's t-test were used for statistical analysis as follows: The Friedman's test and Bonferroni's test were used for evaluation of RDD in CEM and MTA groups and HCAL in CEM group. Repeated measures ANOVA and Bonferroni's test were used for evaluation of HCAL in MTA group and VCAL, GML, and PPD in both MTA and CEM groups. The Student's t-test was applied for evaluation of RDD, OHFD, OVFD, HCAL, VCAL, GML and PPD in baseline; RDD, HCAL, VCAL, GML and PPD after 3 months; and VCAL, GML and PPD after 6 months. The Mann-Whitney test was used for evaluation of RDD, OHFD, OVFD and HCAL after 6 months.

#### RESULTS

A total of 40 furcation defects were evaluated in this study; 20 of which were treated with MTA + collagen membrane and the remaining 20 were treated with CEM + collagen membrane.

**Table 1.** Comparison of soft tissue parameters between treatment results with MTA and CEM at baseline, 3 months and 6 months (re-entry) in mm

Variable	Group	Baseline	Three months	Six months	F	P
RDD	MTA	4.08±1.06 <sup>a,b</sup>	0.33±0.58 <sup>a</sup>	0.17±0.25 <sup>b</sup>	122.04	p<0.001
	CEM	4.37±1.42 <sup>a,b</sup>	0.33±0.58 <sup>a</sup>	0.08±0.19 <sup>b</sup>	92.45	p<0.001
	P	0.574	1	0.356		
HCAL	MTA	2.33±1.8 <sup>a,b</sup>	0.33±0.39 <sup>a</sup>	0.417±0.36 <sup>b</sup>	13.55	0.003
	CEM	2±1.98 <sup>a,b</sup>	0.25±0.39 <sup>a</sup>	0.17±0.25 <sup>b</sup>	10.37	0.008
	P	0.67	0.61	0.07		
VCAL	MTA	6.46±1.8 <sup>a,b</sup>	3±1.17 <sup>a</sup>	3.33±0.83 <sup>b</sup>	57.13	p<0.001
	CEM	6.58±1.82 <sup>a,b</sup>	2±1 <sup>a</sup>	2.21±0.92 <sup>b</sup>	125.7	p<0.001
	P	0.867	0.035	0.005		
GML	MTA	-1.17±1.27 <sup>a,b</sup>	-1.92±1.22 <sup>a</sup>	-2.17±1.15 <sup>b</sup>	9.53	0.007
	CEM	-0.58±0.87 <sup>a,b</sup>	-1.25±0.84 <sup>a</sup>	-1.33±0.83 <sup>b</sup>	27.69	p<0.001
	P	0.203	0.133	0.055		
PPD	MTA	5.29±1.05 <sup>a,b</sup>	1.08±0.63 <sup>a</sup>	1.17±0.89 <sup>b</sup>	144.59	p<0.001
	CEM	5.83±1.40 <sup>a,b</sup>	.75±.58 <sup>a</sup>	.96±.33 <sup>b</sup>	213.42	p<0.001
	P	0.297	0.194	0.455		

A: Statistically significant difference between baseline and 3 months

B: Statistically significant difference between baseline and 6 months

All the subjects were cooperative and returned for re-entry evaluation at 6 months postoperatively. Healing was favorable and uneventful in both groups but the truth is we cannot completely treat the furcation defects with (GTR) alone.

There were no significant differences in baseline variables between the two groups, indicating that the differences between the two groups at final evaluation were not influenced by the initial characteristics of the defects; thus, the postoperative results could be easily compared. The soft and hard tissue changes at 3 and 6 months postoperatively in both groups and the intergroup comparisons are presented in Tables 1 and 2.

The mean baseline pocket depth was similar in both groups ( $P=0.297$ ). At 3 months postoperatively, the mean pocket depth reduction in the MTA and CEM groups was 4.21 and 5.08 mm, respectively. Pocket depth decreased significantly in both groups compared to baseline values, with no statistically significant differences between the two groups ( $P=0.194$ ). At 6 months post-operation, pocket depths increased in comparison to 3 months in both groups; however, the changes were not statistically significant.

Evaluation of soft tissue outcomes at 3 months post-operation showed significant improvements in VCAL and HCAL in both groups compared to baseline.

In relation to HCAL variable, the difference between the two groups was not significant at 3 and 6 months postoperatively.

However, in relation to the VCAL variable, attachment level improvement with CEM cement was significantly greater than that with MTA at 3 ( $P=0.035$ ) and 6 months ( $P=0.005$ ) post-operation. The improvements in VCAL and HCAL in the MTA group were 3.13 and 1.91 mm, respectively. In the CEM group, VCAL and HCAL improvements were 4.37 and 1.83 mm, respectively, with no statistically significant differences at 3 and 6 months between the two groups in any of the variables (Table 1).

Evaluation of the gingival margin level at 3 and 6 months post-operation revealed no significant differences between the MTA and CEM groups in gingival recession.

Evaluation of hard tissue outcomes at the 6-month re-entry showed significant improvements in vertical and horizontal bone fills in both groups in comparison to baseline. The improvements in vertical bone fill and horizontal bone gain in the MTA group were 3.5 ( $P<0.001$ ) and 3.76 mm ( $P=0.002$ ), respectively. Vertical and horizontal bone fill improvements in the CEM group were 4.08 ( $P<0.001$ ) and 3.66 mm ( $P=0.002$ ), respectively (Table 2).

## DISCUSSION

It is difficult to control the factors affecting the outcomes of regeneration therapy of furcation defects; which include the oral hygiene, smoking, occlusal loads, pulpal status and furcation-related factors such as root divergence or root trunk length [3].

**Table 2.** Comparison of hard tissue parameters between treatment results with MTA and CEM at baseline, and 6 months (re-entry) in mm

Variable	Group	Baseline	Six months	P
OHFD	MTA	3.84±0.62	0.08±0.19	0.002
	CEM	3.66±.57	0.0±0.0	0.002
	P	0.382	0.148	
OVFD	MTA	3.83±.49	.33±.39	p<0.001
	CEM	4.33±0.83	.25±.40	p<0.001
	P	0.003	0.514	

In the present study, an attempt was made to control and exclude the confounding variables; therefore, smokers and teeth with endodontic and pulpal involvement were excluded.

In groups I and II, MTA and CEM were applied, respectively, in combination with a membrane barrier. MTA has been used successfully in various clinical studies to repair furcal perforations [7-12, 22]; but to the best of our knowledge, MTA has not been used for the treatment of Class II furcation defects. CEM cement has been used for endodontic surgical operations and repair of furcal perforations in animal studies [23-25]. This study was the first to use CEM cement for treatment of Class II furcation defects.

CEM is a bioactive calcium- and phosphate-enriched material, consisting of a white powder with hydrophilic particles. It is mixed with a water-based solution a few minutes before placement. This reduces the solubility of CEM during clinical application. Recent studies have shown that mixed CEM cement releases calcium and phosphate ions and then forms hydroxyapatite in both simulated body tissue fluids (SBF) and in normal saline solution. It has a similar pH value and increased flow, but decreased setting time, film thickness, and price compared to MTA. The chemical composition of CEM cement is different from that of MTA; but it has clinical uses similar to those of MTA [15, 18].

The use of MTA and CEM in this study was based on the hypothesis that they have the potential of bone formation, osteoconduction and regeneration [22-30]. Zhu [30] reported that osteoblasts attach to and spread on MTA surface by forming a monolayer. Bonson [26] showed that MTA has the capacity to induce alkaline phosphatase expression and activity in the PDL and gingival fibroblasts. Tomson et al [29] reported that MTA induces cementoblast attachment and growth, has a role in the production of mineralized matrix gene and protein expression and has cementoconductive activity.

Perinpanayagam [27] showed that cells attach to and spread out on the surface of MTA within 24 hours and form a collagenous matrix overlay within 1 week of growth. Asgary [23] showed regeneration of periapical tissues with the use of CEM cement and MTA as root-end filling biomaterials in dogs, with no statistically significant differences in the response of periradicular tissues to these materials. Rahimi [24] demonstrated osseous reaction to CEM and MTA in a rat femur model. Bone formation was similar in both groups. One week after implantation, slight bone formation was observed; which was consisted of bony islets and coverage of less than 25% of the material surface with bone. At four weeks, there was moderate bone formation, i.e. coverage of at least 50% of the material surface with bone; and finally after eight weeks extensive bone formation was observed, consisting of complete coverage of the material surface with bone or the formation of an osseous bridge around the material. Samiee [25] compared the histological outcomes of repairing furcal perforations with MTA and CEM cement in dog, reporting that MTA and CEM cement exhibited similar and favorable biological response after furcation perforation repair procedures, particularly by inducing a cementum-like hard tissue.

Asgary et al. compared chemical properties of MTA and CEM using a scanning electron microscope and electron probe microanalysis (EPMA) technique. They reported endogenous phosphate in CEM [18]. In another study, Asgary reported that presence of significant concentrations of calcium and phosphate ions in CEM is more efficacious in forming hydroxyapatite in comparison to white MTA [15].

The osteogenic activities of MTA and CEM are attributed to the release of large amounts of calcium ions from these materials; which interact with the phosphate groups in the surrounding tissue fluid to form hydroxyapatite on MTA and CEM surfaces. This hydroxyapatite layer is highly biocompatible, has low tox-

icity and might possess osteogenic potential since it releases calcium and phosphorus ions, with a role in bone metabolism [24, 26-30]. Other mechanisms of hard tissue deposition include an alkaline pH value [28], the potential to attract blastic cells and to promote a favorable environment for the formation of cementum [8], potential to induce expression of alkaline phosphatase by fibroblasts [28], conductive effect on bone and cementum [31], the capacity to induce adhesion and cell proliferation [32] and expression of osteocalcin and other interleukins by osteoblasts [33].

Good clinical results were achieved in both groups, with no statistically significant difference between them. During this study, no infection, abscess or delayed healing was observed or reported by any patient, even in patients with poor plaque control, which might be attributed to antibacterial properties of MTA and CEM released over time [34, 35]. Only mild marginal gingivitis was observed on the sites undergoing treatment. Soft tissue inflammatory processes and their durations were greater in patients treated with MTA. Mild pain was reported by some patients at the surgical site and the number of patients with mild pain was higher in the MTA group compared to the CEM group.

In relation to the delivery of materials to the surgical site, handling and delivery of MTA was more difficult compared to that of CEM. CEM cement set more rapidly and preserved its consistency better than MTA in the furcation area, with less dispersion and inflammation in the adjacent tissue. Presence of colloidal particles at flap margins during suture removal and even 2 weeks after the surgical procedure was common in both groups. Virtually in all the cases treated with MTA, tissue darkening was observed. In the CEM group, irrespective of gingival recession, no pockets were observed or they were trivial. In addition, the periodontal probe did not penetrate into the space between the soft tissue and CEM even with pressure and the flaps were elevated with

difficulty during re-entry. This finding was not frequently seen in cases treated with MTA. Soft tissue adhesion to the graft material was weak in cases treated with MTA due to inflammation or wash-out of MTA. In none of the groups any dehiscence of graft materials from tooth surfaces was observed. On radiographic examination, graft materials were clearly radiopaque and easily distinguished from the surrounding bone and roots in both the MTA and CEM groups. There was no bone reaction or radiolucency. No tooth ankylosis or distinct changes in the opacity of surrounding bone were seen.

Our study showed that application of MTA and CEM for Class II furcation defects gave rise to significant improvements in HCAL and VCAL at 3 months postoperatively. In fact, large variations can be found in the literature when gains in the vertical and horizontal attachment levels are considered. Gains in VCAL and HCAL, in the range of 0.2–4 mm, have been documented [36].

In our study, improvements in HCAL and VCAL in the MTA group were 1.19 and 3.13 mm, respectively. In the CEM group, HCAL and VCAL improved by 1.83 and 4.37 mm, respectively. Both materials gave rise to HCAL and VCAL improvements. There are no similar studies on the use of MTA and CEM for the treatment of Class II furcation defects; therefore, the results of this study were compared with the use of a different material. Bowers [37] used ePTFE membrane along with DFDBA to treat Class II furcation defects and reported a decrease of 1.62 mm in pocket depth. Lekovic [38] applied platelet-rich plasma plus bovine porous bone mineral plus GTR to treat mandibular grade II molar furcation defects and reported a 4.07 mm reduction in pocket depth. In our study, pocket depth reduction in the MTA and CEM groups was 4.21 and 5.08 mm, respectively. In both groups, improvements in pocket depths were statistically significant compared to the baseline values and were similar to each other.



Although improvements in OVFD and OHFD were not equal to vertical and horizontal bone fills of the defect, respectively, they were important factors for the assessment of furcation defect treatment success. Studies on the application of different methods for treatment of furcation defects have shown a wide range of OVFD and OHFD changes [37-40]. Houser [40] showed improvements of 2 and 0.5 mm in OVFD after application of Bio-OSS+Bio-Gide and platelet-rich plasma (PRP), respectively. Jepsen [5], in a systematic review evaluated the results of six studies for the treatment of furcation defects and reported improvements of 1.77 mm in OVFD after treatment of Class II furcation defects. The results of our study showed reductions of 4.08 and 3.5 mm in OVFD in the CEM and MTA groups, respectively. Both materials resulted in significant improvements in OVFD at 6 months post-operation, with comparable effects on the vertical bone fill. In addition, OHFD was 3.66 mm in the CEM group and 3.76 mm in the MTA group, indicating significant improvements compared to baseline values. However, there were no significant differences between the two groups. If Class II furcation defect is defined as a defect with a horizontal depth of more than 3 mm and Class I defect is defined as a horizontal defect of  $\leq 3$  mm, in our study 95.3% and 100% of the sites treated with MTA and CEM, respectively, were converted to Class I and none progressed to Class III. An ideal treatment modality for furcation defects has minimal effect on gingival margin level in addition to improving periodontal attachment, without causing apical migration of the gingival margin. Bowers [37] reported 0.39 mm of gingival recession after the application of ePTFE membrane along with DFDBA for the treatment of CI II furcation defects. Anderegg [39] reported 1.3 mm of gingival recession with the application of DFDBA+ Gide for furcation defects. In our study, gingival recession was 1 mm with MTA and 0.75 mm with CEM.

It should be pointed out that these recession values were not statistically significant in the two groups.

Finally, both MTA and CEM treatments gave rise to a significant improvement in the periodontal indexes. Further studies for long-term evaluations of MTA and CEM cement with larger sample sizes are recommended before they are used for treatment of Class II furcation defects.

## CONCLUSION

Based on the results of the present study, both MTA and CEM were effective in the treatment of Class II furcation defects. Therefore, MTA and CEM can be considered alternatives for other more expensive regenerative treatment modalities for furcation defects.

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