Egyptian
Orthodontic Journal

EFFECT OF ACIDIC SOFT DRINK ON SEALED ENAMEL AND BOND STRENGTH OF TWO ORTHODONTIC RESINS.

Salama E. A*. and El Mehy GH.**

ABSTRACT

The purpose of this current study was to evaluate the effect of acidic soft drink (Cola type) on etched and sealed enamel and bond strength of conventional chemical cure and fluoride releasing light cure orthodontic resins. Twenty extracted premolars were collected and part of the buccal surfaces were etched and then divided into two groups. The first group (n=10) was sealed with chemical cure and the second group (n=10) was sealed with fluoride releasing light cure resin and buttons were bonded. The teeth were prepared and exposed to cola, the sample was tested to evaluate the difference of shear bond strength of both groups, then the samples were examined under electron microscope scanning. The results indicated that enamel defect zones were observed in both groups, but the fluoride releasing groups was less than that of the chemical cure resin. Shear bond strength was significantly high in fluoride releasing group than that of the conventional chemical cure resin.

INTRODUCTION

Despite careful patient selection, decalcification of enamel still remains a problem during fixed orthodontic treatment decalcification can

be defined as the loss of calcified tooth tissue. It occurs when calcium and phosphorus ions leave the enamel, and it can be brought on by a change in the PH value of the oral environment below the critical level PH 5.5 indeed many soft drinks consumed today have a PH well below this value [(1)].

*Ahmed E. Salama, Lecturer of Orthodontics, Fac. of Dent. Al-Azhar Univ.
**Ghada A.El-Mehy, Lecturer of Orthodontics, Fac. of Dent. Tanta Univ.

The first in vitro study of morphological changes resulting from enamel decalcification was conducted by Head (1910). The decalcification areas were macroscopically observed as softened white spots on the enamel of teeth incubated within orange pulpy segments [2].

Ten Cate et al (1991)[3] showed loss of calcium from human root surfaces exposed to artificial demineralization caused by a pH 4.8 substances during different time periods. Polarized light microscopy demonstrated the direct relationship between the mineral sissolution and the time of demineralization.

It was reported that the relationship of bacteria, sugar and time to enamel decalcification is well accepted, however other factors, including oral hygiene, nutrition, and orthodontic appliances which restrict the ability of the tongue to remove food particles from the mouth, also increases the risk of decalcification. The type of acids can also play a critical role in decalcification [4,5]. It was found that drinks that contain citric acid have been shown to be more erosive than those containing phosphoric acid [6]. Malic acid containing sport drinks was shown to cause only slight erosion when compared with the same drinks with citric acid [7]. Thus, there is no doubt that the chemical composition of an acidic drink is important with regard to enamel decalcification.

Gedalial et al., (1991)[8] observed enamel softening after cola was applied to the tooth surface for 1 hour. According to the researchers, chewing hard cheese can provide rehardening and perhaps reformation of calcium and phosphorus ions, but chewing paraffin to produce saliva does not have the same effect.

Cola type beverages were suggested to produce more enamel decalcification on etched tooth surface than other acidic soft drinks in the study of [9] Dincer. In a simulated oral environment, the test beverages were cola, orange soda, lemon soda and sparkling mineral water.

It was demonstrated that glass ionomer is effective in reducing demineralization but on the other hand it has a weaker bond strength than composite resin this had led researcher to be guarded over their clinical acceptability [10,11].

The application of fluoride solution on initial enamel decalcification of human third molars immersed in cola type beverage for up to 15 minute cause an increase in enamel hardness and thus resist decalcification [12].

Some reports [13,14] showed that the topical application of fluoride might interfere with the etching effect of phosphoric acid on enamel surface, resulting

in reduced bond strength of the resins. Other studies[15,16,17] however, demonstrated that the topical application of fluoride to enamel surfaces did not negatively affect the etch pattern on the enamel or the bond strength of composite resins.

The aim of this study was to compare the use of conventional chemical cure and fluoride releasing light cure resins with exposure to Cola type acidic soft drink, and to evaluate shear bond strength of both groups.

Materials and methods

Tooth specimens:-

The sample of this study was collected from patients undergoing extraction orthodontic treatment at the Department of Orthodontics, Faculty of Dentistry, of both Al-Azhar University, Girls section and Tanta University. Twenty freshly extracted sound premolars without any treatment with any chemical agents were used. The premolars were cleaned with pumice and brush, washed, dried then the first parts of the buccal surfaces were etched with 37% phosphoric acid for 60 second. The sample was divided into two groups, group one (n=10) was sealed with conventional chemical cure composite (No- mix direct bond) and group two (n=10) was sealed with Fluoride releasing light cure composite (Relay– A-bond). Shear bond strength of the tested groups was evaluated using Instron Universal testing machine at AL-Azhar University.

Preparation of teeth:-

The buccal surface of each premolar was divided into two main parts; the first part which was etched and sealed to bond a button, the second part was covered by sticky wax before bonding which removed just before the Scanning electron microscope (SEM) which represented normal enamel texture.

Test drink:-

The test beverage used in this study was Coca-Cola as it was reported by Dincer et al (2002), to have the most decalcification effect on enamel surface. The PH value of cola was determined by Dincer et al (2002) to be 2.7. The soft drink was Dept at room temperature, the teeth were held in the cola for 15 minutes and then in artificial saliva for 2 hours, this was repeated for three times a day for 7 days and then the specimens were kept in artificial saliva until scanning performed. Artificial saliva which was used in this study was prepared by faculty of Pharmacy, Cairo University and kept at room temperature.

SEM study:-

After exposure to the cola the samples were gold coated via sputtering (Ladd sputter coated, USA) with a thin layer of gold then morphologically examined under the scanning electron microscope (Joel, XL Philips, Holland).

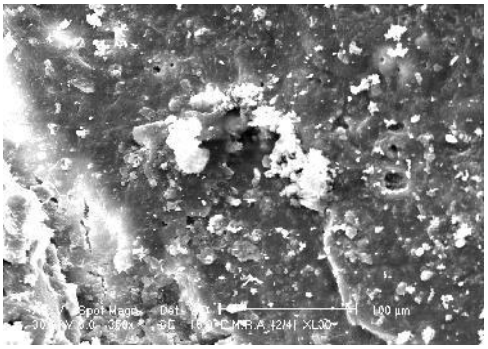

Fig.1 Areas of demineralization beside bracket

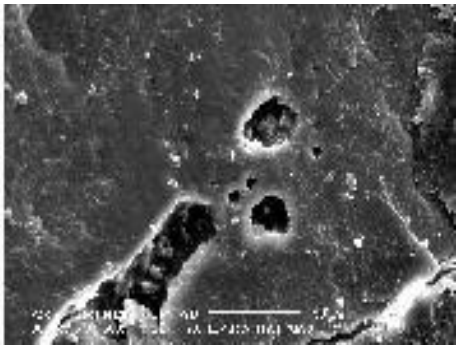

Fig.2 Areas of Decalcification appeared on tooth surface

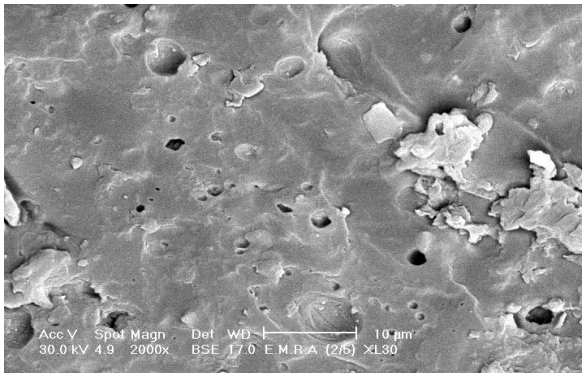

Fig.3 Areas of Decalcification (Higher Magnification)

RESULTS

Electron photomicrographs evaluation showed that there were demineralized areas of the first part of the buccal surfaces of both groups. The fluoride release group showed demineralized zones lesser than that of the conventional resin group. The second part of the buccal surfaces (control) represents normal enamel.

The statistical analyses of shear bond strengths of both groups are presented in table (1). Shear forces are given in Newton. The results of the T-test indicated significant differences of both groups ($p<0.05$). Bond strengths of Fluoride release group were higher than that of the conventional resin group.

Table (1):- statistical analysis of shear bond strengths of both the tested groups:-

Group	n	Mean	Standard deviation	Standard error	T-test	P-value
Fluoride releasing light cure	10	120.34	39.87	12.61	3.13	0.006*
Conventional chemical cure	10	78.94	12.70	4.02		

* Significant.

DISCUSSION

The significance of fluoride on sealed enamel and on bond strength was originally questioned. Manufacturers have incorporated fluoride into orthodontic resin to help in prevention or reducing enamel decalcification.

The in vivo studies on dental decalcification of human teeth are ethically limited, studies of extracted human or animal teeth are necessary[18].

The purpose of this present study was to evaluate the effect of acidic soft drink (cola-type) on sealed enamel and bond strength among fluoride releasing light cure resin and conventional chemical cure resin. After the experiment (just before EMS) the wax coating was mechanically removed (as a block without leaving any trace).

In this study EMS showed that there was enamel demineralization defect observed at the interface between waxed and unwaxed enamel surfaces of both the tested groups, this was in agreement with many other studies [1,8,9,19].

Fluoride releasing resin was found to produce less enamel decalcification than that of the conventional resin. The effect of fluoride on the tested group was explained by Ogaard et al[20] who reported that a larger part of the deposited fluoride was retained in an alkali insoluble form (fluoroapatite) if compared with sound enamel. The effect of topical fluoride to decrease decalcification of enamel was suggested in many studies [21,22,23].

The significance of fluoride on shear bone strength was originally questioned because fluoride releasing was used in this current study it was found that there was a significant difference among the two tested groups. Fluoride releasing light cure resin showed higher shear bone strength than that of the conventional resin. This might be due to the curing method.

On the other hand it was suggested that topical administration of fluoride has little or no effect on enamel bone strength than that of the conventional resin. This might be due to the curing method.

On the other hand it was suggested that topical administration of fluoride has little or no effect on enamel bond strength. [25 – 26 – 27]. However other studies [13 – 14] suggested that topical application of fluoride can result in reducing bond strength of dental resins.

Reynolds[28] reported that minimum bond strength of 6 – 8 mega Pascal (MPa) was adequate for most clinical orthodontic needs, to be able to withstand masticatory and orthodontic force.

All the in vitro laboratory studies of bond strength can't predict clinical performance but considered only as a screening tool. The reliability and clinical relevance of laboratory bond strength studies have been criticized[29].

Kimura et al [28] recommended that most bond strength studies use the bracket base area in calculating stress. This will not allow interpretation across other studies because brackets differ in design and size and bracket base morphology varies significantly.

Recommendation:-

From this study it was found that acidic soft drinks affect the integrity of the bonded enamel in spite of using fluoridated resin, so it is recommended that:-

1- Orthodontists have to advice their patients to decrease the frequency of acidic soft drinks intake mainly Cola- type.

2- The orthodontist should give the parent and patients motivation and education to perform proper oral hygiene including using additional topical fluorides.

3- The use of fluoride releasing resins was preferable than that of conventional resin.

4- Orthodontist should avoid the presence of adhesive flash around the bonded orthodontic attachment, to restrict the bond material to the area, that covered by the base to prevent the erosive effect of the soft drinks of the adhesive material and by pass it to affect the underlying etched enamel.

REFERENCES

1. Ireland A.J, MC Guinness N, Sheriff M: An investigation into the ability of soft drinks to adhere to enamel. Caries Res. 1995: 29:470 – 476.
2. Grando LJ, Tames DR, Cardoso AC, Galiban NH: In vitro study of enamel erosion caused by soft drinks and lemon juice in deciduous teeth analyzed by stereomicroscopy and scanning electron microscopy. Caries Res. 1996 , 30: 373 – 8.
3. Ten-Cate JM., Nyvad B., Plassche-Simons YM vande, Fejersko O: A quantitative analysis of mineral loss and shrinkage of in vitro demineralized human root surface. J.Dent. Res. 1991, 70: 1371 – 1374.
4. Asher C, Read MJF: Early enamel erosion in children associated with the excessive consumption of citric acid. Br. Dent. J. 1987 162: 384 – 7.
5. Mitchell L: Decalcificaiton during orthodontic treatment with fixed appliances – An overview. Br, J. orthod. 1992;19, 199 – 205.
6. Holloway PJ, Mellanby M, stewart BJC: Fruit drinks and tooth erosion Br. Dent . J. 1985; 104: 305 – 309.
7. Meurman JH: Progression and surface ultrastructure. Caries. Res. 1991.,25: 81 – 7.
8. Gedalia I, Ionat-Bendat D., Ben-Mosheh S and shopiral: Tooth enamel softening with cola type drink and rehardening with hard cheese or stimulated saliva in situ J. Oral. Rech. 1991; 18: 501 – 6.
9. Dincer B, Hazar S. and Sen B.H: Scanning electron microscope study of the effect of soft drinks on etched and sealed enamel. Am. J. Orthod. Dentofac. Orthop 2002;122: 135 – 41.
10. Fox, N.A: Bond strength of orthodontic bonding materials: An in vitro study. Br. J. Orthod. 1991; 18: 125 – 130.
11. Rezk- lega F. and Ogaard. B: Tensile bond force of glass ionomer cements in direct bonding of orthodontic brackets: An in vitro comparative study, Am, J. Orthod. Dentofac. Orthop. 1991; 100; 325 – 361.

12. Sorvari R., Meurman JH., Alakuijala P. and Frank RM: Effect of fluoride varnish and solution on enamel erosion in vitro. Caries Res. 1994; 28: 227 – 232.

13. Garcia- Godoy F., Hubbard GW., Storey AT: Effect of a fluoridated etching gel on enamel morphology and shear bond strength of orthodontic brackets AM. J. Orthod. Dentofac. Orthop. 1991; 100: 163 – 70.

14. Meng CL, liCH and Wang WN: Bond strength with APF applied after acid etching.. Am. J. Orthod. Dentofac. Orthop. 1998; 114: 510 – 3.

15. Wang WN, Sheen DH: The effect of pretreatment with fluoride on the tensile bond strength of orthodontic bonding. Angle Orthod 1991; 61 : 31 – 4.

16. Meng CL., Wang WN., Yeh IS: Fluoridated etching on orthodontic bonding. Am . J. Orthod. Dentofac. Orthop. 1997; 112: 259 – 62.

17. Bishara SE, Chan D. and Abadir EA: The effect on the bonding strength of orthodontic brackets of fluoride application after etching. Am. J. Orthod. Dentofac. Orthop. 1989; 95: 259 – 60.

18. Mistry M., Grenby TH: Erosion by soft drinks of rat molar teeth assessed by digital image analysis. Caries Res. 1993; 27 : 21 – 5.

19. Van Eygen I., Vande Vannet B. and Wehrbein H: Influence of a soft drink with low pH on enamel surfaces: An in vitro study. Am. J. Orthod. Dentofac. Orthop. 2005; 128: 372 – 7.

20. Ogaard B., Rolla G and Helgeland K: Alkali soluble and alkali insoluble fluoride reterntion in demineralized enamel in vivo. Scand. J. Dent. Res. 1983; 91 : 200 – 4.

21. Boyd RL: Comparison of three self- applied topical fluoride preparations for control of decalcification. Angle Orthod. 1993; 26 : 25 – 30.

22. Boyd RL: Long term evaluation of a SnF2 gel for control of gingivitis and decalcificaiotn in adolescent orthodontic patient Int. Dent. J. 1994; 44: 119 – 30.

23. Chadwick BL., Jayne R, Jeremy K. and Elizabeth T: The effect of topical fluorides on decalcificaiotn in patients with fixed orthodontic appliances: A systematic review Am. J. Orthod. Dentofac. Orthop. 2005; 128: 601 – 6.

24. Powers JM., Messersmith ML: Enamel etching and bond strength in: Brantley WA. Eliades T. editors orthodontic materials: scientific and clinical aspects. New York: Thieme. 2001; 107 – 22.

25. Garcia- Godoy F: Shear bond strength of a resin composite to enamel with an APF gel. Pediatric Dent. 1993; 15 : 272 – 4.

26. Damon PL, Bishora SE, Olsen ME, Jakobsen JR.: Effect of fluoride application on shear bond strength of orthodontic bracket. Angle Orthod. 1996; 66 : 61 – 4.

27. Kimura T., Dunn W., Taloumis L: Effect of fluoride varnish on the in vitro bond strength of orthodontic bracket using a self-etching primer system. Am. J. Orthod. Dentofac. orthop. 2004; 125 : 351 – 6.

28. Reynolds IR: A review of direct orthodontic bonding. Br. J. orthod. 1975; 2: 171 – 8.

29. Eliades T., Lekka M. Eliades G., Brantly WA: Surface characterization of ceramic brackets: a multitechnique approach. Am. J. orthod. Dentofac orthop.1994;105: 10 – 8.