*Available online* **www.ijpras.com**

**International Journal of Pharmaceutical Research & Allied Sciences, 2018, 7(4):7-12**


**Research Article**

**ISSN : 2277-3657**
**CODEN(USA) : IJPRPM**

# *In Vitro Comparison of Sports Drinks' Effect on the Hardness of Different Temporary Restorative Materials*

**Osama A Qutub**

*BDS, DScD, Assistant Professor, Oral and Maxillofacial Prosthodontics Department, Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia.*

**ABSTRACT**

*Dental erosion has become a pervasive and persistent dental problem in all age groups across the globe. One of the most common causes of dental erosion and failure of restoration is the consumption of acidic food and drinks. The primary challenge in the durability of restorative composite materials is dental erosion. However, some temporary restorative materials are more resilient, and their surface microhardness is higher than other materials. In this study, four temporary restorative composite materials including GC, Cad Temp, Kerr and ProTemp have been used to evaluate and analyze the impact of sports drinks, which included Red Bull, C Vitamin, and Cod Red beverage. It has been concluded that the surface microhardness of all the restorative materials had deteriorated after their immersion in all the drinks. However, some restorative materials had less deterioration in certain drinks in comparison to other drinks. Selection of restorative materials should be considered by individuals, who have preferences for certain drinks and who consume those particular beverages.*

**Keywords:** *Dental erosion, Failure of restoration, Microhardness, Restorative materials*

## INTRODUCTION

In recent years, the intake of sports and energy drinks has gained much popularity. The sports drinks are consumed for boosting performance, replacing electrolytes, and preventing dehydration during high-activity sports. These drinks are extensively used to enhance physical resistance, increase the rate of giving responses, increase the state of awareness, and stimulate the athletes' metabolism during sport activities [1]. Sports drinks are different from energy drinks as they contain an active ingredient, known as caffeine. Caffeine is not added in the sports drinks as it does not support rehydration.

Sports drinks contain electrolytes that help to keep the individual hydrated. Additionally, they help replenish the minerals that have been lost through sports. The different electrolytes; such as sodium, chloride, potassium, magnesium, calcium and phosphate are vital for the healthy functioning of the body. These electrolytes help the nerves and muscles to stay balanced and work optimally. Apart from electrolytes, sports drinks contain a higher concentration of sugar particles. They also contain acids that cause cavities, and they have been proven detrimental for oral health. The acid and the extra sugar in the sports drinks induce the growth of bacteria in teeth, leading to various oral health problems; like gum diseases, cavities and periodontal diseases. The low pH level and high acidic content of sports drinks can result in erosion of the enamel and dentin. Furthermore, they might also damage the restorative materials, discolor the glass ionomers and resin composite materials [1].

The erosive lesions in the teeth have been successfully treated through a variety of restorative materials including glass ionomer cement, resin composite, and resin modified glass ionomer. There has been a significant increase in the use of composite resins due to their enhanced formulations, excellent aesthetic appearance, and ability to create

bond with the hard dental tissues [2]. Hardness of restorative materials is linked with compressive strength, degree of conversion, and their resistance to acidic changes in the environment. A restoration is likely to fail due to the reduction in the value of surface hardness causing inadequate wear resistance [3]. Surface degradation can also occur due to the acidic nature of sports drinks. Consuming sports drink can lead to the loss of subsurface ions; such as silicone and calcium resulting in surface degradation. It ultimately results in roughening of the surface and a reduction in wear resistance. Furthermore, acids in the sports drinks also infiltrate in the resin matrix, subsequently releasing unreacted monomers to the environment, leading to lower surface hardness scores of the composite resins [4].

A study conducted by [5] has shown that the consumption of sports drinks is one of the major factors responsible for causing dental erosion. The occlusal height of the composite resin in the filled tooth is decreased due to the roughening of the surface that is caused by the wear and chemical degradation. Sports drinks have the ability to reduce the surface hardness of the restorative materials; however, the impact of the sports drinks on the restorative material has not been studied extensively. Therefore, this study aimed to evaluate the impact of the sports drinks on the hardness of different temporary restorative materials.

**Literature Review**

A study by [6] was conducted to examine the effects of five beverages; such as Coca-Cola, coffee, beer, orange juice, and apple cider on the surface characteristic changes and the microhardness of giomer and nanohybrid resin composite. Nanohybrid resin composite is widely being used because of its combination of mechanical, physical, and esthetic features. Surface characteristics and the baseline data of vicker's microhardness were examined with the scanning electron microscopy (SEM) before immersing the discs. 93 specimens of each giomer and resin composite were prepared. Five groups of discs were alternatively immersed in 25ml of each drink for 5 seconds, and 25ml of artificial saliva for 5 seconds for a total of ten cycles. Subsequently, the discs were stored in artificial saliva for 24 hours. This was repeated for 28 days. The study came to a conclusion that the microhardness of all the groups of discs decreased after they were immersed in the drinks. Surface degradation was seen in all the groups through scanning electron microscopy photomicrographs [6].

Another study by [7] was conducted to compare the microhardness of amalgam, resin composite, and glass ionomer cement when they were exposed to three acidic drinks and distilled water. This experimental six-month study was conducted in de' Montmorency college of dentistry. 96-disc specimens were prepared with three restorative materials. The baseline study of the microhardness was done at one day after mixing and before immersion. The restorative material specimens were the storage media containing orange juice, apple juice and cola; however, distilled water was used as the control. A quantitative examination of the final surface microhardness of the material specimens was conducted at 2, 5 and 7 days after the immersion of the discs. It was concluded that the exposure to acidic drinks reduced the surface microhardness of all the 3 restorative materials. Distilled water did not affect the microhardness of the restorative materials. Furthermore, amalgam and resin composite showed less reduction in the surface microhardness as compared to the resin modified glass ionomer cement. Therefore, it was revealed that amalgam and resin composite provided the best stability and constancy under acidic conditions [7].

## METHODOLOGY

This study included four restorative materials: TemPhaseTM (Kerr Corp., Orange California), UNIFAST III (GC Corp., Tokyo, Japan), ProtempTM (3M-ESPE.Seefeld Germany), and CAD Temp® (Vita Zahnfabrik, Bad Sackingen, Germany) to evaluate the impact of the sports drinks: Red Bull, Vitamin C and Cod Red beverages on the material hardness. Polytetrafluoroethylene mold was used to make 40 specimens of TemPhaseTM, UNIFAST III and ProtempTM. The molds were over-filled to avoid any air bubble, and then covered with glass slides and mylar strips. Also, 40 samples of CAD Temp® blocks were sectioned using a diamond saw disc under the water coolant (Techcut 4, ALLIED high tech products, USA). All samples were stored in deionized water for 24 hours. A flat polished surface was obtained by polishing the sample with fine and ultra-fine aluminum oxide abrasive disks. 10 samples from each restorative material were immersed in a container with 20 ml of each sport drink for 7 days with the controlled group stored in the distilled water. All of the solutions were refilled, and the pH of those solutions were recorded on daily basis. A digital microhardness tester was used to obtain Vicker's hardness measurements. The Vickers indentation process was done, and the diagonal lengths of the indentations on the material surface with Micromet® 2003 Micrhardness Tester (Buehler, Lake Bluff, Illinois) were measured. The applied load was adjusted

to 300 g with the dwelling time of 15 seconds for all. Ten measurements were made on each sample, and the mean was calculated. The data obtained was analyzed using Statistical Package of Social Sciences (SPSS) version 20.0.

**RESULTS AND DISCUSSION**

The mean value of the restorative material UNIFAST III before polishing was 11.7 in Red Bull, 9.1 in C vitamin and 7.7 in Cod Red (Table 1). The mean value of the restorative material UNIFAST III after polishing and immersing it in the drinks was 11.8 in Red Bull, 11 in C vitamin and 10.4 in Cod Red. Therefore, the results indicated that the microhardness of the provisional material UNIFAST III was the highest when immersed in Red Bull as compared to the other drinks. Moreover, the microhardness of UNIFAST III was enhanced in all the drinks after polishing. Consequently, it was revealed that the microhardness of UNIFAST III was the lowest when immersed in the Cod Red beverage.

**Table 1.** The effect of Red Bull, Vitamin C and Cod Red on the microhardness of UNIFAST III

| UNIFAST III Microhardness | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | mean | SD |
| Control | 15 | 16 | 16 | 17 | 16 | 15 | 16 | 16 | 17 | 16 | 16 | 0.7 |
| Red Bull | 12 | 13 | 12 | 11 | 11 | 12 | 13 | 12 | 11 | 11 | 11.8 | 0.8 |
| Vitamin C | 11 | 12 | 10 | 11 | 11 | 11 | 12 | 10 | 11 | 11 | 11 | 0.7 |
| Cod red | 10 | 10 | 10 | 11 | 11 | 10 | 10 | 10 | 11 | 11 | 10.4 | 0.5 |

The mean value of the restorative material CAD Temp® before polishing was 24.7 in Red Bull, 21 in C vitamin, and 22.7 in Cod Red (Table 2). The mean value of the restorative material CAD Temp® after polishing and immersing was 34.2 in Red Bull, 24.6 in C vitamin and 53.8 in Cod Red. The results indicated that the microhardness of the restorative composite material CAD Temp® was the highest, when immersed in Cod Red. However, the microhardness of CAD Temp® before polishing was the highest in the Red Bull (24.7). Consequently, it was revealed that the microhardness of CAD Temp® was the lowest before polishing, and also after it was immersed in the C vitamin beverage.

**Table 2.** The effect of Red Bull, Vitamin C and Cod Red on the microhardness of CAD Temp®

| CAD Temp® Microhardness | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | mean | SD |
| Control | 19 | 22 | 22 | 20 | 21 | 19 | 22 | 22 | 20 | 21 | 20.8 | 1.2 |
| Red Bull | 45 | 27 | 41 | 28 | 30 | 45 | 27 | 41 | 28 | 30 | 34.2 | 7.8 |
| Vitamin C | 26 | 23 | 25 | 24 | 25 | 26 | 23 | 25 | 24 | 25 | 24.6 | 1.1 |
| Cod red | 53 | 55 | 55 | 55 | 51 | 53 | 55 | 55 | 55 | 51 | 53.8 | 1.7 |

The mean value of restorative material TemPhaseTM before polishing was 17.3 in Red Bull, 19.3 in C vitamin and 18.7 in Cod Red (Table 3). The mean value of the restorative material TemPhaseTM after polishing and immersing was 16.6 in Red Bull, 17 in C vitamin and 15.6 in Cod Red. The results highlighted that the microhardness of the restorative composite material TemPhaseTM was the highest when immersed in C vitamin in comparison to the other drinks. Similarly, the microhardness of the TemPhaseTM before polishing was also the highest in the C vitamin beverage (19.3). Consequently, it was revealed that the microhardness of TemPhaseTM was the lowest before polishing and also after it was immersed in Red Bull.

**Table 3.**The effect of Red Bull, Vitamin C and Cod Red on the microhardness of TemPhaseTM

| TemPhaseTM Microhardness | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | mean | SD |
| Control | 17 | 18 | 18 | 18 | 17 | 17 | 18 | 18 | 18 | 17 | 17.6 | 0.5 |
| Red Bull | 18 | 16 | 16 | 17 | 16 | 18 | 16 | 16 | 17 | 16 | 16.6 | 0.8 |
| C vitamin | 16 | 18 | 17 | 17 | 17 | 16 | 18 | 17 | 17 | 17 | 17 | 0.7 |
| Cod red | 15 | 15 | 16 | 15 | 17 | 15 | 15 | 16 | 15 | 17 | 15.6 | 0.8 |

The mean value of the restorative material of ProtempTM before polishing was 16.7 in Red Bull, 18.4 in C vitamin and 17.7 in Cod Red (Table 4). The mean value of the restorative composite material of ProtempTM after polishing and immersing was 14.6 in Red Bull, 16.6 in C vitamin and 15.2 in Cod Red. The results showed that the microhardness of the restorative composite material of ProtempTM was the highest, when immersed in C vitamin. Similarly, microhardness of ProtempTM before polishing was also the highest in the C vitamin beverage (18.4). Consequently, it was revealed that the microhardness of ProtempTM was the lowest before polishing and also after it was immersed in Red Bull.

**Table 4.** The effect of Red Bull, C Vitamin and Cod Red on the microhardness of ProtempTM

| ProtempTM Microhardness | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | mean | SD |
| Control | 13 | 14 | 13 | 14 | 13 | 13 | 14 | 13 | 14 | 13 | 13.4 | 0.5 |
| Red Bull | 15 | 15 | 15 | 14 | 14 | 15 | 15 | 15 | 14 | 14 | 14.6 | 0.5 |
| Vitamin C | 16 | 17 | 17 | 16 | 17 | 16 | 17 | 17 | 16 | 17 | 16.6 | 0.5 |
| Cod red | 16 | 15 | 15 | 14 | 16 | 16 | 15 | 15 | 14 | 16 | 15.2 | 0.8 |

Surface hardness of restorative composite materials was adversely affected when they were exposed to highly acidic sports drinks. Moreover, caffeinated drinks also have shown to have a damaging effect on the microhardness of the restorative composite materials that have been used in oral dentistry. Apart from this, some fruit drinks that are sour, like orange and lime juices would also have a deteriorating effect on the composite materials. In a study by [8]; 40 human enamel discs were immersed in saliva to permit pellicle formation. They were later divided into three groups of 15 human enamel discs for the immersion in orange juice; 15 for the whitening treatment; and 10 human enamel discs for the normal saline controls. The microhardness and surface topography were further analyzed. It was revealed that the enamel surface hardness had reduced by 84% after the human enamel discs were immersed in orange juice. However, there were no significant changes in the whitening treatment and the saline control groups. The orange juice erosion not only reduced the hardness but also increased the roughness of the human enamel discs [8].

Similarly, a study was conducted to evaluate the effects of staining solutions on the surface roughness of nanohybrid resin composite by the inclusion and exclusion of Liquid Resin Polishing (RP). 96-disc specimens of resin composites were prepared and divided into two groups. Liquid resin polishing was included in one group, and excluded in the other. Surface roughness and specimen color were ascertained by using profilometer and colorimeter. Each group was further divided into four subgroups after baseline measurements were taken. They were immersed in three different staining solutions; such as red wine, ice tea and cola for a week, and alternatively immersed in distilled water. There was a re-examination of surface roughness and color. Furthermore, after measurements, all of the specimens were bleached by using hydrogen peroxide gel and subsequently, they were reevaluated. It was concluded that liquid RP did not restore the surface roughness or enhance the color stability of the composite resins [9].

## CONCLUSION

In recent decades, dentists have been facing many challenging issues that have been related to dental erosion, not only amongst the adult population, but also in children and adolescents. Apart from the dental erosion, the consumption of beverages can also cause gastroesophageal and psychosomatic problems [10]. Young adults and children need to take preventive measures to avoid dental and other health issues, associated with the consumption of sports and energy drinks. Furthermore, the consumption of these beverages must be in moderation to avoid long-term and expensive dental treatments. This study has shown the damaging effects of sports drinks on the restorative composite materials. There have been very few studies being conducted on the effects of sports drinks on the restorative composite dental materials; and the author of this study would advise that more research must be encouraged and funded in the future.

## ACKNOWLEDGEMENT

The author is very thankful to all the associated personnel in any reference that contributed in/for the purpose of this Research.

**Conflict of Interest**

The research had no conflict of interest, and it was not funded by any source.

**REFERENCES**


1. Erdemir, U., Yildiz, E., Saygi, G., Altay, N. I., Eren, M. M., & Yucel, T. (2016). Effects of energy and sports drinks on tooth structures and restorative materials. World J Stomatol, 5(1), 1-7. Doi: 10.5321/wjs. v5. i1.1
2. Fatima, N., & Hussain, M. (2014). Effect of two different commonly available energy drinks on surface micro hardness of tooth color restorative materials. Journal of Research in Dentistry, 2(3), 269-276. Doi: 10.19177/jrd.v2e32014269-276
3. De Moraes, R. R., Marimon, J. L. M., Jochims Schneider, L. F., Sinhoreti, M. A. C., Correr-Sobrinho, L., & Bueno, M. (2008). Effects of 6 months of aging in water on hardness and surface roughness of two microhybrid dental composites. Journal of Prosthodontics, 17(4), 323-326. Doi: 10.1111/j.1532-849x.2007. 00295.x
4. Tahmassebi, J., Duggal, M. S., Malik-Kotru, G., & Curzon, M. E. J. (2006). Soft drinks and dental health: a review of the current literature. Journal of dentistry, 34(1), 2-11. Doi: 10.1016/j.jdent.2004.11.006
5. Al-Dharrab, A. (2013). Effect of energy drinks on the color stability of nanofilled composite resin. The journal of contemporary dental practice, 14(4), 704. Doi: 10.5005/jp-journals-10024-1388.
6. Tanthanuch, S., Kukiattrakoon, B., Siriporananon, C., Ornprasert, N., Mettasitthikorn, W., Likhitpreeda, S., & Waewsanga, S. (2014). The effect of different beverages on surface hardness of nanohybrid resin composite and giomer. Journal of conservative dentistry: JCD, 17(3), 261-265.
7. Khurram, M., Zafar, K. J., Qaisar, A., Atiq, T., & Khan, S. A. (2018). Restorative dental materials; a comparative evaluation of surface microhardness of three restorative materials when exposed to acidic beverages. Professional Medical Journal, 25(1).
8. Ren, Y. F., Amin, A., & Malmstrom, H. (2009). Effects of tooth whitening and orange juice on surface properties of dental enamel. Journal of dentistry, 37(6), 424-431.
9. Halacoglu, D. M., Yamanel, K., Basaran, S., Tuncer, D., & Celik, C. (2016). Effects of staining and bleaching on a nanohybrid composite with or without surface sealant. European journal of dentistry, 10(3), 361-365.
10. Klink, A., & Huettig, F. (2016). The challenge of erosion and minimally invasive rehabilitation of dentitions with BEWE grade 4. Quintessence International, 47(5), pp.365-72.