RESEARCH PAPER

Effect of multivitamin syrup and tablets on the surface roughness of glass ionomer cement - An invitro study

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ABSTRACT

Background: A move away from metal restorations and toward non-metal ones is what distinguishes modern dentistry and change in the current generation's lifestyle. Glass ionomer cement is one such aesthetic restoration. GIC is typically utilised for restorations in occlusal or proximal cavities with moderate occlusal stresses. However, glass ionomer restorations are frequently less durable due to their susceptibility to moisture, lack of mechanical strength, and restricted resistance to wear.

Aim: The objective of this study to assess the surface roughness of glass ionomer restoration after immersion in multivitamin syrup and tablets.

Materials and Methods: 16 samples were produced using moulds, each of which had dimensions of 3 mm in height and 1 mm in diameter. The samples were polished after being removed from the moulds to remove any flaws. For a period of seven days, the prepared samples were submerged in multivitamin syrup for two minutes each day at a temperature of 37 °C. To avoid contamination and dehydration, the specimens were immersed in water between each other immersion. Values of Ra, Rq, and Rz were measured before and after immersion for each sample.

Result: The findings of our experiment suggest that soaking multivitamin tablets for seven days resulted in a decrease in surface roughness, and as a consequence, exhibited results that are negligible when the p value is more than 0.05. Significant Ra and Rq indices are seen while immersed in multivitamin syrup, with p values of 0.0381 and 0.0456, respectively, indicating that there is increase in surface roughness.

Conclusion: The findings of our experiment suggest that soaking the samples in multivitamin tablets for seven days resulted in a decrease in surface roughness, and was insignificant. The Ra and Rq indices indicate an increase in surface roughness while immersed in multivitamin syrup and was statistically significant.

Keywords: Glass ionomer restoration, Multivitamin syrup, Surface roughness, Tablets, Profilometer, lifestyle.

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INTRODUCTION:

Modern dentistry is defined by a shift away from metal restorations and toward non-metal ones.(1). One such important aesthetic restoration is glass ionomer cement. Wilson and Kent created glass ionomer cements (GICs) for the first time in the late 1960s(2).It consists of a powder and liquid. Silica, Alumina, Aluminium fluoride, calcium fluoride, sodium fluoride,calcium fluoro alumino silicate glass are some of the constituents of the powder. The liquid is polyacrylic acid with itaconic and malice acid, tartaric acid and water are also present. Having 9 different types, GIC was a breakthrough innovation in the field of dentistry.For restorations in occlusal or proximal cavities with moderate occlusal forces, GIC is frequently used(3,4). However, due to their sensitivity to moisture, lack of mechanical strength, and limited resistance to wear, glass ionomer restorations are often less long-lasting(5) The calcium released from the glass and the liquid polyacid ionomer combine to produce insoluble polysalts, which is how they originally set. The complex anionic aluminium ions then progressively give up their metal atoms as relatively distinct entities, forming aluminium carboxylate structures.(6)

Multivitamin syrups are dietary supplements used for people with vitamin deficiency. Multivitamin formulations are said to have an erosive tendency.(7).When compared to other vitamin forms, syrups and effervescent tablets are frequently

utilised as an option to make taking vitamins more interesting and appetising for kids. Studies have demonstrated that the use of supplements in syrup form can act as extrinsic agents for dental erosion and have detrimental effects on dental hard tissue because of the high titratable acidity and low pH of the solution. Depending on the frequency of consumption, this can lead to the degradation of resin-based materials.(8), (9),(10). Tooth-colored materials must retain intrinsic colour stability and tolerate surface stains in order to provide great aesthetics.

An important factor affecting the durability and clinical efficacy of GIC restorations is surface roughness. Plaque buildup, bacterial adhesion, staining susceptibility, wear resistance, and patient comfort are all directly impacted by the surface topography of restorative materials. Increased surface roughness encourages the production of biofilms and may be a factor in periodontal inflammation and secondary caries. Thus, long-term clinical effectiveness depends on attaining and preserving a smooth surface finish.

Arithmetic average roughness (Ra), which is defined in International Organization for Standardization standards like ISO 4287, and areal surface characteristics, which are outlined in ISO 25178, are frequently used to quantify surface roughness. To assess the microstructural properties of GIC surfaces both before and after polishing or aging, measurement methods such stylus profilometry, atomic force microscopy, and scanning electron microscopy are commonly used.
It seems likely that people will take these drugs at some time in their lives, thus it is critical to understand the erosive potential of these commonly suggested treatments(11).Though GIC is considerably one of the best restorative materials the effect of such syrups must be assessed in order to prevent surface roughness and erosion.Therefore the objective of this study to assess the surface roughness changes of glass ionomer cement after immersion in multivitamin syrup and tablets.

MATERIALS AND METHODS:

Sample preparations
With the use of moulds, 16 samples, each measuring 3 mm in height and 1 mm in diameter, were created. After being taken out of the moulds, the samples were polished to remove any irregularities. To accomplish the materials' polymerization and rehydrate them, they were maintained in distilled water for 24 hours at 37°C.

Staining procedure
The prepared samples were immersed in multivitamin syrup for two minutes a day at a temperature of 37 °C for seven days. To promote the same condition as that of multivitamin syrup use, the solutions were varied everyday.The specimens were submerged in water between every other immersion so as to prevent contamination and dehydration.

Roughness Measurement
The Ra,Rq, and Rz values were taken for each sample before immersion using a stylus profilometer. Followed by immersion of the samples in multivitamin syrup for 7 consecutive days, the above values were taken post immersion again using stylus profilometer.

Statistical Analysis
With the before immersive and post immersive values acquired, one-way Anova statistical analysis was performed.

RESULTS:
Our experiment demonstrated that immersing the samples in multivitamin tablets for seven days resulted in a marginal decrease in surface roughness. The change, on the other hand, was not statistically significant because the p-value was greater than 0.05. This means that the difference we saw could have happened by chance and isn't important from a scientific point of view.

With multivitamin syrup, though, a different pattern was seen. After immersion, the surface roughness parameters Ra and Rq went up a lot. The changes were statistically significant, with p-values of 0.0381 and 0.0456, respectively (both less than 0.05). This shows that the syrup really did make the surface rougher, not just because of random changes.

In general, this means that multivitamin syrup may have a bigger effect on surface properties than tablet forms, which don't seem to have much of an effect in the same conditions.

GROUPS	MEAN	STD.DEVIATION	SIGNIFICANCE
Pre Immersion	0.8504	0.7504	0.6323

Post immersion	0.6948	0.4962	0.6323

Table 1: The table depicts mean, standard deviation, and significance of the Ra parameter pre and post immersion in multivitamin tablets. It shows the comparison of the Ra parameter in multivitamin tablets before and after immersion. The mean Ra value decreased from 0.8504 in the pre-immersion group to 0.6948 in the post-immersion group, indicating a slight reduction in surface roughness following immersion. The standard deviation also decreased from 0.7504 to 0.4962, suggesting reduced variability in surface texture after immersion. However, the p-value of 0.6323 is greater than 0.05, indicating that the observed difference is not statistically significant. Therefore, immersion in multivitamin tablets did not produce a significant change in the average surface roughness

GROUPS	MEAN	STD.DEVIATION	SIGNIFICANCE
Pre Immersion	0.5861	0.3152	0.0381
Post immersion	0.9744	0.3618	0.0381

Table 2 : The table depicts mean, standard deviation, and significance of the Ra parameter pre and post immersion in multivitamin syrups.The mean Ra value increased from 0.5861 pre-immersion to 0.9744 post-immersion, indicating an increase in surface roughness after exposure to the syrup. The standard deviation showed a slight increase from 0.3152 to 0.3618, reflecting a marginal rise in variability. The p-value of 0.0381 is less than 0.05, demonstrating that the increase in surface roughness is statistically significant. This suggests that immersion in multivitamin syrup has a significant surface-altering effect.

GROUPS	MEAN	STD.DEVIATION	SIGNIFICANCE
Pre Immersion	1.1306	0.9002	0.5433
Post immersion	0.8878	0.6362	0.5433

Table 3: The table depicts mean, standard deviation, and significance of the Rq parameter pre and post immersion in multivitamin tablets.The mean Rq value decreased from 1.1306 in the pre-immersion group to 0.8878 in the post-immersion group, indicating a slight reduction in root mean square surface roughness. The standard deviation also decreased from 0.9002 to 0.6362, showing reduced dispersion in measurements after immersion. However, the p-value of 0.5433 exceeds 0.05, indicating that the difference is not statistically significant. Hence, immersion did not significantly affect the Rq surface roughness of multivitamin tablets.

GROUPS	MEAN	STD.DEVIATION	SIGNIFICANCE
Pre Immersion	0.7834	0.4111	0.0456
Post immersion	1.354	0.6098	0.0456

Table 4: The mean Rq value increased from 0.7834 in the pre-immersion group to 1.354 in the post-immersion group, indicating an increase in root mean square surface roughness following immersion. The standard deviation also increased from 0.4111 to 0.6098, suggesting greater variability in surface irregularities after exposure. The p-value of 0.0456 is less than 0.05, demonstrating that this increase is statistically significant. This indicates that immersion in multivitamin syrup significantly increased the surface roughness as measured by the Rq parameter, implying a pronounced surface-altering or erosive effect.

GROUPS	MEAN	STD.DEVIATION	SIGNIFICANCE
Pre Immersion	5.9475	3.770	0.3844
Post immersion	52.1018	145.1068	0.3844

Table 5: The table depicts mean, standard deviation, and significance of the Rz parameter pre and post immersion in multivitamin tablets.The mean Rz value showed a substantial increase from 5.9475 pre-immersion to 52.1018 post-immersion. However, there was a marked increase in standard deviation from 3.770 to 145.1068, indicating extremely high variability in the post-immersion group. Despite the apparent rise in mean values, the p-value of 0.3844 is greater than 0.05, indicating that the
difference is not statistically significant. Therefore, although there appears to be an increase in maximum peak-to-valley height (Rz), it cannot be considered statistically meaningful.

GROUPS	MEAN	STD.DEVIATION	SIGNIFICANCE
Pre Immersion	4.979	2.557	0.1332
Post immersion	4.979	3.8531	0.1332

Table 6: The table depicts mean, standard deviation, and significance of the Rz parameter pre and post immersion in multivitamin syrup. The mean Rz value remained the same at 4.979 for both pre- and post-immersion groups. However, the standard deviation increased from 2.557 to 3.8531, suggesting slightly greater dispersion in measurements after immersion. The p-value of 0.1332 exceeds 0.05, indicating that there is no statistically significant difference between the groups. Hence, immersion in multivitamin syrup did not significantly affect the Rz surface roughness parameter.

DISCUSSION

Glass ionomer cements (GICs) have undergone alterations to their original formulation since Wilson and Kent first introduced them in the early 1970s to enhance their clinical behaviour.(12),(12,13) such as their ability to release fluoride,incorporation of nanoparticles etc.(14)The clinical outcome of a restoration is significantly influenced by the surface roughness of dental materials, flexural strength and other properties(15); smoother surfaces may produce more robust aesthetics and longer-lasting restorations.(16)(17)(18). 0.2 micrometers is the minimum acceptable surface roughness for bacterial colonisation.(19)) An increase in surface roughness causes plaque to accumulate more quickly, which raises the likelihood of developing caries and periodontal inflammation.(19). Bacterial colonisation and gingival irritation may develop from residual surface roughness as well.(20).Changes in light reflection that might make a material's surface opaque can also be brought on by an increase in surface roughness. A surface has been demonstrated to be reflective when flaws are significantly less than 1 micrometer (21). Our team's in-depth expertise and experience in the field of research have resulted in publications of fine quality.

The liquid component of GICs may also affect how rough their surfaces are, Because of this, producers now use solid polyacrylic acid rather than liquid polyacid when combining with glass ionomer powder.(22)(23). Precautions include avoiding leaving the formulation in the mouth for too ong and delaying brushing after use should be considered while using multivitamins in general, whether they are in syrup or effervescent form (11).Shorter application intervals may be suggested to minimise surface modifications of restorative materials because the change in the surface roughness is substance dependant.(19,24)

The results of our investigation indicate that soaking multivitamin pills for seven days causes a reduction in surface roughness and therefore showed insignificant results that are greater than p value of 0.05.When submerged in multivitamin syrup, significance is seen in Ra and Rq indices with a p value of 0.0381 and 0.0456 and concludes that there is increase in surface roughness. According to a research by Guler et al, shows that the control subgroups for both materials showed a steady decline in surface microhardness as well as an increase in surface roughness. These alterations were much smaller in comparison to the vitamin supplement groups, which can be related to the multivitamins' lower pH.(11)

According to Yogesh J kale et al compared to typical GICs, which exhibit greater resistance, modified GICs showed increased vulnerability to syrup-induced damage. Many pediatric medication syrups have a clear risk of discolouration and increased surface roughness when used chronically, according to the in vitro research included in this study. The majority of medication syrups used on children showed a risk of discoloration and increased surface roughness, especially those with high sugar content, acidic components, and pigmenting agents.(25)

According to another study by Arun james et al in addition to compomer exposed to paracetamol syrup, the SR of the restorative material increased dramatically for compomer and nanofill materials treated with haematinic syrup.(26)

The study's overall limitations is its small sample size of only 16 samples. The effects of multivitamin pills and syrups on glass ionomer cement have not been extensively studied. Therefore, further studies must be done to determine the impact they have made.

CONCLUSION

The findings of our experiment suggest that soaking samples in the multivitamin tablets for seven days resulted in a decrease in surface roughness, and was statistically insignificant. Whereas soaking the samples in multivitamin syrup showed increase in surface roughness thereby increasing the risk of caries and staining. The Ra and Rq indices in multivitamin syrup was thus statistically significant.

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CONFLICT OF INTEREST

The authors hereby declare that there was no conflict of interest in this study.

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