

ART approach is considered a valuable approach for dental caries management. The advantages of this approach include the use of easily available and inexpensive hand instruments rather than the more expensive electrically-driven dental equipment. This applied specially to countries that suffer from sleazy economy. Besides, developing countries that suffer from severe shortage in providing the governmental dental care units with the required equipment's and if happened maintenance never provided. In addition, ART approach offers sound tooth tissue conservation due to the chemical adhesion of glass ionomers with minimal pain, thus it limits the use of local anesthesia *Frenken (2009)*.

As it known, the biggest barrier for introducing a new technique in oral health care is to proof scientifically its success compared with the already available approaches. The earlier ART studies indicated that the mechanical strength of conventional glass ionomer restorations might not be sufficient to reliably restore stress bearing areas such as in occluso-proximal cavities or certain large occlusal cavities. Therefore, ART restorations were assumed to be restricted to small cavities surrounded by sufficient tooth structure *Holmgren et al. (2000)*. However, more recent studies reported that HVGIRM have better results than the earlier versions due to improved handling and mechanical properties. ART approach using HVGIRM is considered an evidence based approach as it has high success rate for both primary and permanent teeth *Cefaly et al. (2005)*.

For this reason, the current study was conducted to compare the clinical performance of the newly launched zinc-reinforced HVGIRM (ChemFil Rock) to the commonly used HVGIRM (Fuji IX). Also, in the current study the number of female patients was almost equal to the

number of male patients in order to test the gender predilection on the success rate of proximal ART restoration. This also reflects the non-biased methods of including subject into the study.

ART proximal restorations may be challenged by a combination of several factors rather than a single one. Cavity size and the dilemma of selecting suitable proximal lesions for restoration using ART technique was reported by *Rahimtoola and Amerongen (2002)* to affect the survival rate of ART restorations. However, *Kemoli and Amerongen (2011)* concluded that a trained and skilled examiner capable of making a good choice of proximal lesions for ART restoration depending on visual estimation. Besides, the medium-sized (bucco-lingually and mesio-distally) proximal cavities were pointed by *Kemoli and van Amerongen (2009)* to have a better success rate. In the present study, all cavities were performed by a single, well-trained operator and were chosen to be of medium-size in order to standardize such variable as much as possible, as well as to test the best case scenario.

Regarding cavity preparation, a small, sharp ART excavator was used to remove carious dentin from the whole cavity walls, as any residual caries might result in marginal gap formation *Kemoli and Amerongen (2011)*. Nevertheless, some studies reported that there is no significant difference between the survival rate of ART restorations for prepared cavities with or without residual caries. This can emphasize that providing a good hermetic seal is more critical than removal of remaining carious lesions *Kidd (2004)*. Besides, ART hatchet and gingival marginal trimmer were used to plan the cavity walls and to cleave out any undermined enamel where unsupported enamel may lead to defective restoration margin *Kemoli and Amerongen (2011)*.

At the same time adequate tooth-isolation during the whole restorative procedures seems to be mandatory. The use of rubber dam as saliva barrier was of no significant value. Moreover, placing the rubber dam compromises the 'atraumatic' aspect of ART, and may lead to a greater discomfort for the participant *Kemoli et al. (2010)*. Also, the use of suction is not adopted with ART technique where the use of dental chair unit was used just to suit positioning the patient in a comfortable way. Thus, Cotton rolls were suggested to be the method of choice for isolation for the proximal ART restoration in the current study.

It was reported that the presence of marginal gaps along the restoration was highly predictive of early failure of restorations. Cervical gap has a plaque retentive capability that leads to secondary caries. This could be partly caused by patient-related factors where the patient oral hygiene was reported to worsen the restorations survival rate *Kemoli and Amerongen (2011)*. Thus, having and maintaining a good oral hygiene was one of the selection criteria for participants in the study. It was noticed by *Kemoli et al. (2011)* that a significant influence was shown with the post-restoration meals consumption. Hence, participants were instructed not to eat on the restored side for at least two hours after the occlusion was checked in order to cancel or to minimize the effect of this variable.

In the current study, the evaluation procedures were done after one week of restorative material placement as a baseline record *Hickel et al. (2007)*. That was done for many reasons; to ensure full setting of the material, to give chance to exclude the faulty restorations "those of unbearable hypersensitivity or with persistent pain" and to avoid Vaseline interference with accuracy of impression and subsequent the final indirect evaluation. At the same time, tooth integrity was evaluated by digital

photographs, direct clinical examination and indirect positive replicas where no crack was found in any treated tooth. This may be attributed to the fact that ART is a minimal intervention approach that preserves tooth structure maintaining its resistance and integrity.

In the literature different criteria are used for evaluation of ART restorations. In the present study evaluation of the restorations was carried out using ART criteria which is the most applied one to evaluate ART restorations *Frencken et al. (2006); Farag et al. (2009)*. Meanwhile both ART USPHS/Ryge criteria were used in few studies carried out by *Cvar and Ryge (2005)* and *Holmgren et al. (2000)* where they reported that there is no significant difference in survival outcomes of restorations when evaluated using both criteria. However, *Lo et al. (2001)* pointed that USPHS/Ryge criteria was insensitive in measuring the minor defects while evaluating the restoration properties that misinterpreted as good clinical performance. So, ART criteria was suggested to be more firm than the USPHS criteria. Furthermore *Farag et al. (2011)* compared FDI criteria introduced by *Hickel et al. (2007)* for evaluation versus ART criteria. They pointed that ART criteria is a simple and reliable measuring tool for assessing ART restorations survival in clinical oral health services while the FDI criteria could be used for studying the quality of restorative materials only.

Radiographic record was one of the evaluation methods utilized in the current clinical study despite it cannot be considered as a reliable method for final assessment. This can be attributed to its limitation for being a two dimensional finding of three dimensional object.

The result of the current study showed that gender had no influence on the final success rate of proximal permanent ART restoration. That

was in accordance with *Carvalho et al. (2010)* and *Schriks and Van Amerongen (2003)* who stated that gender predilection had no effect on the survival rate of ART restorations in primary teeth.

The final outcome of the following clinical trial showed that there is no statistically significant difference between both tested HVGIRM in their clinical performance up to six months. It was claimed by the manufacturer that ChemFil Rock HVGIRM has a superior diametral tensile, flexural and compressive strength *Busanello et al. (2009)* than the conventional glass ionomer restorative materials containing alumina silicate glasses. The incorporation of reactive glass fillers modified with zinc oxide being easily released from the matrix, acts as network modifiers that increase reactivity of the powder and thus speeding maturation of the cement during setting reaction. As well as the inclusion of itaconic acid in the liquid of ChemFil Rock improved the handling procedures and sufficient shelf life without compromised its workability *Moshaverinia et al. (2009)*. Both factors together may explain the good mechanical properties of this newly modified high viscous glass ionomer material. This assumption was supported by the results of an *in vitro* study conducted by *Molina et al. (2013)*. However, it did not show superior survival rate in the current study.

The manufacturer claimed that ChemFil Rock even without coating had an equal or better wear resistance compared to other competitive glass ionomer materials. In the current study, ChemFil Rock showed generalized minor wear after the six month follow up period. This was in agreement with the *in vitro* study carried out by *Zoergiebel and Ilie (2013)*. The reason behind the low wear resistance may be the filler size and morphology of the glass particles of ChemFil Rock *Xie et al. (2000)*. Resin coating also seemed to improve the flexural strength of the glass

ionomer restorative material as it protects the surface from some visible defects like crazing and voids *Zoergiebel and Ilie (2013)* despite of being not instructed by the manufacturer. Therefore, Fuji IX showed better behavior ever for ART occluso-proximal restorations.

ART restorations proved its high success rate in restoring simple occlusal cavities in primary and permanent teeth *Frenken et al. (2004)*, *Amorimet et al. (2012)*. Besides, an acceptable success rate was recorded for proximal restorations in primary teeth *Holmgren et al. (2000)*. The study results confined that using ART approach and HVGIRMs was successful as intermediate restorations (up to six months). Moreover, the obtained results encourage us to further investigate the survival rate along extended periods. Study findings also open the way for studying the effect of other variables on the success rate of ART restorations.