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# **PhD THESIS**

**CARIES PREVENTION THROUGH ENAMEL  
QUALITY MANAGEMENT**

**– SUMMARY –**

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## INTRODUCTION

Dental caries is a hot topic regardless of the year, be it 1960, 2000 or 2022, the subject is always the same, namely how high is the incidence of dental caries at state, continental or world level. This should give us all who work in the dental profession and higher education institutions in the field food for thought. Let's ask ourselves what are we doing wrong?

We are in the century of speed and technology developed as never before in history, yet we still struggle with increased rates of carious injury in all age segments. The fact that in this modern age, people of all ages are still suffering from untreated carious lesions suggests that either our treatment methods to date are not working or our approach to the problem is wrong.

This being so, we must keep in mind that unlike other diseases and conditions in the human body, carious lesions can actually be prevented. In addition to the two major preventive methods (fluoridation and sealing), dental hygiene is very important for both methods to be successful, and the patient's dietary habits complement and can tip the balance of the above therapies towards success or failure. Therefore, no method of preventing the development of carious lesions can be successful without a health education about nutrition and hygiene to change the patient's behaviour and lifestyle. This leads to the conclusion that dental disease is not infectious in nature but may be individual behavioural in nature. enamel quality management must start with determining and controlling risk factors at the individual level, followed by education on healthy diet and dental hygiene and finally non-invasive preventive enamel therapies.

As far as these therapies are concerned, the approach should be different.

To be able to choose the right therapy method, the dentist has to make the diagnosis accurately. For accurate diagnosis there are many medical devices that can do this, such as intraoral cameras, the Diagnodentul, VistaCam iX or even CLMS in the office version.

After accurate examination and diagnosis, the correct treatment can be chosen fluoridation, sealing, balancing the diet to increase salivary pH or infiltration with low viscosity resins.

With this PhD thesis I have tried to highlight the importance of these things, the thesis includes studies on the most important methods to prevent the occurrence of demineralization/carious lesions. The first study of the thesis is the therapy of demineralisation lesions by fluoride therapy, low viscosity infiltrating resin and alkaline saliva of pH 8.

The results of the study show that fluoride therapy remains important but only within certain limits, namely for the enamel surface and in small and medium demineralisation lesions. Low viscosity infiltrated resin therapy is a real success because it can penetrate into the deepest demineralisation lesions, obliterating the enamel pores and stopping the evolution of the lesion. With lesser but equally important results is the remineralising saliva therapy, which reinforces the conclusion that by modifying the diet the salivary pH can also be modified and remineralisation occurs naturally. The second study looks at what happens to enamel exposed to acid saliva over time and how alkaline saliva can contribute to remineralisation. And this study once again highlights the importance of changing patient behaviour in terms of diet and nutrition. The third study looks at what happens to the main macroelements in enamel during demineralisation and remineralisation. The fourth study shows the efficacy of infiltrating resin treatment in the case of a new acid attack following treatment. This time, too, this therapy has successfully proven its effectiveness. The last study examines dental sealing as a preventive method and its evolution and behaviour over time. The research studies underlying this thesis support the importance of methods to prevent demineralization lesions but in a new concept and a new approach to the problem, placing patient education, caries risk assessment, then personalized choice of non-invasive therapy appropriate to the caries risk detected as the first prevention method.

## **SUMMARY OF PERSONAL CONTRIBUTIONS**

### **1. STUDY 1: CHEMICAL DEMINERALISATION VERSUS CHEMICAL INFILTRATION**

There are many studies that have evaluated penetration of infiltrated resins and penetration with Fluor Protector. The current research, on the other hand, attempts to emphasize the significance of the results for dentist clinical practice. Given the number of cases of tooth structure demineralization lesions in clinical practice, it is critical that the practitioner, after an accurate diagnosis of the lesion, chooses the adequate treatment for every case. In case of early enamel lesions, the proper recommendation is to change the diet so that the salivary pH could increase, and the remineralization occurs as a natural process with the help of alkaline saliva. A treatment based on fluoride solutions can be applied to a moderate enamel demineralization lesion.

Fluoride remineralization treatment is therefore no longer appropriate for enamel demineralization lesions (without substance loss). Therefore in specific instance, obliterating the porous structure with low-viscosity resin is advised to prevent the demineralization process. Demineralization can also be precisely diagnosed in clinical practice using a DiagnoDent laser source.

This research also includes two demineralization procedures since several agents inside the oral cavity end up causing demineralization lesions. These are external agents such as carbonated beverages, carbohydrate consumption, various acidic gels applied to enamel or internal agent like gastroesophageal reflux disease, and acidic salivary pH.

Citric acid, with a pH pertaining to carbonated beverages having a quick but aggressive demineralization action, was selected for the present research. As a result, we had been using confocal laser microscopy to assess the infiltration ability of chemical and natural substances in demineralization lesions of tooth enamel.

## **CONCLUSION**

Of the three treatments applied to the demineralised enamel samples, the most effective was the treatment with the low viscosity infiltrating resin Icon, from DMG, Hamburg, which fully penetrated the demineralisation lesion.

Fluoridation also further proved its importance, the results of fluoride treatment with Fluor Protector (Ivoclar Vivadent) being very effective in cases of medium-depth demineralised lesions.

Fluoride can still maintain its title as a preventive method because it helps remineralize enamel even if it fails to penetrate deep into the enamel.

Low viscosity resin has been able to fully penetrate even the deepest demineralisation lesions, proving its effectiveness in therapy.

Also, salivary base pH can produce remineralisation, but only over a long period of time, requiring a change in patient behaviour in terms of diet and oral hygiene.

CLMS is a very beneficial tool in the measurement of deep demineralization lesions and can also be a useful tool in the medical office due to its in vivo working on patients.

## **2. STUDY 2: SALIVARY DEMINERALISATION VERSUS SALIVARY REMINERALISATION**

This study examined the demineralization of human enamel samples in acidic artificial saliva, pH 3, and the penetration capacity of basic saliva, pH 8, into demineralized lesions. Artificial saliva was able to simulate the real situation in the human mouth, as microorganisms in the oral cavity have no role in tooth mineralization. Once mineralisation reaches maturity, mineralisation ends and microorganisms play a more important role in plaque formation or biofilm formation on the tooth surface (108).



Saliva was used in this study only in terms of pH, as our interest was in its acid-base properties, not its microorganism content. In vivo, pH triggers the process of demineralization/ remineralization in the oral cavity by migration of ions from enamel to saliva and vice versa.

## CONCLUSIONS

Remineralisation of samples in artificial saliva was present, which is very important, but it is necessary to study remineralisation over a longer period, analysing the habits, diet and nutrition of patients in detail.

Diet and nutrition play an important role in influencing salivary pH, because an acidic diet will lower salivary pH, while eating alkaline vegetables will increase salivary pH.

Preventing the pH from falling below the critical level can be achieved by educating the patient about a healthy diet and optimal hygiene and by periodic monitoring of salivary pH through tests performed in the doctor's office

It is very important to know that remineralisation of small demineralisation lesions can be achieved naturally with saliva.

### **3. STUDY 3 MACRO ELEMENTAL ANALYSIS OF DEMINERALISED AND REMINERALISED ENAMEL**

This study investigates the content of mean macro elements (Ca, Mg, K) in the teeth before and after demineralisation in citric acid and the impact of natural remineralisation.

### **CONCLUSIONS**

Calcium is the most important element in the structure of enamel and therefore it is good to know what happens during demineralization.

Following the analysis of the present study, it was found that during demineralization there is a loss of calcium and magnesium, but an interesting thing to be investigated in the future is the fact that K showed a significant increase in demineralization.

The demineralisation/remineralisation processes influenced the macro elemental composition of enamel.

Demineralisation with natural saliva, was less aggressive in decreasing Ca and Mg content, than acid citric demineralisation.

#### **4. STUDY 4 RESISTANCE OF INFILTRATING RESIN TO ACID ATTACK**

This study investigates the stability and resistance of demineralisation lesions treated with low viscosity resin in case of exposure to a new acid attack. Citric acid with a pH similar to carbonated drinks, which have a short-lived but aggressive acidic action on enamel, was used for this study.

#### **CONCLUSIONS**

Low viscosity resin treatment is a micro-invasive treatment that can be used as a preventive therapy.

This treatment can be called as an intermediate between preventive fluoride therapy and invasive therapy of incipient carious lesions.

When subjected to a new acid attack, the enamel treated with low viscosity resin has preserved its integrity, so the therapy is effective.

Used in conjunction with fluoride-based therapy can greatly enhance its effectiveness in the treatment of salt and prevention of demineralisation lesions.

This method is still open to research because there is not enough data to show the compatibility and stability of this resin over time

## **5. STUDY.5. EVALUATION OVER TIME OF DENTAL SEALANTS USING VISTACAM iX**

In this study, dental units were analysed that had sealings of the fissures and fossae between 3 months and 24 months old. The aim of this study was to follow the changes of dental sealants over time and to determine the period in which they lose their preventive function.

For this study(135) an intraoral fluorescent camera with self-calibrating function, VistaCam iX, Durr Dental, Bietigheim-Bissingen, Germany, was used.

### **CONCLUSIONS**

Due to the analysis performed, we conclude that the sealing material shows tightness and maintains its properties between 3 and 6 months. After this period some changes appear such as staining, marginal dehiscence or even carious lesions between the sealing edge and the enamel.

Dental sealing is a preventive method, but it should be evaluated periodically. For an accurate diagnosis, the use of the intraoral camera, VistaCamiX and Proof, is the most accurate.