INTERACTION BETWEEN ENAMEL, PORCELAIN AND A GOLD ALLOY: AN IN VITRO WEAR STUDY

UYEN TRAN KIEU HA (BDS, MDS)

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School of Dentistry

The University of Adelaide

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PREFACE

This thesis reports on research work that was carried out during my PhD candidature at the School of Dentistry, The University of Adelaide, from August 2006 to 2010. The work initially aimed to investigate wear between enamel and different indirect materials including four porcelain systems (a porcelain bonded to metal veneering system, a leucite-reinforced glass ceramic used for veneering, a leucite-reinforced pressable ceramic, a machinable ceramic) and a type III gold alloy under various pH conditions. However, an interesting finding from qualitative analysis of the machinable ceramic has lead to a more detailed examination of this system. In addition, over the years for the project to be accomplished, zirconia has become more popular, therefore a preliminary study on the wear behaviour of this relatively new material has been conducted to make the thesis more complete.

This thesis consists of seven sections, starting with a review of the literature, leading to the aims and rationale of the study (Section 1). The next three sections (Section 2, 3 and 4) present on the studies of enamel/ceramic wear, effect of acid on machinable ceramic and preliminary study of zirconia wear, respectively, that have been carried out. Each of this section composes of four chapters including an introduction, materials and methods, results and discussion for that specific study. These were followed by a section of general conclusions (Section 5), references (Section 6) and appendices (Section 7).

ABSTRACT

In dental practice, wear of the natural dentition is commonly seen in patients of all ages. It can have a mild effect on teeth, or be severe enough to affect patients' quality of life. Although different indirect restorative materials such as gold alloy or porcelain have been used for many years to restore excessively worn teeth, the procedures are generally complex and challenging to the dentists as well as costly and time-consuming for the patients.

A good restorative material should be aesthetic, durable and not be abrasive to the opposing dentition. Gold has been reported to be "enamel-friendly", but the colour makes it un-aesthetic. On the contrary, porcelain is aesthetic, biocompatible, durable and has become a popular choice for both clinicians and patients. However, previous studies have shown that some of the porcelain systems can be abrasive to the opposing natural enamel. The use of such abrasive porcelain systems would therefore be harmful to a patient's dentition in the long term.

Four porcelain systems and a gold alloy have been selected for this study:

- a veneering porcelain normally used in porcelain bonded to metal restorations (PBM-veneering porcelain)
- a leucite-reinforced glass ceramic used for veneering (LR-veneering ceramic)

- a leucite-reinforced pressable ceramic (LR-pressable ceramic)
- a machinable ceramic
- a type III gold alloy (gold).

The aims of the study were to determine the wear rates of the selected porcelains and opposing enamel under controlled conditions which simulated two clinical conditions:

- heavy attrition at near neutral pH (pH 6.1)
- heavy attrition with gastric regurgitation (pH 1.2)

In addition, preliminary studies on the wear of zirconia and enamel were conducted.

In this study, electro-mechanical tooth wear machines were used to simulate wear. Wear volume loss was measured by scanning specimens with 3D profilometers and evaluating the data using a purpose-written software. The surface micromorphology of wear facets was also observed by scanning electron microscopy (SEM). As a result of this analysis a more detailed investigation of the machinable ceramic was undertaken.

The results revealed that at pH 6.1, while enamel wear caused by the PBM-veneering porcelain, LR-veneering ceramic, machinable ceramic and gold alloy were not significantly different to the control group in which enamel specimens were worn against each other, significantly increased enamel wear was associated with the LR-pressable. Although enamel wear rates increased dramatically in conditions simulating attrition combined with gastric regurgitation, the gold alloy did not wear the opposing enamel more than the enamel controls. In addition, in this study the machinable ceramic became porous under acidic conditions.

The findings presented in this thesis have implications for selection of porcelain for specific clinical cases. Although the findings should be cautiously extrapolated to in vivo conditions, they contribute to the understanding of new porcelain materials in terms of wear and erosion. In addition, results from preliminary experiments with zirconia will provide data to inform the development of protocols for future research.

DECLARATION

This work contains no material which has been accepted for the award of any other degree or diploma in any other university or other tertiary institution to Uyen Tran Kieu Ha and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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UYEN TRAN KIEU HA

Dated this………………..day of ………………..2011

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