



# Effect of placing intentionally high restorations: Randomized clinical trial



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## ARTICLE INFO

### Article history:

Received 23 October 2014

Received in revised form 2 November 2015

Accepted 21 November 2015

### Keywords:

Prosthetic dentistry/prosthodontics

Occlusion

Clinical outcomes

Oral rehabilitation

Orthodontic tooth movement

Remodeling

## ABSTRACT

**Objective:** The aim of this study was to examine the behavior of posterior teeth restored with single-tooth restorations with intentionally high occlusal contacts.

**Methods:** Consent was obtained from 17 patients who were seen a total of 5 times over 3.5 years. The restorations placed were all full occlusal coverage gold restorations. Tooth mobility was recorded using the Periotest device and tooth movement was determined from impressions and 3D imaging. Patients were randomly assigned into two groups, the control group which received restorations with no intentional increase of the occlusal vertical dimension; or the treatment group where they received intentionally high restorations in 0.5 mm supraocclusion.

**Results:** Statistical analysis showed no significant difference in mobility between visits for both the control and the treatment groups while a significant dependency and difference in tooth movement was observed between the subjects of the two groups. Most patients from the treatment group reported discomfort but no pain for the first 7–10 days after the restoration was fitted, which subsided over a period of couple of weeks. At review, 3 years later, no mobility or additional movement was observed.

**Conclusions:** Cementation of an intentionally high single-tooth restoration causes no increase in tooth mobility while occlusal adaptation re-establishes and restores the occlusal plane.

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## 1. Introduction

Historically, it has remained a generally well-established principle that restorations should be constructed to have the correct occlusal vertical dimension so as to conform to the existing occlusion. However, in an increasing number of situations the clinician may elect to intentionally place a restoration at an increased vertical dimension. This is often carried out in the treatment of tooth wear to replace tooth tissue that has been lost [1–4] or with the use of minimum preparation bridges where the clinician elects not to cut space to accommodate the retainer wing.

The application of intentionally high restorations became well known through the work of Dahl et al. [1,5,6], originally with removable frameworks and more recently with direct bonding of resin composite [7–9].

Many clinicians are still of the belief that a high full occlusal coverage restoration will result in pain despite publications to the contrary going back for more than 50 years. Anderson [10] in 1962 demonstrated that a high metal crown did not cause pain. Occlusal force will intrude a tooth stimulating the periodontal mechanoreceptors before the pain receptors will be activated. These periodontal mechanoreceptors are Ruffini nerve endings similar to those in the subcutaneous skin and provide the sensation of pressure, not pain [11]. Their activation brings about inhibition of the masticatory muscles limiting the occlusal load and avoiding pain.

The introduction of the 'Dahl appliance', the 'Dahl effect' which uses intrusion and extrusion forces to restore heavily damaged teeth [1] and the numerous new techniques working around this concept [3,7,12–15] has given a new perspective on occlusal adjustments of a single-tooth restoration. It is therefore important not only to re-evaluate the early work of Anderson [10], using current techniques but also to evaluate established guidelines and consider the possibility of allowing the occlusion to adjust. Adaptation occurs in many such situations and is a necessary feature following dental treatment including restorative dentistry, orthodontics and tooth eruption.

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Practical applications of this technique occurs in cases where the temporary crown for a single-tooth restoration is lost or is subject to occlusal wear, resulting in overeruption of the tooth within the time needed for the technician to fabricate the final restoration. Further preparation and reduction of the tooth tissue to achieve the required vertical dimension could result in an unnecessary root canal treatment and is not recommended. Fitting a high single-tooth restoration with consent will bring about intrusion of the tooth and is a less invasive option.

The outcome of fitting such intentionally high crowns on unworn teeth is not known hence the present study to test that this treatment modality is non-inferior to traditional treatment methods. The aim of this study is to examine and evaluate the effect of fitting intentionally high crowns on posterior teeth into supra-occlusion.

## 2. Methods and materials

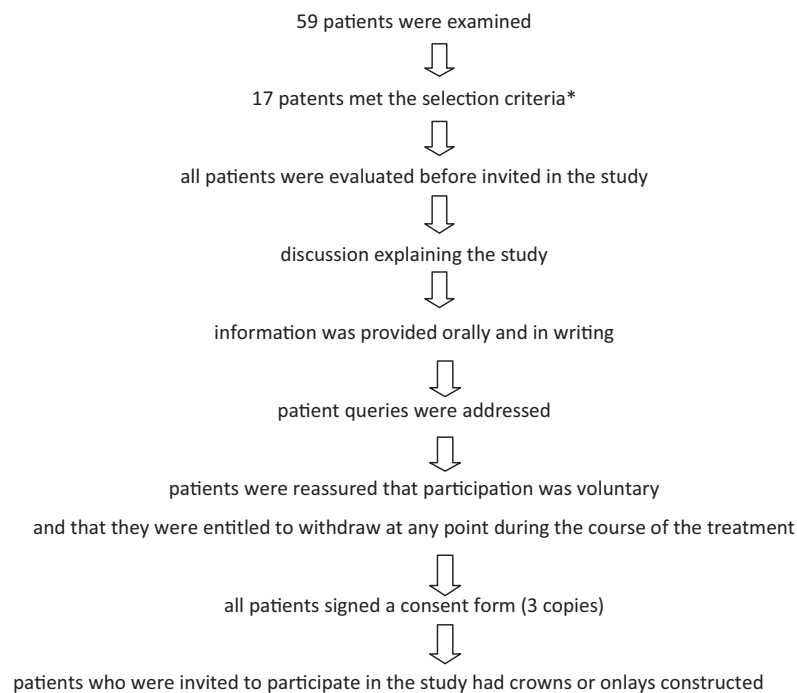
Over a period of 3.5 years, 17 patients (9 females and 8 males) were seen a total of 5 times with a 2 week interval between the first (tooth preparation, TP) and the second (crown cementation, CC) appointments. Reviews were carried out at one month (RV1), 3 months (RV2) and 3 years later (RV3). All patients were under the age of 55 years. See flow chart for the selection process and eligibility criteria (Fig. 1). All 17 patients had full dentitions with no removable prostheses, healthy periodontal tissues, natural opposing and not heavily restored opposing dentitions while the teeth receiving the restorations were all posterior and vital. Gender distribution was: 9 females and 8 males. Tooth type was 6 molars and 3 premolars in the control group (C1), 6 molars and 2 premolars in the treatment group (C2).

The type of restoration used in this group was full coverage gold crown or onlay. The patients were randomly assigned by blind

allocation into one of two parallel groups using a sealed envelope to determine the type of treatment they would receive with details of whether they would be part of the *control group* (Group C1) which received restorations with no intentional increase of the occlusal vertical dimension; or the *treatment group* (Group C2) where the patients which received intentionally high restorations. Initially none of the patients were told which group he or she were part of. All patients signed a consent form in accordance with the Ethical Committee approval. Ethical committee approval: King's College London Dental Institute Research Ethics Committee approval 04/Q0704/57.

All restorations were prepared and cemented by one clinician and data was collected and analyzed within King's College London. Pre-defined procedures and outcome measures were set with no changes once the study commenced. Following preparation impressions, occlusal registration and face bow readings were recorded. A temporary crown was cemented. The technician was sent instructions about the occlusal vertical dimension of the restoration depending on the group the patient was assigned to. The increase in occlusal vertical dimension for the intentionally high restorations was approximately 500  $\mu\text{m}$ . This was preselected as it was judged to be broadly equivalent to the height of a high crown where a temporary restoration had been worn or lost. Also, it matches anterior opening of close to 1 mm which is frequently used in "Dahl" treatments for tooth wear. The occlusion on the restoration was carefully designed to provide vertical loading with minimal lateral component.

Two weeks later the finished restoration was checked and cemented on the tooth. At this point, the subjects became aware of restoration they had received. Recordings were taken 30 min later to allow the teeth to return to previously normal mobility levels following the cementation process. Tooth mobility



**Fig. 1.** Flow chart of patient selection and enrolment procedure with eligibility criteria.

The criteria for patient selection were:

Patients of either gender between 18 and 65 years of age, who were in need of a fixed restoration (onlays/single-tooth crowns) on a posterior segment of the upper or lower arch, with healthy periodontal tissues and able to attend all recall appointments. The tooth receiving the restoration must be vital and not endodontically treated with a natural opposing dentition, where the opposing teeth must not be heavily a. Excluded pregnant female patients at the last trimester of their pregnancy it has been shown that tooth mobility is increased [18], or patients undergoing orthodontic treatment or with pre-existing TMJ dysfunction.

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