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A clinical evaluation of all-ceramic bridges placed in patients attending UK general dental practices: Three-year results☆

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ABSTRACT

Objectives. To report the results at year three of an evaluation of fixed–fixed all-ceramic bridges, constructed in a yttria oxide stabilized tetragonal zirconium oxide polycrystal (Y-TZP) substructure, placed in adult patients in UK general dental practices and luted using a self-adhesive resin-based cement.

Methods. Ethical approval was obtained. Four UK general dental practitioners were asked to recruit patients in accordance with the trial protocol. After obtaining informed written consent, appropriate vitality and radiographic assessments were completed and the pre-operative status of the gingival tissues noted. The teeth were prepared and bridges constructed in accordance with the manufacturer's instructions. Each bridge was reviewed annually within 3 months of the anniversary of its placement by a calibrated examiner, together with the clinician who had placed the restoration. The examiners evaluated the integrity of the restoration, its anatomic form, marginal adaptation, surface quality, sensitivity, the condition of the adjacent gingivae, and the presence or absence of secondary caries.

Results. A total of 34 bridges were examined at the three-year review. All Y-TZP frameworks were intact and no bridge retainers had debonded. Two veneering ceramic chips, in total, were detected over the three-year period of observation: the patients in whom this had occurred were unconcerned. A further abutment tooth had been successfully endodontically treated, through an occlusal access cavity, in addition to the two already reported at year one.

Significance. At year three, the 34 Lava Y-TZP fixed–fixed bridges, placed in patients attending UK general dental practices, were found to be performing satisfactorily.

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1. Introduction

The paper reporting the first-year results of this evaluation of fixed–fixed all-ceramic bridges in general practice was published in 2008 [1]. That paper also discussed the value of research in general practice, with particular reference to the UK-wide practice based research group The PREP (Product Research and Evaluation by Practitioners) panel, of which the four general dental practitioners (GDPs) involved in this evaluation were members. In late 2008 the value of practice-based research was further recognized in Europe by the establishment of the Pan European Region Practice-based Research Network [2], part of the worldwide Practice-Based Research Network Group of the International Association for Dental Research, inaugurated in 2007.

1.1. *Yttria oxide stabilized tetragonal zirconium oxide polycrystal substructure and CAD–CAM technology*

Zirconia ceramic (ZrO_2) is produced from zircon ($ZrSiO_4$) mined primarily in Australia and South Africa, but also in the USA and Indonesia. Pure ZrO_2 has a monoclinic crystal structure at room temperature and transitions to tetragonal and cubic phases at increasing temperatures. On cooling from high temperatures the volume expansion caused by transformation back to the monoclinic phase induces very large stresses and can cause pure ZrO_2 to fracture. The addition of 3% yttria oxide (Y_2O_3) stabilizes the tetragonal phase ceramic, and the material is then known as yttria oxide stabilized tetragonal zirconium oxide polycrystal (Y-TZP). This material also has the advantage of enhanced fracture toughness due to transformation toughening, since, when stress is applied, it is magnified by stress concentration at the crack tip causing the tetragonal phase to change phase. The associated volume expansion places the crack tip in compression, retarding its growth. The use of Y-TZP ceramic material for CAD–CAM constructed restorations in dentistry has increased rapidly, less than a decade after its introduction [3,4], with a wide variety of systems available at the time of writing.

In order to overcome the opacity of pure white Y-TZP, in the material under investigation in the present study (Lava, 3M ESPE, Seefeld, Germany) the milled framework is stained after the milling stage and prior to sintering, with a dye available in seven different shades appropriate to the shade of the overlay ceramic.

For reasons explained in the paper reporting the one-year results [1] the self-adhesive resin-based luting material RelyX Unicem (3M ESPE, Seefeld, Germany) was used to place the fixed–fixed bridges with no additional surface treatment of the Y-TZP framework fitting surface.

1.2. *Objective*

The purpose of this practice-based multi-center clinical observational study was to evaluate the three-year performance of all-ceramic fixed–fixed bridges, constructed with a Lava substructure, placed in adult patients in four UK general dental practices and cemented using a self-adhesive resin based cement. The primary end points of this investigation were retention of the restoration, lack of fracture of the restoration, margin integrity, secondary caries status and post-operative sensitivity. Secondary end points were the health of gingival tissues surrounding the restored teeth, color match, stain resistance and surface quality.

2. Materials and methods

2.1. *Ethical standards*

The study was conducted in accordance with the Declaration of Helsinki (1964) as revised in Venice in 1983. Ethics Committee approval was obtained prior to commencing the study (MREC/04/6/08 South West Multicentre Research Ethics Committee, Dartington, Devon, UK, TQ9 6JE), as too was an additional ethical requirement (peculiar to the UK) for each practice, Site Specific Assessment. Informed written consent was obtained from all patients prior to registration for participation in the evaluation. Implicit in giving informed written consent was the right of patients to withdraw from the study at any time.

2.2. *Patient recruitment*

Four general dental practitioner members of the PREP panel (mean time since graduation of 24 years) with practices in Alness (Scotland), Buxton and Liverpool (England), and Coleraine (Northern Ireland) agreed to recruit ten patients who required a fixed–fixed bridge, and complying with the criteria set out in Table 1.

Having had an opportunity to read and consider the patient's information sheet and having received satisfactory answers to any questions concerning the evaluation, each patient was asked to complete and sign a consent form.

The pre-operative status of the gingival tissues adjacent to the tooth/teeth to be restored was assessed using codes and criteria set out in Table 2. Appropriate vitality and radiographic assessments were completed where indicated, and the outcome recorded.

2.3. *Operative procedures*

The preparation of the teeth was carried out to the manufacturer's specification with rounded line and point angles, a shoulder of 1 mm at the gingival margin and a minimum of 2 mm occlusal clearance. The tooth shade(s) was (were) selected using the Vitapan (Vita Zahnfabrik, Germany) Classical shade guide. The impression was taken in a vinyl polysiloxane material, with an opposing arch impression in alginate and bite registration as indicated. A temporary bridge was constructed and placed. Impressions were then sent to the designated laboratory for the study (Castle Ceramics, Tamworth, Staffs, UK).

2.4. *Laboratory procedures for the construction of Lava bridges*

As detailed previously [1], the dies and models were mailed to 3M ESPE, Seefeld, Germany, for the construction of the Lava