



Clinical performance of full rehabilitations with direct composite in severe tooth wear patients: 3.5 Years results

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ARTICLE INFO

Keywords:

Survival
Success
Tooth wear
Rehabilitation
Composite resin restorations
Clinical study
Interventions
Increase vertical dimension of occlusion

ABSTRACT

Objectives: To evaluate the mid-term clinical performance of direct composite restorations placed in patients with pathological tooth wear needing full rehabilitation with an increase of vertical dimension of occlusion.

Methods: In a prospective trial 34 patients (34.0 ± 8.4 years; 25 males, 9 females) were treated with a minimal invasive additive technique using composite restorations. The restorative treatment protocol was to provide all teeth with composite build-up restorations in an increased vertical dimension of occlusion (VDO) using the DSO-technique. Recall appointments were planned after 1 month, 1 and 3 years after treatment. Restorations were scored for clinically acceptability (FDI-criteria) and scores 4 and 5 were recorded as clinically unacceptable. Frequencies of failures and Kaplan Meier survival curves are presented and effect of relevant variables was calculated with a multifactorial Cox regression ($p < 0.05$).

Results: 1256 Restorations were placed, 687 anterior, 324 premolar, and 245 molar restorations. After a mean observation time of 39.7 months a total of 69 failures were observed, of which 61 restorations were repaired (score 4) and 8 were replaced (score 5). Most common reasons for failure were (chip) fractures ($n = 43$) and caries ($n = 11$). Placement of anterior restorations in two sessions led to significant 4.6 times more failures than placed in one session.

Conclusions: In patients with severe tooth wear a full rehabilitation, in an increased vertical dimension of occlusion, direct composite resin restorations show a 94.8% success and 99.3% survival rate after a period of 3.5 years.

1. Introduction

As prevalence of caries is decreasing, especially among younger generations, more people tend to keep their dentitions relatively unrestored for life. However, surfaces of teeth abrade during function or due to acids in food and treatment of tooth wear in those individuals may pose a new challenge to the dental profession [1]; it seems to become increasingly common, among younger adults [2,3]. A pooled 30% prevalence of any sign of tooth wear of permanent teeth in children and young adults is reported, although the included studies showed wide variation [4,5]. In individual cases, tooth wear may become severe and/or pathological. Severe tooth wear is defined as 'tooth wear with substantial loss of tooth structure, with dentin exposure and significant loss ($\geq 1/3$) of the clinical crown' while pathological tooth wear is defined as 'tooth wear which is atypical to the age of the patient, causing pain or discomfort, functional problems, or deteriorations in aesthetic appearance, which, if progressing, may give rise to

undesirable complications of increasing complexity' [6]. From a meta-analysis some years ago it appeared that the prevalence of severe tooth wear increased during life, from 3% with 20 year olds to 17% with 70 year olds [7].

Due to its multifactorial nature, the aetiology of tooth wear is hard to discern [1,8]. The two main causes are chemical wear and mechanical wear. Chemical wear or erosion is the loss of tooth substance by acid dissolution of either intrinsic or extrinsic origin, e.g. gastric acid or dietary acids. Mechanical wear can be divided in attrition, which is the loss of tooth substance as a result of tooth to tooth contact during normal or parafunctional masticatory activity, and abrasion, which is the wear of tooth substance through bio-mechanical frictional processes, e.g. tooth brushing [9].

Patients with pathological tooth wear, either by chemical or mechanical cause, may need restorative care to compensate for the loss of tooth tissue, possibly comprising full rehabilitation at an increased vertical dimension of occlusion (VDO) [10–12]. The conventional

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therapy with full crowns is challenging in terms of technical skills, financial resources and time. For this reason minimally invasive techniques are preferred, but this approach tends to be as complex and demanding as conventional techniques. Several techniques using direct or indirect composite restorations, ceramics or hybrid materials have been described to build-up worn teeth and to reconstruct the occlusion [13–18]. If a worn dentition is restored, than the specific aetiology leading to the pathological condition may be a risk factor for the restorations. Ongoing erosive wear may disintegrate the marginal interface of restorations leading to breakdown. Bruxing patients impose high loads to the restoration increasing the risk for fracture [19,20]. Therefore, restorations in tooth wear patients require strong materials and should be applied in a reasonable thickness to provide resistance against the forces applied during parafunctional habits [21,22]. From the referred restoration techniques, long term results are only available for direct composites and different success rates have been reported [23–27]. So, there is a strong need for clinical evidence for techniques and materials if a full rehabilitation in increased VDO is necessary in case of pathological tooth wear. The present report evaluates the mid-term clinical performance of direct composite resin restorations placed in patients with pathological tooth wear needing full rehabilitation with an increase of vertical dimension of occlusion. Specific risk factors on restoration and patient level were distinguished.

2. Materials and methods

2.1. Design and inclusion

This study was designed as a prospective trial in which patients suffering from moderate to severe tooth wear were treated (Tooth Wear Index (TWI) ≥ 2 ; including dentine exposure in premolar and molar regions [28]). It was aimed to provide full mouth reconstructions of the natural teeth with a minimal invasive additive technique using composite restorations, without extensive prosthetic devices. Thirty-four patients (mean age 34.0 ± 8.4 years; 25 males and 9 females) fulfilling the criteria (see below) were after written informed consent included and were randomly assigned to 1 out of 5 operators. The operators were dentists working in the academic clinic, specifically experienced in adhesive dentistry with knowledge of the applied dental procedures. Ethical approval from the METC was obtained (ABR code: NL30346.091.10).

The patients were referred by general dental practitioners to the Radboud Tooth Wear Project at the Department of Dentistry of the Radboud university medical center, Nijmegen (The Netherlands). All patients had a clear request for restorative intervention due to functional problems such as difficulties with chewing, discomfort or aesthetics. The inclusion took place between December 2010 and June 2013, using the following criteria:

- 1) Patient age at least 18 years;
- 2) Generalized moderate to severe tooth wear (TWI ≥ 2) with treatment demand;
- 3) Full dental arches, but one diastema due to one missing tooth in the posterior area allowed.

Exclusion criteria were:

- 1) Limited mouth opening (< 3.5 cm);
- 2) Temporomandibular dysfunction, periodontitis, deep carious lesions or endodontic problems;
- 3) Systemic or local conditions that would contra-indicate dental procedures.

No exclusions were made on basis of aetiological tooth wear factors (e.g. severe bruxism or reflux). All participants signed an informed consent document before entering the study.

2.2. Baseline registrations

Baseline dental condition of each participant was documented by full-arch stone casts mounted in an articulator (Artex) in Maximal Occlusion (MO), bite-wing radiographs and intra-oral photographs. The amount of tooth wear per tooth was scored with the TWI [28], scoring between 0 (no loss of enamel surface characteristics) and 4 (complete enamel loss, pulp exposure or secondary dentin exposure).

The assumed aetiology of the tooth wear for each patient was assessed from the casts in combination with the intra-oral photographs, using the classification system of tooth wear [29] to broadly distinguish between erosive and mechanical wear. If for chemical wear at least 4 out of 7 characteristics and for mechanical wear at least 2 out of 4 characteristics were positively scored, the etiological factor was regarded a risk-factor. Patients with systemic underlying disease such as bulimia or gastroesophageal reflux disease were referred for adequate medical treatment. When appropriate, in cases with extrinsic erosive background, such as acidic nutrition at high frequency levels, a dietary advice was provided.

2.3. Restorative treatment

The restorative treatment protocol was to provide all teeth with composite build-up restorations followed the DSO-technique ('Direct Shaping by Occlusion') [18,30]. First, the new vertical dimension of occlusion (VDO) was determined using the mounted casts by an operator not involved in the treatment. The required increase in VDO was based on the anticipated reconstruction of the anatomical form of the teeth, carefully considering the necessary interocclusal space posteriorly and anteriorly. To be able to convert this desired VDO to the intra-oral situation, two polyvinyl silicone bite stops (Star VPS, Danville Materials, USA) were made at both sides in the premolar area on the mounted casts in increased VDO. The stops were adjusted by removing the imprint at the occlusal side of the stop with a scalpel to allow free lateral and protrusive movements when inserted, and were intra-orally relined in Centric Relation under guided closure using the same bite registration material. The bite stops were later used as supports while reconstructing the teeth in increased VDO. Reconstructions of the teeth were generally made in CR, but in case of end-to-end anterior relation MO was preferable.

Then, according to the lip-generated smile design [31], an intra-oral mock-up was designed using direct composite placed on teeth #13–#23 to check the new aesthetics with the patient. After approval of form and colour by the patient, the mock-up was recorded photographically for documentation and was removed. Before restoring the teeth in the new VDO, amalgam restorations were replaced with composite restorations and unreliable composite restorations were fully or partially replaced using materials and techniques as described below.

The scheme for restoring teeth in increased VDO started with the lower anterior teeth followed by the upper anterior teeth, using the bite stops as occlusal supports in the premolar region. The lingual, the incisal as well as the buccal surfaces of the anterior teeth were built up; the lower anteriors by estimated sculpting the proper anatomical form, leaving interincisal space for the upper anterior teeth. The lower anteriors were then reconstructed on the basis of the mock-up for the buccal/incisal form and available interdental space, followed by the palatal surfaces of the upper anteriors according to the DSO technique to obtain occlusion in the anterior area [18]. The composite used on the palatal surfaces of the anteriors was Clearfil AP-X (Kuraray, Japan), on the buccal and incisal surfaces IPS Empress Direct in dentin, enamel and incisal shades (Ivoclar Vivadent, Liechtenstein).

The next step in the restoration scheme was to restore the first premolars in the upper jaw by estimated sculpting the proper anatomical form, leaving sufficient interocclusal space for the antagonist. The composites used were the same as in the anterior region, but the less esthetical demanding, the less IPS Empress Direct was used. Thereafter

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