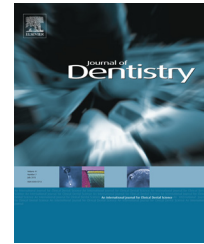


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# A multi-centred clinical audit to describe the efficacy of direct supra-coronal splinting – A minimally invasive approach to the management of cracked tooth syndrome

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## ABSTRACT

**Objectives:** This audit looked at the use of direct composite splinting to manage cracked tooth syndrome (CTS).

**Methods:** Patients who had been assessed as having CTS were offered the treatment of a directly bonded, composite overlay restoration placed in supra-occlusion. Cases were reviewed up to 3 months later.

**Results:** In all, 151 restorations were followed up in the audit of which 131 were successful at 3 months. The remaining 20 restorations failed due to pulp complications (11), failure of the composite (5) or intolerance to the high restoration (4). Of the 131, patients described transient problems with chewing (94), composite breakage (13), TMD (1), phonetics (1), increased mobility (1) and tender to chewing (1).

**Conclusions:** This is a successful non-invasive method of managing CTS in the short term for patients willing to accept transient effects.

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## Clinical significance

The use of a minimally invasive directly bonded composite flat occlusal splint for the symptomatic management and concomitant protection of teeth diagnosed with cracked tooth syndrome was described previously. This audit assesses its efficacy amongst 151 cases. In all, 131 were successful and reported a reduction in symptoms before proceeding to further treatment.

## 1. Introduction

Incomplete fractures of posterior teeth are typically associated with the symptoms of sharp pain during biting and thermal hypersensitivity, usually to cold stimuli. The condition is usually referred to as 'cracked tooth syndrome' (CTS).<sup>1</sup> The aetiology of CTS is often multi-factorial.<sup>2</sup>

The presenting symptoms of this condition can however display considerable variance, thereby sometimes leading to

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confusion and misdiagnosis. A range of dento-facial disorders have been frequently incorrectly diagnosed as CTS<sup>3</sup> and are listed in Table 1.

It is generally accepted that a history of pain on biting (or particularly on release), coupled with thermal hypersensitivity to cold and hyper-sensitivity to an applied cold stimulus, together with a positive response to a 'bite test' is sufficient to arrive at a diagnosis of CTS.<sup>2</sup> However, in the opinion of the authors, there is a lack of sensitivity with this approach.

The active restorative management of CTS is not simple; however there is consensus for the need of immobilisation. A splint should aim to prevent the independent movement of the fractured portions upon the application of a bolus to the affected tooth and prevent further progression of the fracture plane.<sup>4</sup>

In the acute scenario, symptomatic management has been achieved by the placement of copper rings, stainless steel orthodontic bands or provisional crowns to the affected tooth.<sup>5,6</sup> Copper rings and orthodontic bands are however seldom at the ready disposal of most General Dental Practitioners, are not well accepted by the periodontal tissues and furthermore may be associated with aesthetic concerns. The application of provisional, full coverage crowns is biologically invasive,<sup>7,8</sup> costly, irreversible and time consuming. Furthermore, there is a risk of overtreatment if the diagnosis is incorrect which a direct coronal onlay splint (DCS) avoids.

A variety of protocols have been described in the contemporary literature for the definitive management of incomplete posterior tooth fractures, ranging from the application of directly bonded intra-coronal restorations,<sup>9-11</sup> directly bonded extra-coronal restorations<sup>10-12</sup> and indirect extra-coronal restorations with varying amounts of tooth coverage.<sup>13-15</sup> The use of CAD-CAM-fabricated restorations has also been suggested.<sup>16</sup>

Evidence exists for the successful, medium-term use of directly bonded resin restorations<sup>10,11</sup> and indirect resin composite onlays<sup>13</sup> to treat cases of CTS. Opdam et al.,<sup>10,11</sup> have described a relatively good short term outlook for teeth affected by CTS to be managed by the placement of direct intra-coronal resin bonded composite restorations, offering a protocol with minimal subtraction (particularly in the presence of a pre-existing restoration). However the medium to longer term efficacy of this form of restoration appears less predictable over one which offers cuspal coverage, perhaps accounted for by an eventual breakdown of the adhesive interface between the restoration and affected tooth from the effects of cyclical loading.<sup>11</sup> In order to provide cuspal coverage without prescribing a change in the intercuspal position, a more invasive protocol is usually necessitated.

In 2010, Banerji et al. proposed the DCS based on the well-established concept of the 'Dahl' phenomenon<sup>17,18</sup> (perhaps

more accurately described as relative axial tooth movement, intrusion and extrusion, or occlusal adaption) as a possible means of effectively, efficiently and economically treating CTS in a minimally invasive manner.<sup>19</sup> The DCS restoration comprises a direct, 'flat' composite resin onlay applied without any tooth preparation across the entire occlusal surface, carried over across the external line angles to extend at least one-third of the way down the axial (buccal, lingual or palatal) walls, respectively. Consequently, it is placed in a supra-occlusal position. The use of supra-coronal adhesive onlay restorations to treat cases of CTS in a minimally invasive manner is not a novel concept.<sup>15</sup> There are, of course, certain limitations and indeed contra-indications to this approach.

The Dahl concept has been historically, successfully applied for the management of localised anterior tooth wear, as a means of creating intra-occlusal clearance without the need for further tooth reduction.<sup>20-25</sup> The phenomenon refers to the tooth movements that take place when a localised appliance is placed in the supra-occlusal position, followed by the concomitant re-establishment of full-arch contacts over a period of time.<sup>26</sup>

A DCS can have several applications. In the first instance, it may serve as a diagnostic aid. Indeed, the authors initially advocated the placement of the DCS onlay restoration as a 'trial approach' (without the use of an adhesive), so as to not only ascertain initial tolerance by the patient but to also help confirm that the symptoms are from a specific tooth, that the source of pain is pulpal and not periapical in origin. When directly bonded it may also provide relief from the symptoms of CTS by providing extra-coronal fixation and reduce fracture risk. Finally, a DCS restoration also has the potential to provide the necessary intra-occlusal clearance required to accommodate a more suitable definitive restoration without the further need of hard tissue removal.<sup>19</sup>

This technique has been in use for some time since initial publication, and therefore, the authors considered an audit was due. The aim of this paper is to describe the outcome for the use of DCS restorations to treat cases of CTS by the means of a multi-centred retrospective audit where a universal protocol had been applied.<sup>19</sup>

## 2. Materials and methods

A total of 151 patients diagnosed with CTS were included in this multi-centred retrospective audit. Patients had been treated at one of four separate General Dental Practices based in South-East England or at the King's College London Dental Institute, London (KCLDI). Overall, five trained operator/assessors were involved each known to the other either in the capacity of colleague, Senior Clinical Teachers or post-graduate Masters level students at the KCLDI. DCS restorations

**Table 1 – A list of conditions/signs frequently misdiagnosed for CTS.**

Acute periodontal disease	Reversible pulpitis	Dentinal hypersensitivity
Galvanic pain	Post-operative sensitivity	Fractured restorations
Hyper-occlusion	Occlusal trauma	Trigeminal neuralgia
Atypical facial pain		

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