Canine guidance on crowned teeth: time for a rethink?

F. J. Trevor Burke,*[1] P. Steve K. Lucarotti[2] and Neil Wilson[3,4]

Key points

Suggests that a possible explanation for the poor performance of crowned upper canine teeth is that these teeth are subjected to excessive excursive occlusal loads if they are crowned and used to control lateral guidance.

Questions previous recommendations that canine teeth should be placed into canine guidance when these teeth are restored with crowns, given the potential stresses on such a tooth influencing its failure.

If clinicians wish to prolong the life expectancy of a canine tooth, they should try to avoid crowning it.

Abstract

This paper aims to discuss the concept of canine guidance in light of recent research with regard to time to extraction of the restored canine tooth, with crowns representing the worst performing restoration at 15 years (66% cumulative survival). Given that the upper canine tooth may be considered the 'cornerstone' of the arch, reasons for this poor performance are discussed by examination of the existing literature on canine guidance and other aspects relating to the preparation of an upper canine tooth for a crown. The authors question previous recommendations that canine teeth should be placed into canine guidance when restored with crowns, given that the previously-published data indicate that survival of upper canine teeth which have been crowned is worse than when they are restored with any other restoration. It is also suggested that, if clinicians wish to prolong the life expectancy of an upper canine tooth, they must try to avoid crowning it.

Introduction

The concept of canine guidance has been one of several theories on occlusion central to creating the ideal occlusion treatment, including that involving crowns and bridges since the advent of fixed crown and bridge treatment, with several textbooks on crown and bridge treatment advocating canine guidance or canine-guided occlusion when crowns are placed[1,2,3] – for example, including statements such as 'the canine-guided occlusion is considered to be protective of the posterior teeth which disclude in lateral guidance'.[1] In this regard, one text on occlusion has stated that 'in doing a complete rehabilitation, it is much easier to use only cuspid guidance',[4] while another stated: 'canines are the optimum guidance teeth for lateral excursions, provided that they are not compromised periodontally, structurally weakened or restored with non-retentive restorations or post crowns'.[5] In that regard, the literature on the percentage of the general population whose natural teeth exhibit canine guidance is sparse and, in two cases, published over half a century ago; this has been estimated to be between 5% and 63%,[6,7,8,9] with the differences being accounted for by differences in the populations studied. It may be of interest to note that results of one study indicated a change to group function as the subjects' age increased, presumably because of wear of the canine teeth.[10]

However, results in recent publications[11,12,13] on the survival of crowned canine teeth in terms of years to extraction appear to challenge the concept of canine guidance.

It is therefore the purpose of this discussion paper to examine these recent publications with regard to crowns on canine teeth. In that regard, it may be considered that it is survival of the (restored) tooth which is most important – rather than survival of the restoration per se.

The data

A dataset was established,[14] consisting of general dental services (GDS) patients, this being obtained from all records for a large stratified sample of adults (aged 18 or over at date of acceptance) in the GDS of England and Wales between 1990 and 2006. The data consist of items obtained from the payment claims submitted by GDS dentists to the Dental Practice Board (DPB) in Eastbourne, Sussex, UK. One study[13] examined the key findings from nine publications with regards to recorded intervals between placing a restoration in any tooth and re-intervention on the tooth, and time to extraction of the restored tooth, while a further two studies examined the time to extraction of restored canine teeth,[12] and survival of crowns and crowned teeth in general.[11]

The data show that, with regards to canine teeth,[12] 1,232,052 restorations were involved,

[1]Professor of Primary Dental Care, University of Birmingham School of Dentistry, College of Medical and Dental Sciences, 5 Mill Pool Way, Birmingham, B5 7EG, UK; [2]Honorary Senior Research Fellow, University of Birmingham School of Dentistry, UK; [3]Specialist in Prosthodontics, Central England Specialist Referral Centre, Shirley, Birmingham, UK; [4]Honorary Senior Lecturer, University of Birmingham School of Dentistry, UK.
*Correspondence to: Trevor Burke
Email address: f.j.t.burke@bham.ac.uk

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including 91,136 crowns. On analysis of the data with regards to time to extraction of the restored canine tooth,[12] the results indicate that porcelain veneers perform best (circa 93% cumulative survival at 15 years). On the other hand, crowns perform worst at 15 years (66% cumulative survival) and teeth restored with direct-placement restorations perform better than crowns in terms of survival to extraction at 15 years (resin composite 82% and glass ionomer [GI] 76%). In terms of restoration type, therefore, crowns provide the worst-performing option for canine teeth with regards to time to extraction. However, direct-placement restorations do not produce such good survival to re-intervention as crowns or veneers. How can this be explained? It may be postulated that, when a crown fails, it fails catastrophically due to fracture of the core (dentine or restorative material), caries hidden by the crown substructure, root fracture or tooth fracture, and also because the volume of tooth structure has been substantially reduced/weakened during crown preparation. Conversely, a direct restoration may be more readily repaired or replaced.

When restorations in upper and lower canine teeth are compared, there is a five percentage-point difference in canine restoration survival to re-intervention, with those in lower canine teeth performing better. The effect is similar with regards to time to extraction, with lower canine teeth performing better than upper canine teeth by two percentage points.

When tooth type is examined, canine teeth again present the worst survival (Table 1).[12,15,16,17] Results of a further publication[11] indicated that, with regards to tooth position, crowns in upper canine teeth performed worse than in any other tooth, including molar teeth. In addition, if a canine tooth received a post on the same course of treatment as the crown, the results indicated that the already poor survival is accentuated[12] – a difference of about 25 percentage points between teeth with and without posts. Unpublished analysis shows that this general finding still applies when restricting the analysis to canine teeth. Indeed, it is sobering to learn that only half of canine teeth restored with a crown and post survive for 15 years.

Compared with a crown, the direct-placement restorations in resin composite or GI do not provide such good survival to re-intervention as veneers or crowns, but provide enhanced survival time to extraction of the restored tooth.

It is therefore apparent that, no matter how this is examined in the dataset, crowns perform less well in upper canine teeth than in any other teeth.

Discussion

The data quoted above are robust, given their genesis in one of the largest datasets ever used for research into restoration longevity.[14] They indicate that crowns in upper canine teeth perform less well than any other type of restoration and least well when compared with other teeth in the arch, in terms of time to extraction of the restored tooth. Reasons for this may only be conjectured, but could be considered to be as a result of the complete removal, during crown preparation, of the (stiffer) enamel from a tooth which is generally expected to sustain heavy occlusal loads. Compared with a crown, the direct-placement restorations do not provide such good survival to re-intervention as veneers or crowns, but provide enhanced survival time to extraction of the restored tooth. It therefore appears that, when the crown on a canine tooth fails, it is more likely to fail catastrophically. Whatever the reasons, the message is loud and clear – if clinicians wish to prolong the life expectancy of a canine tooth, try to avoid crowning it.

Occlusal guidance on anterior teeth can be categorised into different occlusal schemes, the ideal being reported to be the disclusion of the back teeth in lateral movement of the mandible using teeth on the working side, with the two reported to be the ideal being group function and canine guidance (also known as canine-protected occlusion, canine disclusion, canine lift and canine rise).[18] The basic premise of canine-protected function is that, on laterotrusive movements of the mandible, only the canine contacts and the remaining dentition are protected from adverse torsional force.[19] The theory of canine-protected occlusion can be attributed to Nagao, Shaw and D'Amico, the concept being based upon the consideration that canines are the most appropriate teeth to guide mandibular excursion.[20] In addition, D'Amico[21] stated that canine protection favours a vertical chewing pattern and prevents the wear of teeth.

Several papers and comments may contribute to the discussion into the poor survival of crowned canine teeth:

- Results from a literature review by Thornton[18] have indicated that a group-function occlusal arrangement may be conducive to occlusal wear, concluding her review by stating that 'to suggest that one occlusal scheme is better than the other is not scientifically defensible', nevertheless considering that, when the anterior guidance needed to be established, current wisdom appears to favour canine guidance
- On the other hand, Schuyler[22] has questioned: 'why place all the stress on the cuspid?'
- Canine teeth have been considered to have higher pressure sensitivity than posterior teeth[23]
- Goldstein[24] used periodontal disease indicators to indicate that canines and molars in canine guidance had a mean lower periodontal index than counterparts in canine guidance

Table 1 Survival of restored teeth at 15 years[12,15,16,17]

Tooth type	Percentage survival of restorations				Percentage survival to extraction			
	Restoration type				Restoration type			
	Crown	Resin composite	Glass ionomer	All restorations	Crown	Resin composite	Glass ionomer	All restorations
Molar	60	37	27	41	83	84	78	83
Premolar	55	37	33	40	78	83	80	83
Incisor	48	33	25	35	75	84	73	81
Canine	40	34	27	33	66	82	76	79

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- The canine tooth has a longer (single) root than any other tooth in the arch, hence perhaps the origin of the concept that it can resist occlusal forces as the 'cornerstone' of the arch
- Canine teeth have a good crown to root ratio and the shape of their palatal surface (being concave) may be suitable for guiding lateral movements
- The long root of an upper canine tooth may be considered to provide stability when subjected to occlusal loads. It might also provide a challenge when root-filling this tooth and may provide, to some degree, an explanation as to why root fillings in canine teeth perform less well than in other teeth.[25] In addition, if a post is placed (and because the canine root is long), the post may extend only half of the distance into the root and could act as a lever to fracture the root.[26] For other teeth with shorter roots, this may not apply
- Canine teeth may be considered to possess more enamel/dentine for reduction than, for example, lateral incisor teeth, yet when these are prepared for crowns, crowned canine teeth have poorer survival than lateral incisor teeth,[11] when the opposite might be expected
- Canine teeth, anecdotally, in the view of the authors, are more difficult to prepare for crowns, but this is not considered enough to account for the disparity in survival of crowned canine teeth compared to other teeth
- The data indicate that crown survival to re-intervention is three percentage points better in the lower arch, as also is the time to extraction of the restored tooth. The reasons for this may be surmised, but could include lower anterior teeth being less prone to caries, or that there may be less occlusal force on the lower, as opposed to the upper, canine tooth. Also, in this regard, the dental anatomy of upper and lower canines is similar, albeit the lower canine is a smaller tooth. However, what differs more fundamentally is the functional load on upper and lower teeth in excursive movements of the mandible, with the potential lateral load on the upper tooth being greater if it is providing guidance.

There may also be various possible reasons for the poor performance of canine teeth, such as increased potential for periodontal disease or caries in these teeth – but there is no evidence for either of these scenarios in the literature. The authors therefore suggest that a possible explanation is that canine teeth are subjected to excessive excursive occlusal loads if they are crowned and used to control lateral guidance. In that regard, there is a paucity of literature on the proportion of canine teeth which are placed into canine guidance when crowned, but the authors suggest that a majority of clinicians (and their technicians) will follow the perceived wisdom from previous teaching and place the crowned tooth in canine guidance, with the attendant stresses on such a tooth influencing its failure.

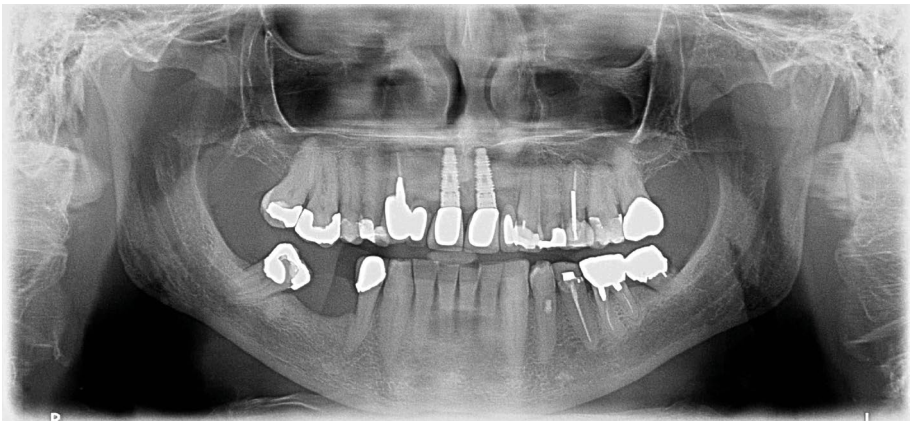

Fig. 1 Orthopantomograph of male patient discussed in the text. Of note are the tilted 47 and the cantilever bridge from the root-filled/post-crowned 13 replacing 12

The worrying effect which crowning has on canines should not make us blinded to other aspects of guidance. The orthopantograph presented in Figure 1 is of a male patient in his late sixties who attended the clinic of one of the authors (NW), as he wished to consider implants to replace the missing teeth in the lower right molar area. He had previously consulted several colleagues who had suggested different treatment plans, among these being crowning the lower right second molar tooth, which was heavily restored, and orthodontically uprighting the lower right molar which had tipped mesially. Of note to this discussion was the cantilever bridge replacing the upper right lateral incisor using the upper right canine for support (Fig. 1) – this had, according to the patient's recollection, been in place for over 30 years. Considering the data from the studies outlined earlier, such good performance would appear quite remarkable, until the patient's occlusal scheme was examined. Such examination indicated that there was a working side interference on the lower right second molar and, as a result, the (crowned) upper right canine did not come into occlusal contact during lateral movements, as it was protected by the lower right second molar. Any treatment to this tooth, such as crowning or uprighting, would change the occlusal scheme to one of canine guidance which would, in our view, have been catastrophic for the canine. Accordingly, we advised the patient to save his money for when the canine did fail, either on its own or following the fracture of the lower right molar.

In summary, the authors therefore question the conclusion from the review by Thornton[18] that, 'when the anterior guidance system must be re-established, current wisdom appears to have more proponents of canine guidance than group function'. They also question the validity of the comment made by McAdams[25] that the guidances in both canine and group-function occlusions are physiologically acceptable in natural dentitions. The most recent literature, discussed above, does not concur with the suggestion that, if a canine tooth is to be crowned, the occlusion on the restored tooth should be canine-guided, given that the data indicate that survival of upper canine teeth which have been crowned is worse than when they are restored with any other restoration.[13] The reasons for this have been discussed (vide supra), but may include the complete removal of the (stiffer) enamel from a tooth which is generally expected to sustain heavy occlusal loads. The message is, therefore, loud and clear – if clinicians wish to prolong the life expectancy of an upper canine tooth, they must try to avoid crowning it. Furthermore, the data described in the present paper indicate that, if a clinician is restoring a patient's teeth and considers that canine guidance is necessary and that the best way to do this is with a crown on the

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canine, then (s)he creates a tooth that has an increased risk of failure in a mouth that is now relying on that tooth to protect the posterior teeth. If a clinician decides that (s) he does need canine guidance, then it would be prudent to avoid crowning the tooth. Indeed, if the canine does need crowning, perhaps another form of guidance would be more prudent, such as group function. Taking some of the load off the canine in theory may help increase the longevity of the canine, but more work is needed to test this hypothesis.

Finally, a secondary concluding comment. Given the age of many of the references on occlusion in the bibliography in the present study, there would appear to be a need for contemporary work on the subject of canine guidance (and indeed the influence of occlusion, in general, on restoration survival), in order to provide more knowledge on the reasons for the suggestions made in the present paper.

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