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INFUNDIBULAR DISEASE – CAUSES, CONSEQUENCES AND POTENTIAL TREATMENTS

Introduction

Abnormalities of the infundibula of the maxillary cheek teeth (CT) have been described as infundibular cemental hypoplasia (IH) and infundibular caries (IC) [1-3]. IH most commonly affects the apical aspect of the infundibulum although rarely there may be more complete or even total absence of cementum [4]. Dental caries has been defined as a progressive acidic demineralisation of the inorganic matrix of dental tissues secondary to bacterial fermentation of impacted carbohydrate substrate and subsequent organic matrix loss [5, 6]. In Sweden infundibular caries of the Triadan 106/206 positions were found to be specifically related to presence of a novel bacteria (*Streptococcus devreisei*) [6]. Clinically, once IH lesions are exposed occlusally, dental caries through either or both of the above mechanisms is invariably present and thus the combined term infundibular hypoplasia / caries (IHC) has been used [7].

Caries of an infundibular cavity progresses peripherally over time and depending on size, may provide a central plane of structural weakness in the tooth predisposing it to pathological fracture when exposed to the normal forces of mastication [8, 9]. Advanced lesions of both rostral and caudal infundibula, especially those that coalesce, are likely to result in significant structural weakness of the CT [10]. A recent study showed caries affecting the full length of the infundibulum in 8.2% of infundibula studied, most commonly in the 12-20 year age group, and concluded that this would be likely to predispose the tooth to pathological fracture [8, 9, 11]. Thus these fractures should be termed pathological fractures, and not idiopathic fractures. Also, extension of caries from the infundibulum has been shown to cause apical sepsis in 16% of maxillary CT apical infections [12-14].

IHC of the rostral infundibulum (RI) or caudal infundibulum (CI) and has been classified and graded as follows, using the Modified Honma Calssification system (MHCS) [15] :

Grade 1 – Caries of infundibular cementum only
Grade 2 – Caries of infundibular cementum and enamel
Grade 3 – Caries of infundibular cementum, enamel and dentine
Grade 4 – Caries of rostral and caudal infundibulum, coalescing lesion
Grade 5 – Advanced caries resulting in apical abscessation, fracture or tooth loss

Potential treatments

Techniques to obturate IHC lesions that could predispose to fractures have been described to arrest caries by preventing the impaction of food material and also providing mechanical stability [10, 16], and long term data shows good results with appropriate technique [17].

Principles of restoration

The principles of dental restoration are:

- Protect the vital pulp
- Prevent progression of caries
- Restore function of the tooth

These goals can be achieved by dental restoration in horses, however to achieve a successful long-term result case selection, choice of materials and restorative technique are all critically important.

Case selection

To date the author has been using a simple occlusal and radiographic classification system for selecting cases for restoration:

- Occlusal infundibular caries lesions of Grade 3 or 4, probing at least 10mm (Grade 5 normally extracted)
- Occlusal infundibular caires lesions of Grade 2-4 for lesions contralateral to a Grade 5 lesion (especially 09 teeth), probing at least 10mm
- No evidence apical sepsis on radiography (or CT)

The age of the horse should also be taken into consideration e.g. IHC probing 10mm in a 27-year-old patient would be highly unlikely to progress to fracture due to the short remaining reserve crown and limited time for further caries to develop and is therefore an unlikely candidate for restorative therapy, however a similar lesion in a 12-year-old horse should be assessed further for potential restorative therapy. The tooth involved may also be a factor e.g. Triadan 09 teeth are the most likely teeth to be affected with deep infundibular caries and therefore most at risk of fracture (and surgical studies show that these teeth are most at risk of saggital fractures [18], whereas 07 or 08 teeth are less commonly affected with clinically significant lesions [13, 19]. Mostly, restorations are performed on Triadan 09 teeth within the age group 12-17 years, when the deep apically enlarged IH lesions become exposed to the occlusal surface. Studies have shown that the average depth of these infundibula is 34mm [19].

Extensive radiographic apical change would suggest that enamel breach and dentinal or pulp caries is present and therefore is unlikely to be a candidate for restorative therapy without knowledge of techniques of endodontic therapy which is outside the scope of this presentation.

The initial part of any restorative therapy is to adequately prepare, debride and disinfect the cavity prior to placement of restorative material. This process should remove all impacted necrotic organic material (feed) and loose carious enamel and/or dentine but should not necessarily aim to bur away dental tissue to 'get back to healthy tooth'. Discoloured but stable enamel or dentine may be left providing adequate debridement and disinfection has taken place. This is to ensure that the minimum amount of dental tissue is removed, in order to preserve as much structural stability of the tooth as possible. Practitioners should avoid the temptation to 'drill a big hole' to aid removal of impacted necrotic debris. Removal of excess dental tissue will increase the risk of vital pulp exposure, increase the difficulty of restoration and increase the risk of subsequent restorative loss.

Initially coronal food material can be removed using a fine needle probe / occlusal explorer or other pick, however within 5-10mm the material will feel firm and be difficult to remove. A no.8 round bur and water irrigated high speed hand-piece is used for removal of further material and initial gentle debridement of cavity walls. Discoloured irrigation water will be seen exiting the cavity as necrotic debris is removed. Many infundibula will still have their crescent shape and the narrow tapered fissure bur will aid in removing debris and carious cementum from these narrow recesses. Continuous intermittent assessment of the cavity is performed with the oroscope to monitor progress. Invariably organic feed material will be seen still present apically and at the margins of the cavity.

Necrotic debris out of reach of the burs can be removed by intermittent use of K and H-files, endodontic gel, NaOCl flushing using needle extension sets, fluid pump (effervescent action of NaOCl in combination with peroxide gel will aid loosening of carious material and impacted organic matter), water /air syringe and/or air abrasion unit.

[NB considerable care should be used if using the 'air abrasion' unit as the possibility of an apical enamel breach of the infundibulum should be considered – such high-pressure air and water applied in an apical direction could logically propel / compress necrotic matter deeper apically causing further apical periodontitis / pulpitis. The author does not recommend use of the 'air abrasion' unit for sole removal of necrotic debris and a recent study has confirmed the ineffectiveness of this approach [20]]

Once the cavity is adequately debrided and devoid of all necrotic organic debris, the cavity may be prepared and restored.

The steps outlined above detail the technique the author currently uses. Other potential treatments and observations from colleagues are as below:

- Material may be given a short 10-15 second light cure intermittently to stabilise the composite to prevent loss through gravity; further layers may then be placed coronally
- Compactible chemical cured composite may be used apically for the deepest of cavities with layers of flowable material coronally

- Many different restorative materials are available however the author has only been able to document normal occlusal wear over years with the BIS-GMA type dual cured microhybrid resin composites; other materials may be excessively hard and wear resistant and should be used with caution
- Colleagues have reported use of the 'sandwich' technique – a glass ionomer cement (GIC, Type II, III, VI or VII) as a cavity liner (chemical bond, compactible to the base of the cavity) followed by a composite coronally however the author has found this difficult in practice with the narrow margins of crescent shaped infundibula
- Glass ionomer cements using the Atraumatic Restorative Treatment technique (a crude bulk fill technique used in the Third World for caries restorations) may be useful however the author has had poor results using GIC

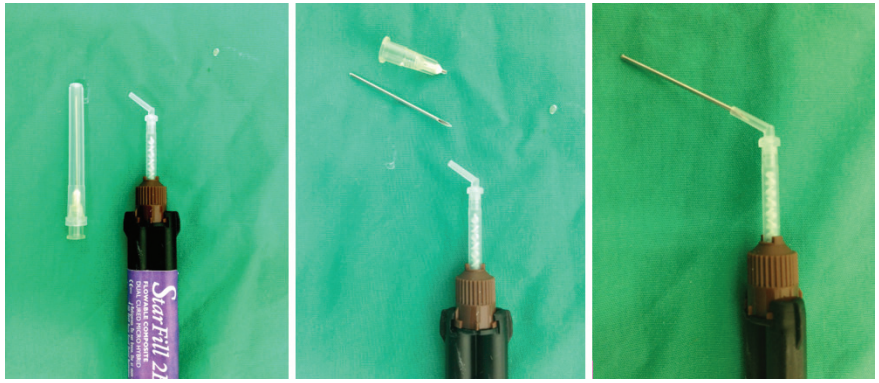

Figure 1. Creating a steel extension tip from a 19G needle

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