Pathology of the teeth: an update

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Abstract

Teeth are rarely submitted to general histopathology departments, meaning exposure to tooth pathology is largely restricted to those working in oral and maxillofacial pathology services. This paper aims to give pragmatic advice regarding the assessment, processing and clinical information that is pertinent to the sound diagnosis of tooth pathology, even if the purpose is effective onward referral of cases with all the information which is required. The main disorders that affect tooth form and structure will be discussed together with an update on the classification of abnormalities of dentine. The relevant syndromes and environmental factors which can affect tooth structure will also be described.

Keywords cementum; dentine; developmental disorders; enamel; ground section; histopathology; tooth

Introduction

The relative rarity of teeth as specimens submitted to a general histopathology laboratory means that submission of teeth can lead to confusion as to how they should be processed and assessed. In this review we aim to give a brief outline of the pathology of teeth with a practical focus on how teeth should be assessed and a brief discussion of the more common abnormalities which may be present in teeth submitted to a general pathology laboratory (dental caries excepted). Admittedly, the equipment and expertise required for some of the techniques described is disappearing, even from Oral and Maxillofacial Pathology services, and the identification of appropriate onward specialist centres for particular specimens is important.

In many cases, the uncertainty starts with the request form itself. A particular source of confusion is tooth notation, which takes various forms. Commonly, clinicians will use full longhand descriptions (e.g. upper left second premolar), which is usually easiest to understand and there is much to commend this approach. However, using this tooth as an example, the FDI notation would record this tooth as "25" while the Universal Numbering System would use "13". Clearly, discussion with referring clinicians is recommended if confusion persists.

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Important elements in the assessment of tooth pathology

Clinical

Most relevant information is gained from an accurate clinical history. This includes a clear description of the clinical appearance of the abnormalities, and a clinical photograph is often very useful. The extent and distribution of the abnormality i.e. single tooth, multiple teeth, a whole quadrant or all teeth affected may also be useful in determination of chronological or other effects. As inherited factors underlie the development of many conditions, a family history should also be provided whenever possible.

In addition to clinical photographs, radiographs are very useful in the assessment of a number of morphological features. Preferably, these should be intraoral radiographs but a good quality panoramic radiograph is also useful. These allow for assessment of the relative radio-density of the dental hard tissues and the morphology of the crown, pulp chamber and roots of the submitted tooth, in addition to other abnormalities or dental disease.

Examination of the tooth

The identity of submitted teeth should be confirmed by morphology where possible and this correlated with the identification on the request form (and other ancillary material). A full description of the tooth should be recorded and, if appropriate, a gross photograph should be taken (Figure 1). Salient features to note include the morphology of the crown and roots, the number of roots and any gross abnormality of enamel, dentine or cementum. The presence of other dental disease, such as dental caries or other non-carious tooth surface loss should also be recorded.

Specimen processing

It is unlikely that many General Histopathology Laboratories will have access to facilities which allow the production of ground sections of teeth, yet as will become apparent in the discussion below, ground sections are required for the assessment of a number of dental abnormalities. Teeth submitted with clinical suspicion of a defect of enamel, regardless of whether this is considered to be environmental in origin or inherited, require a ground section to examine the structure of enamel. This is particularly important as the enamel matrix of erupted teeth has a very low organic content, thus after decalcification little significant organic matrix is retained for examination. On occasion, a ground section may also be useful in the detailed assessment of dentine and cementum. Usually only half of a tooth is used for ground sections and the other half should be decalcified. Ground sections are mounted using Pertex or Harleco Synthetic Resin (HSR), as these have a similar refractive index to enamel. When referring teeth on to a laboratory with the facility to produce ground sections, it is important to ensure that the additional information outlined above is transmitted to the pathologist. The use of microcomputed tomography can also be used in specialized laboratories to provide an objective measure of mineral content.[1]

Teeth may be decalcified in formic acid (5–10%, for approx 5–8 days). EDTA (10%, in various formulations) may also be used; however this process is much slower. Where microwave decalcification is available, this can be used to speed up the

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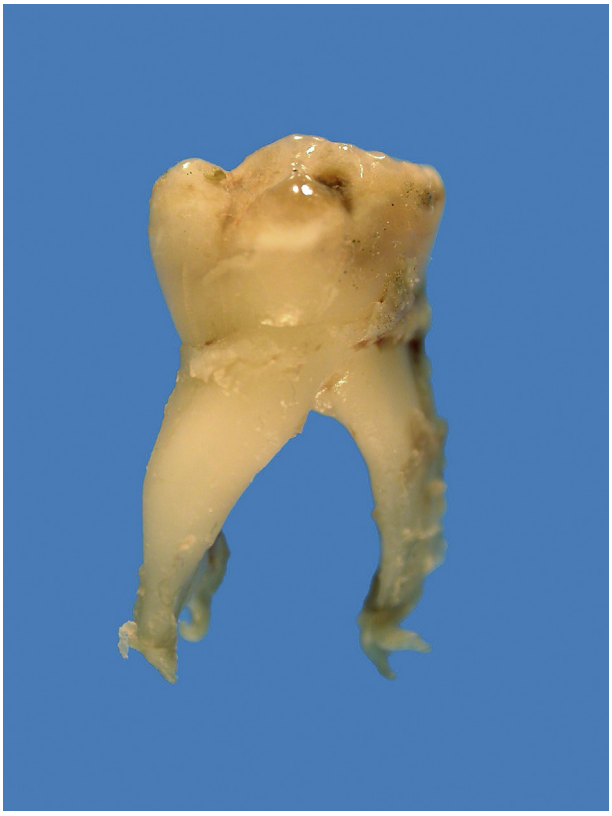

Figure 1 Gross photo of an upper molar tooth with abnormal enamel affecting the whole crown.

decalcification process, reducing decalcification time by up to 50%, with no adverse effect on morphology.[2] Radiographs may be useful to allow assessment of completeness of the decalcification process, prior to an attempt to cut the tooth. In circumstances where examination of the coronal pulp is required, it may be advisable to section the tooth with a fine saw across the root(s) to allow the pulp to fix properly before decalcification.

Histological examination of teeth

Examination of teeth may require the use of polarized light and, on occasion, a source of fluorescent or ultra violet light.

Localized conditions which only affect the teeth

Developmental disturbances in tooth form

There are many variations in the form of teeth that are common and relatively unimportant. These include variation in the form of the occlusal surface and shape of the crown, the number, size and shape of roots and, more rarely, fused or incompletely divided teeth.

Odontomes: are relatively common and are catalogued with odontogenic tumours despite being hamartomatous proliferations of dental hard tissues.[3] Two main types are described: complex and compound. Histopathological examination can be conducted solely on decalcified sections, although there are occasions where a ground section may be useful. The complex odontome is classically described as comprising haphazardly arranged dental hard tissues, whilst the compound variant comprises a number of well-formed tooth-like structures. Intermediate forms do occur and the predominant form determines the final diagnosis.

Complex odontomes: occur largely in the 2nd decade and may be found as an incidental finding on a radiograph taken for orthodontic reasons or for investigation of unerupted teeth. They are most commonly found in the mandibular premolar/molar region, but can occur anywhere in the jaws. Complex odontomes are often associated with unerupted teeth and may attempt to erupt into the oral cavity, when symptoms of pain and swelling may rapidly develop. Radiographically, a radiopaque mass, often with a "radiating" structure and a pronounced radiolucent rim is present (Figure 2a). Histologically, the complex odontome contains irregularly arranged enamel, dentine, cementum and dental pulp, with dentine often predominating but with the tissues maintaining their normal morphogenetic relationships one to another (Figure 2b). Odontogenic epithelium is present in some cases. Enamel can be recognized by residual enamel matrix after decalcification.

Compound odontomes: most often develop in the anterior maxilla (Figure 3a). The small tooth-like structures within the lesion have a normal relationship of enamel, dentine and cementum (Figure 3b), but do not resemble individual teeth from the normal dentition.

When odontomes are immature, with little hard tissue formation, inexperienced pathologists may misdiagnose these lesions as ameloblastic fibroma (AF) or ameloblastic fibro-odontoma (a term now removed from the 2017 WHO Classification of Tumours of the Head and Neck).[3] Clinical and radiological correlation should be utilized to avoid this error; as a developing odontome is more likely in a young patient with a non-expansile lesion in the jaws. An expansile lesion in an individual where tooth development is complete is likely to represent an AF.[4]

Invaginated "odontome", also known as "dens in dente": this results from invagination of part of the enamel organ into the crown of the developing tooth and is not a hamartoma. The teeth most commonly affected are the maxillary lateral incisors and the abnormality may be bilateral. The clinical appearance and presentation is variable, but often pulpitis or its sequelae develops, due to the easy ingress of microorganisms into the invagination and thus to the dental pulp via patent dentinal tubules that may not be lined fully by the invaginated enamel. The teeth may be distorted or swollen, with a radiographic or gross appearance of a tooth inside a tooth (Figure 4). Histologically, there is invagination of enamel and dentine into the crown and/or root of the tooth. The invagination opens onto and is in continuity with the enamel of the occlusal surface.

Common developmental disturbances in tooth structure

There are numerous causes of alteration in the structure of the dental hard tissues, which may be related to local factors (infection, trauma), generalized environmental factors (systemic infection and other disease: the so-called chronological hypoplasias, see later) and inherited factors.

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