Management of Dental Emergencies in Children and Adolescents

Edited by
Klaus W. Neuhaus and Adrian Lussi

with website

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Preface

Dear readers,

Dental emergency situations are often demanding due to the patient's pain, or due to time constraints on the dentists' side. When children or adolescents suffer dental emergencies, the situation might be even more challenging because of the patients' age, the worried patients, not rarely accompanied by loud screaming. In this setting it is demanding for the dental team to remain quiet and provide the necessary and considerate treatment.

This book aims at providing some assistance to dental practitioners in order to better manage potentially stressful situations with children and adolescents in the dental office.

The focus lies on the management of therapeutic demands.

The content of this book is not totally new. Knowledge can be obtained from books on dental traumatology, cariology, pediatric dentistry, endodontology, or orthodontics. However, this is the first time that a textbook particularly emphasizes how to manage emergency situations with young patients only, and which treatments potentially could be offered once the acute emergency is over.

While the first section of the book recapitulates the biologic and developmental differences between treatment of adults vs. children/adolescents, the following chapters emphasize how to manage tooth substance loss, how to deal with endodontic problems in deciduous teeth or in teeth with an open apex. Furthermore, general dental practitioners should be aware of the long-term consequences of early tooth loss, and of methods to deal with that.

Because teeth are not the only possible cause for emergencies in the dental office, other chapters focus on oral health related problems and on the management of non-infective conditions.

We are happy about the more than competent team of contributing authors. We chose authors that deal with young to very young patients every day in order to guarantee as much practical relevance as possible. At the same time the authors are experienced lecturers and have up-to-date theoretical knowledge included in their chapters.

We hope that reading this book help the readers to acquire a higher level of confidence while coping with demanding emergency situations of children and adolescents during daily work.

Klaus W. Neuhaus
Adrian Lussi

Invited Preface

Dental emergencies in children and adolescents are 'grist for the mill' for paediatric dentists and endodontists. However, during our initial dental training, we are mostly taught by individual disciplines, and therefore it is easy to miss the interdisciplinary nature of the care required for paediatric and adolescent emergencies that provides the best outcome for the patient.

To have a book that brings the elements of comprehensive emergency care together is of great benefit to clinicians. The editors have brought together a host of dental clinicians as authors who have a wealth of relevant experience that is shared in the text.

Emergencies in children are different to those for older individuals. As development is still occurring, this has great influence on treatment planning, as well as the ability to provide the best care for the child. Development includes both physical, psychological and behavioural aspects, and these need to be considered in both immediate and long-term definitive care.

Treatment of emergencies has evolved over the years as the evidence has improved, however, there is still much to learn regarding the most appropriate care for the individual patient. For example, the chapter on management of deep carious lesions illustrates the vast changes that have evolved as the related evidence-base increases in size and validity – treatment of the deep carious lesion is far less aggressive than in previous decades, as the importance of maintenance of pulpal health and 'sealing' of the lesion has become preeminent.

Another example is the chapter on regenerative endodontics, an area of clinical care that was non-existent 25 years ago. The use of MTA, and now including newer calcium silicate-based materials, has revolutionised endodontics. The ability to encourage healthy tissue to re-establish itself in a root canal system previously filled with necrotic tissue creates the possibility of continued root development in a partially developed tooth and has wide-ranging clinical consequences.

In paediatric and adolescent emergencies, treatment decisions often need to be made immediately, therefore a sound understanding of the short- and long-term consequences of treatment options is vital, and the following text provides the clinician with a sound base to inform these decisions. The decision may be as dichotomous as whether to replant an avulsed permanent incisor or not – leading to the thought process which may include – how long has the extra-oral time been? How long was the 'dry time'? What storage medium has been used? How developed is the tooth? Is the soft tissue and/or bony socket damaged? Is the child capable of accepting care in the dental chair, or will sedation or a general anaesthesia be necessary? Will this change my treatment options or recommendations? What do I talk to the parents about? Do I have informed consent? Should I extirpate the pulpal tissue – now or later, or at all? When and how often is follow-up? What tests should I undertake? All leading to the question – what is the best option for the individual patient?

This contextually broad but concise text provides the clinician with ample information on how to deal with emergencies, from pulpotomies to facial swellings to post-trauma orthodontic tooth movement. The comprehensive nature of the text covering treatment of both the primary and permanent dentitions makes it a valuable reference text that should be in all dental clinics.

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About the Companion Website

This book is accompanied by a companion website:

www.wiley.com/go/neuhaus/dental_emergencies

Scan this QR code to visit the companion website

The website includes multiple choice questions.

Unit 1

General Considerations for Emergency Management in Children and Adolescents

1.1

Developmental and Histological Aspects of Deciduous and Young Permanent Teeth

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Differences between Deciduous and Permanent Teeth

The most noticeable difference between deciduous and permanent teeth is related to their anatomy: deciduous teeth are generally smaller than their permanent counterparts and have a significantly thinner enamel layer (Grine, 2005; Mahoney, 2013) (Figure 1.1.1a,b). Additionally, histological differences may influence their susceptibility to dissolution.

Deciduous teeth have an outermost layer of aprismatic (prismless) enamel, with a thickness varying from 15 to 30 μm (Kodaka et al., 1989; Ripa, 1966; Ripa et al., 1966). The aprismatic layer is significantly thicker on the labial than the lingual surfaces of anterior deciduous teeth, but no significant differences have been found between the surfaces of deciduous molars (Shellis, 1984a).

A prismatic enamel layer has been observed in both deciduous and permanent teeth, with a variable thickness of between 10 and 30 μm (Horsted et al., 1976; Kodaka et al., 1991). In relation to the enamel crystals, the arrangement of enamel prisms is fairly similar in both deciduous and permanent teeth (Radlanski et al., 2001); they reach the surface at an almost perpendicular angle in both dentitions (Horsted et al., 1976). Shellis (1984a) was able to trace the prisms in permanent teeth all the way to the surface, but the prisms in deciduous teeth are distinctly different – more gently curved, with slightly more pronounced Hunter–Schreger bands (Shellis, 1984b) (Figure 1.1.2a,b). Furthermore, the prisms in deciduous teeth are smaller, with more complete boundaries, and are more widely spread out than those in permanent teeth (Shellis, 1984b), which is suggestive of more porous enamel in deciduous than in permanent teeth. The interprismatic fraction and prism-junction density are also greater in the enamel of deciduous teeth than in that of permanent teeth (Shellis, 1984a).

The organic content of enamel also varies according to the kind of tooth. It has been shown to range between 0.7 and 12.0% in deciduous teeth, as compared to 0.4–0.8% in permanent ones (Stack, 1953). Studies of the inorganic content have found that a mineralisation gradient from the surface to the amelo-dentinal junction is clearly observable in both dentitions: a more mineralised layer of enamel is present nearer to the tooth surface and decreases towards the amelo-dentinal junction. In general,

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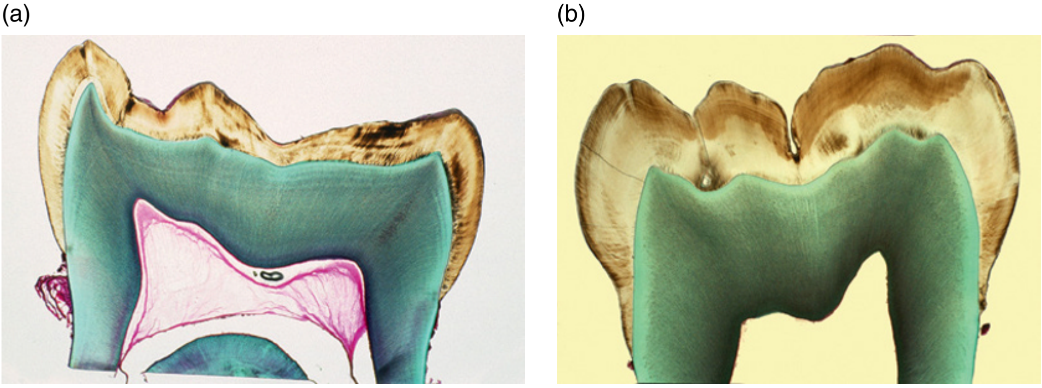

Figure 1.1.1 (a) Deciduous teeth have a significantly thinner enamel layer than (b) permanent teeth. Note: The enamel - cementum border in the deciduous teeth is more coronal compared to permanent teeth.

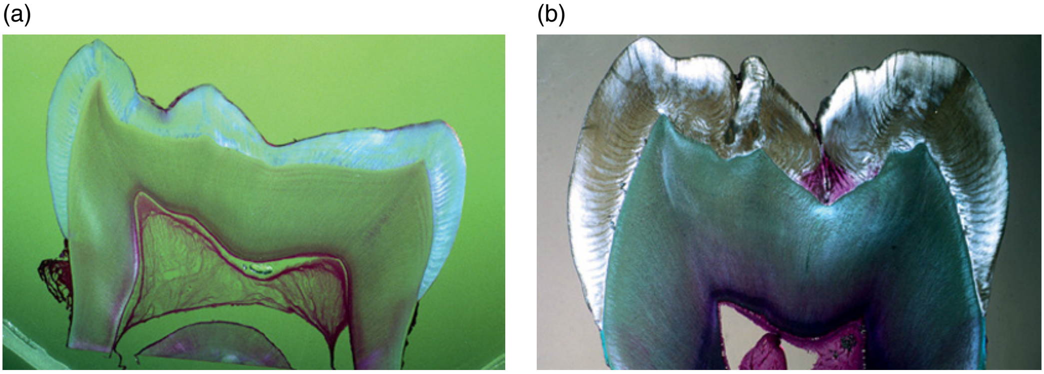

Figure 1.1.2 The prisms in deciduous teeth are more curved than those in permanent teeth. Therefore (a) deciduous teeth show more pronounced Hunter–Schreger bands than (b) permanent teeth.

deciduous enamel is considerably less mineralised than permanent enamel (Wilson and Beynon, 1989). Moreover, Sønju Clasen and Ruyter (1997) observed that deciduous enamel has a greater total carbonate content than permanent enamel. The carbonate ion can occupy the position either of the hydroxyl (OH−) groups (type A carbonated hydroxyapatite) or of the phosphate (PO_4^{3-}) groups (type B carbonated hydroxyapatite) in the hydroxyapatite crystal. The same authors noted that there is more type A carbonated hydroxyapatite in deciduous enamel than in permanent enamel.

Although the carbonate ion can cause distortion of the apatite crystal lattice in both positions, when it is in the position of type A, it is assumed to be less tightly bound and to contribute to greater solubility of the enamel.

All of the preceding histological differences between deciduous and permanent enamel may be related to the fact that deciduous enamel has significantly lower surface microhardness (Lussi et al., 2000; Johansson et al., 2001; Magalhães et al., 2009) and elasticity (Lippert et al., 2004). This, in turn, could render deciduous teeth more susceptible to dissolution. In vitro studies of deciduous teeth have shown them to be more susceptible to caries-like acid dissolution than permanent teeth (Shellis, 1984a), and artificial caries lesions have been shown to progress 1.5 times faster in deciduous than in permanent enamel (Featherstone and Mellberg, 1981).

Tooth Development and Structural Characteristics of Dental Hard Tissue

Tooth development in the human embryo begins at between 28 and 40 days of gestation. Epithelial cells grow in the ectomesenchymal (mesectodermal) parts of the jaw. A protruberance of the oral epithelium is formed, derived from the inner and outer enamel epithelium of the enamel organ (bud stage; Figure 1.1.3a). The dental papilla is formed by the further penetration of the epithelial cells into the ectomesenchyme (cap and bell stage;

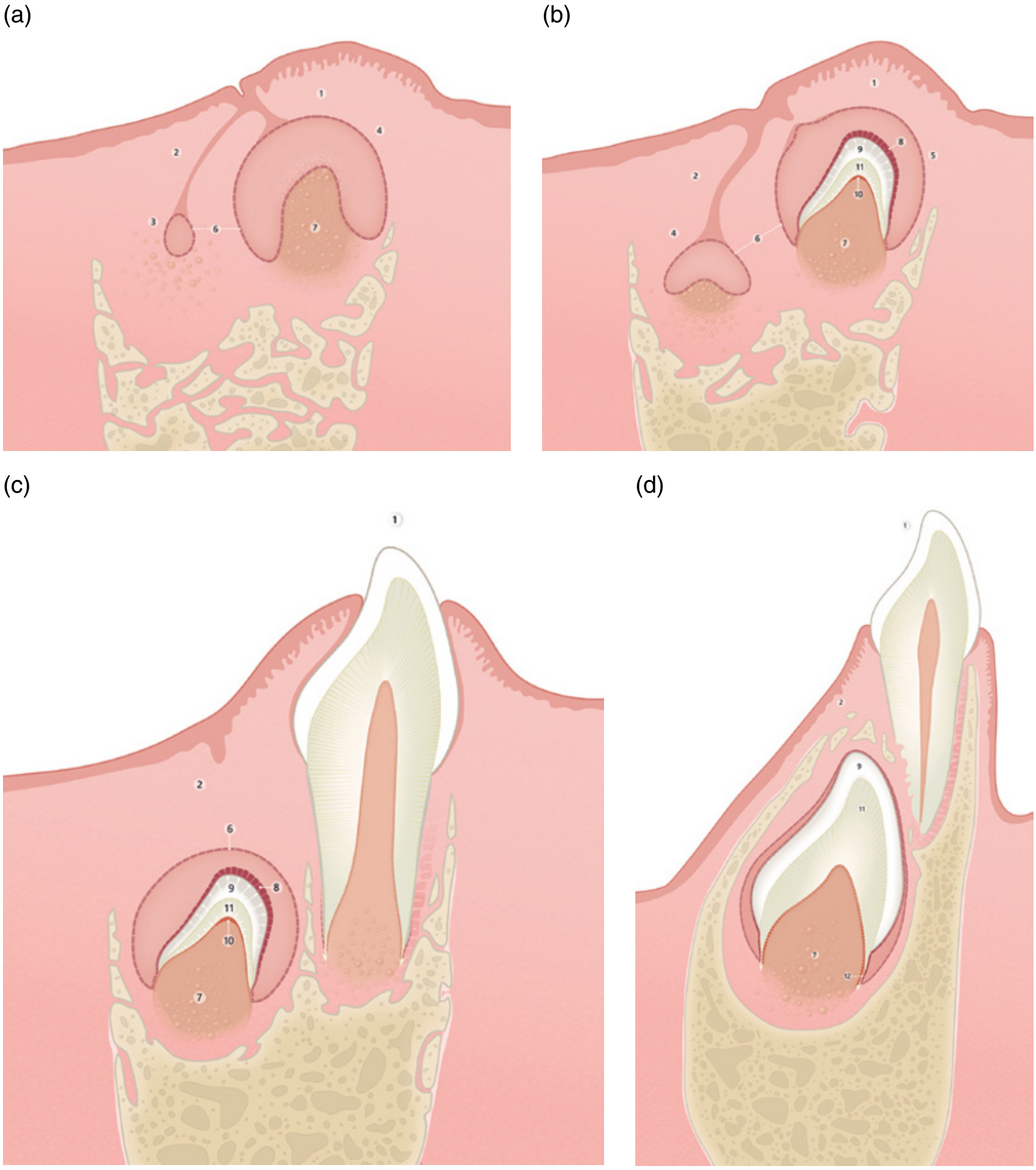

Figure 1.1.3 (a–d) Stages in the development of deciduous and permanent teeth: (1) development of deciduous tooth; (2) development of permanent teeth; (3) bud stage; (4) cap stage; (5) bell stage; (6) enamel epithelium; (7) dental papilla; (8) ameloblasts; (9) enamel; (10) odontoblasts; (11) dentin; (12) Hertwig epithelial root sheath.

Figures 1.1.3b, 1.1.4–1.1.6). At this time, cell differentiation for the formation of the dental hard tissue occurs. Ameloblasts arise from the ectodermal cells, whilst odontoblasts arise from the adjoining ectomesenchymal cells of the dental papilla, as part of a mutual induction chain. The formation of the dental hard tissue does not start simultaneously in the ectodermal parts and the dental papilla along the entire contact surface. In the case of front teeth, the first layers of enamel and dentin are formed in the middle of the later incisal edge; with lateral teeth, this occurs in the region of the later cusp tips (Figures 1.1.3b–d). With continued growth, the various areas of tooth formation fuse, forming the occlusal surface.

Through further penetration of the epithelial cells into the ectomesenchyme, the double-layered Hertwig's epithelial root sheath is produced (Figures 1.1.3d and 1.1.7). This determines the size, shape and number of the resulting tooth roots. In multirooted teeth, tongue-like extensions grow from the circular edge of the Hertwig's epithelial root sheath over the apical edge of the dental papilla. These projections fuse into the bi- or trifurcation. The resulting dentin layers will later form the base of the crown cavity. The Hertwig's epithelial sheaths proliferate apically and form the tooth roots (Figure 1.1.8a–d). The remnants of the Hertwig's epithelial sheaths are responsible for the formation of true enamel pearls or cementum-free root parts. These remnants are known as epithelial cell rests of Malassez, and play a role in the formation of odontogenic cysts.

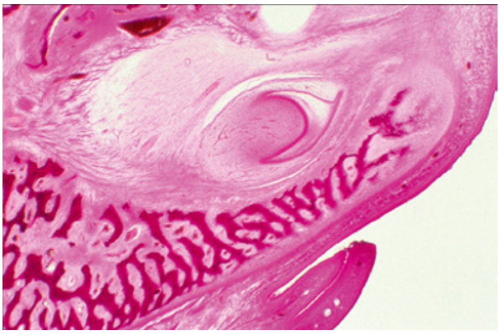

Figure 1.1.4 Tooth germ at the cap stage.

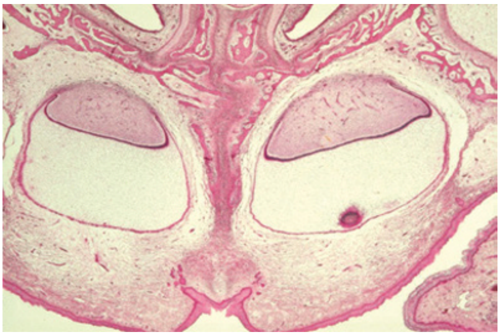

Figure 1.1.5 Tooth germ at the early bell stage.

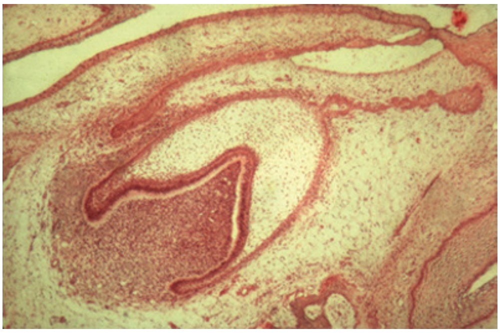

Figure 1.1.6 Tooth germ at the bell stage.

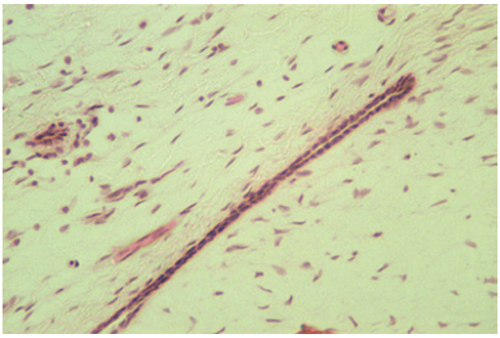

Figure 1.1.7 Hertwig epithelial root sheath with outer and inner enamel epithelium.

Structural Features of the Enamel

Light microscopy reveals brown lines in the enamel, which run obliquely to the occlusal direction from the enamel–dentin border.

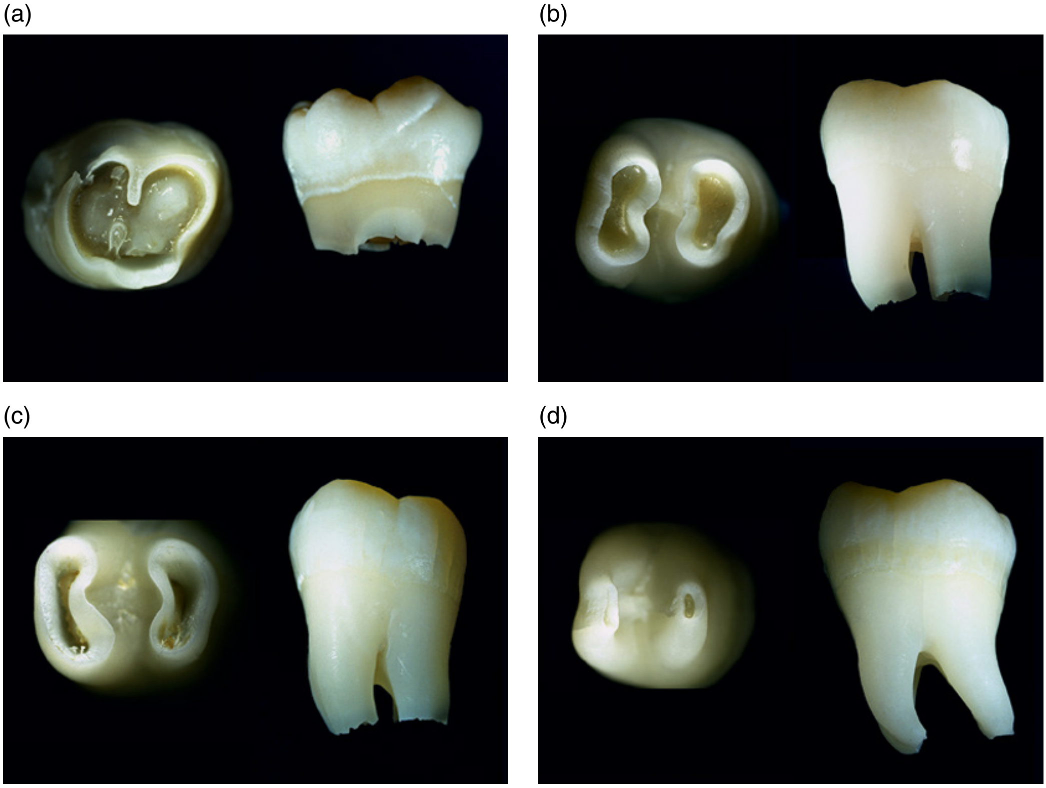

Figure 1.1.8 Apical view (left) and view from the side (right) of the developing tooth roots. (a) The tongue-like projections meet in the region of the later bifurcation, fuse there and form new epithelial sheaths for the development of two tooth roots. (b–d) With increasing root development, there is a narrowing of the root canals until the apex is reached. The root growth accelerates the tooth eruption.

These are the cross-striations and striae of Retzius, which reflect the cyclical deposition of the enamel in the developing teeth (Figure 1.1.9). In a horizontal cross-section, these stripes resemble the annual rings of a tree. Where the striae of Retzius meet the surface of the enamel, imbrication lines are formed. Between the imbrication lines are the perikymata, which are easily recognisable in newly erupted teeth (Figure 1.1.10).

Structural Defects and Paraplasia of the Enamel

In most teeth, structural defects of the enamel are visible under the light microscope. A large proportion of these defects occur during enamel development. Examples include enamel spindles and enamel tufts. Enamel spindles are formed by odontoblast projections, which extend from the enamel–dentin boundary into the enamel matrix and are enclosed by the enamel during fusion (Figure 1.1.11). Enamel tufts are produced by incompletely mineralised matrix-enriched areas, which extend along the enamel prisms (Figure 1.1.12a,b). Enamel tufts can be a weak spot with regard to caries spread.

An enamel pearl is a developmental anomaly whereby enamel occurs in an atypical localisation. Enamel pearls come in two types: real and composite. The real ones are composed only of enamel. They are up to 0.3 mm in size and are often covered with cementum (Figure 1.1.13). The remains of Hertwig's epithelial root sheaths are responsible for their formation. These epithelial sheath residues can give rise to the differentiation of

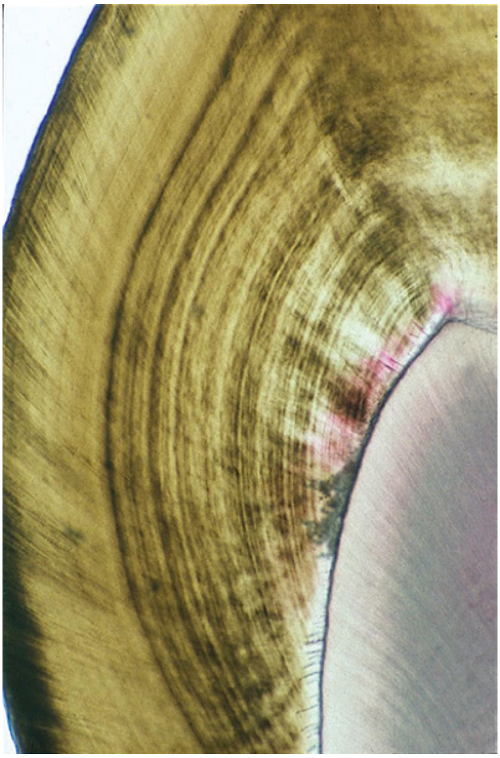

Figure 1.1.9 Vertical section through the crown of a permanent tooth. The cyclical pattern of enamel formation is reflected in the striae of Retzius.

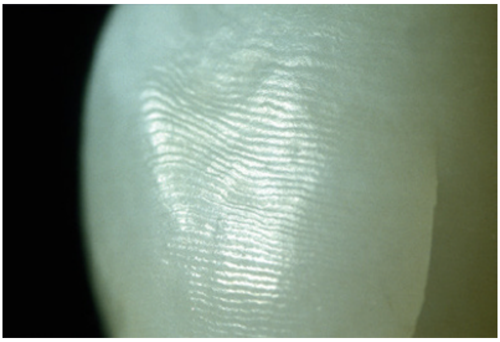

Figure 1.1.10 Enlargement of the tooth surface, clearly showing the perikymata and the imbrication lines between them.

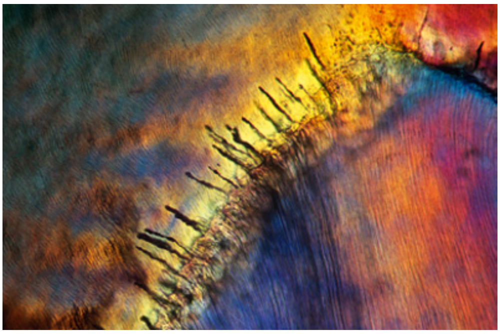

Figure 1.1.11 Columnar and piston-like enamel spindles extending from the dentinoenamel junction into the enamel.

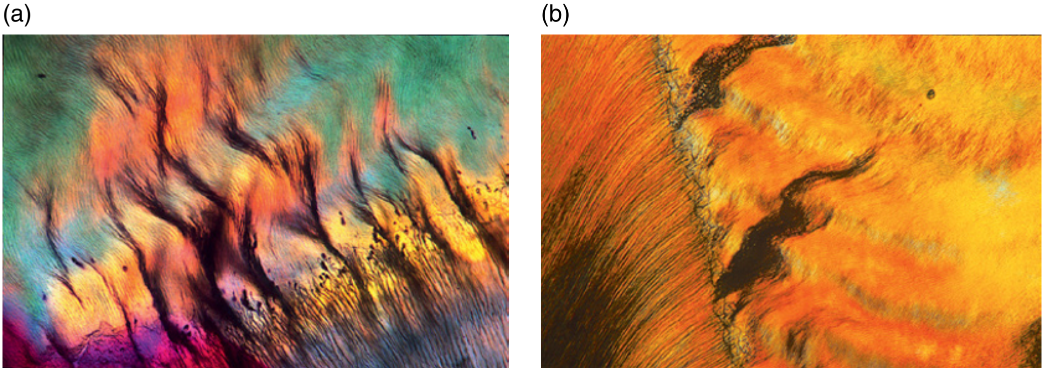

Figure 1.1.12 (a,b) Enamel buds unfold like grass tufts from the dentinoenamel junction into the enamel. The figure clearly shows the incompletely mineralized matrix-enriched enamel components running along the enamel prisms.