

儿童龋病学

Paediatric Cariology

编 著 Chris Deery
Marie Therèse Hosey
Paula Waterhouse
主 译 秦 满
译 者 赵玉鸣 李 静
管 悦 颜沁子

 人民军医出版社
PEOPLE'S MILITARY MEDICAL PRESS

北 京

前 言

儿童龋齿的治疗工作对于每一位口腔医生都是一种挑战。对每个口腔诊疗小组来说，应努力通过优质口腔护理，帮助每一位儿童认识牙齿的重要性并避免医源性损伤，成长为拥有健康牙齿的年轻人。这主要是通过向儿童及其监护人提出预防性建议，使他们认识到牙齿健康的价值，知道如何维护牙齿健康。

在儿童口腔科保健中，预防龋齿始终是第1位的，这就需要口腔诊疗小组的全体成员经常深入到社区，开展促进口腔健康活动，尤其是氟化水源。

不幸的是，当乳牙，尤其是乳磨牙发生龋坏时，由于其形态特点可导致牙髓早期受累。因此，尽管早期诊断很困难，但对于简化治疗来说十分重要。幸运的是，乳牙牙髓治疗和预成冠方法相对简单易行，口腔医生都应具备这些技术。

我们希望这本书首先能够促进常规预防护理工作，其次能够向口腔医护人员（如口腔医生和技师等）提供现代的诊断方法和修复技术，以便更好地防治儿童龋齿。

现在仍有许多儿童不断受到龋齿的折磨，小小年纪就要面对各种各样的口腔治疗，而这些治疗手段很可能还包括一次或多次全身麻醉，这实在让人感到难过。虽然龋齿是一种可以预防的疾病，但遗憾的是很多儿童都有龋齿。

《儿童龋病学》一书，是迅速壮大的“口腔临床要点快速掌握系列”中一本非常优秀的新著。很多人还不能了解预防及治疗儿童龋齿的重要性，但如果工作做好了是非常有价值的。通常，要做好这项工作，医师必须在同一时间至少处理三个问题：患儿、龋齿，以及焦虑不安、心怀内疚或是漠不关心的家长，后者更加难以应付。这并非一项简单的工作。通过阅读这本简单易懂，并附大量图解的书，熟悉其中的最新观点和临床指导原则，你一定会大受裨益，工作也变得简单、轻松多了。

正如“口腔临床要点快速掌握系列”的一贯宗旨，本书重点阐述最新的、与临床密切相关的知识和观点。同样，这本书在儿童口腔护理方面也可能发挥很大作用。近年来，儿童口腔科发生了巨大的变化，而且随着新材料和新技术的不断应用，儿童口腔健康状况可望进一步改进。儿童龋病学是临床实践的一部分，临床医师需要不断更新相关的信息。本书就是为满足这种需求而编撰出版的。

主 编 Nairn Wilson

内容提要

“口腔临床要点快速掌握系列”是国际著名的Quintessence出版社近期出版的介绍口腔各科基本技术和最新医学理论的专业丛书。该丛书自2002年起陆续出版发行,我社第一时间引进,以便国内读者同步了解国际口腔技术发展的新情况。儿童龋病长期以来没有得到足够的重视,方法、技术的更新不及其他口腔学科。本书介绍了许多最新的儿童龋病治疗原则、修复方法及技术设备。本书采用中英对照编排方式,对提高读者的专业英语水平大有裨益,适合临床口腔科医师、技师和口腔医学生阅读。

责任编辑 杨 淮 韩 志

图书在版编目(CIP)数据

儿童龋病学 / (英) 帝瑞著; 秦 满主译. - 北京: 人民军医出版社, 2006.9
(口腔临床要点快速掌握系列)

ISBN 7-5091-0133-6

. 儿... . 帝... 秦... . 小儿疾病: 龋齿 - 诊疗 - 汉、英 . R788

中国版本图书馆CIP数据核字(2006)第001122号

Paediatric Cariology, by Chris Deery, ISBN 1-85097-073-4由国际精萃出版集团
(International Quintessence Publishing Group) 提供中文版权 授权人民军医出版社出版并
在全球发行该书中文版。

版权登记号: 图字 - 军 - 2005-056 号

策划编辑: 杨 淮 文字编辑: 韩 志 责任审读: 黄栩兵

出 版 人: 齐学进

出版发行: 人民军医出版社 经 销: 新华书店

通信地址: 北京市 100036 信箱 188 分箱 邮 编: 100036

电话: (010) 66882586 (发行部) 51927290 (总编室)

传真: (010) 68222916 (发行部) 66882583 (办公室)

网址: www.pmmp.com.cn

印刷: 北京印刷一厂 装订: 春园装订厂

开本: 889mm × 1194mm 1/32

印张: 6.5 字数: 245 千字

版、印次: 2006年9月第1版第1次印刷

印数: 0001 ~ 2500

定价: 68.00 元

版权所有 侵权必究

购买本社图书, 凡有缺、倒、脱页者, 本社负责调换

电话: (010) 66882585、51927252

第1章 儿童龋病学：治疗和认识误区	(1)
第2章 龋齿的诊断	(13)
第3章 治疗设计和止痛	(48)
第4章 预防龋齿的系列方法及其应用	(67)
第5章 乳后牙的冠内修复	(90)
第6章 操作简单的预成冠	(118)
第7章 乳牙牙髓治疗	(133)
第8章 避免拔除龋坏的乳前牙	(173)
第9章 如何使用口腔科橡皮障	(192)

第 1 章 儿童龋病学：治疗和认识误区

Paediatric Cariology: Management and Myth

目 的

本章的目的是从儿童牙列发育和心智发育的角度来强调儿童龋病治疗的重要性。此外，也将讨论有关儿童龋病学的各种认识误区。

要 点

通过阅读本章，读者应认识到使儿童免受急、慢性牙痛之苦的重要性，特别是乳牙列对于维护全身健康及发育所发挥的重要作用。口腔诊疗小组成员应熟悉牙列的发育时间表，并且懂得如何利用这些知识来辅助判断儿童常见病对于牙体硬组织的影响。

引 言

龋齿是人类的一种常见病，涉及

Aim

This chapter aims to emphasise the importance of the management of caries in children in respect of their continued dental, emotional and educational development. In addition, various myths surrounding paediatric cariology will be discussed.

Outcome

Upon reading this chapter, the practitioner should have gained an understanding of the importance of ensuring that children remain free of both acute and chronic dental pain and appreciate the contribution of the primary dentition, in particular, to overall health and development. The dental team should also be familiar with the chronology of the development of the dentition and appreciate how knowledge of this assists in determining the effect of common childhood illnesses upon the dental hard tissues.

Introduction

Dental caries is one of the most preva-

到牙齿的硬组织,即牙釉质、牙本质和牙骨质,是口腔微生物作用于可发酵的糖类的结果。龋齿的特点是使牙体硬组织脱矿,进而引起牙齿的有机成分崩解,最终可导致细菌侵入,牙髓坏死,根尖周组织感染,并引起疼痛。然而在病变早期,由于可能发生再矿化,龋齿尚可以停止。近年来,西方世界的患龋率有所下降,可能的原因包括:氟化物的广泛应用(尤其是含氟牙膏),饮食习惯的改变,越来越多的使用抗生素,也可能由于微生物毒性的改变。

牙齿光滑面的患龋率下降最明显。尽管磨牙颊侧及腭侧的点隙也易患龋,但目前磨牙殆面窝沟点隙的龋齿易感性是最高的。然而患龋率的下降并不是均匀一致的。苏格兰健康委员会在1992/1993年度进行的口腔流行病学调查显示,12岁儿童患龋率达7%。

lent of human diseases. This disease involves the mineralised tissues of the teeth, namely enamel, dentine and cementum, caused by the action of microorganisms on fermentable carbohydrates. It is characterised by demineralisation of the mineral portion of these tissues followed by the disintegration of their organic material. The disease can result in bacterial invasion and death of the pulp and the spread of infection into the periapical tissues, causing pain. In its early stages, however, the disease can be arrested since it is possible for remineralisation to occur. Over recent years there has been a decline in the prevalence of caries in the Western World. Possible reasons for this include the widespread use of fluoride (especially in toothpaste), changes in the diet, the increased use of antibiotics, and possible changes in the virulence of microorganisms.

The decline in caries prevalence has been greatest on the smooth surfaces of teeth. The pit and fissured surfaces of the molar teeth now have the greatest disease susceptibility, although buccal and palatal pits and fissures remain caries prone. The decline in caries, however, has not been uniform but skewed. The Scottish Health Boards' Dental Epidemiological Programme survey carried out in 1992/93 showed caries in 7% of 12-year-old children.

不幸的是，很多口腔医师没有意识到保存乳牙列的重要性，这也更加误导了很多家长，认为乳牙可以不用治。我们希望通过本书，鼓励口腔医生、口腔治疗师以及口腔卫生士进一步完善自己的临床技能，更好的满足儿童的治疗需要，从而改变那些不重视乳牙列的观点（图 1-1）。

我们为什么要保存乳牙列？

人们越来越清楚地认识到牙齿健康与全身生长发育及健康是密切相关的。疼痛和感染会对健康造成不良影响。这些影响在儿童的急性疼痛中表现得尤为明显，然而慢性牙痛同样会出现问题。长期的慢性牙痛使儿童不能健康成长，所有龋坏牙都有可能会不时地引起疼痛及敏感，从而导致：

Unfortunately, many dental practitioners do not see the value in restoring the primary dentition. This reinforces the view of many parents that primary teeth are expendable. We hope that this book will encourage dentists, dental therapists and hygienists to develop their skills to meet the challenge of treating the young child and promote a change in attitude in those who do not value the primary dentition (Fig 1-1).

So Why Should We Restore the Primary Dentition?

It is becoming increasingly clear that dental health is intertwined with general health and development. Pain and infection have a detrimental effect on health. These are obvious in the child with acute pain, but chronic toothache also causes problems. A child with chronic dental pain cannot thrive and all carious teeth are likely to cause pain and sensitivity from time to time, resulting in:

图1-1 看牙应该是一个愉快的经历

Fig 1-1 A visit to the dentist should be a pleasant experience



- 失眠
- 情绪、行为的改变和注意力不集中
- 进食不适，食欲相应减退，使儿童错过正常生长发育的关键阶段：如身高、体重及头（大脑）围的最佳发育阶段

因此与无龋儿童相比，患龋儿童可能不能在生理、情感或者智力方面健康成长(图1-2至图1-4)。关爱儿童，他们的身体，特别是牙齿的健康至关重要。即使很简单的牙齿问题，也可能影响他们的全身健康或是学习，特别是对那些已经诊断患有全身疾病或有学习障碍的儿童。

口腔医生的工作目的是劝导患者及其家人不要随意放弃乳牙，因为维持乳牙列健康有助于：

- loss of sleep
- mood, behaviour changes and poor concentration
- uncomfortable eating, with subsequent loss of appetite and failure to meet developmental milestones: height, weight and head (brain) circumference.

Therefore, the child with dental caries may not thrive physically, emotionally or intellectually, compared to the caries-free child (Figs 1-2 to 1-4). Where children are concerned, their medical, and particularly dental, well-being is of paramount importance. Even relatively simple dental problems can impact upon the medical or educational needs of children, especially on those already diagnosed with medical disorders or learning disabilities.

The dental practitioner should aim to motivate the patient and their family by demonstrating that teeth are not disposable and restore primary dentition because it helps:



图1-2 上切牙龋坏，伴上牙槽脓肿的患儿
Fig 1-2 Young child with carious upper incisors and an abscess on tooth 61



图1-3 无龋儿童:a. 乳牙;b. 恒牙

Fig 1-3 Caries-free child with (a) primary teeth and (b) permanent teeth



图1-4 多颗牙齿拔除的儿童:a. 口内观;b. 口外观

Fig 1-4 Child who has had multiple teeth extracted (a) intra-oral view and (b) extra-oral view

- 保持牙列形态
- 保持牙齿美观
- 维持牙齿功能（咀嚼和说话）
- 保持恒牙间隙（图 1-5）
- 适应环境性
- 避免疼痛及脓毒血症——进而避免损伤恒牙

- restore form
- restore aesthetics
- restore function (mastication and speech)
- maintain space for the permanent teeth (Fig 1-5)
- acclimatisation
- avoid pain and sepsis — avoid damage to the permanent teeth



图1-5 乳牙就像一个天然间隙保持器 ,为恒牙的萌出保持间隙

Fig 1-5 Primary teeth act as a natural space maintainer for the permanent teeth

- 避免拔牙，尤其是全麻下拔牙
- 对免疫力低下的患儿 ,避免脓毒血症以及手术治疗的风险

牙列发育时间表

乳牙列和恒牙列的生长发育受以下因素的影响：

- 遗传因素
- 营养因素
- 全身的生长发育情况

据报道，乳牙列萌出时间在种族间很少有差异。但是 ,恒牙列萌出时间有种族差异 ,例如 ,亚洲儿童牙齿发育完成要早于同龄的高加索白种人。所以当医师检查一个儿童牙齿的萌出时间是否在正常范畴内时一定要注意（表 1-1）。

对秘鲁营养不良的儿童调查表明，他们在婴儿期乳牙萌出时间延后。这

- avoid extraction, particularly under general anaesthesia
- avoid sepsis and surgical intervention in the medically compromised child.

The Chronology of the Development of the Dentition

The development of the primary and permanent dentitions is affected by:

- genetic factors
- nutrition
- somatic growth and development.

There is little variation reported between different races in the timing of eruption of the primary dentition. Racial variation, however, can be seen in the eruption of the permanent dentition—for example, Asian children complete their dental development faster than their Caucasian peers. Therefore, care must be applied when dentists seek to compare an individual child to the normal eruption times (Table 1-1).

Studies in Peru, on malnourished children, have shown that infants were delayed

表1-1 乳牙及恒牙的萌出时间

Table 1-1 Eruption dates of primary teeth and secondary teeth

乳 牙	萌出时间 (月)
乳中切牙	6
乳侧切牙	9
乳尖牙	18
第一乳磨牙	12
第二乳磨牙	24

注：钙化开始：妊娠4~6个月；根尖发育完成：萌出后12~18个月

恒 牙	萌出时间 (年)	钙化开始时间 (年)
中切牙	7	0.3
侧切牙	8	0.3/1 [#]
尖牙	9/12 [#]	0.3
第一前磨牙	10	2
第二前磨牙	11	2
第一磨牙	6	出生
第二磨牙	12	3
第三磨牙	16~24	8~14

注：# 下颌 / 上颌；萌出后2~3年根尖发育完成

种营养与牙齿发育、全身发育的联系也可见于早产或低出生体重儿。只有在解决营养和疾病问题后，孩子的牙齿发育才能‘赶上’正常的水平，全身生长发育才能在身高、体重以及头围等方面‘赶上’正常标准。

in the eruption of their primary teeth. This link between nutrition, dental development and general growth can also be seen in premature and low birthweight babies. These babies will catch up on their dental development once their nutrition and medical problem has been rectified and somatic growth will catch up with the normal milestones for length, weight and head

营养学家经常研究错过正常发育阶段的儿童，这些儿童可能需要补充营养食品：这些食品通常富含糖类，所以对这些儿童来说保持口腔卫生和应用氟化物是至关重要的。对其他儿童来说可以通过适当地限制饮食，提供口腔护理以达到预防牙痛的目的。

口腔诊疗小组在婴幼儿生长发育过程中起关键作用。

儿童发热性疾病和龋齿易患性

儿童常见病可以影响同时期发育的牙体硬组织的形成，可能导致牙体硬组织矿化不全和色泽改变。一旦明确诊断，口腔诊疗小组应该警惕该儿童可能是龋齿高度易患者，因而需要针对该个体采取强化预防控制手段。

受儿童发热性疾病影响的牙齿更易患龋，因为：

- 牙齿形态的改变
 - 釉质多孔性
 - 由于敏感，难于维持良好口腔卫生状态
- 例如磨牙切牙矿化不全（MIH），

circumference.

A nutritionist often investigates children who fail to meet their normal developmental milestones. Such children may be placed on dietary supplements: these are generally carbohydrate-rich and so oral hygiene and fluoride therapy are of paramount importance. Other children are referred for dental care to manage dental pain, which may be deterring adequate food intake.

The dental team plays a key role in infant growth and development.

Childhood Fever and Caries Susceptibility

Common childhood illnesses can affect the coincidental dental hard-tissue formation. This can result in hypomineralisation and discolouration. As soon as this is diagnosed, the dental team should be alerted to the fact that the child will have a high caries risk and consequently needs personalised, enhanced preventive management.

Teeth affected by childhood fevers have increased susceptibility to dental caries due to:

- altered tooth morphology
- enamel porosity
- difficulties in maintaining good oral hygiene due to sensitivity.

An example of this is molar incisor

即：恒切牙和第一恒磨牙受累(可能也有尖牙的牙尖),受累牙齿表现为萌出后釉质丧失。

举例说明可引起釉质缺陷的儿童常见病有：

- 水痘
- 麻疹
- 中耳炎
- 呼吸或泌尿系统感染引起的发热
- 可引起皮疹的其他发热疾患(记住釉质和皮肤同是来源于外胚层)

认识误区

缺 钙

- 机体对钙离子水平的调节非常精细,因此在发达国家很少出现缺钙现象。
- 缺钙并不会导致牙齿中钙质向外“泄漏”。
- 釉质一旦形成,造成钙质流失的惟一的原因是环境因素,如龋、酸蚀或磨损。

母乳喂养和牙齿？

- 高度推荐母乳喂养。
- 对婴儿来说母乳优于牛乳。

hypomineralisation (MIH), in which the permanent incisors and first permanent molars are affected (and possibly also the tips of the canines). The affected teeth appear to be prone to post-eruptive enamel loss.

Examples of the common childhood illnesses that can cause enamel defects are:

- chickenpox
- measles
- middle ear infections
- fevers caused by respiratory or urinary tract infections
- other fevers that cause skin rashes (remember that enamel and skin share a common ectodermal origin).

Myths

Calcium Deficiency

- The body regulates calcium levels so rigorously that deficiency in the developed world is rare.
- Calcium deficiency does not lead to calcium “leaking” back out of the teeth.
- Once enamel is formed, the only reason calcium is lost is due to an environmental cause such as caries or acid erosion or attrition.

Breastfeeding and Teeth?

- Breastfeeding IS highly recommended.
- Human milk IS better than cows’ milk

- 母乳喂养有助于孩子的发育 ,特别是大脑的发育。
- 如果在正常的时间内断奶 ,则对牙齿无害。
- 但有求必应的母乳喂养 ,尤其是夜间和超过断奶期的母乳喂养 ,可以导致龋齿。

“ 软 ” 牙会在家族内传播吗 ?

遗传缺陷

先天釉质缺陷的儿童 ,如釉质发育不全 ,或其他牙体硬组织疾病(如牙本质发育不全) ,可能会对龋齿更加易患 ,但这种情况很少见。

- 如果怀疑是先天性牙体硬组织缺陷 ,必须询问家族史(家系)。
- 显微镜下检查脱落或拔出的牙齿。
- 应首先排除环境因素(如儿童常见病的影响)。

“ 家族 ” 龋

- 一个家族倾向于一代一代地将其饮食习惯传递下去。由此 ,祖母(奶奶)的牙齿早失可能暗示 “ 甜食牙 ” 是其家族现象。

for human babies.

- Breastfeeding assists growth and is especially beneficial to brain development.
- Provided children are weaned at the normal time there is NO damage to teeth.
- BUT breastfeeding on demand, especially during the night, beyond weaning, DOES cause caries.

Do “Soft” Teeth Run in the Family?

Inherited defects

Children with congenital enamel defects such as amelogenesis imperfecta or disease of the other dental hard tissues (e.g. dentinogenesis imperfecta) may be more susceptible to caries, but these conditions are rare.

- A family history (pedigree) should be ascertained if a congenital defect of the dental hard tissues is suspected.
- Exfoliated or extracted teeth can be examined microscopically.
- Environmental causes (i.e., the effect of a common childhood illness) should be ruled out first.

“Family” caries

- Families DO tend to pass on their dietary habits through generations. Therefore, granny losing her teeth early could be an indication of a “sweet tooth” being a family phenomenon.

- 龋齿的主要病原体——变形链球菌是可传染的，确切的证据证实，细菌可以从母亲传递给婴儿。
- 母亲患龋率高，孩子也很有可能患龋。

药 物

- 药物尤其是药品的配剂，可以致龋，但是只有在含糖的时候才致龋。
- 一些药物是无蔗糖的，但是可能含有其他糖的成分，如葡萄糖浆。
- “无糖制剂”意味着完全无糖。
- 许多儿科药物包括抗生素已经有了无糖制剂。口腔医生及其诊疗组应该建议家长和医药人员在处方上添加字母SF，表示无糖制剂——这对需要反复用药的孩子尤为重要。
- 抗生素不会导致牙齿变色或者矿化不全进而增强龋齿易患性；需要服用抗生素的疾病才是罪魁祸首。尽管如此，今后我们仍要鼓励开具无糖抗生素。

- 医师们只在特殊情况下（如纤维

- Streptococcus mutans, the main pathogen responsible for caries, IS transmissible and there is very good evidence to show that it is passed from mother to baby.

- Children of mothers with a high caries rate are more likely to develop caries themselves.

Medicine

- Medicines, in particular, elixirs, CAN cause caries BUT only if they contain sugar.

- Some medicines are sucrose-free, but may contain other sugars such as glucose syrup.

- “Sugars-free” means no sugar at all.

- Many paediatric medicines including antibiotics ARE now available in “sugars-free” preparations. Dentists and their teams should advise parents and medical and pharmacy colleagues to add the letters ‘SF’ for sugars-free to written prescriptions — this is particularly important in cases in which repeat prescriptions are required.

- Antibiotics DO NOT cause discolouration or hypomineralisation leading to increased caries susceptibility; it was the illness for which antibiotics were prescribed that was the culprit. However, ensure sugars-free antibiotics are prescribed in future.

- Doctors rarely prescribe tetracyclines

化囊肿)，才会给孩子用四环素。

实用提示

- 如果在婴儿期就养成良好的口腔保健习惯，那么恒牙患龋的可能性会减小（图 1-6）。
- 长期慢性牙痛会影响儿童的健康成长，所以牙齿疾患需要治疗。
- 如果儿童有无需治疗的龋齿，一定要告知家长，并且取得家长的认同（如快要脱落的牙齿）。

to children, only in exceptional circumstances (e.g. cystic fibrosis).

Practical Tips

- If good dental health habits have been established in infancy, caries in the permanent teeth is less likely (Fig 1-6).
- A child with chronic toothache can fail to thrive, so dental disease needs to be treated.
- If caries is left untreated the parent must be informed of this and be in agreement (e.g. a tooth that is soon to exfoliate).



图1-6 从小做起
Fig 1-6 Start early

第 2 章 龋齿的诊断

Diagnosis of Dental Caries

目 的

本章的目的是更新龋齿检查、诊断和记录原则，介绍正确使用儿童和青少年龋齿辅助诊断方法的指导原则。

要 点

通过阅读本章，临床医师应该在龋齿的诊断，尤其是在龋齿检查和儿童龋齿危险性评估上更加自信，熟悉现代龋病学的相关理论。

引 言

所有儿童和青少年都是独立的个体，应针对个体需求为他们制定口腔保健计划。制定口腔保健计划的第一步是了解病史(包括口腔病史、全身病史以及社会背景)，并且完成细致的口腔检查。病史采集和检查要全面，要运用系统方法进行记录，以便于获得所有有用的信息，避免疏漏。采集病史时

Aim

This chapter aims to update the principles of caries detection, diagnosis and record-keeping, and to give guidance on the appropriate use of adjuncts to caries diagnosis in the child and adolescent.

Outcome

On reading this chapter, the practitioner should feel more confident in caries diagnosis, especially in respect to the examination and caries risk assessment of children and be familiar with the relevant supporting theories in modern cariology.

Introduction

All children and adolescents are individuals and, as such, their dental care should be customised to their specific needs. The first stage in this process is to take a history (dental, social and medical) and complete a careful examination. The history and examination should be thorough and recorded in a systematic way, in order

要考虑儿童的年龄 ,例如 ,对年纪大一点的孩子 ,即使违背了父母或看护者的意愿 ,也应注重考虑孩子的意见。采集病史成功的关键就是一开始便能很顺利地取得孩子及其家长的信赖。因此 ,同孩子及其监护人的第一次会面是至关重要的 (图 2-1)。

初 诊

首先要记录简短的口腔治疗史 ,以及本次主诉 (如果有的话)。很重要的一点是要使前来就诊的家庭觉得他们是很受欢迎的。任何对以前行为的含蓄批评都可能导致对将来行为的负面影响。简单的说 ,孩子不愿意再来就诊 ,或如果他们认为会被责备 ,他们的依从性会变差。采集病史帮助我们评估这个家庭对待口腔卫生的态度 ,也有助于进行龋齿危险性评估 (图 2-2)。

to gather all the available information and avoid omissions. The history must also be appropriate to the age of the child — for example, with older children it is important to take the child’s views into account, even at the expense of those of their parents or carers. The key to success is to get off on the right foot and gain the child’s trust and the parent’s confidence. Therefore, the initial greeting of the child and their carers is critical (Fig 2-1).

The First Visit

A brief history of dental attendance should be recorded, as should the current complaint (if any). It is important that the family is made to feel welcome when they attend for care. Any implied criticism of past behaviour is likely to have a detrimental effect on future behaviour. In simple terms, child patients won’t wish to return for treatment or will be less compliant if they think they will be told off. History-taking helps with the assessment of the



图2-1 与孩子的初次会面是很重要的
Fig 2-1 The initial greeting of the child is paramount

图2-2 第一颗牙齿一萌出就有必要进行口腔保健

Fig 2-2 Dental care is needed as soon as the first teeth erupt



简单地了解口腔治疗既往史是非常重要的。例如,知道孩子对待以往修复治疗和局麻过程的态度是非常有用的。局麻的应用也可提示现有修复体的质量和预后。这些信息可帮助我们预估孩子接受治疗的能力。

检 查

在与孩子交谈的时候,可迅速判断出孩子对检查和治疗的配合程度。所以,下一阶段的检查就可以按照孩子的合作能力进行调整。首诊时也许只能进行简短的检查。

families' attitudes to dental health and caries risk assessment (Fig 2-2).

A brief history of previous dental care is invaluable. For example, it is useful to know how well the child coped with the provision of previous restorations and local anaesthesia. The use of local anaesthesia is also an indication of the quality and prognosis of existing restorations. Such information can help with assessing the child's ability to cope with any proposed treatment.

Examination

While talking to the child, it should quickly become apparent how agreeable to examination and treatment they are likely to be. The subsequent stages of the examination can then be tailored to the patient's ability to cooperate. It may be that only a brief examination will be possible at the initial consultation.

口外检查

- 观察一般情况
- 行为举止
- 有无肿胀现象
- 有无面部的不对称
- 有无淋巴结肿大
- 骨骼类型

口内检查

- 软组织
- 牙周组织
- 菌斑水平（口腔卫生）
- 牙龈出血（提示牙龈炎或可能存在于活动性邻面龋）
- 牙齿：
 - 龋齿的诊断
 - 发育不全 / 不透明
- 殆关系

龋齿危险性评估

对患者进行龋齿危险性评估是检查中的一个关键步骤。评估的结果应记录在案,作为对患者的特殊提示,以便采取适合的预防措施,如进行窝沟封闭等。通过给临床复查提供帮助,记录龋齿危险性也能促进完善临床治疗。

Extra-oral Examination

- Check general appearance
- Demeanour
- Swelling
- Asymmetry
- Lymphadenopathy
- Skeletal pattern.

Intra-oral Examination

- Soft tissues
- Periodontal tissues
- Plaque levels (oral hygiene)
- Gingival bleeding (as well as being indicative of gingivitis, may indicate active approximal caries)
- Teeth:
 - caries diagnosis
 - hypoplasia/opacities
- Occlusion.

Caries Risk Assessment

A key element of the examination of a patient is the caries risk assessment. The results of this assessment should be recorded in the notes, as a patient-specific prompt, to encourage appropriate preventive management, such as the provision of fissure sealants. The recording of caries risk will also promote best practice by assisting with clinical audit.

龋齿危险性评估对绝大多数口腔医生来说并不是一个新概念；毫无疑问多数口腔医生都会对患者进行评估。更新的理念是使评估简单易行。

既往史

了解过去的行为和患病的经历是预测未来疾病的最好方法之一。龋齿活动性高的预示因素有：

- 现存的修复体
- 既往拔牙史
- 新发疾患

饮食因素

- 饮食中的非内源性、非奶源性糖可以致龋。
- 如果患者饮食中含有大量上述糖类，且频繁进食，则患龋危险性高。
- 摄食的时间同样重要：
 - 夜间摄取任何糖都会增加患龋危险
 - 夜间唾液的抗龋作用减弱，如果此时给孩子随时喂奶，那么牛奶也能致龋。
 - 幼儿睡前 1h 内吃含糖零食会导致患龋率增加。

Caries risk assessment is not a new concept to most dentists; it is something most dentists do implicitly for all patients. The step that is more novel is to make this an explicit action.

Previous Disease

Past behaviour and disease experience are one of the best predictors of future disease. Therefore, predictors of high caries activity are:

- The presence of restorations
- Previous extractions
- New disease.

Dietary Factors

- Non-intrinsic non-milk sugars in the diet cause caries.
- Patients whose diet is high in such sugars, and particularly when these products are consumed frequently, are likely to be of high caries risk.
- Time of consumption is also important:
 - access to any sugar at night increases caries risk,
 - milk can cause caries if a child is given free access at night, when the anti-caries benefits of saliva are reduced,
 - access to a sugary snack within an hour of bedtime in a young child is associated with increased caries risk.

社会因素

像心脏病、癌症一样，龋病是一种与社会 - 经济背景相关的疾病。因此，从广义上讲，患者所在的邮政编码区可帮助我们预测其龋齿危险性。查明以下情况对更好地进行健康管理是很有帮助的：

- 谁在照看孩子？
- 他们带孩子来看牙方便吗？
- 收集有关其兄弟姐妹、爱好和宠物的信息，可使孩子感到不寻常，从而有助于行为管理。
- 患儿在学校可能有明显的学习障碍表现。

氟化物的使用和菌斑控制

- 过去的 30 年中，西方国家龋齿发病率下降与含氟牙膏的使用密切相关。
- 作为检查刷牙(假定使用含氟牙膏)频率和效果的尺度，口腔卫生是一个重要因素。
- 对有幸生活在氟化水源地区，或者有氟添加剂应用史的人，这些情况必须计入评估。

全身病史

全身病史可以从几个方面影响龋

Social Factors

Like heart disease and cancer, caries is a socio-economic disease. Therefore, in broad terms, the patient's area post code helps predict their caries risk. For better management it is helpful to find out:

- Who cares for the child?
- How easy is it for them to attend?
- Information about siblings, interests and pets helps with behaviour management by making the child feel special.
- School performance might highlight a learning disability.

Fluoride Use and Plaque Control

- The use of fluoride toothpaste is largely responsible for the reduction in caries prevalence seen in the Western World over the past 30 years.
- Oral hygiene as a measure of the frequency and effectiveness of tooth-brushing (assuming a fluoride toothpaste is used) is therefore an important factor.
- For those lucky enough to be living in fluoridated areas or with a history of use of fluoride supplements this must be included in an assessment.

Medical History

Medical history may influence caries risk

齿危险性：

- 患者处于一种龋齿易感状态(如化疗过程中的口腔干燥)。
- 龋齿(无论是其治疗或引发的脓血症) 会威胁到患者的生命 (如：对于有感染性心内膜炎危险的患者)。
- 患者处于一种不能配合口腔治疗或者维护口腔卫生的状态 (如：脑瘫)。

唾 液

由于唾液含有特异性和非特异性抗菌因子,如IgA、溶菌酶和乳铁蛋白,可以在防龋过程中起到了重要作用。它可以缓冲酸,维持口腔pH值。唾液分泌量下降会增加个体的患龋风险。唾液的质量因人而异,尽管有试验可以测定其成分和缓冲能力,但它们的临床意义有限。但是,如果一个口腔医生怀疑患者唾液流量减低,这将会影响对患者龋齿危险性的评估。

细 菌

变形链球菌和乳酸菌的水平与人群的龋齿危险性相关。遗憾的是无法预检测个体的细菌水平。

in a number of ways:

- A condition that predisposes to caries (e.g. xerostomia during chemo-therapy).
- A condition where the consequences of caries (either its treatment or sepsis) can be a threat to the patient (e.g. those at risk of infective endocarditis).
- A condition that confers reduced ability to cooperate with dental care or to perform oral health procedures (e.g. cerebral palsy).

Saliva

Saliva plays a pivotal role in the prevention of caries, as it contains both specific and non-specific antibacterial agents such as IgA, lysozyme and lactoferrin. It buffers acids and maintains the oral pH. A reduction in the production of saliva will therefore increase an individual's caries risk. There is considerable individual variation in the quality of saliva, and although tests for the constituents of saliva and buffering capacity exist, these have a limited role at the chairside at present. However, if a dentist suspects a reduction in salivary flow this would influence a caries risk assessment.

Bacteria

Streptococcus mutans and *Lactobacillus* levels correlate with caries risk at a population level. Unfortunately, the levels of

窝沟形态

窝沟形态不是一个很好的龋齿危险性预测指标。尽管识别龋齿的好发部位在龋齿的诊断和预防方面起重要的作用，如恒磨牙颊面窝沟是龋齿的好发部位，但是临床医生常不能准确地说出窝沟的深度，更重要的是不能准确认识它的形态。

口腔医生的预测

如前所述，多数口腔医生会在初诊时为患者进行龋齿危险性评估。事实上这种评估被证明是有效的。

危险分类

临床医生通常将龋齿危险程度分为高、中、低三度。

作者认为，中间度分类没有任何意义，二分法相对较好，即：分为“需要附加的预防措施”和“在患者已有的预防措施之外，不需要更多的干预”两型。

龋坏过程

为理解与龋病诊断的相关问题，了解龋坏的进展过程是很重要的。如

these bacteria are not predictive at an individual level.

Fissure Shape

Fissure shape is not a good predictor of caries risk. The identification of caries predilection sites, which includes the occlusal fissures of the permanent molars, does play an important role in caries diagnosis and prevention, but a clinician cannot reliably tell the depth or, more importantly, the shape of a fissure.

The Dentist's Hunch

As stated earlier, most dentists make a risk assessment for their patients during the first meeting. It has been demonstrated that this assessment can be a valid predictor of risk.

Risk Categories

Generally the practitioner is advised to categorise caries risk into either high, moderate or low.

In the view of the authors, the moderate category does not add any value and it is better to use the dichotomy of "requires extra prevention" or "no intervention beyond what the patient is already doing".

The Carious Process

In order to understand the problems associated with the diagnosis of dental caries,

果我们采用现代生物学手段和循证医学的途径来预防和控制龋齿，同样也需要了解龋病的进程。

牙冠部龋发生在三个部位：

- 光滑面
- 邻面
- 窝沟点隙

尽管产酸学说不是龋病病因学的惟一假说，但它得到了有力证据的支持。Miller在1983年总结认为：龋齿是由于细菌入侵，其酸性产物使牙体组织脱矿，最终导致剩余牙体组织的崩解而引发的。龋齿的发病和进展受多因素影响。经过一段时间，龋损可以发生在有致龋菌斑和细菌底物堆积的易感牙面上。窝沟点隙是龋齿的好发部位，因为它们为菌斑滞留区，不易清洁并去除菌斑。氟化物的防龋效果在殆面不如光滑面显著。

牙冠的结构包括(从牙面向内)釉质、牙本质和牙髓组织。牙本质和牙髓通常被认为是一个复合体。釉质是人体矿化程度最高的组织(体积比为92%，重量比为97%)。牙本质的矿化

an understanding of the disease process is essential. This is also necessary if we are to adopt a modern biological and evidence-based approach to its prevention and management.

Coronal caries occurs on three sites:

- Free smooth surfaces
- Approximal surfaces
- Pits and fissures.

Although not the only theory postulated for the aetiology of dental caries, the acidogenic theory has overwhelming evidence to support it. Miller, in 1883, concluded that caries results from decalcification caused by bacterial acid production followed by bacterial invasion and the destruction of any remaining tissues. The causes for the initiation and progression of caries are multifactorial. Over a period of time, caries can occur on a susceptible tooth surface in the presence of cariogenic bacterial plaque and bacterial substrate. Pits and fissures are predilection sites for caries because they are stagnation areas, inaccessible to cleaning and thus the removal of bacterial plaque. Occlusal surfaces benefit less than smooth surfaces from the caries preventive action of fluoride.

The crown of a tooth consists of (from the surface inwards) enamel, dentine and the dental pulpal tissues (pulp). The dentine and pulp are often considered to be a single complex. Enamel is the most highly

程度虽然高（体积比为 48%，重量比为 69%），但低于釉质。

窝沟、点隙常出现在：

- 磨牙和前磨牙的殆面
- 切牙、尖牙和磨牙的腭侧面
- 下颌磨牙的颊面

窝沟、点隙龋和光滑面龋的病理学特点相似，但通常认为由于发生的牙面形态不同，其临床表现（肉眼所见）有所不同。

釉质龋

在口腔内，釉质表面处于离子交换状态。当 pH 值低于 5.5 时，矿物质就会溶解，并可导致龋齿的形成。若 pH 值处于较高水平，尤其是有氟化物存在时，这个过程就逆转了。

白垩斑的探查

釉质龋的初期可见标志是白垩斑，发生在外露的光滑面上的白垩斑相对较易识别（图 2-3）。然而，由于表面形态的问题，窝沟、点隙处的白垩斑通常不易诊断。牙齿干燥时白垩斑比较明显。这是由于釉质、空气和水的折射率

mineralised tissue in the human body (92% by volume; 97% by weight). The degree of mineralisation of dentine, although high, is less than that of enamel (48% by volume; 69% by weight).

Pits and fissures generally occur:

- in the occlusal surface of the molars and premolars.
- the palatal surface of incisors, canines and molars.
- the buccal surface of lower molars.

The pathological features of caries in pits and fissures are similar to those seen in smooth surface caries but it is generally assumed that differences in surface form result in a later clinical (macroscopic) presentation.

Enamel Caries

In the mouth, the enamel surface is in a state of ionic flux. Below pH 5.5 mineral is eventually lost and this can lead to the formation of caries. At higher pH levels, and particularly in the presence of fluoride, this process is reversed.

White spot detection

The first visible sign of enamel caries, the white spot lesion, is relatively easily identified on free (exposed) smooth surfaces (Fig 2-3). However, it is often impossible to diagnose in pits and fissures because of surface morphology. White spot

图2-3 白垩斑

Fig 2-3 White spot



不同。健康的釉质折射率为 1.62。脱矿后，釉质变得多孔，如果牙面湿润，病损部的折射率就和水相近（1.33），与正常组织相比显得不透明。如果牙面干燥，小孔中的水分被折射率为 1.0 的空气所代替，病损变得更加明显。所以为探查白垩斑病损，应该清洁和干燥牙齿。

白垩斑的镜下表现

在磨片中，明确的白垩斑病损可以分为 4 层，每层的光学性质反映了不同的矿化程度以及病损活动性（图 2-4）：

- 第 1 层——透明层是可识别的最初组织学变化，位于病损前沿。
- 第 2 层——暗层是其次可识别的

lesions are more obvious when teeth are dry. This is because of the different refractive indices of enamel, water and air. Sound enamel has a refractive index of 1.62. When demineralised, enamel becomes porous, if the teeth are wet the lesion has a refractive index approaching that of water (1.33) and will appear opaque compared to sound tissue. If dried, the water in the pores is replaced with air of refractive index 1.0 and the lesion becomes more obvious. To detect white spot lesions, teeth should be clean and dry.

Microscopy of a white spot

In ground section the established white spot lesion can be described as having four zones, the optical properties of which reflect differing degrees of mineralisation and lesion activity (Fig 2-4):

- Zone 1 - The translucent zone is the first recognisable histological change at the advancing edge of the lesion.
- Zone 2 - The dark zone is the second

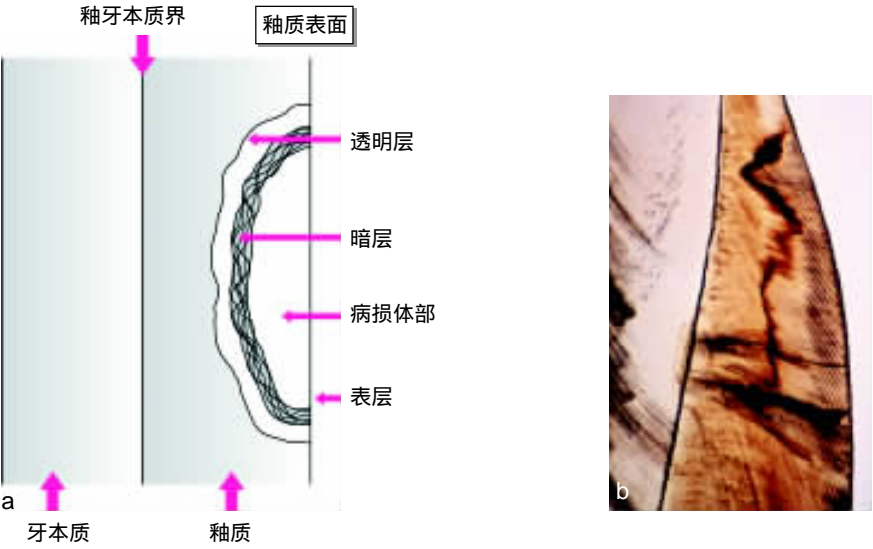


图2-4 a. 光滑面釉质龋的四层结构;b. 釉质龋磨片的偏振光显微镜观察

Fig 2-4 (a) The zones of an enamel carious lesion on a smooth surface, (b) Ground section of an enamel carious lesion in polarised light

组织学变化。有人认为在进展快速的病损中暗层较窄,在病损进展较慢并发生再矿化时暗层较宽。

- 第3层——病损的体部是组织学的第三层。
- 第4层——组织学第四层是表层。这层大约有40 μm宽。正常釉质其表面成分与深层不同;正常釉质表面矿化程度更高,并且含氟量高,含镁量低。过去曾认为釉质表面的某些区域由于其特殊结构,抗酸能力不如邻近区域,因此,酸能够通过一些这样

recognisable histological change. It is thought that the dark zone is narrow in rapidly advancing lesions and wider in more slowly advancing lesions when remineralisation is occurring.

- Zone 3 - The body of the lesion is the third histological zone.
- Zone 4 - The fourth histological zone is the surface zone. This zone is approximately 40 μm in width. The surface of normal enamel differs in composition from the deeper layers; it is more highly mineralised and has, for example, a higher fluoride level and a lower magnesium level. It has been

的区域渗透到深层,导致表面下脱矿。然而,如果去除釉质表层,在暴露的表面诱导人工龋,病损处仍可出现一层相对不受侵犯的表层。对这种相对正常表层的可能的解释是,它表明表层的一定区域发生了矿物质的重新沉积,这种矿物质可能来自于牙齿表面的菌斑,也可能来自于病损深层区域溶解的矿物质。在表层及暗层,釉质晶体的直径大于健康釉质,这是该区域再矿化的证据。

釉质龋的进展

龋损进展的第一步是表面脱矿。随后是表层下透明层的改变,这是临床检查和X线检查所不能发现的。表层下透明层的扩大导致中心部位开始出现暗层,随着病变继续扩大,更多的矿物质流失,暗层的中心变成病变的主体。这时,临床检查可发现白垩斑(图2-3)。龋损逐渐被食物中的外源性色

suggested that there may be areas of the enamel surface, which, because of their particular structure, are less resistant to acid attack than neighbouring areas. Thus, acid is allowed to penetrate into deeper layers in some of these areas, resulting in sub-surface demineralisation. However, if the enamel surface is cut away and an artificial caries is induced in the exposed surface the lesion still shows a relatively unaffected surface zone. A possible explanation for this relatively normal surface zone is that it represents an area of reprecipitation of mineral derived both from the plaque on the surface and from mineral dissolved in deeper regions of the lesion. In the surface and dark zones, the enamel crystals are of greater diameter than found in sound enamel. This is evidence of remineralisation in these areas.

Progression of Enamel Caries

The first stage in the carious process is surface demineralisation. This is followed by the development of a subsurface translucent zone, which is unrecognisable clinically and radiographically. Enlargement of the subsurface translucent zone leads to the development of a central dark zone. As the lesion enlarges more mineral is lost and the

素染色，就形成了临床上见到的棕色斑（图 2-5）。

如果龋坏到达釉牙本质界，它就会向两侧扩展，釉质以这种方式被逐渐破坏，临床上釉质就呈现出蓝白色（图 2-6 和 2-7）。这种侧向扩散可能与该部分釉质有机成分相对较高而氟含量较低有关，但是最近这种侧向扩展的概念受到质疑，有人认为组织学病变范围在釉质表面和在釉牙本质界处相同。龋坏的最终阶段是表层崩解，形成龋洞。然而这个阶段在龋损形成过程中有时出现得较早，如：出现在龋损还局限于釉质的时候。

centre of the dark zone becomes the body of the lesion. At this point the caries is clinically recognisable as a white spot (Fig 2-3). The caries may then become stained by exogenous pigments derived from food and become clinically recognisable as a brown spot (Fig 2-5).

If the caries reaches the amelodentinal junction (ADJ) it spreads laterally and in this way the enamel may become undermined, giving a bluish-white appearance to the enamel clinically (Figs 2-6 and 2-7). This lateral spread may be related to the relatively high organic content and low fluoride content of this part of the enamel, although this concept of lateral spread has recently been questioned, and it has been suggested that the histological extent of the lesion on the surface is the same as its extent at the ADJ. Extension along the ADJ results in undermining of sound enamel adjacent to the lesion. The final stage is breakdown of the surface zone with formation of a cavity, although this stage may



图2-5 棕色斑
Fig 2-5 Brown spot



图2-6 龋损不断破坏釉质,并扩展到牙本质

Fig 2-6 Caries extending into dentine and undermining the enamel



图2-7 被破坏的牙釉质呈现蓝白色外观

Fig 2-7 The bluish-white appearance of undermined enamel

窝沟釉质龋

窝沟龋常常是多中心发生,病变独立发展,经过一段时间后融和在一起。随着釉质龋的进展,病变在釉柱排列方向的“指引下”向牙本质进展。在窝沟底部,病变可能与其他窝沟的龋坏相结合,形成尖端朝向釉质的锥形病损。随着病损的进展,首先受累的茶本质区域比光滑面龋时受累的茶本质区域范围大。光滑面的龋损也呈锥形,但其尖端指向牙本质。

sometimes occur earlier in lesion formation — for example, while the lesion is still confined to enamel.

Enamel Caries in the Fissures

Fissure caries is frequently of multicentric origin, lesions developing independently and coalescing over time. As the enamel caries progresses, it extends towards the dentine. Guided by the orientation of the enamel prisms. At the base of the fissure it may coalesce with lesions present on the other surfaces of the fissure, forming a cone with its apex towards the enamel surface. The area of dentine initially involved, should the lesion progress, is therefore large compared with that of a smooth surface lesion. The lesion on a smooth surface is also a cone but with its apex towards the dentine surface.

牙本质 - 牙髓联合体的龋坏

与釉质不同，牙本质和牙髓都是至关重要的组织。这两种组织关系非常密切，以至于它们可以被视为一个联合体。成牙本质细胞突起伸入牙本质：牙本质由牙髓提供血运。这种牙本质 - 牙髓联合体可以对刺激，比如龋坏，作出反应并有修复功能（图2-8）。

如果龋坏达到釉牙本质界，它将侧向扩展波及大面积的牙本质。直到釉质龋达到釉牙本质界后牙本质才开始脱矿，但此前可能已经形成了修复性牙本质。

牙本质龋的组织学分层

与釉质龋相似，牙本质的病变也被分为以下几层（图2-9）：

Caries of the Dentine-Pulp Complex

Unlike enamel, both the dentine and the dental pulp are vital tissues. The two tissues are so intimately connected that they are best considered as a single complex. The odontoblast processes extend into dentine: dentine receives its blood supply from the pulp. This dentine-pulp complex is capable of reaction and repair to a stimulus such as caries (Fig 2-8 a-b).

If the caries reaches the ADJ, the caries will spread laterally to involve a large area of dentine. Dentine demineralisation does not occur until the enamel lesion has reached the ADJ, although reactive dentine may form before this.

The histological zones found in dentine caries

As with the caries in enamel, the lesion in dentine has been described as having a

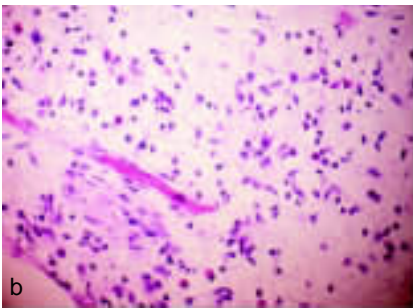
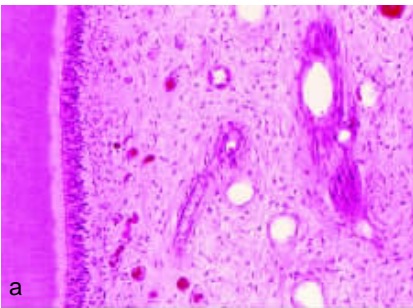


图2-8 a. 健康牙髓;b. 炎症牙髓
Fig 2-8 Dental pulp (a) healthy and (b) inflamed

图2-9 从组织学和生物学角度观察牙本质龋的分层结构

Fig 2-9 Zones of the caries in dentine can be thought of from a histological and biological viewpoint



- 第1层 —— 硬化层
- 第2层 —— 脱矿层
- 第3层 —— 细菌侵入层
- 第4层 —— 坏死崩解层

一些研究人员仅将牙本质龋分为两层：

- 外层牙本质，发生了不可逆性变性，感染，并且不能再矿化（感染层）。
- 内层牙本质，发生的是可逆性变性，并且未受感染（影响层）。

把牙本质龋分为两层的概念，即感染层和影响层，是现代龋病治疗的关键。

龋坏在牙本质中的进展：

龋坏在牙本质中的进展速度不是一定的。事实上，龋坏进展并不是不可避免的，龋齿是可以静止的。在快速进展性龋中，坏死的牙本质非常软并且呈黄白色。在慢性或者静止龋中，牙本

number of zones (Fig 2-9):

- Zone 1 - Sclerosis
- Zone 2 - Demineralisation
- Zone 3 - Bacterial invasion
- Zone 4 - Destruction.

Some researchers describe only two layers (zones) in carious dentine:

- An *outer layer* of dentine, which is irreversibly denatured, infected, and cannot be remineralised (infected layer).
- An *inner layer* reversibly denatured but not infected (affected layer).

The concept of two layers of caries in dentine, the infected and the affected, is the key to modern caries management.

Caries progression through dentine

The rate of progression of caries through dentine is variable. In fact, progression is not inevitable — the caries can arrest. In rapidly progressing caries, the necrotic dentine is very soft and yellowish-white. In

质坚硬，颜色呈黑褐色。如果牙本质龋无限制的发展，就会导致不可复性牙髓炎并使牙齿丧失活力。

乳牙龋病学

龋齿在乳牙和恒牙中没有什么不同，但是在比较乳、恒牙时需要注意以下几点（图 2-10）。

乳牙

- 体积较小
- 釉质较薄
- 髓腔相对较大
- 髓角高（更接近表面）
- 乳牙釉质有机成分较高
- 乳磨牙的邻面接触点与恒牙相比平坦且宽。

乳牙的解剖和形态学特点使龋坏进展更迅速，并且在临床上更难于用肉眼判断是否脱矿。幸运的是，乳牙牙髓与恒牙一样，具有能够愈合或形成继发牙本质的潜能。

chronic or arrested caries, the dentine is hard and brownish-black in colour. If dentine caries does progress unchecked, it may lead to irreversible pulpitis and loss of vitality of the tooth.

Cariology in Primary Teeth

Caries are no different in primary teeth than in permanent teeth but there are some issues to be considered when primary and permanent teeth are compared (Fig 2-10).

Primary teeth

- are smaller
- the enamel is thinner
- the pulp is relatively larger
- the pulp horns are nearer to the surface
- there is more aprismatic enamel present in the enamel of primary teeth
- the contact points between posterior primary teeth are flatter and wider than permanent teeth.

The anatomy and morphology of primary teeth lead to more rapid progression of caries and make the clinical visual identification of demineralisation more difficult. Fortunately, the pulps of primary teeth have

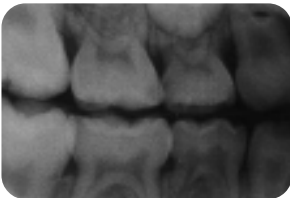


图2-10 从咬合翼片可见乳恒牙在形态学上的区别
Fig 2-10 Bitewing radiograph illustrating the differences in morphology between permanent and primary teeth

龋齿的诊断

龋齿的诊断是困难的。即使是在训练有素和经验丰富的医师之间，检查、诊断以及由此所制订的治疗计划都会有差异。龋齿的诊断、检查需要分解为以下几个步骤：检查、诊断、记录（图 2-11）。医师们往往把他们所看到的记录为处置决定而不是一个诊断，例如，右下第一恒磨牙的近中牙本质龋坏记录为“MO 银汞合金”。

the same potential to heal or produce secondary dentine as their permanent counterparts.

Caries Diagnosis

Caries diagnosis is difficult. Even among well-trained and experienced clinicians there will be variation in detection, diagnosis and, for that matter, treatment-planning. A caries diagnostic examination should be broken down into a number of stages: detection, diagnosis, and recording (Fig 2-11). Clinicians all too frequently record what they see as a treatment decision rather than a diagnosis, for example, a mesial cavitated dentine lesion in a lower right first permanent molar recorded as ÒMOamalgamÓ.

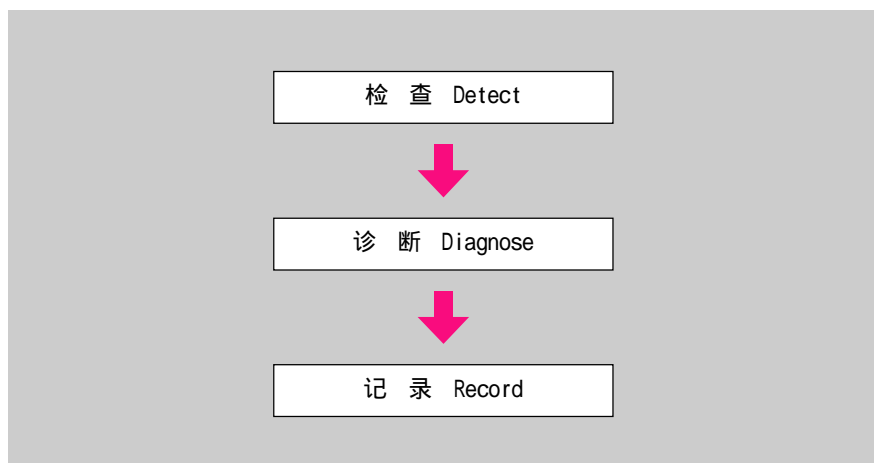


图2-11 龋病诊断的步骤

Fig 2-11 The caries diagnostic process

龋齿的诊断性检查

临床视诊

临床视诊检查包括5个阶段 ,是龋齿诊断的基础 (图 2-12)。

系统检查

通常从口腔中的一定位置开始 ,遵循一定顺序进行检查 ,可以从右上区段的远中面开始 ,顺时针进行一直到右下区段 ,这也符合 FDI (国际牙科联合会)的牙位记录法 (图 2-13)。因为很容易疏漏下牙的舌面或上牙的颊面 ,所以对于每个牙齿 ,应以系统方式检查所有的牙面 (图 2-14)。

The Caries Diagnostic Examination

Clinical Visual

The clinical visual examination consisting of five stages forms the basis of caries diagnosis (Fig 2-12).

Systematic

Always start at the same place in the mouth — there is a logic in making this the most distal surface in the upper right quadrant and working clockwise to the lower right, as this ties in with the FDI tooth notation (Fig 2-13). For every tooth, work round its surfaces in a systematic manner, as it is all too easy to miss the lingual surfaces of lower teeth or the buccal surfaces of upper teeth (Fig 2-14).



图2-12 视诊是诊断龋齿的基础
Fig 2-12 Visual inspection is the foundation of caries diagnosis

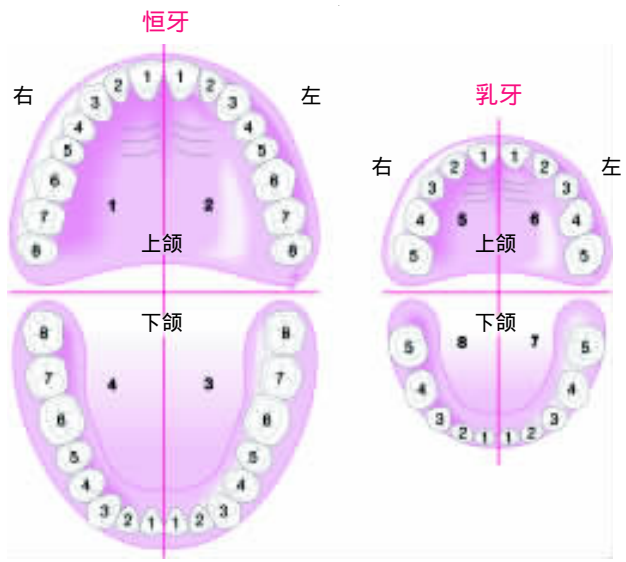


图2-13 FDI记录法：恒牙和乳牙
Fig 2-13 FDI notation: secondary and primary teeth

图2-14 61舌面的白垩斑，其近远中面的病损可能更严重，这些都易被忽视
Fig 2-14 White spot lesion on the lingual surface of tooth 46, with the possibility of more advanced lesions on the mesial and distal surfaces. These can easily be missed



清 洁

牙菌斑是不透明的，所以即便是很明显的病损，也需要去除牙菌斑后才能诊断(图2-15)。过去曾有一些口腔医生先抛光再检查。检查之前先让患者刷牙去除菌斑的做法更明智，这

Clean

Dental plaque is not translucent, so to diagnose even quite advanced lesions it must be removed (Fig 2-15). For some reason dentists have historically provided an examination followed by a polish. It is

样我们也有机会对患者的刷牙方法提出建议。在准备给龋齿下诊断之前为患者抛光牙齿。

照 明

在良好的光照条件下口腔医生才有可能作出准确的诊断。除了位置适宜的手术灯能够提供良好的照明之外，还可用一个光源进行透射检查（图 2-16）。

干 燥

早期龋的检测依赖于龋齿和健康牙体硬组织因孔隙不同所致的折光系

much more sensible for the patient prior to examination to brush their own teeth to remove the plaque. This also presents the opportunity to provide advice to the patients on tooth-brushing ability. Polish the patients teeth prior to attempting to diagnose caries.

Illumination

The dentist requires a light source to make diagnosis possible. In addition to good illumination provided by a suitably positioned operating light, the use of a light source will facilitate transillumination (Fig 2-16).

Dry

The detection of caries in its early stages relies on the differences in the porosity and



图 2-15 恒切牙牙面上的菌斑使得医师不能够判断是否有龋齿

Fig 2-15 Plaque on surface of permanent incisors, making diagnosis of the caries present impossible

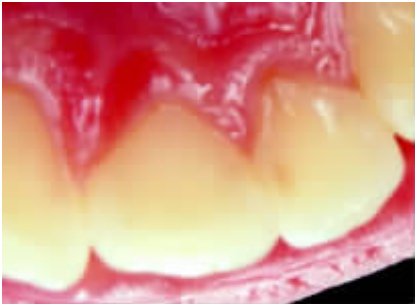


图2-16 前牙透射检查可见2┘近中面邻面龋的阴影

Fig 2-16 Transillumination of anterior teeth, demonstrating the dark shadow of the approximal lesion present on the mesial surface of tooth 12

数不同。当我们吹干牙面时,可以发现处于最初阶段的龋坏(白垩斑病损)。分类系统是一种通过牙面干燥和湿润的表现来区分龋损所处阶段及其活动性的方法。

干燥后的牙面可以帮助评估龋坏的活动性:

- 如果釉质的白垩斑表现出毫无光泽(类似酸蚀后的牙面),这通常提示活动性病损。
- 如果病损表面是有光泽的,则通常是静止龋。
- 如果不事先吹干受累牙面,几乎不能区分出有光泽或是无光泽这种细小的差别。

禁用尖探针!

许多年来,较之单纯的视诊,视诊加探诊的检查方法在龋齿诊断中占据主导地位。以后将不再如此,理由如下:

- 探针的应用并不能提高龋齿诊断的准确性。
- 在脱矿部位(仍有再矿化潜力的部位)进行探诊,将会进一步损坏釉质的结构,形成医源性龋洞,并且阻止了再矿化的可能性。

therefore refractive index of carious versus sound dental hard tissue. When we dry the teeth we will have the ability to detect disease at its earliest visible stage (the white spot lesion). Classification systems have been developed that use the appearance of the teeth wet and dry to classify the stage and activity of the disease.

Drying the teeth helps with caries activity assessment:

- A white spot enamel lesion has a matt enamel (acid-etched appearance) surface; this frequently indicates an active lesion.
- A lesion with a glossy surface is often arrested.
- It is almost impossible to detect the subtle differences between matt and gloss without first drying the affected surface.

Put the sharp probe away!

For many years a visual-tactile examination rather than a purely visual examination was the mainstay of caries diagnosis. This should no longer be the case for a number of reasons:

- The use of a probe does not improve the accuracy of caries diagnosis.
- Probing of a demineralised site (which has the potential to remineralise) will further destroy the enamel structure creating an iatrogenic cavity and pre-

- 有可能导致致龋菌植入至其他部位。

基于以上原因,在龋齿诊断中,尖锐探针已经没有任何地位了(图 2-17)。窝沟探诊所能说明的只是探针和窝沟的大小相匹配。然而,一个钝头探针,如牙周探针,可用来挖除窝沟中的菌斑。虽然钝头探针不能确定一个棕色斑病损是否已经形成龋洞,但可用来确认牙面是否已经崩解。

放射学检查

临床视诊检查可能仅能发现部分釉质和牙本质的龋损,因此需要用放射学检查来补充。对龋齿诊断有价值

venting any possibility of remineralisation.

- There is the possibility of inoculating other sites with cariogenic bacteria.

For these reasons, a sharp probe has no place in caries diagnosis (Fig 2-17). All that the diagnosis of a sticky fissure tells you is that there is a good fit between the probe and the fissure. However, a blunt probe, such as a periodontal probe, can be used to remove plaque from fissures using a dredging motion. As it can be problematic determining if a brown spot lesion is cavitated or not, the side of a blunt probe may also be used to confirm if a surface has broken down.

Radiographs

A visual clinical examination will detect only some of the enamel and dentine carious lesions that may be present. Therefore,



图 2-17 探针并不能提高殆面龋诊断的准确性

Fig 2-17 Probes do not improve the validity of occlusal caries diagnosis

的 X 线投照方式有：

- 咬合翼片
- 曲面断层片 (OPT)
- 口外片
- 根尖片

咬合翼片

咬合翼片是龋病诊断的首选。它可以同时提供殆面牙本质龋以及邻面釉质和牙本质龋的相关信息 (图 2-18 和图 2-10)。

曲面断层片 (OPT)

OPT 并不是检查龋齿的首选方法。但使用 OPT 也可提供有用的信息。OPT 可以很精确地显示殆面牙本质龋。邻面病损也可以通过 OPT 观察到, 但是

it needs to be supplemented by radiological examination. The views that are of value for caries diagnosis are:

- bitewings
- orthopantomogram (OPT)
- bimolars
- periapicals.

Bitewings

Bitewings are the first choice view for caries diagnosis. Bitewings provide information on both occlusal dentine caries and approximal enamel and dentine caries (Fig 2-18 a-b and Fig 2-10).

Orthopantomogram (OPT)

OPT is not the first choice for caries detection but when these are available they do provide useful information. OPT can detect the presence of an occlusal dentine



图 2-18 尽管低龄儿童可能只有最初的理解能力, 但经过解释并使孩子明白后, 可以拍摄咬合翼片

Fig 2-18 (a, b) With explanation and understanding it is possible to take bitewing radiographs of young children though they may initially be apprehensive

其精确性远不如咬合翼片。

双磨牙 X 线片

双磨牙 X 线片显示不如咬合翼片，因为经常有结构的重叠。它经常应用于不合作的患儿，也就是那些不能配合拍摄咬合翼片以及曲面断层片的儿童。

根尖片

根尖片在龋病诊断上和咬合翼片一样精确，但是明显的不足之处是每张底片所能提供的信息较少。在诊断根尖周病以及诊断和观察牙外伤方面，根尖片仍然起到了关键的作用。

拍摄过程和读片

高质量的 X 线照相技术和高水平的洗片技术是非常重要的，同样重要的还有读片方法和条件：

- 系统的读片步骤
- 读片灯箱
- 隔绝外来光线干扰的目视筒
- 放大镜

carious lesion with a high degree of accuracy. Proximal surface lesions can also be seen on OPT but with much lower accuracy than with bitewings.

Bimolar view

Bimolars are not as useful a view as bitewings because there is often overlap of structures. However, they are of use in the pre-cooperative child who will not cope with bitewings or an OPT.

Periapicals

Periapicals are as accurate as bitewings for caries diagnosis, but obviously less information is available on any one film. The key role of the periapical view is in the diagnosis of periodontal disease and the diagnosis and monitoring of dental traumatic injuries.

Processing and viewing radiographs

It is important that the radiographic and processing techniques are of a high quality. Just as important are the viewing methods and conditions:

- a systematic approach
- viewing box
- blacked-out viewing box
- magnification.

多久需要进行一次放射学检查？

对于所有有患龋危险的患者来说，从4岁开始就应该进行咬合翼片检查。然而并不是所有这个年龄的儿童都能耐受将胶片放在嘴里。临床医师应该问的问题是：“为什么不拍咬合翼片？”而不是“为什么要拍？”。较早拍摄X线片可以发现邻面釉质龋，从而可以给口腔医师以及患者（家长/看护者）提供机会，以便在龋齿发展到不易治疗之前就采取防护措施。X线片检查的频率应取决于全面的龋齿危险性评估。口腔医生应权衡额外诊断结果的益处和暴露于X线粒子辐射的危害。

龋齿诊断的辅助手段以及新技术

放大镜

修复科医生越来越多地应用放大镜来辅助进行牙体预备。放大镜也可用来帮助检测及诊断龋齿（图2-19）。

How frequently should a radiographic examination be performed?

Bitewing radiographs should be considered for all children from the age of four years and above who are at risk of caries. However, not all children can tolerate the placement of the film at this age. The clinician should ask the question “Why not take bitewings?” rather than “Why take bitewings?”. Radiographs at an early stage will detect approximal enamel caries, thus offering the opportunity for the dental operator and patient (parent/carer) to take preventive action before the caries become more advanced and consequently more difficult to treat. The frequency of radiographic examination needs to be based on a thorough caries risk assessment. The dentist has to balance the benefits of the additional diagnostic yield with the risks of exposure to ionising radiation.

Adjuncts and Novel Aids to Caries Diagnosis

Magnification

Restorative dentists are increasingly using magnification to assist with the preparation of teeth. Magnification can also help with the detection and diagnosis of caries (Fig 2-19).



图2-19 使用口腔放大镜

Fig 2-19 Magnification loops

光导纤维透照技术 (FOTI)

FOTI 可以帮助发现邻面釉质及牙本质病损，同时也可用来发现骀面牙本质的龋坏（图 2-20）。一般而言，尖端直径是 0.5mm 的光导纤维探针用来检测邻面病损，而尖端直径是 5mm 的用来检测骀面病损。其实直径较小的探头也可用于骀面，但那样的话医生不得不在骀面上移动探针。临床上，FOTI 还可以应用在以下一些方面，如口腔医生可以在每次检查中常规应用 FOTI，帮助确认 X 线片所显示的影像是否可靠。如果通过彻底的临床检查以及观察 X 线片，医生仍不能确定，也可以通过 FOTI 来提供更多的信息。FOTI 的一个特殊用途就是帮助鉴别骀面的

Fibre Optic Transillumination (FOTI)

FOTI helps with the detection of approximal enamel and dentinal lesions, and it can also be used to detect occlusal dentinal caries (Fig 2-20). In general, a 0.5mm tip is used for approximal lesions and a 5mm tip is used for occlusal surfaces. However, the smaller diameter tip is just as appropriate for occlusals as the operator just has to move it over the surface. Clinically, FOTI can be used in a number ways — for example, the dentist can use it routinely at every examination helping to decide if radiographs are indicated. It can also be used to provide further information when, despite a thorough clinical visual examina-

图2-20 FOTI探头放置在两牙之间的外展隙处，可以看到牙本质龋的阴影

Fig 2-20 FOTI probe in the embrasure between the teeth. The shadow of a dentine carious lesion is visible



龋坏和着色。

暂时性分牙 (TTS)

应用正畸分牙器将牙齿分开，可以直视牙面进行诊断。这种方法同咬合翼片相比，主要有两个明显的优势：

- 避免了放射线辐射。
- 可以确认牙面是否已经形成龋洞。

分牙过程大概需要3~4d。在去除分牙器的几小时内，牙齿可以回到原来的位置。暂时性分牙可以用在个别部位或者所有的接触区，从而降低了放射线的辐射。暂时性分牙的一个不足之处就是：在分牙器放置过程中，患者会感觉不舒服，并且当分离所有

tion and radiographs, the clinician still remains unsure. One particular use of FOTI is to help differentiate between staining and caries on the occlusal surface.

Temporary Tooth Separation(TTS)

The placement of an orthodontic separator to move the teeth apart allows direct visual access to a surface for diagnosis. This approach has two significant advantages over bitewing radiography:

- The avoidance of exposure to ionising radiation.
- The ability to detect whether the surface is cavitated.

The process of separation takes about three to four days. The tooth returns to its original position following removal of the separator within hours. TTS can be used at specific individual sites or for all contacts, limiting radiographic exposure. This brings us to one of the drawbacks of TTS: the pa-

接触区的时候，这种不适可能会加重（图 2-21）。

激光荧光法

激光荧光法可以用来辅助发现并诊断龋齿。目前应用的商业成品仪器（Diagnodent KaVo Germany）可以测量

tient may experience some discomfort while the separator is in place, and this discomfort is likely to be greater if all contacts are separated (Fig 2-21 a-d).

Laser Fluorescence

Laser florescence can be used to assist with the detection and diagnosis of caries. The currently available commercial device

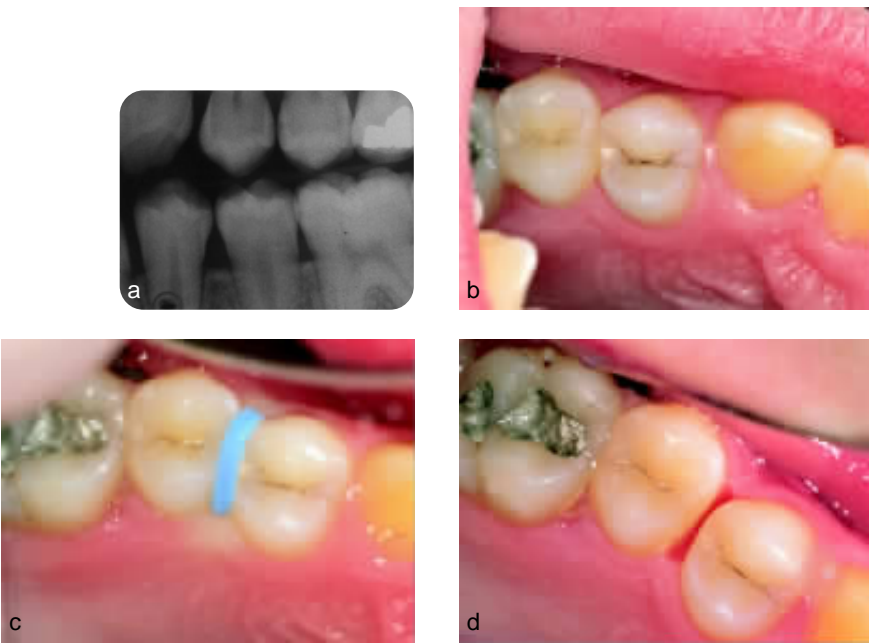


图2-21 a. 咬合翼片显示5 近中和4 远中的低密度影。同样5 远中和6 近中也有龋坏；b. 5 4 的临床所见；c. 将5 4 分离；d. 4d后去除分牙器，可直接观察到两牙的邻面。两个牙面均无龋洞形成，但是可见白垩斑的存在

Fig 2-21 (a) Bitewing radiograph showing radiolucency 15 mesial and 14 distal. There are also lesions at 15 distal and 46 mesial, (b) The clinical appearance of teeth 14 and 15. (c) Separator in place between teeth 14 and 15. (d) Four days after removal of the separator the surfaces can be assessed directly. In this case both surfaces are intact and white spot enamel caries lesions are present

到龋坏部位细菌所产生的卟啉荧光。这种仪器用于诊断骀面龋坏,也能在可探及的光滑面上诊断龋齿。激光荧光法不是一种筛查工具,此法存在一定的假阳性率,但可以辅助口腔医生检测可疑病损。在应用时,口腔医生将探头置于受检牙面,电子读数可以显示从健康的牙体组织到牙本质深层龋的牙面状态(图2-22)。

电子龋齿检测仪(ECM)

釉质是电的不良导体。然而由于受到龋坏的攻击,釉质变得多孔,存在于孔隙中的离子可以使病损区的电阻大大低于健康釉质而导电。这就是电子龋齿检测仪(ECM Lode Netherlands)的工作原理。和激光荧光仪器一样,电

(Diagnodent, KaVo Germany) measures the fluorescence of the porphyrins made by bacteria in the caries. This device is designed for the diagnosis of occlusal caries but it can be used on accessible smooth surfaces. It is not designed to be a screening tool, where it is likely to generate a number of false positive diagnoses, but to aid the dentist with equivocal lesions. In use, the dentist applies the probe tip to the tooth surface under investigation and a digital reading indicates the status of the surface through sound to deep dentine caries (Fig 2-22 a-b).

Electric Caries Meter (ECM)

Enamel is a very poor conductor of electricity. However, following carious attack the enamel becomes more porous and the ions present in the pores in the lesion will conduct electricity with much less resistance than sound enamel. This is the prin-



图2-22 a. 激光荧光仪;b. 置于骀面上的DIAGNodent 探头

Fig 2-22 (a) Laser fluorescence devise (b) DIAG-NOdent probe on the occlusal of 85

子龋齿检测仪主要用来检测殆面龋。所有的龋齿诊断和检测方法都依赖于对细节的观察，但电子龋齿检测仪可能是技术敏感性最强。需特别提醒儿童口腔医生的是，电子龋齿检测仪对于未发育成熟的牙齿是不可靠的，常常出现假阳性（图 2-23）。

上述所有方法都有各自的优缺点，但都可作为备选方案供医生选择，用于提高龋齿检测和诊断的精确性（图 2-24）。

记录龋齿

详细检查完成之后，医师须记录所见。这不但可以帮助制定治疗计划，还可以在复诊中监测病情的进展和消

ciple behind the working of the ECM (ECM Lode Netherlands). Like the laser fluorescence devices, the ECM is principally of use on occlusal surfaces. All methods of caries diagnosis and detection rely on attention to detail but ECM is perhaps the most technique-sensitive. Of particular relevance to paediatric dentistry is that the ECM is not reliable on immature teeth, frequently indicating caries when it is not present (Figs 2-23).

All of the above methods have both advantages and disadvantages, but they should be considered a toolkit from which the dentist selects to improve the accuracy of caries detection and diagnosis (Figs 2-24).

Recording Caries

Having completed a meticulous examination the clinician must record what has been found. This aids with treatment-plan-



图2-23 电子龋齿检测仪
Fig 2-23 Electric caries meter

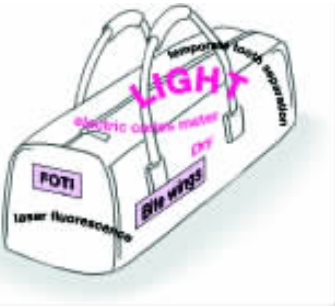


图2-24 诊断龋病的“工具箱”
Fig 2-24 The caries diagnosis Toolkit

退情况。

表 2-1 为记录临床视诊所见的简单系统，它适用于一般的临床工作和现行的计划制定方法

通常我们只记录牙本质龋，而忽视了有价值的信息。无论是采用哪种诊断方法，临床医生都应尽可能记录下所有检测到的病损。

类似的方法也可用于 X 线片记录龋坏波及的范围。Pitts(1984)提出了一种实用的分类系统，表2-2为Pitts系统的改编版。

ning and also allows the monitoring of lesion progression and regression at subsequent recalls.

A simple system for recording the finding of a visual examination, which is suitable to general dental practice and current charting methods, is given in Table 2-1.

All too often only dentine caries is recorded, disregarding valuable information. The clinician should attempt to record as much on all lesions detected as possible, no matter which diagnostic tool has been used.

A similar approach can be used for radiographs recording the extent of the lesion. A useful system was proposed by Pitts (1984), and an adaptation of Pitts system is given in Table 2-2.

表2-1 记录临床视诊结果

Table 2-1 Recording a clinical visual examination

编 码	诊 断	Diagnosis
W	活动性釉质白垩斑	An active white spot enamel lesion
WI	非活动性釉质白垩斑	An inactive white spot enamel lesion
B	活动性釉质棕色斑	An active brown spot enamel lesion
B	非活动性釉质棕色斑	An inactive brown spot lesion
D	牙本质龋	Dentinecaries
D A	静止性牙本质龋	Arrested dentine caries
P	龋坏波及牙髓	Caries extending to the pulp

表2-2 记录x线片龋齿诊断信息
Table 2-2 Recording caries diagnostic information from radiographs

编 码	诊 断	Diagnosis
0	正常	Sound
1	透影区(釉质龋)达釉质厚度 1/2	Radiolucency(enamel lesion)extending up to halfway through enamel
2	透影区(釉质龋)超过釉质厚度 1/2, 尚未越过釉牙本质界	Radiolucency(enamel lesion)extending beyond halfway through enamel but not beyond the ADJ
3	透影区(牙本质龋)达牙本质厚 度 1/2	Radiolucency(dentine lesion)extending up to halfway through dentine
4	透影区(牙本质龋)超过牙本质 厚度 1/2	Radiolucency(dentine lesion)extending beyond halfway through dentine
9	排除不能辨认牙面	Excluded surface not readable

总 结

- 患者口腔病史、全身病史和社会背景,以及详细的饮食、口腔卫生状况和氟化物应用资料是评估其龋齿危险性的重要因素。
- 应把龋齿危险性评估记录在册;这有助于确定最佳治疗,尤其是确定有效的预防目标和拍摄 X 线片的频率。
- 了解龋齿在釉质中的进展,以及向牙本质 - 牙髓复合体的发展有助于进行诊断。
- 乳牙的解剖学和形态学特点使龋齿很快波及牙髓,且不易通过视诊进行诊断。

Summary

- The dental, medical and social histories together with detailed knowledge of the child's diet, oral hygiene and fluoride usage are key components of caries risk assessment.
- The caries risk assessment should be recorded in the notes; this will assist in determining best practice, particularly the effective targeting of prevention and frequency of radiographs.
- Understanding caries progression in enamel and onwards into the dentine-pulp complex can assist in diagnosis.
- The anatomy and morphology of primary teeth lead to both caries reaching the pulp faster and making visual

· 龋齿诊断性检查的步骤如下：

- 检查
- 诊断
- 记录

实用提示

- 龋齿检查：清洁、照明、干燥。
- 咬合翼片是诊断龋齿的首选X线投照方式。
- 进行龋齿危险性评估。

diagnosis more difficult.

- The stages of a caries diagnostic examination are:
 - detection
 - diagnosis
 - record- keeping.

Practical Tips

- For caries detection: Clean, Illuminate and Dry.
- Bitewing radiographs are the first choice view for caries diagnosis.
- Perform a caries risk assessment.

推荐阅读

Further Reading and References

- 1 Ekstrand K, Ricketts DN, Kidd EA. Occlusal caries: pathology, diagnosis and logical management. Dental Update, 2001; 28: 380-387
- 2 Kidd EAM, Joyston-Bechal S. Essentials of Dental Caries. 2nd edition. Oxford: Oxford University Press, 1997
- 3 Pitts NB. Systems for grading approximal carious lesions and overlaps diagnosed from bitewing radiographs. Proposals for future standardization. Comm Dent Oral Epidemiol, 1984; 12: 114-122
- 4 Scottish Intercollegiate Guidelines Network National Guideline 47. Preventing dental caries in high-risk children. Edinburgh: Royal College of Physicians, 2000

第 3 章 治疗设计和止痛

Treatment Planning and Managing Toothache

目 的

本章的目的是概述治疗设计的原则,也涉及到治疗儿童的牙痛。比较了可复性牙髓炎和不可复性牙髓炎的治疗方法,并联系上下文概述了龋齿危险性、患儿的配合能力以及家长的支持程度之间的关系。

要 点

阅读本章后,口腔医生应在制定治疗计划、治疗患儿牙痛以及选择合适镇痛方法上更加自信。

引 言

尽管龋齿几乎是可以完全预防的疾病,在西欧国家中,英国的一些地区患病率最高。龋齿的充填率很低,尤其是在乳牙。事实上在英国的许多地区,

Aim

The aim of this chapter is to outline the principles of treatment planning. The management of the child with toothache will also be considered. The treatment of reversible and irreversible pulpitis will be compared and presented within the wider context of caries risk, the child's potential for cooperation and the degree of parental support.

Outcome

On completing this chapter, the practitioner should feel confident in treatment planning and in the management of toothache in children and in the selection of the appropriate method of achieving pain control.

Introduction

Although dental caries is almost completely preventable, some parts of the UK have amongst the highest prevalence of the disease in Western Europe. The number of

要求在全身麻醉下拔牙是目前儿童医院门诊就诊的最常见原因。出现这种情况的原因是复杂的，它与社会经济学、种族以及地域因素相关。解决的办法也同样复杂，很多已经超出了口腔医生个人的能力范畴，也超出了本文的范围。但是口腔诊疗小组应如何为孩子治疗牙痛呢？

切实可行的治疗计划

正确的诊断仅仅是制定治疗计划的第一步。最终的治疗计划取决于患者的依从性、家长的支持和同意程度。最好的治疗计划是实用的，或者说，一旦实践就能获得成功。

不经过家长的同意不能进行治疗，这意味着家长或看护人在制定最终治疗计划中发挥一定作用，尤其是在讨论不同的治疗方案（如果有的话）时。因此，口腔医生必须用一种患者和其家长能够理解的语言来解释疾病的过程。医生还必须解释治疗方法，向他们

carious teeth that are treated by restoration is low, and this is particularly the case when primary teeth are considered. Indeed, the demand for general anaesthesia for removal of carious teeth is by far the most common reason for an out-patient paediatric hospital admission in many regions of the UK. The reasons for this are complex and relate to socio-economic status, ethnicity and geographic location. The solutions are equally complex and many are beyond the scope of the individual practitioner and therefore beyond the scope of this text. But how can the dental team manage a child with toothache?

Pragmatic treatment planning

Correct diagnosis is only the first part in the formulation of the treatment plan. The final piece of the treatment plan jigsaw is determined by measuring the likely compliance of the child and the level of parental support and consent. The best treatment plans are pragmatic — in other words, they will only be successful if they are achievable in the first place.

Dental treatment cannot be carried out without parental consent. This means that the parent or carer has a role in developing the definitive treatment plan. This is particularly true when the different treatment options (if there are any) are discussed. Therefore, the dentist has to explain the

说明临床和放射学检查结果可以达到最佳效果（图 3-1）。

disease process to the patient and parent in a language they will understand. He/she also has to explain the management, and this is best achieved by demonstrating both the clinical and radiographic findings (Fig 3-1).

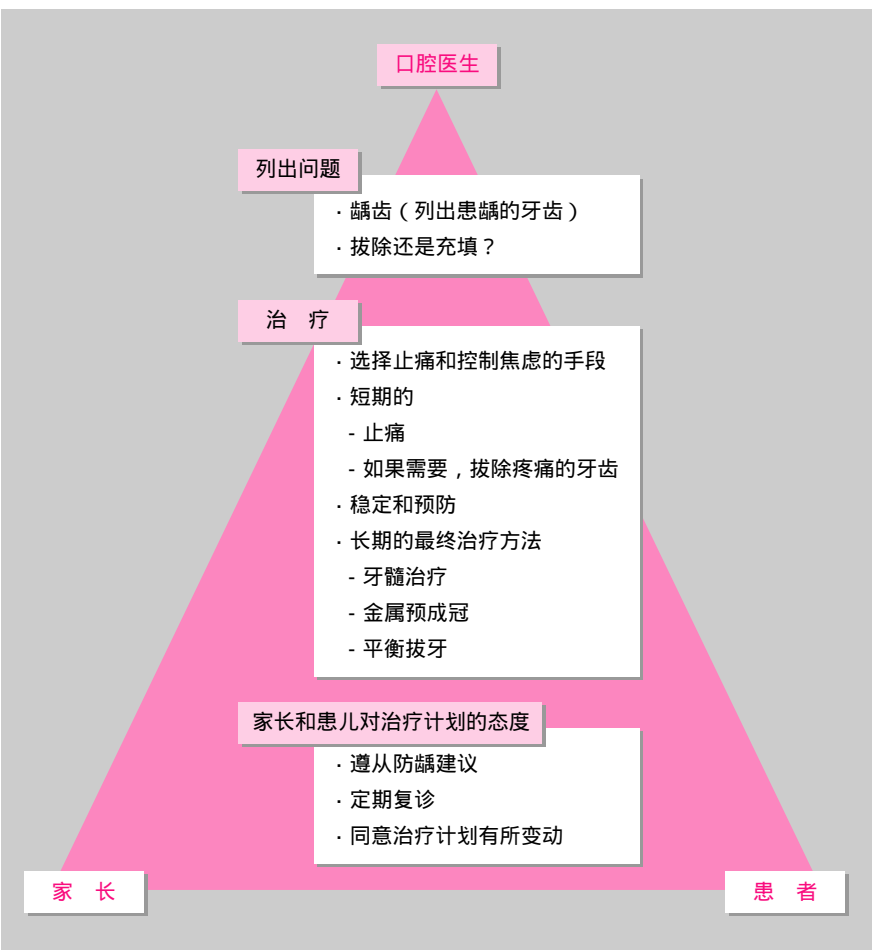


图 3-1 口腔医生、家长和患儿之间的协商对于治疗成功是很重要的

Fig 3-1 The conference between the dentist, child and parent is essential to success

列出问题

列出所有问题可以帮助医生把精力集中在影响制定治疗方案的重要因素上。这些因素包括:疼痛、龋齿危险性、合作能力,以及所选治疗方法的潜在风险性。

制定治疗计划的步骤

治疗计划由以下几部分组成:

- 缓解疼痛
- 家庭日常预防措施
- 专业预防措施
- 稳定现有的龋损
- 充填治疗
- 牙髓治疗
- 拔牙
- 行为管理
- 强化预防

计划保健系统的基础是在缓解疼痛之后首先实施预防,这也是整个治疗设计的重点。预防措施,尤其是那些患者和家长可以每天在家里实施的预防措施,对于患者的口腔健康来讲有最好的远期效益。治疗也要有层次,从一些简单的、愉快的治疗开始,随着患者自信心和依从性的增强,逐渐过渡到技术要求高并可能引起不适感的治疗。

Problem List

A problem list can help focus the dentist's attention on the important factors that determine the shape of the treatment plan. These factors include pain, caries risk, co-operation and the potential complexity of the operative treatment options.

The Stages of a Treatment Plan

A treatment plan is made up of a number of stages:

- relief of pain
- prevention at home
- professional prevention
- stabilisation of caries present
- restorations
- pulp therapy
- extractions
- behaviour management
- reinforce prevention.

This system of planning care is based on putting prevention first after pain relief and is the focus of the treatment plan. Preventive treatments, particularly those provided by the patient and their family at home every day, will have the greatest long-term benefit on the patient's oral health. There is also a hierarchy of treatment, commencing with simple, pleasant procedures, moving on as the patient's confidence and compliance increases, to more technically demanding and perhaps more unpleasant

经过拔牙或其他引起不适感的治疗过程之后，以一次轻松的以实施预防措施为主的复诊来结束本疗程是明智之举。这将会加强正面影响，有助于抹去不愉快的记忆。

镇痛、镇静和全身麻醉

毫无疑问，在局部麻醉下充填，其质量和寿命都很好。遗憾的是，不是所有的孩子都能够在首次就诊时配合局麻注射。

或许需要根据患者的年龄、合作能力和治疗计划的性质，来决定镇静（通常吸入性镇静）或者全身麻醉，以帮助患者配合所需的治疗。无论是选择镇静还是全身麻醉，特别是全身麻醉，总要针对风险和益处以及其他可选择的方法进行全面考虑（图 3-2）。

牙痛的患儿

牙痛的诊断依赖于详尽的病史和全面的检查。虽然本章的重点是讨论牙痛，医生仍要考虑排除其他引起疼

ones.

Following extractions or other unpleasant procedures it is wise to end the course of treatment with a pleasant visit focusing on prevention. This will provide positive reinforcement and help erase unpleasant memories.

Analgesia, Sedation and General Anaesthesia

There is no doubt that restorations placed under local anaesthesia are superior in terms of quality and longevity. Unfortunately, not all children can cope with local anaesthetic injections at their initial presentation.

Depending on the child's age, cooperation and the nature of the planned procedure, there may be a need for a decision on the appropriateness of sedation (usually inhalation sedation) or general anaesthesia to help the child cope with the required operative care. The choice to use either sedation or, particularly, general anaesthesia should always be made with a full assessment of the risks and benefits and consideration of any possible alternatives (Fig 3-2).

The Child with Toothache

Diagnosis of toothache relies on a thorough history and examination. Even though this chapter focuses on toothache, the den-

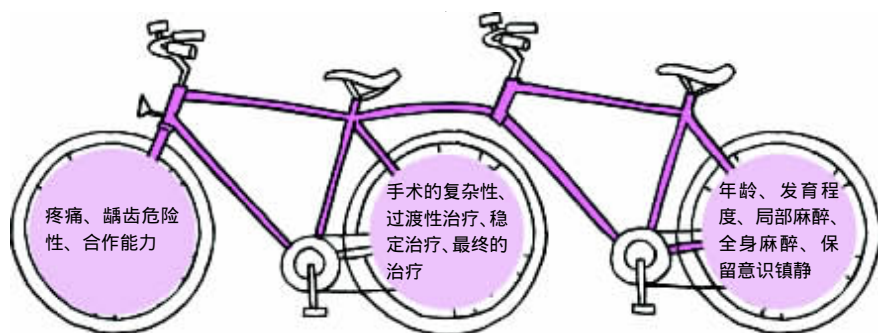


图3-2 最终方案取决于所存在的问题和对患儿配合能力的预测

Fig 3-2 The final plan depends on the problem list and the expectation of how the child will cope to accept treatment

痛的原因。

儿童口内疼痛常见的病因包括：

- 脓肿
- 龋齿（通常无痛）
- 外伤
- 牙齿磨损
- 感染
- 软组织病变（如：复发性口腔溃疡）
- 牙齿脱落 / 萌出

可复性或不可复性牙髓炎？

治疗牙痛的关键，尤其是在乳牙，就是区分可复性牙髓炎，还是不可复性的牙髓炎。正确的诊断来自采集病史及临床和X线检查。总结见表3-1。

tist must take care to exclude other causes of pain.

Common causes of oral pain in children include:

- abscesses
- caries (often no pain)
- trauma
- tooth wear
- infection
- soft tissue lesions (i.e. recurrent oral ulceration)
- exfoliation/eruption.

Reversible or Irreversible Pulpitis?

The key to managing toothache, especially in primary teeth, is determining whether or not the pulpitis is reversible or irreversible. The correct diagnosis can be elicited through the history and the clinical and radiographic examination. A summary

表3-1 区分儿童可复性牙髓炎和不可复性牙髓炎

Table 3-1 Differentiating between reversible and irreversible pulpitis in children

	可复性牙髓炎	不可复性牙髓炎 / 脓肿
病史	<ul style="list-style-type: none">· 甜食、冷热刺激痛· 刺激去除后疼痛消失· 症状出现的时间短· 主要在吃饭时发生	<ul style="list-style-type: none">· 持续的· 只有镇痛可缓解· 无法入睡· 曾有过可复性牙髓炎的症状但是未治疗症状就消失了
检查	<ul style="list-style-type: none">· 可复性牙髓炎没有体征和症状· 早期龋损	<ul style="list-style-type: none">· 淋巴结肿大· 体温升高· 广泛的边缘嵴破坏· 瘻管· 口内脓肿
影像学 (咬合翼片最 易发现龋齿)	<ul style="list-style-type: none">· 龋坏达牙本质	<ul style="list-style-type: none">· 龋坏接近髓腔· 出现密度减低影像

龋齿危险性

为有效地治疗牙痛，应对患者的龋齿危险性有足够的认识。

龋齿高危儿童

- 拔牙也许更适宜 ,尤其是有多颗龋齿。
- 理想的设计应该包括所有龋坏牙的治疗。
- 初步缓解疼痛之后 ,应开始实施预防措施。

of this is shown in Table 3-1.

Caries Risk

The effective management of a child in pain has to pay due cognisance to their caries risk.

High caries risk

- Extraction might be more appropriate, especially if there are multiple carious teeth.
- The ideal plan should include the management of all the other carious teeth.
- A preventive regimen should be initiated following initial pain relief.

龋齿低危儿童

- 如果患牙大面积龋坏，有牙髓炎症状且疼痛，则应拔除。
- 考虑是否需要平衡拔牙。
- 其他龋齿应该可以充填。
- 理想的设计应该包括治疗其他龋齿。
- 在初步缓解疼痛之后，应开始实施预防措施。

对依从性的评估

儿童的依从潜力取决于：

- 既往口腔治疗史。
- 既往的成功治疗经历（记住：现在他们可能更成熟）。
- 他们的一般行为举止（患儿可能由于牙痛和失眠而脾气不好）。
- 既往就诊模式——定期复诊可使儿童对口腔诊室环境更熟悉，且更容易接受治疗。

保留还是拔除？

决定是否保留牙齿取决于（图 3-3）：

- 可复性牙髓炎或不可复性牙髓炎的诊断。

Low caries risk

- The caries extent and presence of pulpitis may indicate that extraction of the painful tooth is required.
- Consider whether balancing extractions are required.
- Other carious teeth might be restorable.
- The ideal plan should include the management of the other carious teeth.
- A preventive regimen should be initiated following initial pain relief.

Assessing Compliance

The potential compliance of the child depends on:

- The past dental history.
- The success of previous treatment (remember they may be more mature now).
- Their general demeanour (the child may be fractious due to toothache and sleep loss).
- Previous attendance pattern — regular attenders may be more familiar with the dental environment and more likely to accept treatment.

Restore or Extract?

The decision to keep the tooth depends on (see Fig 3-3):

- Diagnosis of reversible or irreversible pulpitis.

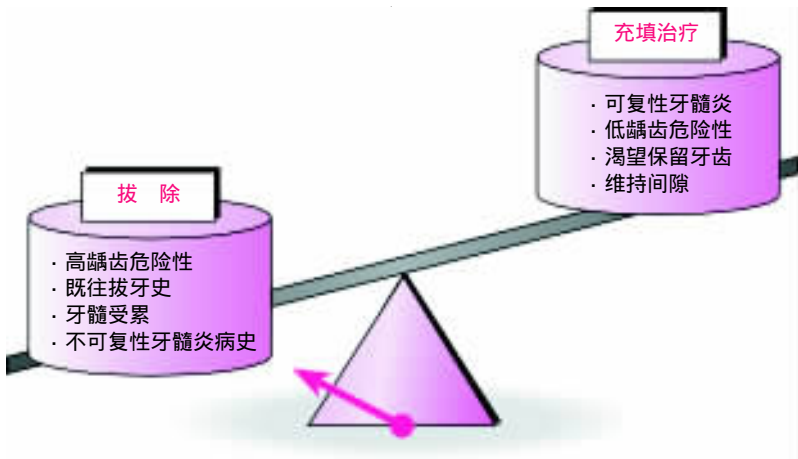


图3-3 充填治疗还是拔除？

Fig 3-3 Restore or extract?

- 牙髓受累的可能性（例如：为了获得良好的充填效果，牙齿需要做活髓切断术）。
- 剩余牙体组织的质和量。
- 已拔除的牙及缺牙间隙的情况。

可复性牙髓炎

有可能的话尽量充填治疗患牙，尤其是以下情况：

- 其他龋齿大多数可以充填。
- 孩子依从性良好。
- 家长渴望保留牙齿。
- 有合适的理由保留该牙齿（如：部分牙齿先天缺失或间隙保持）。

- Likelihood of pulpal involvement (i.e. the tooth will require a vital pulpotomy to successfully restore it).
- Quality and quantity of remaining tooth tissue.
- Previous extractions and edentulous spaces.

Reversible Pulpitis

Restore if possible but especially when:

- The majority of the other carious teeth are restorable.
- The child is compliant.
- The parent is keen to save the teeth.
- There is good reason to save this tooth (e.g. hypodontia or space-maintenance).

以下情况可予拔除：

- 其他的龋齿可能需要拔除，平衡拔牙可能是明智之举。
- 孩子不合作。
- 家长不同意充填治疗该牙。

· 除非为了缓解疼痛，否则不愿就诊。

不可复性牙髓炎或死髓牙

以下情况可试充填治疗：

- 其他龋齿多数可以充填。
- 孩子依从性好。
- 家长渴望保留牙齿。
- 无牙髓治疗的禁忌证。
- 有合适的理由保留该牙齿（如：部分牙齿先天缺失或间隙保持）。

以下情况可予拔除：

- 其他的龋齿可能需要拔除，平衡拔牙可能是明智之举。
- 孩子不合作。
- 家长不同意充填治疗该牙。
- 除非为了缓解疼痛，否则不愿就诊。
- 牙齿已不能修复。

Extract when:

- Other carious teeth may need extraction and it may be wise to balance.
- The child is non-compliant.
- There is no parental support for restoration.
- The family is unlikely to attend beyond pain relief.

Irreversible Pulpitis or the Non-Vital Tooth

Try to restore if:

- The majority of the other carious teeth are restorable.
- The child is compliant.
- The parent is keen to save the teeth.
- There is no medical contraindication to pulp therapy.
- There is good reason to save this tooth (e.g. hypodontia or space-maintenance).

Extract when:

- Other carious teeth may need extraction and it may be wise to balance these.
- The child is non-compliant.
- There is no parental support for restoration.
- The family is unlikely to attend beyond pain relief.
- The tooth is not restorable.

充填：姑息治疗

暂封材料(图3-4)可以有效地缓解可复性牙髓炎，不可复牙髓炎甚至死髓牙的疼痛。对未列入修复治疗计划的牙齿，抗生素或类固醇糊剂可以缓解疼痛。在乳牙，牙髓切断术的药物也可以用来暂时性缓解疼痛，直到可以拔除该牙。对可复性牙髓炎的牙齿，如果计划修复治疗，所用的暂时性充填材料不能损害牙髓的健康，且应具有良好的封闭性(如：玻璃离子或氧化锌丁香油粘固剂)。

平衡还是代偿？

- 平衡是拔除同颌同名牙。
- 代偿是拔除对颌同名牙。

Restore: Temporise

The placement of a temporary dressing (Fig 3-4) may be effective in relieving pain in teeth with reversible, irreversible pulpitis or even non-vital teeth. In the case of a tooth that is not scheduled for restoration, antibiotic/steroid paste may provide relief. In primary teeth, medication used for pulpotomy may also be used to provide temporary pain relief until extraction can be arranged. In the case of reversible pulpitis, where restoration is planned, the temporary restoration should be a material that is not detrimental to the health of the pulp and produces a good seal (e.g. glass ionomer or zinc oxide eugenol cement).

Balancing and Compensation?

- Balancing is the extraction of a tooth in the same arch.
- Compensating is an extraction in the opposing arch.



图3-4 暂封可以缓解疼痛

Fig 3-4 A temporary dressing can provide pain relief

平衡和代偿是为了保持对称，尤其是避免恒切牙中线偏斜导致的以后更复杂的正畸治疗(图3-5)。目前尚没有足够的证据支持在乳牙列进行平衡和代偿拔牙。然而，多数正畸科医生和儿童口腔科医生赞同在以下情况下进行拔牙，特别是对于没有间隙的个体：

- 通常平衡拔除乳尖牙。
- 平衡拔牙不要拔除第二乳磨牙。
- 乳牙列不必代偿拔牙。
- 牙列越拥挤，越需要平衡拔牙。

以下情况例外：

- 当对侧已有一个乳磨牙或是尖牙早失，并导致中线偏移和间隙

Balancing and compensation are indicated to maintain symmetry, in particular to avoid a centre-line shift of the permanent incisors, which may avoid the need for more complex orthodontic treatment later (Fig 3-5). The evidence supporting balancing and compensating extractions in the primary dentition is scant. However, most orthodontists and paediatric dentists would agree with the following, particularly in an individual without spacing:

- Always balance the extraction of primary canines.
- Do not balance the extraction of primary second molars.
- Compensatory extractions in the primary dentition are never indicated.
- The more crowded the dentition, the greater the need to balance.

Exceptions are:

- Where a primary molar or canine has already been lost from the contralateral side, resulting in a centre line shift



图3-5 中线偏移

Fig 3-5 A centre-line shift

关闭时，需要全面的正畸评估。

- 乳牙列有间隙存在——不提倡平衡拔牙。

第一恒磨牙

如果必需拔除第一恒磨牙，适宜的时间是9~10岁，即第二恒磨牙的根分歧开始钙化的时间。这时，第二恒磨牙的近中移动可能会关闭第一恒磨牙拔除后的间隙。如果延迟到第二恒磨牙的牙根形成时才拔牙，那么关闭间隙的可能性会减低。有时不得已过早拔牙，有可能会增加正在发育中的第二前磨牙向远中移动的危险。

通常情况下：

- 平衡拔牙或代偿拔牙经常是因龋而被迫进行的，并且主要应用在 类错殆的儿童。
- 如果上颌第一恒磨牙需要拔除，而下颌牙经过完善治疗并保持良好，则预后良好。
- 如果下颌第一恒磨牙需要拔除，那么对颌牙也应该拔除。如果不

and space closure, this requires a full orthodontic assessment.

- The spaced primary dentition — balancing is not indicated.

First Permanent Molars

When extraction of the first permanent molars is necessary, the appropriate time to consider this is between the ages of nine to 10 years, when the bifurcation of the second permanent molar is starting to calcify. At this point, the mesial movement of the second permanent molar tooth is likely to close the space created by the extraction of the first permanent molar. If extractions are delayed until the roots of the second permanent molars are forming the potential for space closure is reduced. Earlier extraction, which is sometimes enforced, increases the risk of distal movement of the developing second premolar.

In general terms:

- These balancing and compensating extractions are usually enforced extractions due to caries and apply mainly to children with Class I occlusions.
- If the extraction of an upper first permanent molar is required then the lower tooth is treated on its own merits and retained, provided it is of good prognosis.
- When the extraction of a lower first permanent molar is indicated the op-

拔除对颌牙,它可能会过长,并阻止下颌第二恒磨牙的近中移动,进而妨碍间隙的关闭。

- 也有很多例外情况,如 Ⅰ类和Ⅱ类错颌,以及先天缺牙的病例。对这些病例,如果准备在牙列发育期间拔除第一恒磨牙,事先应听取专家的意见。

镇痛药和抗生素

应用镇痛药缓解疼痛。在儿童,扑热息痛或布洛芬是常用药。应根据厂商的说明书服用。

抗生素缓解牙髓炎症状的作用不明确。即便有止痛的作用,也要至少1d之后才能感觉到效果。不正确地使用抗生素可导致细菌耐药性增加。使用任何药物都有发生过敏反应的危险。因此,抗生素应只用于有系统症状的病人,如发热、牙关紧闭或面部肿胀。

posing tooth should also be extracted. If this opposing tooth is not extracted there is a risk of it over-erupting and in the process preventing the mesial drift of the lower second permanent molar and therefore space closure.

- There are numerous exceptions to this rule, such as in Class II and Class III malocclusions and in cases of hypodontia. A specialist opinion is usually indicated before embarking on the extraction of first permanent molars in the developing dentition in these circumstances.

Analgesia and Antibiotics

Analgesics should be used to provide pain relief. In children the drugs of choice are paracetamol or ibuprofen. These should be prescribed according to the manufacturers' instructions.

Antibiotics do not reliably relieve the symptoms of pulpitis. Even in cases where pain relief is achieved there can be a delay of at least a day before any effects are felt. The inappropriate prescription of antibiotics leads to the growing problem of antimicrobial resistance. There is also a risk of an allergic reaction when any drug is prescribed. For these reasons, antibiotics should be reserved for the patient who has systemic symptoms, such as pyrexia, trismus or facial swelling.

引流的优点

如果孩子的合作能力允许的话，牙槽脓肿的治疗应首选引流。引流通常可迅速缓解症状，且不需服用抗生素。

可以用涡轮等器械打开髓腔引流，也可切开软组织引流。对波动感明显的口内脓肿，可以在局部麻醉下或用棉卷沾氯乙烷表面冷冻麻醉下切开。当脓肿还没有波动感时，切开常常是无效的。

开放髓腔引流最好在局麻下进行，以免碰到活髓时引起牙痛。局麻时应避免向感染区域内注射。如果口腔医生确定没有残存的活髓，则可以不施行局部麻醉。此时，即使是对那些没有或只有极少口腔治疗经验的儿童来说，这也是一种快捷而简单的缓解疼痛的方法。

如果引流的牙齿需要拔除，可以继续开放，但不能开放得太久。对计划进行牙髓治疗的牙齿应该尽快封闭。只有在脓液不断流出的情况下，才可以长时间地开放牙齿。

The Benefit of Drainage

Whenever the child's cooperation will allow, drainage of an abscessed tooth is the treatment of choice. This gives almost immediate relief of symptoms and often prevents the need to prescribe antibiotics.

Drainage can be achieved either by accessing the pulp chamber, using rotary instruments, or by incision of the soft tissues. A pointing fluctuant intra-oral swelling can be incised with the aid of topical anaesthetic or ethyl chloride applied to a cotton wool roll. The incision of a swelling that is not pointing is frequently futile.

Drainage through the pulp chamber is best done following administration of local anaesthetic to avoid the danger of causing pain by accessing a tooth with remaining vital tissue. The local anaesthetic technique used should avoid injection into a region of infection. Where the practitioner is sure that no vital tissue remains this procedure can be performed without local anaesthetic. In such clinical cases, this is a quick and simple method of providing pain relief even in young children with little or no experience of dental care.

Where the tooth being drained is to be extracted it can be left open to drain, but not for a prolonged period. Where endodontic therapy is planned the tooth should be sealed as soon as possible. The only in-

有活动性龋儿童的治疗

滞留于牙齿光滑面的菌斑启动并促进了龋损的进展。不管现有病损有多严重,只要没有菌斑,就没有龋齿。不幸的是,一旦龋洞形成,基本上不能有效的清除菌斑。因此在这种情况下,对龋齿高危儿童,在进行最终的修复和预防治疗的同时,减缓龋损的进展速度,使病变稳定是惟一合适的选择。

稳定治疗

如果在去除病损边缘的腐质后暂封,可以将龋和光滑面上的菌斑分离开的话,那么龋损的进展过程就会减慢,还有可能停止。即便不可能去除任何腐质,暂封物还是能够争取到时间。在殆面龋没有明显成洞前,窝沟封闭可以减慢或者阻止龋齿的进展。当殆面龋明显成洞时,在窝沟封闭前应先使用玻璃离子暂封。这种方法有助于加强相对脆弱的封闭剂(图3-6)。

dication for leaving these teeth open for any extended period is when the pus is continuing to drain.

Managing the Child with Active Caries

The continued presence of bacterial plaque on the tooth surface both initiates and then continues to drive the carious process forward. If there was no plaque there would be no caries, no matter how advanced the lesion. Unfortunately, once cavitation has occurred it generally becomes impossible to remove plaque effectively. Therefore, under such circumstances stabilisation becomes the only appropriate option in the high caries risk child, slowing down caries progression while the definitive restorations are being undertaken and the preventive treatment provided.

Stabilisation

If the caries can be isolated from the plaque on the surface by the placement of a dressing following removal of caries at the margins of the lesion, caries progression will slow and possibly arrest. Even if it is not possible to remove any caries, a dressing may still buy time. In the case of occlusal lesions, without obvious cavitation, the placement of a pit and fissure sealant may slow or arrest lesion progression. In the case of an occlusal lesion



图3-6 稳定治疗的顺序

Fig3-6 The sequence of stabilisation

稳定治疗的特殊价值：

- 对于不合作的患者——阻止龋齿进展直到可以进行永久性修复。
- 患者有多个龋齿——治疗过程时间长，应先阻断龋齿的进展。
- 用于间接盖髓或分次去腐——避免牙髓治疗。
- 预防在局麻区域外治疗牙邻牙的敏感性。

with obvious cavitation it may be appropriate to place a glass ionomer dressing before sealing. This approach helps provide the support necessary for the relatively brittle sealant (Fig 3-6).

Stabilisation is of particular value for:

- The pre-cooperative patient — preventing lesion progression until definitive restoration is possible.
- The patient with multiple carious lesions — arresting caries progression over the course of a long treatment plan.
- The use of an indirect pulp cap or as part of serial excavation — avoiding the need for endodontic therapy.
- Prevention of sensitivity in teeth in proximity to the one being restored but outside the anaesthetised area.

治疗的顺序

如果可能的话，治疗开始可行上颌结节麻醉，因为该部位麻醉效果最好。阻滞注射应该在病人已经产生信心并能充分理解之后再行进行。在局部浸润麻醉带来无痛感后，患者会建立对麻药效果的信心。

必须防治相结合，否则龋齿活跃的儿童在治疗过程中会发生新龋。

典型的序列治疗步骤如下：

- 第1步——暂封（稳定治疗）
- 第2步——放置窝沟封闭剂
- 第3步——不需要局麻的简单（小）修复治疗
- 第4步——局麻下上下后牙的修复治疗，牙髓治疗或者乳磨牙的拔除。
- 第5步——需要行下颌阻滞麻醉的治疗（治疗整个区段）
- 第6步——前牙的修复治疗。

The Sequence of Operative Care

Where possible, operative care is commenced in the maxillary buccal segments because this is where painless local analgesia is best achieved. Block injections should be delayed until the patient has grown in confidence and understanding. This confidence will follow after experiencing painless infiltration local anaesthesia.

Operative care must be integrated with preventive therapy otherwise new lesions will develop in the caries-active child during the course of the operative treatment.

A typical operative sequence is as follows:

- Step 1 - Temporary dressing (stabilisation)
- Step 2 - Placement of fissure sealants
- Step 3 - Simple (minimal) restorations where no local analgesia is required
- Step 4 - Restorations, pulp therapy or primary molar extractions in the posterior maxilla with local analgesia
- Step 5 - Operative treatment requiring a mandibular block (treat the whole quadrant)
- Step 6 - Anterior restorations.

实用提示

- 解释治疗计划时 ,不要认为任何知识都是理所当然的。
- 列出 “ 问题 ” 清单。
- 治疗计划应符合孩子 (以及家长) 的需要 , 要求和能力。
- 将预防放在第 1 位。

Practical Tips

- When explaining a treatment plan do not take any knowledge for granted.
- Present the “problem” list.
- Make the plan appropriate to the child’s (and their parents’) needs, desires and abilities.
- Put prevention first.

推荐阅读

Further Reading

Chadwick BL, Hosey MT. Child Taming: How to Manage Children in Dental Practice. Quintessentials Dental Series Vol. 9. London: Quintessence Publishing Co.Ltd, 2003

第 4 章 预防龋齿的系列方法及其应用

The Caries Prevention Tool Kit and How to Use it

目 的

本章的目的是使口腔诊疗小组掌握能成功预防儿童龋齿的方法。读者可以大致了解社区基础保健项目，以便在社区保健与全科口腔服务间确立有机的联系。据此，本章的焦点将转移到如何根据先前的龋齿危险性评估，在口腔诊所中对儿童和家长进行个体化的预防保健。

要 点

学习完本章的内容，临床医生应能掌握最新的知识，以便对每个儿童进行预防保健，并了解如何利用社区基础保健项目来进行补充。

Aim

The aim of this chapter is to equip the dental team to successfully prevent caries in children. The reader will become familiarised briefly with community-based programmes so that these can be more easily identified locally to facilitate linkage between the community and general dental services. Following this, the focus will shift to how preventive care can be individualised and delivered to children and their parents within the dental surgery environment based on the prior assessment of caries risk.

Outcome

On completing this chapter the practitioner should be equipped with contemporary knowledge to provide preventive care for individual children and understand how community-based programmes might complement this effort.

引言

精心地治疗孩子的龋齿，没想到复查时又发现有新龋，没有比这更让人感到悲哀的了。乳牙龋坏的儿童，恒牙患龋的危险性会更高。从理论上来说，我们首先希望患儿不患龋。但是，怎样才能做到呢？

近年来的研究告诉我们，婴儿期的口腔保健教育是预防儿童龋齿的最好方法。另外，许多社区基础保健计划也将焦点放到幼儿园，把产前育儿教育和健康随访与新妈妈联系起来。但是，忙碌的口腔医生将如何参与到这项工作中来？在口腔治疗中怎样对高危患龋儿童实施预防？

现在已经知道龋齿是口腔中多种细菌（主要是变形链球菌）、糖类底物和易感的牙齿表面共同作用的结果。龋病的病因学和预防措施见图 4-1。

预防龋齿的系列方法

预防龋齿的基本方法：

- 饮食结构的改变

Introduction

There is nothing more soul-destroying than carefully restoring a carious dentition for a child only to find new caries at a subsequent review. Children with carious primary teeth are at greater risk of developing caries in their permanent dentition. Ideally, we would hope that our child patients remain caries free in the first place. But how can this be achieved?

Contemporary research informs us that oral health education is best when delivered to infants. Hence, many community-based schemes are now focussed on nursery schools and linked to antenatal classes and health visitor contact with new mums. But how can the busy dental practice contribute towards this, and what can be done in the dental surgery to prevent caries in high-risk children?

It is already understood that caries is the result of the simultaneous long-term presence of oral commensals (most notably *Streptococcus mutans*), a carbohydrate substrate and a susceptible tooth surface. Caries aetiology and prevention tools are shown in Fig 4-1.

The Caries Prevention Tool Kit

The cornerstones of caries prevention are:

- diet modification

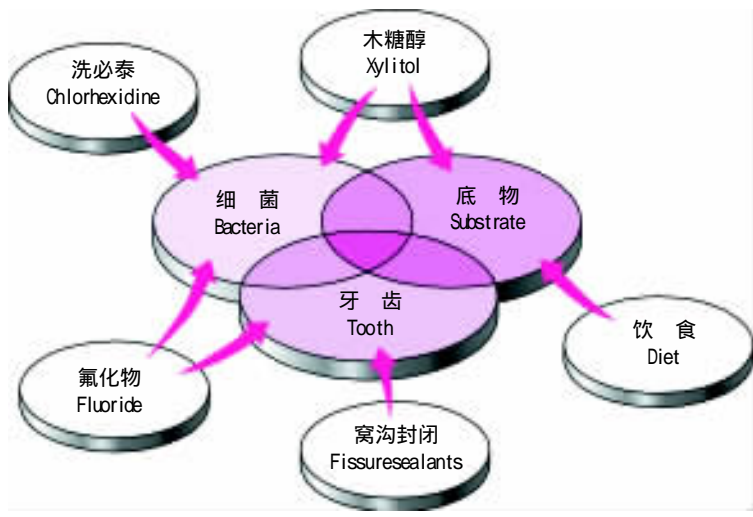


图4-1 龋病病因学和预防措施
Fig4-1 Caries aetiology and prevention tools

- 氟化物
- 窝沟封闭
- 咀嚼口香糖（木糖醇）
- 氯己定

饮食结构的改变

预防龋齿的饮食建议要点：

- 减少糖的摄入量
- 限制糖的摄入次数，只在进餐时间吃糖

为使饮食结构的改变行之有效，必须做到：

- 个体化的
- 可行的
- 明确的

- fluoride
- fissure sealants
- chewing gum (Xylitol)
- chlorhexidine.

Diet Modification

The cornerstone of diet counselling to prevent dental caries is to:

- reduce the amount of sugar consumed
- limit sugar frequency to meal times only.

For diet modification to be effective it must be:

- personal
- pertinent
- positive.

避免让患儿的家长感到内疚

家长真诚地希望能够避免孩子的龋齿进一步发展，所以一旦出现龋齿进一步发展的情况，他们就会感到内疚。要记住，选择低致龋性食品是困难的：

- 糖的含量并不总是注明在食品标签上。
- 在社会贫困地区，很难获得健康食品。
- 在社会贫困地区，健康食品是比较奢侈的选择。
- 不是每个人都会做饭。
- 比起政府对儿童牙齿健康保健宣传，制糖业的市场广告宣传更为广泛（只要看看周六早晨的儿童电视节目就知道了）。
- 几乎没有家庭能够坚持“一日三顿正餐”，而是喜欢随意的 / 快餐的方式。
- 白天，孩子在幼儿园、由保姆或是其他的亲属照管。
- 学校的糖果店很诱人。

以饮食日记的方式制定个体化建议

- 3d 饮食日记可以帮助口腔诊疗小组和家长一同关注糖的消耗，进而有助于减少摄入致龋食品

Avoid making parents feel guilty

Parents genuinely wish to avoid dental caries developing in their children, so in the event of caries development they can feel guilt. Remember, the selection of less cariogenic food is difficult:

- Sugar content is not always clear in food-labelling.
- Access to healthy foods can be difficult in socially deprived areas.
- Healthy foods can be a more expensive option in socially deprived areas.
- Not everyone can cook.
- The sugar industry spends more on marketing and advertising (just watch Saturday morning children's TV) than the government has to spend on the provision of dental health services for children.
- Few families stick to the three square meals a day epithet and favour a grazing/snacking style.
- The child may be looked after in a nursery school, by a child minder or by another relative during the day.
- School tuck shops are tempting.

Personalised advice using a diet diary

- A three-day diet diary can help the dental team and the parent work together to highlight sugar consumption

的数量和频率。

- 使用指导：
 - 连续记录 3d
 - 记录进食的时间、数量，如果可能的话记录食品的牌子
 - 其中应当包括一个周六或周日。

当回顾饮食日记时，

- 请患儿或家长（看护人）指出困难之处。
- 提出可供选择的非致龋性食品。
- 推荐与家庭生活方式相适应的可供选择的食品。
- 记住应保护孩子在同伴中的自尊心（例如：时尚的水杯有助于从喝含糖的汽水过渡到喝水）。

记住，许多饮食日记并不准确，因为：

- 患者怕被责备。
- 患者为取悦于你而向你提供你想看到的记录。
- 用同一支笔记录的日记尤其要引起怀疑。

非奶源性糖

家长经常混淆食品标签上表明的糖分，即使是教育程度最高和最在意的家庭也会不知不觉地食用那些看似

and then to reduce the amount and frequency of cariogenic foods.

- The instructions for use are:
 - use for three consecutive days
 - give the times and amount, and food brand if possible
 - one of the days should include a Saturday or Sunday.

When reviewing the diet diary:

- Ask the patient or parent (carer) to identify where they feel the problems are.
- Offer alternative non-cariogenic foods.
- Recommend alternatives that will fit in with the family life-style.
- Remember to preserve the child's dignity in front of their peers (e.g. a trendy water container to facilitate the transition from sugared pop to water).

Remember, many diet diaries are not accurate because:

- The patient is worried about being reprimanded.
- The patient wants to please you, so gives you what they think you want to see.
- Be particularly suspicious of diaries written with the same pen.

Non-milk extrinsic sugars

Parents are often confused by food labelling of sugars. Even the best-educated and best-intentioned families can unwittingly

健康实则含糖量很高的食品，饮料上标注的“不加糖”是最常见的欺骗和陷阱。

致龋食品：

- 糖果
- 饼干和蛋糕
- 饮料和果汁

大众的错误观念（引起龋齿的食品）：

- 纯饼干
- 一些风味的炸薯片（如：虾味的、鸡尾酒味的薯片）
- 果酱和沙拉酱
- 酸乳酪
- 干果
- “低糖”饮料
- “不加糖”饮料
- 豆奶
- 母乳喂养超过正常的断奶时间
- 夜间喝果汁或牛奶

可以选择的零食：

- 薄脆饼干
- 面包
- 面包棍
- 胡萝卜条
- 水果片（儿童可能吃不了整个水果，但是可以成片吃）

tingly consume an otherwise healthy diet that has a high sugar content — drinks labelled as no added sugar being a common trap and culprit.

Foods that cause caries:

- sweets
- biscuits and cakes
- drinks and juices.

Popular misconceptions (foods that DO cause caries):

- plain biscuits
- some flavours of crisps (e.g. prawn cocktail flavour)
- sauces and salad dressings
- yoghurts
- dried fruits
- low sugar drinks
- no sugar added drinks
- soya milk
- breast milk if continued beyond normal weaning time
- access to juice or milk through the night.

Alternative snacks:

- crackers
- bread
- bread sticks
- carrot sticks
- slices/pieces of fruit (children may not feel able to eat a whole fruit but may

- 硬奶酪

氟化物

我们知道氟化物具有防龋作用已经有半个世纪了。美国的许多城市已经提供了氟化水源，世界上其他一些地方也有天然的氟化水。在英国，诺森伯兰郡的部分地区和东内陆地区已经有30多年氟化水源的历史了。

氟化物是怎样预防龋齿的？

氟化物具有全身和局部两种作用。它的防龋作用归纳如下：

- 改变成釉细胞
- 使窝沟变浅
- 稳定釉质中羟基磷灰石分子矩阵结构，增强了釉质抗酸溶解性
- 影响糖酵解，降低细菌产酸速度
- 具有直接的抗菌作用
- 其抗龋作用的原理是改变再矿化与脱矿之间的平衡关系，促进再矿化

氟化物对光滑面的保护作用最强

eat a slice)

- hard cheese.

Fluoride

The benefit of fluoride in caries prevention has been known for half a century. Many cities in the USA have fluoridated water supplies, and other parts of the world have natural fluoridated water. In the UK, parts of Northumbria and the West Midlands have been fluoridated for over 30 years.

How does Fluoride Prevent Caries?

Fluoride acts both systemically and topically. Its anti-caries effect can be summarised as follows:

- alters the ameloblast
- makes fissures more shallow
- stabilises the matrix of the hydroxyapatite molecule within enamel, making it more resistant to acid dissolution
- interferes with glycolysis, slowing down bacterial acid production
- has direct anti-bacterial effect
- its principal anti-caries action is to alter the balance of remineralisation v. demineralisation in favour of remineralisation.

Fluoride gives greatest protection to smooth surfaces

氟化物处方

最简单的氟化物处方是：

- 只选择一种全身使用方法
- 可选择多种局部使用方法(表4-1)

含氟牙膏

在过去的几十年中，世界范围内的龋齿患病率有了显著的降低，这主要归功于含氟牙膏的使用。实际上，作为最有效的氟防龋手段，只有氟化水源的效果好于含氟牙膏。当我们要求患者增加刷牙的频率或更有效地刷牙时，我们是在巩固现有的社会健康行为规范。因此，改变行为方式比改变饮食习惯更容易。

刷牙还可以有效地释放氟，同时正确的刷牙可以减少菌斑的形成，从而有助于消除一项龋齿致病因素。正

Prescribing Fluoride

The simple rule of thumb to prescribing fluoride is:

- select only ONE systemic method
- select ANY NUMBER of topical methods (Table 4-1)

Fluoride Toothpaste

Caries rates have been falling gradually around the world over the past few decades. This fall can be almost solely attributed to the introduction of fluoride toothpaste. Indeed, toothpaste is bettered only by water fluoridation as the most effective method of delivering the preventive benefit of fluoride. When asking a patient to brush more frequently or teaching them to brush more effectively, we are reinforcing practice of an already social norm. Therefore, this is often an easier behaviour modification to achieve than dietary change.

As well as toothbrushing being an effective method of delivering fluoride, when performed properly it reduces the build-up

表4-1 氟化物的全身和局部应用
Table 4-1 Systemic vs. topical fluoride prescribing

全身用氟	局部用氟
水 (Water)	牙膏 (Toothpaste)
药片 (Tablets)	保护漆 (Varnish)
	漱口液 (Mouthrinse)

在萌出的磨牙的殆面尤其易患龋的原因之一是：因为牙齿尚未建立殆关系，咬合面上堆积的菌斑不能通过咀嚼去除。萌出的过程持续1年以上。问题的复杂性在于对尚未完全萌出的牙齿很难做到有效地刷牙。

氟化物的剂量与龋齿的减少

龋齿减少的量很大程度上依赖于氟化物的剂量（表 4-2）。

· 牙膏中氟化物的剂量越高，龋齿

of plaque, thus helping to eliminate one of the actiological causes of caries. It has been suggested that one of the reasons the occlusal surface of erupting molars are particularly caries-prone is that plaque builds up on these surfaces and is not removed by mastication because the teeth are not in occlusion. The eruptive process can take over a year. This problem is compounded by the difficulty in effectively brushing these teeth.

Fluoride Dose and Caries Reduction

The magnitude of the caries reduction is entirely dependent on the dose of the fluoride (Table 4-2):

· the higher the dose of fluoride in

表4-2 牙膏中氟的含量是多少？(摘自:Creasey SJ. Fluoride in Toothpaste. Br Dental J 1994;176: 330)

Table 4-2 How much fluoride is in toothpaste? (Adapted from: Creasey SJ. Fluoride in Toothpaste. Br Dental J 1994; 176: 330)

品 牌	氟化物水平（1 106）
Boots Children Gel	163
Punch & Judy	1 053
Mentadent	1 461
Signal	1 500
Colgate 0-6	395
Boots Tom & Jerry	526
Tesco Bubble Gum	526
Super Drug Strawberry Gel	1 053

减少越显著

- 对龋齿高危儿童 ,牙膏中的氟化物含量至少在 1 1 000
- 刷牙以后将牙膏吐出 ,不要用水漱口。

吞咽或吃进牙膏

不幸的是 , 没有几个孩子在刷牙后能将牙膏吐出来 , 有的儿童喜欢牙膏的味道 , 以至于将牙膏吃掉。因此 , 尽管牙膏的含氟量与防龋的有效性相关 , 在规定含氟量时还是要小心。牙刷头的面积也可以用来衡量牙膏的量 , 所以 :

- 只用豌豆粒大小的牙膏
- 为孩子选择一款小尺寸的牙刷
- 建议将牙膏按刷头的宽度挤出 , 而不是按刷头的长度
- 至少在 7 岁以前 , 孩子刷牙时应有父母监督

患龋危险性评估和氟化物的剂量

所选牙膏的含氟量取决于孩子的龋齿危险性。

toothpaste, the greater the reduction in caries

- children at high caries risk should have at least 1000ppm fluoride in toothpaste
- spit out after brushing but don't rinse with water.

Swallowing and Eating Toothpaste

Unfortunately, few infants can spit out toothpaste after brushing and some children like the taste of it so much that they eat it. Therefore, despite the link between dose and efficacy in caries reduction, some care in prescribing is required. Even the size of the toothbrush head surface can be a determinant of the amount of toothpaste used, so:

- only use a pea-sized amount of toothpaste
- select a small-sized toothbrush for children
- suggest that the toothpaste is applied across the bristles rather than length-wise
- parents must supervise children toothbrushing until they are at least seven years old.

Caries Risk Assessment and Fluoride Dose

The dose of fluoride toothpaste to prescribe depends on the caries risk of the child.

- 龋齿低危儿童 = 氟化物含量不超过 0.6 1 000
- 龋齿高危儿童 = 氟化物含量 1 1 000

对于6岁以上的儿童,氟化物对恒切牙的危害可不予考虑,他们可以开始安全地使用成人的含氟牙膏 1.5 1 000。

氟保护漆

对于易患龋的牙齿光滑面,局部使用氟保护漆是一种提供高剂量氟的方法(1ml 含有 22.6mg 氟)。保护漆中几乎所有的氟最后都会被吞入,所以应谨防过量。保护漆对于干牙面有良好的粘接性,所以使用时应当尽量干燥牙面。用氟保护漆牙线通过接触点也能增加其效果(图4-2)。有可能产生过敏反应,尤其是对于有哮喘病的儿童。

- a child with a low caries risk = up to 600ppm fluoride
- a child with a high caries risk = 1000ppm fluoride.

The risk of fluorosis to the incisors is negligible in children aged over six years and they can safely start to use the adult strength toothpaste (1500ppm).

Fluoride Varnish

The topical application of a fluoride varnish is a method of delivering a very high fluoride dose (1mL contains 22.6mg of fluoride) to the smooth surfaces most susceptible to caries. Almost all of the fluoride in the varnish will eventually be ingested, so take care not to overdose. The varnish adheres to a dry surface best, therefore the tooth should be dried whenever possible. Flossing fluoride varnish through contact points also increases its effectiveness (Fig 4-2). There is a possibility of allergic reaction, especially with children with asthma.



图4-2 小心地用牙线将氟保护漆涂布在邻面接触区

Fig 4-2 Floss fluoride varnish through the inter-proximal contacts with care

氟 片

氟片在吞咽之前在口中含一段时间,可发挥全身和局部作用。制定氟片原始剂量的基础是假定孩子每天喝至少 1L 的水。后来发现,这一饮水量过高,因此,1997 年对氟片剂量进行了修改,见表 4-3。

含氟漱口水

说明如下:

- 每天最好使用 0.05% 的含氟漱口液漱口。
- 刷牙和使用漱口液的时间应当不同,这样可以在一天当中维持唾液中氟的浓度。建议用法:早、晚各刷牙 1 次,放学回家时使用漱口液。
- 孩子应当具备将漱口液吐出的能力,所以一般是 8 岁以上儿童。

Fluoride Tablets

Fluoride tablets act systemically and topically if they are sucked before swallowing. The original dosage was based on the assumption that a child would drink at least one litre of water a day. This volume of consumption was later found to be too high and so the amended fluoride tablet dosages shown in Table 4-3 were implemented in 1997.

Fluoride Mouthwash

To prescribe this:

- Daily rinsing is best with 0.05% fluoride.
- Use at a different time to toothbrushing so that salivary fluoride levels can be maintained throughout the day. Therefore, suggest a regime of brushing morning and night and use the mouthwash on returning home from school.
- The child needs to be capable of spitting out the mouthwash and thus they normally need to be over eight years

表4-3 氟添加剂的修订剂量
Table 4-3 Fluoride supplement revised dosages

年 龄	剂量 (mg)
6 个月 ~ 3 岁	0.25
3 ~ 6 岁	0.5
> 6 岁	1.0

- 使用不含酒精的漱口水(一些漱口水酒精含量在20%以上)。使用含有酒精的漱口水会对口腔黏膜产生不良反应,还有报道儿童由于误吞了含有酒精的漱口水而造成急性酒精中毒。
- 应当建议所有龋齿高危儿童和青少年使用这种方法,特别是有邻面龋的儿童。

氟斑

大约有10%的人其成釉细胞对氟化物的作用相当敏感。

治疗釉质斑

轻度的氟斑不一定难看,但可以通过简单的磨除少许釉质的方法进行治疗,即用酸蚀-磨砂膏微打磨(更准确的用词是“磨耗”)技术。比较严重的氟斑可以在青少年期做暂时性的直接树脂贴面,成年后改做瓷贴面。

氟化物的前景

最新的离体牙实验显示:持续的低剂量给氟是减少龋齿的最有效方法。所以最近的新发明,如:“氟珠”——

of age.

- Use an alcohol-free variety (some mouthwashes have alcohol levels as high as 20%). Rinsing with alcohol has an adverse effect on the oral mucosa, and there have been reports of acute alcohol poisoning in children who have drunk mouthwash.
- All high-risk children and adolescents should be advised to use this approach but especially those with approximal caries.

Mottling

Approximately 10% of the population have a greater susceptibility to the effect of fluoride on their ameloblasts.

Management of enamel mottling

In its milder forms this is not necessarily unaesthetic but can be treated simply using the method of controlled enamel removal by acid-pumice micro abrasion (sometimes more correctly termed *ÒabrasionÓ*) techniques. More severe mottling can be treated in adolescence by the provision of direct composite veneers followed by porcelain veneers in adulthood.

The Fluoride Future

New in-vitro research is suggesting that sustained, low-dose fluoride exposure may be the most efficacious means of reducing

一种缓慢释氟装置 ,类似于牙饰 ,对于
龋齿高危儿童会是福音。

急性氟过量的诊断和处理

即使是 1mg/kg 这么小的剂量也
会引起中毒。症状包括：

- 恶心和呕吐
- 胃痛
- 腹泻
- 流涎

超过 5mg/kg 会致命。症状包括：

- 惊厥抽搐
- 呼吸衰竭和心力衰竭
- 昏迷

1 1 000 的牙膏是指 1g 牙膏中
含氟 1mg。

氟过量的处理：

- 检查是否服用了其他有毒物质。
- 服用牛奶作为螯合剂(尽管其依
据还不清楚)。
- 确定摄入氟化物的剂量(有时得
不到可靠的摄入剂量 ,因为这取
决于口腔医生与过度紧张的家长之间的沟通情况 ,所以宁可失

caries. Therefore, recent innovations such
as the Òfluoride beadÓ — a slow-release
device, akin to tooth jewellery, may be of
particular benefit in high caries risk
children.

*The Diagnosis and Management
of Acute Fluoride Overdose*

As little as 1mg/kg can cause toxicity.

Symptoms include:

- nausea and vomiting
- stomach pain
- diarrhoea
- hypersalivation.

Overdose of 5mg/kg could be fatal.

Symptoms include:

- convulsions
- respiratory and cardiac failure
- coma.

In 1000ppm toothpaste there is 1mg
of fluoride in 1g.

To manage overdose:

- Find out if any other poisons have been
consumed.
- Give milk as a chelating agent (al-
though the evidence for this is un-
clear).
- Establish dose (sometimes the dose can
be unreliable since it is based on the
communication between the dentist
and the overwrought parent and so it

之过于小心)(表4-4和4-5)。

· 如果有任何疑问，送往医院

窝沟封闭

在龋齿高危儿童，窝沟封闭是预防保健系列方法中关键的一项。龋齿易感的牙齿，一经萌出就应做窝沟封闭。窝沟封闭对操作技术敏感，必须保证良好的隔湿。另外，即使操作非常小心，窝沟封闭仍要持续复查，如果发现脱落迹象，就需要重新封闭。

is wisest to err on the side of caution (Tables 4-4 and 4-5).

· If in any doubt, send to hospital.

Fissure Sealants

Fissure sealants are a key component of the prevention tool kit in high caries risk children. Sealants should be applied to caries-susceptible teeth as soon as they erupt. Fissure sealants are technique-sensitive, and excellent moisture control is essential. Moreover, even after they have been carefully applied, fissure sealants require continued monitoring and will need replacing, should they begin to show signs of failure.

表4-4 根据氟化物摄入的剂量采取不同的解毒方法

Table 4-4 Overdose management is dependent on amount of fluoride ingested

剂 量	措 施
< 5mg/kg	给牛奶
5 ~ 15mg/kg	催吐剂（吐根糖浆） 18个月以下的孩子 10ml 18个月以上的孩子 15ml
> 15mg/kg	紧急送往儿童重症监护病房

表4-5 儿童平均体重与年龄

Table 4-5 Average child weights in relation to age

年 龄	体 重 (kg)
2 岁	10
5 岁	20
10 岁	40

需要作窝沟封闭的牙齿有：

- 第一恒磨牙的殆面以及颊面点隙
- 上颌侧切牙的腭点隙
- 第二恒磨牙和所有的前磨牙

封闭后的定期检查

窝沟封闭失败不会引起龋齿，但是如果封闭不全，就失去了预防的作用。因此，每次复诊时都要检查窝沟封闭的情况，检查包括：

- 视诊
- 用探针检查封闭是否完善
- 如果发现缺陷应当重新封闭
- 当发现窝沟封闭周围有着色或窝沟龋时，用咬合翼片对窝沟进行检查，特别是那些高危儿童

我应当使用哪种窝沟封闭剂？

无添加剂（透明的）窝沟封闭剂
无添加剂窝沟封闭剂既可以是透明的，也可以是不透明的。不透明是因为制剂中加入了颜色而不是添加剂。无添加剂窝沟封闭剂优于有添加剂窝沟封闭剂，因为：

- 材料可以更好地浸润牙面，使其更有效地流入窝沟内
- 材料使用方便

The teeth to fissure seal are:

- first permanent molars — occlusal surfaces and sometimes buccal pits
- palatal pits of upper permanent lateral incisors
- second permanent molars and all premolars.

Monitoring Following Placement

Failed fissure sealants do not cause dental caries, but if they become inadequate they cease to prevent it. Therefore, sealants should be checked at each recall. This includes:

- visual inspection
- check adequacy with a probe
- replace if defects are found
- use bitewing radiographs to monitor fissures where fissure sealants were applied over stains or fissure caries, particularly in high-risk children.

Which Fissure Sealant do I Use?

Unfilled (clear) fissure sealants

Unfilled fissure sealants can come in either clear or opaque. The opaquer is added colour rather than added filler. Unfilled fissure sealants are better than filled fissure sealants because:

- the material wets the surface better so it flows into the fissure more efficiently
- the material is easier to apply.

有添加剂窝沟封闭剂

理论上这种材料的优点是耐磨性增强,但相对来说浸润牙面的能力较弱。这就意味着材料流入和渗透到窝沟内的能力不佳。如果封闭剂能够很充分地流入窝沟内,无添加剂封闭剂耐磨性差的问题就显得不那么重要了。

是否选择光固化材料?

理论上光固化和化学固化窝沟封闭剂在临床上几乎没有什么差别。光固化材料有向光性固化收缩,因此,它们会从牙面上脱离,形成短小的树脂裂隙。尽管如此,口腔医生更倾向于优先选择可控制固化的材料,所以,化学固化窝沟封闭剂的应用在减少。

封闭有龋的部位

良好的窝沟封闭可以使龋齿静止,但是,材料的机械性质决定了这是一种短期的,而不是长期的解决方法,尤其是如果已经形成了龋洞。因此,对于焦虑的儿童这是一种稳定龋齿进程的方法,同时应当配合进一步的预防措施和行为管理。

Filled fissure sealants

The theoretical advantage of improved wear resistance is balanced by their poorer ability to wet the surface. This means they flow and penetrate the fissure less well. The poorer wear resistance of the unfilled material is not a concern if the sealant flows well enough into the fissure.

To Light-cure or Not?

While there is perhaps little clinical difference between light-cured or self-cured fissure sealants in theory, light-cured materials set towards the light source. Therefore, they can be pulled away from the tooth surface forming shorter resin tags. In spite of this, dentists increasingly show a preference towards materials with a command set and so self-cured fissure sealants are becoming less readily available.

Sealing Over Caries

A well-applied fissure sealant can arrest dentinal caries but the mechanical properties of the material determines that this may be a short-term rather than a long-term solution, particularly if there is cavitation. As such, it is a method of stabilising caries progression in an anxious child when coupled with continued preventive care and behavioural management.

釉质的检查

什么时候应该打开窝沟？要根据咬合翼片所显示的龋齿情况才能作出决定。

- 如果有釉质着色(提示釉质龋),但是咬合翼片上还不能确定有龋,将着色部做封闭,并严密观察窝沟封闭的情况。
- 激光荧光仪或龋齿电检测仪可以在一定程度上帮助我们作出决定。
- 如果龋齿扩展到牙本质但范围局限,则可以选择预防性树脂充填。
- 如果X线片检查后仍可疑则进行窝沟封闭并且严密观察。

木糖醇口香糖

木糖醇是一种糖,但是因为它不能被口腔中的细菌发酵并且能够抑制变形链球菌,所以可以降低龋齿。实际上,当它作为口香糖中的一种成分时,可以刺激唾液流量从而进一步减少龋齿。

在瑞典,对6岁儿童龋齿流行情况的研究发现,在孕期和产后咀嚼木糖醇口香糖的母亲,其孩子的龋齿明显少于对照组。通过这种方法可以减少母亲的变形链球菌量,从而减少向新生儿的传播。

Enamel Biopsy

When do you open up the fissure? This decision is dependent on the appearance of the caries on bitewing radiographs.

- If the enamel is stained (suggestive of enamel caries) but there is no dentine caries on the bitewing radiographs, seal over the stain and monitor the adequacy of the fissure sealant.
- Laser fluorescence or electric caries meter devices may have a role in helping with this decision.
- If the caries extends minimally into dentine the restoration of choice is a preventive resin restoration.
- If in doubt following radiography — seal and monitor.

Xylitol Chewing Gum

Xylitol is a type of sugar but it can reduce dental caries because it is not fermentable by oral commensals and inhibits *Streptococcus mutans*. Indeed, when it is an ingredient of chewing gum, salivary flow is stimulated to give additional caries reduction.

In Swedish studies, the caries prevalence in six-year-old children, whose mothers were given Xylitol gum to chew during and after pregnancy, was less compared to controls. In this way, the maternal load of *Streptococcus mutans* was reduced, and so

- 有些孩子已经考虑将木糖醇口香糖作为糖和薄荷的替代品。
- 使用糖的替代品,如木糖醇,会产生胃肠道副作用,导致胀气和腹泻。
- 还应注意在幼儿中使用合成甜味剂的安全性问题。
- 建议龋齿高危孕妇使用木糖醇口香糖。

氯己定涂料

抗菌药氯己定也可以被用作涂料,对于龋齿高危的青少年有一定的好处。然而尚无定论支持它的使用,所以氟保护漆仍是比较好的选择。氯己定和氟保护漆都是通过附着于牙面上发挥作用,所以不宜同时使用。

社区基础保健计划

社区健康教育的重点应当放在:

- 幼儿园
- 早餐俱乐部,在那里鼓励孩子以健康食品开始每一天

less was transmitted to the newborn child.

- Some children might readily consider Xylitol chewing gum to be an acceptable alternative to sweets and mints.
- There are side-effects of the use of sugar substitutes, such as Xylitol, in the gastrointestinal tract, resulting in increased flatulence and diarrhoea.
- There may also be safety concerns regarding the use of artificial sweeteners in young children.
- Suggest the use of Xylitol gum to expectant mothers who are at high caries risk.

Chlorhexidine Varnish

The anti-bacterial agent chlorhexidine is also available as a varnish. This may have some benefit in high caries risk adolescents. However, the evidence to support its use is not conclusive and so fluoride varnish would still appear to be the better choice. Chlorhexidine and fluoride varnish should not be applied at the same visit, as they both function by adhering to the tooth.

Community-Based Programmes

The delivery of health education in the community focuses on:

- nursery schools
- breakfast clubs, where children are encouraged to start the day with a healthy meal

· 产前课堂和健康咨询员

一生的饮食习惯在生命早期，甚至是在出生前就已经形成了。健康咨询员和产前课堂的帮助对孕妇是非常有价值的。龋齿高危儿童常常在入学前就发生了乳牙龋。在孩子长到青春时期，他们的生活方式已经形成并且很难改变。早餐俱乐部有助于保证孩子在早餐和午餐间减少饥饿感，从而减少吃零食的情况。还可鼓励养成健康的饮食习惯，且口袋里只装少量零钱，否则他们会把钱花在“糖果店”里。

新型口腔治疗小组

现在，为儿童口腔健康组成的新的扩大型口腔治疗小组包括：

- 口腔卫生士
- 口腔健康教育员
- 口腔医生

多学科小组

不仅是口腔医生和口腔专业辅助人员（PCDs）能够参与并帮助开展口腔预防教育，促进口腔健康。为使孩子们的口腔更健康，医生、医学相关专业人员和学校老师都可以发挥作用。在英国的一些地方，组织了“口腔健康行动小组”（OHAT），或“口腔健康合作社”——一个旨在为一定的区域或范

- antenatal classes and health visitors.

The dietary habits of a lifetime are established early in life, even before birth. The help of health visitors and antenatal classes in educating expectant mothers is valuable. Children who are at high caries risk often develop caries in their primary dentition before they start school. By the time a child reaches adolescence their lifestyle is set and more difficult to modify. Breakfast clubs help to ensure that a child is less hungry mid-morning and so less likely to snack. They also inspire healthy eating practices, and the small fee charged commits pocket money that might otherwise be spent in the Otuck shop.

The New Dental Team

The new-extended dental team for the oral health care of children now includes:

- dental hygienist
- dental health educator
- dental therapist.

Multi-Disciplinary Teams

It is not just dentists and professionals complementary to dentistry (PCDs) who can be enrolled to help deliver dental preventive education and to promote dental health. Doctors, professions allied to medicine and schoolteachers can all play a part in the campaign for better oral health for our children. In some parts of the UK, these

围提供基本医疗和口腔保健的个体专业医师组织。

个体化的预防保健措施

表4-6和表4-7根据不同的龋齿危险性列出了预防措施。无论如何都应当注意：

- 这些措施不能替代口腔医生的自身判断，术者应当力求为每个孩子提供个体化的保健。

are grouped into Oral health action teams (OHAT) or Oral health cooperatives - a focussed grouping of individual professionals with the aim of primary medical and dental care within a given region or area.

Personalising Preventive Care

In Tables 4-6 and 4-7 a risk-dependent schematic of preventive treatment is presented. It is worth noting, however:

- This approach does not replace the dental operator's own judgement as she/he strives to give each child pa-

表 4-6 非氟化水源地区内（低于 3 10 000）龋齿高危儿童的预防计划

Table 4-6 A prevention plan for a high caries risk child living in a non-fluoridated area (less than 0.3ppm)

预防方法	应 用	频 率
饮食	· 每日三餐 · 个体化建议 · 正面的信息 · 监测和鼓励	· 在初诊时，以后在每次复诊时进行监测
氟化物 *	· 局部用保护漆 · 含氟牙膏 1 1 000 · 氟添加剂（根据年龄使用氟片或漱口水）	· 每年 2 次 · 每日 2 次 · 每日 1 次
窝沟封闭	· 窝沟和点隙（恒磨牙和侧切牙）	· 萌出后
木糖醇口香糖	· 孕妇 · 青少年	· 每次就诊时
氯己定	· 邻面之间	· 每 3 个月

注：* 氟化水源地区的儿童不需要氟添加剂

表 4-7 龋齿低危儿童的预防计划
Table 4-7 A prevention plan for a low caries risk child

预防方法	应 用	频 率
饮食	· 个体化建议 · 正面的信息 · 监测和鼓励 · 保护漆	· 在初诊时 以后在每次复诊时进行监测 · 磨牙萌出中
氟化物	· 4 ~ 6 岁应使用含氟 6 10 000 的牙膏	· 每日 2 次
窝沟封闭	· 只在窝沟有着色时考虑	
木糖醇口香糖	· 只有当危险水平改变时	
氯己定	· 只有当危险水平改变时	

- 应当对每一个孩子进行持续监控 确保及时更新他们的全身健康 / 口腔健康信息。
- 儿童患龋危险性会随时间而改变 (如 : 到了一个新的学校 , 可以自由的去糖果店 , 或参加了一项新的或更紧张的体育运动 , 导致频繁饮用含糖饮料)。

实用提示

- 建议只选择一种全身系统用氟方法 , 但是可以选择多种局部用氟方法。
- 用含氟牙膏刷牙后 , 将牙膏吐掉 , 不要漱口。

- tient individual care.
- It is essential to continually monitor each child and ensure that their medical/dental history is updated.
 - A child's caries risk can change with time (e.g. going to a new school with free access to a lollipop shop or taking up a new or possibly more strenuous sport, resulting in the frequent consumption of glucose-containing drinks).

Practical Tips

- Prescribe only one systemic but as many topical vehicles for fluoride.
- Spit, don't rinse after toothbrushing.

推荐阅读

Further Reading

- 1 British Society of Paediatric Dentistry. Policy document on fluoride supplements and fluoride toothpastes for children. *Int J Paediatric Dent*, 1996; 6: 132-142
- 2 Murray JJ, Nunn JH, Steele JG. *Prevention of Oral Diseases*. 4th Edition. Oxford: Oxford University Press
- 3 Scottish Intercollegiate Guidelines Network National Guideline Number 47. Preventing Dental Caries In High Risk Children. Edinburgh: Royal College of Physicians, 2000

第 5 章 乳后牙的冠内修复

Intracoronar Restorations for Posterior Primary Teeth

目 的

本章的目的是讨论乳牙龋齿的冠内修复。联系临床,重点讲述乳牙与恒牙解剖学上的不同。

要 点

通过阅读本章,临床医生应该能够掌握现代的去腐技术和乳磨牙冠内修复的方法,并且理解这些治疗方法与乳磨牙形态学的关系。

引 言

家长和口腔医生都希望能够消除牙痛对孩子的困扰。乳牙对于将来的咬合发育起着关键作用,同时会影响孩子在同伴眼中的地位。乳牙,尤其是乳磨牙的解剖形态,意味着乳牙龋会比恒牙龋更快地波及到牙髓。幸运的是,乳牙的充填技术比恒牙的简单,这

Aims

The aim of this chapter is to discuss the intracoronar restoration of carious primary teeth. In addition, the clinical relevance of the anatomical differences between the primary and permanent dentitions are highlighted.

Outcome

After reading this chapter, the practitioner should feel able to perform modern operative approaches to caries removal and intracoronar restoration of primary molar teeth and understand how these relate to the morphology of primary molars.

Introduction

Parents and dentists alike are keen to avoid the spectre of toothache in a child. Primary teeth have a key role to play in the future development of both occlusal development and in the acceptance of the child by their peers. The anatomical form of primary teeth, especially primary molars,

得益于乳牙的形态学特点。

解剖学

乳恒牙在解剖学方面的差异见图 5-1。与恒牙相比，乳牙的解剖形态可以概括如下：

means that caries can cause changes in the pulp faster than in permanent teeth. Fortunately the restorative techniques are simpler compared to permanent teeth and profit from primary tooth morphology.

Anatomy

The anatomical differences between primary and permanent teeth are illustrated in Fig 5-1. Compared to a permanent tooth,

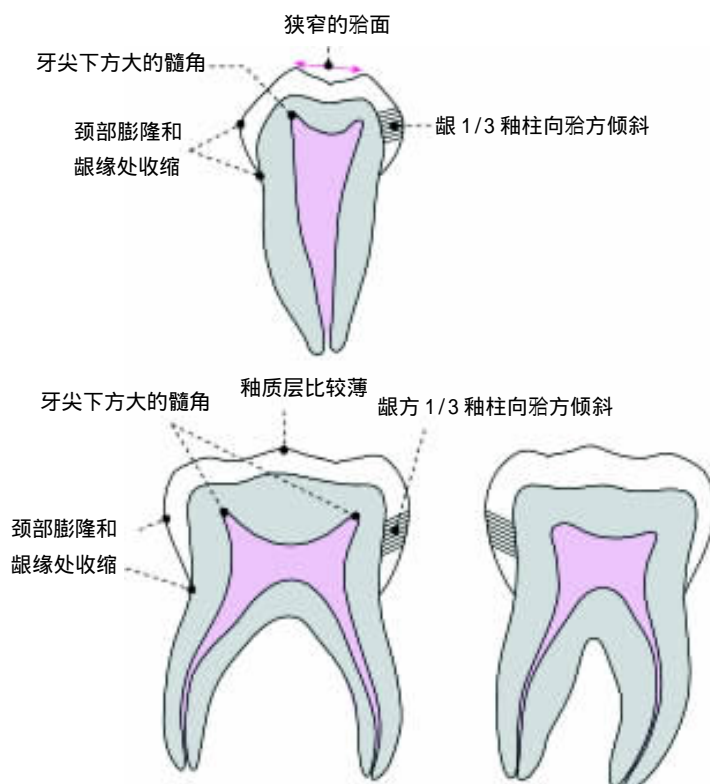


图5-1 乳牙解剖形态

Fig 5-1 The anatomy of primary teeth

- 釉质薄，颜色浅，用牙钻切割比恒牙釉质更容易。
- 牙冠为球茎状，尤其是近牙颈部。
- 牙齿的颈部膨隆，其下方明显缩窄。
- 在磨牙，殆面颊舌径窄。
- 髓角高，突入解剖牙冠。
- 牙颈部区域，釉柱斜向殆面。

尽管乳牙的去腐原则在本质上与恒牙相同，但临床上仍存在一些重要的差异。表 5-1 对此进行了总结。

充填的适应证

当龋损刚刚侵犯到牙本质并形成龋洞时，小面积的充填治疗相对比较容易，可以避免将来大面积充填治疗甚或拔牙。这样，可以简化口腔治疗过程，同时结合预防措施，使患者对口腔治疗和终身口腔健康保持一种积极的态度。

乳牙的充填治疗是为了：

- 预防疼痛和后遗症，例如不可逆

the anatomy of a primary tooth can be summarised as follows:

- The enamel is thin, lighter in colour and easier to cut with a bur compared with enamel of permanent teeth.
- The crown is bulbous, especially towards the cervical area.
- There is a marked cervical constriction apical to the cervical bulge.
- In molars, the occlusal table is narrow in a buccolingual direction.
- The pulp horns extend high into the anatomical crown.
- The enamel rods are inclined occlusally in the cervical region.

Although the principles of caries removal in primary teeth are essentially the same as those for the permanent dentition, there are some differences that are important clinically. These are summarised in Table 5-1.

Indications for Restoration

A minimal restoration, placed with relative ease when the lesion has just penetrated dentine and cavitated, can avoid the need for a larger restoration or even extraction later. In this way, dental operative procedures can be kept simple and used in combination with preventive care to ensure a positive attitude to dentistry and life-long oral health.

Primary teeth are restored in order to:

- Prevent pain and sequelae, such as ir-

表5-1 乳牙解剖形态的临床意义

Table 5-1 Clinical significance of primary tooth anatomy

牙冠的形态	临 床 意 义
釉质层比较薄	<ul style="list-style-type: none"> · 龋损侵犯的距离短 · 使用小号牙钻 · 髓角接近釉质表面
颈部膨隆和龈缘处收缩	<ul style="list-style-type: none"> · 有洞底预备过深的可能性 · 被迫将轴壁向牙髓方向推进，以重新建立洞底
狭窄的殆面	<ul style="list-style-type: none"> · 颊舌径过度扩展会削弱牙尖
接触区宽且靠近龈方	<ul style="list-style-type: none"> · 窝洞的颊侧和舌侧壁需打开接触区，特别是在接近龈阶的部位
牙尖下方髓角大	<ul style="list-style-type: none"> · 峡部要窄以免露髓 · 为减少充填材料的失败，应加深髓轴线角以增加材料的体积
龈 1/3 釉柱斜向殆面	<ul style="list-style-type: none"> · 不需要做洞斜面，因为洞底的釉柱是有支持的

性牙髓炎和感染。

- 避免在某些全身疾病下拔牙(如出血异常)。
- 避免为焦虑的儿童拔牙。
- 维持咀嚼功能。
- 保持完整的牙列 (乳牙列)。
- 保持间隙 (混合牙列)。
- 维护前牙的美观。

序列计划

对于大多数的儿童，在充填治疗之前要有一段环境适应期。记住，要使用与孩子年龄相称的语言。对于非常小的孩子，要使用放在小手机上的小

reversible pulpitis and infection.

- Avoid extraction in certain medical conditions (e.g. bleeding disorders).
- Avoid extractions in anxious children.
- Preserve masticatory function.
- Maintain an intact arch (primary dentition).
- Provide space maintenance (mixed dentition).
- Maintain anterior aesthetics.

Sequential Planning

For most children, a period of acclimatisation is required before embarking upon a restorative approach. Remember to use language that is appropriate to the age of

号牙钻去除腐质。如果孩子患有乳牙龋，应考虑第一恒磨牙一萌出就进行窝沟封闭。

窝洞预备

一般而言，乳牙和恒牙窝洞预备的原则和方法相同，但在治疗乳牙龋齿时，有几个因素需要考虑：隔湿、充填材料的寿命、龋损的范围与髓角的关系以及孩子的合作程度。

隔 湿

理想的隔湿方法是使用口腔橡皮障，但是孩子不合作就只能放弃。好的隔湿方法是使用小的吸唾器、棉卷和干燥棉垫（图 5-2）。

材料的选择和修复体的耐久性

当口腔医生充填乳牙的时候，必须考虑充填体能否坚持到牙齿脱落，或者只是暂时性的充填，最终需要更换。这种选择受很多因素的影响，不只

the child. In the very young, access for caries removal can be improved by the use of miniature burs in a miniature handpiece. If a child has experienced caries in the primary dentition, you should consider fissure sealing the first permanent molars upon eruption.

Cavity Preparation

In general, the same principles and approach apply to the preparation of primary teeth as for the permanent dentition, but there are several factors worthy of consideration when treating dental caries in primary teeth: moisture control, the longevity of restorative materials, the extent of the caries in relation to the pulp horns and the cooperation of the child.

Moisture Control

Ideally, this should be achieved using dental dam isolation, but lack of cooperation may lead to compromise. Good moisture control can be achieved using small saliva ejectors, cotton wool rolls and dry guards (Fig 5-2).

Choice of Material and Durability of Restorations

When placing a restoration in a primary tooth the dentist has to decide whether the filling is to last the lifetime of the tooth or if it is a temporary restoration that she/he

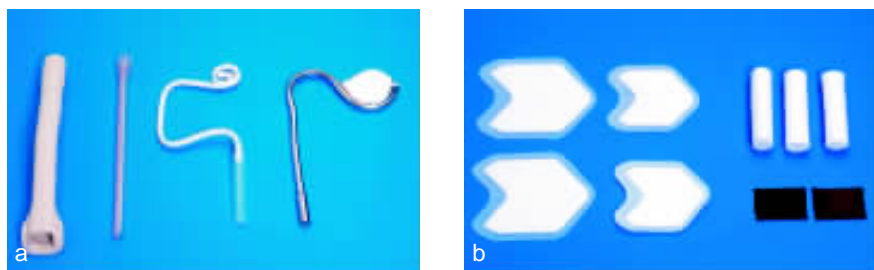


图5-2 用于隔湿的装置：a. 吸引器和吸唾器；b. 棉卷和干燥垫

Fig 5-2 Equipment used to obtain moisture control (a) suction and saliva ejectors, (b) Cotton wool rolls and dry guards

是牙齿的预期寿命。不过，按照材料的耐久性来选择材料可以归纳如下：

- 可塑性充填材料，如银汞合金、复合树脂和玻璃离子粘固剂，最适合用于单面洞和复面洞充填。玻璃离子类材料有与牙体组织直接粘结的优点，还可以释放氟，尽管释放氟的临床意义还未被证实。
- 比较新的树脂改良型玻璃离子粘固剂和复合体具有直接与牙体组织粘结的优点，由于有复合树脂成分，它们的固化是可以控制的。这一点对于治疗那些爱动的孩子很有帮助。
- 更新的树脂改良型玻璃离子和

expects to eventually replace. This choice is dependent on various factors, not least the expected longevity of the tooth. Nevertheless, in terms of durability the selection of materials can be summarised as follows:

- Plastic restorations, such as amalgam, composite resins and glass ionomer cements perform best in one or two surface restorations. The glass ionomer materials have the advantage of directly adhering to tooth structure. They also release fluoride, although the clinical significance of this is unproven.
- The newer resin-modified glass ionomer cements and compomers have the advantage of directly adhering to tooth tissue and a command set due to the resin component. This may be helpful when dealing with a wriggly child.
- The more recent resin-modified glass

粘性玻璃离子不但具有玻璃离子的优点，而且提高了强度。

- 对于 类洞的充填，复合体与银汞合金的寿命相同，通过使用粘结剂，复合体有与牙体组织粘结的优点。
- 乳磨牙有两个甚至更多的牙面需要修复时，建议使用金属预成冠（不锈钢冠）。除了小面积单面龋，金属预成冠优于其他任何修复材料。

影响材料选择的两个主要因素——需要修复的牙齿和病人的条件。

牙齿因素

- 龋损波及的范围（与耐久性有关）。
- 去净腐质后窝洞的形态（如：获得固位的方法，保留健康的牙体组织）。

病人因素

- 隔离和隔湿的效果（对潮湿敏感的技术）。
- 龋齿进展速度（开始时暂封以控制龋齿的进展）。

ionomers and viscous glass ionomers have the advantages of glass ionomer but with improved strength.

- The compomers appear to have survival rates similar to amalgam in class II cavities and have the advantage of adhering to tooth tissue via bonding agents.
- The recommended restoration for primary molars with two or more carious surfaces is the preformed metal crown (stainless steel crown), and these restorations outperform other materials in all but the smallest of single surface restorations.

Two main factors affect the choice of material - those relating to the tooth to be restored and factors pertinent to the patient.

Tooth factors

- The extent of the carious lesion (linked with durability).
- The cavity shape after caries removal (e.g. method of retention, maintaining healthy tooth tissue).

Patient factors

- Efficacy of isolation and moisture control (moisture-sensitive techniques).
- Caries rate (temporise initially to obtain caries control).

- 对美观的要求

乳后牙龋

可以将其分成下面的亚类：

- 窝沟点隙龋。
- 邻面龋伴有窝沟点隙龋。
- 邻面龋不伴窝沟点隙龋。

去腐所用的器械

- 锋利的小挖匙。
- 慢速手机：不锈钢球钻和裂钻。
- 高速手机：小球钻和直的金刚砂钻。

窝沟点隙龋

图 5-3 示殆面窝沟点隙龋去腐。

入 路

- 从殆面磨开龋坏区域达牙本质层（深达牙本质层 1.5 mm × 0.5 mm）。
- 如果孩子能够接受，可以使用直的金刚砂高速钻针。如果孩子不能接受，可以使用低速手机和不锈钢裂钻和低速金刚砂钻针。

- Aesthetic expectations.

Caries in Primary Posterior Teeth

These can be put into the following sub-categories:

- Pit and fissure caries.
- Approximal caries with pit and fissure caries.
- Approximal caries without pit and fissure caries.

Useful Instruments for Caries Removal

- Small sharp excavators.
- Slow speed: round and flat fissure steel burs.
- High speed: small round and straight diamond burs.

Pit and Fissure Caries

Occlusal pit and fissure caries removal is shown in Fig 5-3.

Access

- Penetrate the occlusal surface within the carious area just into dentine (to a depth of 1.5mm x 0.5mm into dentine).
- A straight diamond high-speed bur may be used if the child can tolerate this. If not, use a steel flat fissure bur in the slow handpiece or slow speed diamond.

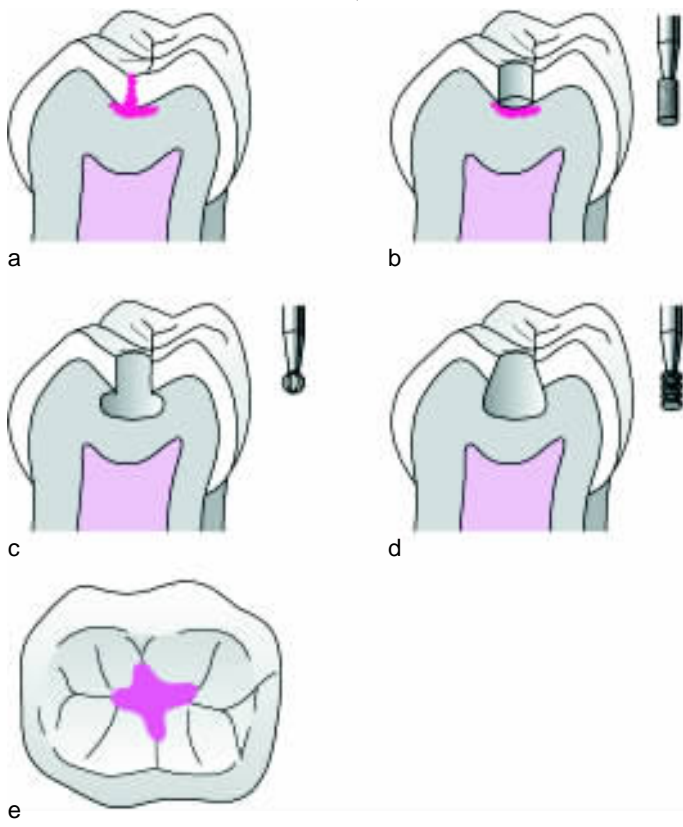


图 5-3 殆面窝沟点隙龋去腐：a. 殆面龋达牙本质层；b. 用直的金刚砂钻或不锈钢裂钻，穿过龋坏的釉质进入龋坏的牙本质；c. 去净腐质后留下的无基釉质，应当一并去除；d. 修整窝洞外形，使洞底平坦并有轻度凹陷，洞壁从殆面向下敞开，以供银汞合金固位；e. 外形线光滑，没有锐角，只扩展到龋坏组织

Fig 5-3 Occlusal pit and fissure caries removal, (a) Occlusal caries into dentine, (b) Access through carious enamel to carious dentine via straight diamond or steel flat fissure bur. (c) Caries removal leaving unsupported enamel, which should be removed, (d) Outline of cavity with a flat, slightly concave floor and walls diverging from the occlusal to provide retention for amalgam, (e) Outline is smooth without sharp angles and extends to include carious tissue only

外形线

- 用不锈钢裂钻或球钻去净窝沟点隙内的腐质，尽可能保留斜嵴。
- 窝洞底平，有轻度的凹陷。
- 如果使用银汞合金，洞壁必须向骀面聚拢，以提供固位型。

去腐

- 去除剩余的腐质。
- 用低速不锈钢球钻或挖匙。
- 用轻柔的力量清洁洞壁和洞底。
- 应去除所有悬釉，直到釉质下方有健康的牙本质。
- 骀面外形线应圆缓，不要有锐角。

充填

- 如果窝洞很深，或是洞底需要间接盖髓，使用固化氢氧化钙制剂。
- 如果使用银汞合金或复合树脂，可以使用玻璃离子垫底材料替代氢氧化钙。
- 对于浅的或中等深的窝洞，不需要垫底。
- 银汞合金、复合体或玻璃离子粘

Outline

- Using a flat fissure or round steel bur, remove caries in pits and fissures, retaining oblique ridges wherever possible.
- Aim for a flat, slightly concave floor.
- If amalgam is to be used, the walls must diverge from the occlusal to provide retention.

Caries removal

- Remove remaining caries.
- Slow round steel bur or excavator.
- Clean walls, then floor, using gentle forces.
- Any undermined enamel should be removed to sound dentine.
- Aim for a smooth occlusal outline form without sharp angles.

Restoration

- If the cavity is deep or if an indirect pulp cap is indicated line the floor of the cavity using a hard setting calcium hydroxide.
- If amalgam or composite resin is used, a glass ionomer lining material may be used as an alternative to calcium hydroxide.
- In shallow and medium cavities no lining is indicated.
- Amalgam, compomer or glass ionomer

固剂都可以用来修复牙冠。如果使用银汞合金充填,窝洞必须有足够的机械固位形。

- 银汞合金有一定的耐湿性。
- 同样的,玻璃离子粘固剂可以替代银汞合金;复合体和树脂材料要使用粘结系统,需要患儿的配合。“多合一”的粘结系统使粘结的过程变得更简单,这足以使一部分孩子能够接受复合体。
- 如果殆面需要大面积充填,应考虑使用金属预成冠。

后牙邻面龋不伴窝沟点隙龋(盒型固位)

这类龋损在殆面通常没有龋洞(图 5-4)。

入路

入路仍然是从殆面开始,但是窝洞修整时不向殆面扩展,关键是:

- 穿透釉质直接进入边缘嵴的下方。
- 一旦穿通釉质,牙钻将“落”入龋坏的牙本质。

cement may be used to restore the crown. If amalgam is used there must be sufficient mechanical retention within the cavity.

- Amalgam will tolerate some moisture contamination.
- Glass ionomer cement may be used as an alternative to amalgam similarly; compomer or composite if the child can cooperate with the use of a bonding system. All-in-one adhesive systems may simplify the bonding procedure enough to allow placement of compomer in some children.
- If a large area of occlusal table is to be restored, consider placing of a pre-formed metal crown.

Approximal Posterior Lesion without Pit and Fissure Caries (Retentive Box)

Often with this type of lesion there is no cavitation occlusally (see Fig 5-4).

Access

Access is still obtained from the occlusal surface, but the preparation has no occlusal extension or key:

- Penetrate the enamel immediately inside the marginal ridge.
- Once through enamel, the bur will drop into the carious dentine.

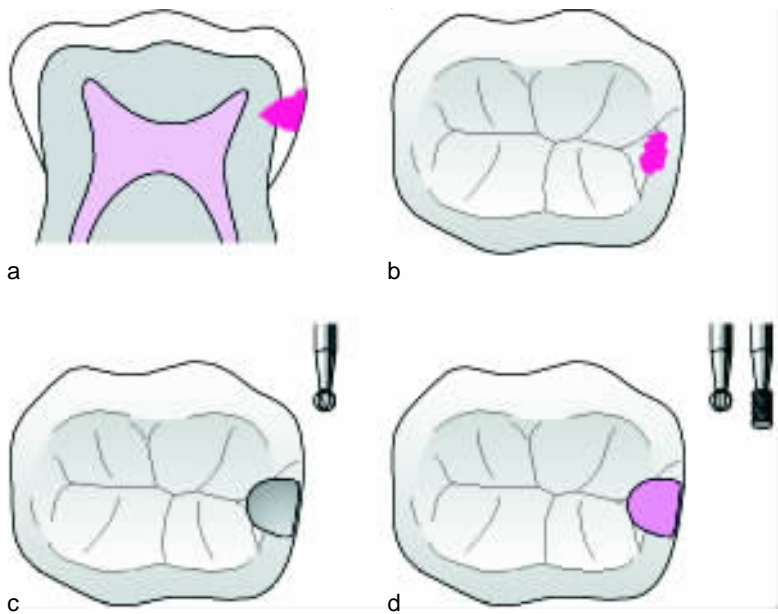


图 5-4 没有窝沟点隙龋的邻面龋去腐：a、b. 邻面龋坏到达牙本质层，但没有窝沟点隙龋；c. 用不锈钢球钻在龋坏的边缘嵴部形成通路，并进一步去除颊 / 舌 / 腭侧壁的腐质。在窝洞和邻牙间保留釉质薄壁；d. 用裂钻去除釉质薄壁，确保龈阶恰在接触区以下。因为需要打开宽的接触区，因此龈阶底部的外形线可能较宽

Fig 5-4 Approximal caries removal without pit and fissure caries, (a-b) Approximal lesion involving dentine, without pit and fissure caries, (c) Access gained at carious marginal ridge using a round steel bur, extending to remove caries at buccal/lingual/palatal walls. A sliver of enamel between cavity and adjacent tooth remains, (d) Remove sliver of enamel with a fissure bur and ensure floor of box is just beyond the contact area. The cavity outline may be wide at the base of the box because of the need to clear the wide contact area

去 腐

获得入路后会在龋洞和邻牙之间留下悬釉。

颊侧和舌侧壁

· 扩展颊侧和舌侧 / 腭侧壁，去除

Caries removal

Gaining access will leave a sliver of enamel between the cavity and adjacent tooth.

Buccal and lingual walls

· Extend the buccal and lingual/palatal

腐质并进入釉牙本质界和牙本质龋。

- 打开面接触区会形成宽的洞缘线。
- 可以用小号不锈钢球钻和裂钻。

洞 底

- 用低速不锈钢钻去除龋坏的牙本质。
- 龈阶应当低于接触区，并随着釉柱的方向向殆面倾斜。
- 洞底不要过深，否则会导致露髓，同时由于乳牙牙颈部明显缩窄，洞底过深就会“失去”洞底。
- 用低速裂钻（或手动器械）去除悬釉，使釉质边缘光滑。

轴 壁

- 轴壁应当位于牙本质层，与牙齿的凸面平行。
- 如果用银汞合金充填，盒形洞的颊侧和舌侧壁应当向殆面聚拢以提供固位（这对于粘接性的材料也有意义）。还可以用 1/2 号不锈钢球钻，在舌侧 / 腭侧壁和龈阶上制备小的辅助固位沟。

walls to remove caries and gain access to caries at the amelodentinal junction and the dentine beyond.

- Clearing the broad contact area may produce a wide cavity outline.
- Small round and fissure steel burs can be used.

Floor

- Remove carious dentine using slowly rotating steel burs.
- The floor of the box should be just beyond the contact area with an occlusal slope to follow enamel rod orientation.
- Do not over-deepen the floor as this will lead to pulpal exposure and loss of the floor due to the marked cervical constriction in primary molars.
- Remove the sliver of enamel with a slowly rotating fissure bur (or hand instrument) and smooth enamel margins.

Axial wall

- This should be just into dentine and parallel to the convexity of the tooth.
- If amalgam is to be placed, the buccal and lingual walls of the box must diverge from the occlusal to provide retention (this is also of value with adhesive materials). This may be supplemented by placing small grooves on the lingual/palatal wall and gingival

- 一定要注意不要在颊侧壁上制备沟槽，因为此处邻近髓角。

充 填

- 对于较深的窝洞，要用固化氢氧化钙或玻璃离子垫轴壁。
- 必须放置成形片，如果使用牙色充填材料，还要在金属成形片的内侧涂凡士林以防止充填材料与金属粘连。
- 充填有固位型的窝洞，首选材料为附粘结系统的复合体。
- 如果使用银汞合金，如前所述应增加固位措施。

邻面龋伴有窝沟点隙龋（类洞）

入 路

最好先制备盒状洞型部分，这样可以帮助我们在直视下决定骀面的扩展范围（图 5-5）。

制备盒形洞

这在前面的部分已经谈过（有固位力的盒形洞）。但是，由于骀面锁结

floor using a 1/2 round steel bur.

- Care must be taken not to groove the buccal wall due to the proximity of the pulp horn.

Restoration

- A hard-setting calcium hydroxide or glass ionomer lining may be placed on the axial wall in deep cavities.
- A matrix band must be placed and if a tooth-coloured restoration is to be placed then the internal aspect of a metallic matrix strip should be smeared with a thin layer of petroleum jelly to prevent adherence to the metal.
- The material of choice to restore a retentive box is a compomer with an adhesive system.
- If amalgam is used, additional retentive measures must be taken as described previously.

Approximal Posterior Caries with Pit and Fissure Caries (Class II)

Access

It is best to produce the box part of the cavity first so that a decision on occlusal extension may be made with the help of some direct vision (Fig 5-5).

Box preparation

This is outlined in the previous section (retentive box), but grooves are not required

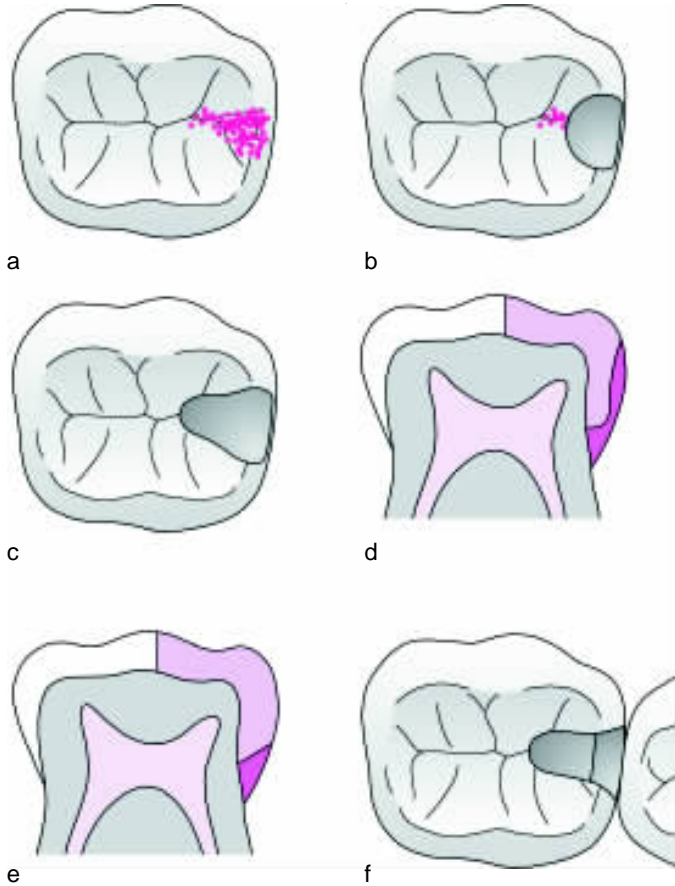


图5-5 伴有窝沟点隙龋的邻面龋去腐：a. 第二乳磨牙的邻面和殆面窝沟点隙龋；b. 盒形洞按要求制备出固位形（图5-4），但不做沟槽；c. 峡部的宽度是颊/舌/腭尖之间宽度的1/3，进一步去除殆面腐质；d. 洞底沿釉柱方向倾斜；e. 如果使用银汞合金充填，轴髓线角应向中央加深以加大充填体的体积；f. 盒形洞的颊/舌/腭侧壁应扩展到与邻牙的接触区以外

Fig 5-5 Approximal caries with pit and fissure caries removal, (a) Approximal, pit and fissure caries in a second primary molar, (b) Box preparation produced as for a retentive box (Fig 5-4) without grooves, (c) Isthmus width is 1/3 of width between buccal/lingual/palatal cusps. Caries removal continued occlusally. (d) The floor of the box is sloping to follow the orientation of the enamel prisms, (e) The pulpoaxial line angle may be deepened centrally for extra bulk of material if amalgam is to be used, (f) The buccal/lingual/palatal walls of the box must clear the broad contact area with the adjacent tooth

提供了固位力，所以不必在盒形洞内制备沟槽。如果使用银汞合金充填这类窝洞，最薄的位置在髓轴线角的位置。应增加银汞合金在这部位（峡部）的强度，线角要加深 1mm。

峡 部

- 峡部的宽度大约是颊尖与舌 / 腭尖宽度的 1/3。
- 峡部过宽，会减弱牙尖的强度，而且增加了露髓的危险（图 5-6）。

窝沟点隙龋

- 与峡部相连，去腐和洞形制备同前面所述的窝沟点隙龋。

充 填

- 对于较深的窝洞，要用固化氢氧化钙或玻璃离子垫底面洞的洞底和（或）轴壁。
- 尽管银汞合金的应用正在减少，它依然是首选材料，但它需要一定的固位型，相对来说有破坏性（图 5-7）。
- 复合体和粘结剂系统联用可以更多地保留牙体组织。

within the box because an occlusal key will provide retention. If amalgam is to be used to restore this type of cavity, it will be at its thinnest in cross-section directly over the pulpo-axial line angle. To increase the strength of amalgam in this area (the isthmus), the line angle may be deepened by 1mm.

Isthmus

- The isthmus width should be approximately 1/3 of the width between the buccal and lingual/palatal cusps.
- A wide isthmus will weaken cusps and increase the risk of pulp exposure (Fig 5-6).

Pit and fissure caries

- Continuing from the isthmus, caries is removed and cavity outline established as described for pit and fissure caries.

Restoration

- A hard-setting calcium hydroxide or glass ionomer lining may be placed at the occlusal floor and/or axial wall of the box in deep cavities.
- Amalgam is still the material of choice, although its use is declining, but requires relatively destructive retentive features (Fig 5-7).
- Compomers may be used with an adhesive to conserve tooth tissue.

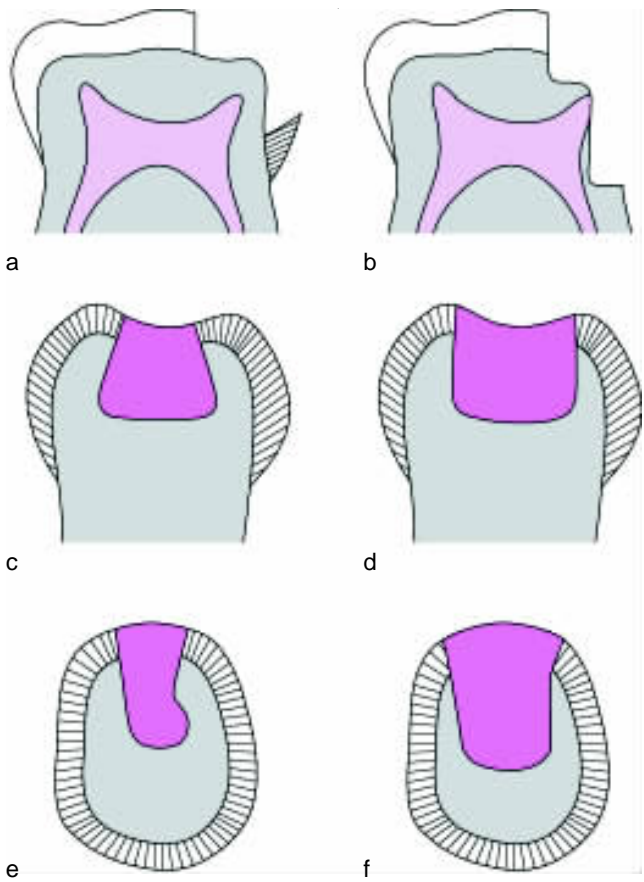


图 5-6 正确与不正确的乳牙洞型设计：a.b. 洞底过深，造成髓角部牙本质被去除，导致露髓；c~f. 峡部的宽度超过颊/舌/腭尖之间宽度的1/3，削弱了牙尖的强度，增加了露髓的危险

Fig 5-6 The correct and incorrect approaches to cavity design in the primary dentition, (a-b) Excess deepening at the floor of the box causes removal of dentine adjacent to the pulp horn resulting in pulp exposure, (c-f) An isthmus width of $>1/3$ of the width between buccal/lingual/palatal cusps will weaken cusps and increase the risk of pulp exposure

图5-7 用银汞合金充填上颌第一乳磨牙邻面龋和窝沟点隙龋

Fig 5-7 An amalgam restoration of approximal caries with pit and fissure caries in a maxillary first primary molar



实施要点

- 如果充填体大,则套金属预成冠(图5-8)。
- 小号机头和小号牙钻对于孩子的小嘴很有用。
- 在治疗过程中不需要严格隔湿时,应允许孩子闭上嘴休息一会儿。这样,当需要他们大张口时,他们会更愿意配合。
- 在使用玻璃离子粘固剂充填时,如果隔湿比较困难,为了保持干燥,可以在充填体表面覆盖一块薄的绿蜡(图5-9);也可以用凡士林或氟保护漆代替。
- 图5-10所示为一例牙色材料充填。

非创性充填治疗(ART)

这项技术在20世纪90年代早期被提出应用于发展中国家。其开发的社

Practical Tips

- If the restoration is large, place a pre-formed metal crown (Fig 5-8).
- Miniature heads and miniature burs are useful in small mouths.
- Allow a child to have a rest and close the mouth during treatment that does not require stringent moisture control. They are then more likely to keep their mouth open when it is needed most.
- If, when using a glass ionomer cement, moisture control is difficult, place a square of thin green wax over the restoration to help keep it dry (Fig 5-9); alternatives to this are petroleum jelly or fluoride varnish.
- Fig 5-10 gives an example of a tooth-coloured restoration.

The Atraumatic Restorative Treatment (ART)

This technique was introduced in the early 1990s for use in developing countries.



图5-8 银汞合金充填：a. 1年；b. 2年以后的情况；c. 牙齿最后用金属预成冠修复
Fig 5-8 Amalgam restorations at (a) one year and (b) two years post-placement, (c) The teeth were subsequently restored with preformed metal crowns



图5-9 把一小块绿色薄蜡覆盖在正在固化的玻璃离子粘固剂表面隔湿
Fig 5-9 A small square of thin green wax placed over a setting glass-ionomer cement to prevent moisture contamination



图5-10 下颌乳磨牙邻面和窝沟点隙龋的牙色材料充填体
Fig 5-10 A tooth-coloured restoration of approximal and pit and fissure caries in a mandibular primary molar

会背景是：在世界上得不到口腔治疗的地区，为孩子的乳牙和恒牙提供修复与预防相结合的治疗方法。它只需要少量的器械和材料。Cole 和 Welbury (2000) 对这一技术进行了很好的总结，其中包括日常条件下应用的可能性。仅用手动器械去腐。经验表明，在操作中几乎不需要局部麻醉。之后，窝洞用一种专门开发的“可压缩的”玻璃离子粘固剂充填，将材料多放入窝洞内一些，用手指将材料压入骀面的剩余窝沟点隙中。这种压入式的技术叫作“指压法”，目的是充填窝洞的同时封闭窝沟点隙。

研究表明单面洞 ART 修复体最耐用。使用手动器械在 20min 内即可完成去腐。

在治疗中，ART 还可能有的用途：

- 用于有牙科恐惧症的病人
- 用于年幼的孩子，作为适应过程的一部分

The ethos behind its development was to provide a combination of restorative and preventive treatment for primary and permanent teeth in areas of the world where dentistry was inaccessible. A minimum amount of instruments and materials are required. Cole and Welbury (2000) have provided an excellent review of this technique, together with its possible uses in everyday situations. Caries removal is undertaken using hand instruments only. It has been found by those experienced in this technique that local anaesthesia is rarely required. The cavity is then slightly over-filled with specially developed ÕcondensableÓ glass-ionomer cement and a finger used to condense the material and force it into the pits and fissures remaining on the occlusal surface. This technique of condensation is known as the Õfinger-pressÓ technique and aims to restore the cavity and seal the pits and fissures.

Studies have shown that one-surface ART restorations are the most durable. It can take up to 20 minutes to remove caries using hand instrumentation.

ART has a possible role in the treatment of:

- dental-phobic patients
- part of an acclimatisation process in a young child

- 智力和身体有缺陷的病人
- 老年病人

ART 技术

器 械

- 镊子
- 挖匙
- 探针
- 凿形挖匙 / 斧形挖匙
- 扁平的塑形刀 / 雕刻刀

入 路

- 用棉卷将牙齿隔开。
- 用水和棉签清洁牙齿。
- 用斧形挖匙将龋损的部位打开。

去 腐

- 用手用挖匙去除所有腐质。
- 用水清洗牙齿，用棉球干燥牙面。

充 填

- 用可固化氢氧化钙粘固剂保护牙髓。
- 处理洞壁（依照产品说明）。
- 在牙上放置玻璃离子粘固剂，使材料略超出窝洞。
- 用戴手套的手指在殆面上加压。

- mentally and physically impaired patients
- elderly patients.

ART Technique

Instruments

- tweezers
- excavators
- probe
- chisels/hatchets
- flat plastic/carver.

Access

- Isolate the tooth with cotton wool rolls.
- Clean tooth with water and cotton wool pledgets.
- Widen entrance to the carious lesion with hatchets.

Caries removal

- Remove all carious tissues using hand excavators.
- Clean with water and dry with cotton wool.

Restoration

- Consider pulp protection with hard-setting calcium hydroxide cement.
- Condition cavity walls (according to manufacturer's instructions).
- Place glass-ionomer cement into tooth, slightly overfilling the cavity.
- Apply pressure with a gloved finger

- 用扁平的塑形刀或雕刻刀去掉多余的材料,窝沟点隙用玻璃离子粘固剂封闭。
- 检查殆关系。
- 在整个玻璃离子表面上涂玻璃离子保护漆或凡士林。

实施要点

- ART 可以作为幼儿或焦虑儿童适应环境过程的一部分。
- 单面洞充填成功率高于复面洞充填。
- 据报道 ART 去腐需 20min, 所以在此之前应作好计划。

最少量牙体破坏

去腐,其目的是在“侵入”牙体组织最少的情况下制备窝洞,尽量减少病人的不适。

常规去腐的方法是:用高速手机获得入路并形成洞缘线,然后用低速手机去除牙本质龋。许多病人,尤其是儿童,不愿意使用“钻”。

over the occlusal surface.

- Remove excess material, with a carver or flat plastic, leaving pits and fissures sealed with glass-ionomer cement.
- Check the occlusion.
- Apply glass-ionomer varnish or petroleum jelly over the whole surface of glass-ionomer.

Practical Tips

- ART can be used as part of an acclimatisation process in the very young or anxious child.
- Single-surface restorations are more successful than multi-surface restorations.
- It is reported that caries removal may take up to 20 minutes with ART, so it is a good idea to plan for this beforehand.

Minimum Tooth Destruction

To remove dental caries, the aim is to prepare a cavity with minimum invasion of tooth tissue and with little or no discomfort for the patient.

Conventional approaches to caries removal still involve the use of dental handpieces — high-speed to gain access and to establish cavity outline, then slow-speed to remove carious dentine. Many patients,

随着口腔粘结剂性能的改进和微创技术的发展,如预防性树脂充填,我们可以对微小的病损进行治疗。除此以外,我们还看到ART技术、空气喷砂和激光去腐的介绍。

化学 - 机械去腐

化学 - 机械去腐的概念已经存在了很长的时间。然而,最早开发的“化学”去腐材料需要使用大量凝胶才能达到去净龋坏牙本质的目的。许多医生认为这种方法缺乏可操作性,因而未能广泛应用。这项技术已经有了长足的进步,目前已有多种产品效果很好,尤其是对拒绝用“钻”的儿童。

有成套的商业产品可供使用(如: Carisolv™),它含有两种凝胶,混合后产生活性物质,可将腐质从健康的牙本质上分离。现代化学 - 机械窝洞预备的一大优点是不去除健康的牙本质。

particularly children, perceive the use of the drill as unpleasant.

With the advent of effective dentine-bonding agents and minimally invasive techniques such as the preventive resin restoration, we are able to be minimally invasive for small lesions. Added to this, we have seen the introduction of the technique of ART, air abrasion and the use of lasers for caries removal.

The Chemo-Mechanical Removal of Caries

The chemo-mechanical removal of carious dentine has been a concept that has existed for quite some time. However, the initial substance developed for chemical caries removal required the application of large volumes of gel to carious dentine to achieve its aim. It was considered unworkable to most operators and was not used widely. Technology in this area has moved forward, and products are now available which are useful, particularly for children who refuse to accept the drill.

There are commercial kits available (e.g. Carisolv™). They contain two gels, which are mixed together to provide the active agent that separates carious from sound dentine. An advantage of modern chemo-mechanical cavity preparation is that sound dentine is not removed by the technique.

凝胶混合后的活性成分：

- 次氯酸钠 (NaOCL)
- 氨基酸：谷氨酸、亮氨酸和赖氨酸

凝胶还可能含有

- 甲基纤维素 (增加凝胶的黏性，提高可控性)
- 四碘荧光素 (是一种染料，可以使凝胶显色)

这种凝胶的反应模式是：

- 次氯酸钠在室温下可以水解蛋白质和降解有机物质。
- 氯可降解变性的胶原，使胶原纤维结构溶解。
- 然后，氨基酸连接到龋坏的牙本质蛋白质链上。
- 氨基酸还可以防止健康牙体组织被次氯酸降解。

凝胶的作用是使龋坏的牙本质从健康的牙本质上分离出来。

使用专门的手用器械可以提高凝胶的作用，这种器械有挖的作用，而没有锐利的切割面（像挖匙和钻头）。一般认为可以降低去除健康牙本质的危险。

The active ingredients of the gel when mixed are:

- sodium hypochlorite (NaOCl)
- the amino acids glutamic acid, leucine and lysine.

The gel may also contain:

- methylcellulose (to increase viscosity of the gel, to improve handling)
- erythrosine (a dye so the gel can be seen easily).

The mode of action of this gel is:

- NaOCl is proteolytic and degrades organic substance at room temperature.
- Chlorine degrades denatured collagen, resulting in dissolution of the collagen fibre structure.
- The amino acids then attach to the protein chains of the carious dentine.
- The amino acids also prevent the degradation of healthy dentine by the hypochlorite.

The action of the gel results in separation of carious dentine from sound dentine.

The action of the gel can be improved by using specially developed hand instruments that have a scraping action rather than a sharp cutting profile (like excavators or burs). This is said to reduce the risk of removing sound dentine.

化学 - 机械去腐技术

这类产品的生产厂家称使用时几乎不用局部麻醉。

器 械

- 两种分离的凝胶，使用前混合。一种含有次氯酸，另一种含有氨基酸。
- 专门设计的没有切割面的用手用器械。
- 小棉球。

入 路

如果龋损没有成洞，就需要借助于手机和钻针建立去腐的入路。

去 腐

- 用凝胶覆盖在牙本质龋的表面。
- 凝胶与牙体组织接触 20s。
- 用手用器械轻轻地将软化的腐质挖出。在使用器械时，要施以轻度的压力，并根据所用的特殊器械采取不同的动作（如：用星形器械做搅拌或旋转的动作）。

Chemo-Mechanical Caries Removal Technique

The manufacturers of these products claim that local anaesthesia is rarely required.

Instruments

- Two separate gels to be mixed together just before use. One contains hypochlorite and the other amino acids.
- The specifically designed non-cutting hand instruments.
- Cotton wool pledgets.

Access

If the carious lesion has not cavitated, access to the carious dentine is required. This may well involve the use of a hand-piece and bur.

Caries removal

- Cover the dentine caries with the gel.
- Wait 20 seconds for the gel to contact the dentine.
- Gently scrape the carious dentine with the hand instruments to remove softened dentine. When instrumenting, a light pressure should be used and different actions are employed depending on the specific instrument being used (e.g. whisking or rotating motion with the star-shaped instrument).

- 凝胶变成云雾状。
- 轻轻冲洗或者用小棉球去除凝胶，再放入新的凝胶。
- 重复以上步骤，直到凝胶保持透明状态并感到牙体表面是硬的。
- 最后用水轻轻冲洗或者用蘸有温水的小棉球去除凝胶。
- 用棉球干燥窝洞。

充 填

- 使用有粘结性的材料充填窝洞。

化学 - 机械去腐的操作要点

- 已活化的凝胶可操作时间短，大约30min后就不能使用，应当抛弃。
- 此技术只能使用专门设计的手用器械。
- 和ART一样，备洞时间比大多数传统方法要长。用凝胶和器械去除所有龋坏牙本质要花15min。厂家已经推出一种慢速手机以减少操作时间，但是对于拒绝使用手机的儿童就没有用武之地了。

- The gel will become cloudy.
- Remove the gel by gentle washing or a cotton wool pledget and apply fresh gel to the dentine.
- Repeat the procedure until the gel remains transparent and the surface feels hard.
- Finally remove the remains of gel by washing gently with water or with a cotton wool pledget soaked in warm water.
- Dry the cavity with cotton wool.

Restoration

- Restore the tooth using an adhesive restoration.

Practical Tips For Chemo-Mechanical Caries Removal

- The activated gel has a short working life and should be discarded after approximately 30 minutes.
- This technique should only be used with the specially designed hand instruments.
- Cavity preparation, as with ART, is prolonged compared to more conventional methods. It may take up to 15 mins of gel applications and instrumentation to remove all carious dentine. The manufacturers have introduced a slow handpiece to decrease instrumentation times, but for a child

- 有些儿童抱怨凝胶的味道和气味，所以良好的隔离有助于操作。
- 如果牙本质龋坏离髓角很近，去除龋坏牙本质后就有可能发生龋源性露髓。如果在治疗之前怀疑会出现这种情况，就必须采取适当的方法控制疼痛，进行间接盖髓或失活牙髓切断术。

激 光

对于治疗幼儿龋齿，激光的作用并不显著，一部分原因是使用激光时很恐怖，其次是，激光只能用于光线可以直接到达的部位。

喷砂去腐

对于治疗幼儿龋齿有一定的作用，但其效果目前还未被证实。一种担心是使用的颗粒很小，这就要求必须在橡皮障下操作。

臭 氧

像喷砂去腐一样，这项技术在乳牙中的应用效果还未被证实。

who refuses to accept the handpiece this is of no benefit.

- Some children complain about the taste and smell of the gel, so good isolation is a positive benefit.
- If dentine caries is very near the pulp horn, then a carious exposure may occur following removal of carious dentine. If this outcome is suspected before treating the tooth, adequate pain control must be used, indirect pulp cap or a devitalising pulpotomy undertaken.

Lasers

Lasers do not have a significant role in the management of caries in the young child, in part because their use is intimidating. Secondly, they are of use only where direct line of sight access is possible.

Air Abrasion

This may have a role in the management of caries in the young child but remains unproven at present. One concern is the small particle size used, which makes the use of rubber dam mandatory.

Ozone

As with air abrasion the role of this technique in primary teeth remains unproven.

推荐阅读

Further Reading

- 1 Cole BOI, Welbury RR. The Atraumatic Restorative Treatment (ART) Technique: Does it have a place in everyday practice? *Dental Update*, 2000; 27: 118-123
- 2 Ericson D, Zimmerman M, Raber H, *et al.* Clinical evaluation of efficacy and safety of a new method for chemo-mechanical removal of caries. *Caries Research*, 1999; 33: 171-177
- 3 Fayle SA, Welbury RR, Roberts JF. BSPD. A policy document on the management of caries in the primary dentition. *Int J Paediatric Dent*, 2001; 11: 153-157

第 6 章 操作简单的预成冠

Preformed Crowns Are Easy

目 的

按照牙体预备、戴入预成冠的每一步骤介绍该项技术。

要 点

通过阅读本章，术者应有信心使用预成冠，事实上，应自信到在没有完全试戴合适的情况下敢于戴入。

引 言

许多研究显示在乳磨牙龋的修复治疗中，预成冠的使用寿命明显长于其他的充填材料。然而，尽管该技术操作简单而耗时短，还是很少被使用。这项技术不被采用的原因是人们觉得它操作困难或费时。用于乳牙的预成冠（图 6-1）与为恒牙定做的冠完全不同。事实上，一些医生采用简化的预备技术、简单的试戴和一套基本工具就能完成乳牙预成冠修复。

Aim

To present the preparation and fitting of preformed crowns using a step-by-step approach to explain the technique.

Outcome

On completion of this chapter the practitioner should feel confident to use preformed crowns — so confident, in fact, as to dare to place them without a full trial fit.

Introduction

Many studies have shown that preformed crowns last significantly longer than other restorative materials used to restore caries in primary molars. However, relatively few are used despite the simplicity of the technique and the speed at which they can be placed. The reason for this under-use must be a perception that the technique is difficult or time-consuming. The crowning of primary molars using preformed crowns (Fig 6-1) is by no means similar to the provision of bespoke crowns for permanent

图6-1 乳磨牙金属预成冠

Fig 6-1 Preformed metal crowns for primary molars



这一技术的关键是避免形成肩台。

预成金属冠是如何固位的？

乳磨牙冠呈球茎状，牙颈部收缩比恒磨牙明显得多。由于形态上的差异，乳牙颈部收缩为预成冠提供了固位力，这是由于预成冠滑过冠的膨隆部，被颈部收缩抓住。所以，预成冠技术不依赖牙冠的锥度或牙冠的高度。这是预成冠能够用于修复乳磨牙大面积龋的原因。

- 肩台会妨碍预成冠完全就位。
- 使预成冠的边缘紧贴牙颈部收缩区，这一步骤叫“收边”，以

teeth. In fact, some operators use a minimal preparation technique, simple trial fit and a basic kit.

The key to the technique is to avoid cutting a shoulder.

How are Preformed Metal Crowns Retained?

A primary molar tooth has a bulbous crown, much more so than a permanent molar tooth. It is this difference in tooth morphology that provides the retention of the crown as it slides over the bulbosity of the crown, to be held by the cervical constriction. Therefore, the preformed crown technique does not rely on either crown taper or crown height. This is the reason why a preformed crown can be used to restore even a grossly carious primary molar.

- A shoulder will prevent the crown from seating fully.
- Contouring the edge of the crown to fit snugly into the cervical constriction,

保证固位。

乳磨牙预成冠的适应证

- 大面积 类洞。
- 破坏严重的牙齿。
- 牙髓切断术后。
- 硬组织异常 (如 : 釉质发育不良或牙本质发育不良) 。

器 械

- 尽可能选一支细的有锥度的金刚砂裂钻 , 避免在牙体预备时形成肩台 (SHOFU PN ISO 0848 013, 图 6-2) 。
- 一把正畸用的带环推子 (图 6-3) 。
- 114 号收边钳 (图 6-4) 。
- 一把正畸用去带环钳 (图 6-5) 。

选 冠

预成冠是按照牙位和尺寸制作的 (图 6-6) 。选择最佳冠有两种方法 :

- 在口腔中测量牙齿的近远中径 , 或者用分规测量间隙的大小 , 然后按测量值选择预成冠。

a process known as ÒcrimpingÓ, ensures a tighter fit.

Indications for Preformed Crowns for Primary Molars

- Large class II cavities.
- Badly broken down teeth.
- Following pulpotomy.
- Hard tissue anomaly (e.g. amelogenesis imperfecta or dentinogenesis imperfecta).

Instruments

- A fine-tapered diamond fissure bur as pointed as possible so that you can avoid cutting a shoulder (SHOFU PN ISO 0848 013, Fig 6-2) works well.
- An orthodontic band pusher (Fig 6-3).
- 114 Contouring ÒcrimpingÓ pliers (Fig 6-4).
- An orthodontic band remover (Fig 6-5).

Selection of the Crown

The crowns are marked with an indication of their size and position (Fig 6-6). There are two methods of choosing the best crown:

- Measure the mesiodistal width of the crown of the tooth in the mouth, or the available space with a divider, and then select the crown using this measurement.



图6-2 一支细而尖的金刚砂钻

Fig 6-2 A fine-tapered diamond bur



图6-3 正畸用带环推子

Fig 6-3 Orthodontic band pusher



图6-4 114号收边钳

Fig 6-4 114 Contouring (crimping) pliers



图6-5 正畸用去带环钳

Fig 6-5 Orthodontic band remover



图6-6 金属预成冠套装

Fig 6-6 Preformed metal crown box

- 直接用预成冠试戴（从 4 号开始）。

牙体预备和带冠步骤

这些步骤概括如下：

- 去净腐质。
- 牙体预备：“殆面 - 邻面 - 外表面”。
- 选择预成冠：
 - 将预成冠放到近远中邻面区进行试戴
 - 不要完全就位，只是检查它将来能否“挤”就位
 - 取下冠
- 如果预成冠原有的边缘被破坏，需要再修整，用收边钳收边。
- 粘固剂粘冠。
- 去除多余的粘固剂。
- 检查殆关系。

第一步：降低殆面

- 殆面高度降低 1.5 ~ 2mm。

第二步：邻面预备

- 用有锥度的车针磨开邻面。
- 将车针分别放在近中和远中边缘嵴上，将邻面磨开。
- 从殆面的边缘嵴开始，向颈部前

- Trial and error (start with a size 4).

Step-by-Step Preparation and Fitting

This can be summarised as follows:

- Remove the caries.
- Prepare the tooth: **Occlusal: Approximal: Peripheral**.
- Select the crown:
 - try it in by placing it into the mesial and distal approximal areas
 - don't seat it fully - just check that it will "squeeze" down over the crown
 - remove it.
- Re-contour the crown margin, if this has been damaged, by using the crimping pliers.
- Cement the crown.
- Remove the excess cement.
- Check the occlusion.

Step One: Occlusal Reduction

- Reduce the occlusal height by 1.5 to 2mm.

Step Two: Approximal Reduction

- Use the tapered fissured bur for the proximal reduction.
- Place the bur on the mesial and distal marginal ridges and reduce the proximal surfaces.
- Start on the occlusal portion of the

后扫磨,直到可以清楚地看到邻面之间的牙龈。

- 形成刃状边缘线 (图 6-7)。
- 用探针检查,如果有肩台的话要去掉,因为肩台会妨碍冠的就位 (图 6-8)。
- 只有当牙齿的近远中面都预备完成后,预成冠才能完全就位。

marginal ridge and sweep back and forth with bur moving cervically, until the interproximal gingivae can be clearly visualised.

- Produce a knife-edge finishing line (Fig 6-7).
- Check for ledges with an explorer and reduce even the slightest ledge since the crown will be prevented from seating (Fig 6-8).
- Performed crowns are made to fit properly only when both mesial and distal reductions are made.



图6-7 去除近远中面的牙体组织,形成刃状终止线

Fig 6-7 Mesial and distal reduction to produce a knife-edge finish



图6-8 检查是否有肩台,因其会妨碍预成冠完全就位

Fig 6-8 Check for a ledge since this will prevent the crown from fully seating

第三步：边缘线的预备

- 在殆面与颊面、舌面和邻面交界的线角处制备斜面（宽约1mm）。
- 圆钝锐利的线角，尤其是在邻面（图6-9）。

第四步：牙冠试戴

- 用手指或正畸用的推子将牙冠戴到已经预备好的牙上。
- 检查下面几项：
 - 近远中接触区（看牙冠宽度是否足够）
 - 殆 - 龈向高度
 - 颊舌面的扩展（看牙冠是否过宽）
 - 殆关系
- 如果牙冠能够完全就位，用正畸用去带环钳将牙冠取下（图6-10）。

Step Three: Peripheral Reduction

- Create a bevel between the occlusal table and the buccal, lingual and approximal surfaces (about 1mm).
- Round off the sharp line angles, especially in the proximal areas (Fig 6-9).

Step Four: Try in the Crown

- Place the crown on the prepared tooth, using your finger or an orthodontic band seater.
- Then check the following:
 - mesial and distal contact areas (see if crown is wide enough)
 - occlusal - gingival height
 - buccal and lingual extension (see if crown is too wide)
 - occlusion.
- If the crown is fully seated, remove it using orthodontic band removers (Fig 6-10).

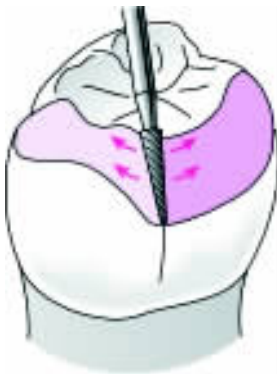


图6-9 边缘的修整

Fig 6-9 Peripheral reduction

完全合适的牙冠在就位时会发出咔哒声：当牙冠突然就位时，操作者会听到清晰的咔哒声，但是随着信心的增加，操作者可以不用这一步骤就可以判断预成冠是否合适。

第五步：收边

- 如果在取冠或调整牙冠时破坏了预成冠原有的颈部收缩，要重新收边（图 6-11）。

第六步：粘固剂粘结

- 干燥预成冠。
- 用棉卷隔离牙齿。
- 干燥牙齿。
- 将调好的粘结用玻璃离子粘固剂放到预成冠中。

The correctly fitting crown seats with a snap: the operator can hear a click clearly as the crown snaps into place, but with growing confidence the operator will learn to judge the likely fit without fully seating it at this trial stage.

Step Five: The Gingival Contour

- Restore the crown contour at the gingival margin if this has been damaged during removal or if the crown failed to fit with a snap (Fig 6-11).

Step Six: Cementation

- Dry the crown.
- Isolate the tooth with cotton rolls.
- Dry the tooth.
- Place a creamy mix of glass-ionomer luting cement in the crown.



图6-10 使用正畸用去带环钳

Fig 6-10 Using orthodontic band removers



图6-11 用收边钳修整冠的边缘

Fig 6-11 Use crimpers to correct the crown margin

- 将预成冠放到已干燥的牙齿上，用手指或正畸用带环推子将其按压就位。
- 将棉卷去除，让孩子咬合。
- 在玻璃离子完全固化之前，去除多余的粘固剂。可以使用打了结的牙线清洁邻面的粘固剂，用探针去除颊舌面的粘固剂（图 6-12）。

问题 - 解决方法

翘 动

- 如果预成冠戴入后出现翘动，是因为它过长或是过宽（图 6-13）。

向一侧倾斜

- 如果预成冠就位后向一侧倾斜，问题可能是牙齿殆面预备不均匀。
- 解决的方法是圆钝殆面的线角。

- Place the crown on the dry tooth and push to place with finger pressure or an orthodontic band seater.
- Remove cotton rolls and invite the child to bite.
- Remove excess cement interproximally using knotted dental floss before the glass- ionomer is fully set and buccal and lingually using a dental probe (Fig 6-12).

Problem-Solving

Rocking

- If the preformed crown rocks this crown is either overextended or too wide (Fig 6-13).

Canting to One Side

- If the crown cants to one side as it is seated, uneven reduction of the occlusal surface may be the problem.
- Correct this by rounding the occlusal line angles.

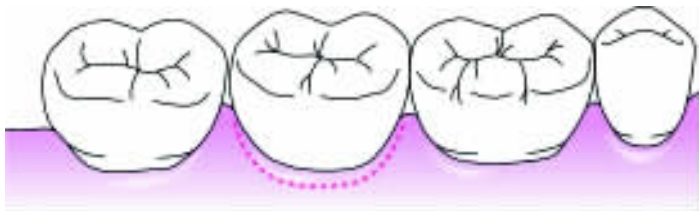


图 6-12 放置金属冠，注意颈部的长度应在龈下 1mm

Fig 6-12 Crown in place. Note cervical extension of 1mm below the gingival margin

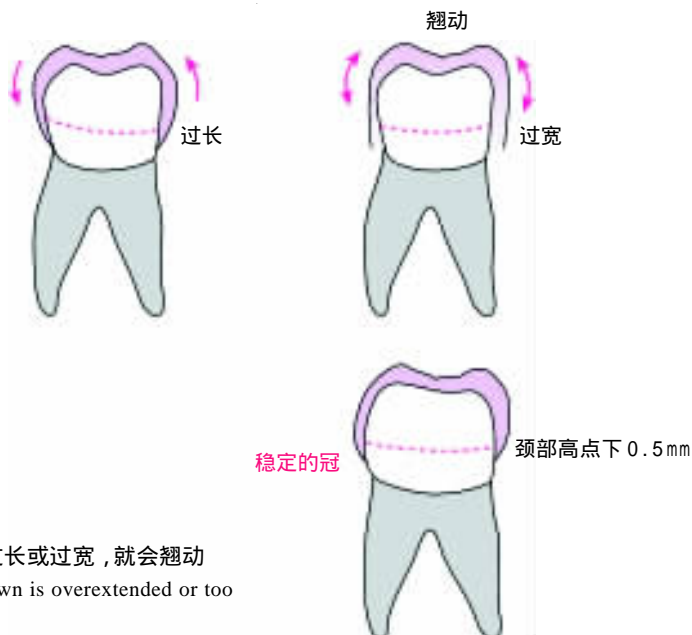


图6-13 如果冠过长或过宽,就会翘动

Fig 6-13 If the crown is overextended or too wide it will rock

大面积龋坏造成的间隙丧失

当龋损造成了牙齿近远中径的减小,并进而导致了间隙丧失时,戴金属冠是非常困难的。

- 上颌乳磨牙的形状是“正方形”
- 下颌乳磨牙的形状是“长方形”

下牙弓间隙丧失

牙体预备后,理想的外形线是长方形的。当间隙丧失后,外形线变成了正方形(图6-14)。可以通过选用上颌

Loss of Space due to Extensive Caries

Where caries has reduced the mesiodistal dimension of a tooth, resulting in space loss, fitting a steel crown can be difficult.

- Upper primary molars are square-shaped
- Lower primary molars are rectangular-shaped

Loss of Space in the Lower Arch

Ideally the prepared tooth should be generally rectangular in outline. When space loss occurs this outline becomes squarer in

对侧的预成冠来解决。

上牙弓间隙丧失

上颌牙齿在牙体预备后已经是正方形,但是由于龋损变得更小。解决的方法是减小颊舌径,按照上颌预成冠的形态制备出正方形的外形线。

需作少量牙体预备的预成冠的放置

有些情况下,只做少量的牙体预备或者不需要牙体预备,通过让病人咬合,就可以将预成冠就位。

shape (Fig 6-14). The solution is to use the upper contralateral crown.

Loss of Space in the Upper Arch

The upper arch preparations are already square in shape but become more foreshortened due to caries. The solution is to reduce the tooth in a buccolingual direction to restore the square outline form needed for an upper preformed crown.

The Placement of Preformed Crowns with Minimal Preparation

In some instances it is possible to place preformed crowns with little or no preparation of the tooth, by having the patients bite to push the crown into place.

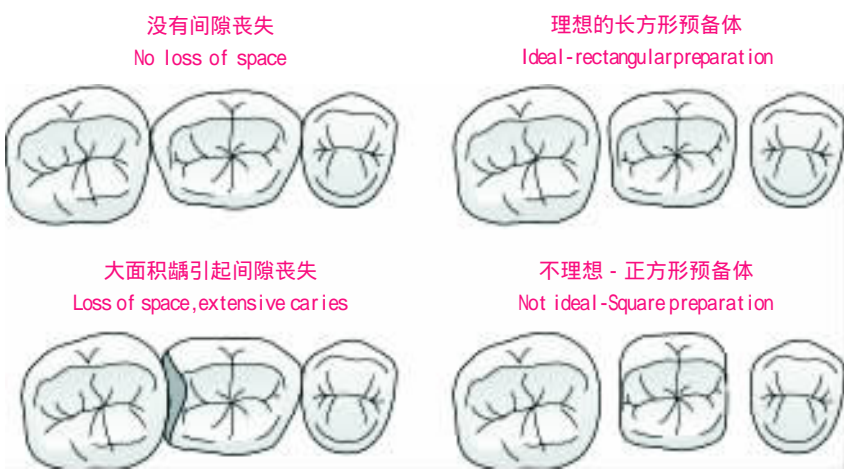


图6-14 下牙弓间隙丧失
Fig 6-14 Space loss in the lower arch

不做牙体预备的预成冠操作步骤

- 向患儿讲解操作步骤。
- 用手动或机用器械去除所有的腐质（图 6-15）。
- 选一个冠——用直接试戴法（从 4 号开始）。如果感到预成冠可以滑过接触点，即为合适。切忌将牙冠压入就位，这样可能取不下来预成冠。
- 干燥牙面，在冠中放入玻璃离子粘固剂，把冠放到牙齿上。将冠从舌侧旋转戴入。轻压使冠完全就位。
- 当冠垂直就位后，在冠与对颌牙之间放入棉卷，让患儿咬合（图 6-16）。



图6-15 去腐后的 7

Fig 6-15 Tooth 85 after the removal of caries

Work Steps for Placing Preformed Crown without Prior Preparation of the Tooth

- Explain the procedure to the patient.
- Remove any caries present using hand and rotary instruments (Fig 6-15).
- Select a crown — this is done using trial and error (start with a size 4). The crown should fit so that it feels that it will slip over the contact point. **DO NOT** place the crown at this point as it will be impossible to remove.
- Dry the tooth. Fill the crown with glass-ionomer cement and place on the tooth. As with a prepared tooth rotate the crown into place from the lingual surface. Press down into place with gentle pressure.
- Once the crown is vertically in place a cotton wool roll between it and the opposing tooth, then ask the child to bite down (Fig 6-16).



图 6-16 儿童咬冠就位

Fig 6-16 Child biting crown into place

- 正畸用带环推子可以帮助患儿咬合（图 6-17）。
- 去除多余的粘固剂。
- 牙龈会有些发白。这是暂时的，不必担心（图 6-18 和图 6-19）。

许多病例由于牙齿殆面的高度没有降低，预成冠会高。由于牙槽骨的代偿作用，在未来的日子里，殆关系会重新调整。这种状况不会引起疼痛，尽管如此，仍应向病人保证这种暂时的咬合变化是正常的，不会持续存在。

- An orthodontic band seater may help direct the force of the child's bite (Fig 6-17).
- Remove the excess cement.
- There may be some blanching of the gingiva. This is transient and not a cause for concern (Figs 6-18 and 6-19).

In many cases, because there has been no reduction in the occlusal height of the tooth, the preformed crown will be high. Due to dento-alveolar compensation the occlusal will readjust over the succeeding days. Pain does not occur as a result of this,



图6-17 孩子咬正畸带环推子辅助SS冠就位

Fig 6-17 Child biting on orthodontic band seater to assist with placement of the SS Crown



图 6-18 不要为牙龈变白而担心，这是暂时的

Fig 6-18 Do not be concerned by blanching of the gingival, this is transient



图6-19 就位的牙冠

Fig 6-19 The crown in place

最小量牙体预备技术的优点：

- 除非需要去除大量的腐质，否则可以不用局部麻醉。
- 相对快速的无创技术，尤其适用于精神紧张的患儿。
- 保存牙体组织，对于发育不全的恒磨牙尤为适用。

避免误吸的操作要点

控制和拿住预成冠是一件困难的事情。如果你担心冠可能会滑脱，有误吸或误吞的危险，可以使用一条对折的高压灭菌胶条或者弹性绷带作为手柄（降落伞拉链）。这在粘固剂固化后很容易去除（图 6-20）。

although the patient should be reassured that the temporary alteration in their bite is normal and will not last.

Advantages of the Minimal Preparation Technique

- Unless significant caries removal is required, local anaesthetic may be avoided.
- Relatively rapid atraumatic technique, of particular value in the anxious patient.
- Conservative of tooth tissue, a particular advantage with hypoplastic permanent molars.

A Practical Tip to Avoid Aspiration

It can be difficult to control and hold a preformed crown. If you are concerned that the crown may slip and endanger the airway or be swallowed, a strip of folded autoclave tape or elastoplast can be used as a handle (parachute chain). This is easily removed after the cement has set (Fig 6-20).

图6-20 SS冠上粘有灭菌用胶条，作为“降落伞拉链”保护呼吸道

Fig 6-20 SS crown with autoclave tape attached to act as a parachute chain to protect the airway



实用提示

- “ 𪚩面 - 邻面 - 外侧面 ”。
- 不要有肩台。
- 如果下颌牙齿有间隙丧失 ,可用上颌对侧牙的冠来修复。
- 使用打结的牙线清除邻面多余的粘固剂。
- 不要担心初期牙龈发白现象 ,如果冠的边缘很合适 ,这种现象会消失。
- 用高压灭菌胶条或者弹性绷带作为 “ 手柄 ” 以防止误吸。

Practical Tips

- **ÒOcclusal: Approximal: PeripheralÓ.**
- Do not cut a shoulder.
- Use the upper contralateral crown to restore a lower molar that has suffered due to space loss.
- Use some knotted floss to clear cement from the contract points.
- DonÕt worry about initial gingival blanching — this will settle if the crown margin is well enough adapted.
- Use autoclave tape or elstoplast as a ÕhandleÓ to avoid aspiration.

第 7 章 乳牙牙髓治疗

Pulp Therapy in the Primary Dentition

目 的

本章的目的是介绍治疗乳牙龋的简单牙髓治疗技术。探讨这些技术的基本原理,并逐步介绍每一步临床操作过程。

要 点

在阅读此章之后,临床医生应该有信心实施常规的乳牙牙髓治疗技术。

引 言

为什么在英国,乳磨牙牙髓治疗一直笼罩着一种神秘的气氛呢?乳磨牙牙髓治疗是所有口腔治疗中最简单、快捷的操作之一。它仅涉及简单的药品和器械,对儿童有两个好处:避免了拔牙造成的创伤,还起到了保持乳牙列间隙的作用。

Aim

The aim of this chapter is to demonstrate the simple pulp therapy techniques that are available to treat carious primary teeth. The rationale for their use will be discussed and each clinical stage demonstrated using a step-by-step approach.

Outcome

After reading this chapter the practitioner should be confident in performing the commonly used pulp therapy techniques for primary teeth.

Introduction

Why is there such an air of mystery surrounding primary molar pulp therapy in the UK? It is one of the most straightforward and quick procedures in the dental armamentarium. It involves simple medicaments and instrumentation and benefits the child two-fold: by avoiding the trauma of extraction and by preserving the space-maintenance role of the primary dentition.

对龋源性露髓的乳磨牙施行牙髓治疗的目的是，保存受损的牙齿并修复其功能，直到继承恒牙萌出。成功的牙髓治疗可减少计划外拔牙和因拔牙可能导致的不良后果。

为了更好地理解现行牙髓治疗技术的原理，我们将简单地论述牙髓受龋侵害后产生的反应。接下来简单地介绍每一个操作步骤。在本章结尾处将列出所需的全部器械和药品的清单。最近，乳牙牙髓治疗的药品有所改变，国际癌症研究中心（International Agency for Research on Cancer, IARC）在2004年6月公开确认了甲醛对人类的致癌作用。结果，使牙髓治疗技术经历了一段显著的改变。本章所介绍的内容代表了英国向使用无醛牙髓治疗技术转变的趋势。

感染和发炎的牙髓

有很多原因可以导致牙髓感染或者发炎，但是目前为止最常见的原因还是龋齿。乳牙龋通过相对较薄的釉质，迅速进展并穿透牙本质，细菌毒素的侵害刺激下方的牙髓，产生炎症性

Pulp therapy for cariously exposed primary molars aims to conserve the damaged tooth and restore its function until the permanent successor erupts. Successful treatment of pulp tissue reduces the need for unplanned extractions and the undesirable consequences that may follow.

In order to understand the principles behind the currently advocated pulp therapy techniques, the response of the pulp to a carious insult shall be discussed briefly. A simple step-by-step guide to the techniques will follow this. A complete list of the instruments and medication used is available at the end of this chapter. There have been recent changes to the medicaments available for pulp therapy in primary teeth. Confirmation by the International Agency for Research on Cancer (IARC) of the carcinogenic effects of formaldehyde in humans was published in June 2004. As a result, pulp therapy techniques are undergoing a period of significant change. This chapter is representative of the trend towards the use of aldehyde-free pulp therapy techniques in the UK.

Infected and Inflamed Dental Pulp

There are several reasons for a dental pulp to become inflamed or infected, but by far the commonest is as a sequel to dental caries. Dental caries in a primary tooth progresses rapidly though the relatively thin

反应(可复性牙髓炎)。

如果发生龋源性露髓,细菌侵犯牙髓组织,引起严重的牙髓反应。其特点是造成不可逆性炎症和在露髓孔邻近部位的牙髓坏死。如果此时不进行任何治疗,细菌及其产物将通过牙髓组织扩散,最终导致整个牙髓系统的不可逆性炎症和组织分解。炎症的扩散是逐步发展的,穿通整个牙髓后经根分歧以及根侧和根尖交通达到根尖周组织。牙髓和牙周组织对于这些损伤的反应可以导致下列结果之一:

- 根尖周组织可能会受影响(根尖周炎),并最终累及相关软组织(图 7-1)。
- 如果露髓范围很大,可能导致增生性牙髓炎(牙髓息肉)(图 7-2)。
- 牙齿有可能发生病理性吸收,例如,炎症性内吸收(图 7-3)。

如果去除发炎的活髓,保留剩余的健康牙髓,若操作正确的话则可以

enamel and penetrates dentine. The insult from bacterial toxins stimulates the underlying pulp to respond by mounting an inflammatory reaction (reversible pulpitis).

If a carious exposure occurs, microbes invade the pulp tissue, causing a massive increase in pulpal response. This is characterised by irreversible inflammation and tissue necrosis directly adjacent to the site of the exposure. If this remains untreated, bacteria and their products will progress through the pulp tissue, resulting in irreversible inflammation and tissue breakdown involving the whole pulp system. The spread of inflammation is gradual and progressive through the whole pulp and then beyond into the periradicular tissues via furcational, lateral and apical communications. The response of pulpal and periodontal tissues to such injury can lead to one of several outcomes:

- The periradicular tissues may become affected (periradicular periodontitis), with eventual involvement of associated soft tissue (Fig 7-1).
- If the exposure site involves a large area, hyperplastic pulpitis (pulp polyp) may occur (Fig 7-2).
- The tooth may be subject to pathological resorption — for example, internal inflammatory resorption (Fig 7-3).

If vital inflamed tissue is removed, leaving residual healthy pulp, it has the capac-



图7-1 乳磨牙大面积龋伴腭侧脓肿

Fig 7-1 A palatal abscess associated with a grossly carious primary molar



图7-2 乳磨牙牙髓的增生性牙髓炎（牙髓息肉）

Fig 7-2 Hyperplastic pulpitis (pulp polyp) seen in the pulp of a primary molar



图7-3 炎症性内吸收影响到乳磨牙的远中根

Fig 7-3 Internal inflammatory resorption affecting the distal root of a primary molar

保持牙齿的健康状态。因此 ,成功的乳牙牙髓治疗依赖于 :

ity to remain healthy if managed correctly. Therefore, the overall success of pulp therapy in the primary dentition depends upon:

- 有效的感染控制。
- 去除不可逆的炎症性组织。
- 恰当的牙髓断面覆盖。
- 治疗中和治疗后有效的冠方封闭。

什么时候需要进行牙髓治疗？

- 急性疼痛史有助于判断受累牙髓所处的大致阶段，但往往很难从儿童那里获得准确的信息。
- 术前X线片有助于判断龋齿的范围及其与牙髓的邻近关系。X线片对判断是否有根尖周病变也很重要。X线片所见可指导制定治疗计划。
- 从临床角度上讲，通常在去腐后更易判断牙髓受累的情况。换句话说，在去腐以后，应仔细寻找露髓点。如果冠髓组织仍然有活力，那么在露髓处就会出血。
- 如果龋源性露髓不出血，如果不是全部牙髓的话，则是一部分牙髓很可能已经坏死。

活髓的炎症评估

判断牙髓炎症的范围和程度可能

- Effective control of infection.
- Removal of irreversibly inflamed tissue.
- Appropriate wound dressing.
- Effective coronal seal during and after treatment.

When is Pulp Therapy Required?

- An accurate pain history is helpful in deciding the probable stage of pulpal involvement, but it is often difficult to obtain such information from a child.
- Preoperative radiographs are helpful to assess the extent of the carious lesion and its proximity to the pulp. They are also important to determine if periradicular pathology is present. Findings from radiographs can guide treatment decisions.
- Clinically, pulpal involvement can often be assessed more easily following caries removal. In other words, after caries removal look very carefully for evidence of pulpal exposure. Blood will be present at the exposure site if the pulp tissue is still vital coronally.
- If a carious exposure is bloodless, then some, if not all of the pulp, is likely to be necrotic.

Assessing Inflammation in a Vital Pulp

It can be difficult to assess the amount

是很困难的。因此在活髓治疗中,我们认为整个冠髓都受到“侵袭”,因此应切除全部冠髓。

在切除冠髓以后,我们的注意力必须转到剩余的根髓组织上来。可根据根髓出血情况来判断炎症是否已超出冠髓进入根管。如果出血不止的话,则根髓认为有不可复性炎症,是活髓切断术的禁忌证。残留牙髓出血不止的牙齿应采取牙髓摘除术。

下列体征和症状提示需要某种牙髓治疗。

体 征

- 殆面龋深度超过 4mm。
- 2/3的边缘嵴已被破坏的邻面龋 (图 7-4)。
- X线片观察龋坏波及或非常接近髓角 (图 7-5)。
- 牙齿松动和叩痛。
- 瘻管形成。
- X线片上出现根尖周骨质低密度透影区。

and level of inflammation within the pulp. Therefore, in vital pulp therapy it is assumed that the whole coronal pulp is affected and so all of the coronal pulp is amputated.

Following amputation of the coronal pulp, our attention must turn to the remaining radicular pulp stumps. The nature of the bleeding from the radicular pulp is used to assess whether inflammation has extended beyond the coronal pulp tissue and into the root canals. If haemostasis cannot be achieved, this tissue is assumed to be irreversibly inflamed and vital pulpotomy techniques are contraindicated. A tooth with persistent bleeding from the pulp stumps should be treated by pulpectomy.

Below are examples of signs and symptoms that could indicate that some form of pulp therapy is needed.

Signs

- Occlusal caries extending more than 4mm in depth.
- Approximal caries where 2/3 of the marginal ridge has been destroyed (Fig 7-4).
- Caries involving or very close to the pulp horns on a radiograph (Fig 7-5).
- Mobility or tenderness to percussion.
- Sinus formation.
- Periradicular bone radiolucency on a radiograph.

图7-4 边缘嵴破坏超过2/3的乳磨牙,强烈建议需要进行牙髓治疗

Fig 7-4 A primary molar with more than 2/3 of the marginal ridge broken down. This gives a strong indication that pulp therapy is required



图7-5 X线片显示邻面龋与牙髓的邻近关系

Fig 7-5 A radiographic view showing the proximity of an approximal carious lesion to the pulp



症 状

· 疼痛

- 温度刺激引发的一过性疼痛 (可复性牙髓炎)
- 自发的和持续性疼痛 (不可逆性牙髓炎)
- 患牙咬合痛 (根尖周或者根间感染)

Symptoms

· Pain

- transient on thermal stimuli (reversible pulpitis)
- spontaneous and lasting in nature (irreversible pulpitis)
- from biting on the affected tooth (periapical or intraradicular infection).

乳磨牙牙髓治疗的适应证和禁忌证

除了体征和症状以外, 牙髓治疗

Indications and Contraindications for Primary Molar Pulp Therapy

Further to the signs and symptoms, ad-

的其他适应证还有：

- 合作的儿童和看护人。
- 避免拔牙造成的心理创伤。
- 有需要避免拔牙的全身疾病(例如血友病)。
- 继承恒牙缺失。
- 保持乳牙列的牙弓完整。
- 在混和牙列中保持间隙。

牙髓治疗也存在重要的禁忌证，包括：

- 儿童或者看护人不合作。
- 儿童全身状况不佳，有患口腔菌血症的危险(例如免疫缺陷或者有发展成为感染性心内膜炎的危险)。
- 口腔总体情况不佳(例如有3颗或3颗以上的牙齿可能存在牙髓问题)。
- 没有足够的冠部牙体组织确保在治疗后形成有效的牙冠封闭。
- 龋坏波及髓室或者根管。

乳磨牙的牙根解剖

由于感觉到乳牙列的解剖形态会对治疗造成一些困难，传统上儿童口

ditional indications for pulp therapy are:

- Cooperative child and carers.
- Avoidance of the psychological trauma of extraction.
- Medical conditions where extraction should be avoided (e.g. haemophilia).
- Absence of the permanent successor tooth.
- To maintain an intact arch in the primary dentition.
- Space maintenance in the mixed dentition.

There are also several important contraindications to pulp therapy, including:

- Lack of cooperation from child or carer.
- Medically compromised children at risk from a dental bacteraemia (e.g. immunocompromised or at risk of developing infective endocarditis).
- Poor general condition of the mouth (e.g. greater than or equal to three teeth with likely pulpal involvement).
- Insufficient coronal tooth tissue to ensure an effective coronal seal post-treatment.
- Caries involving the pulp chamber or root canal.

The Root Anatomy of Primary Molar Teeth

Paediatric dentists have traditionally favoured pulpotomy as opposed to com-

腔医生偏爱牙髓切断术，而反对摘除全部牙髓（牙髓摘除术）。这些解剖形态有：

- 带状根管(很难进行器械预备)
- 根管壁薄(侧穿的危险性相对增加)
- 许多侧支交通和根分叉交通(很难清洁和封闭)
- 生理性根尖吸收(根尖孔粗大)
- 乳牙根尖紧邻恒牙胚(有损坏继承恒牙的相对危险性)

首先...

在活髓乳牙牙髓治疗之前，充分的局部麻醉至关重要。

另外应记住，尽管一颗牙看似完全失去活力，但是仍可能残留活的牙髓组织。所以，为确保孩子始终感觉舒适并且配合治疗，充分止痛是相当重要的。对去腐和之后的牙髓治疗来说，有效的隔湿（理论上应在可能的情况下使用橡皮障）也很重要。如果不能放置橡皮障，一旦打开髓腔，必须使用隔湿器、棉卷和吸唾器。

plete extirpation of the pulp (pulpectomy) because of several perceived difficulties relating to the anatomy of the primary dentition. These are reported as:

- Ribbon shaped canals (difficult to instrument).
- Thin walls to canals (relative increase risk of perforation).
- Many lateral and furcal communications (difficult to clean and obturate).
- Physiological apical root resorption (wide open apical regions).
- Close proximity of the permanent tooth germ to the apex of primary tooth (relative risk of damaging successor tooth).

To Begin...

It is essential to provide adequate local anaesthesia before pulp treating a vital primary tooth.

Additionally, it is worth remembering that even a tooth that appears to be completely non-vital may still have vital pulp tissue remaining. Therefore, it is essential that adequate pain relief is administered to ensure the continuing comfort and cooperation of the child. Effective moisture control is also important (ideally with dental dam where possible) for caries removal and any subsequent pulp therapy. If placement

牙髓治疗技术

基本牙髓治疗技术的选择取决于牙髓的炎症范围，因此这些技术可大致分为：

- 盖髓术——包括两种方法：直接法和间接法。在乳牙列，直接盖髓术并不常用。
- 牙髓切断术——此方法可用于活髓牙，但根据所用的药品和所需的诊疗次数不同，操作技术可以有所不同。
- 牙髓摘除术——此方法可用于有或没有感染体征的死髓牙。普遍的做法是彻底摘除乳牙牙髓并用可吸收的材料充填根管。

下图示常用牙髓治疗技术，所用的制剂和可能的就诊次数（图7-6和7-7）。出血性龋源性露髓（活髓）的处理方法见图7-6。无出血的龋源性露髓（死髓）的处理选择见图7-7。

of dental dam is not achieved, dry guards, cotton wool rolls and a saliva ejector must be used once the pulp chamber is breached.

Pulp Therapy Techniques

The basic pulp therapy techniques available are dependant on the extent of pulpal inflammation and as such can be broadly divided into:

- **Pulp Capping** - This involves two approaches; direct and indirect. The direct pulp cap is not routinely used in the primary dentition.
- **Pulpotomy** - This can be performed on vital teeth, but the technique can differ in respect of choice of medication and the number of visits required.
- **Pulpectomy** - This can be used for non-vital teeth with or without signs of infection. Complete extirpation of the pulp of a primary tooth and obturation with a resorbable material is gaining in popularity.

The common pulp therapy techniques available, the agents that can be used and the likely number of visits required are given (Figs 7-6 and 7-7). The management of a bleeding carious exposure (vital) is shown in Fig 7-6. The options for managing a carious exposure that does not bleed (non-vital) is shown in Fig 7-7.

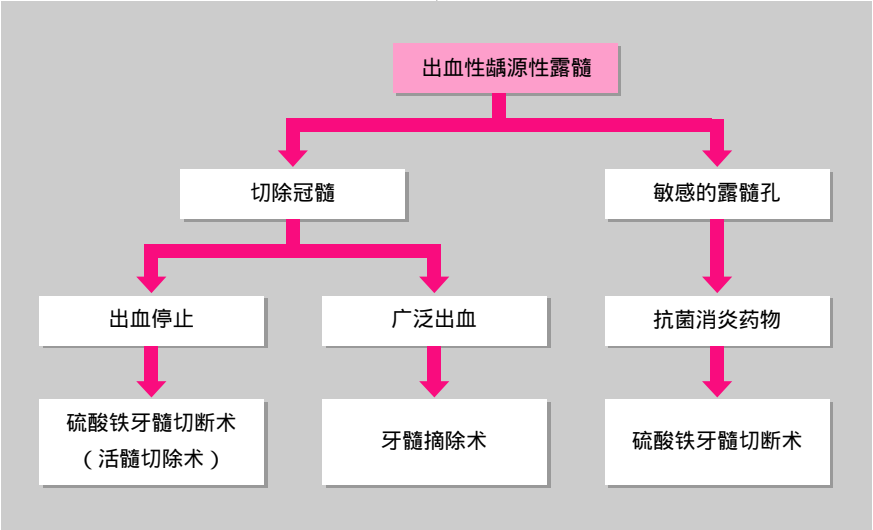


图7-6 乳牙出血性龋源性露髓的治疗选择流程图

Fig 7-6 A flow diagram showing the options for treating a bleeding carious exposure in a primary tooth

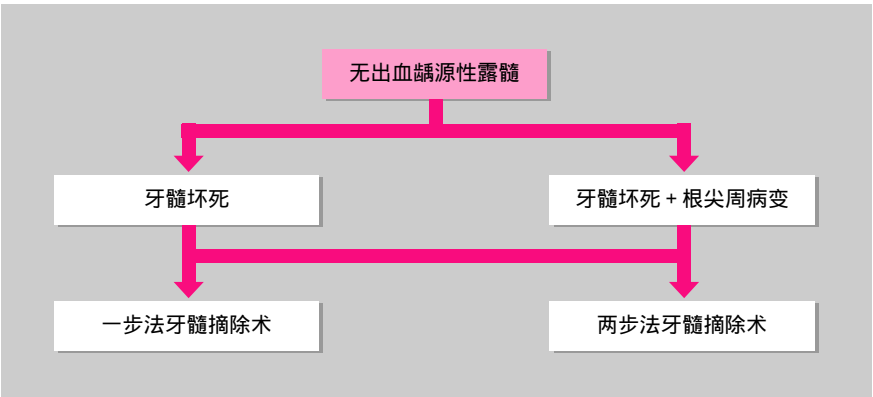


图7-7 乳牙无出血龋源性露髓的治疗选择流程图

Fig 7-7 A flow diagram showing the options for treating a bloodless carious exposure in a primary tooth

盖髓术

亦称为间接牙髓治疗术，在乳牙列用于保存活髓。乳牙盖髓术可被分为两种不同的技术：

- 间接法
- 直接法

乳磨牙间接盖髓术

又称为间接牙髓治疗术，包括在深部的软化牙本质上垫底以消除细菌并刺激修复性继发牙本质生成，保持牙髓活性。一般认为，此技术可成功地治疗乳牙牙本质深龋的可逆性牙髓炎。

间接牙髓治疗技术

- 乳牙应无任何症状。
- 洞壁必须无龋，以保证窝洞的边缘封闭。
- 对于无症状的牙齿，如果去除洞底深层软化牙本质有露髓的危险，则应予以保留。
- 必须没有任何露髓的迹象：
 - 去除洞壁所有的腐质。

Pulp Capping

Also termed indirect pulp therapy, this is used in the primary dentition to maintain vital pulp tissue. Pulp capping in the primary dentition may be divided into two different techniques:

- indirect
- direct.

Indirect pulp capping in primary molars

Also termed indirect pulp therapy, this involves placing a lining onto deep, softened dentine in order to eliminate microbes and stimulate reparative secondary dentine and maintain pulp vitality. The technique is thought to be successful in pulp treatment of reversible inflammation in primary teeth with deep dentine caries.

Indirect pulp therapy technique

- The primary tooth must be symptom-free.
- The walls of cavity must be rendered caries-free, to permit sealing of the cavity margin.
- Deep, softened dentine may be left at the floor of the cavity, if its removal risks pulp exposure in a symptom-free tooth.
- There must be no evidence of pulpal exposure:
 - remove all caries from cavity walls

- 小心地挖除洞底腐质。
- 保留软化的牙本质，或薄层坚硬牙本质，但不要露髓。
- 在着色或薄层牙本质上垫固化氢氧化钙或玻璃离子粘固剂。
- 进行封闭良好的永久性修复（复合体、金属预成冠）。
- 定期进行临床和X线片复查。

乳磨牙直接盖髓术

在小的外伤性露髓处直接放置盖髓剂，在露髓处刺激钙化屏障的形成，其作用是隔绝和保护相邻的牙髓组织。这种方法不能用于龋源性露髓。

直接盖髓只能用于因器械造成的极微小的露髓。在儿童口腔科，如果孩子备洞过程中不自觉地咬住钻针，有时可能造成露髓（尽管很罕见）。

对于龋源性露髓的乳牙，由于应该去除感染的、有不可逆性炎症的冠髓，因此理想的治疗方法是牙髓切断术。即使氢氧化钙盖髓剂与有炎症的牙髓小面积地接触，也是无效的，可导致牙髓持续性炎症，牙髓坏死且常引

- excavate cavity floor carefully
- leave softened dentine, or thin layer of hard dentine, but do not expose the pulp
- place a setting calcium hydroxide or a glass-ionomer cement lining over the stained or thin dentine
- place a permanent, well-sealed restoration (compomer, preformed metal crown)
- provide regular clinical and radiographic review.

Direct pulp capping in primary molars

This involves placing an agent directly onto a small traumatic pulpal exposure in order to stimulate the formation of a calcific barrier at the exposure site. This acts to protect the pulp tissue adjacent to the barrier. This approach should never be used for a carious exposure.

A direct pulp cap should only be used for pinpoint exposures caused by instrumentation. In paediatric dentistry, this may sometimes arise (although rarely) if a child unwittingly bites down on a bur during cavity preparation.

If a primary tooth has a carious exposure, the preferred method of treatment is a pulpotomy because infected and irreversibly inflamed coronal pulp should be removed. If there is a small area of contact between a calcium hydroxide direct pulp

发内吸收。当氢氧化钙作为直接盖髓剂覆盖于健康牙髓的小露髓孔处时，可以刺激牙本质屏障的沉积。

直接盖髓技术

- 盐水（0.9%）湿润的无菌小棉球置于露髓处，轻加压止血1~2min。
- 必须充分止血。
- 在露髓孔处及邻近的牙本质表面轻轻地放置一薄层固化氢氧化钙。
- 氢氧化钙上方以氧化锌丁香油或玻璃离子粘固剂垫底。
- 永久性修复。
- 定期进行临床和X线片复查。

乳磨牙牙髓切断术

在乳牙列中，牙髓切断术或者牙髓切断术指去除冠部牙髓，保留根管内剩余的牙髓组织。乳牙牙髓切断术各种方法的相对成功率见图7-8。

cap and an inflamed pulp, it will be ineffective, resulting in persistent inflammation, pulp death and often internal resorption. When calcium hydroxide is used as a direct pulp cap over a small exposure of healthy pulp tissue it can stimulate the deposition of a dentine barrier.

Direct pulp capping technique

- Arrest bleeding with gentle pressure from a sterile pledget of cotton wool moistened with saline (0.9%) placed over the exposure for 1-2 minutes.
- Bleeding must stop.
- Gently place a thin sub-lining of setting calcium hydroxide over the exposure and extend this to cover the adjacent dentine.
- Place a lining such as zinc oxide-eugenol or glass-ionomer cement over the sub-lining
- Permanently restore.
- Provide regular clinical and radiographic review.

Primary Molar Pulpotomy

In the primary dentition, pulp amputation or pulpotomy involves the removal of the coronal portion of the pulp, leaving residual pulp tissue insitu in the root canals. The relative success of pulpotomy procedures in the primary dentition is illustrated in Fig 7-8.

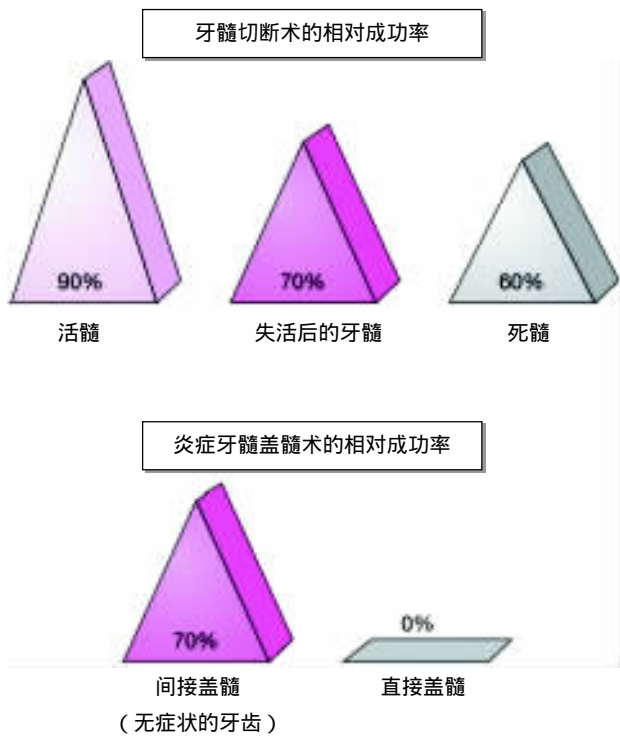


图 7-8 乳磨牙牙髓切断术的相对成功率。由于停用了 Buckey 的甲醛甲酚法，因此不再提倡使用失活牙髓和死髓的牙髓切断术

Fig 7-8 The relative success of pulpotomies in primary molar teeth. The devitalising and non-vital pulpotomies are no longer advocated since the removal of Buckley's Formocresol from use

硫酸铁活髓切断术

经典的硫酸铁活髓切断术包括去除有不可逆性炎症和已感染的冠部牙髓组织，在根管内保留无炎症的根部牙髓组织。在临床上，由于冠部牙髓呈充血状态因此出血很多，这部分组织被切除，而保留有活性的、出血轻微在 2~3min 后即可止住的根髓组织，如果

The Ferric Sulphate Vital Pulpotomy

Classically, this involves the removal of irreversibly inflamed and infected coronal pulp tissue, leaving the uninflamed radicular pulp tissue insitu. Clinically, the coronal pulp will bleed vigorously because it is hyperaemic — this is amputated, leaving vital, gently bleeding radicular pulp stumps,

出血止住了，这就意味着牙髓组织有能力从龋损和切割的创伤中恢复过来。如果出血不止，就意味着牙髓存在不可逆性的炎症，应施行牙髓摘除术(图7-9)。

目前已经过时的甲醛甲酚溶液(即使是20%的稀释配方)不能使根髓组织愈合，而是导致不同程度的广泛牙髓固定，这种固定在邻近甲醛甲酚

which should stop bleeding after two to three minutes. If bleeding stops, the tissue is assumed to possess the ability to recover from both the insult of caries and the amputation. If the bleeding does not stop there is irreversible inflammation and pulpectomy should be performed (Fig 7-9).

The now outmoded application of formocresol solution (even in its 20% dilute formulation) did not allow the radicular pulp tissue to heal, but instead widespread

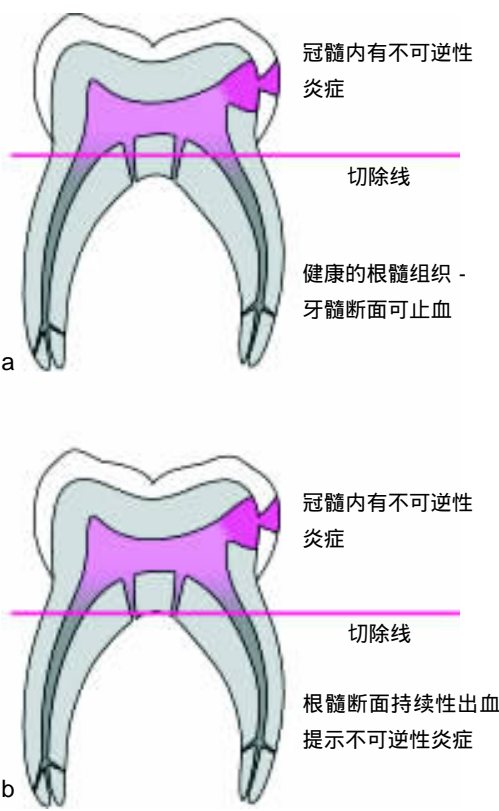


图7-9 a. 理想的活髓切断术；
b. 预后不良的活髓切断术

Fig 7-9 (a) The ideal scenario for vital pulpotomy, (b) Vital pulpotomy would have a poor prognosis here

溶液的部位最为严重。有些研究表明牙尖部可能存留活的牙髓组织。尽管如此,应用甲醛甲酚的技术应被列为一种失活牙髓的技术。硫酸铁(15.5%配方溶液)是一种替代甲醛甲酚的方法,已经取得了良好的临床成功率,越来越受到欢迎。当硫酸铁用于正在出血的组织时,铁和硫酸根离子与血液蛋白凝集,在断裂的血管末端形成机械屏障,发挥止血作用。它对牙髓组织无固定作用,其抗菌性不明确,如果有的话。

一次就诊的硫酸铁活髓切断技术 (图 7-10)

- 在牙髓切断术治疗过程中,在切除牙髓之前,去净所有腐质并评估牙冠部的缺损程度是非常重要的。开髓后,使用消毒的器械和冲洗液也非常重要(图7-11a)。
- 备洞,扩展洞形以保证揭净髓室顶。使用末端无刃的切削钻针(例如Batt 钻针)以免穿通薄的髓室底(图 7-11b)。

fixation occurred along a gradient, which was greatest near the point of application. Some studies have shown that vital pulp tissue may remain apically. Despite this, the technique that used formocresol should be classed as one that rendered the radicular pulp non-vital. Ferric sulphate (15.5% formulation), an alternative to formocresol that is gaining in popularity, has shown good clinical success rates. When applied to a bleeding tissue the ferric and sulphate ions agglutinate with blood proteins to form a mechanical barrier at the ends of cut blood vessels, causing a styptic effect. It does not possess fixative properties and its antimicrobial properties, if any, are unknown.

Single-visit vital ferric sulphate pulpotomy technique (Fig 7-10)

- In pulpotomy procedures it is important to remove all caries and assess the degree of coronal destruction before embarking on pulp amputation. Once access to the pulp has been achieved, it is also important to use instruments and irrigant solutions that are sterile (Fig 7-11a).
- Prepare access cavity, extending to ensure complete removal of the roof of the pulp chamber. A non-end cutting bur (e.g. Batt bur) avoids perforating the thin floor of the pulp chamber (Fig 7-11b).

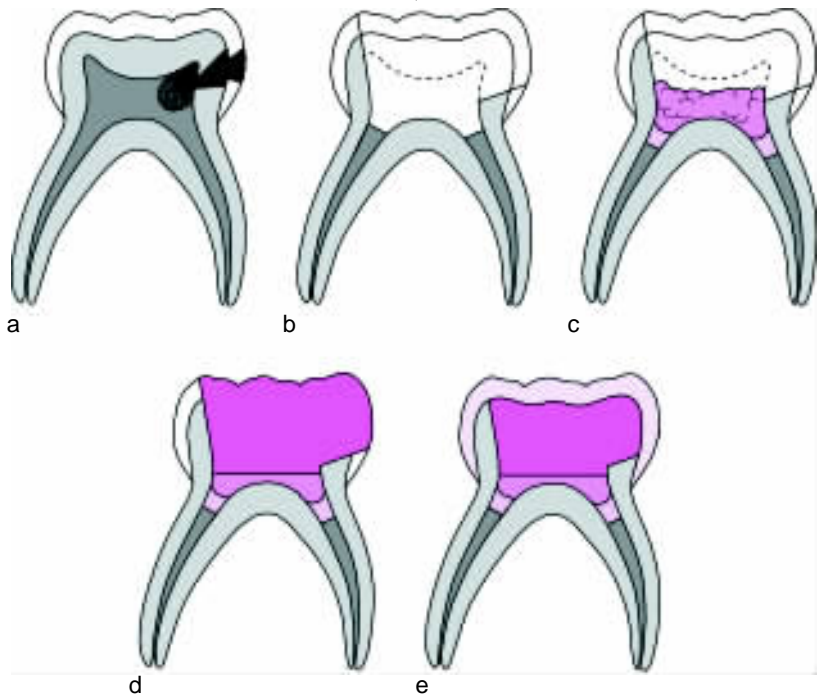


图 7-10 一次就诊的硫酸铁牙髓切断术：a. 龋源性露髓的乳磨牙。龋损露髓处不可逆性炎症和坏死的牙髓组织。去腐会造成冠髓暴露；b. 去腐和充分开髓。切除冠髓后断面不出血，说明根髓没有炎症；c. 用棉球或合适的器械将 15% 硫酸铁溶液置于牙髓断面 15s；d. 取出棉球后，用氧化锌丁香油粘固剂直接覆盖在牙髓断面上，然后用玻璃离子粘固剂充填；e. 最后用金属预成冠修复。注意断面处根髓组织的出血反应

Fig 7-10 The single-visit ferric sulphate pulpotomy. (a) Cariously exposed primary molar. Irreversible inflammation and necrosis of pulp tissue exposed to caries. Caries removal will expose coronal pulp tissue, (b) Removal of caries and good access to the pulp chamber. Coronal pulp amputated leaving arrested bleeding sites indicative of uninflamed radicular pulp, (c) A 15% ferric sulphate solution applied to pulp stumps for 15 seconds via a cotton wool pledget or via a proprietary applicator, (d) Cotton wool removed, tooth restored with zinc oxide-eugenol cement directly over pulp stumps, then glass-ionomer cement, (e) A preformed metal crown is the definitive restoration. Note the haemostatic reaction within the coronal aspect of the radicular pulp tissue.

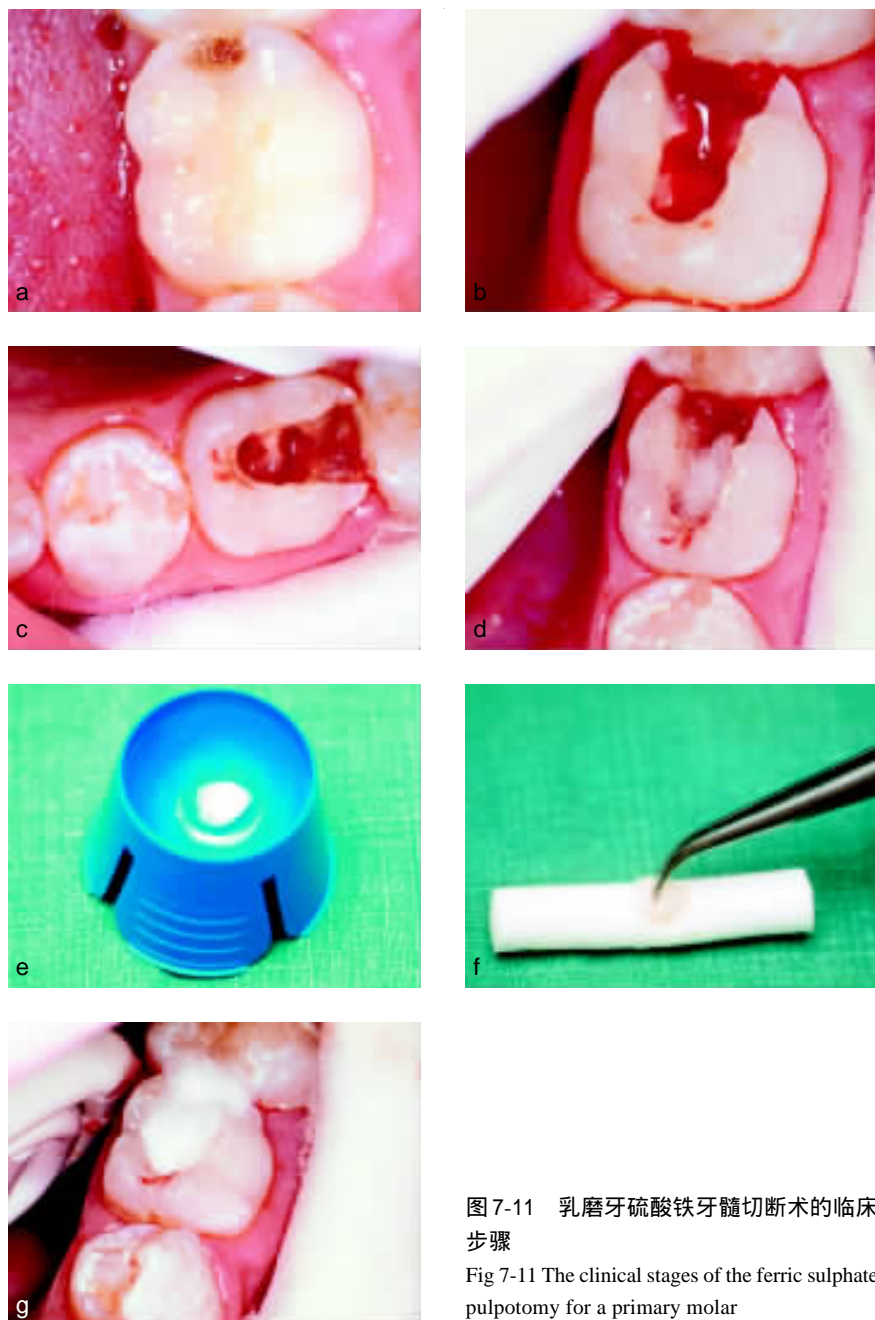


图 7-11 乳磨牙硫酸铁牙髓切断术的临床步骤

Fig 7-11 The clinical stages of the ferric sulphate pulpotomy for a primary molar

- 用挖匙或者慢速手机上的球钻去除冠部牙髓 避免穿通薄的髓室底, 并去净所有冠髓 (图 7-11c)。
- 用盐水 (0.9%) 或者无菌清水冲洗。
- 盐水润湿的小棉球覆盖在牙髓断面上, 轻压 3~4min (图 7-11d)。
- 如果在 3~4min 之内止血, 那么继续进行下一步操作。否则, 应考虑用挖匙去除更多的牙髓组织, 或者行牙髓摘除术。持续性的出血提示有不可逆性炎症。
- 在小棉球上滴 1 滴 15% 硫酸铁溶液 然后用干净的棉球或者纱布吸去多余药液。小棉球上的硫酸铁不应是饱和的 (以防止液体流到牙龈上), 而应是微湿的 (图 7-11e, f)。
- 把微湿的硫酸铁小棉球放在牙髓断面上, 轻轻接触 15s (图 7-11g)。
- 如果是乳切牙, 放一个较大的纸尖 (用类似方法湿润) 与牙髓断面相接触。
- 15s 后去除药物, 然后判断牙髓出血是否停止。如果继续出血的
- Amputate the coronal pulp with excavators or slowly rotating round steel bur. Avoid perforating the thin pulp floor and remove all the coronal pulp tissue (Fig 7-11c).
- Irrigate with saline (0.9%) or sterile water.
- Apply light pressure to pulp stumps with small pledget of cotton wool moistened with saline for three to four minutes (Fig 7-11d).
- If bleeding stops within three to four minutes, proceed. If not, consider removing further pulp tissue with an excavator or pulpectomy. Persistent bleeding is a sign of irreversible inflammation.
- Place a small pledget of cotton wool into a drop of 15% ferric sulphate solution and blot this on fresh cotton wool or gauze. The cotton wool pledget should not be soaked (to avoid seepage onto the gingiva) but moistened with ferric sulphate (Fig 7-11e, f).
- Place the cotton wool pledget, moist with ferric sulphate, in gentle contact with the pulp stumps for 15 seconds (Fig 7-11g).
- In primary incisors, place a large paper point (moistened in a similar manner) in contact with the pulp stump.
- Remove the dressing after 15 seconds and assess whether pulpal bleeding has

话，可考虑再次使用硫酸铁。

- 用硬化氧化锌丁香油粘固剂垫底后，进行永久性修复，保证良好的牙冠封闭（例如金属预成冠）。
- 乳切牙需要用可吸收的根管内充填材料（例如纯氧化锌粉末和丁香油液调和而成的）。如果糊剂稀薄，可用螺旋充填器导入，如果糊剂较稠则可用纸尖送入根管。
- 定期进行临床和X线片复查。

氢氧化钙牙髓切断术

氢氧化钙粉剂作为甲醛甲酚的替代品已被用于活髓切断术。过去，临床医生曾经用过很多不同的氢氧化钙制品，取得了不同的结果。如果根髓出血能够止住的话，纯氢氧化钙粉是一种有用的制剂。粉末可直接压到牙髓断面上，然后对牙齿进行永久性修复。

适应证

与硫酸铁牙髓切断术相似。但是，应严格地遵守下列要点：

stopped. If bleeding continues, consider a second application of ferric sulphate.

- Restore with a setting zinc oxide-eugenol lining and restore with a permanent restoration affording good coronal seal (e.g. preformed metal crown).
- In primary incisors, a resorbable intracanal filler is required (e.g. pure zinc oxide powder mixed with eugenol liquid). This can be placed with a spiral filler if a thin paste, or packed down the canal with a paper point if a thicker paste is used.
- Provide regular clinical and radiographic review.

The Calcium Hydroxide Pulpotomy

Calcium hydroxide powder has also been used as an alternative to formocresol in vital pulpotomy. In the past, clinicians have used many different calcium hydroxide preparations, with varying results. Pure calcium hydroxide powder appears to be a useful agent, provided bleeding from the radicular pulp stumps stops. The powder is packed directly over the pulp stumps and the tooth is permanently restored.

Indications

These are similar to those cited for ferric sulphate pulpotomy. However, the follow-

- 必须是无症状的牙齿。
- 牙髓应该是有活力的。
- 用氢氧化钙粉末盖髓之前必须切除冠髓。
- 切除的根髓断面处不应有大量和长时间的出血。

技 术

直到切除冠髓这一步，氢氧化钙牙髓切断术的操作步骤与硫酸铁活髓切断术相同。去除冠髓后：

- 直接在牙髓断面上覆盖一层高度浓缩的氢氧化钙粉末。可以用银汞输送器将粉末放到牙上(图 7-12a)。
- 用干燥消毒的小棉球将粉末压实(图 7-12b)。

ing points should be adhered to strictly:

- The tooth must be symptom-free.
- The pulp should be vital.
- Coronal amputation must be achieved before the powder is placed in contact with the pulp tissue.
- Bleeding from the amputated radicular pulp stumps must not be copious and prolonged.

Technique

The stages of the technique are identical to the vital ferric sulphate pulpotomy up to achieving amputation. After which:

- Place a layer of well-condensed calcium hydroxide powder directly over the pulp stumps. The powder can be delivered to the tooth using a retrograde amalgam carrier (Fig 7-12a).
- Pack the powder well using small pledgets of dry, sterile cotton wool (Fig 7-12b).

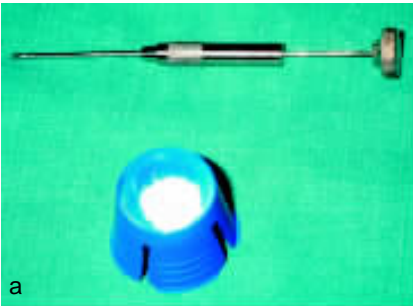


图7-12 乳磨牙的氢氧化钙活髓切断术临床步骤

Fig 7-12 The clinical stages of the calcium hydroxide vital pulpotomy for a primary molar

- 氢氧化钙层上直接以速硬氧化锌丁香油粘固剂垫底。
- 如前所述进行修复。

成 功

对于纯氢氧化钙粉末的疗效一直鲜有报道,但是有一项研究表明,在活髓切断术中使用纯氢氧化钙粉末和使用稀释的甲醛甲酚溶液相比,其成功率相似。值得注意的是,该研究只包括没有任何症状的龋源性露髓的乳磨牙。氢氧化钙成功率好的原因,很可能是由于此研究只选取了根髓健康的牙齿。

牙本质桥的形成

氢氧化钙覆盖没有不可逆性炎症的牙髓,能促进牙本质的沉积。在龋源性露髓的乳牙施行牙髓切断术后用氢氧化钙盖髓,可反应性地形成牙本质桥。这提示牙髓已经成功地将自己“筑墙隔离”,避免氢氧化钙的刺激作用。牙本质屏障下方的牙髓组织仍然保持活力。因此,氢氧化钙牙髓切断术试图使根髓发生愈合反应,而不是像甲醛甲酚术后所见到的将牙髓固定。

- Place a lining of fast setting zinc oxide-eugenol cement directly over the calcium hydroxide layer.
- Restore as discussed previously.

Success

There has been little published on the efficacy of pure calcium hydroxide powder, but a study which compared this preparation with a dilute solution of formocresol in vital pulpotomy showed comparable success rates with both medicaments. It is worth noting, however, that the study only included cariously exposed vital primary molars which were symptom-free at presentation. The good success rates seen for calcium hydroxide in this study were probably because only teeth with healthy radicular pulps were included.

Dentine Bridge Formation

Calcium hydroxide is known to favour dentine deposition if placed over a pulp that is not irreversibly inflamed. Dentine bridge formation in response to the calcium hydroxide can be seen following its use as a pulpotomy agent in cariously exposed primary teeth. This indicates that the pulp has been successful at walling itself off from the irritant effects of the calcium hydroxide. The pulp tissue beneath the dentine barrier can maintain vitality. Therefore the calcium hydroxide pulpotomy seeks to allow heal-

注意事项

乳磨牙氢氧化钙牙髓切断术后，牙本质桥的出现并不说明本质上的治愈。尽管有牙本质屏障的出现，牙髓切断术仍可能失败。电子显微镜研究表明，牙本质屏障多孔且渗透性高，因此不是阻挡微生物入侵的真正屏障。氢氧化钙具有强碱性，会刺激牙髓细胞。牙髓必须能够对这种损害做出反应，并且在反应性或“刺激性”牙本质层下方保持活力。

- 对活髓牙，处理和治疗的 success 取决于正确的诊断。
- 牙髓切断术本身不会导致病理性吸收，但技术不当，牙冠封闭不良或者牙髓切除不完全可以促进吸收。

失活法牙髓切断术

历史上，这种两步法技术是使用多聚甲醛糊剂固定和失活牙冠部和根部的牙髓组织。因为不再使用像 Aeslick 或者 Miller 配方一类的糊剂，所

ing within a radicular pulp, rather than the fix the pulp as is seen following formocresol.

Caution

The presence of a dentine bridge beneath a calcium hydroxide pulpotomy in a primary molar does not indicate healing per se. The pulpotomy may fail, even in the presence of a dentine barrier. Electron microscopy studies have shown dentine barriers to be porous and therefore not true barriers to the ingress of microbes. Calcium hydroxide is highly alkaline, and this will irritate the cells of the pulp. The pulp must be able to react to this insult and remain vital beneath the layer of reactionary or irritation dentine.

- In vital pulps, successful management and treatment outcome is dependent upon correct diagnosis.
- Pulpotomy itself will not result in pathological resorption, but inappropriate technique, poor coronal seal or deficient amputation can potentiate this.

Desensitising Pulpotomy

Historically, this two-stage technique used paraformaldehyde paste to fix and devitalise the coronal and radicular pulp tissue. Pastes such as Aes-lick or Miller

以建议采用下列替代方法。

适应证

- 龋源性露髓的活髓牙,但是由于儿童无法接受局部麻醉而不能进行硫酸铁法牙髓切断术。
- 另一方面,尽管已经施行了局部麻醉,但仍不适合作牙髓切断术(过度疼痛的牙髓)。

将一种含类固醇的抗生素糊剂(例如 Ledermix™)轻轻地覆盖在露髓处。这种糊剂可以灭菌并减轻炎症。露髓孔越大,降低牙髓敏感性的效果就越明显。

两步法的失活牙髓切断技术

第一次就诊

- 用消毒盐水(0.9%)冲洗露髓孔,并用小棉球轻轻擦干(图 7-13a)。
- 去腐后露髓。牙髓有活力且非常敏感则不能进行活髓切断术(图 7-13b)。
- 在露髓处直接放置蘸有糊剂的小棉球。不要过度加压,否则会引起疼痛。

are no longer used, therefore an alternative is suggested below.

Indications

- A tooth with a carious exposure of vital pulp, but a ferric sulphate pulpotomy cannot be carried out because the child will not accept local anaesthesia.
- Alternatively, local anaesthesia has been administered, but is inadequate for pulp amputation (hyperalgaesic pulp).

A steroidal antibiotic paste (e.g. Ledermix™) is placed gently over the exposure site. This may kill microbes and reduce inflammation. The larger the exposure, the more profound the effect of reducing pulp sensitivity.

Two-stage desensitising pulpotomy technique

First visit

- Irrigate exposure site with sterile saline (0.9%) and gently dry with cotton wool pledgets (Fig 7-13a).
- Pulp exposure following caries removal. The pulp is vital and very sensitive — vital pulpotomy cannot be attempted (Fig 7-13b).
- Place a small pledget of cotton wool loaded with paste directly over the exposure site. Do not apply excess pressure, as this is thought to precipitate

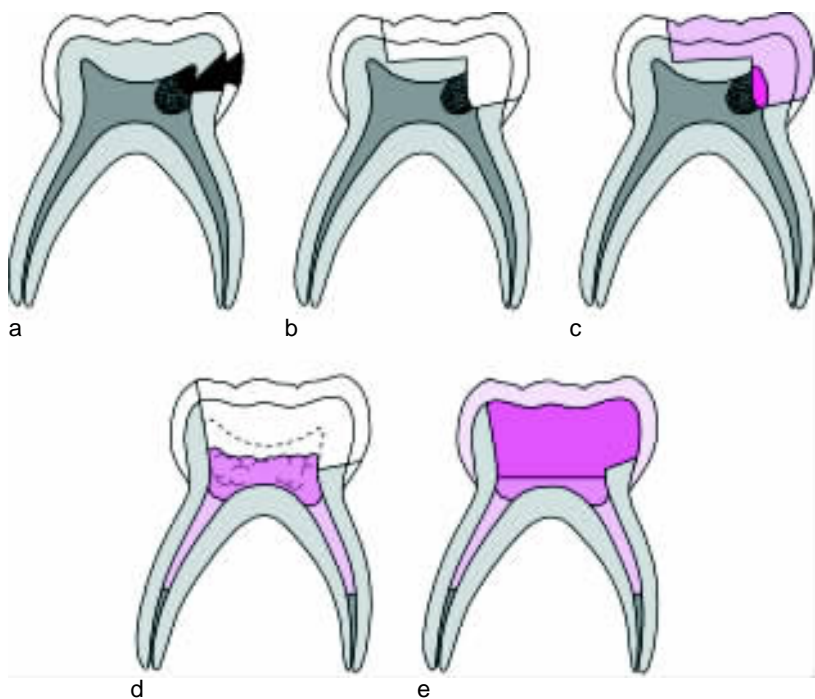


图7-13 失活法牙髓切断术

Fig 7-13 The desensitising pulpotomy

- 用一层固化氢氧化钙垫底材料将小棉球固定。
- 放置封闭性好的暂时充填体，等 7 ~ 14d (图 7-13c)。

第二次就诊

- 如果原来的露髓孔较大，那么牙髓组织(至少是冠髓)应该不再敏感。可给予局部麻醉并施行硫酸铁牙髓切断术(图 7-13d)。

pain.

- Anchor the cotton wool with a setting calcium hydroxide lining material.
- Place a well-sealed temporary restoration and leave for seven to 14 days (Fig7-13c).

Second visit

- If the initial exposure site was large, the pulp tissue (at least coronally) should be less sensitive. Administer local anaesthesia and proceed to a ferric

- 如果冠髓仍然敏感,应扩大露髓孔再次使用糊剂。
- 金属预成冠是最终的修复体(图 7-13e)。

成功率

使用多聚甲醛的失活法牙髓切除术,没有一次就诊法牙髓切除术的成功率高:其成功率接近 70%。乳牙列使用 Ledermix™ 的报道较少。

牙髓摘除术

由于甲醛甲酚已不再用于死髓牙的牙髓切断术,乳牙的牙髓摘除技术逐渐被人们所接受,并将被广泛应用。

成功率

死髓牙的牙髓切断术不如活髓牙牙髓切断术和失活法牙髓切断术的成功率高,其成功率只有 60%。牙髓摘除术的成功率仍需全面的调查,目前只有极少数的大范围研究。尽管如此,在一些国家,它正逐步成为凌驾于牙髓切断术之上的更受青睐的治疗方法。

sulphate pulpotomy (Fig 7-13d).

- If the coronal pulp remains sensitive, enlargement of the exposure site may be carried out with further application of paste.
- A preformed metal crown is the definitive restoration (Fig 7-13e).

Success rate

The devitalising pulpotomy using paraformaldehyde was not as successful as the single-visit pulpotomy: it had an approximate success rate of 70%. There is little published data on the use of Leder-mix™ in the primary dentition.

Pulpectomy

Pulpectomy techniques in the primary dentition are gaining in popularity and will become more widespread now that formocresol is no longer available for use in non-vital pulpotomy techniques.

Success rate

Non-vital pulpotomy was not as successful as either the vital or devitalising techniques, with an approximate success rate of 60%. The success rate of pulpectomy has yet to be investigated fully, with very few large scale studies. Despite this, it is becoming the preferred treatment over pulpotomy in some countries.

适应证

- 根髓组织有明显的不可逆性炎症, 表现为冠髓切除后根髓断面持续性出血。
- 无论有无感染的体征, 根髓完全无活力。

牙髓摘除技术

牙髓摘除术有两种方法, 取决于根髓是存在不可逆性炎症(甚至在取出硫酸铁后仍然有大量出血), 还是无活力(不出血)(图7-14)。只有在切除冠髓后才能进行判断。

一次就诊的牙髓摘除术: 用于不可逆性牙髓炎(只进行根管清创)

此法的适应证是根髓出血不止和不可逆性炎症。操作步骤包括清洁根管但不进行根管成形。

- 识别根管。
- 用有效的冲洗液冲洗根管, 例如次氯酸钠溶液(0.5%~1%)或者氯己定溶液(0.4%)来清除根管内碎屑。将小号根管锉插入根管内(不能超过30号), 插入长度比X线片上的根尖短2mm, 轻柔地锉根管壁, 再次冲洗以去

Indications

- Irreversible inflammation evident in radicular pulp tissue, shown by persistent bleeding at the radicular pulp stumps after coronal amputation.
- Completely non-vital radicular pulp with or without signs of infection.

Pulpectomy technique

There are two methods of approaching a pulpectomy, depending on whether the radicular pulp is irreversibly inflamed (copious bleeding even after removal of the ferric sulphate) or non-vital (no bleeding) (Fig 7-14). This can be assessed only after coronal pulp amputation.

One-visit pulpectomy: irreversible radicular pulpitis (canal debridement only)

This is indicated for a radicular pulp that will not stop bleeding and is irreversibly inflamed. The process involves cleaning the root canals without attempting to shape.

- Identify root canals
- Irrigate with an effective irrigant solution, such as sodium hypochlorite solution (0.5-1%) or chlorhexidine solution (0.4%) to clear debris. Insert small files (no greater than size 30) into canals, keeping 2mm short of the radiographic apex. File canal walls

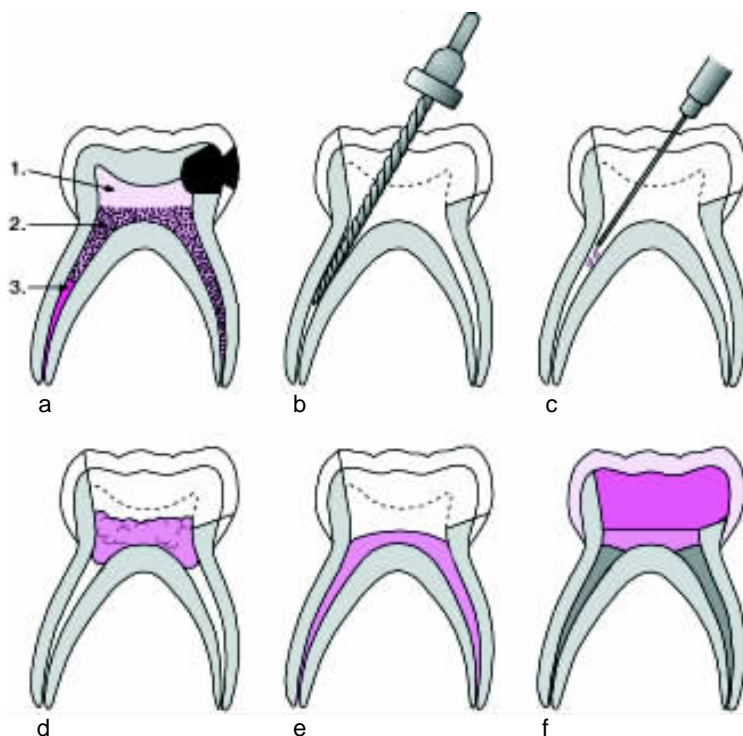


图7-14 牙髓摘除术。a. 1. 有牙髓坏死区的龋源性露髓乳磨牙；2. 不可逆性炎症；3. 一些残余的活髓组织。b. 利用X线片确定根管。将小号根管锉插入根管内至距X线片上根尖2mm处。轻柔地清洁根管壁，但是不要进行根管成形；c. 用大量次氯酸盐溶液冲洗根管，用事先测量好长度的纸尖擦干根管；d. 如果根管内分泌物过多，考虑向根管内注入不固化的氢氧化钙糊剂，并在髓室中放一个小干棉球，暂封7~14d。根充前可保留封药7~14d；e. 如果根管是干燥的，或者在封药7~14d后出现愈合的迹象，则用螺旋充填器或钝头纸尖，将缓慢固化的糊剂充入根管（例如纯氧化锌丁香油糊剂）；f. 像活髓切断术那样修复牙齿

Fig 7-14 The pulpectomy. (a) A cariously exposed primary molar with areas of necrotic pulp (1), irreversible inflammation (2) and some residual vital tissue (3). (b) Identify root canals using a radiograph. Insert small files into root canals, keeping 2mm from the radiographic apex. Lightly and gently clean walls of canal but do not shape, (c) Copious irrigation with hypochlorite solution. Dry canals with premeasured paper points, (d) If the root canals are wet with exudate, consider injecting non-setting calcium hydroxide paste into the canals. Place a dry pledget of cotton wool in pulp chamber and restore temporarily for seven to 14 days. This can be left in-situ for seven to 14 days before obturating, (e) If the canals are dry, or if there is evidence of healing after seven to 14 days, obturate root canals with a slow-setting paste (e.g. pure zinc oxide-eugenol) using a spiral paste filler or blunt end of a paper point, (f) Restore as for vital pulpotomy

除碎屑。因为乳牙根管壁非常薄，所以不要锉除牙本质（即“根管成形”）。

- 用预先测量好长度的纸尖擦干根管（长度为距离根尖 2mm）。
- 使用缓慢固化的糊剂（例如慢凝的纯氧化锌丁香油糊剂）充填根管，用螺旋充填器或者钝头纸尖把糊剂导入根管。
- 如前所述，用封闭性好的材料进行永久性修复。

两步法牙髓摘除术：用于死髓牙

此方法最适用于死髓牙，也可用于与牙髓坏死有关的慢性牙周（感染）。开始的根管清洁和封药用于治疗任何可能存在的感染。

第一次就诊（拔髓、清洁根管和封药）

- 这些步骤与一次就诊的牙髓摘除术相同。
- 根管内放入不固化的氢氧化钙糊剂，再放一个干的小棉球，然后用可固化的氧化锌丁香油酚粘固剂暂封。可考虑全身使用抗生素。

第二次就诊（封闭和牙冠修复）

如果出现了愈合迹象，则有关的治疗步骤与一次就诊法牙髓摘除术的

lightly and gently, irrigate again to remove debris. Do not remove dentine (i.e. òshapeÓ), as the canal walls are very thin.

- Dry canals with a premeasured paper point, (remaining 2mm from the apices)
- Obturate with slow-setting paste (e.g. slow-setting pure zinc oxide-eugenol) using spiral paste filler or packing with the blunt end of a paper point.
- Place a well-sealed permanent restoration as before.

Two-visit pulpectomy: non-vital teeth

This technique is best reserved for those teeth that are non-vital but may also have an associated chronic sinus (infection). The initial cleaning and dressing serves to treat any infection that may be present.

Visit one (extirpation, cleaning and dressing)

- The steps are identical to the one-visit pulpectomy.
- Dress the tooth with non-setting calcium hydroxide paste and seal with a dry cotton wool pledget and setting zinc oxide-eugenol cement. Consider prescribing a systemic antimicrobial.

Visit two (obturation and coronal restoration)

If healing has occurred the steps involved are identical to the latter stages of the one-

后半部分操作步骤相同。如果没有任何愈合的迹象，则是拔牙的指征。

牙髓治疗一旦开始，儿童就必须定期进行临床和X线检查。牙髓治疗后，如果孩子的牙齿出现任何症状，建议看护人及时带患儿复诊。

复诊的临床和放射学检查

复诊的临床检查

治疗后大概1个月应该复诊进行临床检查，然后每间隔6个月复诊一次。临床成功的指标有：

- 经牙髓治疗的牙齿无痛。
- 没有任何根尖周感染的体征或症状，例如：
 - 叩痛
 - 颊 / 舌 / 腭侧牙龈敏感或者肿胀
 - 瘻管的形成和与之相关的动度。

放射学复查

一般来说，建议牙髓治疗的牙齿每年进行一次X线片检查(咬合翼片即可。图7-15)。X线片上成功的指标有：

visit pulpectomy. If healing has not occurred, extraction is indicated.

Once pulp therapy has been undertaken it is essential that the child is reviewed on a regular basis, both clinically and radiographically. After undergoing pulp treatment, carers should be advised to return if any symptoms arise from their child's tooth.

Clinical and Radiographic Review

Clinical Review

The tooth should be monitored clinically perhaps one month postoperatively, then subsequently at six-monthly intervals. Successful clinical outcome can be marked by:

- A pain free pulp-treated tooth.
- Absence of any signs or symptoms of periapical infection, such as
 - tenderness to percussion
 - buccal/lingual/palatal tenderness or swelling
 - sinus formation and associated mobility.

Radiographic Review

Generally, it is recommended that any tooth that has undergone endodontic treatment is assessed using annual radiographs (bitewings will suffice. Fig 7-15). Successful radiographic outcome can be marked by:

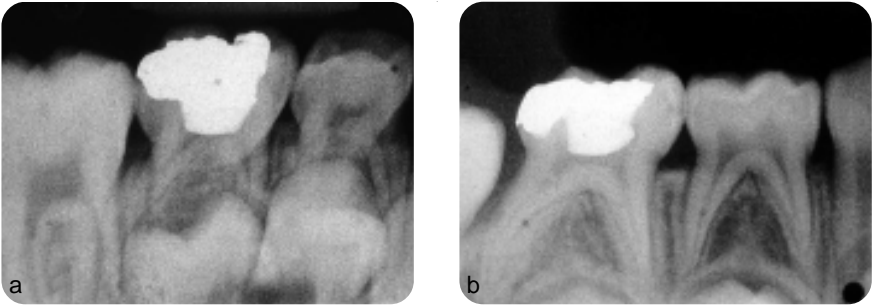


图 7-15 成功的活髓切断术，术后一年左右的 X 线表现：a. 使用甲醛甲酚；b. 使用氢氧化钙粉

Fig 7-15 Radiographic views of successful vital pulp potencies using (a) formocresol and (b) calcium hydroxide powder approximately one year after treatment

- 牙髓摘除术的牙齿正常脱落。
- 根尖周无病变。
- 无牙内吸收。
- 继承恒牙正常萌出。

- Normal exfoliation of the pulpoto-mised tooth.
- Absence of periradicular pathology.
- Absence of internal resorption.
- Normal eruption of the permanent successor.

甲醛甲酚的争论已经结束

直到 2004 年 6 月，在进行活髓或死髓牙牙髓切断术时，还建议使用 1:5 稀释的 Buckley 配方甲醛甲酚覆盖根髓表面。这种溶液也用于牙髓摘除术。

甲醛甲酚包含甲醛成分，甲醛是有效的杀菌剂和组织固定剂。甲醛甲酚含有邻、间、对三种甲酚混合物，具有抗微生物作用，但在甲醛甲酚中的作用仍不清楚。

The Formocresol Controversy has Ended

The medicament that was advocated up until June 2004 for application onto the radicular pulp stumps for a vital or non-vital pulpotomy was a 1:5 dilution of Buckley's formocresol. This solution was also used during pulpectomy procedures.

Formocresol contains formaldehyde, which is a potent antimicrobial agent and tissue fixative. It also contains tricresol, which is antimicrobial, though role in formocresol is unclear.

20世纪50年代以来,甲醛甲酚活髓治疗技术运用于乳牙取得了较大的成功。20世纪70年代提倡使用稀释的溶液,其效果与高浓度溶液一样好。有报道其成功率在80%~100%。

但是,甲醛甲酚的安全性日益受到关注,即使是稀释到1:5,关注的焦点是其成分之一——甲醛,甲醛溶于水,机体反应性高且代谢迅速。以下是人类病例报道和动物实验或细胞培养研究所引证的一些效应。

局部效应

- 软组织灼伤。
- 下方牙胚形成障碍(人类病例研究报道)。
- 继承恒牙萌出紊乱(人类病例研究报道)。

全身效应

甲醛甲酚迅速分布到全身(灵长类和犬科动物研究报道),并且已知有诱导基因突变和致癌的潜能(灵长类,细胞培养和大鼠的研究报道),还有胚胎毒性和致畸作用(鸡胚研究报道)。

The technique of vital pulp therapy has been used in primary teeth since the 1950s with much success. The dilute solution was advocated for use in the 1970s and is as effective as the full-strength solution. Success rates ranging from 80-100% were reported.

There was growing concern, however, over the safety of even a 1:5 dilution of formocresol, centred on one of its constituents, formaldehyde which is soluble in water, highly reactive and metabolised rapidly. The following effects have been cited in human case reports and laboratory-based animal or cell culture studies.

Local Effects

- Soft-tissue burns.
- Disordered formation of underlying tooth germ (reported in human case studies).
- Disturbance of eruption of the permanent successor tooth (reported in human case studies).

General Effects

Formocresol has a rapid systemic distribution (reported in primates and canine studies) and is known to have mutagenic and carcinogenic potential (reported in primates, cell culture and rats studies) as well as being embryotoxic and teratogenic (reported in studies using chick embryos).

狗的研究发现，多个牙进行甲醛甲酚牙髓切除术后，放射性同位素标记的甲醛甲酚在下列组织中可以检测到：

- 牙周韧带、骨、牙本质和牙髓。
- 肝、肺和肾。
- 脑。

直到2004年6月国际癌症研究会 (International Agency for Research on Cancer, IARC) 发出了甲醛甲酚蒸汽对于人类具有致癌性的警告，儿童口腔科界才做出废止使用甲醛甲酚的决定。这部文献指出，在总结了多项系统研究结果之后，发现甲醛甲酚与鼻咽癌有正相关性，并且可能与上呼吸道其他部位的肿瘤有关，例如鼻黏膜和鼻旁窦。硫酸铁作为甲醛甲酚的替代品已经用于一些教学中心。

甲醛甲酚的替代品

对一些可能成为甲醛甲酚活髓切断术替代方法的制剂 / 技术进行了评估。它们包括：

- 氢氧化钙糊剂、粘固剂和氢氧化钙粉剂。
- 电刀。
- 激光。
- 硫酸铁。

Radioisotope-labelled formaldehyde has been identified systemically in the following tissues in dogs after multiple formocresol pulpotomies:

- Periodontal ligament, bone, dentine and pulp.
- Liver, lungs and kidney.
- Brain.

However, within paediatric dentistry, the decision to abandon the use of formocresol was finally made following a release from the IARC in June 2004. This document stated that formaldehyde vapour is a carcinogen in humans. The large, systematic review concluded from several extended cohort studies that formaldehyde has a positive correlation with nasopharyngeal carcinoma and possibly other upper respiratory tract sites such as the nasal mucosa and paranasal sinuses. The alternative agent that some teaching centres have begun using is ferric sulphate.

Alternatives to Formocresol

Several agents/techniques have been evaluated as possible alternatives to the formocresol vital pulpotomy. These include:

- Calcium hydroxide pastes, cements and powder.
- Electrosurgery.
- Lasers.
- Ferric sulphate.

- 骨形成蛋白。
- 矿物三氧化物聚合体(MTA)。

尽管已证实其中一些制剂 / 技术很有发展前途, 但缺乏有关这些替代品的临床研究。过去甲醛甲酚是牙髓切断术制剂的“金标准”, 但是现在已不再提倡。过去它之所以即使是由新手操作也非常成功, 其中一个原因是它“处理”炎症性根髓的作用优于其他任何替代品。它可以固定有炎症的牙髓, 其他替代品, 例如氢氧化钙、硫酸铁和 MTA, 并不能产生固定作用, 而是更依赖于促进牙髓的愈合。但问题的关键是, 即使是在现代条件下, 我们仍旧不能使一个不可逆性牙髓炎愈合。尽管如此, 氢氧化钙粉末、硫酸铁溶液和 MTA 的早期研究结果非常令人鼓舞。人们普遍认为, 在根髓没有炎症 (或者轻度的可逆性炎症) 的情况下使用这些替代药物, 其成功概率较大。有关这些药物 (特别是硫酸铁) 的临床试验日渐增多, 但仍需要进一步的研究来评估长期疗效, 以及对牙髓组织的作用和全身系统性分布的可能性。

- Bone-morphogenic proteins.
- Mineral trioxide aggregate.

Although some of these agents/techniques prove promising, there has been insufficient clinical research involving these alternatives. Formocresol was the gold standard of pulpotomy agents but can no longer be advocated. One of the reasons why it was so successful, even in inexperienced hands, was because it could deal with an inflamed radicular pulp better than any of its alternatives. It will fix an inflamed pulp, whereas alternatives such as calcium hydroxide and ferric sulphate and mineral trioxide aggregate are unable to produce fixation, but rely more upon allowing the pulp to heal. The bottom line is that, even in this modern age, we are still unable to promote healing in an irreversible pulpitis. Despite this, there have been promising early results from calcium hydroxide powder, ferric sulphate solution, and mineral trioxide aggregate. With these alternative medicaments it is generally thought that they have a greater chance of success if there is no inflammation (or mild reversible inflammation) present within the radicular pulp. Clinical trials looking at these agents (particularly ferric sulphate) are increasing but further research is required to assess long-term survival rates, effects upon pulp tissue and the possibility of systemic distribution.

内吸收——牙髓治疗后内吸收的危险性会增加吗？

现在的观点认为剩余牙髓组织的炎症状态最大程度地决定了活髓切断术是否成功。如果根髓断面广泛且长时间的出血，则不应采用活髓切断技术，患牙应该行牙髓摘除术。

从理论上讲，在活髓切断术中，如果硫酸铁或氢氧化钙用于有不可逆性炎症的根髓，将不会出现愈合现象。肯定会发生慢性炎症，导致内吸收的危险性增加。慢性炎症将激活牙髓系统内的破牙细胞，产生病理性吸收。

器械和药品

表 7-1 概括了一系列用于乳牙牙髓治疗的基本器械和所需的充填修复材料。值得注意的是全部设备都很简单，大多数物品都很容易得到。

药 品

常用的牙髓治疗药品如下。

Internal Resorption - Is There An Increased Risk Following Pulp Therapy?

Present-day thinking suggests that the inflammatory status of the residual pulp tissue has greatest bearing upon a successful outcome following vital pulpotomy. If the radicular pulp stumps are bleeding copiously and prolonged, vital pulp therapy techniques should not be used. The tooth should be treated with a pulpectomy.

In vital pulpotomy, it follows logically, that if ferric sulphate or calcium hydroxide is used on an irreversibly inflamed radicular pulp, healing will not occur. Chronic inflammation will ensue, leading to a greater risk of internal resorption. Chronic inflammation will stimulate odontoclastic activity within the pulp system, producing pathological resorption.

Instruments And Medicaments

Table 7-1 outlines the basic instruments and restorative materials required for a range of pulp therapy treatment for primary teeth. It is worthwhile noting that the armamentarium is simple and most of the items are very readily obtainable.

Medicaments

The commonly used pulp therapy medicaments are described below.

表7-1 牙髓治疗术所需的基本器械和充填材料

Table 7-1 The basic instruments and restorative materials for pulp therapy

步 骤	器 械 / 药 品
窝洞外形和去腐	小号金刚砂高速钻（裂钻和球钻） 小号不锈钢低速钻（1 号和 2 号球钻）
揭髓顶	口腔科橡皮障 末端无刃的裂钻（例如 Batt 钻）
冠髓切断	消毒的锐利挖匙 消毒的不锈钢球钻（例如 2 号）
根髓断面止血	小的消毒棉球 冲洗器中的消毒盐水或清水
根管器械预备（牙髓摘除术）	带橡皮制动片的小号根管锉，可控制工作长度 装有冲洗液的冲洗器（例如次氯酸盐或氯己定溶液） 纸尖（测量好工作长度）
根管充填（牙髓摘除术）	缓慢固化的纯氧化锌丁香油粘固剂 螺旋充填器，或者用于导入糊剂的钝头纸尖
髓腔充填	速硬氧化锌丁香油酚粘固剂
冠内修复	玻璃离子粘固剂或配合适当粘结剂的复合体
冠外修复	玻璃离子粘固剂粘着的金属预成冠

15% 硫酸铁溶液

Astringent™ 15%硫酸铁水溶液

有浓度更高的溶液，但不适用于牙髓治疗。用棉球或者其他特殊器械放置。

Ferric sulphate 15% solution

Astringent™ Ferric sulphate 15% in aqueous vehicle.

Stronger solutions are available but are not indicated for pulp therapy. It can be applied using cotton wool, or a special applicator.

Ledermix™ 糊剂

1 克糊剂包含：

活性成分：

曲安西龙丙酮(甾类) 10mg

地美环素(抗菌药) 30mg

还包括：

氯化钙

氧化锌

硫酸钠

三乙醇胺

聚乙二醇

纯净水

实用提示

- 治疗失败的原因常归结于以下一种或多种原因：
 - 患牙选择不当
 - 牙髓切除不完全
 - 牙冠微渗漏
- 在决定牙髓治疗前拍摄 X 线片。
- 在可能的情况下应行局部麻醉。在下颌第一恒磨牙萌出之前,可以采用浸润麻醉。
- 最常露髓的部位是高尖的近中髓角。

Ledermix™ paste

1 gram of paste contains:

active ingredients

Triamcinolone acetonide (steroid)
10mg

Demeclocycline (antimicrobial)
30mg

also contains

calcium chloride

zinc oxide

sodium sulphite

triethanolamine

polyethyleneglycols

purified water

Practical Tips

- The reasons for failure often fall into one or more of these categories:
 - poor choice of teeth
 - inadequate pulp amputation
 - coronal leakage.
- Radiographs should be taken before a decision is made to perform pulp therapy.
- Local anaesthesia should be administered wherever possible. In the mandible, infiltrations can be used until eruption of the first permanent molar.
- A common exposure site is the high mesial pulp horn.

- 用小而锐利的挖匙去除最后的冠髓残余。避免在髓室底用钻针；因为髓室底很薄，容易穿通。
 - 将硫酸铁湿棉球置于切断面之前应吸干。即使是使用了橡皮障，也应在其上方置一干棉球，以防药液流到软组织上。
 - 牙髓治疗后，进行完善、持久地修复，金属预成冠最为理想。
- Use a small sharp excavator to remove the last fragments of coronal pulp tissue. Avoid the use of burs on the floor of the pulp chamber; it is thin and liable to perforate.
 - Blot the ferric sulphate-moist cotton wool pledget before placing it over the amputation site. Place dry cotton wool over the top of this to prevent seepage onto soft tissues, even if you have dental dam placed.
 - Place a good, long-lasting restoration post pulp treatment, ideally a pre-formed metal crown.

参考文献

References

- 1 Barr ES, Flaitz CM, Hicks MJ. A retrospective radiographic evaluation of primary molar pulpectomies. *Pediatric Dentistry*, 1991; 13: 4-9
- 2 Casas MJ, Kenny DJ, Johnston DH, Judd PL. Long-term outcomes of primary molar ferric sulfate pulpotomy and root canal therapy. *Pediatric Dentistry*, 2004; 26: 44-48
- 3 Eidelman E, Holan G, Fuks AB. Mineral trioxide aggregate vs. formocresol in pulpotomized primary molars: A preliminary report. *Pediatric Dentistry*, 2001; 23: 15-18
- 4 Farooq NS, Coll JA, Kuwabara A, Shelton P. Success rates of formocresol pulpotomy and indirect pulp therapy in the treatment of deep dentinal caries in primary teeth. *Pediatric Dentistry*, 2000; 22: 278-286
- 5 Fuks AB. Current concepts in vital primary pulp therapy. *European Journal of Paediatric Dentistry*, 2002; 3: 115-120
- 6 Hobson P. Pulp treatment of deciduous teeth. Part 2: Clinical investigation. *Br Dental J*, 1970; 128: 275-283
- 7 International Agency for Research on Cancer. IARC classifies formaldehyde as carci-

nogenic to humans. Press Release No 153. http://www.iarc.fr/pageroot/PRE-LEASES/prl_53a.html

- 8 Smith NL, Seale NS, Nunn ME. Ferric sulfate pulpotomy in primary molars: A retrospective study. *Pediatric Dentistry*, 2000; 22: 192-199
- 9 Waterhouse PJ. Formocresol and alternative primary molar pulpotomy medicaments. A review. *Endodon Dent Traumatol*, 1995; 11: 157-162
- 10 Waterhouse PJ, Nunn JH, Whitworth JM. An investigation of the relative efficacy of Buckley's formocresol and calcium hydroxide in primary molar vital pulp therapy. *Br Dental J*, 2000; 188: 32-36

第 8 章 避免拔除龋坏的乳前牙

Avoiding Extraction of Carious Anterior Primary Teeth

目 的

本章的目的是讨论适用于乳前牙的修复技术。

要 点

阅读本章后，临床医生应该了解修复乳前牙龋齿的各种不同方法。此外，应该清楚本章所述的许多治疗技术简便易行，所使用的器械和材料也易于得到。

引 言

乳前牙龋齿对儿童的容貌有很大影响（图 8-1），家长们可能会因此而求助于口腔医生，以改善孩子的容貌。治疗取决于龋损破坏的程度和儿童年龄以及他们的配合程度。值得注意的是理论上大多数儿童口腔科医生更愿意先治后牙再治前牙，因为乳磨牙在保持牙弓长度中发挥重要的作用。尽

Aim

The aim of this chapter is to discuss the techniques available to restore anterior primary teeth.

Outcome

After reading this chapter the practitioner should have knowledge of the different approaches to restoring caries in anterior teeth. In addition, you should have awareness that many of the techniques covered in this chapter are simple to provide, using equipment and materials that are easily obtainable.

Introduction

Dental caries affecting the anterior primary teeth can have a major impact upon a child's appearance (Fig 8-1) and, to this end, parents may seek the help of a dentist in order to improve their child's appearance. Treatment depends upon the extent of the carious destruction and the age and level of cooperation of the child. It is worth not-



图8-1 低龄儿童的乳牙猖獗龋
Fig 8-1 The primary dentition of a young child with rampant caries

管如此，在治疗计划中涉及到孩子的适应性时，还是应该首先治疗小面积的前牙龋。改善孩子的前牙美观，也许还会促使父母 / 看护人和孩子积极配合既定的预防项目。

乳前牙龋

在年龄很小的儿童中，那些学龄前的儿童，上前牙龋常常是因为发生了所谓的低龄儿童龋，以前被定义为“喂养龋”（图 8-2）。通常的原因是长期频繁地饮用非乳制品来源的外源性高糖液体。经常是用奶瓶或者奶杯给孩子喂这些饮料，特别是在睡觉时，含糖饮料在孩子前牙的周围形成一个饮料池。少数病例后牙也会受累，最终导

ing that, ideally, most paediatric dentists would treat caries in the posterior teeth before the anterior, since the primary molars are important in maintaining arch length. Despite this, there is some value in treating small anterior lesions first in a treatment plan involving acclimatisation. Improving anterior aesthetics in a child may also boost the willingness of both the parents/carers and the child to cooperate with any planned preventive programme.

Carious Lesions In Primary Anterior Teeth

In very young children — those of pre-school age — the presence of caries in the upper anterior teeth is often due to a condition known as early childhood caries, previously termed ‘nursing caries’ (Fig 8-2). Prolonged and frequent drinking of liquids high in non-milk extrinsic sugars usually cause it. These drinks are often given to the child via a nursing bottle or feeder-cup,

图 8-2 奶瓶内含糖饮料造成的低龄儿童龋——“喂养龋”或者“奶瓶龋”

Fig 8-2 Early childhood caries caused by sugary liquids in a feeding bottle — Nursing caries or Bottle caries



致严重的牙冠破坏。年幼儿童的低龄儿童龋或喂养龋可以是侵袭性的，发展迅速，可导致牙冠大面积破坏。在这些病例中，龋坏常始于唇侧（Ⅴ类），唇侧龋可与邻面龋融合（Ⅲ类），最终导致大范围的环状龋。

学龄儿童也会发生前牙龋，但龋损的侵袭性不如喂养龋，并且具有不同的分布特点，邻面龋（Ⅲ类）比较常见。

乳牙下前牙龋相对比较少见。这些牙齿得益于下颌下腺和舌下腺唾液的持续冲洗作用，而且当婴儿用奶瓶或者奶杯喝饮料的时候，舌头盖住了下前牙。如果下前牙发生了龋齿，则是猖獗龋的诊断指征。

particularly at sleep-time, allowing sugary liquid to pool around the anterior teeth. In severe cases, the posterior teeth may also be involved. Early childhood caries or nursing caries in young children can be aggressive and develop rapidly, resulting in gross coronal destruction. The carious destruction in such cases often begins with a labial lesion (Class V), which may then become confluent with approximal (Class III) lesions — resulting in a large circumferential lesion.

School-aged children may also develop carious anterior teeth, but lesions tend to be less aggressive than nursing caries and of a different distribution, with approximal lesions (Class III) common.

It is less common to see dental caries affecting the lower anterior primary teeth. These teeth benefit from being constantly bathed in saliva from the submandibular and sublingual glands, and the tongue acts to cover these teeth when infants drink from

邻面龋

- 邻面龋始发于邻面宽的接触区。
- 常见部位在乳切牙的近中面。
- 在混合牙列当中,乳尖牙的远中面可以受累,特别是如果乳尖牙和第一乳磨牙有接触的话(没有灵长间隙存在)。
- 如果不作任何处理,乳牙邻面龋会比恒牙更快地破坏切端,因为乳牙牙冠长度相对较短。

对釉质龋应该采取一系列预防性措施(不仅仅是局部用氟)。一旦累及牙本质,就应采取修复治疗。当决定去腐时,是应该使用通过片切的方法让牙齿“自洁”,还是应该备洞充填呢?

片切

这是一项实用技术,用于治疗未

a bottle or feeder cup. If caries is present at this site, a diagnosis of rampant caries is appropriate.

The Proximal Lesion

- This lesion starts at the site of the broad contact area.
- A common site appears to be the mesial surface of the primary incisors.
- In the mixed dentition the distal aspect of primary canines can be affected, particularly if there is contact between the canine and first primary molar (no primate space).
- If left untreated, the proximal lesion will undermine the incisal edge relatively quicker than would occur in the permanent dentition because of the shorter crown length of the primary tooth.

Caries involving enamel should be treated by a package of preventive measures (not just topical fluoride application). Once dentine is involved, restorative treatment should be provided. When a decision has been made to remove the caries, should the tooth be left self-cleansing by using the method of discing, or will cavity preparation be required with subsequent restoration?

Discing

This is a useful technique to treat proxi-

累及牙髓的邻面龋。它要求磨除全部或者部分邻面龋，剩余牙冠的近远中面平行或者向切端轻度聚拢。这种方法最适用于3岁以上的儿童，因为此年龄上颌尖牙已完全萌出。一般认为一旦乳尖牙萌出，减少乳牙切缘的近远中宽度不会导致间隙丧失。

- 片切只去除表面腐质，留下自洁区内的腐质。
- 预防性治疗是否成功取决于患者的依从性，因为其治疗目的是促进残余的龋损静止。
- 尽管这是一项非常实用的技术，但可能不太美观。

牙齿磨除的量，受限于与髓角的邻近程度。片切后涂高浓度的氟保护漆（例如Duraphat™）以促进牙齿再矿化（图 8-3）。

实用器械（图 8-4）

- 从粗到细的小号片切盘。
- 轴柄。

mal lesions, which have not involved the pulp. It requires full or partial caries removal proximally, leaving either a crown with parallel sides mesially and distally or gently tapering towards the incisal edge. This approach is most appropriate in children older than three years, since the upper canines are fully erupted by this age. Once the primary canines are erupted it is thought that reduction in the mesiodistal width of the primary incisal edges will not result in space loss.

- Discing removes superficial caries only, leaving any remaining caries in a self-cleansing area.
- It relies upon compliance with a preventive programme to be successful, since the aim is to promote arrest of residual caries.
- Although this technique is extremely useful, aesthetics can be poor.

The amount of tooth removal is limited by the close proximity of the pulp horns. A high fluoride concentration varnish (e.g. Duraphat™) can be applied after discing to promote remineralisation (Fig 8-3).

Useful instruments (Fig 8-4)

- Small abrasive discs ranging from coarse to fine.
- Mandrel.

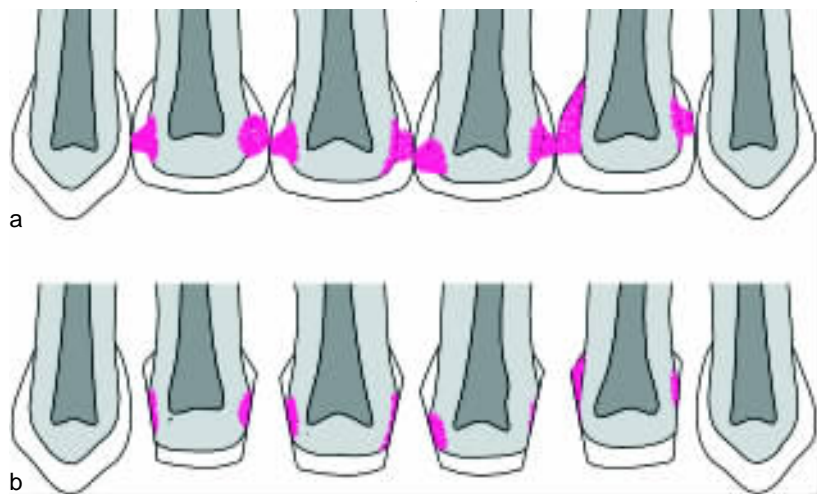


图8-3 a. 上颌乳切牙邻面龋（未及牙髓）; b. 片切后的上颌乳切牙，牙齿呈锥形而且并不是完全没有龋损，片切的区域应有自洁性，此阶段应在片切区局部涂氟

Fig 8-3 (a) Approximal caries (not involving the pulp) in maxillary primary incisors, (b) Maxillary primary incisors after discing. The teeth appear tapered and are not caries free. The disced areas should be self-cleansing. Topical fluoride may be applied to the disced areas at this stage



图8-4 为更安全的片切而设计的微型抛光切盘和小号轴柄，可用在片切表面涂氟保护漆的小刷子

Fig 8-4 Miniature abrasive polishing discs and small mandrel used for safer discing. Topical fluoride varnish can be applied to the disced areas with a brush

- 慢速手机。
- 锥形钻或许可以代替切盘。

入 路

切盘应放在邻间隙中，以便磨除表层的腐质。应将患者的唇舌拉开以防止医源性损伤，这一点十分重要。可用棉卷（唇）和小号吸唾器（舌）以及口腔医生的手指来做到这一点。

去 腐

该项技术的目的是使牙齿切缘的近远中径窄于牙颈部宽度以形成“自洁”区。病变的部位决定了切盘在牙齿表面的角度。如果龋坏很深，就不要试图用片切法去腐，因为可能会露髓。片切的目的是使近远中面平行或呈轻度锥形。用细切盘圆钝锐利的线角。

氟化物的应用

有一些儿童口腔科医生喜欢用含高浓度氟的保护漆涂布片切过的邻面，以帮助龋齿静止。

- Slow handpiece.
- A tapered bur maybe an alterative instrument.

Access

The discs are placed interproximally in order to remove superficial caries. It is vitally important that the patient's lips and tongue are retracted to avoid iatrogenic injury. This can be achieved with cotton wool rolls (lips) and a small saliva ejector (tongue) and the dentist's fingers!

Caries removal

The aim of this technique is to make the tooth's incisal edge narrower in a mesio-distal aspect than its cervical width - to produce a "self-cleansing" area. The site of the lesion dictates the angulation of the disc at the tooth surface. If caries is deep, do not attempt to remove it with the disc, since pulpal exposure will occur. Aim for parallel sides or a gentle taper mesiodistally. Smooth sharp line angles with the finer grades of abrasive disc.

Fluoride application

Some paediatric dentists favour application of a varnish containing a high fluoride concentration to the prepared approximal surfaces to aid arrest of caries.

实施要点：片切法

- 此项技术必须与预防性措施联合使用,包括饮食建议和口腔卫生指导。
- 开始片切之前,讨论片切后所形成的牙齿形态是明智之举。
- 使用小号磨盘可以减少伤害软组织的可能性。
- 避免使用金属抛光条或者抛光盘。他们会产生大量的热并可能造成牙龈的损伤。

备洞（ 类洞）

如果龋坏深达牙本质,但尚未累及牙髓,应该备洞充填而不是片切,这样更美观。

有用的器械

- 小号锐利挖匙。
- 低速手机的1号和2号不锈钢球钻。
- 高速手机的梨形和小号球形金刚砂钻。

入 路

这取决于前牙邻面接触是开放型还是封闭型。

Practical Tips: Discing

- This technique must be used in conjunction with preventive programme involving dietary advice and oral hygiene instruction.
- It is wise to discuss the resulting shape of the teeth before you embark on discing.
- Miniature abrasive discs are available and lessen the potential for soft-tissue damage.
- Avoid metal polishing strips or discs. They generate excessive amounts of heat and may cause gingival trauma.

Cavity Preparation (Class III)

When caries is well into dentine, but not involving the pulp, cavity preparation and restoration should be done instead of discing. This will give a better aesthetic result.

Useful instruments

- Small sharp excavators.
- Slow speed - sizes 1 and 2 round steel burs.
- High speed - pear shaped and small round diamond burs.

Access

This can depend on whether the anterior tooth proximal contacts are open or

· 封闭型——入路可以从颊侧(下牙)或者腭侧(上牙)的冠中1/3处进入。小号不锈钢球钻或者金刚砂钻对于寻找入路很有帮助。

· 开放型——使用小号不锈钢球钻或小挖匙 较容易从邻间隙直接进入。

去 腐

· 为避免破坏健康牙体组织 ,洞缘线应由去腐情况来决定 ,很可能是“C”形。同样使用不锈钢球钻去腐。

· 内部线角应圆钝以防止露髓。

修 复

· 在轴壁上垫一层固化氢氧化钙作为间接盖髓 ,也可以直接在轴壁上垫玻璃离子类洞衬材料(例如Vitrebond)

· 在封闭型接触的前牙 ,必须使用赛璐珞成形片以确保形成良好的接触区和楔状隙。

closed.

· Closed — access may be gained via the buccal (mandibular teeth) or palatal (maxillary teeth) aspect at the level of the mid-third of the crown. Small round steel or diamond burs are useful to gain access.

· Open — access achieved more easily directly via interproximal surface using small round steel burs, or small excavators.

Caries removal

· Avoiding unnecessary destruction of sound tooth tissue, the cavity outline will be dictated by caries removal but will probably be C shaped. Again, round steel burs are used to remove caries.

· Internal angles should be rounded to avoid pulp exposure.

Restoration

· A lining of hard-setting calcium hydroxide may be placed on the axial wall as an indirect pulp cap. However, glass-ionomer-type lining agents (e.g. Vitrebond) may be placed directly on the axial wall of the cavity.

· In anterior dentitions with closed contacts, cellulose matrix strips must be used to ensure contacts and embrasures remain patent.

- 可以使用玻璃离子充填材料修复牙体组织 ,因为玻璃离子有粘结性和释放氟的特性。但是 ,在美观方面 ,它不够透明。
- 如果孩子能够耐受使用粘结系统和更加严格的隔湿措施 ,也可以用更加透明的材料 ,例如复合树脂或复合体。
- 可以使用特殊的“ 儿童 ”色复合树脂 ,其颜色与相对色浅的乳牙釉质很匹配。

颊侧或唇侧龋 (类洞)

这类龋损通常累及切牙或者尖牙的唇面龈1/3 ,并可通过直接视诊做出诊断。如果龋损扩展到龈下 ,处理起来可能会有困难 (图 8-5)。

- A glass-ionomer restoration may be used because of its adhesive and possible fluoride-releasing properties. However, aesthetically it is quite opaque.
- More translucent materials such as composite or compomer may also be used if the child can tolerate the use of bonding systems and more stringent moisture control.
- Special ÒpaediatricÓ shades of composite are available to shade-match with the relatively lighter enamel of primary teeth.

The Buccal or Labial Lesion(Class V)

This lesion usually involves the gingival one-third of the labial surface of an incisor or canine and can be diagnosed by direct vision. They can be difficult to deal with if the carious lesion extends below the gingival margin (Fig 8-5).



图8-5 颊/唇面龋侵犯了上颌乳尖牙和乳切牙

Fig 8-5 Buccal/labial caries affecting the maxillary primary canine and incisors

实用器械

- 小号锐利挖匙。
- 低速手机的1号和2号不锈钢球钻。
- 高速手机的梨形和小号圆形金刚砂钻。

技 术

此类病损的龋坏可能会向侧方扩展,累及大范围的牙体组织。在去腐后形成的窝洞中,暴露的牙本质质量多于釉质。在牙颈部釉牙骨质交界处,釉质层相对较薄,所以,此区域的窝洞中可供粘结的牙本质多于釉质。

入 路

窝洞预备的入路直接明了。可以使用金刚砂钻形成洞缘线。

去 腐

去腐的原则与邻面龋相似。去腐后常会产生“腊肠形”或者肾形洞缘线。可以用小号不锈钢球钻或者小号锐利挖匙去腐。

Useful instruments

- Small sharp excavators.
- Slow speed - sizes 1 and 2 round steel burs.
- High speed - pear shaped and small round diamond burs.

Technique

In these lesions, caries appears to spread laterally to involve a large surface area of tooth tissue. Caries removal results in a cavity where there is much more dentine than enamel exposed. The enamel layer is relatively thin in cross-section at the cervical region of the tooth, so a cavity in this region will have more dentine than enamel available for bonding.

Access

Access is obviously direct for cavity preparation. Outline can be established using diamond burs.

Caries removal

The principles of preparation are similar to approximal lesions. Caries removal often produces a "sausage" or kidney-shaped cavity outline. Caries may be removed using a small round steel bur or a small sharp excavator.

修 复

对于垫底和充填材料的选择与邻面龋损相似。但由于窝洞内可供粘结的釉质量极少,而牙本质相对较多,若不使用玻璃离子的话,在充填复合树脂或复合体之前,应考虑使用牙本质粘结剂。专用的透光成形片(例如 Hawes Neos 颈部成形片)可用以形成修复体的外形并缩短抛光时间。

实施要点

- 距主要病损 2mm 范围内的釉质脱矿或缺损都应该包括在制备的主窝洞中。
- 使用 1 号或者 2 号不锈钢球钻去除龈下腐质。操作时,你必须依赖于慢速手机的去腐“感觉”。
- 现在有一步法粘结系统可供使用(例如 Scotchbond 1),简化了粘结的步骤。
- 如果不用颈部成形片,用一个钝头直探针也可以保证填实充填材料,并去除所有多余的充填材料。

Restoration

The choice of material for lining and restoring is similar to approximal lesions. However, the cavity affords little enamel and relatively more dentine available for bonding, so if glass-ionomer is not used, consider the use of a dentine-bonding agent prior to placing composite or compomer. Proprietary light-transmitting matrices (e.g. a Hawes Neos cervical matrix) can be used to contour the restoration and reduce polishing time.

Practical Tips

- Any areas of enamel decalcification or areas of enamel breakdown within 2 mm of the main lesion should be included in the main cavity preparation.
- Use a size 1 or 2 round steel bur to remove subgingival caries. Doing this you are reliant upon the “feel” of caries removal afforded by a slow hand-piece.
- There are now single-stage bonding systems available (e.g. Scotchbond 1), which simplify the stages of bonding.
- If a cervical matrix is not used, use a blunt, straight probe to ensure the restorative material is well packed and any excess restorative material is removed.

环状龋

在同一颗牙上，唇面龋可能伴发邻面龋，因此这两处病损可能非常接近或者互相融合。这样就可能导致相当广泛的冠部缺损（图8-6）。同样地，在决定是否要修复牙齿，和选择什么样的修复方法真正对儿童最好之前，需要再次考虑所有建议修复体的必需寿命，孩子的年龄和他们的合作程度。这里有两种修复方法可供选择：

- 片切和充填相结合的方法。
- 放置树脂透明冠。

片切加充填修复

此法包括片切邻面病损和去除唇面腐质，并且只修复唇面。前面已经讨论过这两种方法，但是下列观点仍然

The Circumferential Lesion

A labial lesion may accompany an approximal lesion on the same tooth, so that the two lesions are in close proximity or merge. This can produce quite extensive coronal breakdown (Fig 8-6). Again, one needs to consider the required longevity of any proposed restoration and the age and level of cooperation of the child before a decision can be made as to whether to restore the tooth and, indeed, what restorative approach is best for the child. There are two restorative options available:

- A combination of discing and restoration.
- Placement of a composite òstripÓ crown.

Discing Plus Restoration

This technique involves discing the approximal lesion and removing caries from the labial lesion and restoring the la-



图 8-6 侵犯上颌乳切牙的环状龋

Fig 8-6 Circumferential carious lesions affecting the maxillary primary incisors

值得注意：

- 此法必须与严格的预防措施联合使用。
- 在唇面修复体与釉质片切面交接处，充填材料没有边界。在此处，修复体的边缘应与预备后的邻面平齐。
- 修复体不具备对侧向移动的抵抗力，因此建议使用粘结剂。

树脂冠

去腐会导致严重的牙体缺损。在乳牙上套“引导”冠的适应证如下：

- 牙冠大范围缺损，但牙齿还需要行使数年功能。
- 牙髓切断术 / 牙髓摘除术后。
- 患儿合作，且父母 / 看护人渴望保留乳牙。

技 术

- 去腐取决于龋损部位的情况，可能包括唇面和邻面的环状龋。
- 如果需要的话，应该在做冠之前

bial surface only. Both these approaches have already been discussed, but the following points are noteworthy:

- This approach should be accompanied by a rigorous preventive package.
- Where the labial restoration meets the area of disced enamel there will be no margin for the restorative material. Here the restoration should be finished flush with the approximal preparation.
- The restoration will not possess resistance to lateral displacement, so bonding agents are recommended.

Composite Crowns

Caries removal will have rendered the tooth severely broken down. The following points may indicate the placement of a DirectÓ crown on a primary tooth:

- Gross coronal breakdown of a tooth still required to give several years more service.
- Post-pulpotomy/pulpectomy.
- Cooperative children with parents/careers who are extremely keen to maintain the primary dentition.

Technique

- Caries removal is dictated by the site of the lesion and may include labial and approximal circumferential lesions.
- Pulp therapy, if required, should be

进行牙髓治疗。

- 如果没有露髓,但是窝洞的轴壁很近髓,则考虑在牙冠修复之前,用固化氢氧化钙洞衬材料间接盖髓。

牙冠修复所需的材料:

- 多用途粘结剂(因为既要粘结牙釉质也要粘结牙本质)
- 超浅色或者“儿童”色混合填料型复合树脂。
- 一系列不同大小的乳前牙赛璐珞成形冠。
- 打磨抛光盘(例如小号的Soflex盘)
- 细的金刚砂树脂磨光钻。
- 咬合纸。
- 剪刀。

如何选择正确的成形冠

选择合适的赛璐珞成形冠,与选择金属预成冠(不锈钢冠图8-7)的原则相似。一般来说有两种方法:

- 使用分脚规来测量牙齿切端的近远中宽度,并且选择最匹配的赛璐珞冠。

carried out before crown placement.

- If the pulp has not been exposed, but the axial wall of the cavity is close to the pulp, consider an indirect pulp cap with a hard-setting calcium hydroxide lining material before coronal restoration.

Materials required for coronal restoration:

- Multipurpose bonding agent (since you will be bonding to both enamel and dentine).
- An extra light or ÒpaediatricÓ shade of hybrid composite resin.
- Celluloid crown formers for primary anterior teeth in a range of sizes.
- Abrasive polishing discs (e.g. small Soflex discs).
- Fine diamond composite finishing burs.
- Articulating paper.
- Scissors.

How to choose the correct crown former

Choosing the correct celluloid crown former is similar in principle to choosing the correct preformed metal crown (stainless steel crown Fig 8-7). Basically, there are two methods:

- Measure the mesiodistal width of the incisal edge of the tooth using a pair of spring dividers and choose the nearest matching celluloid crown.

- 把选中的赛璐珞成形冠与牙齿的切端相比较 并选择最匹配的冠（检验和误差）。

制备赛璐珞成形冠

因为成形冠通常也要覆盖牙齿的根面（图 8-8），所以这些成形冠必须经过修整：

- Offer up the chosen celluloid crown, its incisal edge to the natural tooth's incisal edge and choose the best match (trial and error).

Customising the celluloid crown former

These always need trimming because the crown former usually also covers the root surface of each tooth (Fig 8-8):



图8-7 一盒赛璐珞成形冠
Fig 8-7 A box of celluloid crown formers



图 8-8 正在用 Beebee 剪修剪的成形冠
Fig 8-8 A crown former being trimmed with Beebee scissors

- 用牙周探针测量天然冠的最大长度,修剪赛璐珞冠使其长度比天然牙长 1mm。
- 在成形冠上重建龈缘的自然轮廓(唇侧和颊侧的“微笑形”,邻面的“皱眉形”)。
- 修剪过程中在牙齿上试戴成形冠。
- 用剪刀或者慢速旋转的砂纸切盘磨平粗糙的边缘。
- 在成形冠的一个切角,用直探针小心地穿一个洞,这样可排出空气和多余的复合树脂。

牙冠修复

- 使用比色板选择颜色合适的复合树脂。
- 隔离准备修复的牙齿。
- 在整个牙冠组织上涂粘结剂(参照厂商的使用说明)。
- 将复合树脂放入成形冠,直到充满冠的 $2/3 \sim 3/4$,具体视牙体组织缺损的量而定。
- 将成形冠稳固而缓慢地戴到牙冠上,从排溢孔排出所有多余的空气和复合树脂。

- Measure the maximum length of the natural crown with a periodontal probe and trim the celluloid crown so that it is 1mm longer.
- Reproduce the natural contours of the gingival margin on the crown former (a "smile" labially and palatally, and a "frown" interproximally).
- Try the crown former on the tooth during trimming.
- Smooth any rough margins with scissors or slowly rotating sandpaper discs.
- Carefully place a vent hole at one of the incisal corners of the crown former using a straight probe. This allows air and a little excess composite resin to flow out of the former.

Coronal restoration

- Choose the appropriate shade of composite resin using a shade guide.
- Isolate the tooth to be restored.
- Apply the bonding system to all the coronal tissue (following the manufacturer's instructions).
- Place the composite resin into the crown form until it is $2/3$ to $3/4$ full. This depends on the amount of tooth tissue missing.
- Place the crown form firmly but slowly over the crown of the tooth, allowing any excess air and composite to escape through the venthole.

- 去除从边缘和排溢孔排出的所有多余材料。
- 按照推荐的照射时间,用口腔光固化灯照射牙冠的每个面使复合树脂聚合。这样可以保证足够的光照固化深度。
- 用小挖匙或直探针小心地将成形冠从牙齿上“剥除”。
- 用咬合纸检查殆关系,并且根据需要使用细的金刚砂磨光钻进行修整。如有必要的话,调整树脂冠的长度。
- 用直探针检查树脂冠的边缘,同样地,使用复合树脂磨光钻或者抛光盘调整过于宽大或者有悬突的区域。

实用提示

- 修整成形冠的时候,每次只调磨少许。
- 如果想切除大片赛璐珞冠的话,会有折断成形冠的危险,因为赛璐珞冠很脆。
- 像削橙子皮一样逐渐向切端修剪,这样就完成了成形冠的“螺旋”式修整。
- 当用直探针扎排溢孔时,确保手指远离探针穿出成形冠的地方。

- Remove any gross excess of material from the margins and the vent hole.
- Polymerise with a dental curing light source for the recommended amount of time on each surface of the crown. This ensures an adequate depth of cure throughout.
- Using a small excavator or straight probe, carefully strip the crown form from the tooth.
- Check the occlusion with articulating paper and adjust as necessary using fine diamond finishing burs. Adjust the composite crown length if necessary.
- Check the margins of the composite crown with a straight probe and adjust any areas that are too bulky or overhanging, again using composite finishing burs or abrasive discs.

Practical Tips

- When trimming the crown form, cut a small amount at a time.
- If you attempt to cut a large slice off the celluloid, you run the risk of fracturing the former. It is quite brittle.
- Trim towards the incisal edge rather like peeling an orange — so that you end up with a spiral of trimmed crown former.
- When placing the vent hole using a straight probe, ensure your fingers are well away from where the probe will

· 牙冠修复完成之后 ,如果不能去除成形冠 ,而成形冠的边缘非常光滑且长度合适的话 ,可以把成形冠留在原位。患者应在一周后复查 ,并再次尝试去除成形冠。

penetrate through the former.

· After restoring the crown, if you cannot remove the crown form it may be left *in-situ* providing the margins are very smooth and the length of the crown appropriate. The patient should be reviewed a week later and further attempt at removing the form should be made.

参考文献

References

Fayle SA, Welbury RR, Roberts JF. British Society of Paediatric Dentistry: A policy document on management of caries in the primary dentition. Int J Paediatric Dent, 2001; 11: 153-157

第 9 章 如何使用口腔科橡皮障

How to Cheat at Dental Dam

目 的

介绍一种在儿童修复治疗中使用口腔橡皮障的简易方法。

要 点

阅读完本章后，临床医生应该有信心在口腔治疗中使用开裂橡皮障技术。

引 言

尽管所有的口腔科修复体都对潮湿敏感，但忙碌的口腔科医生们在给儿童治牙时并不常考虑使用口腔科橡皮障。但是，掌握简单的“取巧”方法，例如开裂橡皮障技术，可以在孩子的小嘴里更好地操作，并且避免使用棉卷。

孩子们通常讨厌棉卷。他们不喜欢口水积在他们的舌下或者磨牙后区，他们拒绝压他们的舌头，而且不喜欢许多口腔科药物的味道。使用口腔橡

Aim

To demonstrate a simple, straight forward method of applying dental dam in the restorative management of children.

Outcome

On completing this chapter the practitioner should feel confident to use the split dam technique during operative dental treatment.

Introduction

All dental restoratives are moisture-sensitive, yet using dental dam is not something that the busy dental operator often considers when managing children. However, mastering a simple “cheat” such as the split dam technique achieves better access in small mouths and avoids cotton wool rolls.

Children often hate cotton wool rolls. They don't like water pooled under their tongue or in the retromolar area. They object to cotton on their tongue and don't like

皮障可以解决这些问题。嘴里放橡皮障可以鼓励孩子保持张口状态，且不需要使用开口器。

口腔橡皮障对容易恶心呕吐的孩子特别有用。尤其是当与氧化亚氮吸入镇静联合使用时，口腔橡皮障可以使孩子的舌头远离操作区，保证他们不会因为误吸材料而窒息，并且使他们感觉到更加远离操作过程。因此，橡皮障在儿童行为管理方面很有意义，而且可视为一种全身麻醉的替代品。

口腔橡皮障的优点

用口腔橡皮障隔离有很多益处：

- 降低交叉感染的危险。
- 保证气道更加安全。
- 使舌、颊和唇远离操作区。
- 不必与湿棉卷作斗争。
- 术者的双手得到解放。
- 减轻儿童对窒息或误吸口腔科材料的焦虑。
- 使氧化亚氮吸入镇静效果更好（因为此方法可以促进鼻呼吸）

the taste of many of the dental medications. Using dental dam solves these problems. The child who has a dental dam in the mouth is encouraged to keep their mouth open without the use of a mouth prop.

Dental dam is particularly useful for children with retching problems, especially when it is combined with nitrous oxide inhalation sedation. It keeps their tongue away from the operating area, reassures them that they will not choke on the materials and helps them feel more disassociated from the operative procedure. As such, it has a prominent role in the management of these children and should be attempted as an alternative to referral for general anaesthesia.

Advantages of Dental Dam

Dental dam isolation has many positive benefits:

- Reduced risk of cross-infection.
- Safer airway.
- Tongue, cheeks and lips are kept away from the operating area.
- No more struggling with wet cotton rolls.
- Operator has both hands free.
- Reduced child anxiety over choking or inhaling materials.
- More effective nitrous oxide inhalation sedation (since it encourages nose

- 减少了镇静过程中氧化亚氮对于环境所造成的污染。

口腔橡皮障的误区

在英国儿童口腔科诊所中，口腔橡皮障（图9-1）不被广泛接受的原因有很多。举例如下：

- 很难用。
- 需要很多设备。
- 增加治疗时间。
- 耐受不良。
- 孩子不喜欢。
- 担心乳胶过敏。

但是在实际操作中，特别是应用了简单的“开裂橡皮障”技术，口腔橡皮障并不难使用，事实上，从长期来看可以节约时间。本章介绍的简易技术，只需要一些基本设备和几个夹子。而且，如果这件“牙齿雨衣”被恰当地引入治疗计划之中，口腔医生会发现孩子更愿意用橡皮障而不是棉卷，孩

breathing).

- Reduced environmental contamination with nitrous oxide during sedation.

Dental Dam Myths

There are various reasons why dental dam (Fig 9-1) is not widely accepted in paediatric dental practice in the UK. Examples are as follows:

- Difficult to apply.
- Needs lots of equipment.
- Adds time to treatment.
- Not well tolerated.
- The child doesn't like it.
- Fear of latex allergy.

However, with practice, especially using a simple 'split dam' technique, dental dam is not difficult to apply and, indeed, saves time in the long run. The simple technique outlined in this chapter requires only basic equipment and very few clamps. Furthermore, if the 'tooth raincoat' is introduced suitably into the treatment plan, den-



图9-1 口腔橡皮障在吸入镇静时特别有用，可用来鼓励孩子鼻呼吸和减少环境中的氧化亚氮

Fig 9-1 Dental dam is particularly useful when inhalation sedation is being used to encourage nose breathing and reduce environmental nitrous oxide

子喜欢在他们和操作过程，药品以及设备之间建立一道屏障。乙烯硅树脂橡皮障可用于减少乳胶过敏的危险性。

最低必需品

口腔橡皮障工具箱的基本设备有 (图 9-2):

- 口腔橡皮布 (图 9-3) ——厚或加厚的。
- 口腔橡皮障夹：
 - K (恒磨牙)。
 - A (乳磨牙或者恒前磨牙)。
 - D (乳磨牙或者恒前磨牙)。
- 单孔打孔器。
- 框架 (金属架比塑料架体积小)。
- 一把剪刀。



图9-2 主要的橡皮障器材

Fig 9-2 Essential rubber dam equipment

tists will find that children prefer it to cotton rolls and like having a barrier between them and the operative procedure, medications and equipment. Silicone vinyl dam can be used to reduce risk of latex allergy.

The Bare Essentials

The basic equipment in a dental dam kit are (Fig 9-2):

- Dental dam (Fig 9-3) - thick or extra thick.
- Dental dam clamps:
 - Ash K (permanent molar).
 - Ash A (primary molar or permanent premolar).
 - Ash D (primary molar or permanent premolar).
- A single hole punch.
- A frame (metal is less bulky than plastic).
- A pair of scissors.



图9-3 口腔橡皮布也可以是“非橡胶”的 (乙烯)

Fig 9-3 Dental dam is also available as latex-free (vinyl)

隔离乳前牙

- 为了达到最好的效果 ,修复龋齿或者外伤切牙时 ,通常需要充分隔湿。
- 在混合牙列中 ,前牙的接触点相对不佳。使用裂孔橡皮障隔离全部四颗前牙并辅以弹性楔子 ,这是一种简单的隔湿方法。
- 尖牙一旦萌出 ,也可以把它们并入开裂橡皮障中。

开裂橡皮障技术：用于前牙

- 在口腔科橡皮布上间隔 2 ~ 2.5cm 打两个孔 (图 9-4)。
- 作一个切口将这两个洞连接在一起 (图 9-5)。
- 将牙科椅尽量放平。



图 9-4 在相距大约 2cm 处打两个孔
Fig 9-4 Punch two holes approximately 2cm apart

Isolating Anterior Teeth

- For best results, restoration of carious or traumatised incisors usually requires adequate moisture control.
- In the mixed dentition the anterior teeth have relatively poor contact points. Using a split dam to isolate all four anterior teeth helped by using elastic wedges is a simple means of isolating these teeth.
- Once the canines have erupted these can be incorporated into the split dam.

The Split Dam Technique: Anterior Teeth

- Punch two holes in the dental dam approximately 2-2.5cm apart (Fig 9-4).
- Make a slit by joining the two holes together (Fig 9-5).
- Put the chair as flat as it can go.



图9-5 作一个切口将两个洞连在一起
Fig 9-5 Make a slit by joining the holes together

- 教儿童将下巴抬“向空中”。
- 在上唇下放置棉卷。
- 干燥牙齿。
- 将裂口的一端放在被隔离区一端的邻间隙处(侧切牙远中或尖牙的远中)。
- 要点——应把口腔橡皮布“锐利”的边缘放入邻间隙内。
- 如需要,可放楔子(不用夹子)。
- 在硬腭前部,用你的口镜或者助手所持的吸引器压住橡皮布(而不是压在口腔顶部)。
- 教孩子在需要排唾时举手(“如果觉得要呛水,你一举手,我就会放上吸管”),否则应把吸唾管放在口外,不然的话孩子会摆弄它。
- Invite the child to raise the chin up into the air.
- Place cotton wool rolls under the upper lip.
- Dry the teeth.
- Place one end of the slit into the interproximal area at one end of the area to be isolated (either distal to the lateral incisor or distal to the canine).
- **Tip** - lead with the sharp edge of the dental dam into the interproximal area.
- Place wedjets if required (no clamps are needed).
- Keep either your mirror or your assistant's suction pressed against the dam (but not the roof of the mouth) in the anterior palate area.
- Invite the child to raise their hand if they need the saliva ejector (If you're drowning, raise your hand and I'll place the sucky straw), otherwise leave it out of the mouth since children tend to fiddle with it.

开裂橡皮障技术：用于后牙

这种改良技术不像原始方法那样能完全隔湿。因此,偶尔还要使用吸唾器,特别是在使用涡轮钻时,建议使用吸唾器。然而,使用开裂橡皮障技术最重要的优点是隔开软组织,这样很便于器械操作,并且对于充填体的粘结

The Split Dam Technique: Posterior Teeth

This cheat technique does not give the complete isolation that the original methods bestow. Therefore, the occasional use of a saliva ejector, especially during air rotation preparation, is to be recommended. However, the key benefit is in soft-tissue control,

和牙髓治疗是非常必要的。

- 在口腔橡皮布上相距 2 ~ 2.5cm 打两个孔。
- 做一个切口将这两个孔连接在一起。
- 将夹子 (雨衣“夹”或者“扣”) 放在最后面的一个磨牙上,是第一恒磨牙或第二乳磨牙。
- 用示指和拇指撑开口腔橡皮布。
- 越过夹子的弓部,然后把橡皮布压到两翼的下方。
- 向前牵拉裂口并放在前牙之间 (图 9-6)。
- 要点——应把口腔橡皮布“锐利”的边缘放入前牙的邻间隙内。
- 放置框架。

技巧和捷径

- 干燥牙齿,否则口腔橡皮障容易

which greatly facilitates access and is a must for adhesive restorations and pulp therapy.

- Punch two holes in the dental dam approximately 2-2.5cm apart.
- Make a slit by joining the two holes together.
- Place a clamp (raincoat clip or toggle) on the most posterior molar tooth, either first permanent molar or the second primary molar.
- Grab the dental dam firmly between first fingers and thumbs.
- Place over the bow of the clamp, then push downwards over the wings.
- Stretch the slit anteriorly and place between the anterior teeth (Fig 9-6).
- **Tip** - use the sharp edge of the dental dam to lead into the anterior interproximal space.
- Place the frame.

Handy Hints And Shortcuts

- Dry the teeth, otherwise the dental dam



图9-6 越过夹子的弓部并把橡皮布压到两翼的下方,然后向前牵拉裂口,把裂口的边缘插入最近的前牙之间

Fig 9-6 Place over the bow and downwards over the wings then stretch forwards and insert the edge between the most convenient anterior teeth

滑脱。

- 用牙线穿过橡皮障夹的两个洞，并缠绕在口腔橡皮障夹的弓部，以防橡皮障夹滑脱时造成误吸（图 9-7）。
- 正规的口腔科产品供应商可以提供不同性能的附件：
 - “楔子”对在邻间隙固定橡皮障很有用。
 - 使用内置框架的预成橡皮障，例如“干燥橡皮障”。

向儿童介绍口腔橡皮障

孩子们总是对未知感到恐惧，无论是新的口腔科环境、术者、技术或者器械，即使他们不见得有牙科焦虑症。因此，正确地向儿童介绍口腔橡皮障，可以极大地促使孩子接受橡皮障。

- 使用儿童熟悉的语言来描述橡皮障及其设备。

slips.

- Put floss through both holes and around the bow of the dental dam clamp to prevent aspiration, should it disengage (Fig 9-7).
- There are various proprietary accessories that are ready available through regular dental suppliers:
 - ÖWedjetsÖ, useful to anchor the dam interproximally.
 - Preformed dam with an inbuilt frame, such as ÖDry DamÖ.

Introducing Dental Dam To The Child

Children are always fearful of the unknown — whether it be a new dental environment, operator, technique or instrument — even if they are not otherwise considered to be dentally anxious. Therefore, appropriate introduction of dental dam to the child greatly improves its acceptability.

- Use child-friendly language to describe the dam and equipment.

图9-7 注意应在夹子的两个洞里穿入牙线，以防误吸

Fig 9-7 Take care to insert floss through both holes in the clamp to avoid aspiration



- 向孩子保证不会把橡皮障打孔器伸到他们的嘴里！
- 放好橡皮障后，让孩子自己照镜子（戴着“万圣节面具”）。
- 首先考虑不使用口腔橡皮障进行充填修复，然后向病人解释下次就诊时使用橡皮障，如何能够避免使用棉卷（后牙区），并“防止碎屑掉在舌头上”。

实用提示

- 干燥牙齿。
- 选择厚的橡皮障布。
- 向儿童介绍橡皮障是治疗计划的一部分。

- Reassure the child that the dental dam punch doesn't go into their mouth!
- Let the child see themselves (wearing the "Halloween mask") in a mirror following placement.
- Consider doing a restoration first without dental dam, then explain how using dam next time will prevent the use of cotton rolls (posteriorly) and stops bits falling on the tongue.

Practical Tips

- Dry the teeth.
- Choose thick dental dam sheets.
- Introduce the dental dam to the child as part of the treatment plan.