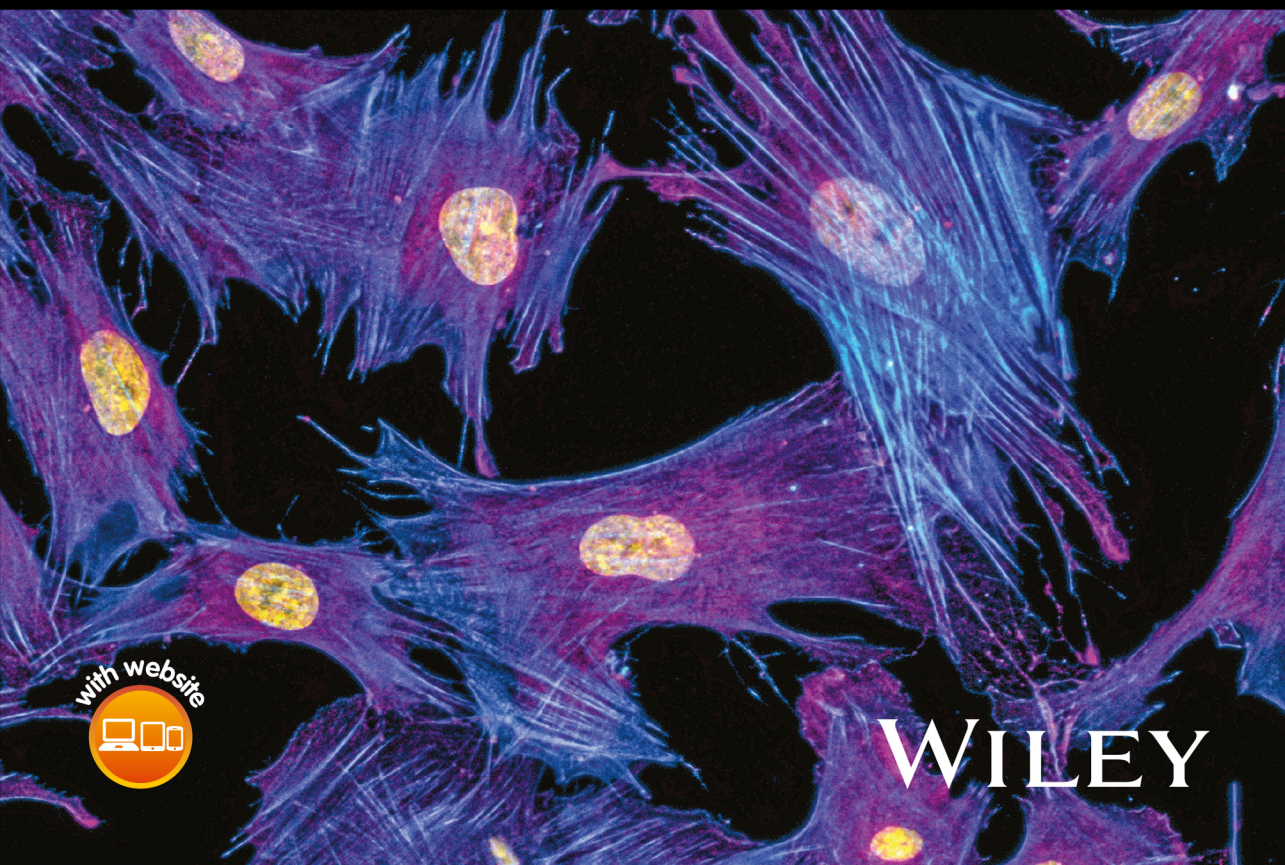


Minimally Invasive Dentistry

Interdisciplinary Clinical
and Scientific Approaches

Edited by
Aylin Baysan • Paul Anderson



with website



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Foreword

Having been a strong proponent of minimally invasive dentistry for many years, I am delighted to have been asked to prepare this Foreword. Also, being firmly of the view that all forms of interventional oral healthcare should be minimally invasive, underpinned by sound science and the best available evidence, and delivered as part of a holistic, patient-centred care, I am delighted to commend this book.

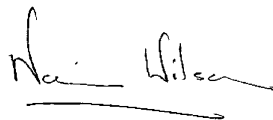
While it is recognized that ‘more experimental research, and research of better methodological quality is needed’ in the field of minimally invasive dentistry, this book makes a compelling case for the approaches advocated. With considerations ranging from saliva – ‘a precious body fluid’ – as a ‘totally non-invasive mechanism for the protection and repair of the dental hard tissues’, not to forget its importance in tooth surface loss and periodontal disease processes, to the impact of minimally invasive approaches on the socio-economic impact of oral and dental disease, this book sheds much-needed light on the enormous importance of minimally invasive dentistry, specifically in the future planning and provision of oral healthcare. In the meantime, this thought-provoking book should make readers consider their continuing use of unnecessarily interventional, traditional approaches in their clinical practice of dentistry. As such, this book will help drive the most welcome dynamic, paradigm shift in dentistry, whereby dentists are becoming as much oral physicians as dental surgeons, and dental teams no longer simply ‘treat’ but ‘care’ for their patients and, in the process, promote a better patient understanding of oral and dental diseases, personal engagement in achieving and maintaining oral health and more widespread appreciation of the importance of oral health to general health and well-being at all ages.

Reading the chapter on developments in dental biomaterials science, which facilitate the practice of minimally invasive dentistry, reinforces the view that many of the impressive materials available today are not being used to their best possible advantage – a problem caused by, amongst other things, teaching in dental schools lagging behind state-of-the-art practice, a reluctance by some oral healthcare professions to ‘move with the times’, and advances in dental biomaterials science being a less attractive topic for continuing professional development programmes than topics such as implant and aesthetic dentistry. Using the right materials, in the right place, at the right time can greatly enhance clinical outcomes.

The inclusion of chapters on Paediatric Dentistry and Orthodontics helps dispel regrettable misunderstandings that minimally invasive dentistry applies to adult dental care only.

Unnecessary, iatrogenic damage done to permanent teeth during childhood and adolescent years, apart from having possible adverse effects on young patients' attitudes to dental care, can lead to a lifetime of repair and replacement therapies, which drive the 'restorative downward spiral', resulting in the early loss of teeth, let alone a lifetime of spiralling costs of care – once a restorative patient, always a restorative patient. Minimally invasive dentistry should be firmly embedded in cradle-to-grave oral healthcare.

While one of the messages from this book is that the development of minimally invasive dentistry remains 'work in progress', colleagues are encouraged to keep on top of innovations as they occur, using this book as a 'stepping stone' in the journey to remain at the forefront of cutting-edge, minimally invasive dentistry. This book facilitates 'boldly going' where the practice of dentistry must be in years to come to best serve the interests of existing and future generations of patients.



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Preface

Minimally invasive dentistry (MID) has emerged as a cornerstone of innovative clinical practice, offering a tailored, patient-centered approach to oral health care. Grounded in the principles of early detection, prevention, tissue preservation and the use of advanced materials and technologies, MID represents a shift away from conventional, invasive methods towards more conservative, sustainable and biologically respectful strategies. As dental science continues to evolve, our methods are guided by research, clinical outcomes and ethical responsibility.

This book presents a comprehensive overview of minimally invasive dentistry strategies, with a focus on interdisciplinary sustainable clinical applications and scientifically supported guidance. The book is designed for clinicians, students and researchers who are seeking a deeper understanding of how to apply minimally invasive principles in real-world settings – across various dental specialties and in collaboration with broader healthcare disciplines.

Each chapter integrates current scientific literature with clinical decision-making, emphasising the importance of evidence-based practice in early detection, prevention, treatment planning and execution. Topics covered include caries risk assessment and management, preventive strategies, adhesive restorative techniques, bioactive materials and the role of emerging technologies. The book also explores how interdisciplinary collaboration whether with periodontists, endodontists, orthodontists, prosthodontists or medical professionals can enhance treatment outcomes and patient satisfaction. A central theme throughout this work is the importance of individualised care. Rather than relying on a one-size-fits-all model, minimally invasive dentistry encourages clinicians to make precise, patient-specific decisions that consider both biological and functional longevity. This approach is particularly relevant in the context of precision healthcare, where patients are increasingly informed and value treatments that are not only effective but also sustainable, conservative, functional and aesthetically rewarding. Furthermore, the integration of interdisciplinary approaches reflects the complexity of mouth care. Oral health is inseparably linked with systemic health, and comprehensive care often requires input from multiple fields. By fostering collaboration and promoting minimally invasive strategies, we can ensure sustainable outcomes for our patients.

In a nutshell, this book aspires to serve as both a reference and a source of inspiration for clinicians, researchers, students and policymakers who aim to combine scientific knowledge with clinical excellence. By embracing minimally invasive and interdisciplinary strategies, we can uphold the integrity of hard and soft dental tissues, improve patient experiences and contribute meaningfully to the advancement of twenty-first century precision dentistry.

About the Companion Website

This book is accompanied by a companion website:

www.wiley.com/go/baysan/minimally_invasive_dentistry



The website includes:

- Case Studies
- Multiple Choice Questions

1

Introduction to Minimally Invasive Dentistry: History of Minimally Invasive Dentistry and Key Concepts

Aylin Baysan and Kenneth Eaton

Key Topics

- Facts and figures: Demographics of dental disease
- Concept of Minimally Invasive Dentistry
- Principles of Minimally Invasive Dentistry with advantages and disadvantages
- History of Minimally Invasive Dentistry

Learning Objectives

- Be able to appreciate the facts and figures on demographics of dental disease
- Be able to appreciate the limited evidence on epidemiology of common dental diseases
- Be able to define the concept of Minimally Invasive Dentistry
- Be able to understand the principles with advantages and disadvantages
- Be able to understand the history of Minimally Invasive Dentistry and impact on clinical dentistry

Introduction

The World Health Organisation (WHO) Global Oral Health Status Report (2022) reported that oral diseases affect approximately 3.5 billion people worldwide. In this respect, it is estimated that 2 billion people present with dental caries in permanent teeth whilst 514 million children have carious lesions in primary teeth [1].

The Global Burden of Oral Conditions report revealed that untreated dental caries in permanent teeth was the most prevalent of all the 291 diseases and conditions investigated. With this respect, severe periodontitis was sixth most common and untreated dental caries in deciduous teeth was the tenth [2].

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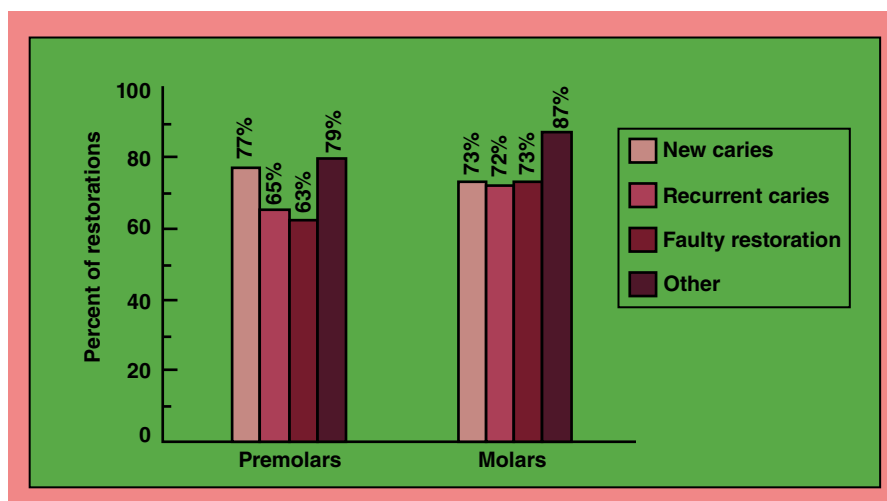


Figure 1.1 Percentage of restorations for which replacement with an increased number of surfaces according to tooth type and reason for replacement.

Following this evidence, the cost of the provision of oral care was reported to be £79 billion and that over two thirds of this cost related to the treatment of dental caries and its sequelae [3]. However, these costs could substantially be reduced if the population was educated in preventive practices and oral health care workers improved the early diagnosis of dental caries in their patients, such that enamel caries was treated with the application of fluoride and early dentinal caries with minimally invasive restorations. Elderton [4] reported a negative factor in replacing restorations which is the likelihood of increasing the size of potential new restorations. This author also emphasised the need for preventive advice and Minimally Invasive Dentistry (MID). Subsequently, Brantley et al. [5] illustrated the percentage of restorations and planned replacement with an increased number of surfaces (Figure 1.1). The reasons “new caries” and “other” (i.e., fracture, fracture risk, abutment, contact/contour problems) led to the greatest proportion of increased surfaces for premolar teeth. The reason “other” was cited most frequently by dentists who recommended replacement of restorations in molar teeth with extensive restorations. However, “recurrent caries” and “faulty restoration” led to the increase in the number of surfaces for approximately one-half of premolar and molar restorations.

The Epidemiology of Dental Caries Worldwide

Dental caries is still a major oral health problem in most countries, affecting 60–90% of schoolchildren and the vast majority of adults. Despite recent improvements in oral health of sections of the population of developed countries, overall there appears to have been some deterioration, particularly amongst under-privileged groups in developed countries

and in many developing countries [1]. It is also a most prevalent oral disease in several Asian and Latin-American countries, whilst interestingly dental caries is less common and less severe in most African countries. Frencken et al. [6], reported that untreated cavitated dentine carious lesions are the only single most common disease that affects humans worldwide.

There is evidence that the severity of cavitated dentine carious lesions amongst 5- and 12-year-old children declined over the last decades. However, the percentage of observed dental caries within these age groups is still high, with a low prevalence among 12-year-olds and among 35- to 44-year-olds in high-income countries [6].

However, the data on which the above trends have been reported must be treated with caution. International comparisons may be very unreliable due to a wide range of factors including, the threshold level for a diagnosis of caries, sampling techniques and the fact that some of the studies took place more than 15 years ago [3].

In the UK, since 1968 for adults and 1973 for children, national epidemiological surveys of oral health have taken place [7]. A remarkable improvement has been reported as far as the prevalence of dental caries in children and adults is concerned. In 1968, 37% of adults were edentulous and by 2009 this had fallen to 6% [8]. By 2013 the percentage of 12-year-old children with no obvious dental caries had risen to 66% (56% in 2003) [9]. However, within these overall improvements, there are still challenges for the management of dental caries.

More people over the age of 75 years are retaining teeth [7], which have often been restored with invasive procedures such as crowns, bridges, and dental implants. Unfortunately, due to the conditions such as rheumatoid arthritis, Alzheimer, and dementia, many are unable to maintain their oral health. In addition, reduced salivary flow affects the ability to buffer acids, produced by cariogenic bacteria, and secondary and/or root caries are more likely to ensue.

In spite of the overall reduction in the prevalence of dental caries in children, there has been a polarisation such that there has been no improvement, over the years, in dental caries in a minority of children, who invariably come from socio-economically deprived groups with the population [9]. Interestingly, extraction of teeth of those under 16 years of age, under general anaesthetic, was previously the most frequently performed hospital operation in the UK.

In order to promote the concepts of prevention for dental caries worldwide, the Alliance for a Cavity Free Future (ACFF) has been formed. The ACFF seeks to work with dental educators, clinicians, policymakers and patients to prevent dental caries and where/when these lesions occur, the ultimate aim is to diagnose and treat this disease, before there is dentinal involvement [10].

If dental caries is present, it is essential to assess its extent in a tooth. The simple diagnosis of caries present or absent is unable to help the practice of MID. A more detailed assessment with different grades is required. This concept has been incorporated in the International Caries Detection and Assessment System (ICDAS), which grades dental caries from 0 to 6 (Figure 1.2) [11]. Diagnosis of early dentinal caries (ICDAS Grade 3) can be an indication for the caries removal and the placement of a restoration following minimally invasive cavity preparation.

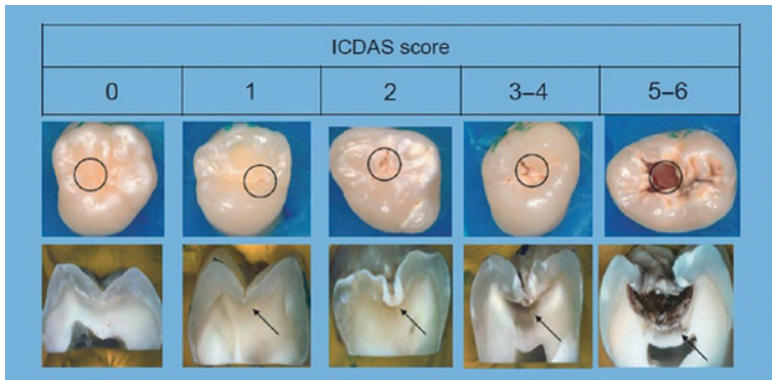


Figure 1.2 ICDAS clinical visual codes, based on evidence of the histological extent of carious lesions by staging the caries continuum. Source: Pitts and Ekstrand [11]/John Wiley & Sons, Inc.

The Epidemiology of Periodontitis Worldwide

As previously stated in 2010 the Global Burden of Disease study suggested that periodontitis was the sixth most prevalent disease on Earth. Periodontitis is a chronic, multifactorial inflammatory disease and is associated with diabetes, hypertension, and cardiovascular diseases. This disease is interestingly linked to behavioural and lifestyle factors (i.e., smoking habits, psychosocial stress, and nutrition) [12–14]. Frencken et al. [6] suggested that the prevalence and incidence of periodontitis are highly age dependent and that there is marked geographic variation. There are no meaningful gender differences and that the prevalence and incidence of periodontitis may have stagnated over the past 20 years (Figure 1.3).

In 2010, worldwide loss of productivity due to severe periodontitis was estimated to be US \$54 billion *per year*. The global prevalence of periodontal disease is expected to increase in coming years due to growth in the aging population and increased retention of natural teeth due to a significant reduction in tooth loss in the older population.

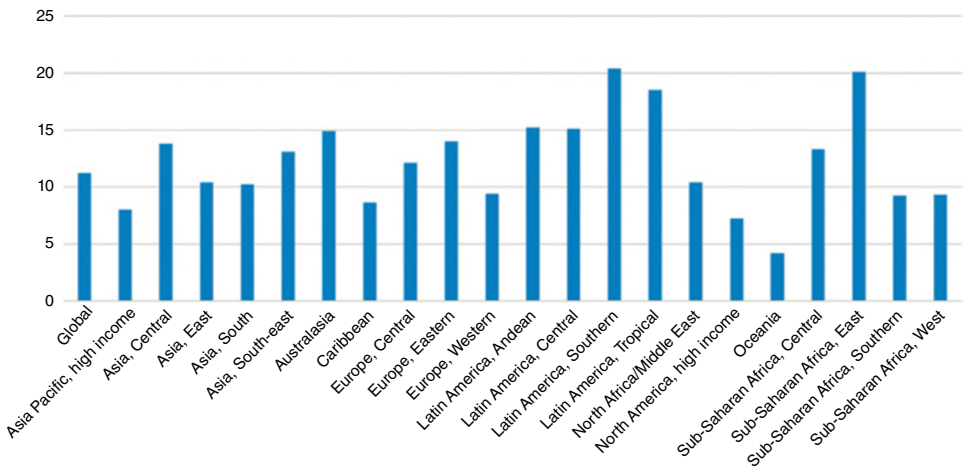


Figure 1.3 Prevalence of periodontitis globally. Source: Frencken et al. [6]/John Wiley & Sons.

However, even worse than epidemiological data for dental caries, national data for severity of periodontitis are unreliable as the thresholds for a case definition of periodontitis have varied widely from country to country [15] and also utilising the techniques for assessment [16].

Periodontal care is being provided in a variety of health systems around the world and given the global burden of disease, the active engagement of a motivated oral health professional team and patients play a key role for the management of this disease. However, as the complexity of treatment increases with disease progression, it is important to plan appropriate primary and secondary care in national health systems. Therefore, consensus on appropriate assessments and enhancement could be achieved and performed in every country for optimising the national oral healthcare strategies and services.

The Epidemiology of Tooth Wear

Tooth wear is an irreversible and cumulative condition. Tooth wear is predominantly related to multifactorial aetiology. Delayed or inadequate diagnosis with a lack of preventive intervention could lead to irreversible and advanced tissue loss. As a consequence, vitality of a tooth with function and aesthetics can be compromised. Despite the high prevalence observed in multiple countries, the information about incidence of tooth wear worldwide remains unclear.

There is some evidence with respect to tooth wear related to erosion worldwide. The global prevalence of dental erosion in children and adolescents aged between 8 and 19 years ranging from 7.2% [17] to 95.0% [18]. According to these authors, the variability in the obtained prevalence rates could be explained by using different indices to diagnose dental erosion, type of examined teeth, sample size, age, and geographic factors.

In this respect, Tooth Wear Index (TWI), which was adopted in most studies, could overestimate the prevalence, since it is not specific for detection of dental erosion [19]. In addition, geographic location seems to influence the prevalence rates observed in the literature, since cultural, ethnical, and dietary habits vary according to the regions [20].

There is a general trend to acknowledge that different aetiological factors to cause tooth wear cannot be determined and analysed separately. Therefore, considering the evaluation of exposed tooth tissue, the presence of enamel/dentine or only dentine exposed fails to explain the heterogeneity of the data presented in the literature.

The Epidemiology of Tooth Loss

The National Institutes of Health estimate that there are 158 million people without teeth worldwide and 120 million Americans are missing one or more teeth according to the Centers for Disease Control (CDC) NHANES data (Figure 1.4).

Data on tooth loss reflects not only dental disease worldwide, however this information will give an indication of patients' and dentists' attitudes, the dentist-patient relationship, the availability and accessibility of dental services, and the prevailing philosophies of dental care [21, 22].