

Foreword

Operative dentistry has been transformed in recent years, and is expected to undergo further, far-reaching changes in the future. One of the most important and exciting innovations in the field is minimally interventive operative dentistry. This tooth-substance-saving concept spans advanced approaches to the diagnosis of caries, risk assessment and minimally invasive operative procedures. This requires a rethink of the 'drill and fill' philosophy for the management of caries, leaving behind outdated principles, in particular 'extension for prevention'.

This book captures the quintessential content of the last two ConsEuro meetings of the European Federation of Conservative Dentistry held in Munich (2003) and Rome (2006), which focussed on state-of-the-art approaches to the management of caries. The views expressed in this book are those of opinion leaders in the field in Europe. All aspects of modern cariology, ranging from prevention to the management of exposed dentine and pulp are considered, together with current thinking on the

repair and refurbishment of failing restorations as an alternative to restoration replacement.

The task of bringing together the current knowledge and understanding of multiple opinion leaders requires an exceptional editor with wide-ranging expertise, and an acknowledged and substantial reputation in the field of minimally interventive operative dentistry. Nairn Wilson fits this profile perfectly, and he is to be congratulated on having conceived, planned and edited this book, which is an excellent addition to existing literature.

This book can be recommended to all practitioners, students and teachers as a valuable guide to developments in the rapidly developing field of modern cariology. All those who read and digest the contents of this book will be enlightened and encouraged to explore new horizons in their clinical practice, with the aim of serving the needs and expectations of patients to best possible advantage.

Reinhard Hickel

Preface

This book stems from memorable ConsEuro conferences held in Munich in 2003, and in Rome in 2006. It is intended for busy practitioners and students wishing to better understand the concept of minimally invasive dentistry and, in particular, the essence of minimally interventive management of dental caries. Through an editorial insistence on focus and brevity, readers will hopefully be spared from having to subsequently assimilate large amounts of existing literature, or resorting to hefty tomes on caries and modern approaches to clinical practice to address their need for a good working knowledge and understanding of minimally invasive dentistry, as it relates to the management of caries. As a consequence, this book may be likened to a well-balanced meal which leaves one satisfied, but not feeling overwhelmed—a carefully selected menu, full of diversity and interest, embracing modern themes and practices, with an emphasis on clinical application and quality rather than copious quantity. Hopefully, this is a recipe which pleases and satisfies the appetite to learn and apply a modern approach to managing caries efficiently and effectively.

As editor of this multi-author, pan-European text, I am deeply indebted to all the contributors, without whose work and subsequent patience this book would not have been possible. I can only take credit for bringing together, blending and presenting the contents. The real credit for this book must go to the authors, who nurtured, developed and crafted the various chapters and sections, all of which are special. That said, I have endeavored, through the editorial process, to give this book interest and zest to stimulate new thinking and changes in clinical practice.

In an ever changing world, change should be the norm. Dentistry, much of which continues to involve the management of caries, should be no exception. Indeed, if it were, this would be a great cause for concern. My views have changed in the process of editing this text. Hopefully this experience will be shared by all those who read the book.

As is said of a memorable meal, it is not so much what you get from it, but what you savor and remember. Hopefully, this book will be likened to a memorable meal, with lots to enjoy and reflect on.

Bon appétit.

Nairn Wilson

Contributors

Birgit Angmar-Månsson
Department of Cariology and Endodontology
Institute of Odontology, Karolinska Institute
Huddinge, Sweden

Avijit Banerjee
Restorative Dentistry, King's College London
Dental Institute, London, England, UK

Aylin Bayson
Restorative Dentistry, King's College London
Dental Institute, London, England, UK

Annerose Borutta
Poliklinik für Präventive Zahnheilkunde
Friedrich-Schiller-Universität Jena
Erfurt, Germany

Paul Brunton
Department of Restorative Dentistry
Leeds Dental Institute, Leeds, England, UK

Paula Celiberti
Klinik für Zahnerhaltung
Bern, Switzerland

Catherine Chaussain-Miller
Department of Conservative Dentistry
and Endodontics
Dental Surgery Faculty,
University of Paris V
Montrouge, France

Marcus Dell
Poliklinik für Präventive Zahnheilkunde
Friedrich-Schiller-Universität Jena
Erfurt, Germany

Richard Foxton
Restorative Dentistry
King's College London Dental Institute
London, England, UK



George Freedman
Esthetic Dentistry Education Center
State University of New York
Buffalo, NY USA

Petra Hahn
Department of Operative Dentistry and
Periodontology, Dental Clinic, Albert-Ludwigs-
University Freiburg, Freiburg, Germany

Roswitha Heinrich-Weltzien
Poliklinik für Präventive Zahnheilkunde
Friedrich-Schiller-Universität Jena
Erfurt, Germany

Reinhard Hickel
Professor of Dentistry
Director of Department of Conservative
Dentistry and Periodontology
Head of Dental School
University of Munich Germany

Jan-Willem Hoekstra
College of Dental Sciences
University Medical Center
Nijmegen, The Netherlands

Karin Huber
Department of Operative Dentistry,
Periodontology and Preventive Dentistry,
Dental Clinic, University of Saarland,
Homburg, Germany

Jean Jacques Lasfargues
Department of Conservative Dentistry and
Endodontics, Dental Surgery Faculty,
University of Paris V,
Montrouge, France

Chris Louca
Department of Primary Dental Care
King's College London Dental Institute
London, England, UK

Adrian Lussi
Klinik für Zahnerhaltung,
Bern, Switzerland

Agustin Pascual Moscardo
Departamento de Estomatologia,
Facultad de Medicina y Odontologia
Universidad de Valencia, Spain

Frauke Müller
Department of Gerodontology and Removable
Prosthodontics, Dental School,
University of Geneva, Geneva, Switzerland

Paul Nixon
Department of Restorative Dentistry
Leeds Dental Institute
Leeds, England, UK

Niek Opdam
Department of Cariology and Endodontology
College of Dental Sciences University Medical
Center, Nijmegen, The Netherlands



George Paolinelis
Restorative Dentistry
King's College London Dental Institute
London, England, UK

Gunnel Hänsel Petersson
Department of Cariology
Faculty of Odontology
Malmo University
Malmo, Sweden

Alphons Plasschaert
College of Dental Sciences
University Medical Center
Nijmegen, The Netherlands

Joost Roeters
Department of Cariology and Endodontology
College of Dental Sciences
University Medical Center
Nijmegen, The Netherlands

Xie-Qi Shi
Department of Cariology and Endodontology
Institute of Odontology,
Karolinska Institute,
Huddinge, Sweden

Christian Splieth
Department of Preventive and Pediatric Dentistry
Ernst Moritz Arndt University
Greifswald, Germany

Lutz Stösser
Poliklinik für Präventive Zahnheilkunde
Friedrich-Schiller-Universität Jena
Erfurt, Germany

Sofia Tranæus
Department of Cariology and Endodontology
Institute of Odontology, Karolinska Institute
Huddinge, Sweden

Renier van den Boomen
College of Dental Sciences
University Medical Center
Nijmegen, The Netherlands

Timothy Watson
Biomaterials and Conservative Dentistry
King's College London Dental Institute
London, England, UK

Eric Whaites
Department of Dental Radiological Imaging
King's College London Dental Institute
London, England, UK

Nairn Wilson
King's College London Dental Institute
London, England, UK

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Fig 7-6 A vertical slot preparation.



Fig 7-7 Schematic illustration of a horizontal slot preparation.

SONICflex

Damage to adjacent tooth surfaces is a common occurrence in completing the preparation of proximal cavities.^{1,6} The smaller the cavity, the worse the damage to the adjacent tooth surface. As a consequence, considerable efforts have been made to develop systems to minimize iatrogenic

damage to tooth surfaces adjacent to, in particular, minimally interventive occlusoproximal preparations.^{6,9}

The sonic oscillating, SONICflex system (KaVo Dental) was developed to cut and finish small proximal cavities. This system uses highly frequent oscillating preparation instruments in an air-driven oscillating handpiece (Airscler, SONICflex 2003, KaVo Dental). The preparation instruments transfer their negative form to the tooth. Damage to neighboring teeth during proximal preparation and finishing is minimized by the use of safe-sided, diamond coated, round-ended preparation tips. Air pressure during preparation is 2.5–4 bar, the frequency of the sonic waves is 6.0 kHz, and the recommended operating pressure during preparation is about 0.1 N.

For finishing, the frequency and operating pressure are reduced. Different tips are available, each in a mesial and a distal form (Fig 7-8). The SONICflex micro and SONICflex bevel tips are suitable for the cutting and finishing of cavities in all localizations. The SONICflex angle instruments may be used in situations in which access is especially difficult—for example, in the cutting and finishing of the proximal section of a tunnel preparation and in the direct access approach to management of proximal caries. The SONICflex PrepGold and SONICflex PrepCeram instruments are designed for minimally interventive gold and ceramic inlay preparations (Figs 7-9 and 7-10). The SONICflex Approx instruments are

Table 7.2 Survival results of tunnel restorations in permanent teeth (N=number of teeth at last evaluation, y=year)

Source	Duration (y)	N	Survival
Svanberg, 1992	3	11	91%
Strand et al, 1996	3	161	46%
Lumley and Fisher, 1995	5	33	79%
Hasselrot, 1998	7	121	39%
Hörstedt-Bindslev et al, 2005	4	84	46%

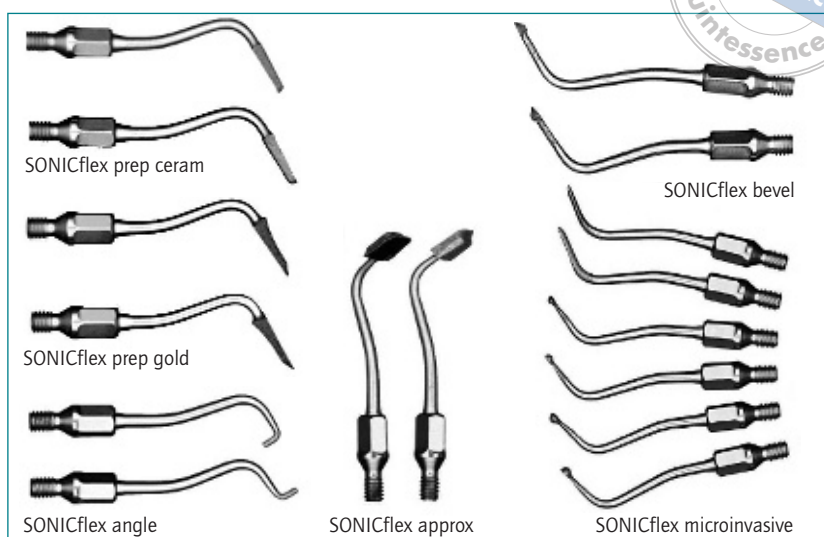


Fig 7-8 Range of SONICflex system tips for minimally interven-tive preparation.



Fig 7-9 Preparation with SONICflex Prep Ceram.



Fig 7-10 Preparation with SONICflex Prep Gold.



Air-abrasion and Bioactive Glasses

Timothy F Watson, Avijit Banerjee and George Paolinelis

Air Abrasion

Air-abrasion is a pseudo-mechanical, non-rotary method of cutting and removing dental hard tissue, originally conceived in 1945. After promising early clinical developments, the advent of the air turbine handpiece and burs resulted in the loss of this early technology to mainstream dentistry. Recent advances in adhesive dentistry have, however, called for changes to concepts in caries removal, cavity design and preparation and air-abrasion has, once again, come to the forefront of clinical operative dentistry. This chapter explains the mode of action of the current units and discusses some of the clinical uses of this technique as well as potential pitfalls.

Background

Over the years, many new 'revolutionary' techniques have been advocated for consigning mechanical cutting techniques to history. It follows that with the development of new materials and treatment

philosophies some of the older methods are worthy of closer re-examination. In this context air-abrasion is as much a new technique as it is old. Robert Black pioneered air-abrasion as early as 1945.⁸ Black was aware that air-abrasion would not replace the use of rotary instruments and his initial aim was to evaluate its potential as a valuable supplement in the treatment of caries.⁹ With the invention of the air-turbine, air-abrasion was superseded by a technology more suited to the mechanistic approaches to dentistry common both then and even to a degree, now. The safety and licensing for the clinical use of alumina were supported by the fact that the particles are large enough to exceed the upper limit (PM10) for respirable airborne pollutants.¹⁵ Nevertheless, the contamination of surgeries by powder, which is inherent with airbrasive cutting, has limited the widespread acceptance of the technique. Recent work has raised some concern regarding chronic occupational exposure to alumina.³⁵ New methods of powder containment and alternative abrasives that are biotolerated, broken down and excreted safely are therefore obviously desirable.

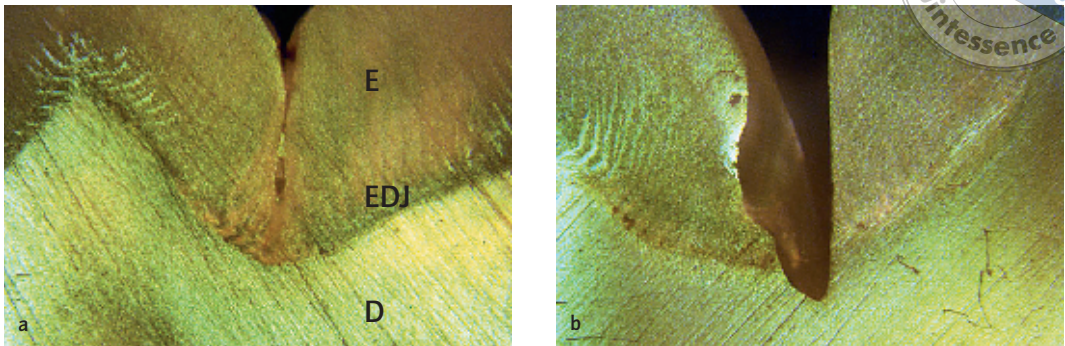


Fig 7-13 Occlusal enamel fissure prepared using air-abrasion (27.5 μ m). Cavity width is approximately 500 μ m. Fieldwidth = 3mm. Reproduced from Banerjee A, Watson TF Air-abrasion: Its uses and abuses (courtesy of Dental Update: Dent update 2002;49:340-346).

With the advent and use of modern-day adhesive restorations the concepts behind cavity design have also altered, as have the methods of providing the correct finish to the cavity surfaces.³⁷ Further developments in the understanding of the carious process have questioned the amount of carious tissue to be removed, increasingly permitting the pulp/dentine complex to repair itself with as little intervention as possible, but relying on an effective restoration-cavity seal.⁵

Dental rotary cutting instruments generate significant structural damage.^{27, 28} Air-abrasion offers multiple benefits for cutting vulnerable materials with minimal temperature changes (+/- 2°C) or vibration, so minimizing the cracking risk.^{9, 16, 22} Scanning electron microscope (SEM) studies reveal a typically roughened, pitted finished surface, devoid of classical substrate features, for example enamel prisms and dentine tubules.^{2, 25} The rounded cavity margins provide ideal contours for modern dental adhesive restorative materials.²⁷ Unlike rotary cutting instruments, the principal action of air-abrasion has been demonstrated as end-cutting.^{10, 32}

Air-abrasion has now become a popular part of the dental armamentarium in the USA, whilst its use is increasing in Europe. Recent work has been

published detailing clinical usage,¹⁷ but few studies have shown actual mechanisms of cutting. It is generally considered that hard particles will remove hard tissue, whilst soft will remove soft. Therefore, interest is recurring using the principles of air-abrasion as a selective cutting technique, targeting only softened diseased tissues.^{1, 2, 11, 25}

Basic Technique

Air-abrasion is essentially a pseudo-mechanical, non-rotary method of cutting dental hard tissues utilizing the transfer of kinetic energy from a stream of desiccated abrasive particles bombarding the tooth surface at high velocity. The abrasive employed for cutting tooth structure is aluminum oxide (Al₂O₃: α -alumina) with an average particle size of 27.5 μ m and possessing a hardness of 9 on Mohs' scale. It is stable, non-toxic and relatively inexpensive. The exit pressure employed commonly ranges between 60–120 pounds per square inch (p.s.i.) and this can impart a particle velocity in excess of 1000 feet per second depending on the diameter of the nozzle tip. The alumina escapes from the nozzle tip in a cone-shaped stream, the walls of which diverge from its long axis at an angle of approximately 3.5°. The dimensions of the cut-