Foreword

For many years now – actually already decades – research in laser supported therapies in dental, oral and craniomandibular sciences is progressing steadily. In the beginning it was only in some branches of this scientific field where significant therapeutic advantages compared to conventional forms of treatment could be reached, but by now this development already includes all branches of dentistry and integrates them into the spectrum of laser supported dental treatment. A great variety of different wavelengths always presents new possibilities of use with constantly new – partly almost unbelievable – accomplishments.

The experiences that could be collected during many years in the Research Center for Clinical Laser Technology in the Department of Conservative Dentistry at the Vienna University Clinic of Dental, Oral and Craniomandibular Sciences have been summarized in this book. In the beginning there were many sceptics, but today no one can deny the results of meticulous studies, that clearly and conclusively document the achievements reached by supportive laser therapy. Everyone who wants to conduct conscientious dentistry in the future inevitably has to integrate the advantages of laser substitution into his or her therapeutic strategy.

This book contains not only a comprehensive introduction to the basics of laser technology, but covers also the specific and accurate use of lasers in all branches of dentistry. Clear guidelines also point out the limits of the possibilities of application, which is of particular importance considering that incorrect, uncritical adjustment of the equipment can lead to serious tissue damage and compromise the success of the therapies.

We should always bear in mind that it has to be the duty of every responsible physician, for the good of the patients entrusted to his or her care, to make use of all the possibilities provided by modern medical science and apply them in accordance with the oath of the University of Vienna

...doctrinam, qua nunc polletis, cum industria vestra culturos tum omnibus incrementis, quae progrediente tempore haec ars ceperit, aucturos, usum et facultatem vestram ad salutem et prosperitatem hominum studiose conversuros,...

This book is an important milestone on the way to a successful future of dental, oral and craniomandibular science, which is no longer thinkable without laser therapy.

Prof. Wolfgang Sperr MD, DMD
Honorary President ESOLA

Preface

There is almost no field of dentistry where development took place at such a tearing pace in recent years as in the field of laser dentistry. Therapy concepts, that seemed merely fiction some years ago, are long since reality and form a valuable part in the spectrum of possible therapies. By now it is comparatively easily accomplished to conserve teeth by means of laser-supported endodonty, which would have been a safe bet for extraction until recently. Today lasers allow for a low-pain preparation, they help us to solve partly severe aesthetic problems by means of laser-supported dental bleaching and dramatically improve the chances for success in periodontal treatment.
In the field of oral surgery the use of lasers has become an established method a long time ago, which enables the surgeon to work safely and efficiently. These are only a few examples of the enormous spectrum of applications for lasers in dentistry, but this fact already conveys one problem:

The great amount of therapy concepts and wavelengths that is available today makes it difficult even for experienced users to keep track of all the applications that seem possible and useful. On this account it seems appropriate to collect the knowledge of numerous authors gathered in many years of laser dentistry in this atlas. This book is addressed to beginners and students in the field of laser dentistry, who are provided with a valuable guide book to the integration of lasers in their practice concept, as well as to experienced physicians, who can use this book to keep their knowledge up to date.

Apart from being a guide to clinical practice, this book offers a detailed examination of the literature in the field of laser dentistry published up to the present and motivates the reader to delve into the latest scientific findings. You can also find a detailed description of the physical basics of laser application, the understanding of which is very important for an efficient use of the different wavelengths.

I would like to thank all the people who contributed to this book for their patience and dedication, they all have played a vital role in the realisation of this piece of work. At this point I would like to commend Mr Boris Spieler, whose sophisticated illustrations substantially added value to this book. I would also like to express my sincere thanks to Professor Sperr, who made it possible for me from the start to engage scientifically and clinically in the subject of laser dentistry. I hope that this book meets with great interest from all readers and I wish you all an exciting reading time with this piece of (Laser-)literature.

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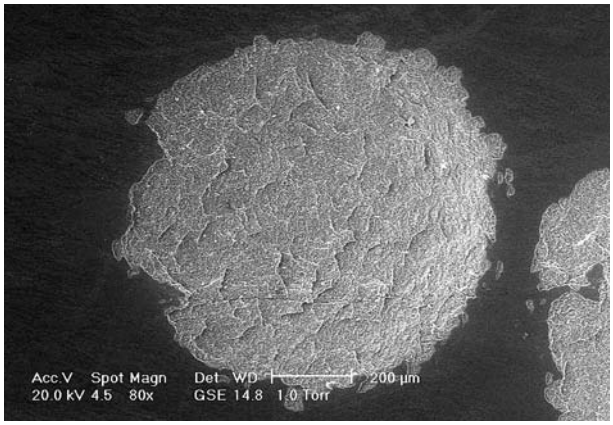

Fig 3-28 Enamel surface after a laser pulse (orig. 80x, fiber diameter 400 µm, pulse energy 400 mJ).

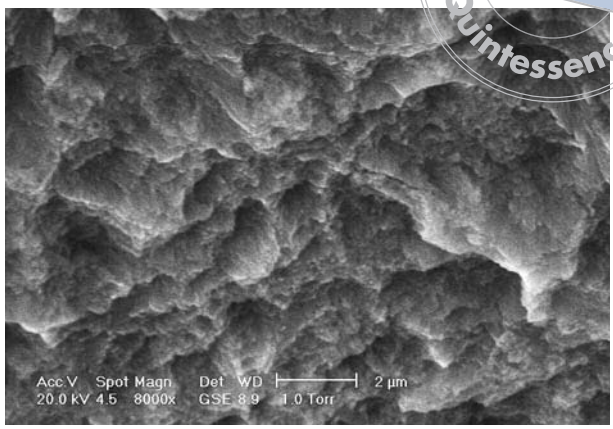

Fig 3-30 Detail from Fig 3-28 (orig. 8000x, fiber diameter 400 µm, pulse energy 400 mJ).

3.3.2 Surface Characteristics of Laser-prepared Cavities

The following series of electron micrographs shows the effect of erbium-based laser systems on dentin and enamel surfaces. The ablations in Figs 3-28 to 3-34 were prepared with an Er:YAG laser. The hand piece was moved so fast that the individual pulses were beside one another. Hence, each ablation illustrated was produced by a single pulse.

Fig 3-28 shows in overview an ablation crater after one pulse. The crater has a diameter of about 1 mm. The roughness of the cavity ground and the typical uneven ablation edge are easily visible. In the ablation pattern the typical shards of the enamel prism layers are clearly recognizable.

Fig 3-29 shows a detail of the ablation area of Fig 3-28. Here, the sites of fracture of the particles thrown out during ablation can be seen. The sites of fracture follow the facets and edges of the enamel prisms. Through their irregular course the microretentive pattern of the laser cavity is produced in the enamel.

Fig 3-30 shows a close-up view of a fracture in the enamel. It can be seen how the roughness of the site of fracture extends into the microstructure even at a magnification of 8000. Therefore, a large adhesive surface is available for bonding with filling materials.

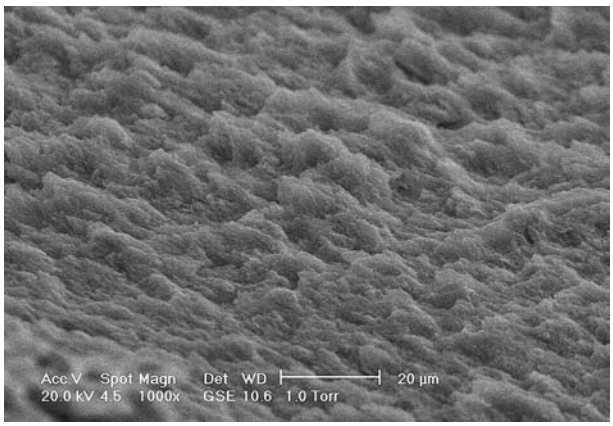

Fig 3-29 Detail from Fig 3-28 (orig. 8000x, fiber diameter 400 µm, pulse energy 400 mJ).

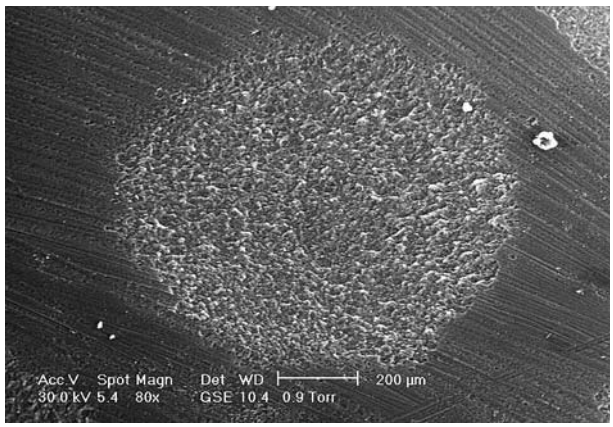

Fig 3-31 Dentinal surface after laser pulse (orig. 80x, fiber diameter 400 µm, pulse energy 400 mJ).

6.9 Clinical Cases

Case 1

A 39-year-old patient, tooth 36 endodontically treated 5 years ago and had a crown as restoration. In the mesial root channels, fractured root channel instruments were detected radiologically, CAP and the tooth generated pain. In one of the mesial root canals the broken instrument could be removed, in the second channel this was not possible, but instrumentation was carried out until 1 mm from the radiological apex. After endodontic laser therapy the patient was symptom-free and the tooth could be filled.

Fig 6-82 X-ray. CAP in tooth 36. Mesial, two fractured root canal instruments are discernible.

Fig 6-83 Measuring X-ray. Despite the fact that one instrument could not be removed, the instrumentation of all canals to the apex was accomplished.

Fig 6-84 Situation after laser treatment and filling of the canals.

Fig 6-85 Control X-ray after 5 months. The defect healing is discernible.

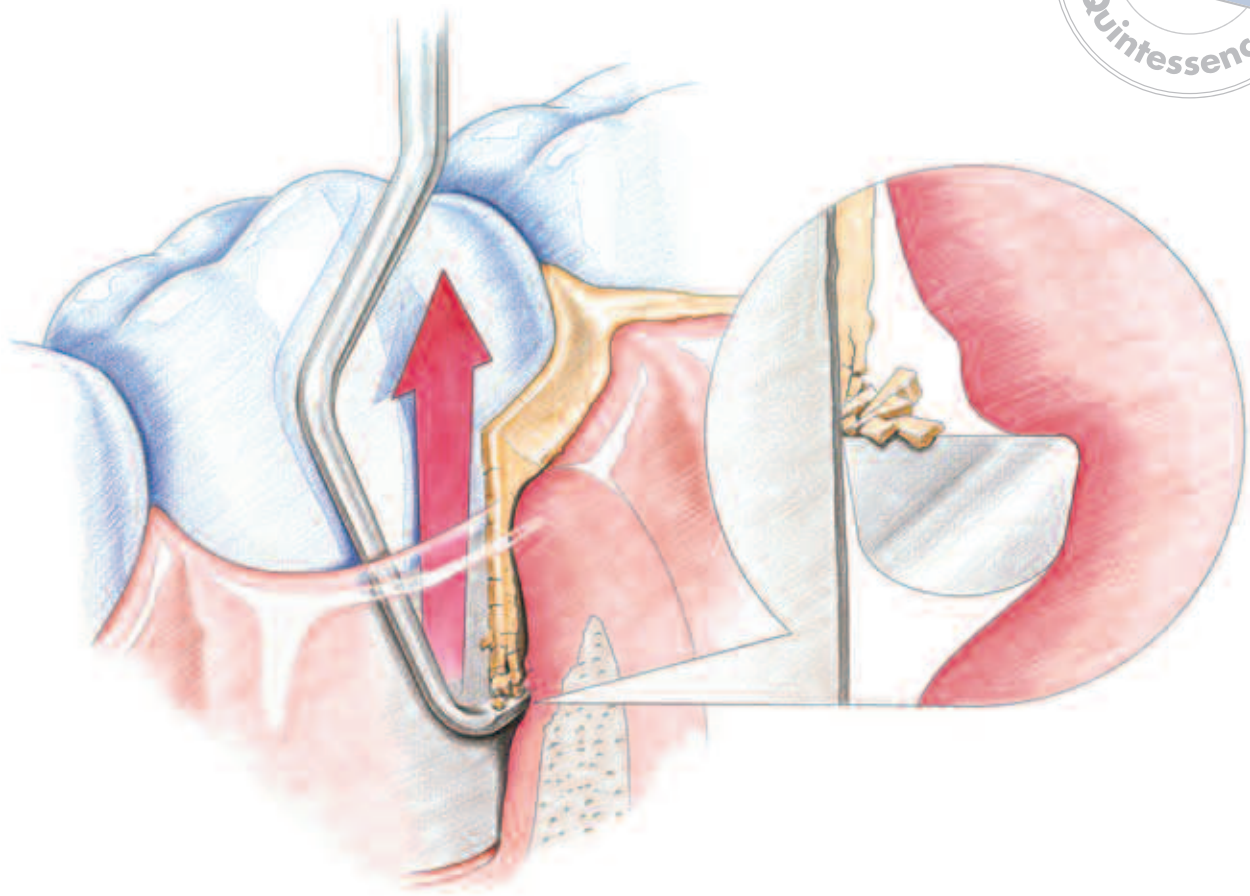

Fig 8-47 Scaling.

Fig 8-48 Scaling.

The light conductor (a fiber with a diameter between 200 and 400 µm) is introduced without use of force, like a probe, step by step into the periodontal pocket. After the activation of the laser the fiber is removed from the bottom of the pocket by sinusoidal movements to the outside of the pocket within 5 s. This is necessary in order to irradiate, on the one hand, as much of the root surface as possible and, on the other hand, to avoid localized overheating. The choice of the correct laser parameters is also of great importance. For pocket disinfection, the Nd:YAG laser is used with a setting of maximally 1.5 W with 15 Hz, with the diode laser, maximally 2.5 W is selected with 15 Hz. These values ensure a high-grade antibacterial effect with, at the same time, small thermal side effects. To accomplish a gingivectomy, higher settings can be chosen advisedly up to ~3 W for both wavelengths. In the case of the Er:YAG laser, a setting of 100 mJ at 15 Hz should not be exceeded, because this setting ensures