

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

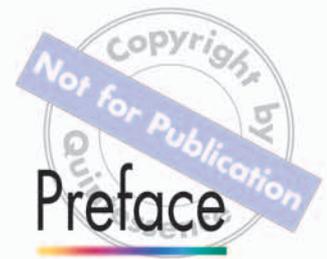
also the specific and accurate use of lasers in all branches of dentistry. Clear guidelines also point out the limits of the possibilities of application, which is of particular importance considering that incorrect, uncritical adjustment of the equipment can lead to serious tissue damage and compromise 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  
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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 endodontology, 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 integrati-

on 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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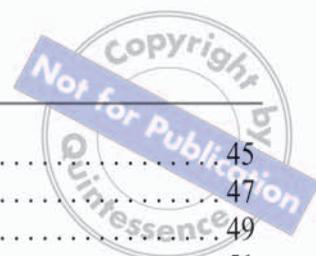
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## chapter 1 Basic Information on Lasers

<b>1.1</b>	<b>Introduction</b> .....	<b>1</b>
<b>1.2</b>	<b>The Nature, Properties and Sources of Light</b> .....	<b>3</b>
1.2.1	What is light? .....	3
1.2.2	Properties of Light .....	4
1.2.3	Sources of Light .....	8
<b>1.3</b>	<b>Optical Concepts for the Function of a Laser</b> .....	<b>11</b>
1.3.1	Stimulated Emission and Amplification in a Laser Medium .....	11
1.3.2	Basic Scheme of a Laser .....	13
1.3.3	Level Schemes of Real Lasers .....	15
1.3.4	The Laser Resonator and its Output Radiation .....	18
1.3.5	Specific Frequency and Temporal Operation Regimes of Lasers .....	23
<b>1.4</b>	<b>Laser Media, Power Input and Optical Output</b> .....	<b>29</b>
1.4.1	Laser Media .....	29
1.4.2	Pumping Methods and Schemes .....	33
1.4.3	Geometrical and Frequency Conversion of the Laser Output .....	34
<b>1.5</b>	<b>Specific Lasers Relevant for Oral Applications</b> .....	<b>38</b>
1.5.1	Excimer Lasers .....	38
1.5.2	Argon ion Laser .....	39
1.5.3	Helium-Neon Laser .....	40
1.5.4	Semiconductor Diode Lasers .....	41



1.5.5	Ruby and Alexandrite Lasers .....	45
1.5.6	Titanium-Sapphire Laser .....	47
1.5.7	Neodymium and Ytterbium Lasers .....	49
1.5.8	Holmium and Holmium-Thulium Lasers .....	51
1.5.9	Erbium and Erbium-Chromium Lasers .....	52
1.5.10	Carbon Dioxide Laser .....	53
<b>1.6</b>	<b>Textbooks and References .....</b>	<b>55</b>
1.6.1	Textbooks .....	55
1.6.2	References .....	55

## chapter 2 Laser Safety

<b>2.1</b>	<b>Introduction .....</b>	<b>57</b>
<b>2.2</b>	<b>Maximum Permissible Exposure .....</b>	<b>59</b>
<b>2.3</b>	<b>Laser Classes .....</b>	<b>60</b>
2.3.1	Class 1 .....	60
2.3.2	Class 2 .....	60
2.3.3	Remarks on Laser Classes 1M and 2M .....	61
2.3.4	Class 3A (old Class) .....	61
2.3.5	Class 3B .....	61
2.3.6	Special Class 3B (old classification) .....	61
2.3.7	New Class 3R .....	62
2.3.8	Class 4 .....	63
<b>2.4</b>	<b>Secondary Hazards .....</b>	<b>64</b>
2.4.1	Common Hazards .....	64
2.4.2	Vapours and Dusts .....	66
<b>2.5</b>	<b>Protective Measures .....</b>	<b>67</b>
2.5.1	Laser Protective Eyewear .....	67
2.5.2	Organizational Protective Arrangements .....	69
2.5.3	Technical Protective Arrangements .....	69
<b>2.6</b>	<b>Standards and Legal Rules .....</b>	<b>71</b>
2.6.1	Laser Safety Officer .....	71
2.6.2	Legal Scope .....	72
2.6.3	Behavior in the Case of Incidents and Accidents .....	72



## chapter 3 Cavity Preparation

<b>3.1</b>	<b>Overview</b> .....	<b>75</b>
3.1.1	Development of the Laser – Assisted Cavity Preparation .....	75
<b>3.2</b>	<b>Technologies for Cavity Preparation</b> .....	<b>77</b>
3.2.1	Indication-specific Problems .....	77
3.2.2	Conventional Methods – Rotating Instruments .....	78
3.2.3	Kinetic Cavity Preparation – KCP .....	80
3.2.4	Preparation Lasers .....	80
<b>3.3</b>	<b>Laser-supported Cavity Preparation</b> .....	<b>86</b>
3.3.1	Er:YAG and Er,Cr:YSGG Lasers .....	86
3.3.2	Surface Characteristics of Laser-prepared Cavities .....	90
3.3.3	Adhesion and Margin Tightness of Laser-prepared and Adhesive Techniques-treated Cavities .....	93
3.3.4	Caries-preventing Properties of Laser-prepared Cavities.....	99
<b>3.4</b>	<b>Mechanisms of Ablation</b> .....	<b>100</b>
3.4.1	Overview .....	100
3.4.2	Physical Factors Influencing on Ablation Efficiency and Quality .....	101
3.4.3	Physical Limitations for Present-day Laser Systems .....	111
3.4.4	Conclusion for the Specifications of Laser Systems Optimized for Minimal Collateral Effects on Dental Hard Tissues.....	112
3.4.5	Future Perspectives .....	113
<b>3.5</b>	<b>Other Laser Types</b> .....	<b>122</b>
3.5.1	The CO <sub>2</sub> Laser .....	122
3.5.2	The Nd:YAG Laser .....	122
3.5.3	The Ho:YAG Laser .....	123
<b>3.6</b>	<b>Practical Procedure in Laser-assisted Cavity Preparation – Clinical Work</b>	<b>124</b>
3.6.1	Application of the Rubber Dam .....	124
3.6.2	Display of the Cavity .....	124
3.6.3	Caries Removal .....	125
3.6.4	Completion of the Cavity .....	125
3.6.5	Choice of Parameters .....	126
<b>3.7</b>	<b>Clinical Cases</b> .....	<b>127</b>
3.7.1	Cavity Preparation Class I, II and III .....	127
3.7.2	Fissure Sealing .....	127
3.7.3	Veneer .....	128
3.7.4	Gold Inlay .....	129
3.7.5	Ceramic Inlay .....	130
3.7.6	Maryland Bridge.....	132

3.7.7	Esthetic Front Restoration .....	134
3.7.8	Esthetic Reconstructions .....	134
<b>3.8</b>	<b>References .....</b>	<b>136</b>

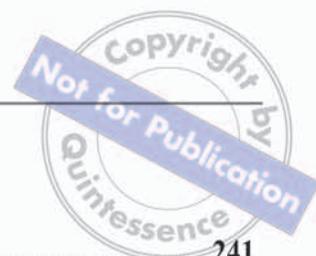
## **chapter 4** Photopolymerization

<b>4.1</b>	<b>Introduction .....</b>	<b>139</b>
<b>4.2</b>	<b>In General .....</b>	<b>141</b>
<b>4.3</b>	<b>Photopolymerization Reaction.....</b>	<b>150</b>
<b>4.4</b>	<b>Laser Photopolymerization versus Traditional Methods .....</b>	<b>153</b>
<b>4.5</b>	<b>Improved Clinical Performance of Laser Cured Materials .....</b>	<b>161</b>
<b>4.6</b>	<b>Caries Prevention by Laser and with Laser Activated Fluoride .....</b>	<b>162</b>
4.6.1	Laser Preventive and Laser-Fluoride Effects on Enamel with the Argon Laser .....	162
4.6.2	Mechanisms of Action: Enamel .....	164
4.6.3	Mechanisms of Action: Root Surfaces .....	166
<b>4.7</b>	<b>General Considerations .....</b>	<b>167</b>
<b>4.8</b>	<b>Clinical Procedure of Photopolymerization by an Argon Laser .....</b>	<b>169</b>
<b>4.9.</b>	<b>Clinical Cases.....</b>	<b>172</b>
4.9.1	Introduction.....	172
4.9.2	Esthetic Dentistry .....	173
4.9.3	High Caries Sensitivity.....	178
4.9.4	Functional Problems .....	181
4.9.5	Orthodontic Problems.....	182
4.9.6	Periodontal Problems.....	183
4.9.7	Pediatric Dentistry .....	184
4.9.8	Geriatric Dentistry .....	185
4.9.9	Prosthetic Dentistry .....	187
<b>4.10</b>	<b>References .....</b>	<b>189</b>



## chapter 5 Caries Prevention

<b>5.1</b>	<b>Introduction</b> .....	<b>193</b>
<b>5.2</b>	<b>Conventional Treatment Methods</b> .....	<b>195</b>
<b>5.3</b>	<b>Laser Application in Preventive Dentistry</b> .....	<b>196</b>
5.3.1	Historical Aspects .....	196
5.3.2	Light Interactions with Dental Hard Tissues .....	196
5.3.3	Scattering and Absorption Parameters .....	197
5.3.4	Mechanism of Laser Irradiation and Improved Caries Resistance .....	200
<b>5.4</b>	<b>The Caries Preventing Effect of CO<sub>2</sub> Lasers</b> .....	<b>204</b>
5.4.1	The Influence of Wavelength and Pulse Duration .....	205
5.4.2	The Influence of the Pulse Number .....	207
5.4.3	The Influence of Wavelength and Fluence .....	208
5.4.4	Oral Safety Parameters .....	210
5.4.5	Surface Morphology .....	211
5.4.6	The Problem of Cracking .....	212
5.4.7	Polished Enamel .....	213
5.4.8	Unpolished Tooth Crowns .....	214
5.4.9	Pulse-Width Effects on Unpolished Human Enamel .....	214
5.4.10	Combined Effect of CO <sub>2</sub> Laser Irradiation and Fluoride Treatment .....	216
5.4.11	Clinical Aspects .....	217
<b>5.5</b>	<b>The Caries Preventing Effect of Argon Lasers</b> .....	<b>219</b>
5.5.1	Oral Safety Parameters .....	219
5.5.2	Surface Morphology .....	221
5.5.3	Combined Effect of Argon Laser Irridiation and Fluoride Treatment .....	222
5.5.4	Clinical Aspects .....	224
<b>5.6</b>	<b>The Caries Preventing Effect of Nd:YAG Lasers</b> .....	<b>225</b>
5.6.1	Oral Safety Parameters .....	227
5.6.2	Surface Morphology .....	228
5.6.3	Combined Effect of Nd:YAG Laser and Fluoride Treatment .....	229
5.6.4	Clinical Aspects .....	231
<b>5.7</b>	<b>The Caries Preventing Effect of Er:YAG, Er,Cr:YSGG, Ho:YAG and UV Lasers</b> .....	<b>232</b>
<b>5.8</b>	<b>Conclusion</b> .....	<b>234</b>
<b>5.9</b>	<b>References</b> .....	<b>235</b>



## chapter 6 Lasers in Endodontics

<b>6.1</b>	<b>Introduction</b> .....	<b>241</b>
6.1.1	The Importance of Endodontics in Dentistry .....	241
6.1.2	Identifying Endodontic Problems .....	241
<b>6.2</b>	<b>Conventional Working Methods</b> .....	<b>253</b>
6.2.1	Chemo-mechanical Disinfections .....	253
6.2.2	Laser-supported Root Canal Sterilization .....	254
<b>6.3</b>	<b>Description of the Different Wavelengths</b> .....	<b>268</b>
6.3.1	The Nd:YAG Laser .....	268
6.3.2	The Diode Laser .....	274
6.3.3	The Er:YAG and Er,Cr:YSGG Lasers .....	275
<b>6.4</b>	<b>Root Canal Shaping</b> .....	<b>278</b>
<b>6.5</b>	<b>Apex Sealing</b> .....	<b>281</b>
<b>6.6</b>	<b>Safety in Laser Treatment</b> .....	<b>284</b>
<b>6.7</b>	<b>Indications</b> .....	<b>288</b>
<b>6.8</b>	<b>Practical Procedure</b> .....	<b>290</b>
6.8.1	Preparation of the Entrance Cavity .....	290
6.8.2	Root Canal Preparation .....	290
6.8.3	Laser Treatment .....	296
6.8.4	Root Canal Filling .....	298
<b>6.9</b>	<b>Clinical Cases</b> .....	<b>300</b>
<b>6.10</b>	<b>Future Perspectives</b> .....	<b>306</b>
<b>6.11</b>	<b>References</b> .....	<b>309</b>

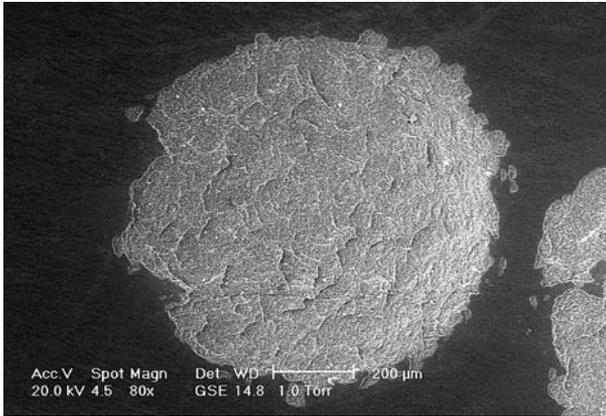


Fig 3-28 Enamel surface after a laser pulse (orig. 80x, fiber diameter 400  $\mu\text{m}$ , pulse energy 400 mJ).

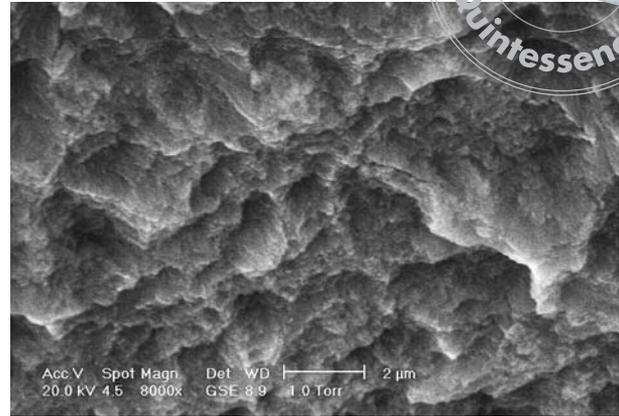


Fig 3-30 Detail from Fig 3-28 (orig. 8000x, fiber diameter 400  $\mu\text{m}$ , pulse energy 400 mJ).

### 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 micro-retentive 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.

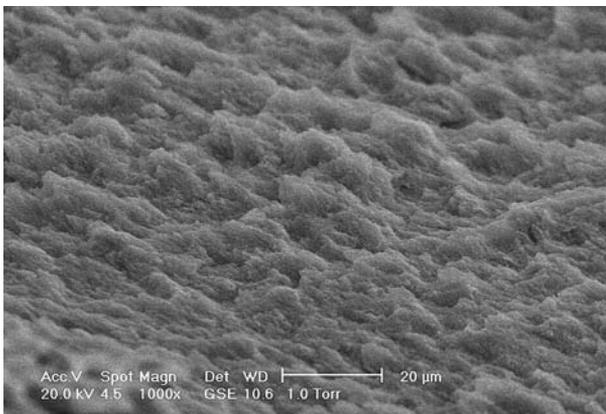


Fig 3-29 Detail from Fig 3-28 (orig. 8000x, fiber diameter 400  $\mu\text{m}$ , pulse energy 400 mJ).

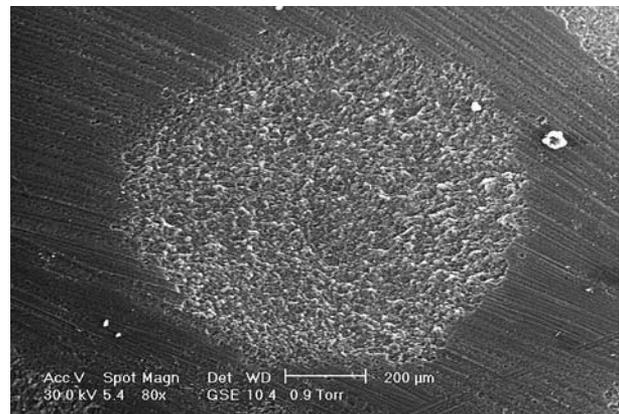


Fig 3-31 Dentinal surface after laser pulse (orig. 80x, fiber diameter 400  $\mu\text{m}$ , pulse energy 400 mJ).

## 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 canal 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.

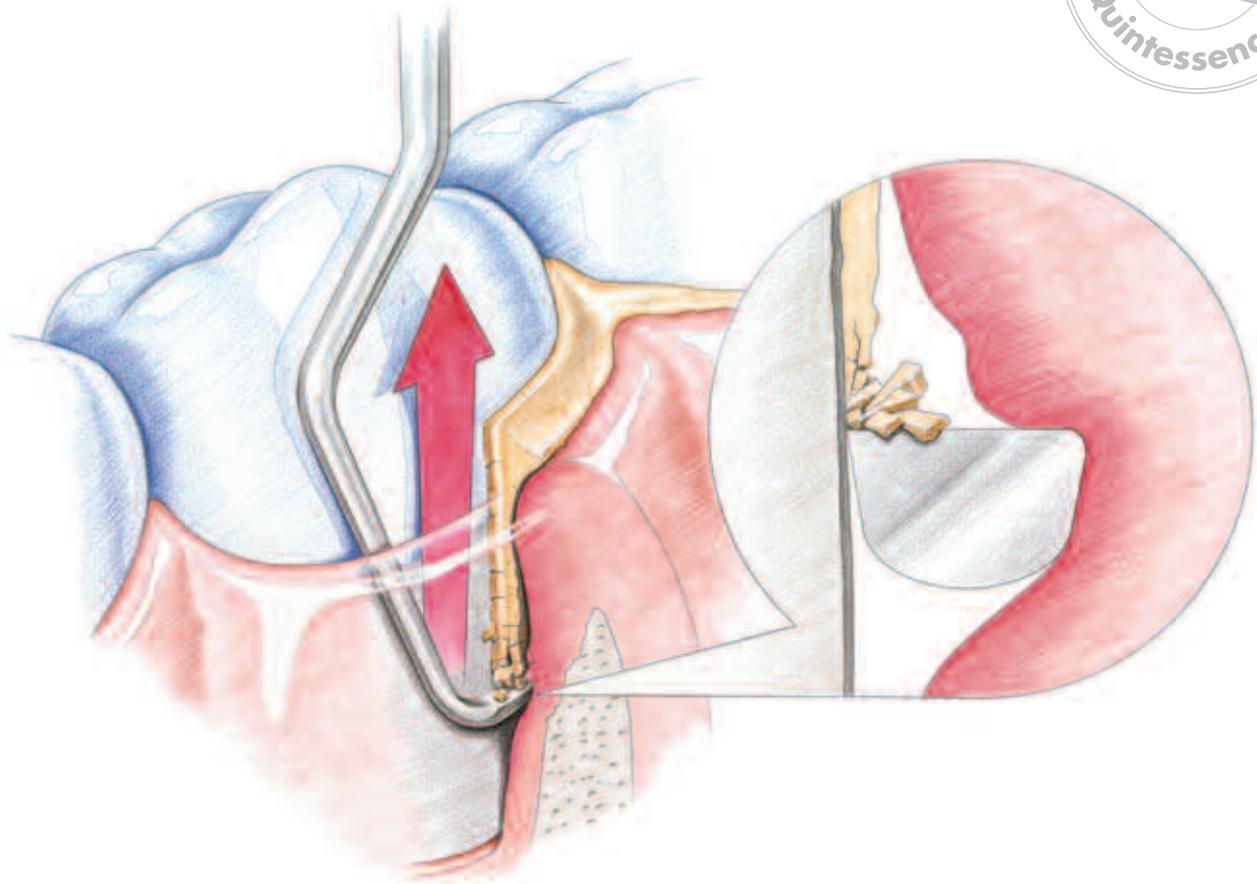


Fig 8-47 Scaling.



Fig 8-48 Scaling.

The light conductor (a fiber with a diameter between 200 and 400  $\mu\text{m}$ ) 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  $\sim 3$  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