

Contents

1	Introduction	1
1.1	Orthopedic Surgery	1
1.1.1	Types of Orthopedic Surgery	2
1.2	Societal and Economic Impact	3
1.3	Bone Machining: Overview	5
1.4	Bone Characteristics	7
1.4.1	Bone Structure	8
1.4.2	Types of Bone	10
1.4.3	Thermophysical Properties of Bone	12
1.5	Physical and Biological Effects of Orthopedic Surgery	15
1.5.1	Physical Damage	15
1.5.2	Osteonecrosis	18
	References	20
2	Fundamental Operations of Bone Machining	23
2.1	Drilling	23
2.2	Sawing	25
2.3	Grinding/Abrasive Machining	28
2.4	Milling	32
2.5	Thermal Machining	34
2.6	Machinability and Surface Quality	40
	References	43
3	Non-conventional and Hybrid Methods of Bone Machining	45
3.1	High Energy Beam Based Techniques	45
3.1.1	Laser Machining	46
3.1.2	Microwave Machining	74
3.1.3	Ion-Beam Machining	78
3.2	Ultrasonic Machining	79
3.2.1	Setup Components	79
3.2.2	Machining Mechanisms	81
3.2.3	Ultrasonic Machining of Bone and Hard Tissues	84

3.3	Pneumatic and Hydraulic Machining	87
3.4	Waterjet Machining	89
	References	95
4	Attributes of Bone Machining	99
4.1	Microstructure and Materials Aspects.	99
4.2	Effect of Machining Parameters.	103
4.3	Crack Formation and Propagation	107
4.4	Chip Formation.	114
4.5	Machined Surface	118
	References	119
5	Temperature Evolution During Bone Machining	121
5.1	General Considerations.	121
5.2	Temperature Measurement	122
5.3	Temperature Evolution During Conventional Machining.	124
5.3.1	Temperature Rise in Drilling	124
5.3.2	Temperature Rise in Milling.	128
5.3.3	Temperature Rise in Cutting.	129
5.3.4	Temperature Rise in Grinding.	133
5.4	Temperature Evolution During Non-conventional Machining.	134
5.5	Temperature Control	135
	References	141
6	Computational Modeling in Bone Machining	143
6.1	Heat Transfer Models.	143
6.2	Stress Based Models	150
6.3	Micro-scaled Modeling.	158
	References	161
7	Potential Automation of Bone Machining	163
7.1	Computer Aided Planning.	163
7.2	Robot Assisted Surgery	167
	References	173
	Index	175

Machining of Bone and Hard Tissues

Dahotre, N.; Joshi, S.

2016, VIII, 181 p. 164 illus., 62 illus. in color., Hardcover

ISBN: 978-3-319-39157-1