

Table of Contents

Note	ii
Table of Contents	1
List of Abbreviations	4
1 Introduction	7
2 State of the Art	8
2.1 Anatomy of the Human Spine	8
2.2 In-Vitro State of the Art Investigation of the Lumbar Spine.....	13
2.2.1 Storage and Hydration	15
2.2.2 Testing Temperature.....	16
2.2.3 Recovery Behavior In-Vitro vs In-Vivo.....	16
2.2.4 Follower Load Principle.....	17
2.2.5 Animal Specimens as a Substitute for Human Specimens	19
2.3 In-Silico State of the Art Investigations of the Spine.....	20
2.3.1 FEM-Simulations.....	20
2.3.2 Neural Networks	21
2.4 Clinical Assessment: Alignment of the Spinal Column	22
2.4.1 Lateral Alignment	22
2.4.2 Sagittal Alignment	23
2.5 Clinical Assessment: Multiaxial Loading of the Lumbar Spine	26
3 Objective	29
4 Material and Methods	30
4.1 In-Vitro Investigations.....	30
4.1.1 General Test Setup.....	30
4.1.2 Preparation of the Specimens.....	32
4.1.3 Preconditioning	33
4.1.4 Motion Tracking	34
4.1.5 RoM calculation	35
4.1.6 24-Hour Testing	37
4.1.7 Multiaxial Loading	38
4.1.8 Cyclic Loading under Different Environmental Conditions	41
4.2 In-Silico Investigations.....	43
4.2.1 FE-Model	43
4.2.2 Validation of the FE-Model for Multiaxial Loading	45
4.2.3 Investigation of Different Sagittal Alignment Postures	45

4.2.4	Follower Load under Daily Motion.....	47
4.2.5	Preliminaries on Artificial Neural Networks	47
4.2.6	Prediction of Moment-RoM Curves Using ANN	50
5	Results	54
5.1	In-Vitro Results.....	54
5.1.1	24-Hour Testing	54
5.1.2	Multiaxial Loading	55
5.1.3	Cyclic Loading under Different Environmental Conditions	57
5.2	In-Silico Results.....	59
5.2.1	Validation of the FE-Model for Multiaxial Loading	59
5.2.2	Investigation of Different Sagittal Alignment Postures	61
5.2.3	Follower Load under Daily Motion.....	63
5.2.4	Prediction of Moment-RoM Curves Using ANN	64
6	Discussion	66
6.1	FE-Model Validation	66
6.2	In-Vitro Testing Time	67
6.3	Multiaxial Loading.....	69
6.4	Follower Load.....	70
6.5	Clinical Assessment of the Lumbar Sagittal Alignment	71
6.6	Temperature and Loading History Dependency	72
6.6.1	In-Vitro Testing.....	73
6.6.2	Prediction Using RNN	75
6.7	Clinical Outlook	76
7	Summary	79
8	Literature.....	80
	Listing of Own Publications	98
	Acknowledgement	99
	Erklärung zur Datenaufbewahrung	100
	Erklärung über den Eigenanteil.....	101