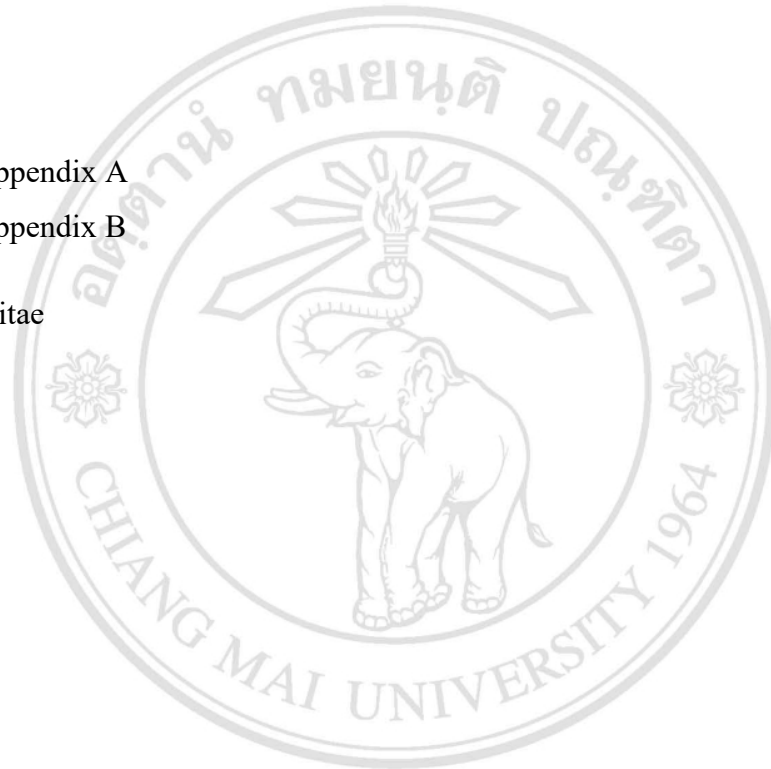


CONTENT

	Page
Acknowledgement	c
Abstract in Thai	d
Abstract in English	f
List of Tables	k
List of Figures	l
Chapter 1 Introduction	1
1.1 Historical Background	1
1.2 Research Objectives	3
1.3 Educational Advantages	3
Chapter 2 Literature Reviews and Relative Studies	4
2.1 Finite Element Analysis	5
2.1.1 Finite Element Analysis in Implant Dentistry	5
2.1.2 Geometry of FEA Modeling	6
2.1.3 Material Properties	6
2.1.4 Interface and Contact Condition	8
2.1.5 Boundary Condition	8
2.1.6 Loading	9
2.2 Dental Implant	9
2.2.1 Mini Dental Implant	9
2.2.2 Survival Rates of Mini Dental Implant Retained Overdenture	10
2.2.3 The Numbers and Locations of Mini Dental Implants for Retention of Overdenture	12
2.2.4 Effect of Stress and Strain Distribution by Implant Overdenture	12
2.2.5 Effect of Implant Numbers on Mandibular Implant Retained Overdenture Stress and Strain Distribution	14

	Page
2.2.6 Effect of Implant Locations on Mandibular Implant Retained Overdenture Stress and Strain Distribution	16
2.2.7 Effect of Implant Angulation and Attachment on Mandibular Implant Retained Overdenture Stress and Strain Distribution	17
2.2.8 Human Occlusal Force	18
2.3 Other Analysis Procedures	18
2.3.1 Photoelastic Analysis	18
2.3.2 Strain Gauge Analysis	19
Chapter 3 Research Methodology	20
3.1 Software and 3D Model Reconstruction	20
3.1.1 Computer software	20
3.1.2 3D model reconstruction	21
3.1.3 Human edentulous mandibular	21
3.1.4 Complete denture	22
3.1.5 Gingiva	23
3.1.6 Mini dental implant and others component .	23
3.1.7 Equator attachment)metal head of mini dental implant(	24
3.2 Methods	25
3.2.1 Finite element analysis procedure	25
3.3 Data and Statistical Analysis	40
Chapter 4 Results	43
4.1 Bilateral Load Condition	43
4.2 Unilateral Load Condition	55
Chapter 5 Discussions	66
5.1 Effect of Loading and Contact Condition in Stress and Strain Distribution.	67
5.2 Effect of Number in Mini Dental Implant Retained Overdenture on Stress and Strain Distribution	69

	Page
5.3 Effect of Position in Mini Dental Implant Retained Overdenture on Stress and Strain Distribution	71
5.4 Effect on Clinical Perspective of Mini Dental Implant on This Study	72
5.5 Limitation of Study and Suggestion for Further Study	73
Chapter 6 Conclusions	75
References	76
Appendix	82
Appendix A	83
Appendix B	87
Curriculum Vitae	91



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่
 Copyright© by Chiang Mai University
 All rights reserved

LIST OF TABLES

		Page
Table 2.1	Survival rate of mini dental implant retained overdentures	11
Table 2.2	Mini dental implant retained overdentures data	12
Table 3.1	Group study classification	26
Table 3.2	Mechanical and Material properties used in this study	33
Table 3.3	Number of elements in example study groups in convergence test	35
Table 3.4	Number of elements and nodes in each component of the models	36
Table 4.1	Bilateral load Von Mises stress of peri-implant from volume-averaged in cancellous and cortical bone	43
Table 4.2	Bilateral load maximum principal strain of peri-implant from volume-averaged in cancellous and cortical bone)microstrain: $\mu\epsilon$(	45
Table 4.3	Unilateral load in volume-averaged Von Mises stress of peri-implant cancellous and cortical bone)MPa(	55
Table 4.4	Unilateral load in volume-averaged maximum principal strain of peri-implant in cancellous and cortical bone.)microstrain(	56

LIST OF FIGURES

		Page
Figure 2.1	Material parameters used in FEA studies of dental implants	8
Figure 2.2	Traditional dental implant and Mini dental implant (MDI)	10
Figure 3.1	Simulation device	20
Figure 3.2	Human edentulous mandibular CT scan	21
Figure 3.3	Human edentulous mandibular model	21
Figure 3.4	Human edentulous mandibular model with cortical and cancellous bone layer	22
Figure 3.5	Denture model from dicom files directly)STL files(	22
Figure 3.6	Modified denture model from STL files	23
Figure 3.7	Gingiva model	23
Figure 3.8	Perspective and side view of mini dental implant	24
Figure 3.9	Equator attachment part)Metalhead(	24
Figure 3.10	O-ring attachment part	24
Figure 3.11	Abutment part	25
Figure 3.12	Edentulous mandibular with 2 mini dental implants at incisor area)group1(	26
Figure 3.13	Edentulous mandibular with 2 mini dental implants at canine area)group2(	27
Figure 3.14	Edentulous mandibular with 2 mini dental implants at premolar area)group3(	27
Figure 3.15	Edentulous mandibular with 3 mini dental implants at midline and incisor area)group4(	28
Figure 3.16	Edentulous mandibular with 3 mini dental implants at midline and canine area)group5(	28
Figure 3.17	Edentulous mandibular with 3 mini dental implants at midline and premolar area)group6(	29
Figure 3.18	Edentulous mandibular with 4 mini dental implants at incisor and canine area)group7(	29

	Page
Figure 3.19 Edentulous mandibular with 4 mini dental implants at incisor and premolar area)group8(	30
Figure 3.20 Edentulous mandibular with 5 mini dental implants at midline, incisor, and canine area)group9(	30
Figure 3.21 Edentulous mandibular with 5 mini dental implants at midline, incisor, and premolar area)group10(	31
Figure 3.22 FEA template model)Solidwork(	32
Figure 3.23 Sample model from one group showed the subtracted area on Edentulous mandibular at the red arrow)dental implant(	32
Figure 3.24 Peri-implant area in cortical and cancellous bone on edentulous Mandibular	33
Figure 3.25 Linear tetrahedron element type and hexahedron element type, Respectively	34
Figure 3.26 Convergence test element	35
Figure 3.27 Meshing and partitioning model to good quality elements	37
Figure 3.28 Boundary conditions were fixed at posterior area	38
Figure 3.29 Unilateral load condition and Bilateral load condition, respectively	39
Figure 4.1 Geometric mean of Von Mises stress on cortical bone layer comparison	46
Figure 4.2 Geometric mean of Von Mises stress on cancellous bone layer comparison	47
Figure 4.3 Geometric mean of Maximum principal strain on cortical bone layer comparison	48
Figure 4.4 Geometric mean of Maximum principal strain on cancellous bone layer comparison	49
Figure 4.5 canine region on right side)buccal(	50
Figure 4.6 canine region on right side)lingual(	50
Figure 4.7 canine region on left side)buccal(	51
Figure 4.8 canine region on left side)lingual(	51
Figure 4.9 midline region)buccal)	52
Figure 4.10 midline region)lingual(	52

	Page
Figure 4.11 premolar region on right side)buccal(	53
Figure 4.12 premolar region on right side)lingual(	53
Figure 4.13 premolar region on left side)buccal(	54
Figure 4.14 premolar region on left side)lingual(	54
Figure 4.15 Geometric mean of Von Mises stress on cortical bone layer comparison	57
Figure 4.16 Geometric mean of Von Mises stress on cancellous bone layer comparison	57
Figure 4.17 Geometric mean of maximum principal strain on cortical bone layer comparison	59
Figure 4.18 Geometric mean of maximum principal strain on cancellous bone layer comparison	60
Figure 4.19 canine region on right side)buccal(	61
Figure 4.20 canine region on right side)lingual(	61
Figure 4.21 canine region on left side)buccal(	62
Figure 4.22 canine region on left side)lingual(	62
Figure 4.23 midlineregion)buccal(	63
Figure 4.24 midline region)lingual(	63
Figure 4.25 premolar region on right side)buccal(	64
Figure 4.26 premolar region on right side)lingual(	64
Figure 4.27 premolar region on left side)buccal(	65
Figure 4.28 premolar region on left side)lingual(	65