

**Comparing Two Designs of Implant Supported
Partial Over- dentures Restoring Lower
Kennedy Class I with Anterior Modification.
(Finite Element Analysis)**

Thesis submitted to the Faculty of Dentistry
Ain Shams University, for the Partial Fulfillment of the
requirement for the Master Degree in Oral and
Maxillofacial Prosthodontics

By

Asmaa Nabil Saad

B.D.S, 2003

Faculty of Dentistry- Ain Shams University

Ain Shams University

2010

SUPERVISORS

Prof. Dr. Hany Eid

Professor of Prosthodontics

Faculty of dentistry

Ain Shams University

Dr.Magdy Eid Mohamed

Associate Professor of Prosthodontics

Faculty of Dentistry

Ain Shams University

Dr.Mohamed Mohamed EL Zawahry

Researcher of Prosthodontics

National Research Center



وَلْيَعْلَمَ الَّذِينَ أُوتُوا الْعِلْمَ أَنَّهُ الْحَقُّ مِنْ رَبِّكَ فَيُؤْمِنُوا بِهِ فَتُخْبِتَ لَهُ قُلُوبُهُمْ
وَإِنَّ اللَّهَ لَهَادِ الَّذِينَ آمَنُوا إِلَى صِرَاطٍ مُسْتَقِيمٍ

صدق الله العظيم

Acknowledgment

In the beginning, I want to thank God for helping me and answering my prayers, without God I would not have accomplished my work.

*I want to thank **Prof. Dr. Hany Ibrahim Eid** Professor of Prosthodontics, Faculty of Dentistry, Ain Shams University who helped me a lot by his ideas and supporting. He guided me to the right path from the beginning to the end of my paper. I appreciate the effort you exerted and the time you spent with me. Thank You.*

*I would like to thank **Dr. Magdy Eid Mohamed** Assoc. Professor of Prosthodontics, Faculty of Dentistry, Ain Shams University, for the information and advice he provided for me. Your assistance has been valuable to me during the process of writing my research till finishing it. I am grateful for what you have done for me.*

***Dr. Ahmed El- Ragi**, Assoc. Professor in Civil Engineering Department, Faculty of Engineering, Fayoum University I do owe you a lot of gratefulness. I am thankful for what you have done with me, for your time and the whole thing you taught me in finite element. I want to thank you for your effort, time and support you provided for me.*

*I want to thank **Dr. Mohamed EL Zawahry** Researcher of prosthodontics National Research Center for supporting me and being so careful. I am grateful for all what you have done for me. I am thankful for your time, effort and information you have provided me through my research. I am thankful and grateful.*

*I want to thank all my professors and my colleagues who were always there for me whenever I needed them and who assisted me in completing my academic journey and succeeding in it. specially **Prof. Dr. Ingy Amin Talaat**, head of porsthodontics department, Ain Shams University.*

My dear father, I am deeply grateful for providing me with the greatest support ever. I want to thank you for fulfilling my dreams and making them come true.

My great mother and my lovely daughter, thank you for your effort. I appreciate your scarify of your time to help me study and finish my work.

My very dear and beloved husband, no matter what I say, words can never express how grateful I feel for you. I really do appreciate your caring heart.

My dearest family thanks for providing me with help, love and support in my life journey. I really owe you a lot. I thank God for having such a great family.

List of contents

	Page
Introduction	1
Review	3
-Distal Extension Removable Partial Denture.	3
Problems of Distal Extension Removable Partial Denture.	4
-Treatment Modalities of Distal Extension RPD with Anterior modification	6
Fixed bridge	6
Removable Partial Denture	6
Implant supported Removable partial denture	7
-Factors affecting the success or failure of dental implant	9
-Types of endosseous dental implants	11
Attachments	14
-Definition of Dental attachment	14
-Types of Dental attachment	14
-Bars Attachment in removable prosthodontics	15
a) Splinting bar	15

b)Clip Bar Attachment	15
-Rigid Versus Non Rigid Attachment	17
-Splinted Implant in Modification area	18
-Splinted Versus Non Splinted Implant concept	18
-Splinted Implants with Clip Attachment in modification area	18
Stress Analysis	20
Experimental Stress Analysis	20
1-Brittle Lacquer Method	20
2-Holographic Interferometry	20
3-StereoPhotogrammetric	21
4-Strain Gauge Method	21
5-Photoelastic Method	22
Numerical Stress Analysis	25
-Finite Element Analysis.	25
-Application of F.E.A In Dentistry	30
Aim of the study	33
Material and methods	34
1-Model construction.	34
2-Numerical model construction.	35
a-Multislice Computed Tomographic scanning:	35

b-Use of MIMICS	38
C-The finite element model:	43
-Preprocessing	43
1-Geometry	43
2-Element type.	45
3-Material property	45
4-Meshing.	47
5-Boundary condition	50
-Processing	51
-Post processing	52
Results	54
<i>A-Stresses induced on working side.</i>	55
1- Stresses induced around second premolar on the working side in splinted implant with and without clip attachment during tissueward loading.	55
-Tensile stresses (S1).	56
-Compressive stresses. (S3)	57
-Von Mises stresses (SEqv).	57
2- Stresses induced around second premolar on the working side in splinted implant with and without clip attachment during tissueaway loading.	58

-Tensile stresses (S1).	59
-Compressive stresses.(S3)	59
-Von Mises stresses (SEqv).	60
3-Stresses induced around the splinted left implant with and without clip attachment during tissueward loading.	60
-Tensile stresses (S1)	61
-Compressive stresses (S3)	62
-Von Mises stresses (SEqv).	62
4-Stresses induced around the splinted left implant with and without clip attachment during tissueaway loading.	63
-Tensile stresses (S1)	64
-Compressive stresses (S3)	64
Von Mises stresses (SEqv)	65
B-Stresses induced on balancing side	66
1-Stresses induced around second premolar in balancing side in splinted implant with and without clip attachment during tissueward loading.	66
-Tensile stresses (S1)	67
-Compressive stresses (S3)	67
-Von Mises stresses (SEqv).	68
2-Stresses induced around second premolar in balancing side in splinted implant with and without clip	68

attachment during tissueaway loading.	
-Tensile stresses (S1)	69
Compressive stresses (S3)	70
-Von Mises stresses (SEqv)	70
3-Stresses induced around the splinted right implant with and without clip attachment during tissueward loading.	71
-Tensile stresses (S1)	72
-Compressive stresses (S3)	72
-Von Mises stresses (SEqv).	73
4-Stresses induced around the splinted right implant with and without clip attachment during tissueaway loading.	73
-Tensile stresses (S1)	74
-Compressive stresses (S3)	75
Von Mises stresses (SEqv).	75
Discussion	76
Summary	85
Conclusions	87
References	88

List of figures

Figure		Page
1)	The Removable Partial Denture (RPD) on the master cast	35
2)	C. T Scan Machine	36
3)	Work Station Desktop	37
4)	CT scan of the cast and the partial denture	38
5)	Thersolding	40
6)	Editing the 3D image	40
7)	Calculating the 3D image	41
8)	The 3D image of the 3 masks	41
9)	The cast metal before remeshing	42
10)	The cast metal after remeshing	42
11)	Exporting the masks to ANSYS 11	42
12)	The resultant model	43
13)	Right and left implant	43
14)	The splinting bar	44
15)	The two splinted implants without attachment	44
16)	The two splinted implants with clip bar attachment	44
17)	The fitting surface of anterior acrylic	44

18)	Element solid 72	45
19)	Cross section in posterior saddle	47
20)	Cross section in tooth area	47
21)	Tissueward load	49
22)	Tissueaway load	49
23)	Boundary condition	50
24)	The solving equation relationship between forces,displacement,stress,and strain	52
25)	Principle stresses in Model 1 and 2. (Tissueward loading)	56
26)	Maximum tensile stresses in left abutment tooth in (Model 1 and 2)	56
27)	Maximum compression stresses in left abutment tooth (Model 1 and 2)	57
28)	Von Mises stresses in abutment tooth (Model 1 and 2)	57
29)	Principle stresses in Model 3 and 4 (Tissueaway loading)	58
30)	Maximum tensile stresses in abutment tooth in (Model 3 and 4)	59
31)	Maximum compression stresses in abutment tooth (Model 3 and 4)	59
32)	Von Mises stresses in abutment tooth (Model 3 and 4)	60
33)	Principle stresses in Model 1 and 2 (Tissueward loading)	61

34)	Maximum tensile stresses in left implant in (Model 1 and 2)	61
35)	Compressive stresses around the left implant in (Model 1 and 2)	62
36)	Von Mises stresses in left implant (Model 1 and 2)	62
37)	Principle stresses In Model 3 and 4 (Tissueaway loading)	63
38)	Maximum tensile stresses in left implant in (Model 3 and 4)	64
39)	Compressive stresses around the left implant in (Model 3 and 4)	64
40)	Von Mises stresses in left implant (Model 3 and 4)	65
41)	Principle stresses in Model 1 and 2 (Tissueward loading)	69
42)	Maximum tensile stresses in abutment tooth in (Model 1 and 2)	67
43)	Compressive stresses around the abutment tooth in (Model 1 and 2)	67
44)	Von Mises stresses in abutment tooth (Model 1 and 2)	68
45)	Principle stresses in Model 3 and 4 (Tissueaway loading)	69
46)	Maximum tensile stresses in abutment tooth in (Model 3 and 4 4)	69
47)	Compressive stresses around the abutment tooth in balancing side (Model 3 and 4)	70

48)	Von Mises stresses in the abutment tooth in balancing side (Model 3 and 4)	70
49)	Principle stresses in Model 1 and 2 (Tissueward loading)	71
50)	Maximum tensile stresses in right implant in (Model 1 and 2)	72
51)	Compressive stresses around the right implant in (Model 1 and 2)	72
52)	Von Mises stresses in right implant (Model 1 and 2)	73
53)	Principle stresses in Model 3 and 4 (Tissueaway loading)	74
54)	Maximum tensile stresses in right implant in (Model 3 and 4)	74
55)	Compressive stresses around the right implant in (Model 3 and 4)	75
56)	Von Mises stresses in right implant (Model 3 and 4)	75

List of tables

Table No.	Description	Page
Table 1	Scanning Parameters	36
Table 2	The mechanical properties of each material	46
Tables 3	The number of elements and nodes	48
Table 4	Stresses around the root of second premolar abutment tooth.	55
Table 5	Stresses around the root of second premolar abutment tooth.	58
Table 6	Principle stresses around the left implant during tissue away loading	60
Table 7	Principle stresses around the left implant during tissue away loading	63
Table 8	Stresses around the root of second premolar abutment tooth.	66
Table 9	<i>Stresses around the root of second premolar abutment tooth.</i>	68
Table 10	Principle stresses around the right implant during tissue away loading.	71
Table 11	Principle stresses around the right implant during tissue away loading.	73