“Assessment of the Primary Stability for implants inserted by CBCT-Guided Stereolithographic Templates using a Partially limiting design versus Completely limiting designs in the posterior mandible: Clinical Study”

Thesis

Submitted to the Faculty of Dentistry, Ain Shams University for Partial Fulfillment of the Requirements of Master Degree in Oral and Maxillofacial Surgery

By

Khaled Taymour Khourshid

B.D.S. (2013)

Misr international University

Supervisors

Mohamed Abdel-Mageed Katamish

Professor of Oral and Maxillofacial Surgery

Faculty of Dentistry, Ain Shams University

Moustafa Mohamed Sayed Taha

lecturer of Oral and Maxillofacial Surgery

Faculty of Dentistry, Ain Shams University

2020

List of Contents

Content	Page number
Dedication	II
Acknowledgment	III
List of Figures	IV
List of Tables	IX
List of Abbreviation	X
Introduction	1
Review of Literature	4
Aim of Study	21
Materials and Methods	22
Results	46
Discussion	70
Summary	79
Conclusion	81
Recommendations	82
Reference	83
Arabic Summary	

Dedication

I would like to thank my dear family and friends for their patience, support and encouragement.

Acknowledgment

Deepest gratitude to my colleagues and friends at the department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Ain Shams University; Dr Mahmoud Yehia, Mahmoud Abdelaziz, Omnia Adel, Yasser El Hadid, for their support and help with this work.

List of Figures

Fig No	Title	Page No
1	Showing Grouping of Implant	25
2	Frontal view	26
3	Lateral view	27
4	Occlusal view	28
5	CBCT for the implant	29
6	Showing axial, 3-D, panoramic and cross-sectional image of the CBCT	31
7	Photo showing the study cast	32
8	Showing photo of the study cast after waxing up	32
9	showing CT scan for the study cast	33
10	Showing STL model for the study cast and waxing up	33
11	Showing STL model for both arch	34
12	Showing STL model for mandibular arch with the proposed prothetic plan	34
13	Showing superimposition of the DICOM data and the STL files in which implants are virtually placed according to the bone anatomy and prothetic design	35

14	Showing the surgical guide after 3-D printing and addition of the metal sleeves, Biohorizon sleeves on the left side and In2Guide sleeves in the right side	36
15	Showing testing the stability of the guide in the patient intraorally	37
16	Photo showing the crystal incision	38
17	Photo showing the traction suture	38
18	Photo showing Anchoring pin	39
19	Photo for the metal sleeve used for the universal kit	39
20	Photo of the Universal surgical kit	40
21	Photo showing drilling in the Partially limiting design through the drill key	41
22	Showing clinical photo of the osteotomy after removal of the guide	42
23	Showing clinical photo for free hand insertion of the implant	42
24	clinical photo for the implants cover by covering screw in the universal kit side	43
25	Photo showing metal sleeve of specific surgical kit	43
26	Photo of the Specific surgical kit of Biohorizon implant system	44
27	Drill Guide for the 21mm drills	45

28	Clinical photo for the Drill guide being seated to the metal sleeve for accurate insertion of the drill	45
29	Showing photo of Internal Implant Driver	46
30	Showing photo of the Depth Stop Handle	47
31	Clinical photo showing the implant insertion with the aid of internal implant drive to pickup the implant and insertion depth limited by Depth stops	47
32	Showing photograph of smart peg and Key	48
33	Smart peg connected to the implant	48
34	Clinical photo showing closure of the wound by simple interrupted suture	49
35	Showing Radiographic accuracy assessment	51
36	Osstell device	52
37	Probe attached to Osstell	53
38	Application of Osstell probe onto the smart peg	53
39	Showing column chart of Comparison between group A and B regarding Osstell reading for primary stability	55
40	Illustrating the angular and 3D deviation between planned and actual implants.	57
41	Showing column chart of Comparison between group A and B regarding Coronal Deviation in Mesio-Distal direction	58

42	Showing Mesio-Disttal deviation of the inserted implant from the planed position , Red arrow; represent the proposed position of the implant while the Blue arrow; represent the actual implant after insertion	59
43	Showing column chart of Comparison between group A and B regarding Coronal Deviation in Occluso-cervical direction	60
44	Showing occluso-Cervical deviation of the inserted implant from the planed position , Green outline; represent the proposed position of the implant while the Blue arrow; represent the actual implant after insertion	61
45	Showing Bucco-Lingual deviation of the inserted implant from the planed position , Green Circle ; represent the proposed position of the implant while the Blue arrow; represent the actual implant after insertion	63
46	Showing column chart of Comparison between group A and B regarding Sum Coronal Deviation	64
47	Showing column chart of Comparison between group A and B regarding Apical deviation in Mesio-Distal direction	65
48	Showing column chart Comparison between group A and B regarding Apical deviation in Occluso-Cervical direction	66

49	Showing column chart of Comparison between group A and B regarding Apical deviation in Bucco-lingual direction	67
50	Showing column chart of Comparison between group A and B regarding sum of Apical deviation	68
51	Showing Comparison between group A and B regarding Angular deviation	69

List of Tables

Table No	Title	Page No
1	Showing Comparison between group A and B regarding Osstell reading for primary stability	55
2	Showing ISQ values for Group A	56
3	Showing ISQ values for Group B	56
4	Showing Comparison between group A and B regarding Coronal Deviation in Mesio-Distal direction	58
5	Showing Comparison between group A and B regarding Coronal Deviation in Occluso-cervical direction	60
6	Showing Comparison between group A and B regarding Coronal Deviation in Bucco-lingual direction	62
7	Showing column chart of Comparison between group A and B regarding Coronal Deviation in Bucco-lingual direction	62
8	Showing Comparison between group A and B regarding Sum Coronal Deviation	64
9	Showing Comparison between group A and B regarding Apical deviation in Mesio-Distal direction	65
10	Showing Comparison between group A and B regarding Apical deviation in Occluso-Cervical direction	66
11	Showing Comparison between group A and B regarding Apical deviation in Bucco-lingual direction	67
12	Showing Comparison between group A and B regarding sum of Apical deviation	68
13	Showing Comparison between group A and B regarding Angular deviation	69

List of Abbreviation

Item	Abbreviation
ASA	American Society of Anesthesiologist
BIC	Bone Implant Contact
CAD	Computer Aided Design
CAM	Computer Aided Manufacture
CBCT	Cone Beam Computed Tomography
CRA	Cutting Resistance Analysis
CT	Computed Tomography
DICOM	Digital Imaging and Communication in Medicine
FDA	Food and Drug Administration
FPD	Fixed Partial Denture
ICP	Iterative Closest Point
ISQ	Implant Stability Quotient
MRI	Magnetic Resonance Imaging
RFA	Resonance Frequency Analysis
SBR	Surface Based Registration
SLA	Steriolithographic
PET	Position Emission Tomography
VBR	Voxel Based Registration
3D	Three dimensional

Introduction

Many patients exhibit a highly compromised dentition due to teeth loss, periodontal diseases, and carious decay making the construction of fixed prostheses impossible [1]. For over a century, the only available treatment option was conventional denture[2]. However, patients often complained of a lack of retention and stability of lower dentures, together with the decreased masticatory ability[3]. Thus, dental implants have been introduced to overcome those problems.

In the 1950s, professor Brånemark discovered that titanium chambers can fuse in a living bone, and could not be separated from one another without fracture[4]. This phenomenon was termed later on as Osseointegration[5]. The concept of Osseointegration caused a paradigm shift in dentistry, and markedly increased the success rate of fixed restoration[6].

Following the technological advances in Implant Dentistry, Implant placement has become a highly predictable procedure[7], with survival rates exceeding 95%[8]. Implants, therefore, have revolutionized restorative dentistry, with benefits unachievable in the past, by adding new treatment options, as well as improving old ones[9].

This revolution rehabilitates the completely edentulous patients, as described by Assunção et al. in 2007 where the researchers reported significantly higher stability of implant-retained mandibular overdentures, compared to conventional mandibular dentures[9]. In addition to improved stability, implant-retained overdentures also caused a significant increase in comfort, ability to chew, and overall patient satisfaction, in addition to a significant decline in oral health-related quality of life problems[2].

Implants have a higher success rate to support the prosthetic appliance when certain conditions are met during surgical procedure prompting to osseointegration[10]. The stability that implant has gained at the placement time indicates the integrity of future osseointegration, and later predictable implant survival[11]. The first requirement for implant placement is the essential implant stability, which is guaranteed by the new bone arrangement and rebuilt around the implant in the repairing period. The implant has to remain stable to secure undisturbed bone development all around the implant surface[12].

Nowadays, implant-supported prosthesis is one of the highly recommended treatment options for the management of completely or partially edentulous patients. Classically, a conventional mucoperiosteal flap was utilized to expose the bone, although recent efforts have been made to reduce the surgical discomfort to the patient. Minimally invasive techniques have been developed to provide the maximum functional and esthetical demands of the patient. flapless technique, as an example, has been preferred by many clinicians comparatively to the conventional surgical procedures, a flapless surgical approach was advantageous regarding preservation and protection to the bone[13].

Having manifested the advantages of a minimally invasive approach regarding postoperative complications and the accuracy of execution, the computer-guided planning before surgery seems to be of great importance. Particularly when choosing a prosthetically-driven approach to ensure the optimal position of restoration about the anatomical position of the fixture.

To ensure the success of the implant, multiple factors should be considered. Primary stability is one of the critical points that must be secured. Primary stability affects the implant at many levels, if it is

compromised in any way it will risk the osseointegration of the implant and later on the secondary stability, which if not sufficient enough the prosthetic part cannot be added and failure of treatment happens as the implant will be lose. Hence the importance of primary stability cannot be neglected and it became one of the points that must be assessed for any technological advancement made for implant placement to ensure the prognosis of the treatment. The primary stability for implant placement by computer-guided stereolithographic templates between the two designs, completely limiting the design and partially limiting design should be assessed to examine the success of the design and which one would provide more stability for an implant.

Review of literature

Available bone has special importance in implant placement, outlining the external architecture and volume of the edentulous area considered for implants to aid treatment planning[1]. Edentulous posterior mandible have specific pattern of bone loss, mainly in a vertical direction pattern that differs from other sites in the oral cavity which could be in both direction, vertical and horizontal. Classification for the different types of defect that could affect the posterior mandible has been established for better, reliable and more convenient way to communicate between surgeon all around the world[2].

The classification for the mandibular ridge is based on the shape and condition of the ridge. Cawood and Howell classified the mandibular defects into different classes, class I is the most normal ridge with natural teeth, class II is the ridge after extraction immediately. Starting from class III to class VI the ridge is deformed, class III represents a round ridge which still has sufficient height and width, while class IV is the knife-edge ridge which have sufficient height and insufficient width. Class V is the flat ridge shape with insufficient height and width and the last class, class VI the alveolar bone is completely resorbed and some degree of resorption has occurred in the basal bone of the mandible[2].

The internal structure of bone was described as bone quality or density, which refers to a number of bio-mechanical features, like the strength and degree of elasticity. The external and internal architecture of bone controls many factors in implant dentistry. The density of the available