

Histological Analysis of Bone Healing After Socket Augmentation Using Platelet-Rich Fibrin Versus Xenogeneic Bone Graft

*Thesis submitted for partial fulfillment of the requirements for
Master Degree in Oral and Maxillofacial Surgery*

Presented by

Rasha Nour-Eldin Mohammed Essa

*Resident at Nasser Institute Hospital for Research and
Treatment*

B.D.S 2010, Ain-Shams University

Supervisors

Marwa Abd-Alwahab Elkassaby

*Professor of Oral and Maxillofacial Surgery,
Faculty of Dentistry, Ain- Shams University*

Nahed Samy Khamis

*Professor of General Pathology,
Faculty of Medicine, Ain-Shams University*

Amr Amin Ghanem

*Lecturer of Oral and Maxillofacial Surgery,
Faculty of Dentistry, Ain-Shams University*

Faculty of Dentistry
Ain-Shams University

2018

Disclosure:

This study, ***STUDY 3*** is a part of a clinical research project conducted on socket augmentation to assess the effect of L-platelet rich fibrin (PRF) application on bone quality after tooth (teeth) extraction and the assessment of its effect in comparison to Xenograft on bone quality and quantity versus non augmentation. This project included the thesis of my colleagues Mohammed Ashour, ***STUDY 1*** “Socket Augmentation Using Platelet Rich Fibrin versus Xenogeneic Graft. Clinical and Radiological Assessment”, and Mohamed Saied, ***STUDY 2*** “Assessment of Primary Stability of Implants Inserted Into Sockets Augmented With Anorganic Bovine Bone Mineral or Platelet Rich Fibrin. A Clinical Study”.

Dedication

***This thesis is
dedicated to :***

My great teacher and messenger, Prophet Mohammed (Peace be upon him), who taught us the purpose of life.

My dear parents, the light that leads my way.

My beloved brothers, my backbone Mohammad and Ahmed.

My true friends and colleagues for their encouragement and cooperation.

Acknowledgment

I would like to express my special thanks and gratitude to my dear colleagues

Mahmoud Abd-ALAziz

*Asst. lecturer of oral and maxillofacial surgery
Faculty of dentistry, Ain- Shams University*

Ahmed Tawfik

*Resident of oral and maxillofacial surgery
Nasser Institute Hospital For Research and treatment*

For their effort and unlimited willingness for help.

I would also like to express my deep gratitude to

Dr. Mona Raafat

*Professor at histology department
Faculty of medicine, Ain-Shams University*

Dr. Kareem Abd-Al Mohsen

*Lecturer of oral and maxillofacial surgery
Faculty of dentistry, Ain- Shams University*

For their help and encouragement

List of Contents :

Introduction.....	1
Review of literature.....	4
Aim of the Study	25
Patients and Methods.....	26
Results.....	49
Discussion.....	79
Summary, Conclusion and Recommendations.....	89
References.....	92
Arabic summary	

List of abbreviations:

CBCT: cone beam computed tomography.

ARP: Alveolar ridge preservation.

BMP: bone morphogenic proteins.

GBR: Guided bone regeneration.

DFDB: Demineralized freeze dried bone.

FDBA: Freeze dried bone allograft.

TCP: Tricalcium phosphate graft.

HA: Hydroxyapatite graft.

P-PRP: Pure platelet rich plasma.

L-PRP: leucocyte platelet rich plasma.

P-PRF: Pure platelet rich fibrin.

PRP: Platelet rich plasma.

PRF: Platelet rich fibrin.

L-PRF: leucocyte platelet rich fibrin

RBC: Red blood cells.

GFs: Growth factors.

PIT: Peak insertion torque.

RFA: Resonance frequency analysis.

list of figures

Figure 1: Distribution (mean %, standard deviation in parenthesis) of the tissue components (granulation tissue, provisional connective tissue, woven bone, lamellar bone/bone marrow) at different healing stages of human extraction sockets. Reprinted from: (18) Trombelli L, Farina R, et al.(2008). “Modeling and remodeling of human extraction sockets” J ClinPeriodontol35: 630–63⁽⁴⁴⁾. 7

Figure 2: Different tissue constituents during socket healing phases. Adopted from Trombelli L, Farina R, Marzola A, et al.: Modeling and remodeling of human extraction sockets. Journal of clinical periodontology. 2008, 35:630-639⁽⁴⁴⁾. 7

Figure 3: Fallscussel for maxilla, & Atwood for mandible adopted from Atwood DA: Reduction of residual ridges: a major oral disease entity. Journal of Prosthetic Dentistry. 1971, 26:266-279⁽⁵⁴⁾. 10

Figure 4: The resorption of bone in the maxilla results with the ridge becoming more narrow because it resorbs toward the midline. The initial mandibular bone loss also resorbs toward the midline. Adopted from Parkinson CF: Similarities in resorption patterns of maxillary and mandibular ridges. The Journal of prosthetic dentistry. 1978, 39:598-602⁽⁶⁰⁾. 10

Figure 5: Lekholm and Zarb presented a classification of anterior bone loss in the edentulous jaws in 1985. Adopted from Lekholm U: Patient selection and preparation. Tissue-integrated prostheses Osseointegration in clinical dentistry. 1985:199-209⁽⁶¹⁾. 12

Figure 6: Misch& Judy classification on bone density. Adopted from Misch C, Judy K: Classification of partially edentulous arches for implant dentistry. The International journal of oral implantology: implantologist. 1987, 4:7-13⁽⁶⁵⁾. 12

Figure 7: Factors affect rate and amount of bone loss. Adopted from Trombelli L, Farina R, Marzola A, et al.: Modeling and remodeling of human extraction sockets. Journal of clinical periodontology. 2008, 35:630-639⁽⁴⁴⁾. 14

Figure 8: Different sources of bone graft. Adopted from Ogunsalu C: Bone substitutes and validation. Implant Dentistry-The Most Promising Discipline of Dentistry: InTech, 2011⁽⁸¹⁾. 17

Figure 9: Properties of various types of bone graft sources. Adopted from Ogunsalu C: Bone substitutes and validation. Implant Dentistry-The Most Promising Discipline of Dentistry: InTech, 2011 ⁽⁸¹⁾	17
Figure 10: Surgical technique steps.	28
Figure 11: Straight periotome used for luxation.	29
Figure 12: Non restorable tooth.	30
Figure 13: Atraumatic extraction using periotome.	30
Figure 14: Delivery of the tooth using forceps	31
Figure 15: (A) Blood collection, (B) Blood collected in 10ml vacuum tube.....	32
Figure 16: PRF centrifugation machine.	32
Figure 17: The three layers formed by centrifugation.	33
Figure 18: PRF separation.	34
Figure 19: PRF membrane.	34
Figure 20: PRF application.	35
Figure 21: PRF stabilization.	35
Figure 22: Xenograft application to bone level.	36
Figure 23: Collagen plug stabilization.	36
Figure 24: Stabilization of retractable gingiva.....	37
Figure 25: Provisional prosthesis application.	38
Figure 26: Time-line of the follow-up.	40
Figure 27: Radiographic guiding stent.....	41

Figure 28: Mucoperiosteal crestal flap incision.	41
Figure 29: Radiographic stent secured in place for clinical measurements and demarcation of the center of the socket for core biopsy harvest.....	42
Figure 30: Core biopsy harvesting.	42
Figure 31: Core biopsy taken via trephine bur.....	43
Figure 32: Implant placement.	44
Figure 33: After implant insertion 1mm above the bone level.	44
Figure 34: Closure post implant placement.	44
Figure 35: Xenograft group follow-up after three days.	51
Figure 36: PRF group at three days follow up.	51
Figure 37: Xenograft group one week follow-up.....	52
Figure 38: PRF group at one week follow-up.....	52
Figure 39: Control group at one week follow-up.....	53
Figure 40: Xenograft group at three month follow-up.....	53
Figure 41: Xenograft group at six month follow-up.	54
Figure 42: Palatal resorption in Xenograft group at six month follow-up.	54
Figure 43: Microscopic photographs of PRF group core biopsy at three month section showing newly formed bone with significant angiogenesis present by large blood vessels with RBCs in its lumen formed in-between and also invading the new bone (NB: newly formed bone, BV: blood vessels, RBCs: red blood cells present in blood vessels lumen) H-E stained sections original ×20.	57

Figure 44: Microscopic photographs of PRF group core biopsy at six month sections showing newly formed bone with significant angiogenesis present by large blood vessels formed in-between (NB: newly formed bone, BV: blood vessels,) H-E stained sections original ×20.	57
Figure 45: Microscopic photograph of Xenograft at three month group core biopsy showing newly formed bone in contact with remnants of xenograft bone, with bone marrow formed inbetween (G: graft remnants, NB: newly formed bone, BM: bone marrow), H-E stained slides original×20.	58
Figure 46: Microscopic photograph of Xenograft at six month group core biopsy showing lamellar newly formed bone with no remnants of xenograft bone, with bone marrow formed (G: graft remnants, NB: newly formed bone, BM: bone marrow), H-E stained slides original×20.	58
Figure 47: Microscopic photographs of control group three month core biopsy section showing newly formed bone with fibrous tissue formation and bone marrow formed in-between (NB: newly formed bone, FT: fibrous tissue, BM: bone marrow), H-E stained sections original×20.	59
Figure 48: Microscopic photographs of control group six month core biopsy section showing increase in newly formed bone area which became more homogenous with fibrous tissue formation indication for new bone formation and scanty bone marrow present (NB: newly formed bone, FT: fibrous tissue, BM: bone marrow), H-E stained sections original×20.....	59
Figure 49: Column chart illustrates a comparison between mean percentages of the regenerated bone area between groups A3, B3 and C3.	61
Figure 50: Column chart illustrates a comparison between mean percentages of the regenerated bone area between groups A6, B6 and C6.	63
Figure 51: Column chart illustrates a comparison between mean percentages of the total regenerated bone area of groups A3 and A6.....	64
Figure 52: Column chart illustrates a comparison between mean percentages of the total regenerated bone area of groups B3 and B6.	65
Figure 53: Column chart illustrates a comparison between mean percentages of the total regenerated bone area of groups C3 and C6.	66

Figure 54: Microscopic photographs of PRF group three month core biopsy section showing newly formed bone with significant angiogenesis presented by large blood vessels with RBCs in its lumen (NB: newly formed bone, BV: blood vessels, RBCs: red blood cells present in blood vessels lumen), MT stained sections original×20 showing areas of immature bone as bluish green areas, and mature bone as reddish areas. 68

Figure 55: Microscopic photographs of PRF group six month core biopsy section showing newly formed bone with significant angiogenesis presented by large blood vessels with RBCs in its lumen (NB: newly formed bone, BV: blood vessels, RBCs: red blood cells present in blood vessels lumen), MT stained sections original×20 showing areas of immature bone as bluish green areas, and increase in mature bone area present as reddish areas. 68

Figure 56: Microscopic photograph of Xenograft three month group, MT stained sections showing newly formed bone in contact with remnants of Xenograft, with bone marrow formed in-between, (G: graft remnants, NB: newly formed bone, BM: bone marrow), greater areas of immature bone presented as bluish areas original and graft material as bluish green areas×20..... 69

Figure 57: Microscopic photograph of Xenograft group six month MT stained section showing newly formed bone with no remnants of xenograft (G: graft remnants, NB: newly formed bone, BM: bone marrow), showing greater areas of mature bone presented as reddish areas and immature bone as bluish green areas original areas×20..... 69

Figure 58: Microscopic photographs of control three month group MT stained section showing newly formed bone with fibrous tissue formation and bone marrow formed in-between (NB: newly formed bone, FT: fibrous tissue, BM: bone marrow), immature bone as bluish green areas, while low amount of mature bone areas as reddish areas, original×20. 70

Figure 59: Microscopic photographs of control six month group MT stained section showing newly formed bone with fibrous tissue formation and bone marrow formed in-between (NB: newly formed bone, FT: fibrous tissue, BM: bone marrow), immature bone as bluish green areas, while mature bone areas as reddish areas, showing increase in mature bone surface area, homogenous, original×20..... 70

Figure 60: Column chart Illustrates a comparison between mean percentages of the immature bone area between groups A3, B3 and C3.....	72
Figure 61: Column chart illustrates a comparison between mean percentages of the immature bone area between groups A6, B6 and C6.....	74
Figure 62: Column chart illustrates a comparison between mean percentages of the mature bone area between groups A3, B3 and C3.....	76
Figure 63: Column chart illustrates a comparison between mean percentages of the mature bone area between groups A6, B6 and C6.	78

List of Tables:

Table 1: Tooth position according to the treatment performed after three or six months.....	49
Table 2: Percentages of regenerated bone formed at A3, B3 and C3.	60
Table 3: Percentages of regenerated bone formed at A6, B6 and C6.	62
Table 4: Group A: Percentages of regenerated bone tissue formed at 3 and 6 months.....	64
Table 5: Group B: Percentages of regenerated bone formed at 3 and 6 months.	65
Table 6: Group C: Percentages of regenerated bone formed at 3 and 6 months.	66
Table 7: Percentages of immature bone formed at A3, B3 and C3.....	71
Table 8: Percentages of immature bone formed at A6, B6 and C6.....	73
Table 9: Percentages of mature bone formed at A3, B3 and C3.....	75
Table 10: Percentages of mature bone formed at A6, B6 and C6.....	77

Introduction

