

Assessment of the Infraorbital Nerve Function After Rigid Fixation of Zygomaticomaxillary Complex Fractures

Thesis

*Submitted to the Faculty of Oral and Dental Medicine,
Cairo University in Partial Fulfillment of the Requirements for the
Master Degree in Oral and Maxillofacial Surgery*

By

Ghada Abd El-Monim Mahmoud

B. D. S. (Cairo)

**Faculty of Oral and Dental Medicine
Cairo University**

2010

Supervisors

Dr. Khaled Mohammed Allam

Professor of Oral and Maxillofacial Surgery

Faculty of Oral & Dental Medicine

Cairo University

Dr. Hamida Refai Hassnine

Professor of Oral and Maxillofacial Surgery

Faculty of Oral & Dental Medicine

Cairo University

Dr. Ann Ali Abd El-Kader

Professor of Neurophysiology

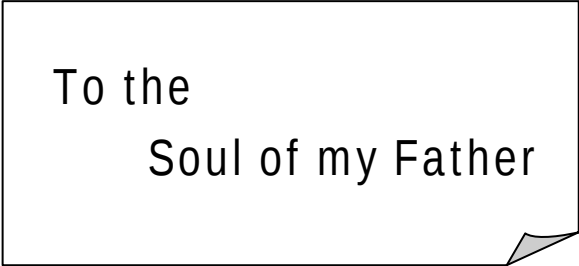
Faculty of Medicine

Cairo University

CONTENTS

	Page
Introduction.....	1
Review of Literature	2
Aim of the Study	43
Patients & Methods	44
Results.....	58
Discussion.....	80
Summary and Conclusions	87
References.....	89
Appendix	113
Araby Summary	

DEDICATION



To the
Soul of my Father

To the one who gave me love, care and
support

Who was by my side in each step in my
life To my dear mother

To my husband and lovely kids

To my dear sisters

ACKNOWLEDGEMENTS

First to "Allah" Goes all my deepest gratitude and thanks for achieving any work in my life

Words can't express my deepest gratitude and appreciation to my great Professor, Dr. Galal Beheiri, Professor of Oral and Maxillofacial Surgery, Faculty of Oral Dental Medicine, Cairo University, for his mastery teaching, generous help and support that helped me in this work.

Words are inadequate, they are only a symbol of my deepest gratitude and appreciation to my great Professor, Dr. Khaled Mohammed Allam, Professor of Oral and Maxillofacial Surgery, Cairo University for his generous help, support, his meticulous scientific supervision and valuable remarks during every step of this work.

My deepest thanks and gratitude to Dr. Hamida Rafai Hassamine, Professor of Oral and Maxillofacial Surgery, Faculty of Oral and Dental Medicine, Cairo University, for her kind supervision encouragement and support. I am really indebted and grateful to her for her generous help and sincere advice.

It is pleasure to express my deepest thanks and profound respect to Dr. Ann Ali Abd El-Kader Professor of Neurophysiology, Faculty of Medicine, Cairo University, for her kind supervision, support and humanity.

Last but not least, my deep appreciation to all my friends and colleagues of the Department of Oral Surgery and Clinical Neurophysiology Department, Cairo University, for their cooperation and encouragement.

Ghada Abd El-Moneim

LIST OF TABLES

Tables	Description	Page
1	Designation of buttress and beam segments	8
2	Clinical progression based on the degree of nerve injury	34
3	Associated mandibular fractures and their treatment	47
4	Demographic data of patients in group I	58
5	Demographic data of patients in group II	59
6	No. of patients, sex, age distribution and of associated fractures for both groups	59
7	Fracture lines observed in all patients preoperatively	62
8	Distribution of numbness sensation over areas innervated by I.O.N in both groups	64
9	Frequencies, percentages and results of McNemar's test for studying the changes by time in numbness sensation within each group as regards lower eyelid	66
10	Frequencies, percentages and results of McNemar's test for studying the changes by time in numbness sensation within each group regarding lateral skin of the nose	66
11	Frequencies, percentages and results of McNemar's test for studying the changes by time in numbness sensation within each group regarding the upper lip	67
12	Frequencies, percentages and results of chi-square test for comparison between subjective assessment in the two groups	68
13	Comparison between means, standered deviation values of the latency in the two groups	70
14	Comparison between means, standered deviation values of the amplitude in two groups	71
15	Changes by time of mean differences and standered deviation values of latencies in affected and normal sides in group I	72
16	Showing changes by time of mean differences and standered deviation values of amplitude in both sides in group I	73
17	Changes by time of mean differences and standered deviation values of latencies in both sides in group II	74

18	Changes by time of mean differences and stander deviation 75values of amplitude in affected and normal side in group II	74
19	Comparison between mean % changes, stander deviation of latency of the two groups	75
20	Comparison between mean % changes, standered deviation of amplitude of the two groups	76
21	Means, standard deviation (SD) values and results of Mann-Whitney U test for comparison between latency in cases with or without numbness sensation in group I	77
22	Means, standard deviation (SD) values and results of Mann-Whitney U test for comparison between latency in cases with or without numbness sensation in group II	78

LIST OF FIGURES

Figures		Page
1	Drawing showing frontal and lateral views of the zygoma and its articulations	2
2	Drawing showing the quadripod nature of the zygoma. Note the four sutures, in particular the location of the zygomaticosphenoid suture at the lateral orbital wall	2
3	Schematic illustration of the fracture types	6
4	Designations of fractures according to horizontal beams (H) and vertical buttresses (V). (s) indicates superior, (i) inferior	8
5	Showing nerve Structure	34
6	Showing international 10-20 system for electrodes placement	38
7	Showing radiographic assessment for ZMC fracture; A) Water's view B) Submento-vertex view C) CT axial cut D) CT coronal cut	45
8	Showing the subciliary approach	49
9	Showing A) Lateral eye brow incision exposing the ZF fracture. B) Maxillary vestibular approach; incision through the mucosa, submucosa, facial musculature, and periostium.	50
10	Showing A) Displaced zygomatic buttress fracture. B & C) Reduction using Carroll-Gerard elevator and fixation of zygomatic buttress fracture. D&E: Reduction and fixation of displaced infraorbital fracture.	51
11	Showing fixation of non-displaced infraorbital fracture as well as reconstruction of the orbital floor. C& D: Reduction and fixation of displaced ZF fracture. E& F: Fixation of non-displaced zygomatic buttress fracture	53
12	Showing closure of the wounds	53
13	Showing trigeminal somatosensory evoked potentials unit Showing the recording electrode 2 cm posterior to C3 and	55
14	C4	55
15	Showing references electrode at the forehead	55
16	Showing ground electrode around the neck	55
17	Showing electrode stimulator	55

18	An example for T.S.E.P; A) Showing amplitude in microvolts (μv). The horizontal lines mark from peak of one polarity to immediately following peak of opposite polarity. B) Showing latency in millisecond (ms) the vertical lines marks from the point of stimulus onset to the wave peak.	56
19	Histogram showing gender distribution in the two groups	59
20	Postoperative photograph showing shortening in lower eyelid	60
21	Histogram showing the preoperative clinical evaluation	61
22	Preoperative photograph showing edema & ecchymosis related to the fracture side	61
23	Postoperative photograph showing resolution of the clinical symptoms	61
24	Preoperative photograph showing edema & ecchymosis related to the fracture side	61
25	Postoperative photograph showing resolution of the clinical symptoms	61
26	Histogram showing sites of fracture	62
27	Preoperative CT scan showing fracture lines at the ZM suture	62
28	Preoperative CT scan showing fracture lines at the A) infraorbital nerve B) Lateral orbital wall	62
29	Postoperative CT scan showing fracture line after reduction with rigid miniplate	63
30	3D CT showing reduction of the fracture lines with miniplates	63
31	Histogram showing changes by time in numbness sensation within each group as regard lower eyelid, lateral skin of the nose and upper lip	67
32	Histogram showing comparison between subjective assessment in the two groups regarding lower eyelid lateral skin of the nose and upper lip	68
33	Showing the T.S.E.P latency measurements for patient No 2 group I	69
34	Histogram showing comparison between means, standard deviation values of the latency in the two groups	70

35	Histogram showing comparison between means, standard deviation values of the amplitude in the two groups	71
36	Histogram showing Changes by time of mean differences and standard deviation values of latencies in both sides in group I	72
37	Histogram showing changes by time of mean differences and standard deviation values of latencies in both sides in group II	74
38	Histogram showing Changes by time of mean differences and standard deviation values of amplitude in both groups	75
39	Histogram showing comparison between mean % changes, standard deviation of latency of the two groups	76
40	Histogram showing comparison between mean % changes, standard deviation of amplitude of the two groups.	77
41	Histogram showing means, standard deviation (SD) values and results of Mann-Whitney U test for the comparison between latency in cases with or without numbness sensation in group I.	78
42	Histogram showing means, standard deviation (SD) values and results of Mann-Whitney U test for comparison between latency in cases with or without numbness sensation in group II.	79

LIST OF ABBREVIATION

3D	Three dimensional
CBC	Complete blood count
CM	Centimeter
CT	Computer tomography
EP	Evoked potential
GA	General anaesthesia
gm	Gram
IM	Intramuscular
INR	International normalized ratio
ION	Infraorbital nerve
mA	Milliampere
mg	milligram
mm	Millimeter
msec	Millisecond
NO	Number
ORIF	Open reduction internal fixation
Pt	Patient
PT	Prothrombin time
PTT	Partial prothrombin time
SD	Standard deviation
Sec	Second
SEP	Somatosensory evoked potentials
TSEP	Trigeminal somatosensory evoked potential
W	Wave
ZF	Zygomaticofrontal
ZM	Zygomaticomaxillary
ZMC	Zygomaticomaxillary complex
ZT	Zygomaticotemporal
μv	Microvolts

INTRODUCTION

The zygoma is considered the most critical bony structure in the lateral mid face, because of its anatomical shape and its critical position, that makes it highly susceptible to fracture⁽¹⁻³⁾ with sequela of acute sensory disturbance of sensory distribution of the infraorbital nerve (I.O.N) in the majority of patients of this type of fractures.^(1,2,4-13)

The reported incidence of posttraumatic sensory disturbance of (I.O.N) in ZMC fractures varies from 24- 94% due to the close proximity of the nerve to the ZMC with higher incidence in displaced than non displaced fractures.^(2,4,7,9,12-20)

Various methods have been used to evaluate the I.O.N function including patient questionnaire and highly sophisticated technology examination modalities. The purpose of these sensory assessment is to acquire information to render a clinical diagnosis, distinguish different degree of nerve injury, monitor sensory recovery, determine whether nerve micro-surgery is indicated or not, monitor sensory nerve recovery following micro-surgery and to help medico legal evaluation.⁽²¹⁻²⁵⁾

Hence, the purpose of this study was to evaluate the efficacy of trigeminal somatosensory evoked potential (T.S.E.P) as an objective neurosensory test pre and post operatively after rigid fixation of the ZMC fractures.

REVIEW OF LITERATURE

ANATOMY OF THE ZYGOMA:

The zygoma is considered the most critical bony structure in the lateral midface. It represents the principal buttress between cranium and maxilla. It is a quadruped central body bone in shape from which four bony processes project articulating with the adjacent frontal, maxillary, temporal and the greater wing of the sphenoid bone through sutural function which are correspondingly named. That is why the zygomaticomaxillary complex ZMC fractures has been also called "Tetrapod fractures" and "tripod fractures" are a misnomer (**Fig. 1, 2**).^(1-4,26)

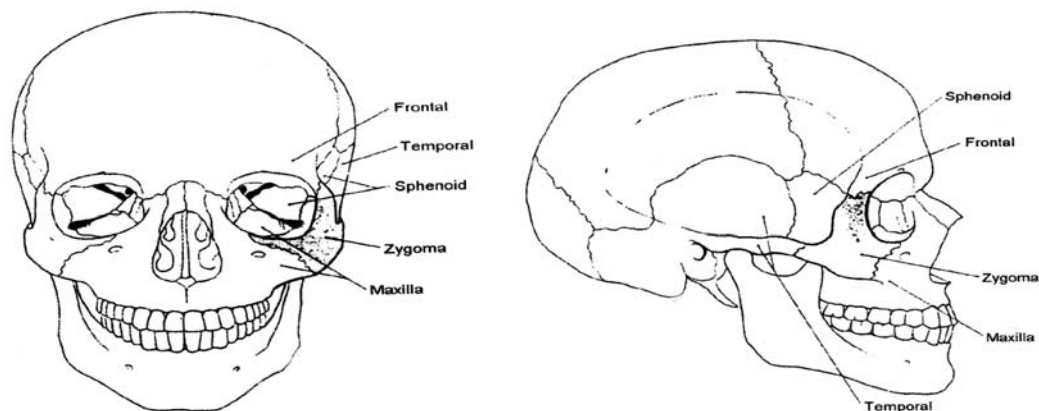


Fig. (1): Drawing showing frontal and lateral views of the zygoma and its articulations.⁽²⁶⁾

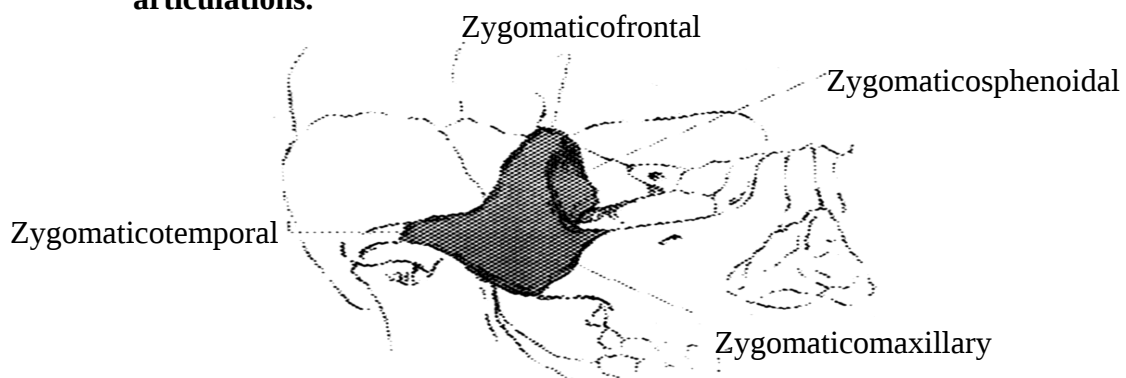


Fig. (2): Drawing showing the quadripod nature of the zygoma. Note the four sutures, in particular the location of the zygomaticosphenoid suture at the lateral orbital wall.⁽³⁵⁾

The zygomatic bone itself usually does not fracture but separation of the suture lines or fracture of the adjacent bones occurs. The zygomaticofrontal (ZF), zygomaticotemporal (ZT) and zygomaticosphenoidal suture lines are considered the weakest sites of four articulation lines and usually they are involved in the (ZMC) fractures. Especially the ZT suture line which represents the articulation of temporal process of zygomatic bone with zygomatic process of temporal bone forming a thin delicate zygomatic arch which commonly fractures when subjected to minimal force. The zygomaticomaxillary (ZM) suture line is stronger and resist fracture; when the cheek receive a blow the force is transmitted from the solid maxillary process of zygoma to the weaker zygomatic process of the maxilla and lateral wall of maxillary sinus that cause their fractures.^(2,3,26-28)

The zygomatic bone has an outer convex and inner concave surface. It's the place of origin to the major portion of the masseter muscle in its lower border and inner surface of zygomatic arch and also gives attachment for temporal and zygomatico minor and major muscles.^(2,3) It plays a significant role in the formation of the bone framework of facial skeleton, temporal fossa, maxillary sinus, cheek contour and the orbit.^(1-3,27,28)

INCIDENCE AND CAUSES OF ZMC FRACTURES:

ZMC fractures are one of the most common facial injuries secondary to the nose. The high incidence of this type of fractures is because of its prominent position in the facial skeleton.^(2,14,29-31)

The main cause of ZMC fractures is road-traffic accidents including: motor vehicle accidents, motor cycle accidents and bike accidents because of high speed driving, insufficient stress on use of seat

belts or protective head guard, and ignoring traffic rules and regulations in 29.8 - 80% of all ZMC fracture patients.⁽³²⁻³⁴⁾

The remaining fractures (20.0%) were caused by falls (6.51 - 6.6%), physical assaults (4.3 - 5.0%), then sport related injuries and interpersonal violence (2.8 - 3.8%) commonly among males between 10-30 years, work accidents (1.8 - 2.2%) and Gunshots (1.08 - 1.4%).⁽³⁰⁻³⁸⁾

The highest incidence of ZMC fractures was found in the 3rd decade of life 31-54% followed by the 4th decade representing 27%, 15% of the patients were below 15 years old, while only 1-4% were between the 7th and 8th decade.^(30-34,36)

The sex distribution ratio is observed higher for males 83-89% than females 11-17% (9:1) and this can be explained as males are more involved in violence and are considered the dominant patient population.^(30,32-38)

The wide variation in the reported incidence and causes of ZMC fractures occur as a result of the variation in the related factors as environmental, geographical, cultural status, age and sex from patient to patient and from one country to another one.^(31,32,39-41)

CLASSIFICATION OF ZMC FRACTURES:

Many classification schemes for ZMC fractures are suggested according to type of fracture, displacement of the fractured bone and the severity of the fracture.^(6,42,43) These variability of classification schemes aim to identify, categorize and describe the anatomical points of the affected bones or position, and criteria of fracture are likely to be stable after selection of proper treatment.^(2,4,6,2642)

Classification of ZMC fractures based on the anatomical points and fracture pattern into 3 types: