Effect of Pulsed Electromagnetic Field on Healing of Mandibular Fracture

A thesis submitted for partial fulfillment of requirements of the master degree in Oral and Maxillofacial surgery

BY

Adham Faisal Mustafa

B.D.S.

Faculty of Oral & Dental Medicine

Cairo University

2009

Supervisors

Dr. Hamida Refai Hassanein

Professor of Oral and Maxillofacial Surgery

Faculty of Oral and Dental Medicine

Cairo University

Dr. Mushira Mohamed Dahaba

Professor and head of Oral Radiology

Faculty of Oral and Dental Medicine

Cairo University

Dedication

To my family, my father, my mother and brothers and to

my* friends and *Supervisors

who help me succeed *and supported during my study*.

Acknowledgement

First of all, I thank Allah for paving the way for me to fulfill this work. Second of all, I would like to express my sincere gratitude and appreciation to Dr. Hamida Refai, professor of Oral and Maxillofacial Surgery, Faculty of Oral and Dental Medicine, Cairo University. I will remain grateful to her for her wise advice, scientific supervision and kind guidance throughout the entire course of this work. I am also grateful to Dr. Mushira Dahaba, professor and head of Oral Radiology, Faculty of Oral and Dental Medicine, Cairo University, for her unlimited effort and time spent.

Finally, many thanks to the members of Oral and Maxillofacial Surgery Department, Faculty of Oral and Dental Medicine, Cairo University, for their kind cooperation towards achieving this work.

Contents

List of abbreviations

PEMF	:	Pulsed Electromagnetic Field
MMF	:	Maxillo-Mandibular Fixation
ASA	:	American Society of Anasthiologist
IM	:	Intramuscular
Fig.	:	Figure
BMD	:	Bone Mineral Density
CSD	:	Critical Size Defect
PRP	:	Platelet Rich plasma
ESWT	:	Extracorporeal shock waves
HBO	:	Hyperbaric Oxygen
LLLT	:	Low-level laser therapy
BMP	:	Bone Morphogenic Protein
CADIA	:	Computer Assisted Densitometric Image Analysis
CT	:	Computerized Tomography

List of figures

List of tables

Introduction

Introduction

Mandible fractures occupy the second most frequent incidence of facial bone fractures [1,2]. The location and pattern of the fractures are determined by the mechanism of injury and the direction of the vector of the force. In addition to this, the patient's age, the presence of teeth, and the physical properties of the causing agent also have a direct effect on the characteristics of the resulting injury [3].

The treatment of mandible fractures has evolved over thousands of years and will likely continue to change. The goals of treatment are to restore proper function by ensuring union of the fractured segments and reestablishing preinjury strength to restore any contour defect that might arise as a result of the injury, and to prevent infection at the fracture site. Restoration of mandibular function in particular, as part of the stomatognathic system must include the ability to masticate properly, to speak normally, and to allow for articular movements as ample as before the trauma. In order to achieve these goals, restoration of the normal occlusion of the patient becomes paramount for the treating surgeon [4].

Therapeutic success of mandibular fractures depends absolutely on both the knowledge of and strict adherence to the biomechanical and surgical principles. The basic treatment principles of mandibular fractures include reduction, fixation, immobilization, and supportive therapies [4,5]. These principles have been achieved in one of two ways. The first involves wiring the teeth and jaws together for a period of 4 to 6 weeks in order to allow the broken jaw to heal (closed treatment). The second way involve a surgical procedure that requires exposing the broken bones and stabilizing them with metal plates and screws that allow the patient to be able to function relatively normally during the healing period (open treatment) [4,5].

It is generally accepted that the vast majority of fractures of the mandible may be treated satisfactorily by the method of closed reduction. Nevertheless, with the advent of the plate and screw fixation devices, open treatment has become more common [6].

The main disadvantage of closed treatment is the need for a relatively long period of immobilization with the subsequent delay of rehabilitation. This draws the attention of many researchers toward accelerating the healing of fractures by stimulation of osteogenesis [7-11] with the subsequent reduction of the immobilization period, prevention of joint stiffness and permission of early rehabilitation. Doubtless, great benefits would accrue to orthopedic patients if the processes of bone healing could be brought under the command of the surgeon, permitting the formation of bone on demand in order to aid in the repair of fractures, nonunions and other skeletal defects [7].

Various devices and methods have been used to enhance bone healing including; low intensity pulsed ultrasound [7-9] and pulsed electromagnetic therapy. The effectiveness of Pulsed Electro Magnetic Field (PEMF) stimulation for enhancement of bone healing has been reported. However, its mechanism of osteogenesis enhancement is not clear [12]. Nevertheless, the use of PEMF to stimulate osteogenesis in patients with mandibular fracture has not yet been reported. Therefore, it was the aim of this study is to investigate the effectiveness of the pulsed electromagnetic field in enhancing the healing of mandibular fracture treated by closed reduction and short period of maxillomandibular fixation (MMF)

Review of literature

Review of Literature

Anatomy/Biomechanics

Knowledge of the anatomy of the mandible and the muscular forces applied to it is the key to proper reduction of mandibular fractures. It is important to understand the factors that account for displacement and how these can be effectively counteracted.

The mandible articulates with the temporal bones of the skull base at the temporomandibular joints. It consists of a curved, horizontal portion, the *body* and two perpendicular portions, the *rami*, which unite with the ends of the body nearly at right angles. The mandible has three processes, the alveolar process which is the tooth-bearing area of the mandible, the condyle which is the postero-superior projection of the ramus, and the coronoid process, the antero-superior projection of the ramus [13]. The masseter, medial pterygoid, lateral pterygoid, and the temporalis are the muscles of mastication that act to produce motion and support the mandible [14].

The blood supply of the mandible is via the inferior alveolar artery that runs in the inferior alveolar canal. Additional blood supply comes from the surrounding periosteum [15]. The nervous supply of the mandible is via the inferior alveolar nerve, branch of the mandibular division of Trigeminal nerve (V), enters the mandibular foramen and runs forward in the mandibular canal, supplying sensation to the teeth. At the mental foramen the nerve divides into two terminal branches: incisive and mental nerves. The incisive nerve runs forward in the mandible and supplies the anterior teeth. The mental nerve exits the mental foramen and supplies sensation to the lower lip [13].

Incidence / Etiology

Mandible fractures occupy the second most frequent incidence of facial bone fractures, with an incidence of about 38% [16,17].

Vehicular accidents, violence, sports trauma and gunshot are the major etiological factors of mandibular fractures. Few fractures of the mandible are secondary to surgical procedures such as lower third molar surgery. The major predisposing factors for mandibular fractures are central lesion such as intra-bony cyst or tumors or osteomyelitic destruction of segments of the mandible [18]**.** The most common etiology for fracture mandible was road traffic accidents [19]**.**

Classification

Various classifications of mandibular fracture have been evolved depending on its anatomic location or the specific characteristics of the fracture. Kelly and Harrigan's [20] divided mandibular fractures based on their anatomic location into:

Dentoalveolar fracture: Any fracture that is limited to the tooth-bearing area of the mandible without disruption of continuity of the underlying osseous structure.

Symphysis fracture: Any fracture in the region of the incisors that runs from the alveolar process through the inferior border of the mandible in a vertical or almost vertical direction.