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## Prospective Study on the Effect of Pulsed Electro-Magnetic Therapy in Established Fracture Nonunion.

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### ABSTRACT

Since 1970's, pulsed electromagnetic fields have been used for accelerating fracture healing in established fracture Non-Unions. The purpose of our study was to determine the effect of pulsed electromagnetic stimulation in promoting healing in established fracture non-unions (FDA definition). 21 patients with established non-union, with an average period of 9 months after the injury, were taken up. These included patients with fractures in Clavicle, shaft of Humerus, both bones upper limb, shaft of Femur, shaft of Tibia, distal Tibia, 1st Metatarsal and medial epicondyle. Among the 21 cases, 14 were initially treated surgically and 7 conservatively. The magnetic field consisted of a pulse burst of 4.5 msec duration repeated at 15 Hz for 5 hours during day and 5 hours during night. Each burst consisted of 20 magnetic field pulses with an increasing phase (0–20 gauss). They were followed up radiologically at the end of 4 weeks and thereafter 2 weekly intervals, until callus appeared radiologically. Among 21 patients, Union was achieved in 80.95% cases, at an average time of 17.95 weeks. 3 cases of fractures of shaft of Humerus and 1 case of distal Tibia showed no evidence of callus formation, even after 6 months of treatment. Analysis of these fractures proved that fracture gap of more than 5 mm negatively influenced healing outcomes. Age, sex, time period and the presence of Implants, did not affect the outcome.

**Keywords:** Non-union, Pulsed Electromagnetic Therapy, Fracture Healing.

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## INTRODUCTION

Bassett et al [3] explained the use of pulsing electromagnetic fields for healing of nonunion fractures. The beneficial effects of electrical stimulation have been reported since then [2]. Based on degree of invasiveness there are three types of electrical stimulation implanted stimulators for treating failed posterior spinal fusion, semi-invasive devices in which direct current is utilized and non-invasive types which help in generating electromagnetic energy and aid in union of fracture[1]. Our study reports the efficacy of pulsing electromagnetic (PEMF) therapy for treating established nonunion fractures. The success and failure factors associated with Pulsing electromagnetic field are discussed.

## MATERIALS AND METHODS

Twenty-One Patients, (14 men and 7 women), with an average of 42.7 years (26 to 63 years) were part of our study. About 78% of the non-union cases due to road traffic accident, and 5 fractures (23.80%) were open type. The disability ranged from 9 months to 22 months. The average period was 12 months after injury. The peak of the distribution of disability period in 21 patients was between 4 and 12 months. Almost 66% of the patients had surgical treatment and about 34% had conservative management.

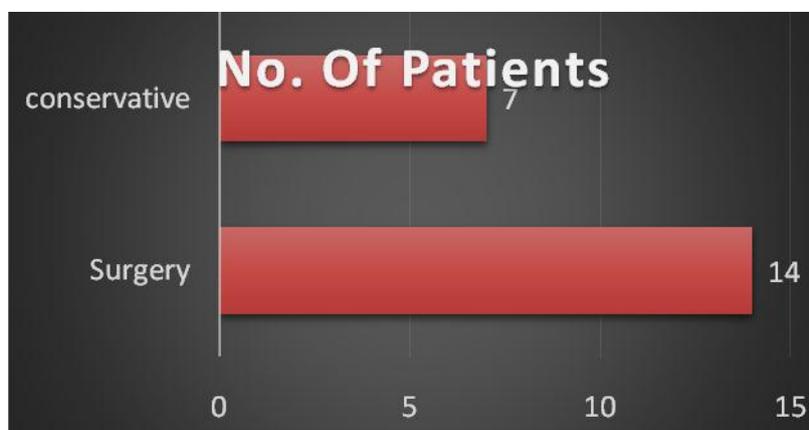
**Inclusion Criteria:** Period of disability more than 9 months.

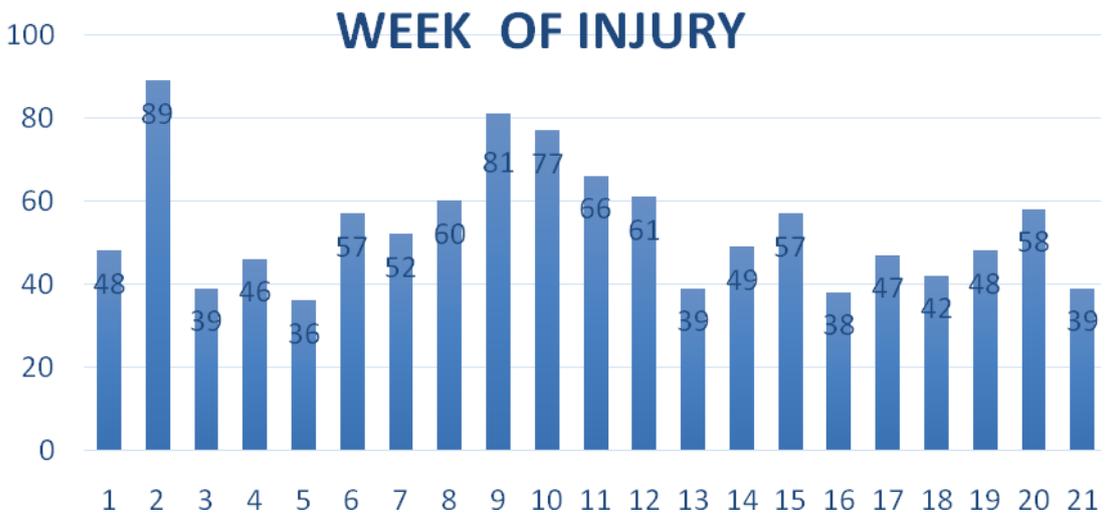
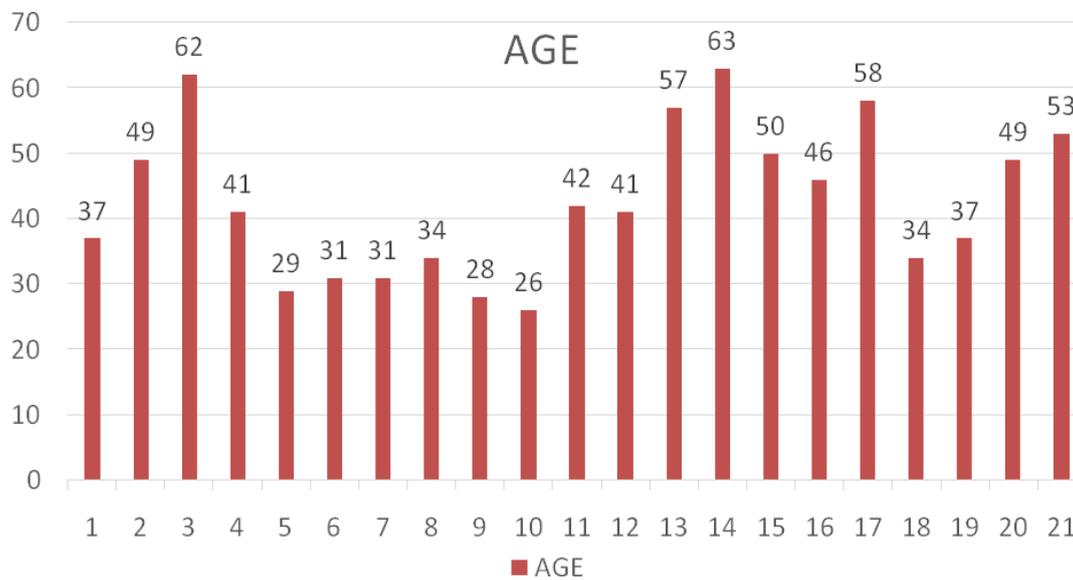
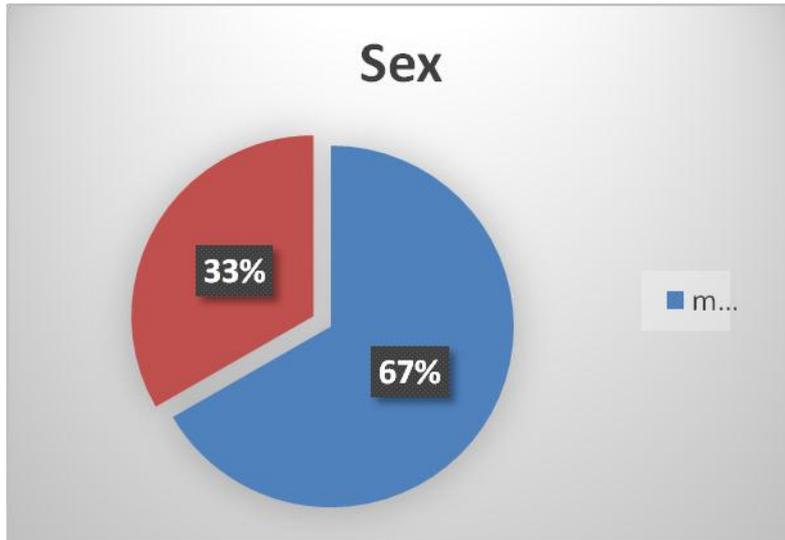
**Exclusion Criteria:** Atrophic type of Non-union.

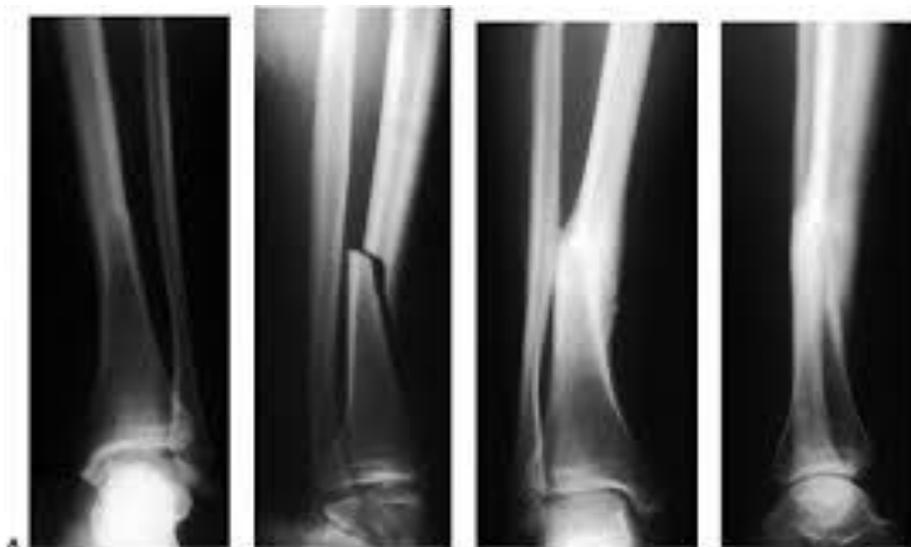
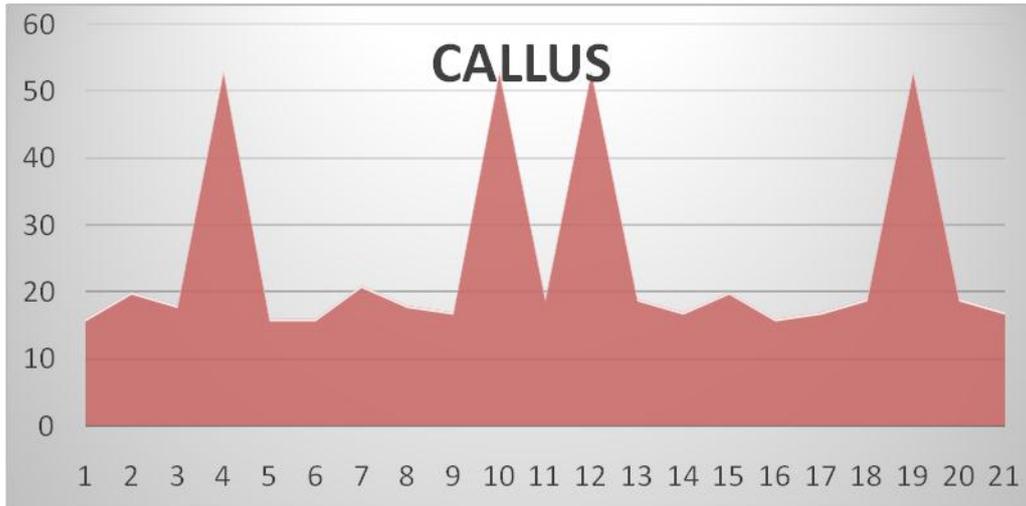
The magnetic field consisted of a pulse burst of 4.5 msec duration repeated at 15 Hz for 5 hours during day and 5 hours during night. Each burst consisted of 20 magnetic field pulses with an increasing phase (0–20 gauss). They were followed up radiologically at the end of 4 weeks and thereafter 2 weekly intervals, until callus appeared radiologically[9]. The bone was immobilized in plaster cast. The Locator blocks position was checked radiographically and was fixed to the coil (Female)[11]. The Other coil was placed opposite to the plaster at 180 degrees to locator coils. 10 hours of therapy was advised for the patients per day. The treatment was given as an outpatient procedure. They were followed up radiologically at the end of 4 weeks and thereafter 2 weekly intervals, until callus appeared radiologically. Electromagnetic treatment was discontinued when no pain on stress, no clinical mobility at the site of union, when slight tenderness over fracture site[5]. For the fracture to be considered as united, radiographic confirmation in two planes showing bony trabecular crossing at least half width of the defect was mandatory[12].

## RESULTS

Among 21 patients, Union was achieved in 80.95% cases, at an average time of 17.95 weeks. 3 cases of fractures of shaft of Humerus and 1 case of distal Tibia showed no evidence of callus formation, even after 6 months of treatment. Analysis of these fractures proved that fracture gap of more than 5 mm negatively influenced healing outcomes [14]. Age, sex, time period and the presence of Implants, did not affect the outcome [10].







Union achieved by Pulse Electro Magnetic Field Therapy in established fracture non-union of tibia .



A case in which union could not be achieved despite Pulse Electromagnetic Field Therapy , Patient was a chronic smoker , which could have not helped in fracture union .



Union achieved by Pulse Electro Magnetic Field Therapy in established fracture non-union of tibia .

### DISCUSSION

Fracture nonunion has no universally accepted definition until date. It is defined as a state that exists when union of fracture will not occur without surgical intervention. Nicoll, Defined Nonunion as a condition in which in the opinion of the surgeon, the fragment will not unite with further conservative treatment [15]. Electrical stimulation can induce fracture union in many cases. These methods have been used since 1981. When they are subjected to electrical therapy, these cause weak currents in the bone. They have been used in many cases of fibular osteotomies, latest studies are now concentrated on mechanism of action of this method. Alterations in pulse therapy [9] have been found to increase the calcium content in chondrocytes [6]. Other studies have found to alter collagen calcium and cyclic amp. Many studies have also been found to alter the dna synthesis [6]. They also cause fibro cartilaginous calcification and later which gets converted into fibrous bone. The success rates vary from 76-81%. These numbers are from a study where the average duration of disability was 4.7yrs; they also found that tibia healed faster than humerus or femur [15]. Bone graft coupled [11] with procedure yielded better results and better in young patients with initiation of therapy within two years of the initial trauma [4]. However we did not involve these components into our study. It is difficult to conduct a double blinded study [8] in this case because of the difficulty in grouping [7] the patients. There were some double blinded studies that were conducted which did not give proper results. Finally together all these studies suggest that Pulse electromagnetic field causes better union in non unions. Weber had classified non union depending upon the blood supply in the ends or whether the ends were active or inactive [13] . However we did not use this classification because some of our cases were infected type of non union. Totally 4 cases failed to unite . Thus we conclude that Pulse electromagnetic fields can be used to treat non union fractures with adequate blood supply to the ends.

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