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Experience on the Use of Ultrasound in Treatment of Non Union / Delayed Union of Fractures.

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ABSTRACT

Several years ago, low intensity pulsed ultrasound was shown to accelerate fresh fracture healing both experimentally and clinically. In this study, the effect of pulsed, low intensity ultrasound was determined in established non-union cases.Subjects with an elapsed time period of 3 months after their last surgical procedure/or injury with no evidence of fracture healing were taken up for the study.18 cases with fractures located in Tibia, femur, both bones, clavicle and metatarsal were taken up. Treatment was started at an average 32.5 weeks after Injury.9 cases were treated conservatively and the rest surgical. The patients underwent 20 minutes of Ultra sound therapy every day.

average healing time was 21.3 weeks. There was a success rate of 88.89%. The study took into consideration the age, gender, associated diseases, bone involved, fracture gap, fracture age,smoking with only smoking causing a undesirable impact. Thus Non-invasive ultrasound therapy can be used in treatment of non-unions with excellent results.

Keywords: Non-union, ultrasound, fracture healing

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INTRODUCTION

Fracture healing is a complex process which involves a myriad of complex events. Fracture healing includes a variety of events acting on the body proteins, gene expression to restore the normal bone anatomy.one of the mechanisms is the use of low intensity ultrasound therapy. Numerous in vivo animal studies and prospective double blinded placebo controlled clinical trials have shown that ultrasound is capable of accelerating and augmenting the healing of fresh fractures. Preliminary evidence suggests the efficacy in treatment of delayed union and non-union as well [1].

The FDA had given its approval for the use of ultrasound therapy for fresh fractures in October 1994 and for treatment of established on unions on December 2000this approval was based on rigorous double blinded,placebo controlled studies [2,3].

These studies demonstrated that ultrasound therapy influenced the three facture healing stages (inflammation, repair, and remodelling) because it increases angiogenic, chondrogenic, and osteogenic activity.

There is accumulating clinical data to suggest the use of ultrasound in the treatment of delayed unions and non-unions and with an added benefit of decreased cost.

Low intensity ultra sound is transmitted into the living tissue as acoustical waves. These pressure waves cause stresses the cause alteration in cellular levels [4-6].

Several authors have suggested the possible mechanisms involved in bone's response to physiological mechanical force-loading [7,8].

Rawool et al [9] demonstrated that low-intensity ultrasound, applied over a ten-days,increased vascularity at the site of ulnar osteotomies in dogs. The increased vascularity persisted even after the removal of the stimulus. This improved vascularity which was monitored by Doppler studies implied and increase in the micro fracture circulation resulting in improved callus formation

this increases in vascularity was found to be due to alternation by modulating gene expression (molecular interaction), by dilation of capillaries (structural intervention) and the enhancement of angiogenesis (cellular interaction)., a major benefit of ultrasound may be that it biologically and biophysically optimizes healing processes and promotes an idealized environment that is conducive to repair. It is indeed the aim of most treatment of fractures to establish the blood flow back to the fractured fragments .It was also found that anything that diminished the oxygenation, such as the severity of the injury, smoking, vascular diseases, or diabetes, will potentially suppress the healing response

Duarte [10,11], using histological studies and radiographs, found out that ultrasound signals similar to those used to treat non-union in humans successfully accelerated cortical bridging across the site of a fibular osteotomy in rabbits by 28% compared with that in controls..This was pursued as an alternative mechanical bearing and that would provide the biological advantages of actual weightbearing.

MATERIALS AND METHODS

This was a prospective study conducted in 18 patients admitted in our hospital between the period of May 2012 to December 2013.These patients had fractures of the Tibia, femur humerus metatarsal, clavicle and humerus. They had undergone treatment by either conservative methods such as native splint or by Plaster of Paris application. The inclusion criteria of the subject was

- History of injury at least 3 months from the day of presentation
- Underwent treatment by either conservative or surgical means.
- Clinically with signs of non-union/delayed union such as painless, abnormal mobility in different planes
- All cases of hypertrophic and atrophic non unions were considered.
- No radiological signs of fracture union such a bridging callus formation or trabecular continuity.

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The exclusion criteria was

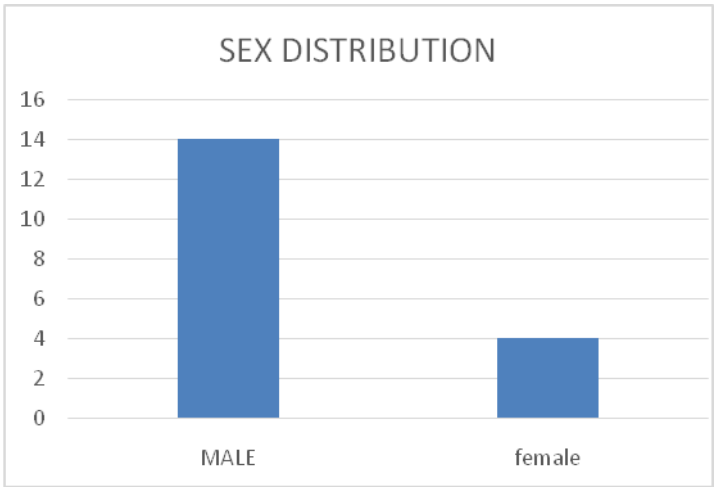
- History of injury with 3 months of the date of presentation
- Clinical signs of union
- Radiological signs of union.

Proper consent was obtained from the patient for conducting the study on them. They were then subjected to low intensity pulsatile ultrasound therapy for a minimum of twenty minutes per day. Serial radiological study was done at four weekly intervals till the time when the first sign of fracture healing was seen

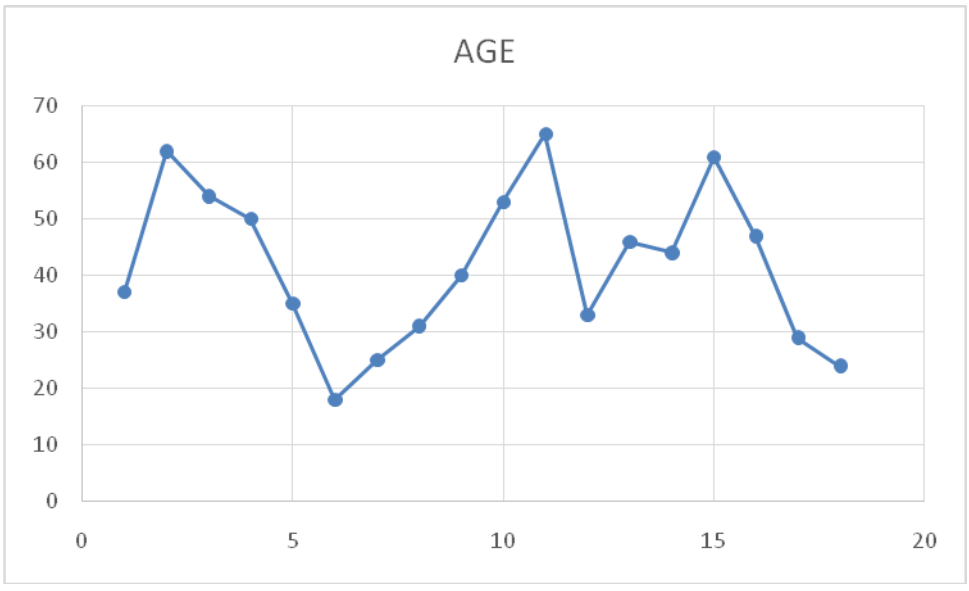
RESULTS

There were 18 subjects selected for the study who fulfilled the criteria that was involved. A detailed consent was obtained from the patient before the start of the study.

There were 9 males and 9 females in the study



The average age of the subjects involved was 44.9 years.



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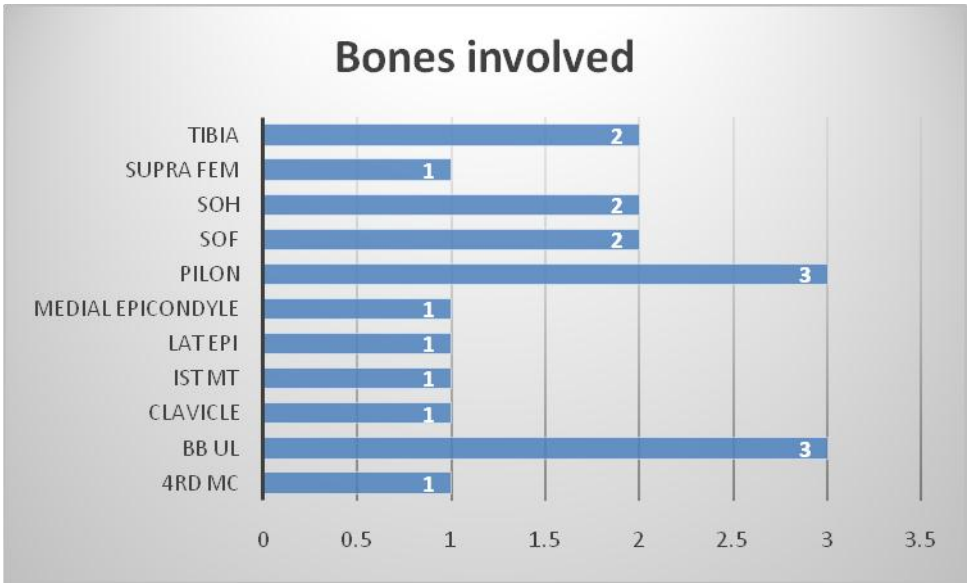
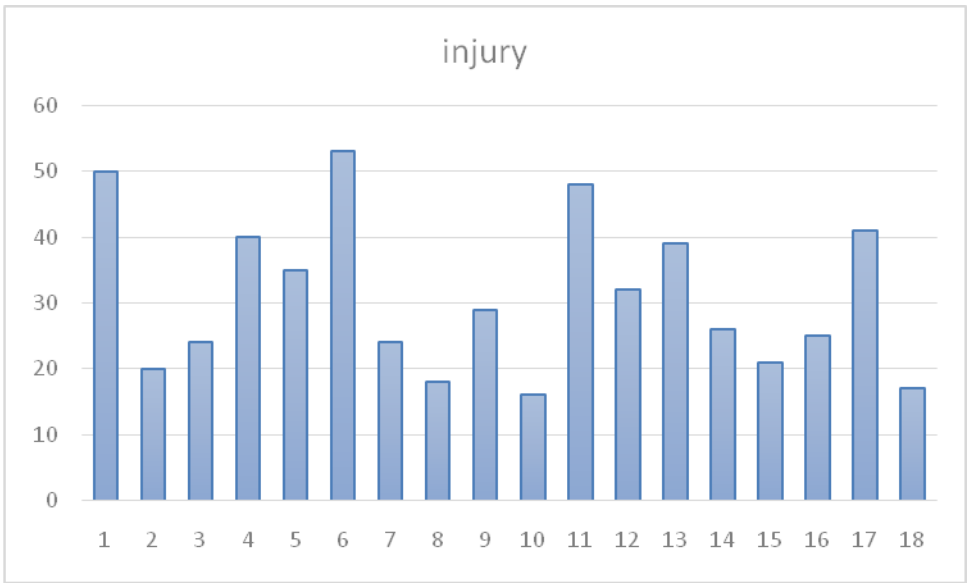
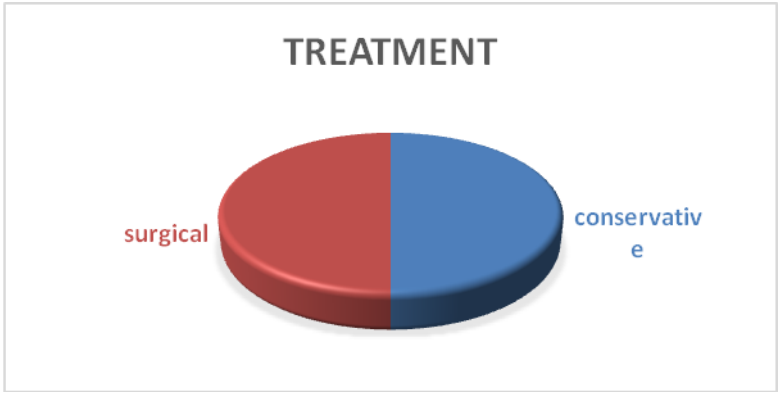
There were 2 tibial shaft fractures,3 pilon fractuers,3 both bones upper limb,2 shaft of humerus and one clavicle,Ist metatarsal,lateral epicondyle,medial epicondyle and fourth metacarpal.



The average duration since injury was 32.5weeks.



Out of the 18 ptients 9 were treated conservatively and 9 by surgical means.



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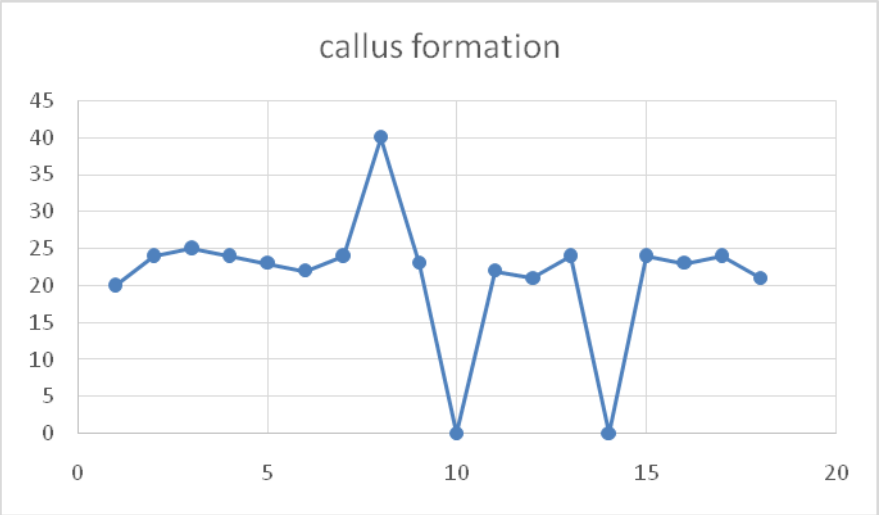
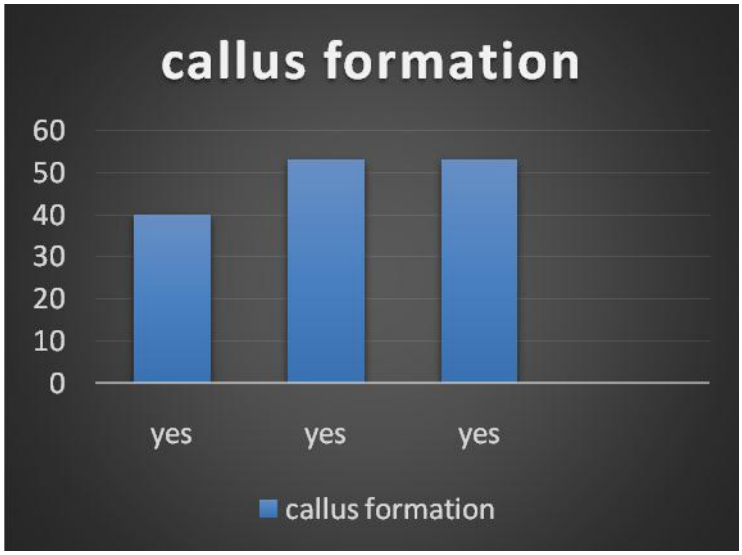
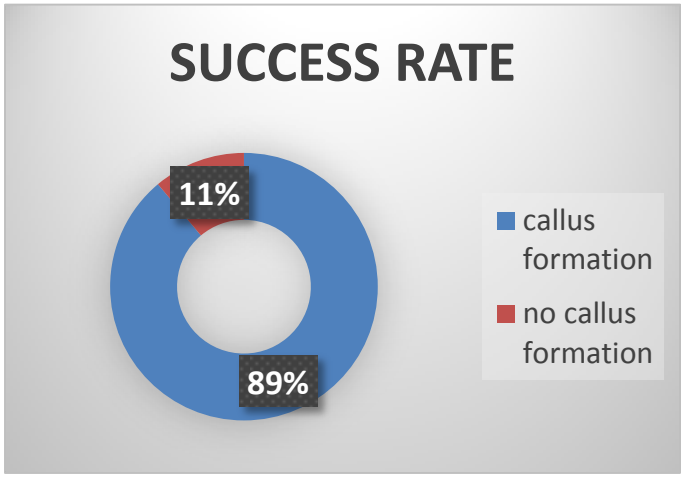
There were subjected to 20 minute of ultrasound therapy everyday. Theaverage time period at which the callus appeared was 21.3 weeks.





There was two instances of no signs of fracture healing even after 40 weeks.(shaft of humerus and medial epicondyle).

The success rate of this modality in our study was 89.99%.



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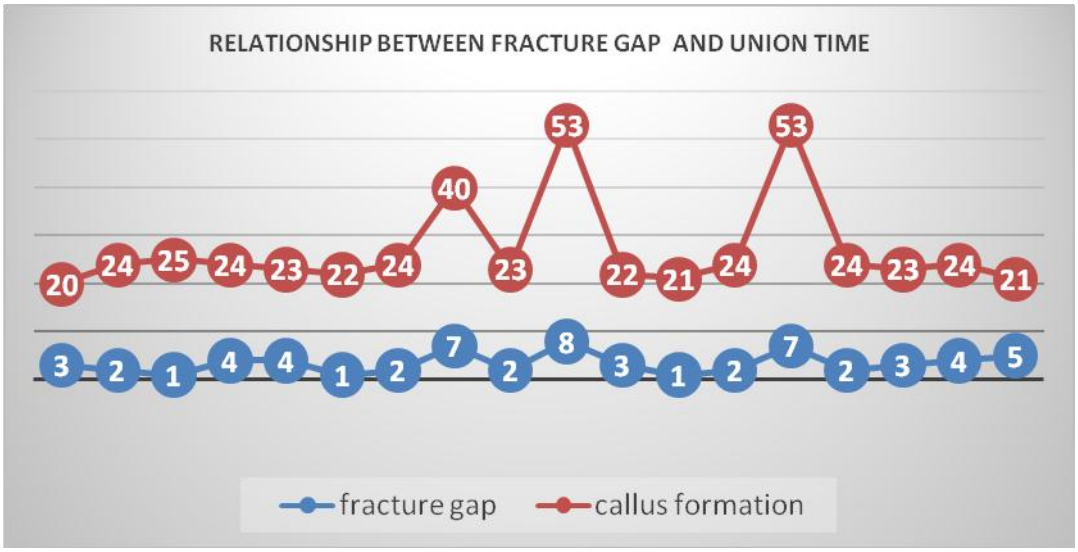
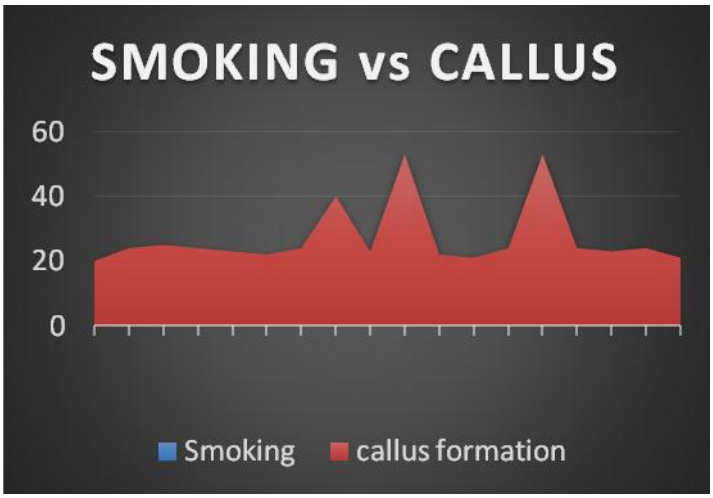
The study took into consideration the age, gender, associated diseases, bone involved, fracture gap, fracture age, smoking with only smoking and fracture gap causing a negative impact in all the cases that were involved.





DISCUSSION

On the basis of all the research several mechanisms have been proposed for the direct and indirect action of ultrasound in fracture healing. In vitro studies have shown that ultrasound may cause changes in cell membrane permeability and second messenger activity [12-15]. These ionic changes would ultimately lead to alteration in gene expression causing and acceleration in the healing process.As reported by Rawool et al [16]. since ultrasound stimulated angiogenesis it would result in increased growth factors and other stimulant factors would reach the fracture area faster resulting in better healing.

Though the mechanism of the cause of faster union by ultra sound is not clear it is postulated to be due to multitude of alterations in the host of cells the genes and other regulatory factors work together during the healing process.

A large amount of data suggests that fracture healing is fastened by ultrasound therapy. Since fracture healing is hindered by a multitude of factors, the multipronged effect of ultrasound is an added advantage. It appears to influence several aspects of the healing process in the inflammatory, reparative, and remodeling phases. The modality being a non-invasive one is an added advantage.

The economical aspect of ultrasound therapy is an added advantage considering the costs needed to treat non unions. Fracture healing is a sophisticated and delicate process. It relies on a wide range of genes and cell types. The systemic status of the patient and the complexity of the injury have a potential for decreased function. With the use of ultrasound and other modalities the healing process can be augmented. Ultimately achieving fracture union is the ultimate goal.

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