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Research Paper

Comparison of Rate of Fracture Healing in Compound Fracture of Both Bones Leg Treated With Conductive VS Non-Conductive Insulated External Fixator

Medical Science

KEYWORDS : Insulated external fixators, Fractures, Gustillo's grade, RUST score

Dr. Anurag Baghel — Senior Resident IInd Department of Orthopaedic Surgery, KG Medical University, Lucknow

***Dr. Narendra Singh Kushwaha** — Assistant Professor, Department of Orthopaedic Surgery, KG Medical University, Lucknow
*Corresponding authors

ABSTRACT

Objective: To compare of rate of fracture healing in compound fracture of both bones leg treated with conductive vs non-conductive insulated external fixator.

Methods: This was a double blind randomized controlled trial. The patients 12-70 years of either sex having compound fracture both bone of legs, Gustillo's grade I and II treatable by external fixators without associated injuries or complications were included in the study. Wounds were debrided and fractures reduced and externally fixed using Epoxy coated Schanz pins and rods. Clinico-radiological union was assessed at 2 weekly intervals from 10-20 weeks.

Results: The both groups were found to be similar on age as well as other baseline parameters. Effect of abnormal mobility in patients of experimental group showed more rate of union as compared to control group treated with conventional conducting fixator. Effect of local tenderness over fracture site showed fracture was healing and experimental group showed more number of patients in which local tenderness was absent as compared to control group treated with conventional conducting fixator. Effect of weight bearing was assigned of fracture union and experimental group showed more rate of union as compared to control group treated with conventional conducting fixator along with time. Effect of movements of distal part showed fracture union and experimental group showed more rate of union as compared to control group treated with conventional conducting fixator. Similar finding was found for RUST score.

Conclusion: It is concluded that fracture healing is faster as compared to patients treated with conventional metallic fixator.

INTRODUCTION

Bone is a very dynamic organ that provides both a structural framework and an almost endless source of mineral for metabolic use. Fracture is a break in the continuity of the trabecular pattern of bone compound or close types are based on communication of fracture hematoma with external environment. Many fractures are the result of high force impact or stress, bone fracture can also occur as a result of certain medical conditions that weaken the bones. Observations on different types of fractures made by Kaplan and Markova1, Nikitin et al2 and Nencheva3 show that when conservative management is used, callus formation occurs more quickly than when operative treatment by metallic implants is undertaken.

External fixation for definitive or initial management of tibial fractures has long history with pin-to-bar external fixation being the standard of care for definitive management of tibial fractures. However, the use of this method lessened because of the increased popularity of intramedullary nailing and drawbacks associated with external fixation. This method still commonly in use in the military environment and can be used for temporary stabilization of tibial fractures, especially in the setting of periarticular injuries. These fixator also may be useful for salvage of open and/or infected fractures that are unsuitable for internal fixation4.

Delayed union and non-union are complications of fracture healing and remain problematic to treat. Delayed union is a term used for a fracture that has not united within a period of time that would be considered adequate for bone healing. Delayed union is at substantial risk for becoming a non union without further intervention5. Between 90% and 95% of all fractures heal without problems6,7. Although delayed union comprise only a small percentage of cases, it still remains a dreadful entity associated with pain and functional and psychosocial disability8.

Experimental research9,10 has shown that in fractures of bone, biopotential is altered. A second negative peak, considerably higher than that at the bone ends, appears at the fracture site and this persists throughout the whole period of bone healing, gradually reducing as callus formation proceed. When bony union is complete, the constant potential regains its initial normal level.

Becker and Murray9 succeeded in demonstrating in amphibians that the normal distribution of potentials is restored on the seventh day after a tibial osteotomy, by which time the bone cells in the immediate vicinity of the fracture already contain all the necessary components for protein and polysaccharides production and transportation. The cells are incorporated in a dense stroma made up of fine fibres and amorphous material. The nuclei have an adequately organized chromatin structure and the cytoplasm contain large number of mitohchondria and dark bodies. These and other similar experiments show that the stimulating mechanism that is intimately related to increased metabolism during callus formation11.

With the growing need for better implant materials bioglass ceramics have aroused interest because of their ability to bond with tissues. Intrinsically low strength of the former, however, restricts their use for load bearing implant applications.

Our study aimed to compare the difference in rate of fracture healing in fractures treated surgically with conductive versus non-conductive external fixator.

MATERIAL AND METHODS

Study design and site

This was a double blind randomized controlled trial. The study was conducted in a trauma centre of tertiary care hospital in north India. The study was approved by the ethical committee of the institute.

Study subject

The patients 12-70 years of either sex having compound fracture both bone of legs, Gustillo's grade I and II treatable by external fixators without associated injuries or complications reporting to the trauma center/ OPD of Department of Orthopaedics, KG Medical University, Lucknow were included in the study. A written informed consent was taken from each subjects before including in the study.

Study period

The study was conducted over a period for one year.

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Sample size
Assuming that insulated group unites in mean 15±2 weeks and Conductive group in 18±2 weeks, with α= 0.05 and β=0.20, 7 patients were needed in each group. However, we decided to keep the sample size as 10 per group to cater to any loss of follow up.

Allocation of subjects
The study subjects were randomly divided into groups by using computer generated random number table.

Intervention
Wounds were debrided and fractures reduced and externally fixed using Epoxy coated Schanz pins and rods. To protect the Epoxy coating, the holes were drilled and tapped in the bones using normal pins which were taken out and Epoxy quoted pins screwed in. All pins were shorted using a metallic wire, switch system in the conductive group to make them equivalent to conventional conductive fixators. At 10 weeks, fixator was removed and functional brace as described by Sarmiento applied till union was judged sound by clinico-radiological criteria. Also clinico-radiological union was assessed at 2 weekly intervals from 10-20 weeks.

Analysis
Then the outcome measures at similar follow up times was compared between groups determining both magnitude and significance of difference using Unpaired t-test with continuous normally distributed data. The changes within groups over different periods was compared by using Paired t-test. The p-value<0.05 was considered significant. All the analysis was carried out by using SPSS 16.0 version (Chicago, Inc., USA).

RESULTS
The both groups were found to be similar on age (p =0.43); fractured bone part (p =0.16); days since injury to management (p=0.52); days since management to discharge (p=0.29); Prehospital care (p=0.89); Grade of compounding (p=0.37); Trauma score (p =0.5681); size of wound (p =0.44); site of injury (p=0.70); Shape of wound (p=0.45); Structures exposed (p =0.97); Distance of wound From the ankle(cm) (p =0.24); contamination (p=0.77); site of fracture (p =0.35); fracture of fibula (p =0.90); wound culture (p=0.29); sensitivity (p =0.35); presence of pus (p =1.00); Hemoglobin (p=0.49); TLC (p=0.43) (Table not shown).

Effect of abnormal mobility in patients of experimental group showed more rate of union as compared to control group treated with conventional conducting fixator. Effect of local tenderness over fracture site showed fracture was healing and experimental group showed more number of patients in which local tenderness was absent as compared to control group treated with conventional conducting fixator. Effect of weight bearing was assigned of fracture union and experimental group showed more rate of union as compared to control group treated with conventional conducting fixator along with time. Effect of movements of distal part showed fracture union and experimental group showed more rate of union as compared to control group treated with conventional conducting fixator. Similar finding was found for RUST score (Table-1).

DISCUSSION
According to Ristiniemi12, external fixation is commonly used, but the method often results in delayed union. Fracture displacement could be better controlled with initial temporary external fixation than with early definitive fixation, but it had no significant effect on healing time, functional outcome or complication rate. Our study aimed to compare the difference in rate of fracture healing in fractures treated surgically with conductive versus non-conductive external fixator.

According to observations on different types of fractures made by Kaplan and Markova1,2, when conservative management is used callus occurs more quickly than when operative treatment is undertaken. The factors which are responsible for this relative failure of the metal devices compared with conservative treatment have been uncertain, but recent research into the electrophysiology of bone has cast light on some of the problems, and the advantages and disadvantages of metallic devices used for osteosynthesis have been evaluated from a different standpoint.

The above studies are undertaken on two different kinds of patient population which differ in baseline characteristics. It is evident that compound fractures heal at slower rate as compared to simple fracture. In our study, the patients randomized in 2 groups are similar in all baseline characteristics specially the patients are of compound fracture Both Bone leg

The study by Dobrev and Vladimirov11 conducted a study on rabbits in which transverse osteotomy was carried out in one of the fore-limb bones, with the other bone serving as a stabilising element. The authors assessed union radiographically as well as histologically by examination of callus when the plates are removed at five months. They also assessed the mechanical properties of the healed bone by assessment of bending strength of bone.

Our study was performed on humans in which Epoxy coated external fixator was used to stabilize the compound fractures of tibia. Pins of external fixators were shorted using a wire in the conductive group to make them equivalent to conventional conductive fixators. Fracture healing was assessed using various electrical properties of bone and radiological assessment done by RUST score and clinical assessment done by observing abnormal mobility, transmitted movements , local tenderness, ability to bear weight.

Our study is comparable with the study on rabbits done by Dobrev and Vladimirov11 but different in the manner that we have performed on humans with the use of epoxy coated non-conductive external fixator. In the present study, the clinico-radiological parameters like abnormal mobility, local tenderness, transmitted movement, RUST score at different weeks were also able to demarcate the healing rate in the two groups. One of the limitations of the present study may be lesser sample size, the study on higher sample size is recommended for more powerful statistical results.

It is concluded that fracture healing is faster as compared to patients treated with conventional metallic fixator.

Table: 1: Comparison of study parameters between the groups

	Group	10 week	12 week	14 week	16 week	18 week	20 week
Abnormal mobility absent	G1	4	4	5	5	7	8
	G2	7	10	14	14	14	14
Local Tenderness absent	G1	1	4	5	5	6	6
	G2	8	8	8	9	9	9
Weight Bearing	G1	0	2	3	3	6	6
	G2	1	4	6	9	10	11
Transmitted Movement	G1	5	6	6	5	5	7
	G2	6	10	8	10	9	9
RUST Score	G1	6	6.3	7.6	8.2	8.5	8.7
	G2	6.2	6.8	8.1	8.5	9.8	10.1

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