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Research Article

Osteomedullography: a simple tool for early detection of impending non union of diaphyseal fracture of tibia

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ABSTRACT

Background: Fractures of the tibial shaft are one of the most common bony injuries to occur and are frequently associated with slow union and non-union. These fractures are commonly treated by closed reduction and internal fixation with intramedullary interlocking nail under image intensifier control. We present the results of a simple diagnostic tool the "Osteomedullography" for early detection of impending non union in diaphyseal fractures of tibia.
Methods: 35 patients of diaphyseal fracture shaft tibia in which there was no clinico radiological evidence of union at 10 to 12 weeks were subjected to the diagnostic test Osteomedullography to detect the cases of impending non union at an early date.
Results: The results were assessed according to the Osteomedullography signs described by Kaski (1971). Out of 35 OMG 26 (74.2%) were positive & 9 (25.8%) were found to be negative.
Conclusions: OMG is a reliable, minimally invasive and economical diagnostic tool for studying the healing process of diaphyseal fractures.

Keywords: OMG (osteomedullography), Diaphyseal fracture, Impending non union

INTRODUCTION

Fractures of the shaft of tibia are among the most common long bone injuries presenting for treatment.[1] Locked intramedullary nailing is currently considered the treatment of choice for most closed and compound type I, II and IIIA tibial shaft fractures. It is especially useful for segmental and bilateral tibial shaft fractures. Intramedullary nailing preserves the soft tissue sleeve around the fracture site and allows early motion of the adjacent joints. The ability to lock the nails proximally and distally provides control of length, alignment and rotation. [2]

Fracture of the tibial shaft is one of the most common bony injuries but because of its location it is the most common of the compound fractures. The displacement of the fragments and severity of soft tissue damage may be extensive. It is not surprising that complications are frequent and one of the most common of these complications is slow union and non-union.[1] However in the clinical situation when following through the progress of fracture union it is sometimes difficult to distinguish the transition from delayed to non union because there are no absolute criteria for guidance.[1] This makes it difficult to decide when to interfere surgically to expedite the union process. Some cases of delayed union can be treated by Dynamisation of the nail with or without fibular osteotomy. Dynamisation is done by removing the locking screws from the longer fragment, thus converting the stable mode to the dynamic mode as advantage of dynamic mode is that it permits axial movements at the fracture site which is thought to be useful for fracture healing.[3] The routine clinico-radiological examination is

of no help in differentiating the delayed union from impending non union. So to overcome this problem a simple diagnostic test Osteomedullography may be employed to detect impending non union in time.

Osteomedullography (intraosseous phlebography, osseous venography or osteomyelography) i.e. visualization of intraosseous veins was introduced by Stienbach et.al in 1957.[4] In a healing fracture the vascular endothelium proliferates & becomes continuous from one bony fragment to another. While the visualization of the intraosseous arterial pattern across the fracture site is difficult the venous pattern can easily be visualized since the intramedullary veins are ten times wider than the principal nutrient artery.

As most of the contrast medium leaks into the surrounding soft tissue veins and with little intramedullary flow the interpretation becomes difficult therefore Kaski modified the technique by soft tissue compression during the procedure by Esmarch bandage to prevent leakage of the contrast medium into soft tissue veins and thereby enhancing the intramedullary flow for better interpretation of results of osteomedullography.[5]

METHODS

This study was conducted between September 2013 to September 2015 in the Department of Orthopaedic surgery at Subharti Medical College, Meerut. A total of 97 tibial shaft fractures were treated by close reduction and internal fixation with intramedullary interlocking nails, out of which 35 patients were selected for the study in which there was no clinico-radiological signs of union at 10 to 12 weeks post surgery. All 35 patients were subjected to Osteomedullography at 10 to 12 weeks post nailing.

The Osteomedullography was performed after 10 weeks of fracture or nailing and not before as Rhinelander et al. observed that vascular connection between the two fragments are established within 10 weeks of injury at the latest.[6,7]

Assessment of results

The results of the osteomedullography are to be assessed according to the OMG signs described by Kaski (1971),who recorded that the radiological signs of venous flow through the fracture are contrast filling in-

1. Intraosseous veins crossing the fracture.
2. Sinusoids network in the proximal fragment.
3. Periosteal veins in the proximal fragment.
4. Asending branch of the main efferent vein of the nutrient vascular system.
5. Veins passing along the periosteal callus from one fragment to another.[5]

Puranen & Kaski and Gupta et al. considered that the presence of any of these signs should be regarded as a positive OMG because even if one vein could be visualized into the proximal fragment then it implies that venous continuation has been established across the fracture and it is likely to unite.[8,9]

On the other hand pooling of contrast medium into the distal fragment was considered as negative OMG indicating that venous continuation has not been restored across the fracture and it is unlikely to unite and therefore surgical intervention should be considered to enhance the process of union.[8,9]

Technique of OMG

We have followed the technique originally described by Puranen & Kaski (1974) [8] & later by Gupta et al (1978)[9] but with a little modification. Puranen & Kaski used spinal anaesthesia while Gupta et al used intravenous diazepam and local lignocaine. We used only local lignocaine.

Patient is laid supine on the table in operation theatre. Part preparation and draping is done as standard protocol. A 2% lignocaine 5 to 10 ml after sensitivity test is infiltrated at the site of injection above the medial malleolus 2 to 4 centimeter proximal to the ankle joint. The leg is then elevated and exsanguinated with Esmarch bandage from toes to the knee joint. A little space is created at the site of injection by adjusting the folds of the Esmarch bandage.

A number eighteen stainless steel spinal needle is mounted over the bone drill and after piercing the skin and soft tissues it is drilled into the medullary canal of the bone. The position of the needle is confirmed by aspirating medullary canal which produces free flow of blood with fat globules. If free flow of blood is not seen the position of the needle is adjusted a little by gently rotating and withdrawing it manually to a more favorable position. The style of the needle is introduced into it to keep the needle clear. Now the radio-opaque contrast medium 20ml of Urograffin is injected into the medullary canal through the needle after removal of style. Immediately AP projection is taken on the image intensifier and then an additional 20 ml of contrast medium is again injected before taking the lateral projection.

After completion of both the projections the needle is withdrawn. The Esmarch bandage is removed and the needle puncture wound is sealed with tincture benjoin and the patient is given broad spectrum antibiotic for three days and an analgesic for a day or two. All patients are sent home after two hours of observation.

RESULTS

This study consists of 35 patients of tibial shaft fractures. All patients were subjected to OMG during the period from September 2013 to September 2011 in the Department of Orthopaedic surgery at Subharti Medical College Meerut.

Twenty seven patients (77.14%) were males while eight patients (22.85%) were females. All patients were above the age of fifteen years, oldest being seventy years. Mean age was thirty nine years.

Out of thirty five fractures twenty one (60%) were simple and fourteen (40%) were compound, eight of which were Gustillo and Anderson type 1 and six were type 2. None of the compound cases had loss of bone and all wounds were clean with minimum soft tissue damage.

All the simple fractures were treated by close reductionand internal fixation with intramedullary interlocking nails within 72 hours of admission in the hospital while all the compound fractures were treated initially by debridement and external fixator application followed by definitive fixation with intramedullary interlocking nail within 6 to 7 days. Post operative period remained uneventful in all patients.

Out of 35 fractures ten (28.5%) were transverse, seventeen (48.5%) were short oblique and eight (22.85%) were comminuted.

Twenty eight (80%) fractures were in the middle third and seven (20%) fractures were in distal third of shaft of tibia.

In six cases fibula was found to be intact which were osteotomised in an oblique fashion percutaneously at the time of nailing

Out of 35 patients eight patients also had associated fractures which did not have any bearing on the treatment.

OMG was done as early as 11th week and as late as 20th week, average being 15.05 wks. At the time of OMG none of the fracture showed clinicoradiological signs of union.

Out of 35 OMG, 26 (74.2%) were positive and 9 (25.8%) were found to be negative.

All the patients with positive OMG were continued with full weight bearing with Delbet cast support and they progressed to uneventful union while out of 9 patients with negative OMG, 6 were treated with Phemister bone grafting and three did not agree to surgical intervention and were lost to follow up. All fractures united within 18 to 30 weeks after bone grafting.

All patients were followed after OMG regularly at periodical interval of 6 to 8 weeks till the clinical and radiological union was achieved.

Out of 35 cases 9 OMG were negative as no sign described by Kaski could be demonstrated. 26 OMG were positive. In positive OMGs Kaski's sign no.1 was demonstrable in 17 cases, sign no.2 in 12 cases, sign no.3 in none, sign no.4 in 8 cases and sign no.5 was seen in 2 cases only.

In none of the positive OMGs all the five signs of Kaski could be demonstrated.

The positive OMGs indicated that vascular channels are patent across the fracture site and the fracture is very likely to unite and so no surgical intervention to stimulate the process of union is required. The negative OMGs indicated that vascular channels have not been established across the fracture site and so the fracture is unlikely to unite unless surgically intervened to enhance the process of union.

Therefore by means of OMG the cases of impending non union could be differentiated at an early date.

Period of clinical union in positive OMG cases varied from 16 weeks to 24 weeks, average being 20weeks. In cases with negative OMGs the period of union after surgical intervention varied from 18 weeks to 40 weeks average being 29 weeks.

DISCUSSION

Osteomedullography with phlebopression is a reliable technique in evaluating the repair process in diaphyseal fractures of long bones in which the usual clinical and roentgenographic criteria might prove inadequate. Intraosseous vascular pattern is established within 10 weeks after injury at the latest.[6,7] This fact can be used in detecting the cases of impending non union as well as in determining whether any surgical intervention is required to enhance the process of union. OMG is applicable in all those Diaphyseal fractures of tibia in which the status of union is questionable.

The technique of OMG is simple, minimally invasive and does not require specialized experience and instrumentation and can be performed at most of the orthopaedic centres and is least hazardous to the patient. Moreover the early detection of impending non union at about 3 months. Duration avoids the complications of frank non union and poor functional results.

In the series of Puranen and Kaski[8] all fractures with positive OMG healed in an average of 20 weeks(range 10 to 20 weeks) and all fractures with negative OMG healed in an average of 21 weeks(range 14 to 26 weeks) after bone grafting.

In the series of Gupta et. al (1983)[9,10] fractures with positive OMG healed in 4 to 16 weeks and fractures with negative OMG healed in 10 to 24 weeks after bone grafting.

In present series all fractures with positive OMG healed in an average of 20 weeks (range from 16 weeks to 24 weeks) and fractures with negative OMG healed in an average of 29 weeks (range from 18weeks to 40 weeks) after bone grafting. Three patients refused for surgical intervention and were lost to follow up.

Puranan and Kaski[8] in their series observed that intraosseous circulation is restored more rapidly when reduction is perfect. However in present series in all fractures the reduction was almost perfect due to intramedullary nailing, therefore it was not possible to establish the role of reduction in restoration of intraosseous circulation.

Puranan & Kaski[8] also repeated OMG after bone grafting to see reestablishment of intraosseous venous circulation to test the reliability of OMG. However in the present series OMG was not repeated after bone grafting as purpose of this study was early detection of impending non union and not to test the reliability of OMG.

Puranon & Kaski[8] observed that in cases of non union the intramedullary injection of contrast medium was difficult due to plugging of medullary cavity. We also in our study noted that intramedullary injection of contrast required a little more pressure in cases with negative OMG.

Puranan & Kaski[8] used an inflatable compression over the fracture site. Gupta et al.[9,11] used Esmarch bandage for compression of soft tissue veins. We in our series also used Esmarch bandage but in some patients we used only crepe bandage and we noticed that crepe bandage gives better and more uniform compression of soft tissue veins as compared to that given by Esmsarch bandage.

Steinbach[4] used short acting General anaesthesia for osseous phlebography, Puranan & Kaski[5] used spinal anaesthesia, R. C. Gupta et al[9,12] used local anaesthesia at the site of injection along with intravenous sedatives .In our series we only used local anesthesia at the site of injection.

CONCLUSION

In the management of Diaphyseal fractures of long bones in which there are no signs of clinico-radiological union even after 8 to 12weeks, how long one should wait for surgical intervention to enhance the process of union for avoiding the complication of non union, is a matter of serious consideration.

Therefore OMG should be performed after 10weeks in all cases of diaphyseal fracture of tibia in which union is questionable because OMG offers the following benefits-

1. Early detection of impending non union,
2. Complications of prolonged immobilization are avoided,
3. Shorter healing time gives better functional results,
4. Economic significance of the improved treatment is obvious,
5. Unnecessary operations on fractures which will consolidate in some months are avoided.

OMG is a reliable method of assessing the healing process of diaphyseal fractures.

The present series is quite comparable to other series and on the whole OMG is found to be a simple, safe, minimally invasive, reliable tool at our disposal which can predict the fate of fracture healing with a high incidence of accuracy.

There is a wide variation among surgeons in their approach towards management of diaphyseal fractures of long bones. There are some surgeons who perform bone grafting in all long bone fractures when there is a doubt in healing process at about 3months and at other extreme there are surgeons who will wait for 6months or more before making a decision as to need for surgical intervention to enhance the union process. If former is the case the OMG will avoid an unnecessary operation and if later is the case, an early and definite decision regarding the treatment of fracture can be made.

"*Osteomedullography is as difficult as to ride a cycle*."

It is a procedure which can be done in any hospital with minimal operation theater and radiological facilities.

So with the results of present series and work of earlier publications, we would also stress further that every case of questionable union of diaphyseal fractures should be subjected to OMG.

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