

# **USE OF INFLATABLE NAIL IN CASES OF PATHOLOGICAL FRACTURES OF FEMORAL SHAFT DUE TO INFECTION**

**Dr. Rajeev Anand**

**M.B.B.S., M.S.ortho (Pat), D.ortho (Pat)**

**Associate Professor,**

**Department of Orthopaedics,**

**Katihar Medical College, Katihar, Bihar,**

**Pin:- 854 105**

**Postal Address :- Dr. Rajeev Anand**

**601, Bimla Raj Enclave**

**Near Nalanda Medical College, Kankarbagh Bypass Road**

**Kankarbagh,**

**Patna -800 020, Bihar**

**India**

**E-mail :- [rajeev\\_anand99@yahoo.co.uk](mailto:rajeev_anand99@yahoo.co.uk)**

## **INTRODUCTION-**

**The Küntscher's nail has remained the choice of treatment for diaphyseal fracture of femur for a very long time. The main indication of K-nail had been from above isthmus to the diaphysio- metaphyseal junction. It covers more than half of the length of the femur. The recent advances of interlocking nail has extended its application even up to metaphyseal fractures and thus covering very large area in comparison of K-nail. However this procedure needs more than two screws to lock accurately which consumes lot of time of surgeons. This locking procedure is the main source of problems, increase radiation hazard to the surgeon and other OT staff. The radiation hazard can be minimized to less than 40% if a means is found not to lock it. Many inbuilt mechanical techniques was used to lock the nail with the bone but with the lots of problems. The inflatable nail has a similar application to similar extent as that of K-nail. It does not need any locking screw to lock it with the bone. Reaming is optional for the procedure but it does not need over reaming to accommodate the similar diameter nail. It is set principle to ream the medullary canal to 2 mm extra than the diameter of the nail, in the case of conventional interlocking nail. This over reaming of cortex is often the cause of Fat embolism and ARDS. The design of the nail being circular prevents the escape of medullary contents causing increase intra-medullary pressure and embolic phenomenon. This over reaming also damages the endosteal blood supply of the bone which is not desirable. The inflatable nail removes all such disadvantages. As this is introduced in the reduced diameter one may not require reaming. Even if one opts to ream there is no need of over reaming. The four slots on its external surface gives way to the medullary content while introduction thus not increasing the intra-medullary pressure and hence the possibilities of embolic phenomenon or ARDS is quite less in comparison to interlocking nail. As it gives 3 or 4 point fixation circumferentially inside the medullary canal. The fixation is very rigid at**

the same time the endosteal blood supply is little damaged if any, while the endosteal tissue can grow in between the fixation points. Therefore, it is a more biological implant than the present interlocking nail.

The inflatable nail consists of collapsible water tight stainless steel tube which incorporates usually four quadrangular rods. The nail is introduced when it is collapsed (reduced diameter) and after adjusting its proper position the collapsed tube is expanded so that the quadrangular rods grips the inner side of medullary canal at several places and to longer length than the interlocking nail. This gives better purchase and stronger fixation. It shapes itself to some extent according to the shape of medullary canal (somewhat like elongated hour glass as it expands more where the medullary canal is wide). When inflated the increase in diameter is about 165% as shown in table-1

	Reduced Diameter (mm)	Maximal Inflated Diameter (mm)
Femur	8.5	13.5
	10.0	16.0
	12.0	19.0

When its position is confirmed the collapsible stainless steel tube is inflated by normal saline with a special simple device, a disposable plastic pump. It requires only one aperture at the upper end of the bone and that's all. Thus it is even much less traumatic than interlocking nail which requires a minimum of five holes. This makes it also a superbly more cosmetic device. Extraction is also simpler. This advantage of being minimally invasive makes this implant most suitable for use in pathological fracture due to infection in femoral diaphysis. The need of making drill holes, forming debris and causing heat necrosis at the sight of interlocking nail makes the interlocking nail rather undesirable implant in such infected cases.

## MATERIAL & METHODS

Six cases of pathological fracture of diaphysis of femur between proximal  $\frac{1}{4}$ th to distal  $\frac{1}{3}$ rd due to osteomyelitis was operated by inflated nail.

Out of six cases 4 males & 2 females between age group of 16 to 38 years of age.

Sl. No.	Time	Name	Age	Sex	Operated/Unoperated	Nail Size	Nail Width	Period of Followup
1.	6 days	Reena Singh	38	F	Operated	36 cm	8.5mm	2 months
2.	10 days	S. Pandey	22	M	Operated	36 cm	8.5 mm	3 years
3.	21 days	Kishore Kumar	28	M	Unoperated	40 cm	8.5 mm	2.5 years
4.	5 days	Anil Kumar	30	M	Unoperated	40 cm	8.5 mm	8 months
5.	7 days	Suresh Kumar	32	M	Unoperated	38 cm	8.5 mm	1.5 years
6.	5 days	Ruchi	16	F	Unoperated	32 cm	8.5 mm	1.5 years

Out of these 6 cases, 2 were operated for chronic osteomyelitis. In one case fracture has occurred seven days post operatively and in one case 3 weeks post operative when patient started weight bearing against advise.

Other 4 cases reported first hand with pathological fracture. They were investigated and was found a case of chronic osteomyelitis. All operations were done on traction table and under control of IITV. In four cases close reduction and internal fixation were done while 2 cases were opened because of prior operation of saucerisation.

ESR, Total count, differential count, Hb % were done initially at one week interval for 2 months then at two weeks interval for next three months and then SOS.

## OUTCOME

The age, sex, time since fracture is shown in table 1. The two cases had fracture post sequestrectomy while other four cases did not show any removable sequestrum. In these cases the involvement of the diaphysis was diffuse and extensive. Fracture occurred due to mild to moderate violence in such cases. None of the case was in acute flare and all were being treated for one month to three months.

In all cases we achieved good stability, weight bearing was allowed in closed cases after three weeks and in post sequestrectomy cases after 6 weeks. The post sequestrectomy cases were delayed regarding weight bearing because of circumferential deficit and therefore chances of telescoping after early weight bearing. At the evidence of earliest callous formation around the fracture patient was mobilized; initially partial weight bearing then full weight bearing in subsequent four weeks. Healing was rather rapid, callous formation was seen in about 3 weeks.

In 2 cases nail was removed after 2 years. Persistent discharge was present till removal of the nail in case no.-2 which showed big sequestrum around the nail at the fracture side. No involucrum and new bone formation was observed on the site of cortical defect and all along the nail remained exposed on that side of the wound. The sequestrum was removed at the time of removal of the nail and the patient was advised one month bed rest after that.

In second Post sequestrectomy (Case No.-1) the nail was not covered on the side of saucerisation and there was little watery discharge till the last followup.

In two of the other 4 closed cases thin sequestrum was seen around the nail at the fracture site. The knee joint function was achieved in all cases within 3 weeks.

a

b

c

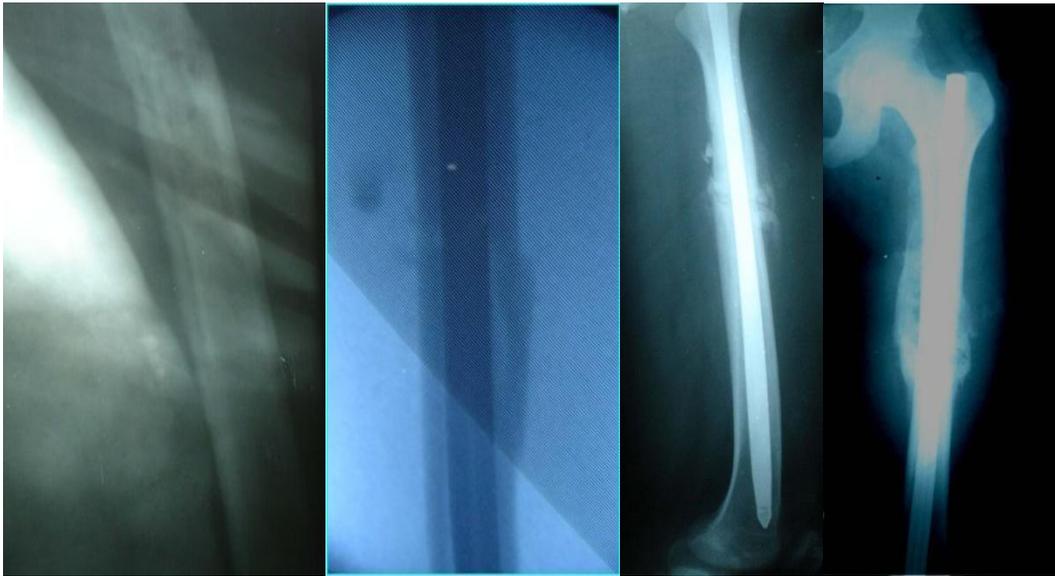


**(a) 1 ½ years Post operative radiograph showing chronic osteomyelitis of diaphysis of femur showing inflatable nail in situ (b) 8 months post operative radiograph showing chronic osteomyelitis of diaphysis of femur showing inflatable nail in situ (c) 2 months post operative radiograph of case no.-1 showing mid shaft fracture of femur with inflatable nail.**

d

e

f



**(d) 6 days post sequestrectomy fracture of diaphysis of femur (e) 2.5 years post operative radiograph showing good union (f) 3 years post operative radiograph showing satisfactory union with inflatable nail.**

## **ANALYSIS**

Out of 6 cases, two cases 1 & 2 were post sequestrectomy and reported six and ten ten days respectively after sequestrectomy. Fracture occurred during the procedure. In these two cases, entire diaphysis was involved and there was bone loss. Ofcourse, care should have taken before doing sequestrectomy and should have been attempted when sufficient involucrum was formed. While doing conventional interlocking nailing in such cases invite various problems of loosening of locking screws and backing out of screws. There is always chances of desimination of infection while reaming in conventional interlocking nail. The locking screws is quite often the site of problem which produces pain and loosening due to the debris formed during drilling and heat necrosis. This often becomes new site of infection which causes loss of stabilization, hence increase in infection and pain. The screw hole become enlarged and locking becomes useless. Considering Ender's nailing is also not suitable in such cases. Though it is also less invasive but if lower metaphysis is also involved loosening and backing out of nail is a major concern. In such type of cases Inflatable Nail is an ideal choice in which all the things can be taken care of. In inflatable nail, only one small aperture is made and introduced with a lesser diameter of nail. In Inflatable Nail no reaming is required and no locking screws and good stability can be achieved.

The other four cases which presented with closed pathological fracture were also treated with Inflatable Nail for similar reason. These cases had a marginal advantage of not having circumferential bone loss due to sequestrectomy. This helped them in union in less time. Such fracture in lower metaphysis will be definitely a disadvantage of such procedure.

## **DISCUSSION**

As the series is rather small no definite conclusion could be drawn. The author's choice of inflatable nail for the treatment in such pathological fracture cases were based on :

1. This being less traumatic,
2. No hole for locking screws therefore no chance of debris, thermal necrosis and chances of loosening and subsequent chances of sinus formation.
3. Long segment contact of nail to the bone therefore less chances of subsequent loosening. In interlocking the weight bearing causes stress to the locking screws therefore loosening and backout of the screws could occur but in these cases because of larger segment of bone nail contact the forces were distributed to the longer area of bone.
4. Nail is introduced in reduced diameter without reaming hence less fear of flaring up of the infection and no dissemination.

Post operative results were very satisfying as there was evidence of early bone formation, exuberant callous (Involucrum) formation. As expected there was no sinus formation at any new site except the two post sequestrectomy wound. The recovery was rather uneventful and patient satisfaction was uniformly good.

A substantial number of cases still report with chronic osteomyelitis involving entire diaphysis of femur with pathological fracture due to trivial trauma. Such cases are usually of low socio-economic group without any insurance coverage. Two cases though suitable could not afford the cost of the nail. This could be taken as major limitation of this procedure.

The average operation time was 40 to 50 minutes. Blood loss was minimal (about 30-40 ml approx). The number of radiation exposure for the entire procedure varied from 30-50.

## **CONCLUSION & RECOMMENDATION**

For above mentioned reasons author is of opinion that diaphyseal pathological fractures due to osteomyelitis also for other reasons should be treated preferably by inflatable nails. When fracture occurs near the metaphysis (proximal 1/4<sup>th</sup> and distal 1/3<sup>rd</sup> ) or supracondylar fractures this procedure is not suitable as stability could not be achieved by this means.

By obviating from injury to any other site (locking screws) this is minimally interfering while achieved better stabilization. This helps strong callous formation and union in spite of chronic osteomyelitis. Once stabilized the infection is also controlled with antibiotics rather more quickly and consistently. It endorses the principle of “infected stable fracture is better than infected unstable fracture”. The comfort of the patient because of pain relief due to stabilization and rapid control of infection is also remarkable.

Thus inflatable nail should be considered as first line of stabilization in:-

1. Cases of pathological fracture due to chronic osteomyelitis of long bones.
2. Cases with iatrogenic fracture during sequestrectomy and the inflatable nail set should be available in operation theatre while undertaking such cases.
3. Pathological fracture of diaphysis of long bones due to other reasons like secondaries, malignancy, long bone cysts etc.

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## DECLARATION

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The dissertation “**Use Of Inflatable Nail In Cases Of Pathological Fractures Of Femoral Shaft Due To Infection**” represents valid work and that neither this dissertation nor one with substantially with similar content under the authorship of Dr. Rajeev Anand has been published or is being considered for publication elsewhere. The authorship as placed in the dissertation is final.

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Sincerely Your's

(Dr. Rajeev Anand)