

Prospective study of results of inflatable nail in pathological femoral diaphyseal fractures due to infection

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Abstract: Infected pathological fracture is always a great problem for the treating clinician. No definite treatment policy has been drafted yet. We have used inflatable self-locking nail in six cases of pathological fracture due to Osteomyelitis (OM) in diaphysis of femur. Though the series is short, uniformly good result has prompted the author to promote this procedure as a new addition to existing ways of management of such fractures.

Key Words: Inflatable Nail, Pathological Femoral Diaphyseal Fractures, Osteomyelitis

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I. 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 diaphysis- 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 were 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.

Table 1

| Femur nail | Reduced Diameter (mm) | Maximal Inflated Diameter (mm) |
|------------|-----------------------|--------------------------------|
| | 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. 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.

II. Material & Methods

6 cases of pathological fracture of diaphysis of femur between proximal ¼th to distal ½rd due to osteomyelitis were operated by inflated nail. Out of the 6 cases, 4 were males & 2 were females, between age group of 16 to 38 years of age.

Table 2

| Sl. No. | Surgery time since fracture | Age | Sex | Treatment received | Nail Size | Nail Width | Period of Follow-up |
|---------|-----------------------------|-----|-----|--------------------|-----------|------------|---------------------|
| 1. | 6 days | 38 | F | Sequestrectomy | 36 cm | 8.5mm | 2 months |
| 2. | 10 days | 22 | M | Sequestrectomy | 36 cm | 8.5 mm | 3 years |
| 3. | 21 days | 28 | M | Conservative | 40 cm | 8.5 mm | 2.5 years |
| 4. | 5 days | 30 | M | Conservative | 40 cm | 8.5 mm | 8 months |
| 5. | 7 days | 32 | M | Conservative | 38 cm | 8.5 mm | 1.5 years |
| 6. | 5 days | 16 | F | Conservative | 32 cm | 8.5 mm | 1.5 years |

Out of these 6 cases, 2 were operated for chronic osteomyelitis. In 1 case fracture has occurred 7 days post operatively and in 1 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 were found a case of chronic osteomyelitis. All operations were done on traction table and under control of image intensifier. In 4 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 2 weeks interval for next 3 months and then as and when required.

III. Results

The age, sex, surgery time since fracture is shown in table 2. The first 2 cases had fracture post sequestrectomy while next 4 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 1 month to 3 months. In all cases we achieved good stability, weight bearing was allowed in closed cases after 3 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. All the cases went to union at average 14 weeks. In 2 cases nail was removed after 2 years.

In Post sequestrectomy case no. 1 the nail was not covered on the side of saucerisation and there was little watery discharge till 4 months, which went to unite 3 months later. 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 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.

Figures



Figures:

- A. 1.5 year post-operative radiograph showing chronic osteomyelitis of diaphysis of femur with 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. 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

IV. 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. Technique 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.
5. 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 shots.

V. Conclusion

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

VI. References

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