

Treatment of Fracture of Shaft of Humerus by Ender Nailing

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= Abstract =

Authors presented the experience of Ender nail treatment for the humeral shaft fractures in 24 patients. The results of treatment in all were satisfactory, though there were four cases of delayed union. Bridging callus was formed at 8.2 weeks on an average. The average clinical union time was 14 weeks. No complications developed during nailing procedure. A case of radial nerve palsy after fracture recovered spontaneously. Longer nails which hit the end of medullary canal of distal fragment distracted the fracture gap, and resulted in delayed union in 4 cases. Therefore, it is recommended to use the proper size of nail to avoid the distraction effect of the inserted nail, and to use two nails at minimum for better fixation.

However, when intramedullary Ender nailing is properly done, single nailing also can give consistently good anatomic and functional results.

Key Words : Humerus, Fracture, Ender nailing, Technique, Disadvantages

INTRODUCTION

The flexible nails in the fixation of long bone shaft fractures already has gotten its place in the armamentarium of fracture fixation. The nail was initially introduced to the orthopedic community by Rush, and was redesigned for the treatment of intertrochanteric and subtrochanteric fractures by Ender and Simon-Weidner. However, now the nail is known as Ender nail.

Though the fracture of the humeral shaft has been treated by the various methods by us, authors present experiences of Ender nailing for the 24 cases of humeral shaft fractures.

MATERIALS AND METHODS

Ender nailing was performed in twenty-four patients in whom other types of surgical treatment was contraindicated because of poor general and/or local conditions.

Of the 24 patients, 17 were females and 7 were males with an average age of 58.4 years (range, 22 to 79 years). Sixteen patients sustained fracture by

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fall, three by direct blow and five by car accident. Among those 24 cases only four were open fractures, and the remainders were closed ones. All cases had fracture in the shafts : seven cases were comminuted, 8 spiral, 7 transverse and 2 segmental fractures. In two segmental fractures one had comminution. Preoperatively one case had radial nerve palsy at the time of fracture. None of the patients had associated injuries in the other parts.

Operative technique and postoperative management :

Under the image intensifier control, 1-2cm vertical longitudinal incision was made over the anterolateral aspect of the shoulder which corresponded to the metaphysis of the humerus, and the metaphysis was exposed. Then with a drill or a nail an entry hole was prepared at the metaphysis, and through the hole one to three Ender nails were inserted and were advanced into the medullary canal. When the tip of the nail reached the fracture site, manipulative reduction was carried out. Once the tip of nail got into the medullary canal of the proximal end of the distal fragment. However short nail was used to avoid the distraction effect of the nail. Because the nail tip which reached the end of medullary canal distracted the fracture gap when the nail was further distally advanced. After the completion of nailing the fracture stability was tested. Postoperatively sling and swathe were applied to the arm to prevent the external rotatory movement of the fracture fragment. Circumduction exercise was prescribed one week postoperatively to prevent shoulder stiffness. One nail was used in six cases, two nails in fifteen cases and three nails in three cases of distal shaft fractures.

RESULTS

Radiologically visible bridging callus was formed at 8.2 weeks on an average : the earliest one was at postop 5 weeks, and the latest was at postop 14

weeks. The average clinical union time was 14 weeks : four of six cases in whom long nailing distracted the fracture gap resulted in delayed union. However, in the remaining two cases distracted gap was reduced when nail migrated proximally through an entry hole. A case of segmental fracture ununited at the distal fracture site until postop 9 months. Even in cases of the delayed union, patients did not have complaints of pain or discomfort at the fracture site of the arm. Therefore the delayed union was neglected without further care by patients themselves. In cases of proximal nail migration, shoulder pain and partial stiffness of the shoulder were complicated. However, in the those cases the complaints were disappeared after nail extraction. It could not be assessed the efficacy of postoperative application of the sling and swathe for the fracture healing, though it might contribute to the fracture union.

Illustrative cases :

Case 1.

This 52 years-old man sustained type I open comminuted fracture of the right humeral shaft for which single Ender nailing was performed on the 7 days after injury. Also he had the diffuse abraded wound on the back. The purpose of nailing was to reduce the displaced fracture and minimize the bending motion. This is an example of a long rod nailing : the tip of nail was protruded in the shoulder, which irritated the soft tissue and caused pain. Ender nailing was chosen to minimize the surgery, to provide comfort, and to mobilize the patient earlier because there was wound around the fracture site and the back. Postoperatively, main fracture fragment was well reduced, and patient was greatly relieved from the discomfort. At the end of postoperative 5 weeks, bridging callus was noted on simple X-rays, though the fracture healing was somewhat delayed. Six months after nailing, the nail was removed with satisfactory result(Fig. 1).

- Fig. 1 A.** Initial X-rays show mid-shaft fracture with large butterfly fragment
- B.** Immediate postoperative A-P and lateral X-rays show good reduction of the fracture, but head of Ender nail is protruding at the entry site.
- C.** At postop. five weeks, bridging callus is visible.
- D.** at postop. six months the nail was removed because bony union was obtained.

Case 2.

This 62 year-old lady sustained the fracture of the proximal humerus by a fall. For the fracture intramedullary Ender nailing was performed under local anesthesia because she had myocardial ischemia. The fracture was well reduced, and postoperatively the sling and swathe was applied to the fractured arm. The fracture united solidly 3 months after nailing without any postoperative complications or residuals(Fig. 2).

DISCUSSION

It is a misconception to believe that fixation with flexible intramedullary nails is inherently unstable^{1,2,3,4}. The reason is that rotatory and bending stabilities are remarkably good after nail fixation of the shaft fracture in a long bone of a younger patient⁵. Those two instabilities can be eliminated if the nails are inserted properly. Also, it is true that the nails are inserted through bilateral portals and cross each other twice in the medullary canal, thus increasing their rotational and bending

Fig. 2 A. Initial X-rays show proximal shaft fracture.

B. Postoperative A-P and lateral X-rays show the well-reduced fracture with two intramedullary Ender nails.

C. Postop 3 months X-rays show bony union.

resistance. In case of single intramedullary Ender nailing, a nail can not fixate the fracture fragment securely, though the nail can prevent bending and side shift movement of fracture fragment. Thus, it is felt that single intramedullary nail fixation of the humeral shaft fracture is superior to hanging cast treatment alone. Another merit of the intramedullary Ender nail is to allow for motions at the fracture site and consequent induction of external callus formation, while, of course, unstable fracture configuration requires adjunctive fixation and measures in all types of intramedullary nailing.

After intramedullary Ender nail fixation of the fractured humeral shaft, sling and swathe was preferably recommended to be applied to prevent the rotatory motions at the fracture site which may result in delayed union or nonunion.

The flexible intramedullary nailing for the humeral shaft fracture has several complications ; shoulder pain, rotatory deformity and contracture, nail migration, failure to obtain fixation, and ulti-

mately failure of fixation⁴⁾. However, some of those can be avoided by precise surgery and postoperative management. Long nail which hit the end of medullary canal in the distal fragment should be avoided to prevent fracture gapping and/or proximal nail migration.

In six cases in whom long nails were used in our series, fracture gapping developed in all : In two of those six cases in whom nails migrated proximally through the entry hole, fracture healed normally, and in the remaining four cases delayed union developed because of persistent fracture gap and early allowance of the free arm motion. Therefore two to three nails having proper length are recommended to be used to bring the successful result, and postoperative sling and swathe are preferably recommended to be applied for 6 weeks at minimum.

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= 국문 초록 =

Ender정을 이용한 상완골 간부골절의 치료

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상완골 간부골절의 치료로 연성 골수정의 사용은 골절 고정 기기로서의 자리를 굳혀가고 있다. 그러나, 일차적으로 회전 안정성이 결여된다는 점에서 이론이 제기되고 있다. 저자들은 상완골 간부골절예중 전신 상태의 불량 및 골절부위의 피부및 기타 연조직의 심한 손상으로 타종류의 외과적 치료가 곤란한 24예의 상완골 간부골절을 Ender정으로 치료한 바 있어 그 결과를 보고 한다. 24예중 4예는 개방성 골절이었고, 나머지는 폐쇄골절이었다. 골절형은 분쇄골절이 7예, 나선골절이 8예, 횡골절이 7예, 그리고 불절골절이 2예 였다. 2예의 분절골절 중 1예는 심한 분쇄골절이었다. 치료결과는 모든 예에서 만족스러웠다. 그러나 4예는 지연유합의 경과를 밟았다.

교판가골(bridging callus)은 평균 8.2주에 형성되었고, 임상적 유합기간의 평균은 14주였다. Ender정 삽입시 합병증은 생기지 않았다. 요골신경 마비 예는 자연히 회복되었다. 긴 Ender정이 삽입된 경우 정 의 끝이 원위골수강의 끝에 닿았을때 정을 계속 삽입시는 골편간에 이개가 생겼고, 그 결과 4예에서는 지연 유합이 일어났다. 그러나 정삽입후 치료경과중 긴 정이 근위로 이동하여 삽입구로 부터 돌출시는 골편의 이개가 사라지면서 유합의 과정을 밟았다.

그러므로 골수강의 길이 보다 긴 정의 삽입은 피해야 할 것으로 사료되고, 삽입정의 수도 최소 두개는 삽입되어야 보다 든든한 내고정이 얻어질것으로 사료되며, Ender정의 삽입요법은 간단한 수술이면서 효과적인 치료법으로 사료된다.