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Comparison between the results of intramedullary nailing and compression plate fixation in the treatment of humerus fractures

Humerus kırıklı olgularda kilitli intramedüller çivi ve plak ile tedavi sonuçlarının karşılaştırılması

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Amaç: Humerus diafiz kırığı nedeniyle, kilitli intramedüller çivi veya plak-vida ile tedavi edilen hastaların sonuçları karşılaştırıldı.

Çalışma planı: Humerus diafiz kırığı nedeniyle cerrahi tedavi gören 60 hasta (43 erkek, 17 kadın; ort. yaş 38; dağılım 19-61) çalışmaya alındı. Hastaların 33'ü kilitli intramedüller çivi, 27'si plak-vida ile tedavi edildi. Fonksiyonel sonuçlar Stewart Hundley ölçütlerine göre değerlendirildi. Kaynama süreleri ve morbiditeleri istatistiksel olarak karşılaştırıldı. Ortalama takip süresi 42 ay (dağılım 28-72 ay) idi.

Sonuçlar: Hasta grupları arasında iyileşme süreleri bakımından anlamlı fark yoktu ($p>0.05$). Radial sinir paralizisi, plak-vida ile tedavi edilen dört olguda gelişirken, intramedüller çivi ile tedavi edilen olgularda görülmedi. İntramedüller çivi ile tedavi edilen olgularda anlamlı düzeyde daha yüksek kaynamama oranı görüldü ($p<0.05$).

Çıkarımlar: Humerus kırıklarının tedavisinde uygun bir tespit materyali henüz geliştirilememiştir. Kaynamama oranlarının yüksekliğine karşın, uygulamanın daha kolay olması, daha az yumuşak doku diseksiyonu gerektirmesi, düşük oranda morbiditeye yol açması, intramedüller çivileri tedavide iyi bir seçenek haline getirmektedir.

Anahtar sözcükler: Kemik çivileri; kemik plakları; karşılaştırmalı çalışma; kırık fiksasyonu, internal; kırık fiksasyonu, intramedüller/yöntem/yan etki; humerus kırıkları/cerrahi/radyografi.

Objectives: The results of open reduction and internal fixation of humeral shaft fractures by either an intramedullary nail or a dynamic compression plate were compared.

Methods: The study included 60 patients (43 males, 17 females; mean age 38 years; range 19 to 61 years) with humerus fractures. Thirty-three patients were treated with intramedullary nails and 27 patients with dynamic compression plates. Functional results were evaluated according to the Stewart and Hundley's criteria. The two methods were compared. The mean follow-up period was 42 months (range 28 to 72 months).

Results: Healing times did not differ between the two treatment groups ($p>0.05$). Radial nerve palsy occurred only in the dynamic compression plate group, with four patients being affected. On the other hand, the rate of nonunion was significantly higher in patients treated with intramedullary nailing ($p<0.05$).

Conclusion: No ideal fixation technique exists in the treatment of humerus fractures. Despite higher non-union rates, intramedullary nailing may be the method of choice in the treatment of humerus fractures because of such advantages as low morbidity, small dissection of soft tissues, and greater ease of application.

Key words: Bone nails; bone plates; comparative study; fracture fixation, internal; fracture fixation, intramedullary/methods/adverse effects; humeral fractures/surgery/radiography.

Humeral diaphyseal fractures are generally able to be successfully treated by conservative methods.[1,2] However, humeral fractures caused by high energy trauma usually require surgical treatment to achieve funtional results.[1,2,3,4,5] Incidences of nonunion increase with the use of surgery.[6]

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Therefore the first choice for treatment should be conservative methods. Surgical treatment methods should be considered for patients with segmental fractures, bilateral fractures, floating elbow or vein and nerve damage.[2,7] The commonly known materials which can be used in surgical treatment are plate and screws, elastic intramedullar nails, locked intramedullar nails and external fixators[2,7]

No one single ideal fixation device has been developed as yet and the advantages of each of the available materials is still under discussion. This study discuses the results of patients with humeral diaphyseal fractures treated with either locking intramedullary nailing or plate and screws.

Material and method

The study comprised 60 patients (43 male (71%) and 17 female (29%)) treated for humeral fracture between 1994 and 2000. The cause of the fracture was traffic accident, inside the vehicle for 28 (46%) patients, traffic accident, outside the vehicle for 11 (18%) patients and a fall from height for 21 (34%) patients. According to AO fracture classification there were 32 Type A, 21 Type B and 7 Type C (Table 1). The surgery site was 5cm proximal to the olecranon fossa, 5cm distally. In the polytraumatic cases where acceptable reduction could not be achieved by conservative methods, fragmented and unstable fractures were treated surgically. The choice of surgical treatment was allocated randomly. All cases received 2 x 1gm per day first generation cephalosporin for 3 days.

A total of 33 patients (24 male,9 female) were treated with locking intramedullary nailing. Mean age was 42 years (range 21 – 61 years). Fractures were 21 left side and 12 right side. Open reduction was performed, then intramedllar nails were placed antegrade and locked from the proximal and distal (Figure 1a,b,c).

A total of 27 patients (19 male, 8 female) were treated with plate and screws. Mean age was 33 years (range 19 – 47 years). Fractures were 20 right side and 7 left side. Open reduction was performed then a 4.5 DCP was applied.

Postoperative treatment

Shoulder and elbow movement was started in the early period. However, resistance and rotating movements were avoided until a callus bridge had been observed on the radiographs. After discharge, patients were called at monthly intervals for follow-up clinical and radiograph evaluations. Healing was accepted clinically when there was no pain or movement in the fracture area, and radiographically when callus was observed on radiographs. Functional results were evaluated according to Stewart and Hundley criteria (Table 1). The time to bone union, iatrogenic nerve damage and nonunion rates for both groups were analysed with Mann-Whitney U and student t-test.

Results

The follow-up period for all the patients was mean 42 months (range 28 – 72 months). The time to healing for the plate and screws cases was mean 3.5 months (range 2.5 – 6 months) and for the intramedullar nailing cases was mean 3 months (range 2 – 5.5 months). There was no statistically significant difference ($p > 0.05$).

Iatrogenic radial nerve paralysis developed in no cases treated with intramedullary nailing and in 4 cases treated wwith plate and screws (Table 2). The cases where radial nerve paralysis developed were seen to completely recover within a mean of 5 months. The difference between the two groups was statistically significant ($p<0.05$).

No wound or skin infection was seen in either group.

Shoulder impingement was seen in 3 of the cases treated with intramedullar nailing. In one of these

Table 1. Typ of fractures according to AO' s classification

Type of Fracture	Patient
A	32
A_1	11
A_2	8
A_3	13
B	21
B_1	10
B_2	8
B_3	3
C	7
C_1	4
C_2	2
C_3	1

Table 2. Results of Treatment with Intramedüller Nailing and Plate.

	Plate-screw	Intramedüller Nailing
Union	%96	%88
Union time (mo)	3.5	3
Complications		
Nonunion	1	4
Refractur	–	–
Iatrojenik radial nerve injury	4	–
Infections	–	–
Impingement	–	3
Sekond surg	1	4

cases during placement of the nails, a nail had become trapped in the medulla so the proximal end remained outside. Proximal and distal locking was not done. Movement was not able to be started in the early period for this patient and shoulder pain developed. Bone union was observed after 3 months then the implant was removed. To prevent refracture a sling was applied for 15 days. Full shoulder and elbow movement was observed in follow-up. No impingement developed in the cases treated with plate and screws.

After the 6th month of follow-up, 4 of the cases treated with intramedullar nailing were determined as having pain in the fracture area and rotational pathologic movement (Table 2). Radiographs showed that callus had not formed. These cases were accepted as nonunion. An evaluation of these cases determined that the distal nails had not been appropriately placed and the screws were not of the correct diameter, therefore rotational stability had not been achieved.The nonunion cases were operated on again using one size larger intramedullar nails. The proximal and distal nails were locked and autogenetic bone was grafted. From the cases treated with plate and screws, in 1 case the plate and screws were insufficient and nonunion developed (Figure 2a,b,c). This patient was operated on again using intramedullary nailing and autograft. The rate of nonunion was greater in the group treated with intramedullary nailing and this was found to be statistically significant ($p<0.05$). The functional results according to the Stewart and Hundley criteria were in the plate and screws group, 88% good, 8% moderate and 4% poor and in the intramedullar nailing group, 81% good, 7% moderate and 12% poor (Table 3).

Discussion

Humeral fractures caused by low energy trauma can be treated in the most successful way by conser-

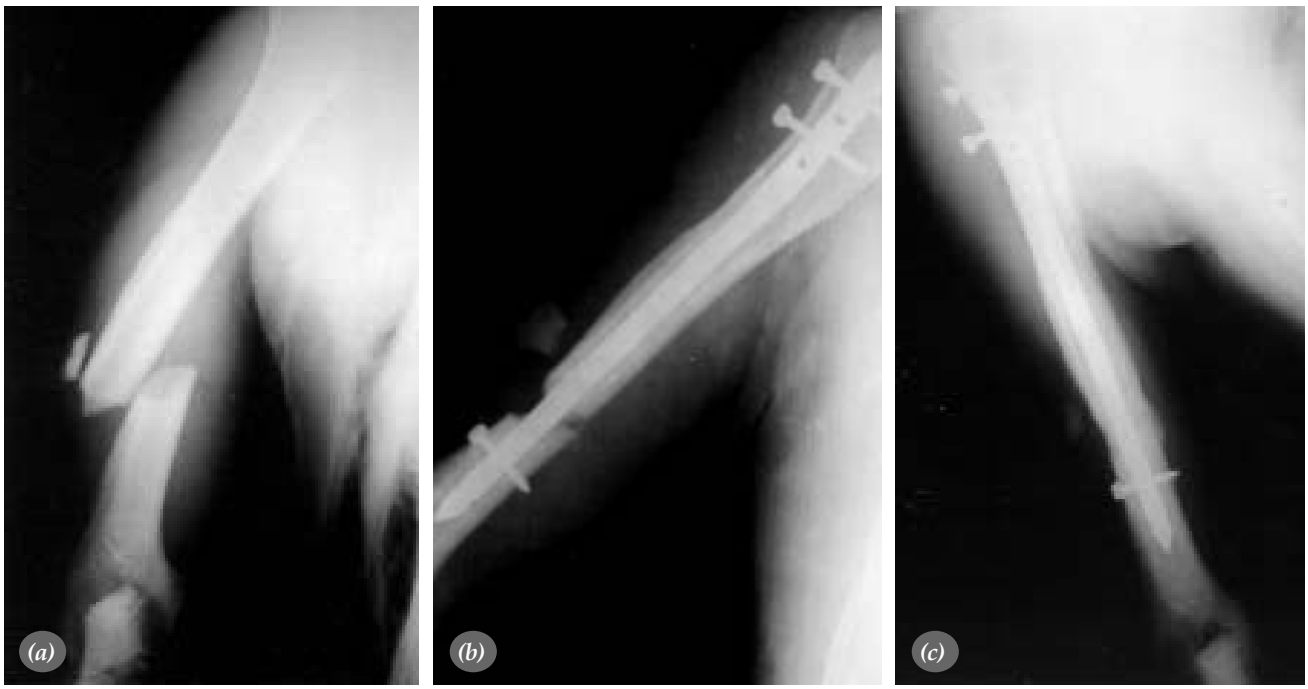

Figure 1. (a) Preoperative AP radiography view of midshaft fracture in a 52 years-old male. **(b)** Radiography view after treatment by ıntramedüler nailing. **(c)** Radiography view after two years.

Table 3. Functional results of patients according to Steward and Hundley criteria

	Intramedüller nailing	Plate-Screw
Pain		
No	27	24
After vork	2	2
Every time	4	1
Shoulder and Elbow Motion Limited		
<20	3	0
20-40	0	0
>40	0	0
Angulation		
<10	0	3
>10	0	0
Nonunion at radiology	4	1
Result		
Good	27	24
Modorate	2	2
Fail	4	1

vative methods.[7] However, to obtain functional results in high energy trauma humeral fractures, surgical treatment is generally required.[7, 8] Definite indications for surgical treatment are fragmented fractures, segmental fractures, floating elbow, bilateral fractures, open fractures and patients with vascular damage and polytrauma.[1,2] Several means of fixation are available for surgical treatment. These are plate and screw, elastic intramedullar nailing, locking intramedullary nailing and external fixators. For open fractures, external fixators are generally preferred.[1,2,3,8,9] There is a high rate of risk of pin site infection and non-union. In particular unilateral external fixators do not achieve sufficiently rigid fixation, nor are they comfortable for the patient.[10] Elastic intramedullary screws have been used in the treatment of humeral fractures but as they cannot maintain sufficient rotational stability, the rate of non-union is high.[6]

Nowadays the treatment most usually selected for humeral fractures is plate and screw and intramedullary nailing.[1,3,4,5] Both forms of fixation are widely used and successful results have been reported.[1,3,4,5,11] Plate and screw is used particularly in fractures in the distal third extending into the joint and in cases where radial nerve exploration or bone graft is necessary.[1]

Locking intramedullary nailing can be used additionally in elderly patients with osteoporosis and poor bone stock.[1] The healing period is known to be shorter in cases of humeral diaphyseal fracture which have been treated with locking intramedullary

Figure 2. (a) 32 years-old male, Nonunion occurred after treatement by plate-screw as initial. **(b)** Radiograph view after reoperation by intramedüler nailing. **(c)** Radiography view after two years.

nailing.[12,13] Robson [5] reported healing in 18 weeks in cases treated with intramedullary nailing and Bell [3] reported 20 weeks with plate and screws. In a study by Demirors et al [14] no significant difference was found between the healing period of cases treated with intramedullary nailing and those which had had plate and screws. In our study the healing period for the cases treated with plate and screw was mean 3.5 months and for the intramedullary nailing cases, 3 months. However this difference was not significant. An examination of literature showed that cases with a shorter healing time were those who had undergone closed reduction. As both groups in our study underwent open reduction, no significant difference was seen between them.

Infection development rates of 2-4% have been reported in cases treated with plate and screws, and 5% in cases of intramedullary nailing.[8]. In the studies by McCormack [8] and Demirors et al[14] infection was not reported from either technique and similarly in our study there was no infection observed in either group. Iatrogenic radial nerve damage is an important problem encountered after surgical treatment of humeral fractures. The radial nerve may be damaged during dissection and separation because of the greater exposure in treatment with plate and screws. While the rates for iatrogenic radial nerve damage have been reported as 3 – 29% in plate and screw treatment,[3,8,11] the rate is 0 -3% in intramedullary nailing.[4,8,9,11] In our study, while infection developed in 14% of the plate and screw group, infection was not observed in any patient in the intramedullary nailing group. Reported cases of radial nerve damage after intramedullary nailing were seen to have developed in patients who had undergone cloed reduction.[9] Radial nerve paralysis may be prevented by treatment with intramedullary nailing together with open reduction.

Surgical treatment for humeral diaphyseal fractures increases the incidence of non-union. A nonunion rate of 2 -10 % has been reported for cases treated with plate and screws.[3,8] In a studies using intramedullar nailing, the rate of nonunion was 22% reported by Flinkela [4], 23% by Robinson[5] but Reimer [13] did not report any nonunion. In our cases treated by intramedullar nailing the nonunion rate was seen to be 13% while in the plate and screw group it was 3%. On examination of these cases it was seen that the higher rate in the intramedullar nailing group had arisen from technical errors. The rate of nonunion can be reduced by a substantial amount with the correct application of intramedullar nailing for the correct indications and if full rotational stability is achieved.

During surgery, the surgical team are exposed to irradiation when distal locking the intramedullar nails.[14] This can be seen as a disadvantage. However this disadvantage can be removed by using the intramedullar nail as a guide for the distal locking. In all our cases guiding nails were used for distal locking. This shortened the duration of surgery and protected the surgeon from radiation exposure.

In conclusion it can be said that no single ideal fixation device has yet been developed for the treatment of humeral fractures. Both of the established methods have their own advantages and disadvantages. Although there is a high rate of nonunion, we are of the opinion that intramedullar nailing is a good choice for the treatment of humeral fractures as application is simple, there is less need for soft tissue dissection, and the morbidity rate is low and can be prevented.

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