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Early results of treatment of proximal humerus fractures with the PHILOS locking plate

Proksimal humerus kırıkların PHILOS plağı ile tedavisinde erken dönem sonuçlarımız

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Amaç: Proksimal humerus kırıklarının kilitli humerus proksimal plağı (PHILOS plağı) ile tedavisinin erken dönem sonuçları değerlendirildi.

Çalışma planı: Çalışmaya, proksimal humerus kırığı nedeniyle PHILOS kilitli plağı ile tespit yapılan 22 hasta (13 erkek, 9 kadın; ort. yaş 57; dağılım 35-83) alındı. Neer sınıflamasına göre 13 hastada parçalı kırık, dört hastada valgus impakte yaralanma, iki hastada kırıklı çıkık, üç hastada 1/3 proksimal cisim kırığı vardı. Sekiz hastada transdeltoid lateral yaklaşım ve minimal invaziv yöntemle dolaylı redüksiyon yapılırken, 14 hastada anterior deltopektoral yaklaşımla açık redüksiyon yapıldı. Tüm olgularda ameliyat sonrası ikinci günden itibaren pasif egzersizlere, 4-6 hafta sonra da aktif egzersizlere başlandı. Değerlendirmede Constant-Murley omuz skorlama sistemi kullanıldı. Ortalama takip süresi 14 ay (dağılım 12-19 ay) idi.

Sonuçlar: Yirmi olguda 10. hafta sonunda radyografik kaynama elde edildi. Bir olguda kaynama 16. hafta sonunda sağlandı. Bir olguda ise, 16. hafta sonunda kaynama görülmemesi üzerine otojen greft ile greftleme yapıldı. Ortalama Constant-Murley skoru 75.5 (dağılım 51-93) bulundu. Deltopektoral girişim ve transdeltoid lateral girişim kullanılan olguların skorları arasında anlamlı fark saptanmadı ($p>0.05$). İki hastada ameliyat sonrası grafide hafif derecede varusta tespit saptanırken, bir olguda da plağın subakromiyal sıkışma oluşturacak şekilde tespit edildiği görüldü. Hiçbir olguda implant yetmezliği gelişmedi. Bir olguda refleks sempatik distrofi, bir olguda avasküler nekroz görüldü.

Çıkarımlar: Proksimal humerus kırıklarının tedavisinde PHILOS plağı ile tespit, kaynama oranının yüksek olduğu ideale yakın bir tedavi yöntemidir.

Anahtar sözcükler: Kemik plağı; kırık tespiti, internal/yöntem; omuz kırığı/cerrahi; cerrahi işlem, minimal invaziv.

Objectives: The aim of this study was to evaluate early results of proximal humerus fractures treated with the PHILOS locking plate.

Methods: Proximal humerus fractures of 22 patients (13 males, 9 females; mean age 57 years; range 35 to 83 years) were treated with the PHILOS locking plate. According to the Neer classification, 13 patients had comminuted fractures, four patients had valgus impact injuries, two patients had fracture-dislocations, and three patients had fractures involving the proximal 1/3 of the humerus. The fractures were reduced by the transdeltoid lateral approach (n=8) using minimally invasive surgery, and by the anterior deltopectoral approach (n=14) using open surgery. Passive and active exercises were initiated on the second postoperative day and after 4 to 6 weeks, respectively. The results were assessed using the Constant-Murley shoulder scoring system. The mean follow up was 14 months (range 12 to 19 months).

Results: Radiographically, union was observed in 20 patients at the end of 10 weeks. In one patient, time to union was 16 weeks. One patient underwent autogenous bone grafting because of nonunion after 16 weeks. The mean Constant-Murley score was 75.5 (range 51 to 93). There was no significant difference between Constant-Murley scores of patients undergoing the transdeltoid lateral and anterior deltopectoral approaches ($p>0.05$). Plate fixation was associated with minimal varus deformity in two patients, and subacromial impingement in one patient. Implant failure did not occur. Reflex sympathetic dystrophy and avascular necrosis were observed in two patients, respectively.

Conclusion: Fixation with the PHILOS plate is a near-ideal technique with a high union rate in the treatment of proximal humeral fractures.

Key words: Bone plates; fracture fixation, internal/methods; shoulder fractures/surgery; surgical procedures, minimally invasive.

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Proximal humerus fractures constitutes 5% of all the fractures.[1] Frequency of proximal humerus fractures is increased in conjunction with the increase in the frequency of osteoporosis.[2] 80% of these fractures present with no or minimal displacement and hence can be treated with success by the application of the conservative methods.[3] By keeping in mind the nourishment of the proximal humerus, Neer's classification evaluates the proximal humerus in four pieces as the facies articularis, the major and the minor tuberculii and the corpus. Any translations more than 1 centimeters or angulations more than 45 degrees in any part of the humerus is defined as displacement. [4] There are many different ways of treatment of the displaced proximal humerus fractures. A painful frozen shoulder, avascular necrosis (AVN), malunion or nonunion, implant insufficiency are frequently encountered complications. The PHILOS plate that consists of new generation of locked plates can be be applied with a minimal invasive method and it is a fixating device that permits early mobility and lowers the risk of complications.

In this study the early results of the proximal humerus fractures which were treated with PHILOS plate are evaluated.

Patients and methods

Between the years 2005-2006 22 patients (13 males and 9 females; mean age: 57; age distribution 35-83) underwent surgical therapy for proximal humerus fractures and PHILOS plate was used in all for fixation. According to Neer classification 7 patients had two piece fractures (5 were surgical collum and 2 were anatomic collum), 4 patients had valgus impaction injuries, 2 patients had fracture-dislocation, 5 patients had 3 piece fracture, 1 patient had 4 piece fracture and 3 patients had 1/3 proximal fracture of the corpus. All of the operations were conducted in a day bed position under scope control. While in 8 patients a transdeltoid approach and minimal invasive method was preferred for an indirect reduction, in 14 patients open reduction with anterior deltopectoral approach was the method of treatment. An incision of 3-4 cm. long from the acromion was performed and prepared as a deltoid split in order to place the plate in a closed fashion in patients in whom the transdeltoid lateral approach was preferred. After the plate was placed percutaneously from the proximal end a guiding Kirschner wire was secured from the proximal hole in a transverse manner. Attention was given to that this guiding Kirschner wire did not pass the peak point of the greater tubercule hence the height of the the plate was adjusted and impingement was prevented. Before final screwing, the height and the position of the plate was controlled under the scope and a temporary K-wire fixation was performed. In order to prevent the movement of the proximal pieces in a varus manner in multiple fractures, Ethibond sutures passed from the rotator cuff were used to reduce the proximal pieces in a valgus manner; however, this method was not used as a routine in all of the patients. Subsequently the proximal screws of the plate were secured. Following this, we marked the places of the distal screws under the scope and then performed the skin incisions. In order to attain the compression of the corpus humerii with the plate the first screw used at the distal part of the plate was a cortical nonlocking one. All the remaining screws used in the distal part were locking screws. A torqued screwdriver was always used in the locking of the screws but a motor was not used for this purpose. Following the locking of all the screws the sutures placed in some of the patients from the rotator cuff were secured to the suturing areas in the proximal part of the plate. In patients in whom open reduction was applied, the plate was placed into the lateral aspect of the groove of the tendon of biceps via anterior deltopectoral approach. All of the distal screws used apart from the first screw in the distal part of the plate were locking screws for all the fractures including the non osteoporotic ones.

The patients received sefazolin sodium for two days for prophylaxis. All patients begun passive exercises after the postoperative second day and active exercises after 4-6 weeks of surgery. All cases were invited for a control by the ends of the 2nd, 4th, 6th and 10th weeks. Cases fulfilling a 12 months of follow up (mean 14 months; distribution 12-19 months) were evaluated with Constant - Murley Shoulder Scoring System (0-55 points: poor, 56-70 points: mean, 71-85 points: good and 86-100 points: very good) [5] in terms of shoulder movement clearness in every direction, pain and efficiency in performing daily activity. The Constant - Murley scores of the cases in whom open reduction was performed with deltopectoral approach and the results of the cases done with indirect reduction using the transdeltoid

lateral approach were compared using the Student t-test.

Results

In 10 of the cases both radiological and clinical union of the bones were achieved. In one case it took 16 weeks to achieve union. In another case non union was observed by the end of the 16th week and therefore it was grafted with an autologous graft.

The average Constant - Murley score was 75.5 (distribution 51-93). In 8 (36.4%) of the cases the results were very good, in 7 (31.8%) of the cases the results were found to be good, in 6 (27.3%) of the cases the results were found to be mean and in 1 case (4.6%) the result was found to be poor. We were unable to put forward a significant difference between the scores of the cases in whom open reduction was performed with deltopectoral approach and the cases in whom indirect reduction was applied by using the transdeltoid lateral approach (p=0.669).

Postoperative x-rays of two patients revealed a fixation in a minor varus position while in one patient we found out that the plate was placed in such a way that it would give rise to subacromial impingement (figure 1). Implant insufficiency was not observed in any of the cases. We noticed reflex sympathetic distrofy in one case and avascular necrosis in another one respectively (figure 2).

Discussion

Methods like closed reduction and percutaneous screwing, pressure band application, intramedullary rod placement with circlage augmentation, T-butress plate, double tubular plate, fixation with a plate having fixed angulation and primary arthroplasty are used in the surgical treatment of displaced proximal humerus fractures. Painful and frozen shoulder, malunion and AVN are among the serious results of this clinical entity.

The PHILOS plate is one of the top of the line locked compression plate used with a minimally invasive technique. It permits indirect fracture reduction thus lowering the possibility of AVN and by reducing the need of immobilization time helps diminishing the possibility of frozen shoulder. Furthermore, it is a low profile plate with the proximal screws having the capability of being applied in different directions thus making it a fixating device with a high stability in osteoporotic bones.

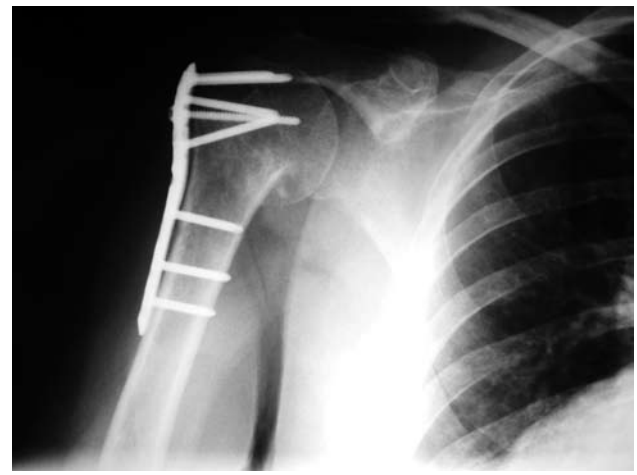

Figure 1. Radyogram reveals plate fixation constituting subacromial inpingement.

In the open reduction and plate placement for the treatment of the proximal humerus fractures, especially when the osteoporotic fractures are concerned, loosening of the implant, subacromial impingement and AVN due to the peeling of the periostium and the soft tissues are considered as serious problems.[6,7] Fixation insufficiency ratio is high in the treatments done with T-buttress plates.[6] In a study performed

Figure 2. The film shows consequent avasculer necrosis after plate fixation.

with 20 patients using PHILOS plate, although the mean age was 61.7 only one case ended up with implant insufficiency.[8]

AVN ratios seem to be less in fixations performed with a minimal invasive approach in the treatment of proximal humerus fractures. Gardner and coworkers[9] demonstrated in a cadaver study that the plate can be placed to a secure area without compromising the nourishment of the head of the humerus with an anterolateral acromial approach. This secure area is an avascular area of approximately 30 mm. wide at the lateral aspect of the humerus, next to the greater tubercule. When the proximal part of the PHILOS plate is placed onto this area both the ascendant branch of the anterior circumflex artery and the posterior branch of the posterior circumflex artery are conserved. When the proximal end of the plate is placed to the area approximately 8 mm. below from the rotator cuff at the greater tubercule there will be a 4mm. distance left to the anteriorly perfusing artery that enters the collum and approximately 7 mm. will be left to the posteriorly entering perfusing artery. However it must be taken into consideration that this study had been conducted on solid humerii in only six cadavers where anatomic variations had been disregarded.

The major perfusing artery of the head of the humerus is the anterolateral branch of the anterior humeral circumflex artery. This branch traverses parallel to the longer head of the biceps muscle and penetrates into the head of the humerus just proximal to the intertubercular groove. The terminal intraosseous branch of this artery is known as the Laing artery. Furthermore, the anastomoses created by the anterior and the posterior humeral circumflex arteries at the intraosseous area and at the medial part of the anatomic collum are very important.[10,11] Due to this type of perfusion properties the possibility of AVN in four piece fractures is around 21-75% [12-16] where this ratio is around 8-26% in valgus impaction injuries.[17-19] In traumatic cases the posteriorly oriented arteries that usually have less contribution to the perfusion of the head of the humerus may be helpful in the survival of the humerus head due to these anastomoses.

The minimally invasive method leads to a minimal damage to the periostium and the soft tissues at the fracture line hence giving rise to an expedition in healing. In our study we performed fixation in the varus position in one of the 8 patients in whom minimally invasive method with lateral transdeltoid approach was used. The reason for this is that we experienced some difficulties in indirect reduction of the fractures of the firs patients and in part lack of experience.

Although we noticed AVN in one patient with plain x-ray imaging, it must be kept in mind that the average age was low,[57] the results were for the early findings and none of the patients underwent magnetic resonance imaging for displaying AVN.

None of the patients but one with reflex sympathetic distrophy, presented with painful or frozen shoulder. This result makes us think that it is important to start both the passive and active exercises as soon as possible after surgery.

There are many studies that put forward the better stabilizing fixation properties of the proximal humerus locking plates in comparison to conventional plates from the biomechanichal point of view. Ensuing insufficiency in the implants (T plates chiefly) by early mobilization, especially in the presence of osteoporotic fractures, is a serious problem. Although in our study we started early mobility in all our patients we did not come across with implant insufficiency.

It has been declared that for some patients having low Constant - Murley scores postoperatively removal of the plate may lead to a better performance.[8] In our study we did not remove the plates from any patients including the one with the plate impingement. In an anatomic study in which minimally invasive transdeltoid approach was used for the insertion of the locking plate Smith et. al. [20] demonstrated the plate distance to the axillary nerve to be 9-13mm (mean 10 mm.) and 3-7 mm. declaring that the placement of the plate and screwing could be done in a secure area. The proximal part of the plate was found to be 31 mm. (distribution 21-41 mm.) away from the lateral acromion in the same study. None of our patients had axillary nerve injury. In cases who underwent indirect reduction and fixation with minimally invasive approach the skin was opened 3-4 cm. long from the lateral margin of the acromion which is a safe distance for the conservation of the axillary nerve.

Many therapeutic means are addressed including conservative therapies to hemiarthroplasty procedures in the treatment of four piece valgus impaction fractures. Open reduction, augmentation and grafting

has been declared to be beneficial in such cases [21] but it is our belief that descent results can be obtained with minimally invasive approach and indirect reduction. Non of our 6 patients who experienced postoperative complications had valgus impaction fractures.

4 of the 8 patients who were treated with lateral deltoid split approach had surgical collum fracture, in three of them valgus impaction fracture and in one of them three piece fracture was present. The minimally invasive method was not applied to patients having fracture-dislocation. Adequate reduction was achieved in four piece valgus impaction fractures with minimally invasive approach. As from the economic point of view, the cost of the PHILOS plate is higher than the other fixating procedures. However this disadvantage can be disregarded when the low morbidity rate is taken into consideration.

In our study, we did not find any significant difference between the mean Constant - Murley scores of the cases who were treated with deltopectoral approach and lateral deltoid split approach. Kormaz et. al. [22] declared no difference in Constant scores and functions of the patients treated with deltopectoral and deltoid split interventions after 6 months of follow up. As a conclusion fixation with the PHILOS plate for the treatment of proximal humerus fractures is a near ideal method with high union rates.

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