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The mid-term results of proximal row carpectomy in the treatment of degenerative wrist joint derangements

Dejeneratif el bileği eklemi patolojilerinin tedavisinde proksimal sıra rezeksiyon artroplastisinin orta dönem sonuçları

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Amaç: El bileği ekleminde proksimal sıra rezeksiyon artroplastisi (PSRA) uygulanan olgularda orta dönem sonuçlar değerlendirildi.

Çalışma planı: Dokuz hastaya (4 erkek, 5 kadın; ort. yaş 38; dağılım 23-66) el bileğindeki ağrıyı geçirmek, hareketleri ve kavrama kuvvetlerini artırmak amacıyla PSRA uygulandı. Bir hastada akut transskafoid-perilunat kırıklı çıkık; bir hastada eski perilunat kırıklı çıkık; dört hastada Kienböck hastalığı; üç hastada skafoid kaynamama sonrasında gelişen SLAC (scapho-lunate advanced collapse) artriti vardı. Semptomların süresi sekiz ay ile 10 yıl arasında değişiyordu. Ameliyat öncesi ve sonrası klinik ve radyografik incelemelerle yöntemin sonuçları değerlendirildi. Aktif-pasif hareketler, kavrama kuvveti, "pulp pinch" ve "key pinch" ölçümleri yapıldı. Hastalar ortalama 35.4 ay (13.5-72 ay) süreyle izlendi.

Sonuçlar: Tüm olgularda ameliyat sonrası dönemde ağrı sona erdi ve erken dönemde komplikasyon görülmedi. Akut karpal kırıklı çıkık olan hastada, ameliyattan üç yıl sonra radyokapitat eklem dejenerasyonu ve ağrı sonucu total el bileği artrodezi uygulandı. Diğer el ile yapılan karşılaştırmalarda, el bileği fonksiyonlarının ağrısız olarak yerine getirilmesinde yeterli olduğu görüldü. Hareket kısıtlılığı açısından, pasif radiyal deviyasyonda anlamlı düşüş görüldü ($p<0.05$). Yaş, cinsiyet, semptomların süresi gibi faktörlerin ameliyat sonrası başarı oranlarını etkilemediği gözlendi.

Çıkarımlar: Seçilmiş olgularda, PSRA ile ağrı giderilmekte, günlük aktiviteler için yeterli hareket sınırı ve kavrama kuvveti sağlanmaktadır. Ancak, radiyal deviyasyondaki düşüşü önlemek için tedaviye radiyal stiloidektominin de eklenmesi gerekir.

Anahtar sözcükler: Karpal kemikler/yaralanma/cerrahi; el gücü; hareket açıklığı, artiküler; skafoid kemik/cerrahi; semilunar kemik/cerrahi/yaralanma; el bileği eklemi/cerrahi/radyografi.

Objectives: We evaluated the mid-term results of proximal row carpectomy (PRC) in patients who underwent treatment for wrist joint derangements.

Methods: Nine patients (4 men, 5 women; mean age 38 years; range 23 to 66 years) underwent PRC to relive pain in the wrist joint and to improve motion and grip strength. Indications for surgery were acute transscaphoid-perilunate fracture dislocation in one patient, formerly unreduced perilunate fracture dislocation in one patient, Kienbock's disease in four patients, and scaphoid nonunion associated with scapholunate advanced collapse (SLAC) in three patients. The duration of the symptoms ranged from eight months to 10 years. The results were assessed with the use of pre- and postoperative clinical and radiographic studies, and measurements of active and passive motion, grip strength, and pulp and key pinch strengths. The mean follow-up was 35.4 months (range 13.5 to 72 months).

Results: Postoperatively, pain relief was achieved in all the patients and no complications were encountered in the early period. One patient with acute transscaphoid-perilunate fracture dislocation developed radiocapitate joint degeneration three years after surgery and underwent total wrist arthrodesis. Compared to the uninvolved side, wrist functions were found adequate with painless motion, except for passive radial deviation which exhibited a significant decrease ($p<0.05$). Age, sex, and the duration of symptoms did not influence postoperative results.

Conclusion: In selected patients with wrist joint derangement, PRC enables painless and adequate motion and grip strength for daily activities. However, radial styloidectomy seems to be necessary to prevent restriction in radial deviation.

Key words: Carpal bones/injuries/surgery; hand strength; range of motion, articular; scaphoid bone; semilunar bone/injuries; wrist joint/surgery/radiography.

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The major function of the upper extremity is to position the hand in three-dimentional geometry for the intended function of the hand.[1,2] The most important part of the articulation and lever systems of the upper extremity is the wrist joint which unites the hand with these systems. The wrist joint with its stability and large range of motion, provides the ability to perform many activities.[1,2] Painful and limited motion of the wrist joint hinders or even prevents these activities.[1,2]

Many disorders interfering with wrist functions have been defined. All of these disorders cause painful, and limited range of motion due to cartilage destruction in the joints comprising the wrist joint.

Various surgical methods have been described for the painful wrist.[1,3-6] There is no consensus over the superiority of different surgical methods to each other in terms of acquiring a painless and mobile wrist.[3,5] Proximal row carpectomy (PRC) is a valuable alternative for patients who need motion preservation and remodeling.[3-5] It was originally described by Stamm in 1944 and involves acquisition of a simple lever system from a complicated transfer mechanism by excision of the scaphoid, triquetrum and lunate bones and making an articulation between the radius and capitate.[1]

This study reviews midterm functional results nine patients, in whom PRC was performed for painful and restricted wrist joint due to degenerative arthritis.

Patients and method

Nine patients (5 females, 4 males, mean age 38 years, age range 23-66 years) who received PRC in the Orthopaedics and Traumatology Department, Hand Surgery Department of the Kocaeli University between June 1997 and July 2003, were evaluated retrospectively. The objectives in performing the operation were to relieve pain, to improve the range of motion of the wrist and to increase grip strength. The operation was performed on the dominant hand in six patients. One patient was a student, three were workers and five housewives. Symptom duration ranged between 8 months and 10 years, except for one patient who was operated on following acute trauma.

One patient had a type IIIA open, contaminated acute transscaphoid-perilunate fracture dislocation, one patient a neglected perilunate fracture dislocation, four patients stage IIIB Kienböck's disease, three patients SLAC (scapholunate advanced collapse) arthritis following scaphoid malunion. Pre and postoperative clinical examination and radiographs were used to evaluate the results. Active-passive motion, grip strength, pulp pinch and key pinch values of the operated side were compared to the normal side in the postoperative workup. These values were calculated from the difference between the two sides and the percentage of change. Active-passive motion were measured by a goniometer. The Jamar device (Sammons Preston, Inc. Bolingbrook, IL. ABD, 60440-4989) was used for measuring grip strength, pulp pinch and key pinch.

Surgical method

Dorsal longitudinal incision was preferred in eight patients, while dorsal transverse incision was used in one. An incision of 6-8 cm was made on the ulnar side of the Lister's tubercle, extending proximally and distally through the skin and subcutaneous tissues. The extensor retinaculum was sectioned between the third and fourth compartments, parallel to the incision. The third and fourth compartments were connected. Proximally, the terminal branch of the posterior interosseus nerve was identified on the ulnar ridge of the distal radius and over the deep fascia and excised after dissection from the proximal 2-3 cm of the radius. Tendons were pulled towards the ulnar side and the capsule was exposed. The capsule was cut open through an 'H' shaped incision, allowing evaluation of the proximal part of the capitate and the lunate fossa. The lunate was separated sharply from the intercarpal ligaments over the triquetrum and the scaphoid. The proximal row was excised by increasing mobility. Proximal part of the capitate was placed in the center of the lunate fossa and its position was fixed using a K-wire. Immobilization was provided by a short arm splint. Following 2-6 weeks of immobilization in the postoperative period, the K-wire was taken out and rehabilitation was applied for four weeks. Patients were followed-up for a mean period of 35.4 months (range 13.5-72 months). All data were evaluated using Mann-Whitney U test and results with $p<0.05$ were taken as statistically significant.

Results

In all patients, pain was relieved after surgery and no early complications were observed. Postoperative

Table 1. Mean and standard deviation values of functional loss and percentage of functional loss of the operated hand as compared to the other side following proximal row carpectomy

Function	Mean±Standard deviation (Kg/strength)	Percentage loss
Active flexion difference	25.00±18.24	39.03
Active extension difference	25.33±15.22	38.82
Active ulnar deviation difference	11.22±8.07	25.71
Active radial deviation difference	12.22±5.12	63.03
Passive flexion difference	26.22±18.05	33.09
Passive extension difference	21.44±13.02	27.32
Passive ulnar deviation difference	13.67±9.45	25.52
Passive radial deviation difference	16.33±7.68	55.14
Grip strength difference	17.52±14.41	41.94
Pulp pinch difference	2.52±2.35	28.45
Key pinch difference	3.43±5.92	24.80

active-passive flexion, active-passive extension, active-passive ulnar deviation, active-passive radial deviation, grip strength, pulp pinch and key pinch values were measured separately for each hand, mean values and percentage loss are listed in Table 1. No change was observed in using the dominant hand postoperatively.

In terms of motion restriction in the wrist joint, the change in passive radial deviation was statistically significant ($p<0.05$). Moreover, for those patients who were workers, postoperative return to normal daily activity was significantly early, regardless of the etiology of the disorder ($p<0.05$). Duration of symptoms and gender were not significant for postoperative wrist functions. One patient operated following acute trauma, received total wrist arthrodesis due to radiocapitate degenerative arthritis after a 3-year period free from pain (Figure 1a-d).

Discussion

PRC was described by Stamm in 1944 for scaphoid nonunion and Kienböck's disease.[1] The tension on the surrounding tissues are relieved by total removal of the proximal row, providing pain relief. Stamm emphasized that partial excision of the carpal row would not create an adequate relaxation and that the destructive effect would contrarily be increased.[1] Following proximal row resection arthroplasty, the mobility and grip strength were reported to be 50-70% of the contralateral side. In heavy workers and in the presence of degeneration of the capitate joint surfaces, this method is reported to be contraindicated.[6]

The largest (24 patients) and best documented study in he literature was published by Crabbe in 1964.[7] Many surgeons have preferred to use PRC as a mobility-preserving method after this report and thus, indication criteria were revised in favor of the method.[6-11] In 1987, Green published the long-term results of PRC and reported that pain was relieved, functional status was preserved and good results were observed in terms of grip strength.[10]

Comparison of reported results may not be possible due to differences in the magnitude of trauma, degree of deformation, etiology of degeneration, duration of symptoms, length of follow-up and methods of rehabilitation used. Generally in the wrist joint, mobility is preserved despite minor decreases and grip strength is increased as compared to preoperative values.[6]

There are many pathologies involving the proximal row where PRC is indicated, the most common one being the SLAC arthritis first described by Watson and Ballet in 1984.[1,12] The most common cause of this arthritis is rotatory subluxation following scaphoid nonunion (Figure 2a-c). Other causes include Preiser's disease, midcarpal instability and fractures involving the articular surfaces of the radioscaphoid and capitolunate joints.[1] For all of these etiological factors, the major pathology is in the scaphoid.[1] SLAC arthritis results from the incongruency of the radioscaphoid joint morphology. Disintegration of the scaphoid and its supportive mechanisms creates a depression on the radial side

of the wrist joint. The initial pathology that occurs between the radial styloid and the scaphoid ultimately terminates in degeneration due to collapse of the radioscaphoid joint surface. As the severity of destruction in the radioscaphoid joint increases, the capitate is displaced proximally and exerts stress on the ligament between the scaphoid and the lunate. In time, degeneration develops on the joint surface between the hamate and the lunate. In SLAC pathology, radiolunate joint surface is hardly affected due to its spherical structure; therefore, treatment is based on this point.[1,12]

Another indication for proximal row carpectomy is instability and resulting pain, loss in mobility and grip strength. When instabilities are dynamic in nature, symptoms occur; however, plain radiographs are normal. Radiographic findings are evident in static instabilities.[13,14] Linscheid et al[15-17] defined the diagnostic criteria for carpal instability.

Begley and Engber[18] reported successful results for PRC in Kienböck stage III patients. In their study, no limitation of the range of motion could be found and grip strength was 72% as compared to the other side (Figure 3a, b). Tomaino et al[19] applied the

Figure 1. **(a)** AP and **(b)** lateral radiographs of an acute transscaphoid, transstyloid perilunate fracture dislocation. **(c)** 36 months after proximal row carpectomy, AP radiograph indicates radiocapitate joint degeneration. **(d)** AP radiograph following total wrist arthrodesis.

method in eight patients with Kienböck's disease, in whom the wrist flexion-extension limit was 30-95 degrees and grip strength 58-100% compared to the other side.

Preiser's disease was described in 1910.[1] PRC performed for osteonecrosis of the scaphoid is quite rare. Jorgensen[20] applied PRC in eight patients with scaphoid osteonecrosis; weakness in grip strength and a 36% loss in range of motion was evident despite pain relief. DeSmet et al[21] report successful results after PRC for Preiser's disease.

In acute fracture dislocations of the wrist joint, PRC was successfully used to preserve mobility. Patients were free of pain, normal grip strength was acquired and no revisions were necessary in the follow-up.[8] Rettig and Raskin,[22] applied PRC in 12 patients with nonreduced and nonreconstructed fracture dislocations of the wrist and reported that significant crush injuries influence results.

First results of PRC in romatoid wrist deformities were reported by Ferlic et al.[11] They reported good results after proximal row carpectomy in two of the eight patients they operated, the other patients

Figure2. Grade III SLAC arthritis following scaphoid malunion **(a)** AP and **(b)** lateral radiographs. **(c)** AP and lateral radiographs at the end of a 36-month follow-up, demonstrate mild degenerative changes of the radiocapitate joint, which was created.

received additional surgical interventions due to progressive pain, tendon imbalance and loss in grip strength. Thus, PRC is not recommended for romatoid arthritis. Other surgical methods are prefered in this patient group.[11]

In another study, revision surgery was necessary in 5-10% of the patients after PRC, and pain relief was achieved after total wrist arthrodesis in most patients.[6] In patients with K-wire fixation, complications like pin track infection, temporary sensory nerve irritation and defect in the head of the capitate were more frequently observed.[6] Another complication was pain due to radial impingement. Revision surgery was performed on these patients to excise the radial styloid.[6] Limiting radial styloidectomy with 5-7 mm and performing the operation cautiously were strongly empasized.[23] In the literature, there are controversial results concerning the development of progressive radiocapitate degeneration following PRC. Imbriglia et al[3] have reviewed the pre and postoperative radiographs of 27 patients they have followed-up for four years for changes in the head of the capitate and the lunate fossa and reported that progressive radiocapitate degeneration was quite rare. Fitzgerald et al[24] detected radiocapitate degeneration with subchondral cyst and osteophyte formation in four out of nine patients they have followed-up. However, these findings were not clinically symptomatic.

Compared to other surgical procedures, PRC is technically easy to apply with a lesser risk of complications.[4] This method helps acquire a relatively strong and available wrist joint, by preserving mobility while relieving pain. When compared to other surgical interventions, PRC is more advantageous for preserving mobility while relieving pain and is preferred over fusion when preservation of mobility is the objective.[4,5]

Total wrist arthrodesis is a final alternative to consider when other surgical interventions prove to be inappropriate.[4,5] Various types of insufficiencies and complications at long-term were encountered in the postoperative period. The rate of nonunion was 26.3% and the total rate of other complications was 29% for nonromatoid patients.[17] However, nonunion is not a complication observed in PRC; moreover, ease of application, short duration of the intervention and less use of implants help provide a significantly low rate of infection.

Silicon or metal prostheses and arthroplasties have been used for preserving mobility and stability

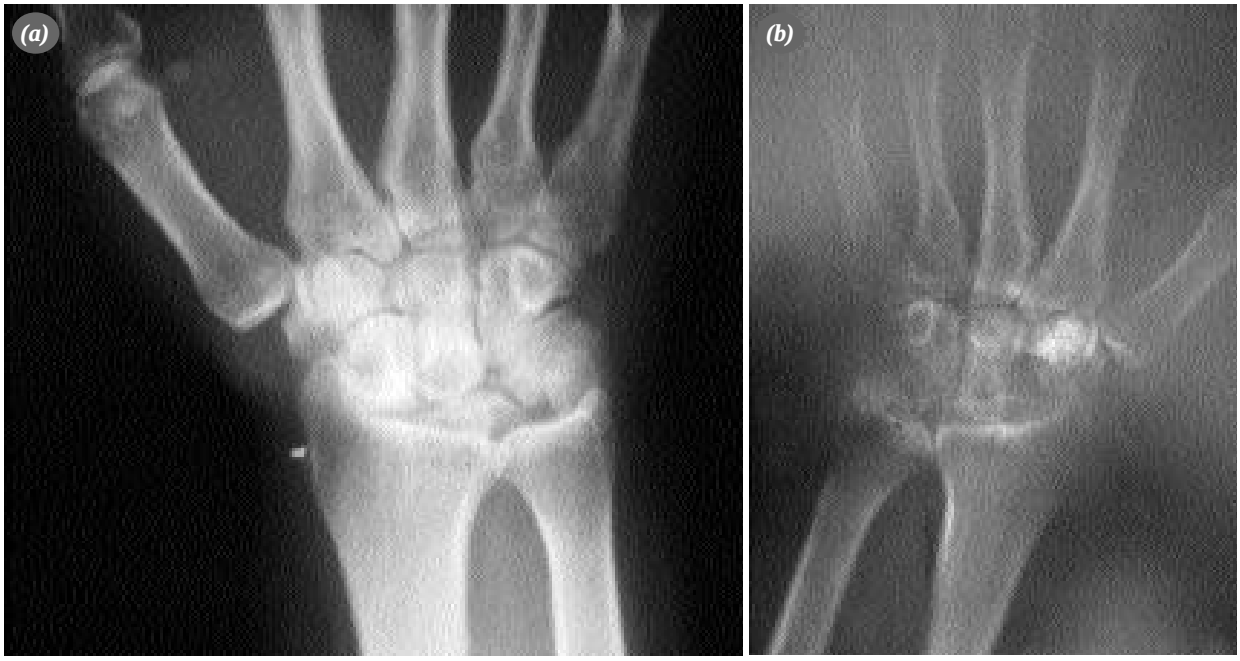

Figure 3. **(a)** Stage III b Kienböck osteonecrosis. AP radiographs shows mild degenerative changes at the proximal joint surface of the capitate. **(b)** AP radiographs of the radiocapitate joint after 72 months of follow up were evaluated as indicative of mild degenerative changes.

of the wrist joint in traumatic and degenerative disorders of the radiocarpal and intercarpal joints.[3] However, at long-term follow-up examinations, silicon synovitis and loosening problems were frequently noted, moreover, infections were also more common in this patient group. These complications prevented a successful long-term outcome for arthroplasties.[18] They may be prevented by refraining from synthetic materials and preserving the biological joint surfaces.[3]

Limited intercarpal fusion is another method where mobility and functional arcs of strength are protected. It reduces pain in the wrist joint, helps preserve stability and carpal height.[3] However, ease of technique, early mobilisation and no risk of nonunion make PRC preferable over limited intercarpal fusion.[5,25]

Instability was observed in the wrist joint after total or partial scaphoidectomy performed for degenerative diseases of the scaphoid. Ulnar and palmar malpositioning and dorsal rotation of the lunate create dorsal instability, causing pain and degeneration necessitating repeat surgical intervention. Thus, the hyphothesis that scaphoid, lunate and triquetrum should be excised as a group is justified.[4] However, for a successful outcome after PRC, the lunate fossa and joint surface of the proximal capitate should not demonstrate any degenerative changes. [1,4,20] Neviaser[25] demonstrated that degenerative changes in the radioscaphocapitate joint influence the long-term results of surgery. Despite the fact that degenerative changes of the radiocarpal joint is a contraindication for PRC, successful results were obtained in the presence of mild degeneration.[4] In our study, progressive degenerative radiocarpal arthritis was not observed in our patients, except for one patient in whom PRC was applied after acute transscaphoid perilunate dislocation.

Following proximal row carpectomy, pain diminished in 80-100% of patients.[3,9,18] In our study, postoperative follow-up examinations did not report any subjective pain during rest or work. Three years after PRC in a patient with acute progressive degenerative arthritis developed during the last two months, causing crippling pain and limited mobility and total wrist arthrodesis was performed. All other patients indicated that they were fine after the postoperative rehabilitation period.

In our study, grip strength was found to be reduced 41.94% compared to the contralateral side. Moreover, our range of motion was also variable (%40-60). Patients reported that they had acquired significant range of motion following the operation. 52% amelioration provided them adequate range of motion for daily activities. Contrarily, limited radial deviation was observed, which we believe is due to the lack of radial styloidectomy.

In conclusion, in selected patients, PRC was able to relieve pain, to provide range of motion and grip strength adequate for daily activities. As compared to workers, nonworkers could return to their postoperative status sooner. Pain was also not observed in this patient group. Age, gender and duration of symptoms were not effective on postoperative success rates. Development of progressive degenerative arthritis could not be prevented following PRC, after large tissue damage and compression injuries involving the radiocarpal joint have occured. The only salvage procedure for these patients was total wrist arthrodesis.

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