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Comparison of clinical and quality of life outcomes of patients who underwent early postoperative rehabilitation and cast immobilization after Achilles tendon repair

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Abstract

The aim of this study is to compare early postoperative rehabilitation (EPR) and six weeks cast immobilization protocols after Achilles tendon (AT) repair. 44 patients who underwent AT repair for acute rupture were included in the study. 25 patients in Group 1 underwent six weeks cast immobilization, and 19 patients in Group 2 underwent early rehabilitation following surgery. Demographic findings, other systemic diseases, the time duration between injury and surgery, follow-up time, complications, time to return to work, re-rupture, injury mechanism, AOFAS, ATRS, and SF-36 subscales were all evaluated. The mean follow-up period was 10.7 ± 2.50 (range 7 to 19) months. Return to work time and the number of complications was significantly higher in Group 1 ($p<0.001$, 0.043 respectively). Mean AOFAS and ATRS scores of Group 2 were significantly higher than Group 1 ($p=0.005$, $p=0.022$ respectively). Two of the SF-36 subscales (physical functioning and role limitations due to physical health) were significantly better in Group 2 than Group 1 ($p=0.025$, $p=0.022$ respectively). Both postoperative treatment protocols can be used safely whereas clinical outcomes of EPR after open AT repair are superior to immobilization, and we recommend EPR after surgical repair of Achilles tendon ruptures.

Keywords: Achilles tendon rupture, primer tendon repair, clinical outcomes, early rehabilitation, cast immobilization

Introduction

The Achilles tendon (AT), is consisted of the gastrocnemius and soleus tendons, is the thickest and strongest tendon in the body. In contrast, Achilles tendon ruptures (ATR) account for 20% of all significant tendon injuries. Its incidence is approximately seven in 100,000 and increases dramatically due to increasing sports activities among the elderly population [1,2]. Although most ATR occur during sports activities, gender, medication, dyslipidemia, and obesity may predispose to the rupture [3]. The most common injury mechanisms are abrupt forced plantar flexion of the foot, and forced dorsiflexion of the plantarflexed foot [2].

Treatment of acute ATR can generally be categorized as surgical (open or percutaneous) or nonsurgical (plaster immobilization or functional rehabilitation) [2]. It has been reported that surgical repair is related to a decreased risk of re-rupture, increased strength, and faster return to sports than nonoperative treatments [4]. There has not been a consensus for the optimal treatment and the postoperative rehabilitation protocol following surgical repair [5]. Various rehabilitation protocols are applied and these protocols change from complete immobilization with non-weight bearing to early weight-bearing with early mobilization [6]. Some protocols use cast immobilization for 6-8 weeks. However, immobilization has negative effects on musculoskeletal system [5]. After prolonged immobilization, complications such as fibrosis, calf muscle atrophy, deep vein thrombosis, and adhesions were reported in the literature [7]. For this reason, early postoperative rehabilitation (EPR) has been increasingly advocated recently [8]. However, it was reported that the ankle joint's early controlled movement causes prolongation of the AT, and extension of the AT causes a decrease in the thrust power in humans and thus a poor functional result [9]. In contrast, compared with cast immobilization, it was shown that performing early range of motion and weight-bearing after surgical Achilles tendon repair did not cause an additional risk and showed a reduction and earlier trend in return to work [6].

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Even though many studies have been published about the postoperative protocol after AT repair, there is no consensus about ideal rehabilitation protocol after acute AT repair. Therefore, the purpose of this study is to compare EPR and immobilization protocols after AT repair.

Materials and Methods

After obtaining Ethics Committee approval (Approval date-number: 20/01/2021, 2021-2/2) this study was performed. Patients were operated for AT rupture between February 2015 and February 2020 were retrospectively assessed. The inclusion criteria for the study were [1] patients over 18 years old, [2] with full-thickness AT rupture confirmed by MRI or USG, [3] with a minimum six months follow-up period. The exclusion criteria were [1] patients younger than 18 years old, [2] partial rupture, [3] history of neurological deficits at the ipsilateral lower extremity, [4] previous surgery from the affected foot or ankle, or [5] congenital or acquired deformities at the affected foot or ankle.

After inclusion and exclusion criteria were applied, 44 of the 83 patients were eligible for the study. The patients were separated to two groups. The patients who received ankle immobilization postoperatively were called Group 1; patients who received EPR were called Group 2.

The patients' age, gender, injured side, body mass index, other major systemic diseases (diabetes, coronary artery disease, hypertension, peripheric arterial diseases), the time duration between injury and surgery, follow-up time, complications, time to return to work, re-rupture and injury mechanism were recorded.

Surgical Procedure

All patients in the study were treated by two different surgeons using the same surgical technique. Operations were performed under spinal or general anesthesia in the prone position with tourniquet. All patients received a single dose of 1 g cefazolin intravenously before tourniquet inflation. A 5 to 7 cm posteromedial skin incision made over the rupture site. The paratenon was exposed and dissected sharply for easy closure after tendon repair. After passing paratenon, tendon rupture sites were identified and prepared for repair. Repair was performed with the end-to-end Krakow technique using core sutures with strong, no. 2 Ethibond nonabsorbable sutures (Ethicon, Johnson & Johnson, Norwood, MA) [10]. The repair was reinforced with an extra nonabsorbable braided suture via the Bunnel technique. After that a continuous epitendinous suture was applied. Then paratenon was repaired at all patients.

Postoperative Management

In Group 1, a below-knee cast in a 30° plantar flexion was applied for the first two weeks. The cast was then changed to reduce plantarflexion angle to 20, 10, and 0 with one-week intervals, and the cast was used for six weeks postoperatively. Weight-bearing was allowed as tolerated. At the sixth postoperative week, the cast was removed, ankle motions and full weight-bearing was allowed. In Group 2, a controlled ankle motion boot was used, which helps active plantar flexion but limits dorsiflexion. Immediate weight-bearing was allowed with crutches as tolerated. The ankle was positioned in 30° of plantar flexion for the first three weeks postoperatively. After the third week, ankle plantar flexion was reduced gradually by 10° for each week. Early motion exercises were started on the first postoperative day; 15-30 degrees of plantar flexion were allowed up to 15° for the first two weeks, up to 30° between the second and fourth weeks postoperatively. After six weeks, patients were allowed to take the full weight with full ROM. In both groups, isotonic resistance exercises were initiated from the eighth postoperative week, and more strenuous activities, including running and strength endurance activities, were commenced in the twelfth postoperative week. High-impact activities were avoided for a total of six months from the date of surgery.

Clinical and Radiological Evaluation

In the last follow-up, the clinical and functional results were assessed with the Achilles tendon rupture score (ATRS) [11], AOFAS [12], and SF-36 score [13] by an independent physician. Postoperative USG was performed in patients with clinical suspicion of re-rupture. Complications were recorded based on patient files. Joint stiffness was defined as loss of 30% of the ankle range of motion compared to the uninjured side despite physiotherapy for at least three months.

Statistical Analysis

The mean, standard deviation, and percent values were used, as appropriate, to describe the data. The distribution for each measured variable was evaluated for normality using the Kolmogorov–Smirnov test. Categorical variables are summarized as frequency (n) and a percent of the total. Statistical analyses were conducted with $\chi 2$ test test to compare categorical variables and the Student t test to analyze between group differences in clinical scores. Analysis was performed with SPSS 23.0 software (IBM, Armonk, NY). A p-value <0.05 was considered significant. Sample size calculation was made, and the response within each subject group was normally distributed with standard deviation of 0.09. Fourty-one patients were required to be able to reject the null hypothesis that the population means of the experimental and control groups are equal with the probability (power) of 0.08. The type I error probability associated with this test of the null hypothesis was 0.05.

Results

The mean age of the patients was 42.40 ± 9.59. Twenty-five (56.8%) patients were included in Group 1, and 19 (43.1%) in Group 2. The mean follow-up period was 10.7 ± 2.50 (range 7 to 19) months. Further patient characteristics are presented in Table 1. Mean AOFAS and ATRS scores were higher in group 2 (p=0.005, p=0.022 respectively). Two of the SF-36 subscales (Physical functioning and Role limitations due to physical health) were significantly better in Group 2 than Group 1 (p=0.025, p=0.022 respectively). Comparison of clinical and functional results and time to return to work between the two groups are shown in Table 2.

Complication rates were higher in group 1 (p=0.043); details of each group's complications are presented in Table 3.

Table 1. Patient demographic data stratified by groups

	All patients	Group 1	Group 2	p-value
Age, years (mean ± SD)	42.40 ± 9.59	43.6 ± 4.53	40.84 ± 3.56	0.351
Gender n (%)	17(34)	14(36.8)	3(25%)	
Female	16 (36.4)	9 (36)	7 (37)	0.513
Male	28 (63.6)	16 (64)	12 (63)	
BMI (kg/m²) (mean ± SD)	25.86 ± 2.68	25.61± 1.09	26.21 ± 1.33	0.461
Injured side n (%)				
Right	30 (68.1)	17 (68)	13 (32)	0.976
Left	14 (31.8)	8 (68.4)	6 (31.5)	
Comorbidity n (%)				
Yes	12 (27.2)	7 (28)	5 (26.3)	0.901
No	32 (72.7)	18 (72)	14 (73.7)	
Time from injury to surgery, days (mean ± SD)	2.56 ± 0.97	2.68 ± 1.14	2.42 ± 0.69	0.254
Injury mechanism n (%)				
Dancing	1 (2)	1 (4)	0 (0)	
Jumping	7 (15.9)	4 (16)	3 (15.7)	
Running	4 (9.0)	0 (0)	4 (21)	0.209
Pushing	13 (29.5)	7 (28)	6 (31.5)	
Playing football	7 (15.9)	5 (20)	2 (10.5)	
Walking	12 (27.2)	8 (32)	4 (21)	

Table 2. Comparison of clinical and functional results and time to return to work between the two groups

	Entire Study Population	Group 1	Group 2	p
AOFAS (mean ± SD)	78.02 ± 14.91	73.12 ± 15.54	84.47 ± 11.43	**0.005**
ATRS (mean ± SD)	73.04 ± 15.36	68.64 ± 15.92	78.84 ± 12.77	**0.022**
SF-36 (mean ± SD)				
Physical functioning	72.61 ± 11.68	67.81 ± 11.55	78.94 ± 8.59	**0.025**
Role limitations due to physical health	64.77 ± 25.47	56.00 ± 25.29	76.31 ± 21.20	**0.022**
Role limitations due to emotional problems	71.95 ± 23.14	71.48 ± 21.94	72.57 ± 25.23	0.912
Energy/fatigue	82.50 ± 13.53	81.20 ± 16.15	84.21 ± 9.16	0.737
Emotional well-being	82.40 ± 11.80	81.52 ± 9.29	83.57 ± 14.66	0.509
Social functioning	81.81 ± 12.48	81.00 ±10.89	82.89 ± 14.56	0.246
Pain	74.43 ± 13.84	73.00 ±14.15	76.31 ± 13.58	0.557
General health	82.61 ± 11.93	80.80 ± 11.33	85.00 ± 12.58	0.722
Health change	79.54 ± 18.88	78.00 ± 22.03	81.57 ± 14.04	0.266
Return to work time, days (mean ± SD)	79.88 ± 20.75	86.81 ± 22.81	70.78± 13.46	**<0.001**

Abbreviations: SD: standard deviation, n: number, AOFAS: American Orthopedic Foot and Ankle Score, ATRS: Achilles Tendon Total Rupture Score, p<0.05 was defined as significant and defined bold

Table 3. Comparison of complication rates between the two groups

Complications n (%)	Entire Study Population	Group 1	Group 2	
No	35 (79.5)	19 (76)	17 (89.6)	
Re-rupture	3 (6.8)	2 (8)	1 (5.2)	
Deep vein thrombosis	1 (2.2)	1 (4)	0 (0)	0.043
Joint stiffnes	2 (4.5)	2 (8)	0 (0)	
Reflex sympathetic dystrophy	1 (2.2)	1 (4)	0 (0)	
Superficial infection	2 (4.5)	0 (0)	1 (5.2)	

Discussion

Our study's most important finding was that the AOFAS, ATRS, and physical functioning and role limitation due to physical health domains of SF-36 score was superior in patients who received early postoperative rehabilitation after AT repair.

In the treatment of ATR, many studies in the literature advocated active rehabilitation. These observed early joint motion improved the tendons' biomechanical integrity after rupture and emphasized that it might be a more optimal rehabilitation approach [14-18]. Nilsson-Helander et al. [16] reported that early mobilization results with better clinical outcomes for patients with acute ATR, independent from treatment type (surgical or nonsurgical). Many studies reported that EPR is related to higher functional results than immobilization after AT repair [19-21]. In their study, Lantto et al. [22] reported a mean of 11-year results for 50 patients. They found similar long-term results in clinical score, isokinetic muscle strength, and subjective outcomes of patients undergoing EPR and immobilization.

Although there is no consensus about the optimal postoperative regime, most recent literature suggested that EPR is related to superior results. Our findings were compatible with the literature.

Suchak et al. [6] evaluated the quality of life of patients after AT repair. They found higher scores in the brace group for physical functionality, social functionality, vitality, and role-emotional areas compared to the cast group. Our study found a statistically significant difference in the EPR group in the physical functioning and role limitations due to physical health results in the Short Form Health Survey (SF-36) quality of both groups' life results. Patients' results were similar in other SF-36 sub-groups. We attribute the similarity of the SF-36 score to the short follow-up period in our study.

Majewski et al. [5] reported that EPR after AT repair provides better clinical results and earlier return to work and sports activities than postoperative immobilization. In a prospective randomized controlled trial, a tendency towards a decrease in working days lost and an earlier return to sports was observed in the early period, compared with cast immobilization and EPR use [6]. In contrast, in a study involving at least one-year of follow-up of 130 patients after treatment for ATR, there was no significant difference between patients who were mobilized early and immobilized to return to work [9]. In our study, we observed that patients who received EPR tend to return to work earlier.

The meta-analysis study concluded that EPR could increase patient satisfaction and facilitate return to activity earlier without increasing complication rates [23]. Arslan et al. [24] stated that complications are lower with the EPR protocol applied after open surgical treatment in patients with ATR and this rehabilitation is a safe method. In our study's accordance with the literature, we encountered more complications in the immobilization group, and the results were statistically significant.

Postoperative complications are not uncommon after AT repair [25]. In our study, the re-rupture rate was 6.8%, which is consistent with the literature. Even though we found no significant difference in complication rates, re-rupture was lower in the early functional rehabilitation group. It is known that mechanical loading enhances tendon healing [26], and AT reaches better elastic modulus when early ROM is allowed [27]. We think that a short follow-up time with a low sample size caused similar complication rates between them.

Sevimli et al. [28] reported that arthroscopic release can be considered a safe and effective option to obtain range of motion in joints in post-traumatic stiff elbow. They performed arthroscopic release to 22 patients with stiff elbow and followed 28.4 months. Their results were satisfying and we think that in patients with stiff ankle, arthroscopic release may be considered for treatment.

Our study had some limitations, including the retrospective nature of the study, short follow-up time, and a relatively small number of patients. Also, patients were operated on by multiple surgeons with varying skills and experience. Another limitation was that we did not inquire whether the patients had heavy or sedentary occupations, changing the time for returning to work.

Both postoperative treatment protocols can be used safely whereas clinical outcomes of EPR after open AT repair are superior to immobilization, and we recommend EPR after surgical repair of Achilles tendon ruptures.

Conflict of interests
The authors declare that they have no competing interests.

Financial Disclosure
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Ethical approval
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