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ORIGINAL ARTICLE / ARAŞTIRMA YAZISI

Orthopedics / Ortopedi

Retrospective Comparison of Open and Percutaneous Repair Methods in Acute Achilles' Tendon Repair

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ABSTRACT

Purpose: In recent years Achilles' tendon tears are becoming more common. Open and percutaneous repair methods have been described in the surgical treatment of tendon tears. The aim of this study is to determine whether there is a difference between open repair and percutaneous repair.

Methods: Patients who underwent surgical repair due to acute Achilles' tendon full-thickness rupture in our clinic, were included in the study. Open repair was performed for one group of patients and percutaneous repair was performed for the other. At the end of follow-up, clinical scores and complication rates were compared statistically.

Results: Thirty-six patients with a mean age of 46.3 years were included in the study. Nineteen patients were treated with the open method and seventeen patients with the percutaneous method. The mean follow-up period was 27.3 months for both groups. Mean Leppilahti scores were 94.71 in the percutaneous repair group and 90.79 in the open repair group ($p>0.05$). Re-rupture, deep infection and DVT rates were similar ($p>0.05$). Skin necrosis was more common in the open repair group ($p<0.05$). While sural nerve neuropraxia was more common in percutaneous repair ($p<0.05$).

Conclusion: In the surgical treatment of acute Achilles' tendon tears, the percutaneous method should be the first choice with its low complication rate and good clinical results. It is necessary to pay attention to the sural nerve during surgery.

Keywords: Achilles' tendon, percunatenous repair, open repair, sural nerve, skin necrosis

Akut Aşil Tendon Onarımında Açık Ve Perkütan Tamir Yöntemlerinin Retrospektif Karşılaştırılması

ÖZET

Giriş: Son yıllarda spora ilginin artması ve toplumun yaş ortalamasının artması gibi nedenlerden dolayı aşil tendon yırtıkları daha fazla görülmeye başlanmıştır. Aşil tendon yırtıklarının cerrahi tedavisinde açık ve perkütan tamir yöntemleri tanımlanmıştır. biz bu çalışmada açık veya perkütan yöntemle tedavi ettiğimiz hastaların klinik sonuçlarını karşılaştırdık.

Hastalar ve metod: Kliniğimizde akut aşil tendon tam kat yırtığı nedeniyle cerrahi tamir uyguladığımız hastalar çalışmaya dahil edildiler. Bir grup hastaya açık tamir diğerine perkütan tamir uygulanmıştı. Cerrahi sonrası iki grubada benzer rehabilitasyon programı uygulandı. Takip sonunda hastaların klinik değerlendirmeleri Leppilahti skoruna göre yapıldı. Komplikasyonlar not edildi. İki grup arasında istatistiksel değerlendirme yapıldı.

Sonuçlar: Çalışmaya yaş ortalaması 46.3 (27-68) olan 36 hasta dahil edildi. Hastaların 28'i (%77.8) erkek, 8'i (%22.2) kadındı. 19 hasta açık, 17 hasta ise kapalı yöntemle tedavi edilmişti. Ortalama takip süreleri 27.3 (12-60) aydı. İki grup arasında yaş, cinsiyet dağılımları ve takip süreleri arasında istatistiksel anlamlı fark yoktu ($p>0.05$). Perkütan tamirde ortalama Leppilahti skorları açık tamirde 94.71 iken açık tamirde 90.79 idi ($p>0.05$). Cerrahi sürelerin karşılaştırılmasında perkütan tamir daha kısaydı (19.47dk, 47.26dk, $p<0.05$). Tekrar yırtık oranı perkütan tamirde %5.9 iken açık tamirde %5.3 idi ($p>0.05$). Derin enfeksiyon perkütan tamirde görülmedi, açık tamirde %10.5 oranında görüldü ($p>0.05$). Cilt nekrozu perkütan tamirde yok iken açık tanirde %36.8 oranında görüldü ($p<0.05$). sural sinir nöropraksisi açık tamirde görülmez iken perkütan tamirde %35.3 oranında görüldü ($p<0.05$). Derin ven trombozu perkütan tamirde %5.9, açık tamirde %5.3 oranında görüldü ($p>0.05$).

Çıkarımlar: Akut aşil tendon yırtıklarının cerrahi tedavisinde perkütan yöntem düşük komplikasyon oranı ve iyi klinik sonuçlarıyla tedavide ilk seçenek olmalıdır. Cerrahi sırasında sural sinire dikkat etmek gerekmektedir.

Anahtar kelimeler: Aşil tendonu, perkütan tamir, açık tamir, sural sinir, cilt nekrozu.

Interest in sports for a healthy life has recently been increasing. At the same time, society is aging. The Achilles tendon is the most frequently ruptured tendon. More people are expected to have Achilles' tendon injuries over time (1). The Achilles tendon is the thickest tendon in the body. These ruptures usually occur among middle-aged individuals during sporting activities or with sudden movements. Achilles' tendon tears should be treated appropriately because of this tendon's importance in walking (2).

The optimal treatment of Achilles tendon injuries is still controversial. Treatment options can be divided between conservative and surgical methods. With conservative methods, patients can return to daily life with functional physical therapy following immobilization with a cast, splint, or brace (3). The advantage of conservative treatment is the absence of wound problems at the site of surgery and infections that may occur with surgical methods. The disadvantages, especially for young and active individuals, are the risk of re-rupture, weakness due to the retracted muscle, and joint stiffness due to long-term immobilization (4). In addition, the injection of agents that stimulate biological recovery has been described, such as platelet-rich plasma or mesenchymal stem cells. However, there is no scientific evidence that these agents change the course of treatment (5). Open, minimally invasive, and percutaneous methods of surgical treatment have been described (6-8). In the open method, the tendon is repaired by end-to-end sutures (6). In the minimally invasive method, the tear line is opened with a small incision, sutures are passed percutaneously from the proximal and distal ends, and the repair is performed with the help of a special device (7). In percutaneous methods, the tendon is repaired with various suture methods without opening the tear line (8).

Percutaneous repair methods have become particularly popular for preventing skin necrosis and deep infection and for increasing patient comfort. Percutaneous repair methods are also preferred because they do not require the use of additional devices. However, there are concerns regarding the risk of re-rupture and sural nerve neuropraxia related to percutaneous repair (9).

In this study, we compare the results of acute Achilles' tendon tears treated with open and percutaneous methods. Our hypothesis is that percutaneous Achilles tendon repair is a more advantageous method than open repair.

Materials and Methods

After obtaining the approval of the ethics committee (Bakırçay University no: 526-506), patients who had undergone surgery for Achilles' tendon injury were retrospectively reviewed. Only acute repairs (operations performed within the first 36 hours) were included in the study. Patients who underwent repairs in the chronic/subacute period were not included in the study. Pediatric patients and patients who could not be followed clinically were not included in the study.

The diagnosis of Achilles tendon rupture was made by palpation of the Achilles tendon on examination, absence of plantar flexion and inability to walk or limping. Radiologically, ultrasound or MRI was performed for all patients in the course of differential diagnosis and tendinitis and partial tears were excluded (Fig. 1). Surgery was performed for full-thickness tears and tendinous region tears. No surgical intervention was performed for partial musculoskeletal injuries. Patients with Achilles tendon tears after direct incisions with cutting tools, patients with avulsion from the calcaneus attachment site with a bone fragment, and patients with previous surgical scars in that area were not included in the study.

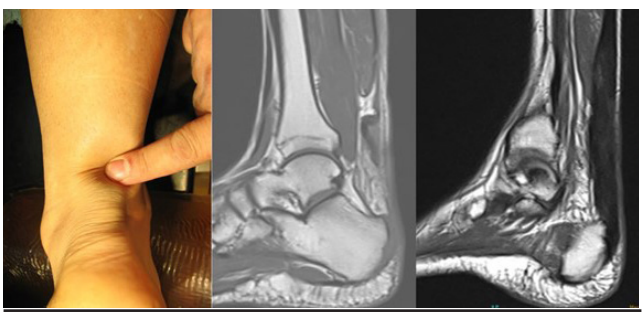

Figure 1: Detection of gap by preoperative palpation. Total tear on preoperative MRI. Healed state of the tendon by MRI control in the 6th month after percutaneous repair.

General or spinal anesthesia was applied for all patients. The prone position was preferred as the surgical position. Antibiotic prophylaxis was administered with 1 g of cefazolin sodium before surgery. Tourniquets were not applied for either the open or the percutaneous method. In the open method, the tear region was opened with an incision in a posterior curve. The body of the tendon was reconstructed with non-absorbable 2-0 Ethicon sutures. Tendon circumference was repaired with 3-0 Prolene sutures. If the plantaris muscle was present, it was augmented

onto the tendon (Fig. 2). In the percutaneous method, six holes were drilled with a total of six #11 scalpels, with two proximal to the tear, two in the tear region, and two distal to the tear. With a long sterile needle, PDS II sutures were applied, with the first suture from the proximal area by drawing eight towards the distal area, and the second suture from the distal in the opposite direction. Sutures were threaded proximally and knotted. Knots were left under the skin (Fig.s 2 and 3). After both repairs, Homan's test was performed passively on the plantar aspect of the ankle. When flexion was observed, the skin was closed. The time between skin incision after anesthesia and skin closure was recorded with the help of anesthesia forms.

Figure 2: Percutaneous repair. Open repair.

deep vein conditions such as thrombosis were noted and recorded.

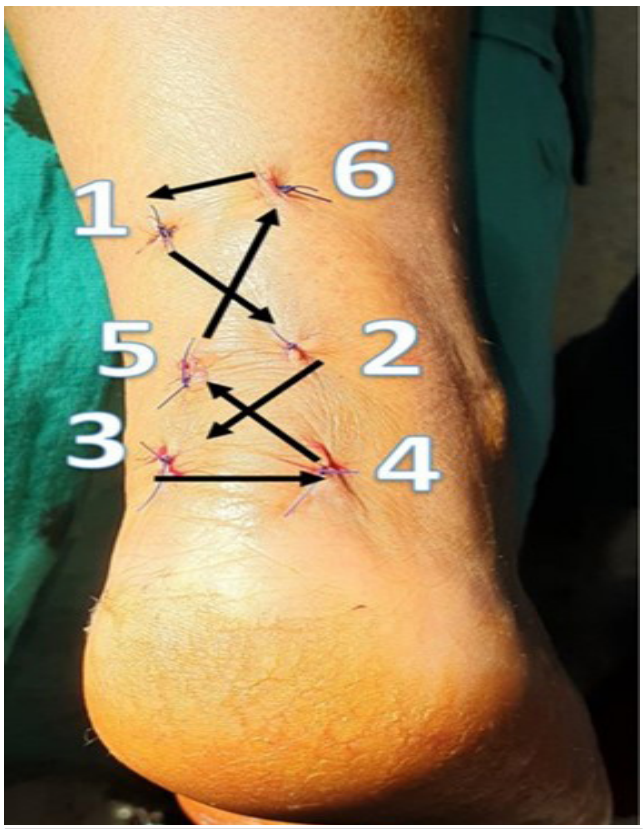

Figure 3: Transition sequence of sutures in percutaneous repair. While going from 1 to 6 for the first suture, two sutures were made in the opposite direction for the second suturing, and these were knotted simultaneously.

After surgery, both patient groups were first treated with a plantar brace. It was followed by an angle-adjustable ankle brace in flexion. At the end of the first week, the brace was adjusted so that the ankle was at 90°. Partial load bearing of 50% was permitted. Sutures were removed in the first week for patients treated by percutaneous method and in the second or third week for the open method. In the fourth week of follow-up, the brace was removed, and weight bearing was recommended as tolerated. Active ankle exercises were also given.

Postoperative clinical control examinations of the patients were performed based on the Leppilahti score at minimum 12 months (10). Skin necrosis, deep infection, neuropraxia in the sural nerve region, re-rupture, and

SPSS was used for statistical evaluation. The obtained data were entered into Microsoft Excel. Data were listed numerically and categorically. Mean and median values were obtained for numerical data and percentages for categorical data. The Shapiro-Wilk test was used to determine whether the numerical data conformed to normal distribution. Parametric tests were used when normal distribution was confirmed, and nonparametric tests were used when it was not. The chi-square test was used to evaluate categorical data. Fisher's exact test was used when observed values in tables were below 5, while Pearson's chi-square test was used for values greater than five. The significance level was accepted as $p<0.05$.

Results

A total of 48 patients were identified in the retrospective evaluation. 8 of these patients had chronic tears. Adequate clinical follow-up could not be performed in 4 patients. There were no pediatric patients in our series. Thirty-six patients with a mean age of 46.3 (27-68) years and appropriate clinical follow-up were included in the study. Twenty-eight (77.8%) of the patients were male and 8 (22.2%) were female. Nineteen patients were treated with the open method and seventeen patients with the percutaneous method. The mean follow-up time for both groups was 27.3 (12-60) months. Age, gender, and side distributions were similar between the two groups (p>0.05, Table 1). There was no statistically significant difference between follow-up times (p>0.05, Table 1).

Mean Leppilahti scores were 94.71±7.800 (80-100) for the percutaneous repair group and 90.79±6.721 (80-100) for the open repair group (p: 0.129, p>0.05). Percutaneous repair was found to be quicker in the comparison of surgical times (19.47 min vs. 47.26 min, p<0.001, p<0.05) (Table 2).

In the comparison of complications, the rate of re-rupture was 5.9% (1 patient) with percutaneous repair and 5.3% (1 patient) with open repair (p: 1.000, p>0.05). Deep infection was not seen in the percutaneous repair group, while it was seen at a rate of 10.5% (2 patients) (fig.4) with open repair (p: 0.487, p>0.05). Skin necrosis was not observed in the percutaneous repair group, but it was seen at a rate of 36.8% (7 patients) with open repair (p: 0.008, p<0.05). While sural nerve neuropraxia was not seen with open repair, it was seen at a rate of 35.3% (6 patients) with percutaneous repair (p: 0.006, p<0.05). Finally, deep vein thrombosis occurred at a rate of 5.9% (1 patient) with percutaneous repair and 5.3% (1 patient) with open repair (p: 1.000, p>0.05) (Table 2).

Table 1: Comparison of general demographic data

		Percutaneous repair		Open repair		p value
Age (years)		47.65	SD: 9,212	45.05	SD: 8,695	0.346*
Gender	male	13	76.5%	15	78.9%	1.000**
	female	4	23.5%	4	21.1%	
Side	Right	8	47.1%	9	47.4%	0.985***
	Left	9	52.9%	10	52.6%	
Follow-up time (months)		30.35	SD:10.839	24.53	SD: 12,642	0.100*

*SD: standard deviation, *: Mann-Whitney U test, **: Fisher's exact test, ***: Pearson's chi-square test*

Table 2: Comparison of clinical outcomes and complication rates

		Percutaneous repair		Open repair		p value
Leppilahti score		94.71	SD: 7,800	90.79	SD: 6,721	0.129*
Surgical time (min)		19.47	SD: 2,831	47.26	SD: 3,956	<0.001*
deep infection	yes	0	17.6%	2nd	10.5%	0.487**
	no	17	82.4%	17	89.5%	
skin necrosis	yes	0	0.0%	7	36.8%	0.008**
	no	17	100.0%	12	63.2%	
Re-rupture	yes	1	5.9%	1	5.3%	1.000**
	no	16	94.1%	18	94.7%	
Sural nerve neuropraxia	yes	6	35.3%	0	0.0%	0.006**
	no	11	64.7%	19	% 100	
DVT	yes	1	5.9%	1	5.3%	1.000**
	no	16	94.1%	18	94.7%	

*SD: standard deviation, DVT: deep vein thrombosis *: Mann-Whitney U test, **: Fisher's exact test*

Figure 4: Superficial skin infection and cellulitis findings. Deep infection and abscess formation.

Discussion

Treatment of Achilles tendon tears is classically either conservative or via surgical open repair. Conservative treatment of Achilles tendon tears may result in weakness, tendon retraction, muscle atrophy, or relapse and open surgery may result in skin problems. For these reasons, surgeons have sought different treatment methods. One of them is the percutaneous method. The percutaneous Achilles tendon repair method was first performed in 1977 by Ma and Griffith (5). In this method, it is aimed to both eliminate skin problems and preserve muscle strength with stable repair. However, the most important problem with the percutaneous method is neuropraxia due to the direct or indirect involvement of the sural nerve, which is close to the Achilles tendon.

In comparative studies of Achilles tendon ruptures treated with open or percutaneous methods, infection rates were found to be lower among patients treated with the open method compared to the percutaneous method (11). Although there were no infections in patients treated with the percutaneous method in their study, Lim et al. found infections in 21% of the patients treated with the open method (p: 0.01) (11). In our patient group, these rates were 0.0% and 36.8%, respectively (p: 0.008, $p<0.05$).

Lim et al. found no difference between their two groups in terms of re-tear rates (open repair 3%, percutaneous 6%, $p>0.05$) or functional scores (11). Karabinas et al. found no difference between the percutaneous and open methods in terms of clinical scores, return to work, or satisfaction rates (12). Henriquez et al. conducted a functional comparison and concluded that plantar flexion strength, calf diameter, ankle range of motion, and single heel strike results were similar between the two groups (13). Re-rupture rates and functional scores were similar between the two groups in our study, as well (p: 0.129). In our study, the rate of re-rupture was 5.9% in the group treated with the percutaneous method, while this rate was 5.3% with the open method (p: 1.000).

Percutaneous repair often comes with a higher rate of sural nerve neuropraxia compared to open repair (11,12,14). Although sural nerve neuropraxia was observed at higher rates in previous studies (3% and 18%) (11,12), this rate is seen to be decreasing in more recent studies (6.45%) (14). This is due to advancements of surgical techniques over time and a better understanding of anatomy. In our percutaneous treatment group, we observed sural nerve neuropraxia at a rate of 35%. For all those patients, neuropraxia regressed within 1 month and completely recovered. At the end of the treatment period, sural nerve lesions had decreased to 0%. McGee et al. showed in a cadaver study that needles or sutures do not directly damage the sural nerve and that there may be compression between the tendon sheath and the nerve (15,16). Although the rate of neuropraxia was high among our patients, the permanent damage rate was 0.0%.

Our study is a retrospective study by design. Therefore, randomization and equal distribution of the characteristics of the groups could not be done. In the future, studies with larger numbers of patients and patient groups with longer follow-up periods should be planned.

Conclusion

Percutaneous repair is a method with significant advantages over open repair for acute Achilles' tendon injuries. In particular, fewer wound problems and infections are seen. The surgery time is also shorter. There are no significant differences between functional results and the risk of repeat tears. The disadvantage of the percutaneous method is sural nerve neuropraxia. However, that risk can be minimized by paying attention to anatomical features, and when it does occur, sural nerve neuropraxia is usually temporary. In conclusion, based on the results of this study, percutaneous repair should be the first-choice method for the repair of acute Achilles' tendon ruptures due to low complication rates and good functional outcomes.

DECLARATIONS

Authorship

All authors equally contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript.

Conflict of interest

None

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There is no any financial support for the study.

Data Availability

All data used in the study available upon request from the author.

Ethics Approval

This study was approved by the İzmir Bakırçay University Research Ethics Committee on 02/03/2022 with the decision number 526-506.

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