



Pedobarographic measurements after repair of Achilles tendon by minimal invasive surgery

Huseyin OZKAN, Tolga EGE, Kenan KOCA, Nuray CAN, Yuksel YURTTAS, Servet TUNAY

From Department of Orthopaedics and Traumatology, Gulhane Military Medical Academy, Ankara, Turkey

The aim of the current study was to assess the changes of plantar foot pressures with pedobarography in patients with Achilles tendon repair by minimally invasive surgical technique.

This retrospective study consisted of 15 consecutive patients who were treated for acute Achilles' tendon repair with minimally invasive technique in our clinic in a two year period between 2010 and 2012. All patients were male. The mean age was 28.7 years (24-42) and the mean follow-up time was 2.3 years (1.5- 3). All patients had sports related Achilles' tendon rupture and all had undergone surgery in 24-48 hours. After surgery, extremity was immobilized with short leg cast for 6 weeks. Peak and mean heel and forefoot pressures in injured extremity were measured by pedobarograph and compared with noninvolved foot. There wasn't any complication associated with surgery such as wound problems, re rupture or neurologic injury. Only three patients had some numbness at the incision site. When we compare the mean foot pressures between the operated foot and the normal foot, there was no statistical difference about peak and mean heel and forefoot plantar pressure between involved site and non involved site.

As a result, Achilles tendon repair with minimal invasive technique and early rehabilitation may prevent changes of plantar foot pressure distribution.

Keywords : Achilles tendon ; pedobarography ; plantar foot pressure.

INTRODUCTION

Achilles tendon is usually caused by sports trauma in middle age population. Degenerative changes decrease elasticity of tendon and may result in partial or complete rupture. Many treatment methods were described from conservative to surgery. Surgery technique includes open, mini invasive and closed.

Results of Achilles tendon repair can be evaluated clinically by American Orthopaedic Foot and Ankle Society score, Achilles tendon rupture score, Hannover score and radiologically like USG and MRI (1). Major reason that influence gait cycle after rupture of the Achilles' tendon is unclear, however muscle weakness and lengthening of the tendon are thought to be responsible in several studies (2).

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- Huseyin Ozkan, MD, Associate Professor.
 - Tolga Ege, MD, Assistant Professor.
 - Kenan Koca, MD, Associate Professor.
 - Nuray Can, MD, Resident.
 - Yuksel Yurttas, MD, Associate Professor.
 - Servet Tunay, MD, Professor.

Department of Orthopaedics and Traumatology, Gulhane Military Medical Academy, Ankara, Turkey.

Correspondence : Huseyin Ozkan, Gülhane Askeri Tıp Akademisi, Ortopedi ve Travmatoloji Kliniği 06010 Etilik, Ankara, Turkey.

E-mail : heorto@yahoo.com, hozkan@gata.edu.tr

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Muscle weakness or lengthening may result from surgical technique and rehabilitation, as a result it may affect clinical results and also the change of load distribution under the foot.

Pedobarograph provides both static and dynamic plantar foot pressure measurements during the standing up position or walking. There are very limited studies in the literature investigating the changes of plantar foot pressure after repair of Achilles rupture (1,3). However, many factors may affect the feature of foot pressure after Achilles repair such as surgical technique and pedobarograph methods.

The aim of the current study was to assess the changes of plantar foot pressures using pedobarography after repair of Achilles' tendon rupture by minimal invasive surgery.

MATERIALS AND METHODS

The study was started after approve of Local Ethic Committee. This retrospective study consisted of 15 consecutive patients who were treated for acute Achilles' tendon repair with minimally invasive technique in our clinic in a two-year period between January 2010 and January 2012. All Achilles' tendon ruptures were associated with sports injury. All patients had undergone surgery in 24 to 48 hours period. Patients who were treated for re-rupture were excluded from the study.

After spinal anesthesia, patients were placed in prone position. A-2 cm of longitudinal skin incision was performed on the medial aspect of the ruptured region of Achilles' tendon. Ends of the ruptured tendon were reached by sharp incision on paratenon. Achilon device was placed inside the paratenon by touching the each side of proximal part of tendon. Then device was pushed towards cephalic end. Three of non-absorbable (no. 2) monofilament sutures were placed percutaneously from holes on the device trough tendon. The same procedure was applied on distal part of tendon. Sutures were looped on each side while the ankle in slight equines position. After checking the integrity of the tendon with Thompson test, ruptured tendon edges were strengthened with additional primer sutures. Short leg soft casting was applied with mild ankle equine position at the end of the surgery. Patient was allowed mobilization by crutches. Casting was changed by ankle neutral position after three weeks surgery. Castings were removed, walking with orthotic device by 90° of ankle position was allowed and

active ankle ROM exercises were started 1.5 months after surgery and strenuous exercises were started at 3rd month.

A pedobarographic measurement was performed 1 year after the surgery by RSscan System (RSscan International NV, De Weven 7, 3583 Paal, Belgium). The patients were asked to walk on the footscan® plate in a natural gait pattern with a normal walking speed. The actual recording of the measurement started on first contact with the footscan® plate and ended when a foot roll-off is detected or the maximum measurement time had elapsed. At least five cycles were recorded for minimizing artifacts and averaging the results. If any of the cycles contained an artifact, the patients were asked to repeat the procedure for another cycle. The mean of the five cycles were used in the final statistical analysis to obtain representative gait patterns. We recorded the mean and maximum peak pressures on the forefoot and heel areas. These findings were assessed compared with contralateral foot.

Data collected are delivered to computer via SPSS 15.0 statistics program and analyzed. Frequency and percentage are used for discrete data as descriptive statistics and average \pm standard deviation are used for continuous variables. Distribution of the groups was analyzed with the Kolmogorov-Smirnov one-sample test. When a comparison was made between two groups, Student's t-test for symmetrical distribution and the Mann-Whitney U test for asymmetrical distribution were utilized. Correlation of the parameters was analyzed with the Pearson Correlation. A *P* value of less than 0.05 was accepted as statistically significant.

RESULTS

Fifteen patients who had Achilles tendon repair were included the study. All of them were male and the mean age was 28.7 (range 24-42) years. The mean time from onset of symptoms to operation was 1.2 days (range 1-2) days. The mean follow-up time was 2.3 years (range 1.5-3 years). Patients had no complication associated with surgery such as wound problems, re rupture or neurovascular. Only three patients had some numbness at the incision site. There was no difference about mean peak heel pressure, max peak heel pressure, mean forefoot peak pressure and max forefoot peak pressure between involved feet and noninvolved feet ($p > 0.05$). The results are summarized in table (Table I).

Table I. — Comparison of pedobarographic parameters between involved and noninvolved site

	Noninvolved foot	Involved foot	p	Pearson correlation	
	Mean ± SD	Mean ± SD		R	p
Mean peak heel pressure	11.5 ± 1.3	11.2 ± 1.1	0.537*	0.826	< 0.001
Max peak heel pressure	15.1 ± 1.8	14.9 ± 1.6	0.676*	0.753	0.001
Mean peak fore foot pressure	9.2 ± 1.4	9.2 ± 1.1	1.000**	0.884	< 0.001
Max peak fore foot pressure	11.7 ± 1.5	11.7 ± 1.7	0.761**	0.856	< 0.001

*Student T test was used. **Mann Whitney U test was used.

DISCUSSION

In the current study, we aimed to assess the foot pressures of the patients with Achilles' tendon rupture treated with minimally invasive method. We found no significant difference about mean and maximum peak heel pressure and mean and maximum peak forefoot pressure between involved and noninvolved extremities in 15 patients.

Achilles tendon is the strongest tendon of body. It has a very important task during walking and running. Strength and appropriate length of the tendon should be provided after repair of the ruptured tendon (4). If tendon is shortened, heel strike cannot be efficient. If the tendon has lengthen with gap formation, tibia goes forward during midstance phase. In addition, this tendon exposes so much force during pus-off phase (5). Therefore, disruption in length and strength of tendon causes change in distribution of foot plantar pressure.

Previously McComis *et al* (6) evaluated 15 patients and they have found that patients who generated less peak vertical force and vertical height during the single-limb power-hop test tended to have poorer clinical scores. Neumann *et al* (7) have reported that there was still kinematic and foot pressure changes at 1 year after surgery compared to normal control group. Recently Costa *et al* (1) assessed patients who had treated for Achilles' tendon rupture even with surgical or conservative methods with in-shoe pedobarography. They have found significant decrease in peak forefoot pressures and increase in heel pressures even after six months after the treatment. Moreover they have not found any disturbances in the ratio between terminal stance

and pre-swing phase period, and total cycle time. In addition, Atik *et al* (3) reported that left foot with Achilles tendon repair has less total contact area ; higher peak pressure on heel, midfoot and forefoot ; more laterally located center pressure and lower arch index. They thought that these changes may result from shortening of Achilles tendon.

Contrary to above study, this current study showed that there was no difference between Achilles repaired extremity and non-injured extremity about peak and mean heel and forefoot pressure. This different result may be explained with early rehabilitation and minimal invasive tendon repair method. However, our study had some limitations. We have not used a control group with noninjured patients, instead we have used contralateral limb as control group. Secondly the pedobarography we have used was floor mat type.

As a result, minimal invasive surgery and early rehabilitation in Achilles tendon rupture can prevent change of plantar foot pressure and improve clinical outcomes by providing strength and length of Achilles tendon.

REFERENCES

1. Atik OS, Bölükbaşı S, Kanath U. Does surgical repair of acute Achilles tendon rupture cause structural changes on 15-year follow-up ? *Eklemler Hastalıkları Cerrahisi* 2011 ; 22 : 54-55.
2. Maffulli N. Rupture of the Achilles tendon. *J Bone Joint Surg Am* 1999 ; 81 : 1019-1036.
3. McComis GP, Nawoczinski DA, DeHaven KE. Functional bracing for rupture of the Achilles tendon. Clinical results and analysis of ground-reaction forces and temporal data. *J Bone Joint Surg Am* 1997 ; 79 : 1799-1808.

4. **Mullaney MJ, McHugh MP, Tyler TF, Nicholas SJ, Lee SJ.** Weakness in end-rangeplantar flexion after Achilles tendon repair. *Am J Sports Med* 2006 ; 34 : 1120-1125.
5. **Neumann D, Vogt L, Banzer W, Schreiber U.** Kinematic and neuromuscular changes of the gait pattern after Achilles tendon rupture. *Foot Ankle Int* 1997 ; 18 : 339-341.
6. **Rosso C, Buckland DM, Polzer C, Sadoghi P, Schuh R, Weisskopf L et al.** Long-term biomechanical outcomes after Achilles tendon ruptures. *Knee Surg Sports Traumatol Arthrosc* 2015 ; 23 : 890-898.
7. **Sadoghi P, Rosso C, Valderrabano V, Leithner A, Vavken P.** Initial Achilles tendon repair strength synthesized biomechanical data from 196 cadaver repairs. *Int Orthop* 2012 ; 36 : 1947-51.