

Macroscopic Anomalies and Pathological Findings in and Around the Achilles Tendon

Observations From 1661 Operations During a 40-Year Period

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Background: Nonsurgical treatments for chronic Achilles tendinopathy (AT) results in unpredictable success rates. Surgical treatment may be chosen as reports show mostly encouraging but variable success rates depending on the pathology. The distribution of surgically confirmed pathologies in AT is largely unknown.

Purpose: To ascertain the distributions of macroscopically observed anomalies in participants undergoing surgical treatment for chronic AT.

Study Design: Case series; Level of evidence, 4.

Methods: The main macroscopic pathologies of 1661 chronic Achilles tendon overuse injuries, which were diagnosed and surgically treated by a single surgeon, were reviewed. The surgeries were performed on professional and recreational athletes during the years 1976-1980, 1986-1990, 1996-2000, and 2006-2010. Surgical diagnoses, along with age- and sport-specific characteristics, were collected retrospectively from patient records.

Results: The relative proportion of tendinosis increased during the study period from 4.2% to 21%, and paratenonitis decreased from 50% to 26%. Retrocalcaneal pathologies were the most common surgically confirmed lesions at 30%, while the mean age at surgery increased by 11 years over the entire study period.

Conclusion: Surgically confirmed pathologies in and around the Achilles tendon showed coherent changes, chronic paratenonitis, and retrocalcaneal problems as the most prevalent findings. The classification of midportion and insertional tendinopathy and retrocalcaneal bursitis in AT should strictly be used as a clinical diagnosis. During surgical evaluations, the diagnosis is further clarified as more specific pathologies may be identified.

Keywords: Achilles tendon; overuse injuries; surgery; tendinopathy

Among chronic overuse injuries leading to surgery, disorders relating to the Achilles tendon are common in athletes.^{13,14,16,23} The descriptive terms *tendino-* and *paratendinopathy* are used widely in clinical diagnosis for

overuse-related problems in and around tendons.¹⁸ Locational prefixes and bursitis along with the suggestion of abandoning the use of Haglund eponyms and other terms related to retrocalcaneal deformities are encouraged.³³ The lesions found in Achilles tendinopathy (AT) are variable and often mixed.^{22,25} Thus, a preoperative clinical diagnosis must be confirmed via intraoperative findings.¹⁶ However, specific diagnoses such as tendinosis or paratenonitis are recorded only after histopathological confirmation.¹⁸ The macroscopic pathologies that are encountered in surgery include tendinosis, paratenonitis, partial rupture, Haglund deformity with or without retrocalcaneal bursitis, insertional calcific tendinopathy (insertional heel spur), and calcific tendinopathy of the main body of the tendon, either isolated or concomitantly.^{3,9,10,16,25,28,35} Rare conditions encountered in surgery for tendinopathy are the anomalous soleus, short Achilles tendon, and tendon xanthomas.

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In this study, we examined which lesions were encountered in surgically treated AT and whether the distribution of the lesions changed over time. There are currently no reports of changes in either surgical outcomes or surgically confirmed pathologies, although these would be expected after new nonsurgical treatments have developed.

MATERIALS AND METHODS

In this quadruple case series study, we retrospectively evaluated data from operations done for AT from 1976 to 2010 in 4 defined periods of time: 1976-1980 (group 1), 1986-1990 (group 2), 1996-2000 (group 3), and 2006-2010 (group 4). The search retrieved 1661 operations—some 400 for each 5-year period. Data for age, sports events, and intraoperative diagnosis were collected from patient records. The exclusion criterion was total tendon rupture.

All patients were professional or recreational athletes. The patient ethnicity was mainly Finnish, but several Spanish, Italian, and British patients also had surgery. Patients complained of pain that impaired normal activity in and around the Achilles tendon arising from training. All patients were previously treated with various nonsurgical measures prior to surgery, including rest; nonsteroidal anti-inflammatory drugs (NSAIDs); physical therapy with eccentric exercise; extracorporeal shockwave therapy; corticosteroid injections, platelet-rich plasma, high-volume saline injections; and shoe and training modifications. Treatment was administered either by the treating surgeon or by other medical professionals.

The modalities used to determine the preoperative diagnosis included clinical examination and different imaging methods (lateral radiography, ultrasound, Doppler ultrasound, magnetic resonance imaging, xerography, thermography, and dynamometry). The diagnosis of tendinopathy included insertional or midportion tendinosis, paratenonitis, bursitis, and abnormality (eg, exostoses). The results from surgery are presented in 1 of 4 categories: paratenonitis, tendinosis, retrocalcaneal pathology (ie, insertional calcific tendinopathy or Haglund heel, with or without associated retrocalcaneal bursitis), and other pathologies (including partial rupture, anomalous soleus muscle, tendon xanthomas, and short tendon). The surgical technique was adapted to the intraoperative findings. Most pathologies were diagnosed intraoperatively by macroscopic observation of the most prominent pathology. A tissue sample was only occasionally collected for histopathological analysis of unconventional lesions. The same surgical classification for diagnosis was used at all times.^{26,36}

RESULTS

The distribution of age, sports activities, and diagnoses are shown in Table 1. The relative number of patients with tendinosis has increased more than 4-fold (4.2% vs 21%), and chronic paratenonitis, in turn, decreased by half (50% vs 26%). Retrocalcaneal pathologies increased

TABLE 1
Distributions of Intraoperative Pathological Findings and Sports Activities (in Percentages) by Years of Collection

	Years of Collection			
	1976-1980	1986-1990	1996-2000	2006-2010
Age, y, mean (range)	28 (19-43)	33 (15-64)	35 (16-65)	39 (18-69)
Intraoperative findings, %				
Chronic paratenonitis	50	36.5	24.7	26
Tendinosis	4.2	9.8	13.4	21
Bursitis and heel problems	22	26	34	30
Other findings	23.8	27.7	27.9	23
Sports activities, %				
Endurance running	41	38	26	22
Sprinting or hurdling	17	14	12	11
Jogging	23	31	19	22
Ball games	11	10	23	28
Skiing events	6	4	2	3
Other sports	2	3	18	14

proportionally and were the most prevalent lesions in group 4 (22% vs 30% in the first and last groups, respectively). Over the study period, the patients' mean ages increased by 11 years (28 vs 39 years). Endurance running was the most prevalent event followed by jogging (41% and 23%, respectively) in group 1. Athletic activities showed a decrease in long-distance running and jogging to 22% each, with ball games the most common activity (28%) in group 4. Over the past 40 years, participation in sports activities other than those in the main categories increased 7-fold (2% vs 14%).

Consistent trends exist in 3 categories over each decade when comparing surgical findings in group 1 and 4: A 24% decrease in paratenonitis, a 17% increase in tendinosis, and an 8% increase in retrocalcaneal abnormalities was observed. At the same time, sports activities have changed, most notably in endurance running (19% decrease) and an increase in ball games (17% increase).

DISCUSSION

This is the first study to extensively examine macroscopic surgical findings in AT. Over the 40-year time frame, changes were observed in chronic Achilles tendon overuse injuries. Retrocalcaneal problems were the major complaint. A comparable study of detailed surgical findings in 150 cases of AT by Leppilahti et al¹⁶ found that paratenonitis occurred in approximately 29% of cases, tendinosis in 19%, retrocalcaneal bursitis in 22%, and various other problems in 29%. Paavola et al²⁵ later reported similar findings from a series of 432 surgeries, with distributions of 40% paratenonitis, 12% tendinosis, 25% retrocalcaneal problems, and 33% other pathologies.

Many mechanisms for the cause of degenerative tendinosis have been proposed, but the definite answer remains

elusive.^{17,27} We have observed a change in the character of recreational sports over the past few decades. Traditional sports in Finland used to constitute skiing and long-distance running. Endurance sports are decreasing in Finland, according to fitness profiles made in young men from 1975 to 2004,²⁹ and presently, a variety of sports with more dynamic pace and different loading on the Achilles tendon have become more popular. Intense training is started at younger ages and continues into old age. In contrast, physical activity as a whole and also in organized sport is decreasing among children in many countries.⁷ An intensive interest in sports that awakens later in life in these earlier inactive people might predispose to tendinosis, but this was not accounted for in this study.

Advances in nonsurgical treatment may lead to improvement or recovery of some tendinopathic lesions, thus postponing surgical treatment by several years or reducing the number of patients needing surgery. Eccentric exercises have made a substantial impact in the treatment of tendinopathy, generating well-established, successful results. These treatments began after Alfredson et al¹ published positive results in 1998, but our patients have participated in regular eccentric exercises since the year 2000.

The preliminary preoperative diagnosis is uncertain, but an adept orthopaedic surgeon can observe the tissue macroscopically at the time of surgery and confirm the diagnosis with histopathology, if necessary. In this series, the preoperative diagnosis was sometimes altered and occasionally found to be incorrect. Histologic specimens were not always studied, but most diagnoses were made by the observations of the clinician. We realize that lacking histopathological confirmation for all operated tendons (N = 1661) may have caused some over- and especially underdiagnosis, mainly with regard to microscopic tendinosis.^{3,11} Despite the possibility of undiagnosed degenerative tendinosis, the macroscopic extent of the lesions gives valuable information, especially when different surgical treatment modalities are evaluated.

In many reports, concurrent pathologies were not mentioned, even though we know the results of operations for paratenonitis, tendinosis, or insertional tendinosis can be remarkably different and isolated paratenonitis often yields the best outcome.[#]

Partial rupture is not identified as an isolated entity in AT in recent literature, despite recognition of this lesion.^{2-4,21,22,25} Macroscopic observations of partial AT rupture occurs more commonly in the distal portion of the Achilles tendon than tendinosis.² This has not, however, been observed in more recent reports of surgically managed distal AT. Histopathological studies found tendinosis in the partially ruptured part of the tendon.³ Histopathology revealed asymptomatic tendinosis, and other studies also found asymptomatic partial tendon tears.^{3,8,11}

The Haglund triad is another typical overuse injury in the athlete.³⁷ Prominence of the posterior superior corner of the calcaneus causes focal pressure on the retrocalcaneal space, inducing friction to the Achilles tendon and adjacent tissues, which causes retrocalcaneal bursitis. This bony

prominence may also be found in conjunction with insertional tendinopathy, ventral tendon tearing, and even insertional heel spurs.^{5,6,9,37}

The Achilles tendon has weightbearing characteristics and surrounding structures that are dissimilar to other tendons. Even so, tendinopathy of the Achilles tendon and other tendons is discussed as if these were the same conditions, despite differences in pathoanatomy.¹⁹ The histopathological classification for different types of AT is not completely compatible with the surgical diagnosis, which is more causal in definition of the problems of the Achilles tendon and posterior heel.

Until the pathophysiology of AT is solved and a cure for the primary cause for degenerative overuse injuries in the tendon is developed, surgery is the last option when nonoperative measures are exhausted. A clear surgical diagnosis is a prerequisite to reliably assess the outcomes. The techniques of choice, duration of healing, postoperative management, and final outcome depend on the quality and quantity of the lesions needing surgical interventions.^{12,25,30,34}

This study has several weaknesses. First, the diagnosis lacks validation with histopathological confirmation. The possible concomitant pathologies were not reported, and a correlation to magnetic resonance imaging was not done. The observed changes in surgical diagnoses include several confounding factors such as changed referral patterns, the surgeons' learning curve, and age- and sex-related changes that were not accounted for. Correlations between patient-specific factors as well as the results from different surgical techniques could have been educational. This task was unfortunately not undertaken in this study.

The changes in surgical diagnoses observed during this study period were merely observations by a single surgeon; however, the strength of this study resides in the use of the same classification system and indications for surgery over a long period of time. Our findings may have implications for targeting preventional measures and optimizing treatment strategies. Early surgery for retrocalcaneal problems should be evaluated in clinical studies, especially in problems related to retrocalcaneal deformities. Also, evaluation of tendinopathy in patients of different ethnicities may give a better understanding of differences in epidemiology. These findings have implications for new treatment agendas with the connotation that current nonsurgical treatments yield uneven relief for different causes of AT.

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