Various authors have recommended surgery for acute and chronic pathologic conditions associated with the Achilles tendon. Surgery about the Achilles tendon has been noted to have wound complication rates of 7% to 14% according to authors based in Europe. Decreased vascularity in the “watershed region” creates a risk of complications when operating on the Achilles tendon, despite good clinical results. Knowledge of the anatomy and incisional approaches may reduce complications. The infection rate in this area may be higher than in other parts of the foot and ankle, but the actual incidence of wound complications is not clear.

Previous studies have documented some of the complications encountered, although the authors have been European based. Williams reported a complication rate of 14% (64 of 461) in patients with surgery for Achilles tendon problems. Problems related to wound healing accounted for 89% of the complications. There were 26 hypertrophic scars, 19 wound dehiscences, five infections, one suture abscess, and six “other” scar problems. Williams did not differentiate between infection types.

In a review of the literature by Cetti et al., the overall complication rate in 4,083 surgically treated complete Achilles tendon ruptures was 12%. The rates of major (repeated rupture and suture granuloma) and minor (scar adherence) surgical complications were...
4% and 8%, respectively, and half of the minor complications were superficial wound problems. In their own study, Cetti et al found fewer repeated ruptures with surgically repaired tendons but more of other complications, such as infection. This is understandable because nonoperated tendons should not be exposed to infection.

Paavola et al reported a total complication rate of 11% (46 of 432) in patients treated surgically for Achilles tendon injury. Surgical procedures included tendon rupture repair, debridement, peritenolysis, bursectomy, and retrocalcaneal exostectomy, similar to the present study. Thirty patients experienced minor complications: superficial wound infection, seroma formation, hematoma formation, and sural nerve irritation. Delayed wound healing appeared more frequently in patients with a partial Achilles tendon rupture, and we hypothesized that the increased frequency was caused by the extensive postoperative thickening of the Achilles tendon, followed by abnormal stretching and impaired local circulation of the skin. They also cautioned against using a tourniquet, which can lead to delayed wound healing, and recommended using drainage to avoid the formation of excessive hematoma.

Bruggeman et al conducted a retrospective study to identify risk factors for wound complications with surgical repair of Achilles tendon rupture. They reported an overall wound complication rate in 164 patients of 10.4%. They evaluated potential risk factors, including age, sex, time from injury to surgery, use of tobacco, diabetes mellitus, corticosteroid use, and body mass index. Log-rank tests were used to compare the rates of postoperative wound complications among groups. The risk ratio was calculated by dividing the rate of wound complications for one group by that for a second group. They reported that the risk of smokers to have wound complications is 8.1 times that of nonsmokers. Corticosteroid use increased the risk of wound complications by 6.8 times. Diabetes mellitus increased the risk of wound complications by 3.4 times.

Because the reports in the literature are based on European populations using, in some cases, different techniques and suture materials, we proposed to study our results. The purpose of this study is to evaluate the results of one surgeon based in the United States for the incidence of wound complications after surgery on and about the Achilles tendon. We studied the incidence of suture reactions and granulomas, particularly in light of the fact that newer materials are being promoted for tendon repair and that there may be differences between Europe and the United States.

**Materials and Methods**

Patients who underwent surgery on the Achilles tendon and its insertion at least 6 months before the present study was undertaken were retrospectively studied. We believe that 6 months is a reasonable timeframe because patients are able to return to activity by that time. Medical record reviews and telephone interviews were conducted of a single surgeon’s (A.S.) patients who underwent surgery between January 1, 1990, and December 31, 2005, by a research assistant not involved with the index procedure. While interviewing the patients after reviewing the medical records, patients were asked whether they experienced any of the complications that were studied or if they needed any additional treatment after their index surgery. A spreadsheet (Microsoft Excel; Microsoft Corp, Redmond, Washington) was maintained by the senior author and surgeon (A.S.). This spreadsheet included data such as patient age and sex and the date the procedure was performed. In addition, for this study of wound complications, data were recorded as to whether the patients experienced infections, suture reactions, symptomatic scarring, peri-incisional neuromas, or delayed suture granulomas requiring excision. This study was initiated before institutional review board approval was mandatory. Health Insurance Portability and Accountability Act compliance was achieved for all surgical procedures performed after April 30, 2003. Informed consent was obtained from all of the patients.

Patients were excluded if their follow-up notes, outcome, or contact information were not available. Other than routine contraindications to any elective surgery, such as unstable health, infection, and a poor support system, there were no other exclusion criteria. Patients were included in this study if they had been operated on for the management of acute and chronic rupture repair, peritenolysis, tenodesis, debridement, retrocalcaneal exostectomy/bursectomy, or the management of calcific Achilles tendinopathy or Haglund’s condition. Additional data were required to fulfill the inclusion criteria.

The inclusion criteria included the availability of typical demographic information: patient sex and age, procedure performed, location of incision, and risk factors for wound healing, such as diabetes mellitus, tobacco use, and corticosteroid use. These factors were chosen because we wanted to see how this series compared with other large series of Achilles tendon surgery. Data collected included the presence of postoperative infection and dehiscence, hematoma, suture reactions (including delayed granuloma reac-
approximated using buried simple interrupted 2-0 Vicryl (Ethicon, Somerville, New Jersey) stitches. The superficial subcutaneous tissue is often closed using simple interrupted 3-0 Monocryl (Ethicon) stitches, and the skin is closed using running subcuticular 3-0 Prolene (Ethicon) or nylon sutures.

Postoperative Course

Insertional Achilles (Calcific) Tendinopathy and Retrocalcaneal Exostectomy. Patients were non-weightbearing for 4 weeks postoperatively. The limb was placed in a below-the-knee posterior splint or a cast boot with gravity equinus immediately postoperatively. Patients returned for a first postoperative visit after 2 to 7 days. An appropriate sterile dressing change was performed. Patients were then placed in a below-the-knee synthetic cast or cast boot for 2 to 3 weeks. Skin sutures were removed 2 to 3 weeks postoperatively. Patients were again placed in a below-the-knee cast boot, and at 4 weeks they began partial to full weightbearing. A 6-mm heel wedge was maintained until 6 weeks postoperatively, and patients were allowed to remove the boot for bathing, active ankle range-of-motion exercises, and cryotherapy. The cast boot was worn for ambulation until 10 to 12 weeks postoperatively and was discontinued only when patients were pain free on ambulation. Physical therapy was initiated 10 weeks postoperatively.
**Achilles Peritenolysis, Debridement, and Rupture Repair.** Patients were nonweightbearing for 1 to 3 weeks postoperatively. The limb was placed in a below-the-knee posterior splint or cast boot with the ankle joint at the neutral position for peritenolysis. Patients whose Achilles tendon was debrided and those who underwent surgery for a rupture had their foot placed in an equinus position. Patients returned for the first postoperative visit in 2 to 5 days, when an appropriate sterile dressing change was performed. The patient was then placed in a below-the-knee synthetic cast or cast boot. Patients with peritenolysis maintained the boot for 2 weeks. Patients undergoing debridement maintained the boot for 6 weeks with a 6-mm heel wedge. Patients undergoing rupture repair used the boot for 8 weeks with a gradually reduced heel wedge from 18 mm (2 weeks postoperatively) to 6 mm (by week 8). Skin sutures were removed 2 to 3 weeks postoperatively. Physical therapy was initiated 6 to 8 weeks postoperatively for patients with debridement and rupture and at 2 to 3 weeks for those undergoing peritenolysis, although all of the patients began active range-of-motion exercises by 3 weeks.

**Statistical Analysis**

Statistical significance was set at \( P < .05 \). A freeware package (Stat-Sak; G.E. Dallal, Malden, Massachusetts) was used to determine the Fisher exact test for increased complications associated with sex, procedure, and other risk factors.

**Results**

Of 224 patients, 210 (140 males and 70 females; mean ± SD age at the time of surgery, 46.5 ± 12.6 years; age range, 16–75 years) fulfilled the inclusion criteria and were available for review. A total of 175 patients had a minimum of 2 years of postoperative follow-up. One hundred forty patients were athletic, and seven were sedentary; the remainder were active with daily and noncompetitive sports. Seventy patients underwent surgery to their Achilles insertion for calcific tendinopathy or avulsion, 42 underwent debridement for tendinopathy of the main body of the Achilles tendon, 38 had retrocalcaneal exostectomy, 29 had peritenolysis, 26 underwent surgery for repair of an acute rupture, and 14 had repair of a chronic rupture or excision of a calcific tendinopathy lesion. There was no association between the procedure and the increased likelihood of a wound complication (\( P = .79 \)).

Two patients smoked tobacco before surgery and quit perioperatively. Two patients were diabetic, and two patients with rheumatoid arthritis used prednisolone orally preoperatively. Using the Fisher exact test, three patients were more likely than the remaining cohort to have a wound complication (\( P = .03 \)). There were 13 patients (ten males [4.6%] and three females [0.9%]) with 22 complications. There was no significant difference in the number of complications by sex using the Fisher exact test (\( P = .34 \)). In the 219 procedures, there were 22 complications (10.0%) sustained by 13 patients (7.3%).

Seven postoperative infections (3.2%) occurred, including one in a patient with rheumatoid arthritis who experienced severe dehiscence in a previously ruptured Achilles tendon repaired at a different institution (Fig. 2). He required revision via a peroneus brevis tendon transfer. Six patients experienced suture reactions, five of whom required simple excision of absorbable sutures. One patient required an advancement flap to allow coverage of the defect without tension (Fig. 3). One patient had a significant reaction to nonabsorbable polyester sutures; he was one of three patients (1.4%) who had keloid formation (Fig. 4).

Delayed granulomas occurred in six patients (2.7%), mostly associated with nonabsorbable polyester sutures, and all became clinically evident more than 6 months after the index procedure. Seven patients required additional surgery after their wound complication. Two patients with suture granulomas required major wound revision, one with a flap. The remainder

![Figure 2. A patient with rheumatoid arthritis who developed dehiscence secondary to infection after a flexor hallucis longus tendon transfer for a chronic Achilles tendon rupture. This wound was infected and was treated with antibiotics, and the patient subsequently underwent revisional surgery with peroneus brevis tendon transfer.](image)
had excision of the offending sutures and associated granulomatous tissue.

Discussion

In surgical repairs of the Achilles tendon, the wound complication rate ranges from 7.0% to 13.6%, and the deep infection rate from 2.5% to 4.0%.8 A summary of the complications found in other studies is given in Table 1. The most common wound complications associated with Achilles tendon surgery include infection and “wound dehiscence.”2, 6, 8, 11 The infection rate in the present series is 2.7% versus 1.1% (Williams8), 2.5% (Paavola et al12), and 3.0% (Bruggeman et al11).

Suture reaction and delayed granuloma have been studied by some authors. In the present series, we had an incidence of 2.7% (six cases) each of suture reactions and delayed granulomas. Bruggeman et al11 experienced suture granulomas in 3.0% of their cases (n = 5). There is some confusion in the literature, and we are not sure whether what we consider to be a suture reaction is instead considered by other authors to be a superficial infection. This should be better delineated in future studies.

All suture materials can cause immunologic and inflammatory reactions locally at the suture site.22 Absorbable sutures generally generate more reaction than nonabsorbable ones. Furthermore, the reaction is stronger with multifilamentous compared with monofilamentous sutures, more with absorbable sutures, and positioning at superficial instead of deep tissue planes.20 The lack of fat in the Achilles region to hydrolyze absorbable sutures is likely to play a role and should be further studied.

Niessen et al20 demonstrated that in patients undergoing breast reduction, monofilamentous poliglecaprone 25 (Monocryl) gave significantly smaller, less reactive scars with a lower tendency toward hypertrophic scar formation compared with multifilamentous polyglactin 910 (Vicryl Rapide; Ethicon). Gabriell

Table 1. Distribution of Wound Complications by Type Studied by Other Authors

<table>
<thead>
<tr>
<th>Abbreviation: NS, not stated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note: The authors do not explicitly state whether skin necrosis, seroma, hematoma, or suture granulomas are also infected.</td>
</tr>
</tbody>
</table>
li et al\textsuperscript{21} demonstrated that in patients undergoing plastic surgery, polylactin 910 (Vicryl) and silk moderately increase the risk of tissue reactivity compared with polyglycolic acid (Dexon; Syneture, Norwalk, Connecticut). Because suture granulomas occurred after a delayed period postoperatively, further long-term study is needed to properly assess this finding. Even with our follow-up, more suture granulomas could occur, in a delayed manner.

Bruggeman et al\textsuperscript{11} found that female sex increased the risk of wound complications by 2.7 times. This finding may be associated with the fact that in the study by Saxena and Cheung\textsuperscript{15} of 91 surgical procedures for chronic Achilles tendinopathy, women took significantly longer to return to activity than men, 18.6 versus 12.2 weeks overall. In the present study, however, this was not the case with wound complications. In this study, there is a five-fold difference in males with wound complications versus females.

The rate of wound complications can be lowered by meticulous handling of the soft tissues, minimizing the use of suture material in or about the tendon. Less tension on the skin may be beneficial.\textsuperscript{7, 15, 22} Despite this, early weightbearing of acute ruptures at 1 week versus 3 weeks does not seem to have a detrimental effect.\textsuperscript{17} Regarding postoperative hematoma, these results support those of Paavola et al.\textsuperscript{12} None of the present patients had a hematoma.

A weakness of this study is that it is a retrospective review. However, most other studies of large series of Achilles tendon surgery are retrospective as well. Another weakness is that this study looks at procedures performed by a single surgeon, although this eliminates surgeon variability. The complications themselves are not often defined similarly in various studies, so some comparisons may be misleading. For example, other studies’ definitions of suture reaction, infection, or “scarring” may vary. Some procedures themselves may be more likely to sustain complications, but larger series and longer follow-up are needed to adequately document this. With granulomas occurring in a delayed manner, longer follow-up would help in this regard as well. In general, more uniform documentation would help surgeons understand all of the potential wound complications with Achilles tendon surgery and their incidences.

**Conclusion**

Achilles tendon surgery is associated with complications. The overall complication rate in this study is 7.3\% and includes infection, dehiscence, and suture granulomas, the latter of which can manifest in a delayed manner (>6 months) and occur with absorbable and nonabsorbable sutures. These complications may not be entirely avoidable when surgically addressing the Achilles tendon.

**Financial Disclosure:** None reported.

**Conflict of Interest:** None reported.

**References**


