

# Distal Biceps Tendon Rupture Surgery: Changing Incidence in Finnish and Swedish Men Between 1997 and 2016

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**Purpose** Distal biceps tendon rupture is a relatively rare injury usually occurring with excess external extension force applied to a flexed elbow. The aim of this study was to examine the incidence of distal biceps tendon rupture surgery in the Finnish and Swedish adult population between the years 1997 and 2016. A secondary aim was to investigate the distal biceps rupture incidence in the Swedish population in 2001 to 2016.

**Methods** We assessed the number and rate of distal biceps tendon rupture surgery using the Finnish and Swedish Hospital Discharge Register as databases. The study included the entire Finnish and Swedish adult population aged 18 years and older between January 1, 1997 and of December 31, 2016.

**Results** During the study period, 2,029 patients had a distal biceps tendon rupture in Finland, and the corresponding figure was 2,000 in Sweden. The rate of distal biceps tendon rupture surgery increased steeply, but equally, in both countries, in Finnish men from 1.3 per 100,000 person-years in 1997 to 9.6 in 2016, and in Swedish men from 0.2 in 1997 to 5.6 in 2016. The incidence of distal biceps tendon rupture in Sweden increased in men from 1.6 to 10.0 per 100,000 person-years from 2001 to 2016.

**Conclusions** There was a 7-fold and a 28-fold increase in the incidence of distal biceps tendon rupture surgery in Finnish and Swedish men during 1997 to 2016. The incidence of distal biceps tendon rupture rose 6-fold in Swedish men in 2001 to 2016. (*J Hand Surg Am.* 2020;45(11):1022–1028. Copyright © 2020 by the American Society for Surgery of the Hand. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

**Type of study/level of evidence** Prognostic IV.

**Key words** Distal biceps rupture, incidence, national database, rate of surgery.

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**D**ISTAL BICEPS TENDON RUPTURE is a relatively rare injury, which usually occurs when an excess external extension force is applied to a flexed elbow. The majority of the patients are otherwise healthy middle-aged men.<sup>1</sup> The clinical signs of the rupture include sudden elbow and forearm pain with weakness in elbow flexion, especially in forearm supination.

Only a few publications on the incidence of distal biceps tendon rupture exist. Safran and colleagues<sup>1</sup> published results from a defined group of patients between 1994 and 1998 and reported a rupture incidence of 1.2 per 100,000 person-years in the United States. Most of the patients were men between 30 and 49 years.<sup>1</sup> A recent publication from Kelly et al,<sup>2</sup> also from United States, showed a surgical rate for distal biceps or triceps ruptures of 2.6 per 100,000 person-years between 2006 and 2010, most of the patients again being men from 35 to 54 years.

Risk factors for distal biceps rupture have been found to be smoking and elevated body mass index.<sup>1–3</sup> It has been suggested that, as in Achilles tendon injury,<sup>4</sup> a predisposing factor might be a degenerative process in the distal biceps tendon. Diabetes has been shown to be associated with Achilles and rotator cuff tendinopathy.<sup>5,6</sup> However, it does not seem to increase the risk of the distal biceps tendon rupture.<sup>2</sup>

There are no randomized controlled trials (RCTs) comparing surgical and nonsurgical treatment. Instead, the RCTs have assessed the number of incisions (1 or 2 incisions) and the choice of surgical implant.<sup>7–9</sup> Thus, the optimal treatment for the distal biceps tendon rupture is unknown, although case series in the literature suggest that patients sustaining this injury might benefit from surgical treatment.<sup>10</sup>

The primary aim of this study was to examine the rate of distal biceps tendon rupture surgery in an adult population between 1997 and 2016. The secondary aim was to determine the distal biceps rupture incidence in 2001 to 2016. The objective of the study was to investigate the incidence of distal biceps tendon rupture in countries with publicly funded and registered health care systems, making the incidence numbers valid because the health care systems encompass the entire country.

## MATERIALS AND METHODS

Our study included both the entire Finnish and the entire Swedish adult populations 18 years and older, between January 1, 1997 and December 31, 2016. The size of the Finnish adult population, according to

Official Statistics of Finland, was 4.0 million in 1997 and 4.4 million in 2016. Respective figures for Swedish adult population were 7.0 million in 1997 and 7.9 million in 2016. Surgically treated patients of the study were obtained from an electronic registry, the National Hospital Discharge Register of Finland (NHDR) and the Swedish Hospital Discharge Register (SHDR). They include all patients admitted to any hospital in both Finland and Sweden. Starting from 2001, the SHDR also recorded outpatient visits, which were, however, lacking from the Finnish NHDR. However, all day-surgery operations are included in the NHDR.

The coverage and accuracy of the NHDR and SHDR have been shown to be excellent.<sup>11–14</sup> In both countries, public health care, including surgical treatment, is equally available for all citizens. Contribution of data to NHDR and SHDR is mandatory for all hospitals, both public and private.<sup>15,16</sup>

The NHDR and the SHDR datasets contain information on patients' age, sex, place of residency, length of hospitalization, diagnoses, and surgical procedures performed during the hospital visit. The 10th revision of the International Classification of Diseases (ICD-10) has been in use in Finland since 1996 and in Sweden since 1997.

The primary outcome variable in this study was the rate (per 100,000 person-years) of surgical treatment of patients with a diagnosis of distal biceps tendon rupture. Only the first procedure for each individual was recorded. The ICD-10 codes used solely for distal biceps rupture were S46.2 in Finland and S46.8 in Sweden (injury of biceps muscle or tendon, excluding S42.1—Injury of long head of biceps). Corresponding NOMESCO (Nordic Medico-Statistical Committee) classification for surgical procedure codes used for biceps operations in Finland and Sweden were NBL19, NBL30, NBL68, NBL99, NCL19, NCL20, NCL32, NCL40, and NCL64.<sup>17</sup> The patients selected for the final analysis had to have both the pertinent ICD-10 diagnosis and NOMESCO procedural codes.

The secondary outcome measure was the total incidence of the distal biceps rupture, as a primary or secondary diagnosis, in the hospital or as outpatients in Sweden. This secondary outcome was possible to assess in Sweden because, since 2001, outpatient visits have also been recorded by the SHDR.

## Statistical analysis

When calculating the binational sex- and age-specific rates of distal biceps tendon rupture

**TABLE 1. Mean Age (SD) of Patients Treated Surgically for a Distal Biceps Tendon Rupture, Divided by Country and Year**

	1997	2016
Male Finland	45.8 (SD, 8.2)	47.1 (SD, 9.7)
Female Finland	46*	40 (SD, 7.1)
Male Sweden	48 (SD, 14.1)	46 (SD, 9.2)
Female Sweden	56 (SD, 14.8)	60 (SD, 8.4)

\*Only 1 female was operated in 1997; SD not available.

surgery and national distal biceps rupture incidence in Sweden, the annual midyear populations were obtained from the Official Statistics of Finland and Sweden, the statutory, computer-based population registers maintained by the 2 countries. Because the incidences were calculated using the entire adult population instead of a cohort or sample, no statistical probability estimation methods were used. This was in full accordance with our previous nationwide studies.<sup>14,18–20</sup>

## RESULTS

During the study period between 1997 and 2016, 2,029 patients were operated on for a distal biceps tendon rupture in Finland, and the corresponding figure in Sweden was 2,000. The annual number of operations increased steadily in both countries, in Finland from 26 patients in 1997 to 215 in 2016, and in Sweden from 12 patients in 1997 to 228 in 2016. The majority of the patients were men ( $n = 1,972$ , 97% in Finland;  $n = 1,943$ , 97% in Sweden). The mean (SD) age of the patients by country and year is shown in Table 1.

The rate of distal biceps tendon rupture surgery increased steeply, but equally, in both countries, in Finnish men from 1.3 (per 100,000 person-years) in 1997 to 9.6 in 2016 (Fig. 1), and in Swedish men from 0.2 in 1997 to 5.6 in 2016 (Fig. 2). In women, the corresponding figures were low without a clear change (0.1 in 1997 and 0.3 in 2016 in Finland, and 0.2 in 1997 and 0.2 in 2016 in Sweden).

During the period between 2001 and 2016, 4398 patients were diagnosed with distal biceps tendon rupture in Sweden. The annual number was 55 in 1997 and it increased to 420 in 2016. Thus, the incidence increased during the study period; in men, the increase was 6-fold from 1.6 to 10.0 per 100,000 person-years from 2001 to 2016. Respective figures for women were 0.06 and 0.6 (Fig. 3). The mean age of the male patients diagnosed with biceps rupture was 46 years (SD, 12.4) in 2001 and 47 years (SD, 11.7) in 2016.

Corresponding figures for women were 58 years (SD, 13.4) in 2001 and 62 years (SD, 17.7) in 2016.

Combining the Swedish data from incidence and rate of surgery was possible between the years 2001 and 2016. Figure 4 shows the increased and symmetrical trend from both per 100,000 person-years.

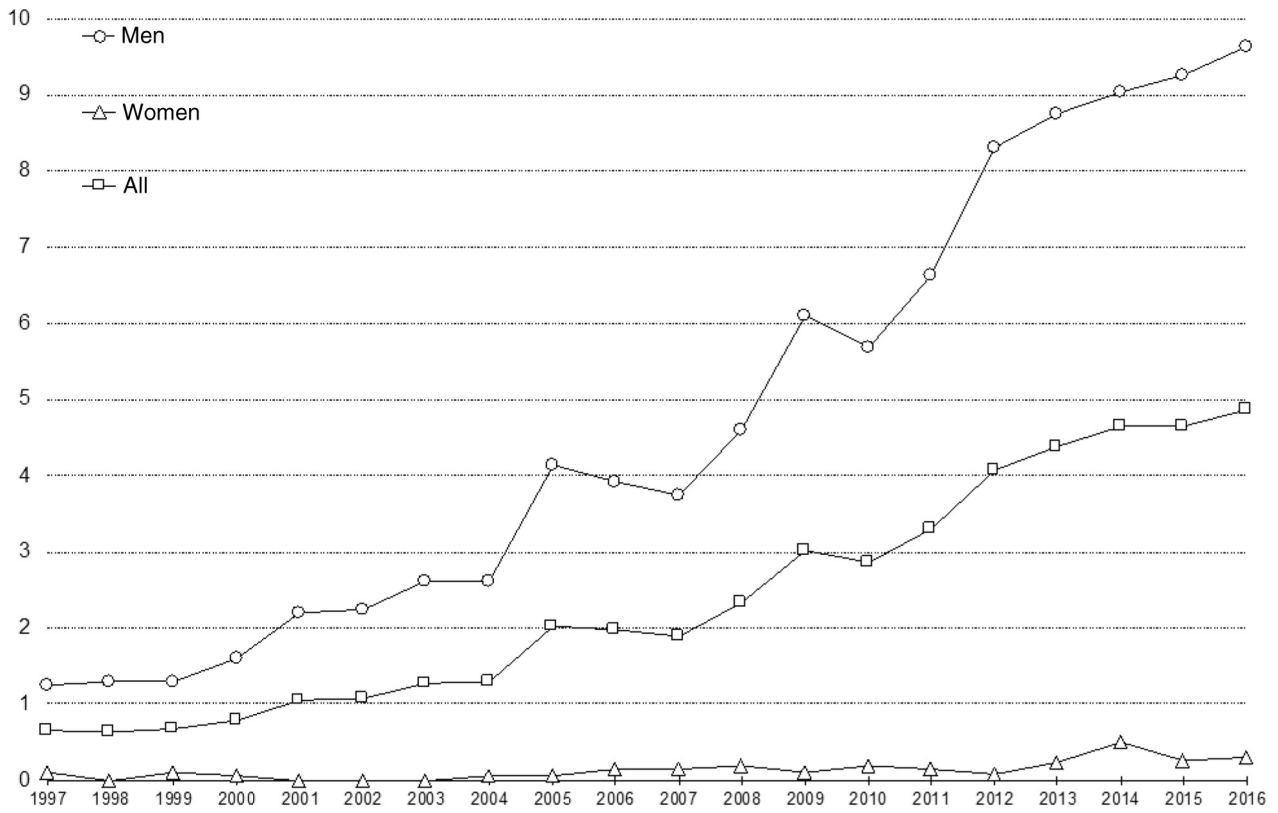
## DISCUSSION

This population-based analysis relied on the single-payer medical system, in which all citizens are publicly covered with free-of-charge health care. Previous analyses have been subpopulations in contrast to the present study that shows whole binational results for distal bicep injury and surgery. The main finding of our study was the 7-fold and 28-fold increase in rate of the surgery for distal biceps tendon rupture in Finnish and Swedish men during the 20-year study period from 1997 to 2016. Interestingly, the actual incidence of distal biceps rupture seemed to increase in Sweden as well. The reasons for this increasing incidence of rupture are not known but a similar phenomenon has been seen in the Achilles tendon.<sup>12</sup>

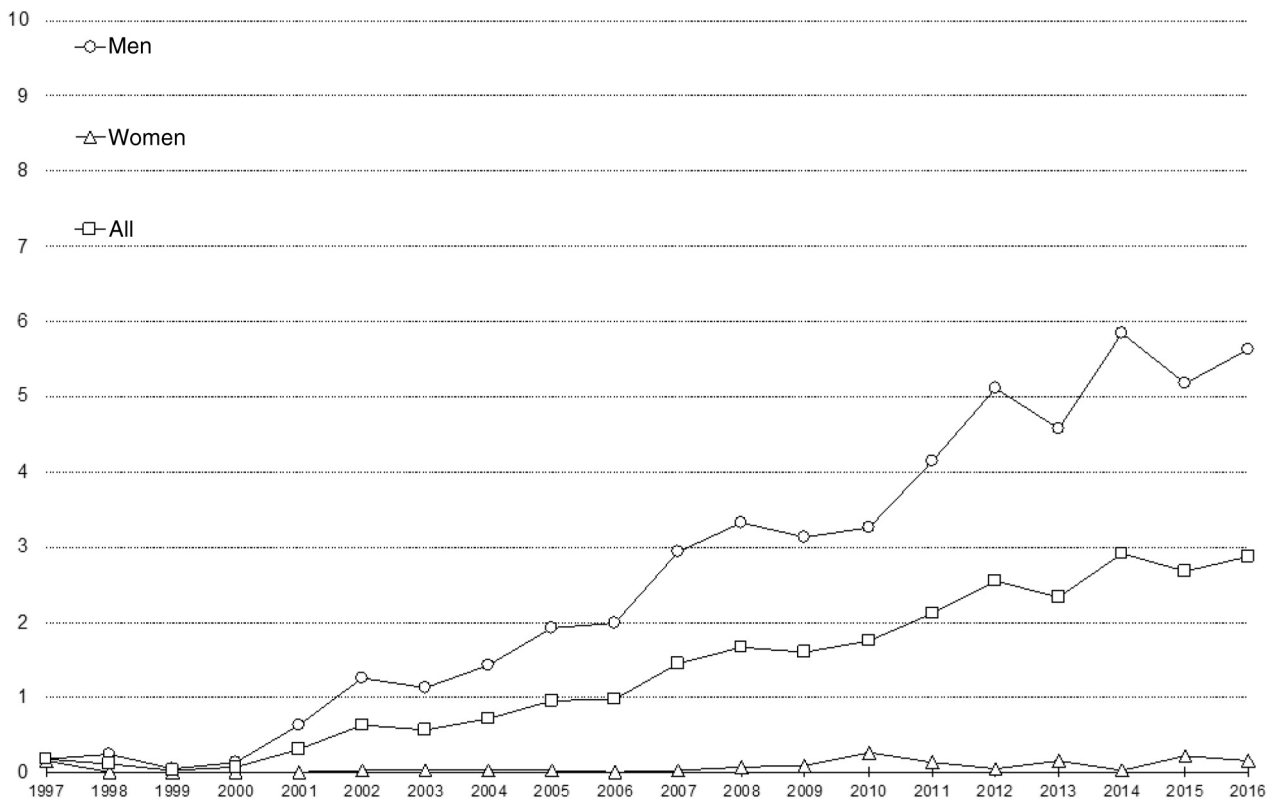
In the literature, there are only a few publications concerning the incidence of distal biceps rupture and the rate of surgery.<sup>1,2</sup> In 2002, Safran and Graham<sup>1</sup> reported a rupture incidence of 1.2 per 100,000 persons in the United States (in an area defined by zip code). In 2015, Kelly et al<sup>2</sup> reported a surgery rate of 2.55 per 100,000 U.S. persons from a national database containing both public and private insurance patients. The observed surgery rates in our study conducted in Finland and Sweden are markedly higher. The reason for the difference is not known, but most likely, the differences between the insurance (single-payer and multipayer) and health care systems between the regions (Scandinavia and North America) are, at least partly, responsible.

The overall incidence of distal biceps tendon rupture seems to have reached a plateau in Sweden during the last years studied; however, this needs further research. Even though the total incidence of rupture remained at the same level during the last years, surgery in Sweden continued to rise. This might be due to the better availability of magnetic resonance imaging and improved surgical techniques.

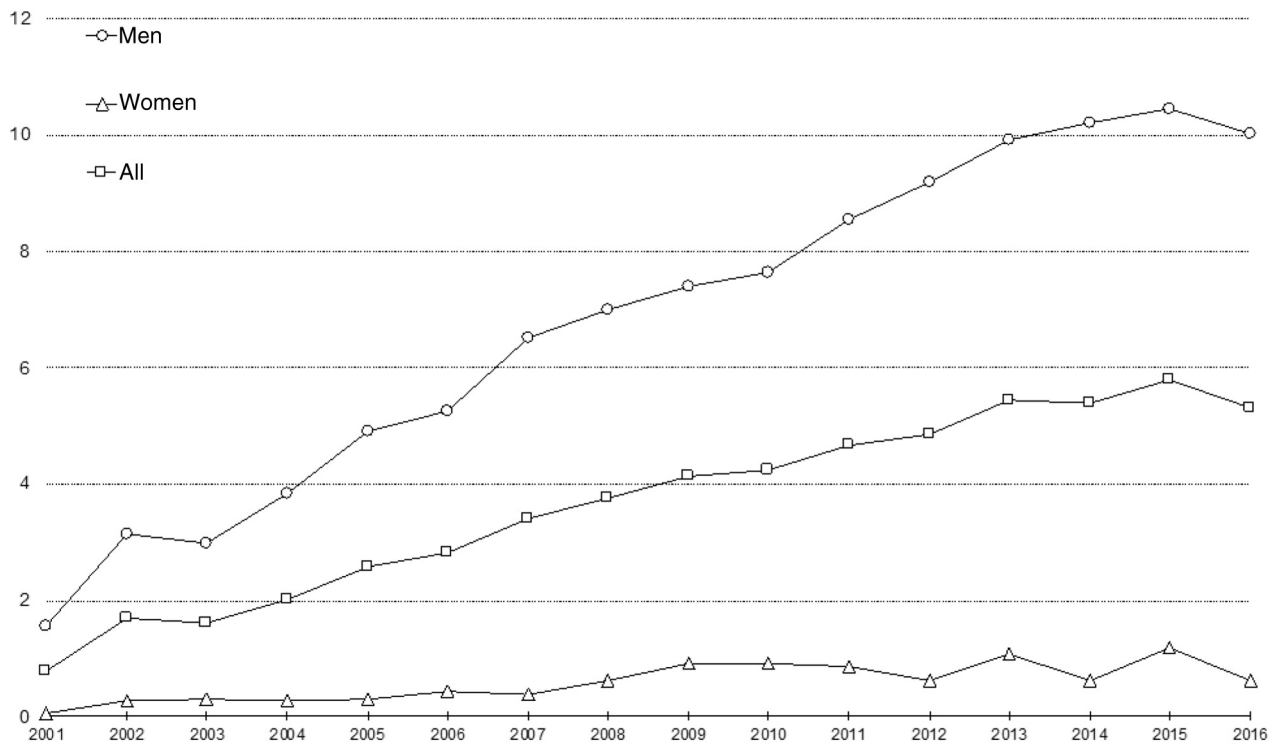
There are several possible reasons for the increased incidence in ruptures and surgical treatments of the distal biceps tendon. First, the accuracy of diagnosis, and especially the accessibility of modern imaging technology, may have made the diagnosis easier and most likely decreased the delay between the injury and the diagnosis. Imaging is performed often and



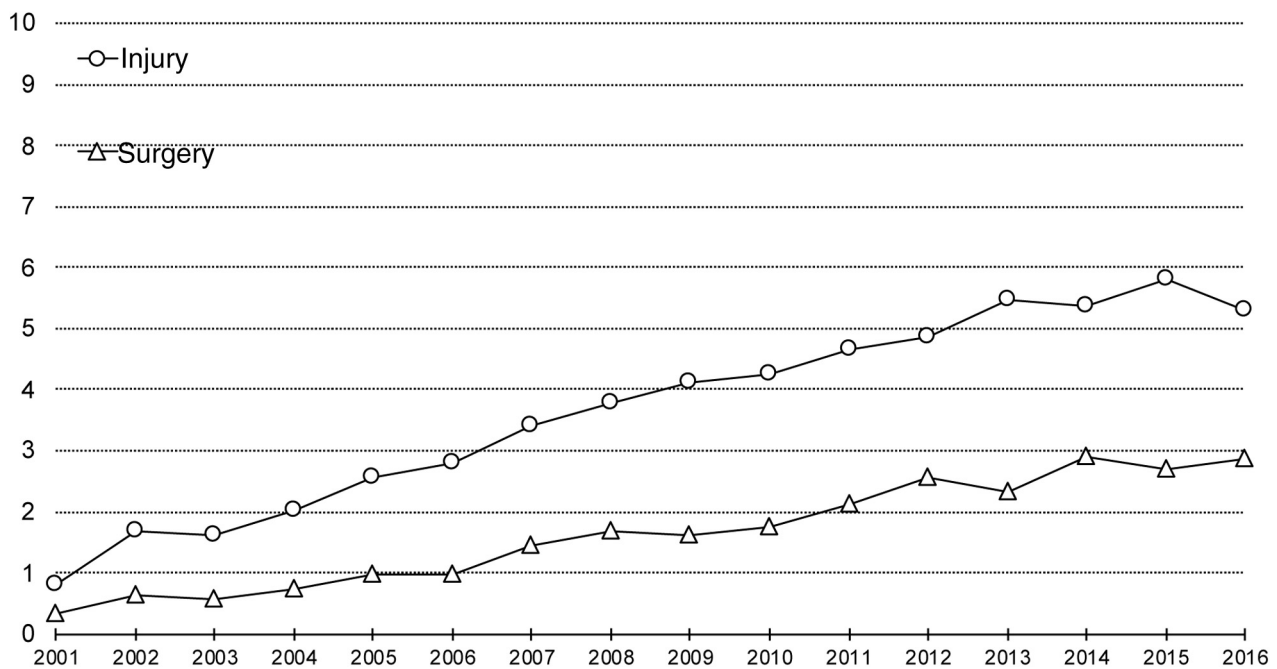
**FIGURE 1:** Rate of surgical treatment (per 100,000 person-years) of distal biceps tendon rupture in Finland between 1997 and 2016.



**FIGURE 2:** Rate of surgical treatment (per 100,000 person-years) of distal biceps tendon rupture in Sweden between 1997 and 2016.



**FIGURE 3:** Incidence of distal biceps tendon rupture (per 100,000 person-years) in Sweden between 2001 and 2016.



**FIGURE 4:** Incidence rate and rate of surgical treatment of distal biceps tendon ruptures (per 100,000 person-years) in Sweden between 2001 and 2016.

magnetic resonance imaging has replaced ultrasound as the gold standard. Second, current patients might be more demanding and more interested in full recovery, and therefore, the surgical options may be more likely to be offered by attending surgeons. Public perception

toward surgical treatment is often positive, although the evidence for the superiority of surgical treatment is often lacking.<sup>21</sup> Third, increased physical activity among middle-age people (often with degenerative tendinopathy) may have resulted in a greater total



number of ruptures in the general population leading to increased surgical activity. These phenomena have been suggested to explain the increase in Achilles tendon ruptures, and possibly supraspinatus tendon rupture surgery in the shoulder.<sup>12,22,23</sup> We found that surgical activity is higher in Finland than in Sweden. Increased surgical activity of degenerative diseases in Finland has been previously published with respect to degenerative knee arthroscopy and Achilles tendon rupture surgery, showing the same difference toward a more conservative approach in Sweden.<sup>12,13,20</sup> The reason for this phenomenon is not known, even though the health systems and training are equal in both countries.

The NHDR and SHDR databases have been proven to be accurate with excellent coverage.<sup>14,15,19</sup> A strength of the present study is also the combination of 2 national registers (altogether a population of 12 million) in Nordic countries with public, and essentially free, health care. In addition, both registers also include the private sector health care along with the public one. The SHDR contains both inpatient and outpatient diagnoses, and hence, the total incidence of diagnosed distal biceps tendon rupture could be determined at a national level.

The weakness of the study is the unknown number of patients who incurred rerupture of the distal biceps tendon. However, although the literature on reruptures is scarce, rates of rerupture appear to be low and, therefore, would not be expected to have a major effect on our main results. Another weakness of the present study is that the coding of the injuries was done by the treating physicians (eg, primary care physicians and not necessarily an orthopedic surgeon), and therefore, the accuracy of injury coding is dependent on the clinical diagnosing skills of the treating physician. In addition, for the same reason, partial ruptures and complete ruptures may not have been differentiated in the data.

The efficacy of surgical treatment compared with nonsurgical treatment in the distal biceps tendon ruptures has never been tested in a randomized study. High-quality RCTs on the treatment of trauma, and most orthopedic conditions, are needed to identify optimal treatment. Similar phenomena have previously been seen in Achilles tendon and degenerative meniscus ruptures.<sup>20,24,25</sup>

In conclusion, we observed 10.0 per 100,000 person-years incidence of distal biceps tendon rupture for Swedish men in 2016 (a 6-fold increase from 2001), and the 7-fold and 28-fold increases in the distal biceps tendon rupture surgery in Finnish and Swedish men, respectively, between 1997 and 2016.

The exact reasons for the rises are unknown, but improved imaging of the rupture, increased physical activity, rising demands of middle-aged people for treatment, and increased surgical activity in general may play a role.

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