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Am J Sports Med. Author manuscript; available in PMC 2015 July 28.

Published in final edited form as:

Am J Sports Med. 2015 May ; 43(5): 1066–1071. doi:10.1177/0363546514568087.

The Epidemiology and Health Care Burden of Tennis Elbow:

A Population-Based Study

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Investigation performed at the Mayo Clinic, Rochester Minnesota, USA

Abstract

Background—Lateral elbow tendinosis (epicondylitis) is a common condition both in primary care and specialty clinics.

Purpose—To evaluate the natural history (ie, incidence, recurrence, and progression to surgery) of lateral elbow tendinosis in a large population.

Study Design—Descriptive epidemiology study.

Methods—The study population comprised a population-based incidence cohort of patients with new-onset lateral elbow tendinosis between January 1, 2000, and December 31, 2012. The medical records of a 10% random sample (n = 576) were reviewed to ascertain information on patient and disease characteristics, treatment modalities, recurrence, and progression to surgery. Age- and sex-specific incidence rates were calculated and adjusted to the 2010 US population.

Results—The age- and sex-adjusted annual incidence of lateral elbow tendinosis decreased significantly over time from 4.5 per 1000 people in 2000 to 2.4 per 1000 in 2012 (P <.001). The recurrence rate within 2 years was 8.5% and remained constant over time. The proportion of surgically treated cases within 2 years of diagnosis tripled over time, from 1.1% during the 2000–2002 time period to 3.2% after 2009 (P <.00001). About 1 in 10 patients with persistent symptoms at 6 months required surgery.

Conclusion—The decrease in incidence of lateral elbow tendinosis may represent changes in diagnosis patterns or a true decrease in disease incidence. Natural history data can be used to help guide patients and providers in determining the most appropriate course at a given time in the disease process. The study data suggest that patients without resolution after 6 months of onset may have a prolonged disease course and may need surgical intervention.

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One or more of the authors has declared the following potential conflict of interest or source of funding: J.S. has received reimbursement for attending a symposium and consulting fees and is an employee of Tenex Health; B.F.M. is medical director for a company (Tenex Health) that offers a procedure for soft tissue problems, including tendinopathy. This study was funded by internal funds from the Mayo Clinic and was made possible by the Rochester Epidemiology Project, supported by the National Institute on Aging of the National Institutes of Health under award number R01AG034676.

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Keywords

lateral epicondylitis; lateral elbow tendinosis; incidence; recurrence; tennis elbow

Lateral elbow tendinosis (epicondylitis) or *tennis elbow* is a commonly seen condition in general practice clinics and has been reported to affect 1% to 3% of adults each year.[1,14] However, most data on the incidence of lateral elbow tendinosis come from studies in individual practices, rather than more comprehensive population-based studies. Therefore, the true incidence and the natural history of this condition remain largely unknown. While there is no standard protocol for treating lateral elbow tendinosis, traditionally, nonsurgical therapy has been the mainstay of initial management. Although lateral elbow tendinosis is regarded as a self-limiting condition, some studies have documented unpredictable healing patterns and identified factors leading to poor symptom resolution, including high baseline pain scores, manual work, and involvement of the dominant extremity.[4,6,7]

While some prognostic indicators are described in the literature,[6] there are virtually no data on the recurrence rate of lateral elbow tendinosis or the proportion of patients who require surgical intervention. The published literature does, however, support use of surgery for patients who fail nonoperative therapy.[3,5,9] One series reported good to excellent outcomes in 92% to 94% of patients at follow-up approaching 10 years after using an open technique.[2] Likewise, Solheim et al[10] reported excellent outcomes in 78% and 67% of patients who had arthroscopic and open treatment, respectively, of recalcitrant tennis elbow. Although surgical intervention is effective for persistent lateral elbow tendinosis, the timeline for operative intervention has not been clearly defined. Some authors have suggested that patients with symptoms persisting 6 months to a year may benefit from surgery.[1,13]

With this background, we performed a population-based study to determine the incidence, characteristics, and the natural history of lateral elbow tendinosis in Olmsted County over a 13-year time span between 2000 and 2012. We also identified patterns in utilization of different operative and nonoperative treatment modalities and recurrence rates.

METHODS

This was a population-based historical cohort study in Olmsted County, Minnesota, which has a population of 144,260 according to the 2010 census. We relied on the resources of the Rochester Epidemiology Project to identify a population-based cohort of individuals with new-onset lateral elbow tendinosis.[8,12] Briefly, the Rochester Epidemiology Project allows ready access to the complete medical records for all residents of Olmsted County, irrespective of where the care was delivered. This population-based data infrastructure ensures virtually complete ascertainment and follow-up of all clinically diagnosed cases of lateral elbow tendinosis in a geographically defined community with the unique ability to access original medical records for case validation. Mayo Clinic and Olmsted Medical Center institutional review board approval was received for this study.

We identified all patients who were residents of Olmsted County and had *International Classification of Diseases, 9th Revision* (*ICD-9*) diagnosis codes consistent with lateral

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epicondylitis (726.32), medial epicondylitis (726.31), synovitis: upper arm (719.22), and synovitis: forearm (719.23) between January 1, 2000, and December 31, 2012. Medial epicondylitis was included in the search to ensure we captured all patients with tendinopathy around the elbow. The medical records of a random 10% sample of patients (selected independently from each calendar year) were reviewed manually to validate diagnosis and collect detailed information on clinical presentation, occupation (categorized using the Bureau of Labor Statistics Standard Occupational Classification, 2010; http://www.bls.gov/soc/), treatment details (rest, bracing, nonsteroidal anti-inflammatory drugs [NSAIDs], physical therapy, corticosteroid injections, iontophoresis, ultrasound, magnetic resonance imaging [MRI], and surgery), and recurrence. Incidence date was defined as the physician diagnosis date. Recurrence was defined as physician-documented resolution of symptoms followed by development of lateral elbow tendinosis in the ipsilateral extremity. Patients who had denied research authorization were excluded.

Selected procedures of interest for the entire cohort of patients were identified using the *ICD-9* procedure codes and *Current Procedural Terminology* (*CPT*) billing codes. The *ICD-9* procedure codes included elbow incision/excision procedures (codes 80.12, 80.22, 80.42, and 80.92), elbow repair/plastic operations (81.92 and 81.93), and muscle, tendon, fascia, and bursa operations and injections (83.02, 83.13, 83.42, 83.72, 83.73, 83.74, 83.97, and 83.98). The *CPT* codes similarly included selected injection, debridement, and elbow arthrotomy codes (20550, 24006, 24358, 24359, 24357, 29837, 29838, 24102, and 24101).

Statistical Analyses

Two sets of analyses were performed. The first set of analyses included the entire cohort of patients with lateral elbow tendinosis between January 1, 2000, and December 31, 2012 (N = 5867), and was focused on describing trends in incidence of lateral elbow tendinosis and the proportion of patients who received injections and/or surgical procedures. The second set of analyses was performed in the 10% sample (n = 576) and focused on describing the natural history, recurrence rates, and utilization of nonsurgical and surgical treatments. Age- and sex-specific incidence rates were calculated by using the number of incident lateral elbow tendinosis cases as the numerator and population estimates based on decennial census counts as the denominator, with linear interpolation between census years. Only patients who were residents of Olmsted County at the onset of disease and who fulfilled the study criteria for lateral elbow tendinosis were included in the incidence calculations. Overall incidence rates were age and sex adjusted to the 2010 population of the United States, and 95% CIs for the incidence rates were constructed using the assumption that the number of incident cases per year follows a Poisson distribution. Incidence trends were examined using Poisson regression models with smoothing splines for age and calendar year. The incidence of surgery and recurrence were calculated in 3-year periods, and the statistical significance of the temporal trends was tested using general linear regression. Recurrence was defined as physician-documented resolution of symptoms of lateral elbow tendinosis followed by documented recurrence of symptoms. Generalized linear models with Poisson distribution with age, sex, and calendar year terms were used to test for significance of incidence and surgical intervention trends over time.

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RESULTS

During the 13-year time period between 2000 and 2012, we identified a total of 5867 individuals (2769 male patients, 3098 female patients) with diagnostic codes consistent with new-onset lateral elbow tendinosis (Table 1). The mean ± SD age at diagnosis was 47 ± 11 years and was the same in male and female patients. The second column in Table 1 shows the characteristics of the 10% random sample of 576 patients with lateral elbow tendinosis. Mean age and the percentage of male patients in the 10% sample were similar to the overall cohort. The most common professions in the 10% sample were office workers/secretaries followed by health care workers, mostly nurses. Profession was not recorded for 116 (20%) patients. The right elbow was more likely to be affected than the left elbow (63% vs 25%), and 12% of patients had both elbows affected. Work restrictions were reported in 16% of the patients, and 4% reported missing 1 to 12 weeks of work. About 25% of patients were referred to a physician specialist (orthopaedic surgery and/or physical medicine and rehabilitation) for management of their condition.

The overall annual age- and sex-adjusted incidence of lateral elbow tendinosis was 3.4 (95% CI, 3.3–3.5) per 1000 (Table 2). Incidence was slightly lower in male patients (3.3 per 1000; 95% CI, 3.2–3.5) than in female patients (3.5 per 1000; 95% CI, 3.4–3.7). The highest incidence was among individuals aged 40 to 49 years, with 7.8 per 1000 in male patients and 10.2 per 1000 in female patients. The second highest incidence was from ages 50 to 59 years, with 7.0 per 1000 in male patients and 6.7 per 1000 in female patients.

Figure 1 shows trends in incidence of lateral elbow tendinosis over the 13-year period between 2000 and 2012. Despite slight fluctuations, the overall annual incidence decreased significantly over time from 4.5 per 1000 (95% CI, 4.1–4.8) in 2000 to 3.0 per 1000 (95% CI, 2.7–3.3) in 2006 and 2.4 per 1000 (95% CI, 2.2–2.7) in 2012 (*P* for trend <.001). This decreasing trend was similar in both male and female patients.

Within the random sample of 576 patients, we examined trends in nonsurgical treatment modalities and recurrence rates. Table 3 shows the number of patients receiving different nonsurgical treatments within the first year of their diagnosis. Most patients received bracing and NSAIDs. The percentage of patients who received ultrasound, iontophoresis, and surgical treatment was less than 6%. Figure 2 shows that half (n = 286; 50%) of the 576 patients had only 1 to 2 visits for lateral elbow tendinosis, and 427 patients (74%) were no longer seeking care after 3 months of their initial diagnosis. Of the 106 patients (18%) who continued to receive care 6 months after first diagnosis, the median duration of care was 844 days, and 12.3% (13/106) of these patients went on to require surgical intervention, with a mean time to operation of about 9 months (271 days) after symptom onset.

Recurrence was observed in 49 (8.5%) of the 576 patients, with a median time to recurrence of 19.7 months, of whom 6 patients (12.2%) went on to require surgical intervention. Recurrence rates were relatively stable over time.

Within the cohort of 5518 patients first diagnosed between 2000 and 2011, 1466 (26.6%) received corticosteroid injections with a median of 1 injection per patient. Furthermore, 89 patients (1.6%) were treated surgically—56 (63%) within the first year of their diagnosis.

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Most surgeries (55/89; 62%) were open surgeries. Table 4 shows trends in the surgical treatment of lateral elbow tendinosis in 3-year time windows between 2000 and 2011. We observed a significant increase in surgically treated cases over time. About 3% of the 1186 lateral elbow tendinosis cases diagnosed between 2009 and 2011 had surgery within 2 years of their diagnosis compared with about 1% in earlier years (P <.00001).

DISCUSSION

Despite the relatively high frequency of lateral elbow tendinosis in general and specialty clinics, very few studies have described the incidence and natural history of this condition. To our knowledge, there are no population-based studies that would be representative of the overall epidemiology of lateral elbow tendinosis in the general population. In addition, we are unaware of any population-based study that describes the recurrence of lateral elbow tendinosis and the percentage requiring surgical intervention. In this study, we describe trends in incidence of lateral elbow tendinosis over time and demonstrate, for the first time, that the incidence decreased significantly over a relatively short time period between 2000 and 2012. The reasons for this decrease in incidence are unknown but could potentially include a variety of factors, including a true change in incidence, changes in the diagnosing patterns among physicians, or fewer patients with mild disease seeking professional care after using alternative resources for self-diagnosis and treatment.

We also noted a significant increase in the rate of surgical intervention in recent years. This trend could reflect more providers offering surgical intervention for treatment as techniques become more refined and outcomes more predictable. In addition, over this time, the indications for surgery have also been clarified. As would be expected, as the effectiveness improves, there is an increased willingness to offer the surgery earlier in the disease process. Alternatively, this trend could simply represent bias as fewer patients with mild disease seek professional care. These intriguing findings underscore the importance of population-based natural history studies in generating important etiological clues of treatment pattern and diagnosis.

Despite the robust population-based design, our study has a number of potential limitations. First, our data reflect clinically recognized diagnoses and do not take into account self-diagnosed/treated patients who did not seek medical attention. Similarly, we may have underestimated the recurrence rate since it is limited to those who seek medical attention. In addition, due to the retrospective design and the size of the overall cohort, chart review–based validation was limited to a 10% random sample of patients. We did not examine patterns of care according to specialty (primary care, physical medicine and rehabilitation, sports medicine, and orthopaedic surgery) and how this might have changed over time and influenced the natural history of the disease. We also did not have access to workers' compensation data to better quantify the disease burden. Finally, the population of Olmsted County, Minnesota, is primarily white,[11] limiting the generalizability of our incidence estimates to more racially diverse populations. Nevertheless, strengths of our study include the unique medical records linkage system provided by the Rochester Epidemiology Project that allows for near-complete ascertainment and validation of all clinically recognized cases of lateral elbow tendinosis in a well-defined population. We accounted for all care provided

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to patients with lateral elbow tendinosis regardless of where the health care was delivered in Olmsted County. Of note, due to its geographical isolation from other large urban centers and availability of excellent health care providers, most Olmsted County residents receive care within Olmsted County, allowing uninterrupted natural history studies. In addition, this is the first study reporting on recurrence of lateral elbow tendinosis over an extended period as well as a trend in incidence patterns.

With an incidence around 3.3 to 3.5 per 1000, lateral elbow tendinosis continues to be a relatively common and debilitating upper extremity condition, and yet relatively little is known regarding risk factors, disease burden, and long-term outcomes. If our findings are generalizable, we estimate that in absolute numbers, there are approximately 1 million individuals with new-onset lateral elbow tendinosis each year in the United States. Further research is needed to replicate these findings in other populations, assess the potential long-term effect of different treatment modalities, and identify factors that can predict patients who will require more invasive treatments.

In conclusion, this population-based study indicates that lateral elbow tendinosis is relatively common, particularly among individuals aged 40 to 49 years during their most productive years. Our findings suggest that those without symptom resolution within 6 months of onset will tend to have a more prolonged course possibly requiring definitive procedural intervention.

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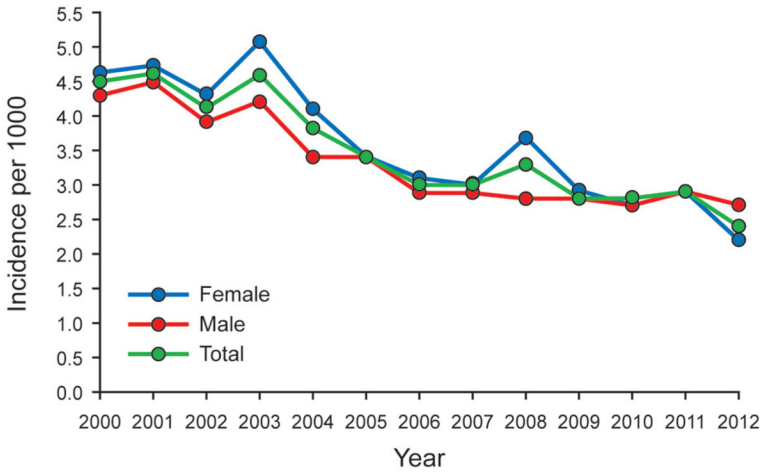

Figure 1.
Trends in incidence of lateral elbow tendinosis (Olmsted County, Minnesota; 2000–2012).

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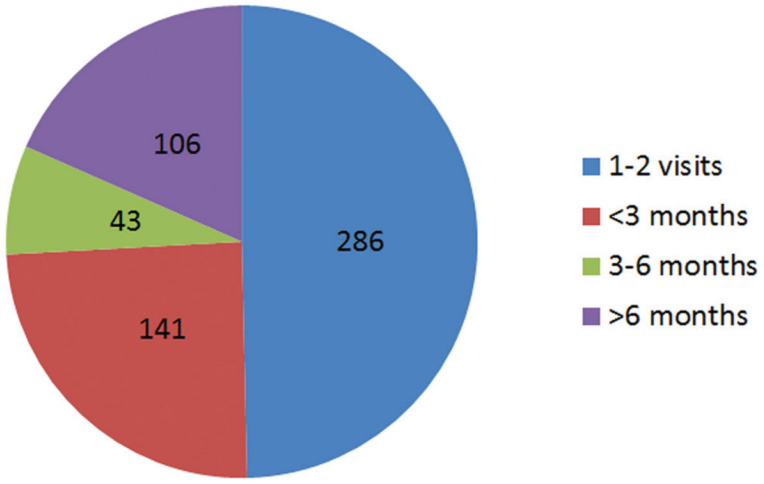

Figure 2.
Duration of care for 10% random sample of lateral elbow tendinosis patients (Olmsted County, Minnesota; 2000–2012).

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TABLE 1

Characteristics of the Incidence of Lateral Elbow Tendinosis (Epicondylitis) in Patients[a]

Characteristic	Entire Study Cohort (N = 5867)	10% Random Sample (n = 576)
Patient sex, No. (%) male	2769 (47)	270 (47)
Age at incidence, y		
Mean ± SD	47 ± 11	46 ± 11
Median (IQR)	47 (40–53)	45 (39–53)
Males		
Mean ± SD	47 ± 12	47 ± 11
Median (IQR)	47 (40–53)	45 (39–54)
Females		
Mean ± SD	47 ± 11	46 ± 10
Median (IQR)	47 (41–52)	46 (40–51)
Occupation, No.[b]		
Office and administrative support		95
Health care practitioner		77
Construction, maintenance, repair, cleaning, etc		73
Business and financial		16
Education		21
Computer related		18
Food preparation		11
Other (mostly personal care services, engineering, transportation)		149
Missing		116
Affected elbow, No. (%)		
Right		362 (63)
Left		147 (25)
Both		67 (12)
Work restrictions, No. (%)		
Reported work restrictions		91 (16)
Reported missed work		24 (4)
Specialist referral		136 (24)

[a] The study cohort consisted of patients in Olmsted County, Minnesota, 2000–2012. IQR, interquartile range.

[b] Occupation was classified according to categories from the Bureau of Labor Statistics, 2010 Standard Occupational Classification (http://www.bls.gov/soc/).

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TABLE 2

Age- and Sex-Specific Annual Incidence (per 1000 People) of Lateral Elbow Tendinosis[a]

	Male		Female		Total	
Age Group, y	**No.**	**Incidence Rate**	**No.**	**Incidence Rate**	**No.**	**Incidence Rate**
<18	47	0.2	38	0.2	85	0.2
18–29	117	0.9	121	0.9	238	0.9
30–39	510	3.9	479	3.7	989	3.8
40–49	1014	7.8	1350	10.2	2364	9.0
50–59	766	7.0	778	6.7	1544	6.9
60–69	239	3.6	223	3.1	462	3.4
≥70	76	1.2	109	1.2	185	1.2
Total (95% CI)	2769	3.3 (3.2–3.5)[b]	3098	3.5 (3.4–3.7)[b]	5867	3.4 (3.3–3.5)[c]

[a] The study cohort consisted of patients in Olmsted County, Minnesota, 2000–2012.

[b] Age adjusted to the US 2010 population.

[c] Age and sex adjusted to the US 2010 population.

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TABLE 3

Treatment Patterns in 10% Random Sample of Patients With Lateral Elbow Tendinosis[a]

Treatment	10% Random Sample (n = 576), No. (%[b])
Any rest	59 (10)
Bracing	446 (77)
NSAIDs	471 (82)
Physical therapy	202 (35)
Injections	108 (19)
Ultrasound	34 (6)
Iontophoresis	26 (5)
Surgery	13 (2)

[a] The study cohort consisted of patients in Olmsted County, Minnesota, 2000–2012. NSAID, nonsteroidal anti-inflammatory drug.

[b] Percentages (except for surgery) refer to percentage of patients receiving therapy within the first year of diagnosis. The percentage for surgery was within 2 years of initial diagnosis.

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TABLE 4

Trends in Time to Surgery in 5518 Patients With Lateral Elbow Tendinosis First Diagnosed in 2000–2011[a]

		Surgeries, Cumulative %			Time to Surgery, d	
Time Period	**Patients Diagnosed, No.**	**6 mo**	**1 y**	**2 y**	**Mean ± SD**	**Median (IQR)**
2000–2002	1604	0.4	0.7	1.1	323 ± 238	320 (57–491)
2003–2005	1500	0.3	0.5	0.9	334 ± 249	248 (136–576)
2006–2008	1228	0.2	1.9	1.6	333 ± 177	286 (222–439)
2009–2011	1186	0.7	2.2	3.2	304 ± 164	282 (198–399)

[a]The study cohort consisted of patients in Olmsted County, Minnesota.