Epidemiology of Lateral and Medial Epicondylitis in a Military Population

Jennifer Moriatis Wolf, MD; Sally Mountcastle, PhD†; COL Robert Burks, USA‡; COL Rodney X. Sturdivant, USA‡; MAJ Brett D. Owens, USA§*

ABSTRACT Objective: To determine the epidemiology of lateral and medial epicondylitis in the U.S. military. Methods: The Defense Medical Epidemiology Database was queried for ICD-9 codes 726.32 (lateral epicondylitis) and 726.33 (medial epicondylitis) for the years 1998–2006. Multivariate Poisson regression was used to calculate incidence rates (IR) and rate ratios (RR) among demographic groups. Results: The IRs for lateral and medial epicondylitis were 2.98 and 0.81 per 1,000 person-years. For lateral epicondylitis, women had a higher incidence (RR = 1.22, 95% CI 1.19–1.26). In both groups, analysis by age showed higher incidence in the ≥40-year-old group. White compared with black race was a risk factor for both lateral (RR = 1.68, 95% CI, 1.63–1.74) and medial epicondylitis (RR = 1.11, 95% CI 1.05–1.17). Conclusions: Female gender was a risk factor for lateral but not medial epicondylitis. Age greater than 40 and white race were significant risk factors for both conditions.

INTRODUCTION

Lateral epicondylitis, or tennis elbow, is an insertional tendinopathy affecting the origin of the extensor carpi radialis brevis (ECRB). Originally described as a consequence of racket sports, tennis elbow has been shown to be associated with gripping and repetitive lifting activities. Nirschl described the abnormalities found on histologic analysis of the ECRB origin as angiofibroblastic tendinosis.[1] Various modalities of treatment have been described for the treatment of this disease, both conservative and operative. Conservative treatments include splinting,[2] therapy,[3,4] shock wave therapy,[5] and injection of various substances including corticosteroids,[2] autologous blood,[6] and botulinum toxin.[7] Various surgical options are open resection of extensor origin,[8] repair of the extensor origin,[9] and arthroscopic debridement.[10]

Medial epicondylitis is characterized by pain at the flexor pronator origin due to tendinopathy. This entity is estimated to make up approximately 10% of all diagnoses of epicondylitis; thus it is far less common than tennis elbow.[11] Gabel and Morrey have identified the pathologic lesion as occurring most commonly at the flexor carpi radialis and pronator teres origins, with no involvement of the flexor carpi ulnaris tendon.[12]

Previous studies have noted that tennis elbow occurs in both males and females in equal proportions, generally between 30 and 60 years of age.[13] One report found an incidence of tennis elbow in 4 patients/1,000 in a study of general practice in Britain.[14] The epidemiology of medial epicondylitis is not well known, with few studies in the literature. In a recent Finnish population study, the authors noted a prevalence of lateral epicondylitis of 1.3%, compared to a prevalence of medial epicondylitis of 0.4%, in a population sample of 4,783 persons.[13] The goal of this study was to determine the epidemiology of lateral and medical epicondylitis in the U.S. military population. The hypothesis was that the incidence would be higher than previous studies of the general population.

MATERIALS AND METHODS

The Defense Medical Epidemiology Database (DMED) compiles International Classification of Diseases, Ninth Revision, and Clinical Modification (ICD-9-CM) coding information for every patient encounter occurring in the active duty United States military population and is updated to reflect the total number of U.S. soldiers on active duty each year. This database also measures demographic as well as military data, which can be used for epidemiological purposes.

To evaluate the incidence of lateral and medial epicondylitis, the DMED system was queried by race, gender, military service, rank, and age for the years 1998–2006 using the ICD-9 CM codes 726.32, lateral epicondylitis, and 726.33, medial epicondylitis. The service categories used were Army, Navy, Air Force, and Marines. The rank categories used were E1–E4, E5–E9, O1–O3, and O4–O9 (enlisted and officer rankings). The age categories used were <20, 20–24, 25–29, 30–34, 35–39, and ≥40 years. Inpatient data were excluded to capture only ambulatory encounters. Events were limited to "first occurrence" criteria to exclude repeat coding of the same initial injury for all services during the study period. The database was also queried for the total number of service members on active duty during the study time period by race, gender, service, rank, and age. One exposure year

*Department of Orthopedics, University of Colorado-Denver, Aurora, CO 80045.

†Department of Preventive Medicine and Public Health, The University of Kansas School of Medicine, Kansas City, KS 66160.

‡Department of Mathematical Sciences, United States Military Academy, West Point, NY 10996.

§John A. Feagin, Jr. Sports Medicine Fellowship, Keller Army Hospital, West Point, NY 10996.

These data have not been previously presented or published.

The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or reflecting the views of the Department of Defense or United States government. The authors are employees of the US government. No funding was received for this study.

was defined as 1 year that a service member was serving in the military.

Poisson regression analysis was used to estimate the rates of lateral and medial epicondylitis per 1,000 person-years for each demographic category (unadjusted rates). Multivariate Poisson regression was also used to determine the rates per 1,000 person-years for each demographic category, while controlling for gender, age, service, rank, and race. Adjusted incidence rate ratios (IRR) were calculated as well as 95% confidence intervals (CIs) for demographic categories, using the demographic subset with the lower incidence rate as the referent category. Statistical analysis was performed using SAS software version 9.1 (Cary, NC).

RESULTS

A total of 36,054 cases of lateral epicondylitis were documented in our population at risk for 12,115,835 person-years. The unadjusted incidence rate of lateral epicondylitis in our population was 2.98 per 1,000 person-years. In comparison, a total of 9,787 cases of medial epicondylitis was seen in the population sample. The unadjusted incidence rate of medial epicondylitis in this population was 0.81 per 1,000 person-years. The ratio of lateral to medial epicondylitis was 3.7:1.

Demographics—Lateral Epicondylitis

Lateral epicondylitis was diagnosed more frequently in women than men. The unadjusted incidence rate was 2.96 for males and 3.06 for females ($p < 0.0001$). The adjusted incidence rate for males was 1.67 compared with the female adjusted rate of 2.05. The adjusted incidence rate ratio was 1.22 (95% CI 1.19–1.26) with males as the referent category, while controlling for race, age, service, and rank.

Increased age was associated with higher rates of lateral epicondylitis when compared to the age group <20 years of age. The highest incidence rate occurred in the service members with an age greater than or equal to 40 years (11.22 per 1,000 person-years). The adjusted incidence rate ratios were significant for all older age groups when compared to the <20-year group, controlling for gender, race, service, and rank ($p < 0.0001$). The greatest adjusted incidence rate ratio was 19.79 (95% CI 18.08–21.65) when comparing those ≥40 years with those <20 years (referent).

Race also showed differential risk for lateral epicondylitis. The unadjusted incidence rate for lateral epicondylitis was 3.24 per 1,000 person-years for whites, 2.77 for service members categorized as other, and 2.17 for blacks. When controlling for gender, age, service, and rank, the adjusted incidence rates were 2.23 for whites, 2.11 for other, and 1.34 for black race. The adjusted incidence rate ratio (controlling for gender, age, service branch, and rank) was 1.66 (95% CI 1.61–1.71) when comparing white service members with black service members (referent), and 1.57 (1.50–1.65) for other service members, controlling for gender, age, service, and rank.

Demographics—Medial Epicondylitis

The unadjusted incidence rate calculated for males was 0.82, compared with 0.71 for females ($p = 0.3950$), indicating no difference in the occurrence of medial epicondylitis between genders. While controlling for age, race, rank, and branch of service, the adjusted incidence rates were 0.67 for males and 0.66 for females. The adjusted incidence rate ratio was 1.03 (95% CI 0.97–1.09) with females as the referent category.

Increased age correlated with higher rates of medial epicondylitis. The highest incidence rate occurred in the population ≥40 years (2.56 per 1,000 person-years). The adjusted incidence rate ratios, with the exception of the 20–24 age group, were significant for all older age groups when compared to the <20-year group, controlling for race, service, and rank ($p < 0.0001$). The greatest adjusted incidence rate ratio was 8.87 (95% CI 7.75–10.15) when comparing those ≥40 years with those <20 years (referent).

Race was a statistically significant risk factor for medial epicondylitis. The injury rate for medial epicondylitis was 0.82 per 1,000 person-years for whites, 0.78 for blacks, and 0.77 for service members categorized as other. While controlling for gender, age, rank, and branch of service, the adjusted incidence rates were 0.71 for other, 0.69 for whites, and 0.62 for blacks. The adjusted incidence rate ratio was 1.11 (95% CI 1.05–1.17) ($p < 0.002$) between white race and black race (referent).

DISCUSSION

Lateral epicondylitis is a common disorder affecting athletes (it is commonly termed "tennis elbow"), industrial workers, and others. Epicondylitis affecting the medial side of the elbow is comparatively rare, with less data about this disease entity. Recent evidence showed an association between tobacco use and forceful arm activity and the incidence of both medial and lateral epicondylitis.[13] The epidemiology of lateral epicondylitis has been previously reported, mostly in small population samples. A study of lateral epicondylitis at a large tennis club noted 75 new and recurrent cases over a 2-month period, with a calculated incidence rate of 441/1,000 person-years. The authors noted increased playing time, experience and ability, and larger grip size correlated with an increased risk of developing lateral epicondylitis.[15] There was no difference shown by gender.

Medial epicondylitis has mostly been studied in association with lateral epicondylitis. Walker-Bone et al. studied upper extremity problems using a questionnaire with exam followup in an at-risk population and noted an incidence of lateral epicondylitis at 7.5 per 1,000 person-years, with medial epicondylitis incidence calculated at 5.6 per 1,000 person-years.[16] The authors showed no difference when comparing genders in lateral epicondylitis, but noted nearly a 2:1 ratio of occurrence for women compared to men with a diagnosis of medial epicondylitis. Shiri et al. analyzed data from the Finnish health survey and reported on both medial and lateral epicondylitis in a population of 4,783 persons.[13] The incidence of cases with a

definite diagnosis of lateral epicondylitis was similar to Walker-Bone's study, at 6.6 per 1,000 person-years, but medial epicondylitis was lower, at 1.8 per 1,000 person-years. In this study, medial epicondylitis occurred twice as frequently in women, but the rate of lateral epicondylitis was similar between sexes.

Only one study has focused on medial epicondylitis exclusively. Descatha et al. studied this entity in the French working population, with a questionnaire followed by examination by occupational physicians over 2 years. They noted a total of 68 cases over 2 years, or an incidence of 19 per 1,000 person-years, and found a relationship between forceful work and medial epicondylitis.[17]

Our investigation analyzed a population at risk for 12,115,835 person-years, representing the United States military. An incidence rate of 3 per 1,000 person-years was found for lateral epicondylitis and an incidence of 0.8 per 1,000 person-years for medial epicondylitis. These rates are lower than those reported in other studies. Because these data are derived from medical provider diagnostic codes, in contrast to other studies utilizing questionnaire responses, these epidemiologic rates may actually be more representative of the clinical population presenting for care.

Women had a significantly higher rate of lateral epicondylitis than men in the military population, with an adjusted rate ratio of 1.22 (95% CI 1.19–1.26) ($p < 0.0001$). This finding differs from other studies in the literature which showed an equal incidence between genders.[13,16] Our study did not, however, show a gender difference in medial epicondylitis, similar to the findings of Shiri et al.[13]

Analysis of the effect of age on the epidemiology of lateral and medial epicondylitis showed that the oldest age group, those service members ≥40 years, had a significantly higher incidence of both lateral and medial epicondylitis ($p < 0.0001$). This is consistent with the findings in the study by Descatha et al., where the prevalence odds ratio in the age group greater than 50 years was 1.98, compared to all younger age groups.[17] Another study also confirmed these findings, with an odds ratio of 2.4 for the 45- to 54-year age group with lateral epicondylitis, higher than the 30- to 44- and 55- to 64-year groups, and an odds ratio of 2.5 for medial epicondylitis in the 55- to 64-year-old age group.[13]

Finally, our study showed that whites have a significantly higher rate of lateral epicondylitis than blacks or other groups, with similar differences shown in medial epicondylitis ($p < 0.001$ and $p < 0.002$, respectively). The adjusted incidence rate ratio was 1.66 (95% CI 1.61–1.71) when comparing white service members to black service members (referent), for lateral epicondylitis. Similar findings were seen in medial epicondylitis, with an adjusted incidence rate ratio of 1.11 (95% CI 1.05–1.17). No previous studies have specifically looked at race as a differential factor in epicondylitis. However, two studies of major tendon rupture found that black race is a risk factor for Achilles, pectoralis, and other tendon ruptures.[18] These findings suggest that whites may have a higher incidence of tendinopathy, while tendon failure is less common.

The limitations of this study include the intrinsic weaknesses of database studies, which rely on the accuracy of the provider or other personnel entering the diagnosis codes and other data. Whereas the advantages of a closed health system and a comprehensive database include accurate capture of diagnosis coding, the type of provider making the diagnosis or any confirmatory physical examination findings were not able to be confirmed. This information would be a valuable addition to this report and would allow more accurate reporting of the diagnosis of epicondylitis.

Furthermore, the data did not include tobacco use, types of activity or occupational exposure data, which would be a useful correlation in the evaluation of epicondylitis. In addition, the study population of primarily young and active individuals that constitute the United States military is not representative of the United States general population. However, the military population may have unique risk factors for upper extremity injury due to the physical activity requirements which emphasize upper arm use. Our incidence rates for epicondylitis are overall lower than those previously reported, which may reflect the youth of the cohort studied. This data suggests that young active populations are also at risk for lateral and medial epicondylitis, in contrast to other reports in the literature, which suggest that insertional tendinopathies of the elbow occur in older age groups. This study may indicate that military occupations place younger people at higher risk due to the special demands for upper extremity use.

This study showed a ratio of lateral to medial epicondylitis of nearly 4:1, with incidence rates of both tendinopathies lower than those previously shown in the literature. These findings are derived from analysis of the largest population at risk reported to date, at over 12 million person-years. Females were more likely than males to develop lateral epicondylitis, whereas the incidence rates were nearly equal between genders for medial epicondylitis. The incidence of lateral and medial epicondylitis increased with increasing age in this population. Finally, a higher incidence of lateral and medial epicondylitis in whites compared to blacks was also seen.

REFERENCES

1. Nirschl RP, Ashman ES: Tennis elbow tendinosis (epicondylitis). Instr Course Lect 2004; 53: 587–98.
2. Haines T, Stringer B: Corticosteroid injections or physiotherapy were not more effective than wait and see for tennis elbow at 1 year. Evid Based Med 2007; 12: 39.
3. Bisset L, Beller E, Jull G, Brooks P, Darnell R, Vicenzino B: Mobilisation with movement and exercise, corticosteroid injection, or wait and see for tennis elbow: randomised trial. BMJ 2006; 333: 939.
4. Bisset L, Paungmali A, Vicenzino B, Beller E: A systematic review and meta-analysis of clinical trials on physical interventions for lateral epicondylalgia. Br J Sports Med 2005; 39: 411–22, discussion 411–22.
5. Pettrone FA, McCall BR: Extracorporeal shock wave therapy without local anesthesia for chronic lateral epicondylitis. J Bone Joint Surg Am 2005; 87: 1297–304.
6. Edwards SG, Calandruccio JH: Autologous blood injections for refractory lateral epicondylitis. J Hand Surg [Am] 2003; 28: 272–8.
7. Placzek R, Drescher W, Deuretzbacher G, Hempfing A, Meiss AL: Treatment of chronic radial epicondylitis with botulinum toxin A.

A double-blind, placebo-controlled, randomized multicenter study. J Bone Joint Surg Am 2007; 89: 255–60.
8. Nirschl RP, Pettrone FA: Tennis elbow. The surgical treatment of lateral epicondylitis. J Bone Joint Surg Am 1979; 61: 832–9.
9. Thornton SJ, Rogers JR, Prickett WD, Dunn WR, Allen AA, Hannafin JA: Treatment of recalcitrant lateral epicondylitis with suture anchor repair. Am J Sports Med 2005; 33: 1558–64.
10. Szabo SJ, Savoie FH 3rd, Field LD, Ramsey JR, Hosemann CD: Tendinosis of the extensor carpi radialis brevis: an evaluation of three methods of operative treatment. J Shoulder Elbow Surg 2006; 15: 721–7.
11. Ciccotti MG, Ramani MN: Medial epicondylitis. Tech Hand Up Extrem Surg 2003; 7: 190–6.
12. Gabel GT, Morrey BF: Operative treatment of medical epicondylitis. Influence of concomitant ulnar neuropathy at the elbow. J Bone Joint Surg Am 1995; 77: 1065–9.
13. Shiri R, Viikari-Juntura E, Varonen H, Heliovaara M: Prevalence and determinants of lateral and medial epicondylitis: a population study. Am J Epidemiol 2006; 164: 1065–74.
14. Hamilton PG: The prevalence of humeral epicondylitis: a survey in general practice. J R Coll Gen Pract 1986; 36: 464–5.
15. Gruchow HW, Pelletier D: An epidemiologic study of tennis elbow. Incidence, recurrence, and effectiveness of prevention strategies. Am J Sports Med 1979; 7: 234–8.
16. Walker-Bone K, Palmer KT, Reading I, Coggon D, Cooper C: Prevalence and impact of musculoskeletal disorders of the upper limb in the general population. Arthritis Rheum 2004; 51: 642–51.
17. Descatha A, Leclerc A, Chastang JF, Roquelaure Y: Medial epicondylitis in occupational settings: prevalence, incidence and associated risk factors. J Occup Environ Med 2003; 45: 993–1001.
18. Owens B, Mountcastle S, White D: Racial differences in tendon rupture incidence. Int J Sports Med 2007; 28: 617–20.