SHORT REPORT

ABSTRACT: We retrospectively reviewed electrodiagnostic studies performed on 169 athletes with 190 sports injuries to nerve fibers. Eighty-eight percent of the injuries were to the upper extremity. Athletes participated in 27 sports, but over one third of injuries were sustained playing football. The most common injuries were burners ($n = 38$) and cervical radiculopathies ($n = 18$), followed by median ($n = 28$), axillary ($n = 22$), ulnar ($n = 19$), suprascapular ($n = 14$), and peroneal ($n = 11$) mononeuropathies. This is the largest reported series of sports-related nerve injuries.

 Muscle Nerve 21: 1092–1094, 1998

SPORTS AND PERIPHERAL NERVE INJURIES: REPORT OF 190 INJURIES EVALUATED IN A SINGLE ELECTROMYOGRAPHY LABORATORY

LISA S. KRIVICKAS, MD, and ASA J. WILBOURN, MD

Department of Neurology, The Cleveland Clinic Foundation, Cleveland, Ohio, USA

Accepted 17 November 1997

Sports injuries that include peripheral nerve fiber damage, i.e., those that damage the nerve roots, plexi, or peripheral nerves, are relatively uncommon. Most of the current literature on sport-related nerve injuries is in the form of case reports. An exception is the article by Hirasawa and Sakakida,[6] published in 1983, which details a series of 66 peripheral nerve injuries sustained by Japanese athletes. However, not all of the injuries were defined electromyographically, and one third of them occurred as a result of mountain climbing, a sport which is much less popular in the United States and many European countries.

We retrospectively reviewed the charts and electrodiagnostic (EDX) studies of 333 patients who were referred to the electromyography (EMG) laboratory for evaluation of sports injuries between 1976 and 1996. Information was obtained regarding the mechanism of injury, the EDX findings, and the clinical recovery or lack of recovery if the patient was seen for follow-up after the EDX examination. This series is, to our knowledge, the largest reported to date.

Key words: sports; injury; nerve; electrodiagnosis
Correspondence to: Dr. Lisa S. Krivickas, Spaulding Rehabilitation Hospital, 125 Nashua Street, Boston, MA 02114, USA

CCC 0148-639X/98/081092-03

RESULTS AND DISCUSSION

From 1976 to 1996, 333 athletes (293 males and 40 females) were referred to our EMG laboratory. They ranged in age from 9 to 76 years, with 80% between 15 and 32 years. One hundred sixty-nine athletes (51%), with a mean age of 26 years, had 190 electrophysiologically proven peripheral nerve fiber injuries; 155 were male, and 14 were female.

Table 1 shows the distribution of nerve injuries seen in this group of athletes. The most common upper extremity nerve injuries were burners. The most common mononeuropathies affected the median, axillary, ulnar, and suprascapular nerves.

Slightly more than one third of all injuries occurred while playing football (57 of 169 athletes). Wrestling, weight lifting, and baseball/softball each had more than 10 injuries. Eight injuries occurred while bicycling and nine while playing basketball. Downhill skiing, water skiing, and equestrian sports had four injuries each, while golf, running, and long jump each produced three injuries. Sixteen other sports produced one or two injuries each.

The 57 football players with nerve injuries had 28 burners (paresthesias, sensory loss, and/or weakness resulting from forceful lateral flexion or hyperextension of the neck, producing EDX findings consistent with either a C5–C6 radiculopathy, or more likely, an upper trunk brachial plexopathy), 10 axillary neuropathies, 5 suprascapular neuropathies, 5 cervical radiculopathies, 3 peroneal neuropathies, 2 ulnar

Table 1. Sports-related nerve injuries.

Upper extremity	167
Burners	38
Median	28
Axillary	22
Ulnar	19
Cervical radiculopathy	18
Suprascapular	14
Brachial plexopathy	8
Long thoracic	5
Radial	4
Musculocutaneous	3
Lateral antebrachial cutaneous	3
Spinal accessory	2
Dorsal ulnar cutaneous	1
Medial pectoral	1
Digital	1
Lower extremity	23
Peroneal	11
Lumbosacral radiculopathy	7
Tibial	2
Saphenous	1
Sciatic	1
Sciatic vs. tibial/peroneal	1
Total	190

neruopathies, 3 asymptomatic median neuropathies at the wrist, and 1 each of the following: brachial plexopathy, long thoracic neuropathy, radial neuropathy, and L5–S1 radiculopathy.

The 18 wrestlers all had upper extremity injuries with a lesion distribution similar to that seen in football players. Nine had burners, 2 had axillary neuropathies resulting from a mechanism of injury similar to that of the burner, and 2 had nonburner cervical radiculopathies. Two had ulnar neuropathies, and 4 had median neuropathies at the wrist (carpal tunnel syndrome: CTS), 2 of which were asymptomatic. One long thoracic and one suprascapular neuropathy were also seen.

The 27 weight lifters had only upper extremity injuries, with 10 cases of CTS (7 asymptomatic), 5 cervical radiculopathies, 5 ulnar neuropathies, 3 suprascapular neuropathies, and 1 each of the following: brachial plexopathy, long thoracic neuropathy, lateral antebrachial cutaneous neuropathy, and medial pectoral nerve injury.

Twenty-four of the 28 median neuropathies were CTS. Symptomatic CTS has been reported in cyclists, tennis players, and baseball players[9]; it is also very common in wheelchair athletes.[2] We saw 6 athletes with symptomatic CTS: 2 wrestlers and 3 weight lifters under age 20 and 1 23-year-old triathlete. In addition, we detected 18 cases of asymptomatic CTS. Twelve of these incidentally detected cases were isolated, and 6 accompanied other lesions, 3 of which were burners. Eleven of the athletes with asymptomatic CTS were age 15–20, an age group in which CTS is quite unusual.[4] These young athletes, all of whom were weight lifters, wrestlers, or football players, lifted weights regularly as part of their training regimen. We suspect that the repetitive wrist motion involved in weight lifting may have contributed to the development of CTS in these young weight lifters, wrestlers, and football players. Several of these young athletes were quite heavy (>250 lbs), and their body habitus may have predisposed them to develop CTS. A previously reported series of cases of CTS in children included included 13 boys who participated in regular weight training.[1]

Thirty-eight wrestlers and football players had clinical manifestations of the "burner (or stinger) syndrome," i.e., paresthesias, sensory loss, and/or weakness resulting from forceful lateral flexion or hyperextension of the neck. The EDX findings in athletes with these lesions were consistent with the diagnosis of either a C5–C6 radiculopathy or an upper trunk brachial plexus lesion. Controversy exists as to whether burners are primarily upper trunk brachial plexopathies[3,5,8,11,13] or cervical radiculopathies.[7,10] Typically, only those athletes with persistent neurologic abnormalities are referred for EDX evaluation. In most of the 38 burners in this series, the appropriate sensory nerve conduction studies were normal, as one would expect in a cervical radiculopathy. However, paraspinal muscle fibrillation potentials also were not found, precluding definite localization to the root level.

Eighteen athletes had unequivocal cervical radiculopathies, and 8 had definite brachial plexopathies, caused by mechanisms other than the "burner syndrome." Only 11 of the 18 cervical radiculopathies could be localized to a single root level. C7 was the most commonly involved single root, but 50% (9 of 18) involved C5, C6, or both. Five of the brachial plexopathies were diffuse and generally severe.

The association between axillary nerve injury and shoulder dislocation is well known; eight of the axillary mononeuropathies in this series occurred with anterior shoulder dislocations. A less well-known mechanism of axillary nerve injury is a direct blow to the shoulded. An additional 5 football players and 2 wrestlers who sustained burners had axillary mononeuropathies rather than the more typical C5–C6 radiculopathy vs. upper trunk brachial plexopathy. Two football players reported direct blows to the shoulder as the etiology of their axillary neuropathies.

Ten of the 11 peroneal nerve injuries occurred at or near the level of the fibular head. Four of the

peroneal injuries, as well as one sciatic vs. combined peroneal and tibial injury, were associated with severe ligamentous knee injuries. The association between knee ligament and peroneal nerve injuries has been described by Veltri and Warren,[12] but it has not been emphasized in the literature. Two peroneal nerve injuries were associated with ankle injuries, two others with anterior and lateral compartment syndromes, and one with a proximal fibula fracture.

CONCLUSIONS

We have described 190 sports nerve injuries in 333 athletes studied during a 20-year period in a laboratory where more than 2200 EDX studies are performed yearly. The only other published large series of sports peripheral nerve injuries is by Hirasawa and Sakakida.[6] None of their athletes participated in football, and few wrestled; mountain climbing, gymnastics, and baseball were the most common sports in which nerve injury occurred.

Burner was the most frequent referral diagnosis in this series, reflecting our institution's patient population. We also identified several cases of CTS in adolescents involved in weight lifting and several peroneal nerve injuries associated with internal derangement of the knee. Although nerve injuries are relatively uncommon in athletes, physicians practicing sports medicine need to be familiar with common nerve injury patterns. Serious nerve injuries can be missed when they are not considered, especially in patients with complex joint injuries such as dislocations and ligament tears.

This article was presented in part in poster form at the 1996 AAEM Annual Meeting in Minneapolis, Minnesota.

We would like to thank Dr. John Bergfeld and the other staff members of the Cleveland Clinic Sports Medicine department, as well as all other referring physicians, for allowing us to perform EDX examinations on their patients. We are equally indebted to other staff members of the Cleveland Clinic EMG laboratory, who performed many of these EDX evaluations.

REFERENCES

1. Berenson FB, Wilbourn AJ: Carpal tunnel syndrome in pediatrics: frequency and etiologies. *Neurology* 1995;45:A348.
2. Burnham RS, Steadward RD: Upper extremity peripheral nerve entrapments among wheelchair athletes: prevalence, location, and risk factors. *Arch Phys Med Rehabil* 1994;75: 519–524.
3. Clancy WG, Brand RL, Bergfeld JA: Upper trunk brachial plexus injuries in contact sports. *Am J Sports Med* 1977;5: 209–216.
4. DeKrom MCTFM, Knipschild PG, Kester ADM, Thijs CT, Boekkoor PF, Spaans F: Carpal tunnel syndrome: prevalence in the general population. *J Clin Epidemiol* 1992;45:373–376.
5. DiBenedetto M, Markey K: Electrodiagnostic localization of traumatic upper trunk brachial plexopathy. *Arch Phys Med Rehabil* 1984;65:15–17.
6. Hirasawa Y, Sakakida K: Sports and peripheral nerve injury. *Am J Sports Med* 1983;11:420–426.
7. Kline DG, Lusk MD: Management of athletic brachial plexus injuries, in Schneider RC, Kennedy JC, Plant ML (eds): *Sports Injuries: Mechanisms, Prevention, and Treatment*. Baltimore, Williams and Wilkins, 1985, pp 724–742.
8. Markey KL, DiBenedetto M, Curl WW: Upper trunk brachial plexopathy: the stinger syndrome. *Am J Sports Med* 1993;21: 650–655.
9. Pianka C, Hershman EB: Neurovascular injuries, in Nicholas JA, Hershman EB (eds): *The Upper Extremity in Sports Medicine*. St. Louis, Mosby, 1990, pp 691–722.
10. Poindexter DP, Johnson EW: Football shoulder and neck injury: a study of the "stinger." *Arch Phys Med Rehabil* 1984;65: 601–602.
11. Robertson WC, Eichman PL, Clancy WG: Upper trunk brachial plexopathy in football players. *JAMA* 1979;241: 1480–1482.
12. Veltri DM, Warren RF: Anatomy, biomechanics, and physical findings in posterolateral knee instability. *Clin Sports Med* 1994;13:599–614.
13. Wilbourn AJ: Brachial plexus disorders, in Dyck PJ, Thomas PK, Griffin JW, Low PA, Poduslo JF (eds): *Peripheral Neuropathy*. Philadelphia, Saunders, 1993, pp 911–950.