Evaluation of multiple level nerve compression

Meral Omurtag BSc, Christine B Novak PT MS, Susan E Mackinnon MD

Division of Plastic & Reconstructive Surgery, Department of Surgery and School of Occupational Therapy, Washington University School of Medicine, St Louis, Missouri

M Omurtag, CB Novak, SE Mackinnon. Evaluation of multiple level nerve compression. Can J Plast Surg 1996;4(3):165-167. In this retrospective study, the charts of 100 patients (81 females and 19 males, mean age 41 years) with a diagnosis of multiple level nerve compression were reviewed. Forty-five patients were involved with Workers' Compensation. The most common referral diagnosis was carpal tunnel syndrome (43%); only one patient was referred with the diagnosis of 'multiple crush'. Of the 43 patients referred with a diagnosis of carpal tunnel syndrome, 35% had two levels of nerve compression (carpal and cubital tunnel or carpal tunnel and thoracic outlet) and 65% had three levels of nerve compression (carpal tunnel, cubital tunnel and thoracic outlet). This study suggests that multiple level nerve compression is frequently unrecognized and recommends full upper extremity evaluation, especially in patients referred with a diagnosis of carpal tunnel syndrome, to identify all levels of nerve compression.

Key Words: Double crush, Evaluation, Nerve compression

Évaluation d'une compression nerveuse à plus d'un niveau

RÉSUMÉ : Dans cette étude rétrospective, les dossiers de 100 patients (81 femmes et 19 hommes, âgés en moyenne de 41 ans) porteurs d'un diagnostic de compression nerveuse à de multiples niveaux ont été passés en revue. Quarante-cinq patients étaient indemnisés par la commission des accidents du travail. Le diagnostic le plus fréquent au moment de la consultation était le syndrome du tunnel carpien (43 %). Un seul patient avait un diagnostic d'écrasements multiples. Parmi les 43 patients adressés porteurs d'un diagnostic de syndrome de tunnel carpien, 35 % présentaient une compression des nerfs à deux niveaux (tunnel carpien et cubital ou tunnel carpien et traversée thoraco-brachiale) et 65 % souffraient de compression nerveuse à trois niveaux (tunnel carpien, tunnel cubital et traversée thoraco-brachiale). Cette étude donne à penser que la compression nerveuse à plusieurs niveaux est souvent ignorée et justifie un examen complet du membre supérieur, surtout chez les patients adressés avec un diagnostic de syndrome du tunnel carpien afin d'identifier tous les niveaux de compression nerveuse.

Problems related to repetitive work injury continue to escalate, and carpal tunnel surgery is performed with increasing frequency. Extensive and expensive modifications of keyboards and work stations have been instituted to alleviate carpal tunnel syndrome

(CTS), yet the apparent incidence of CTS in the working population continues to grow. It is recognized, however, that carpal tunnel release in this patient population fails to relieve symptoms in many patients (1,2). The emphasis on CTS has perhaps 'blinded' clinicians, preventing them from identifying concomitant proximal levels of nerve compression. Wrist flexion and extension increases pressure within the carpal canal, and similarly abnormal posturing or positioning of the head, neck or upper extremities may cause either direct nerve compression at the level of the cubital tunnel and/or brachial plexus and cervicospinal muscle imbalance (3). CTS may, therefore, be only one of several compression neuropathies responsible for only sensory disturbance in the median nerve distribution of the hand. Thus, when more problems than CTS are present, a carpal tunnel release alone will not relieve a patient's symptoms. The purpose of this retrospective study was to compare the referring diagnosis with the final diagnosis of multiple level nerve compression in patients referred to a tertiary care facility.

PATIENTS AND METHODS

The charts of 100 patients with a diagnosis of multiple level nerve compression were reviewed. These patients were seen between January 1992 and July 1994 by one surgeon. The chart review included referring diagnosis, sex, age, Workers' Compensation involvement and results of initial patient evaluation. There were 81 females and 19 males, mean age 41 years (SD 10 years, range 16 to 71). Forty-five patients were involved with Workers' Compensation, mean age 40 years (SD eight years, range 24 to 60); non-Workers' Compensation patients had a mean age of 40 years (SD 11 years, range 16 to 71).

The diagnosis of multiple level nerve compression was based on patient history, subjective complaints and clinical testing which included provocative manoeuvres (Tinel's sign, pressure/movement provocative test) at common sites of nerve entrapment in the upper extremity, such as the carpal tunnel, cubital tunnel and thoracic outlet. The Tinel's sign was determined as previously described (4), applying four to six taps on the median nerve at the carpal tunnel (5), the ulnar nerve at the cubital tunnel (6) and supraclavicularly between the anterior and middle scalene muscles (7). Carpal tunnel testing was done with neutral forearm pronation/supination, wrist in comfortable flexion, and pressure was placed by the examiner's thumb on the median nerve just proximal to the carpal tunnel (4,5). Cubital tunnel syndrome was confirmed with a positive response to the pressure-flexion test (6). With forearm supination, elbow flexion and wrist in neutral position, pressure was placed by the examiner on the ulnar nerve at the cubital tunnel (4,6). Compression of the brachial plexus was confirmed with arm elevation and supraclavicular pressure downward on the brachial plexus between anterior and middle scalene muscles (7). Each site was evaluated bilaterally and considered positive with reproduction of symptoms in the appropriate neural distribution.

Data analysis: The data were analyzed descriptively with frequency tables, percentages and mean values. χ^2 analysis was used to evaluate the relationship between Workers' Compensation status and the presence of three levels of nerve compression.

RESULTS

Primary referral diagnosis: In this group of patients with a diagnosis of multiple level nerve compression, the most common referring diagnosis was CTS (43%) (Table 1). Of the 43 patients referred with a diagnosis of CTS, 65% had three levels of nerve compression (carpal tunnel, cubital tunnel and thoracic outlet), 14% had carpal tunnel and thoracic outlet syndrome, 14% had carpal tunnel and cubital tunnel syndrome, and 7% had cubital tunnel and thoracic outlet syndrome (Table 1). In three cases, despite an initial diagnosis of CTS, no signs or symptoms of the median nerve at the carpal tunnel were found. Only one patient was referred with a diagnosis of 'multiple crush' and on examination had nerve compression at the carpal tunnel, cubital tunnel and thoracic outlet. A statistically significantly higher number of non-Workers' Compensation patients than Workers' Compensation patients presented with all three levels of nerve compression ($P < 0.05$).

TABLE 1: Distribution of referring diagnoses and resultant findings

Primary referring diagnosis (n)	CTS+TOS	CUB+TOS	CTS+CUB	CTS/CUB +TOS
Carpal tunnel syndrome (CTS) (43)	6	3	6	28
Thoracic outlet syndrome (TOS) (14)	1	4	0	9
Numbness and/or pain (17)	1	1	4	11
Reflex sympathetic dystrophy (3)	1	1	0	1
Cubital tunnel syndrome (CUB) (7)	0	4	0	3
Trauma (1)	0	0	0	1
Brachial plexus neuritis (2)	0	1	0	1
Multiple crush (1)	0	0	0	1
Other (12)	1	4	2	5
Total (100)	10	18	12	60

DISCUSSION

The concept of the double crush mechanism as described two decades ago by Upton and McComas (8) suggests that nerve compression proximally will make more distal entrapment sites less tolerant and, therefore, more susceptible to compression neuropathies. Lundborg (9) reported a reverse double crush where distal compression can affect the more proximal entrapment sites. Associations between multiple entrapment sites have been documented for thoracic outlet, carpal tunnel and cubital tunnel syndrome (4,7,10,11). Therefore the presence of proximal or distal sites of compression may influence the 'effectiveness' of carpal tunnel release in relieving symptoms in the median nerve distribution. In this review of 100 patients with multiple level nerve compression, multiple crush was the referring diagnosis in only one patient, and 43% of patients were referred with a primary diagnosis of CTS.

The focus of nerve compression has predominately been directed towards the carpal tunnel, in both treatment and preventative measures. Despite this attention, CTS

incidence has steadily increased. Many patients with CTS have not experienced improvement in their overall symptomatology, despite adequate conservative and surgical management. This emphasis on the carpal tunnel has probably stopped clinicians from looking beyond the carpal tunnel for other more proximal levels of nerve compression. Wrist flexion and extension have been shown to elevate pressures in the carpal canal, which may increase pressure on the median nerve, thus contributing to CTS (4,12). To minimize increased pressure in the carpal canal, positioning in either flexion or extension should be minimized, and the wrist should be maintained in a neutral position. Therefore, initial conservative management and prevention of CTS suggests maintaining the wrist in a neutral position even during work activities. However, the most functional wrist position is 30° of extension, and attempts to maintain the wrist in a neutral position during functional activities may result in compensatory positioning of the more proximal regions of the upper extremity, as these proximal joints accommodate the fixed wrist position. The adjunctive use of devices to maintain the wrist in neutral may result in compensatory abnormal postures of the elbow, shoulder and cervicospinal region, causing additive problems and/or exacerbating subclinical problems. Thus, from the patient who begins with a simple carpal tunnel syndrome may come increased complaints of pain and discomfort in the cervical, scapular and shoulder region, which may result from the abnormal postures that must be assumed in order to keep the wrist in neutral position. Proximal muscle imbalance may better explain patients' complaints of pain, fatigue and discomfort in the proximal extremity and cervical region than the diagnosis of CTS.

Weaknesses of this study include its retrospective nature and the fact that diagnoses were made clinically and not with electrodiagnostic studies. However, our study does suggest that multiple level nerve compression is frequently unrecognized, and therefore, in cases of CTS, evaluation should include more proximal levels of compression in the upper extremity (3,8,9,13). With the identification of all levels of nerve compression, appropriate conservative management may be initiated to relieve patient's symptoms in the entire upper extremity. Recognition and management of proximal problems will complement the results achieved with successful treatment of CTS.

REFERENCES

1. Strasberg SR, Novak CB, Mackinnon SE, Murray JF. Subjective and employment outcome following secondary carpal tunnel surgery. *Ann Plast Surg* 1994;32:485-9.
2. Mackinnon SE. Secondary carpal tunnel surgery. *Neurosurg Clin N Am* 1991;2:75-91.
3. Mackinnon SE, Novak CB. Clinical Commentary: Pathogenesis of Cumulative Trauma Disorder. *J Hand Surg* 1994;19A:873-83.
4. Mackinnon SE, Dellon AL. *Surgery of the Peripheral Nerve*. New York: Thieme Medical Publishers, 1988.
5. Williams TM, Mackinnon SE, Novak CB, McCabe S, Kelly L. Verification of the pressure provocative test in carpal tunnel syndrome. *Ann Plast Surg* 1992;29:8-11.

6. Novak CB, Lee GW, Mackinnon SE, Lay L. Provocative testing in cubital tunnel syndrome. *J Hand Surg* 1994;19A:817-20.
7. Novak CB, Mackinnon SE, Patterson GA. Evaluation of patients with thoracic outlet syndrome. *J Hand Surg* 1993;18A:292-9.
8. Upton ARM, McComas AJ. The double crush in nerve-entrapment syndromes. *Lancet* 1973;ii:359-62.
9. Lundborg G. *Nerve Injury and Repair*. New York: Churchill Livingstone, 1988:142-3.
10. Massey EW, Riley TL, Pleet AB. Coexistent carpal tunnel syndrome and cervical radiculopathy double crush syndrome. *South Med J* 1981;74:597.
11. Wood VE, Biondi J. Double-crush nerve compression in thoracic-outlet syndrome. *J Bone Joint Surg* 1990;72A:85-7.
12. Gelberman RH, Szabo RM, Williamson RV, Dimick MP. Sensibility testing in peripheral nerve compression syndromes. *J Bone Joint Surg* 1983;65A:632-8.
13. Mackinnon SE. Double and multiple "crush" syndromes – Double and multiple entrapment neuropathies. *Hand Clin* 1992;8:369-90.