J Rehabil Med 2009; 41: 778–779

LETTER TO THE EDITOR

ABOUT THE HYPOTHESIS OF OVERWORK WEAKNESS IN CHARCOT-MARIE-TOOTH DISEASE

Sir,

We read with interest the recently published article by Van Pomeren and colleagues (1), describing their study of 28 patients with Charcot-Marie-Tooth disease (CMT), which aimed to verify our hypothesis (2) of overwork weakness (OW) in this neuromuscular disorder.

They found equal muscle strength in the dominant and non-dominant hands, rather than more strength in the non-dominant hand, and they therefore questioned the occurrence of OW in CMT and suggested that the patients' activities should not be limited. However, we are of the opinion that their results differ from ours because their sample differed from ours, and that their patients have undergone OW.

Our study was conducted on a large sample of patients ($n = 106$) with all degrees of muscle impairment, whereas the study by Van Pomeren et al. considered only 28 patients with far milder hand involvement (our 25th percentile for the dominant abductor pollicis brevis muscle was Medical Research Council (MRC) grade 0, whereas theirs was MRC = 4 in CMT type 1 and MRC = 3 in type 2). If only a few nerve fibres have undergone axonal degeneration, overloading has little chance to act because there are enough remaining motor units to alternate, even in the case of movements requiring quite a high level of muscle power. On the contrary, if only a few axons have survived and have undergone sprouting to compensate for the loss of other nerve fibres, they are more susceptible to possible deleterious effects of intense physiological stimulation because all the motor units must always be activated; in addition, muscle fibres that have undergone compensative hypertrophy might split and degenerate in cases of overuse, as happens in post-polio syndrome.

The fact that both sides showed the same strength, rather than greater strength in the dominant side, as is seen in most normal subjects due to muscle hypertrophy in muscles that are used more (2–4), suggests that the OW phenomenon is also present in the patients tested by van Pomeren et al.: if it was not so severe as to cause more weakness in the dominant hand than in the non-dominant hand, this may have been due to the mildness of the neuropathy in their cases. Also, in our study approximately one in 3 hands showed equal strength, and this figure would be higher if only the muscles at MRC = 5 and 4 were considered.

In questioning the occurrence of OW in CMT, van Pomeren et al. also cite the results of a study by Carter et al. (3), who found equal grip and pinch strength in both hands of their patients. Apart from the fact that grip and pinch strength is generated not only by the intrinsic hand muscles selectively involved by the neuropathy, but also by relatively unaffected forearm muscles that can undergo hypertrophy as in healthy subjects, Carter et al. (3) found that, in controls, the dominant hand was stronger than the non-dominant hand, which suggests that some OW had also occurred in their patients.

Van Pomeren et al. also cited 2 clinical trials (5, 6) on limb strength training to support their hypothesis of no risk of OW in CMT. In both of these studies the resistance exercises included only proximal muscles (hip, knee and elbow activators), which are relatively spared by the disease (7), maximal resistance was never used, and the sessions and the training period were short, which may be why these exercises were not harmful.

On the contrary, prolonged maximal contraction of the distal muscles, the axons of which are selectively involved in a length-dependent neuropathy such as CMT, as required by some occupational activities or compensations, can result, in time, in permanent damage, as we have observed in numerous patients after long periods of intense handwriting or using a computer mouse (8–9).

To conclude, despite the fact that a direct demonstration of OW cannot be given, because a study of OW using exercise against maximal resistance would be unethical as it may lead to permanent loss of muscle strength, there is sufficient evidence that OW also occurs in CMT.

We therefore conclude that it is appropriate to advise patients, especially if their form of CMT is not mild, about the proper use of their strength and about surgical or orthotic measures (8, 9) to maintain an active life without accelerating neuromuscular deterioration.

Submitted May 26, 2009; accepted June 23, 2009

Paolo Vinci, MD[1], Sandra Linet Perelli, MD[2] and Paola Gargiulo, MSc[1]*

From the [1]Service of Rehabilitation, Italian Charcot-Marie-Tooth Association (AICMT-Onlus), Via dei Castelli Romani 6, 00040 Rocca di Papa and [2]Unit of Rehabilitation, San Camillo-Forlanini Hospital, Rome, Italy. *E-mail: paolovinci@libero.it

RESPONSE TO LETTER TO THE EDITOR BY VINCI ET AL.

We read with interest the comments of Vinci et al. on our study (1) in which we found no indications of overwork weakness (OW) similar to those reported earlier by Vinci et al. (2)

In their comments on our study, Vinci et al. set out 2 main points. First, they argue that the different findings in both studies may be related to more severe muscle weakness in their population and that more severely impaired patients would be more susceptible to OW. Secondly, they argue that our population, as well as that of Carter et al. (3), may have OW, since the dominant hand in these 2 studies is not significantly stronger than the non-dominant hand.

The difference in population pointed out by Vinci et al. is important. In general, our sample of patients is smaller, relatively heterogeneous, and apparently less seriously affected (2). However, we added a more quantitative and reliable method for assessing intrinsic muscle strength (10) to the adapted Medical Research Council scale used by Vinci et al. (2). While it seems logical that there is a higher risk of overuse in subjects with more severe involvement, we also found no indications of OW in our subpopulation of patients with severe muscle weakness (MRC < 3) when comparing the strength of both hands.

We do not agree with Vinci et al. that our patients and those studied by Carter et al. (3) have OW based on the reported symmetry in hand strength. The assumption that the dominant hand is stronger in the absence of OW is controversial. When reviewing the literature, a large number of studies on healthy subjects can be found that report symmetry in grip strength between both hands (e.g. 4, 11–14). In addition, Burns et al. (15) have shown, in a large homogeneous group of children with Charcot-Marie-Tooth (CMT) disease type 1A, that grip and pinch strength develop symmetrically, indicating no OW in this group. When looking at other aspects of hand function, Videler et al. (16) reported no differences in sum scores for the Sollerman Hand function test in a homogeneous group of subjects with CMT disease type 1A between both hands, also not indicating the presence of OW in this population.

In summary, we believe that discussing the conflicting results between our study and that of Vinci et al. is highly relevant, since the presence of OW would have direct implications for prescribing rehabilitation protocols and for advising on activities of daily living. Unfortunately, at present, non-reversible damage due to OW cannot be detected using reliable and objective diagnostic methods. In addition, there are no controlled studies to indicate whether training of severely impaired CMT patients leads to OW (17). Since the hypothesis of OW has such major treatment implications, we would encourage other groups to study this phenomenon in their population and report the outcomes.

Wim G. M. Janssen, MD[1], Ruud W. Selles, PhD[1,2], Madlenka van Pomeren, MD[1,3], Berbke T. J. van Ginneken, PhD[1], Ton A. R. Schreuders, PT, PhD[1] and Henk J. Stam, MD, PhD, FRCP[1]*
From the [1]Department of Rehabilitation and [2]Department of Plastic and Reconstructive Surgery, Erasmus MC, University Medical Center Rotterdam, Rotterdam and [3]Rehabilitation Center Sophia Revalidatie, The Hague, The Netherlands
*E-mail: w.janssen@erasmusmc.nl

REFERENCES

1. Van Pomeren M, Selles RW, Van Ginneken BTJ, Schreuders TAR, Janssen WGM, Stam HJ. The hypothesis of overwork weakness in Charcot-Marie-Tooth: a critical evaluation. J Rehabil Med 2009; 41: 32–34.
2. Vinci P, Esposito C, Perelli SL, Antenor JA, Thomas FP. Overwork weakness in Charcot-Marie-Tooth disease. Arch Phys Med Rehabil 2003; 84: 825–827.
3. Carter GT, Abresch RT, Fowler WM Jr, Johnson ER, Kilmer DD, McDonald CM. Profiles of neuromuscular diseases. Hereditary motor and sensory neuropathy, types I and II. Am J Phys Med Rehabil 1995; 74 Suppl 5: S140–S149.
4. Incel NA, Ceceli E, Durukan PB, Erdem HR, Yorgancioglu ZR. Grip strength: effect of hand dominance. Singapore Med J 2002; 43: 234–237.
5. Lindeman E, Leffers P, Spaans F, Drukker J, Kerckhoffs M, Koke A. Strength training in patients with myotonic dystrophy and hereditary motor and sensitive neuropathy: a randomized clinical trial. Arch Phys Med Rehabil 1995; 76: 612–620.
6. Chetlin RD, Gutmann L, Tarnopolsky M, Ullrich IH, Yeater RA. Resistance training effectiveness in patients with Charcot-Marie-Tooth disease: recommendations for exercise prescriptions. Arch Phys Med Rehabil 2004; 85: 1217–1223.
7. Vinci P. Strengthening of the proximal muscles in Charcot-Marie-Tooth disease. Arch Phys Med Rehabil 2001; 4: 563.
8. Vinci P. Rehabilitation management of Charcot-Marie-Tooth disease. Rome: I:SIE; 2001.
9. Vinci P. Approccio clinico e riabilitativo alla malattia di Charcot-Marie-Tooth [A clinical and rehabilitative approach to the Charcot-Marie-Tooth disease]. In: Valobra GN, Gatto R, Monticone M, editors. Trattato di medicina fisica e riabilitativa. Torino: UTET; 2008, p. 2363–2374 (in Italian).
10. Selles RW, van Ginneken BT, Schreuders TA, Janssen WG, Stam HJ. Dynamometry of intrinsic hand muscles in patients with Charcot-Marie-Tooth disease. Neurology 2006; 67: 2022–2027.
11. Anakwe RE, Huntley JS, McEachan JE. Grip strength and forearm circumference in a healthy population. J Hand Surg Eur Vol 2007; 32: 203–209.
12. Armstrong CA, Oldham JA. A comparison of dominant and non-dominant hand strengths. J Hand Surg [Br] 1999; 24: 421–425.
13. Tanaka M, McDonagh MJ, Davies CT. A comparison of the mechanical properties of the first dorsal interosseous in the dominant and non-dominant hand. Eur J Appl Physiol Occup Physiol 1984; 53: 17–20.
14. Kadir E, Ahmet H, Aymelek C, Nurzat E, Saim Y, Haci B, et al. An investigation of hand dominance, average versus maximum grip strength, body mass index and ages as determinants for hand evaluation. Isokinetics Exercise Sci 2005; 13: 223–227.
15. Burns J, Bray P, Cross LA, North KN, Ryan MM, Ouvrier RA. Hand involvement in children with Charcot-Marie-Tooth disease type 1A. Neuromuscul Disord 2008; 18: 970–973.
16. Videler AJ, Beelen A, van Schaik IN, de Visser M, Nollet F. Manual dexterity in hereditary motor and sensory neuropathy type 1a: severity of limitations and feasibility and reliability of two assessment instruments. J Rehabil Med 2008; 40: 132–136.
17. Krivickas LS. Exercise in neuromuscular disease. J Clin Neuromuscul Dis 2003; 5: 29–39.