

The Thigh Corset: Its Effects on the Quadriceps Muscle and its Role in Prosthetic Suspension

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The present study aims at evaluating the etiology of the frequently observed atrophy of the thigh in patients who use thigh corsets.^{1,2} This was done on the basis of femoral nerve conduction studies and electro-myographic findings in the quadriceps muscle. Measurements of thigh circumference were used to quantitate volume changes in the thigh.

The purpose of the thigh corset is to distribute the weight-bearing surface area of the stump while suspending the below knee prosthesis. It also adds increased sensory feedback and additional mediolateral stability. A commonly observed clinical finding among users of the corset is a decrease in the soft tissue bulge of the thigh. Whether this is the result of neuropathic or myopathic changes due to either the corset, the underlying disease process, or the result of disuse, has not been clearly defined.

MATERIALS AND METHODS

Five patients using thigh corsets were included in this study. Four were males, one was female; all were in the age group between 61-78 years. One patient had bilateral amputations (case #5) but only used

the thigh corset unilaterally. The age, date of amputation, date of prosthetics and corset fitting and past medical history are shown in Table 1.

The circumference of the thigh was measured bilaterally at the junctional level between the middle and lower third of the thigh. The length of the thigh was defined as the distance between the anterior superior iliac spine and the medial tibial plateau. Bilateral femoral nerve conduction studies were performed stimulating just below the inguinal ligament as described by Gassel (1963).⁹ Measurement of the distance was made from the cathode of the bipolar stimulating electrode to the active recording electrode. The temperature of the patient's extremity was controlled to 90-92°F. The latencies were measured and plotted against the distance to the recording surface electrodes (TECA #6030). The response was recorded with a DISA electromyograph system. Needle EMG studies were carried out in the vastus lateralis and medialis of both sides; first at rest, then with increasing effort and maximal effort—using a method described by Buchtal⁷ (1957, in his study of normal subjects).

Similar to Buchtal's study, the measurements of duration and number of phases were taken in at least 20 action potentials in

Patient	Age	Amput.	Age Corset	PMH
C. R.	67	R 1/80	8/80	DM PVD
T. McD.	62	R 1974	1976	DM PVD
M. L.	78	L 1976	1976	DM PVD
T. C.	76	L 1955	1955	
A. L.	61	Bil. 1979	1979	DM

Table 1. Patients using the corset.

each muscle site. Three sample sites were used in each muscle studied. The values were compared to the normal values of the same age group using needle electrodes (Buchtal 1957) and also compared to the contralateral side. A deviation of + 25 percent of the mean value was considered normal.

amputation with thigh corset on one side) had increased duration in the vastus medialis of both sides and Case #1 had symmetrically increased duration in both of the vastus muscles. All patients showed mild increases in the percentage of polyphasic potentials.

Patient	Total Thigh	Circumference	
	Length	R	L
#1 R. C.	43 cm.	52 cm. amp.	60
#2 M. T.	55 cm.	50 cm. amp.	56
#3 L. M.	46 cm.	51	45 amp.
#4 C. T.	48 cm.	46	34 amp.
#5 L. A.	45 cm.	40	39 amp.

Table 2.

RESULTS

Reduction of the circumference of the thigh as compared to the contralateral side was present in four cases (Table 2). Case #5 with bilateral amputation had almost symmetrical wasting. Femoral nerve conduction latencies were normal in three cases. Patient #4 (the eldest of the group) had bilateral increased latencies and patient #3 had a mild increase in the contralateral side (Figure 1).

Needle EMG findings were characterized by a reduction of motor unit potentials and of either poor recruitment or occasional spontaneous activity at rest. Measurements of the mean duration of at least 20 action potentials in each sampled site is represented in Table 3. They were found to be within normal limits in three patients and increased in two. Patient #5 (bilateral

DISCUSSION

Atrophy of the quadriceps muscle may arise from a variety of disorders; neurogenic causes include peripheral neuropathy or compression of the nerves supplying the muscle, e.g., pneumatic tourniquette compression of the thigh (Weingarden 1977).¹⁶ Myopathic processes include intrinsic muscle disease or myofibrotic changes following intramuscular injections (Alvarez 1980),¹ (Hollaert 1975).¹¹ Disuse atrophy of the thigh resulting from prolonged immobilization has been studied with CAT scanning techniques. These studies have described the wasting to be primarily restricted to the quadriceps muscle. The electromyographic and histological aspects of this disorder are well documented both in humans (Wolf 1971)¹⁷, (Brooks 1970),² and animals (Patel 1969).¹⁴

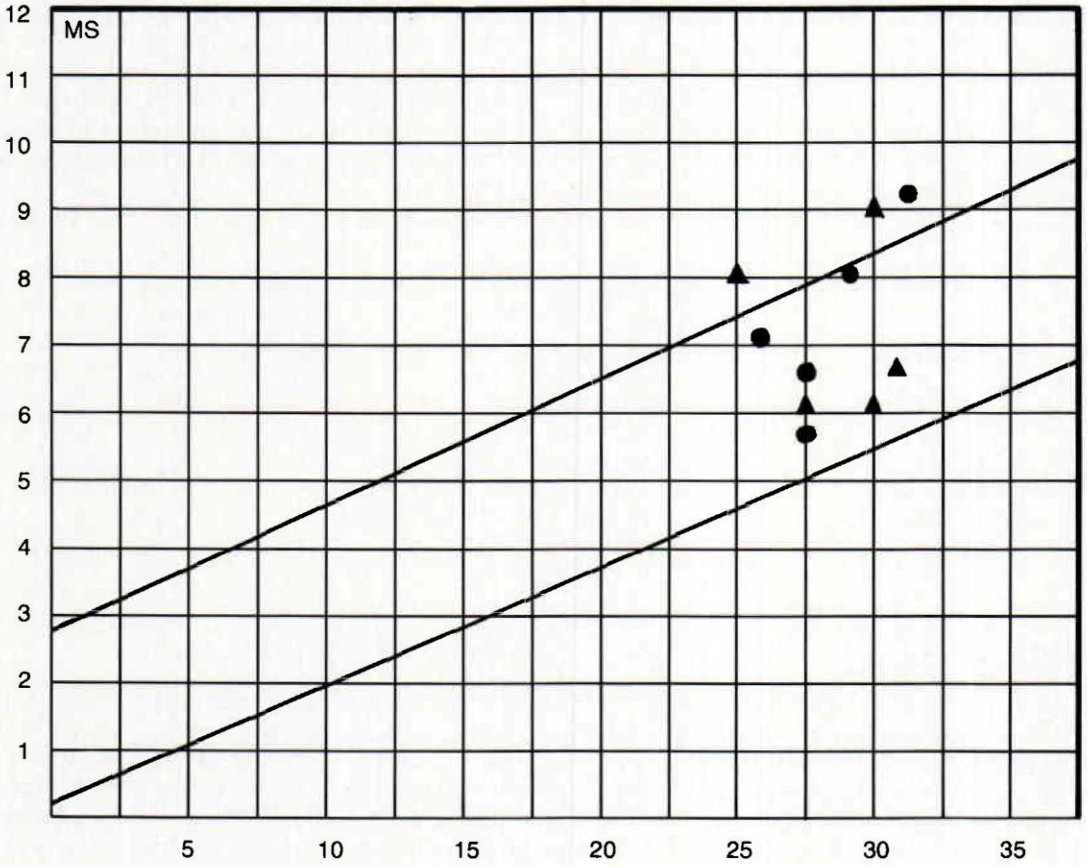


Figure 1. Femoral nerve latencies against the distance. Lines indicate normal usage (Gassell 1963).

A brief review of the electrodiagnostic findings of old age is helpful before commenting on our findings. Changes in conduction velocity were reported first by Norris, Shock, and Wagman in 1953¹³, and were later confirmed by others (Campbell 1973)⁶. Buchtal was the first to report changes in duration and shape of action potentials in the elderly (Buchtal 1954)³ with an increase in both mean value and standard deviation in subjects over 70. A significant reduction in the number of motor unit potentials was found by Campbell, et. al. to be the major EMG findings in the muscles of the older population. Awad in 1977, using the Willison method for automatic analysis, found evidence of increasing mild chronic partial denervation. Therefore, the electrophysiologic data of the present study indicated in Figure 1 and Table 3 excludes the diagnosis of myopathy as the cause of the muscle wasting, both in terms of quantitative and qualitative electromyography. The differential diagnosis should therefore consider neurogenic or disuse atrophy. Considering the age group of the patients studied, the only criteria is the duration of the action potentials. In neurogenic atrophy, the duration is found to be increased (Buchtal and Pinelli 1953)⁵ while in disuse atrophy, the mean duration remains within normal limits (Quidin 1980),¹² (Wolf 1971).¹⁷

In the present series of patients, duration remains within normal limits in three out of five patients. In two cases, an increase in duration was found but this involved both legs; hence, the increase in duration may be unrelated to the corset. Furthermore, in Case #5, the patient had bilateral amputation and used a thigh corset on one side only. He was found to have identical cir-

cumference of thigh in both legs and bilateral increase in motor unit action potential duration. Therefore, with the limited sample of patients included in this study, it can be suggested that:

- A. The atrophy of the thigh observed in amputees using the thigh corset does not seem to be the result of either neuropathic or myopathic injury from the corset itself.
- B. In our series, the quadriceps atrophy correlates with the electromyographic characteristics of disuse. This probably relates to the fact that in our patients, the corset suspension was selected because these were marginal ambulators.
- C. The corset itself may be uncomfortable to wear, which may further discourage activity of the amputated extremity and manifest as quadriceps atrophy.
- D. In our series, the electrical abnormalities also may be related to the underlying disease (e.g., diabetes or PVD).

Further studies, perhaps in a younger or more active age group, could further define the presence of degree of atrophy. In an extremity that has more than the marginal function of our geriatric age group, perhaps the findings should not be as significant.

Nevertheless, the data from our work and related studies indicate that the thigh corset offers no direct harmful effects to those who wear it. The energy cost of the corset suspension has been shown to be equivalent to the supracondylar cuff (Cummings).⁸ It has been employed with success in pediatric settings where physiologic knee instability or genu valgum

Patient	Years of Use	VASTUS LATERALIS		VASTUS MEDIALIS	
		Corset	Noncorset	Corset	Noncorset
No. 1	1 year	20.4 (+31%)	17.1 (+9.6%)	19.4 (+97%)	16.4 (+30%)
No. 2	7 years	14.6 (-2.6%)	16.28 (+8.5%)	13.8 (+14%)	14.8 (+22%)
No. 3	5 years	15.5 (-1.8%)		13.8 (+6.1%)	
No. 4	26 years	16.8 (+9.3%)	21.3 (+32%)	13.5 (+3.8%)	20.6 (+5%)
No. 5	3 years	15.9 (+6.0%)	15.3 (+2%)	19.9 (23.1%)	15.1 (29%)

Table 3. Mean deviation of M.V.P. and deviation from mean normal.

exists. It has also been recognized for providing significant relief from excessive pressure on the patellar tendon and has therefore been popular among diabetics, and those who subject their residual limb to prolonged use. It has been effective in assisting greater mediolateral stability in those patients having a short residual limb.

NOTES

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