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Effect of "Neurotripsy" on the Partially Denervated Muscle of the Dog.*

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Regenerating nerve fibers may produce an increased number of axone branches. Billig, van Harreveld, and Wiersma[1] have applied this principle in their treatment of paretic muscles by a procedure which they have called "neurotripsy." This technic consists of either crushing the nerve as it enters the paretic muscle—surgical "neurotripsy"—or of a forceful massage of the affected part which is directed at breaking nerve fibers within the muscle sheath—closed manual "neurotripsy." Upon regeneration of the traumatized or broken nerve fibers, it is assumed that an increased number of axone branches may innervate a greater number of motor end plates. According to these authors, "neurotripsy," performed on muscles paralyzed by anterior poliomyelitis, has resulted in an increase in strength of approximately one half of a grade rated according to the Lovett System. Maximum effect was observed after about one year, although a considerable proportion of the total improvement was evident at 3 months. Muscles of low rating seemed to respond better than those of higher ratings. Increases in action potentials were parallel to increases in strength.

Prior to the report by these authors, Hines, Wehrmacher, and Thomson[2] had found that crushing the tibial nerve to the partially denervated gastrocnemius muscle of the rat resulted in a decrease in strength and weight of the muscle. Hodes[3] observed in patients with anterior poliomyelitis that there was a decrease in the action potentials of paretic muscles during the first four months following closed manual "neurotripsy." From 4 to 8 months after the operation the action potentials were slightly greater than those of controls and at more than 8 months there was an average increase in action potentials of 22%. Muscles which showed no electrical activity before the operation likewise showed no electrical activity after the operation.

This article is a preliminary report on studies which were undertaken to determine the effect of closed manual "neurotripsy" on the partially denervated anterior tibial muscle of the dog. The plan was to produce a partial, pure motor denervation of the anterior tibial bilaterally, to subject one anterior tibial to the operation, and to use the other as the control. For this experiment to be valid the following conditions would have to be fulfilled:

1. The strength and weight of the two normal anterior tibial muscles must be closely correlated.

2. The contribution of the ventral root of each spinal nerve supplying the anterior tibial must be determined.

3. The contribution of the ventral root of each spinal nerve must be the same for both left and right anterior tibial muscles.

4. Following bilateral section of identical ventral roots, the rate of atrophy and strength loss of the two muscles must be closely correlated.

Method. The partial denervation was accomplished by sectioning the ventral root of L_6 bilaterally. Closed manual "neurotripsy†" was performed on one anterior tibial muscle three months later and the animal sacrificed 5 months after the initial lesion. Autopsy was performed to check for any nerve regen-

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1 Billig, H. E., van Harreveld, A., and Wiersma, C. A. G., *J. Neuropath. and Exp. Neur.*, 1946, **5**, 1.

2 Hines, H. M., Wehrmacher, W. H., and Thomson, J. D., *Am. J. Physiol.*, 1945, **145**, 48.

3 Hodes, R., *Fed. Proc.*, 1948, **7**, 56.

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TABLE I.
Mean Weight and Total Strength in Grams of Anterior Tibial Muscles.

	No. animals	Left	Right	t ratio	Correlation coef.
Total strength	31	3870	4020	1.18	.82
Weight	17	7.24	7.23	.24	.98

TABLE II.
Average Strength in Grams Developed by Anterior Tibial Muscles by Stimulation of Ventral Roots of Spinal Nerves.

No. animals	Nerve stim.	Left	Right	t ratio	Correlation coef.
21	L_4	108	100	.48	.40
21	L_5	504	509	.05	.83
20	L_6	2810	3015	.38	.80
20	L_7	342	323	.20	.23

TABLE III.
Average Strength and Weight in Grams of Anterior Tibial Muscles Following Bilateral Resection of Ventral Root L_6

	3 mos. after oper.; 6 animals				5 mos. after oper.; 5 animals			
	Left	Right	t ratio	Corr. coef.	Left	Right	t ratio	Corr. coef.
Strength direct stim.	1917	2000	0.58	.989	1800	1660	.78	.972
Strength sciatic stim.	1683	1883	1.45	.990	1540	1400	.55	.948
Weight	5.56	5.23	1.41	.979	5.14	4.92	.49	.915

eration and to verify the resected root. All animals showing any signs of regeneration were discarded. The contribution of the ventral roots supplying the anterior tibial muscle was determined in a group of normal dogs by recording the maximal tension developed by the muscle upon electrical stimulation of the individual ventral roots (L_4 to L_7 inclusive). Tension development was measured by a torsion myograph of the Blix type.

The control animals were subjected to a bilateral section of ventral root L_6, and with no further treatment they were sacrificed three and five months following the production of the original lesions. Wet weights and tension development upon maximal direct and indirect stimulation of the muscles were determined. Statistical analysis of the experimental data was carried out by the method of paired comparisons.

Results. Our experimental findings may be summarized as follows:

1. There was no significant difference between mean strengths and weights of the two normal anterior tibial muscles, and a high degree of correlation between the muscles of the same animal. (Table I).

2. L_6 supplied approximately 75% of the motor innervation to the anterior tibial. L_4, L_5, and L_7 supplied the remaining motor fibers (Table II).

3. In the individual animals the contribution of each L_5 and L_6 was practically the same for left and right muscles as indicated by the correlation coefficient (Table II).

4. At 3 months and at 5 months after bilateral resection of the ventral root of L_6 the loss of strength and degree of atrophy of the left and right anterior tibials was the same (Table III).

5. Two months after "neurotripsy," there was no significant difference in either weight or strength between the treated and untreated muscle (Table IV).

Discussion. Billig, van Harreveld, and Wiersma found that a considerable proportion of the improvement in their patients was evident at 3 months after "neurotripsy;" likewise, a better response was obtained on poorer muscles. The two-month interval following

TABLE IV.
Average Strength and Weight in Grams of Anterior Tibial Muscles After Neurotripsy on One Side.

	2 mos. after neurotripsy; 5 animals			
	Treated	Untreated	t ratio	Corr. coef.
Strength direct stim.	1980	2140	.68	.819
Strength sciatic stim.	1700	1860	.88	.869
Weight	5.48	5.74	.88	.813

"neurotripsy" in the dog should be long enough to bring out any improvement resulting from the treatment. Our failure to demonstrate any such improvement in weight and strength of the treated muscles would indicate that in the dog this procedure does not increase the residual innervation of the partially denervated muscle. However, additional experimental animals with a greater degree of denervation are being run for a longer period of time following the "neurotripsy" procedure.

The results indicate that stimulation of the spinal nerves exclusive of L_6 yields approximately 1000 g of tension for each muscle. However, three months after bilateral resection of L_6, each muscle showed an average strength of approximately 1950 g and 5 months after bilateral resection a strength of approximately 1900 g. This may indicate that following partial denervation there may be an increase in the residual innervation as suggested by some investigators[2,4,5] or hypertrophy of the remaining innervated muscle fibers. This phenomenon is being investigated further.

Summary. Treatment of the partially denervated anterior tibial muscle of the dog with closed manual "neurotripsy" produces no significant increases in wet weight and muscle strength 2 months after treatment.

4 Weiss, P., and Edds, Jr., *Am. J. Physiol.*, 1946, **145**, 587.

5 Van Harreveld, A., *Am. J. Physiol.*, 1945, **144**, 477.

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Isolation of Brucella from Apparently Healthy Individuals.

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In recent years the isolation of brucella organisms from cases of Hodgkin's disease[1] has caused considerable discussion. The confirmation of this finding in our laboratory and the statements in the literature that these organisms could be isolated from patients with various infections[2] led us to seek an explanation.

It seemed to us that the most likely explanation was that infection with brucella was widespread, at least in certain regions, and that the organism persisted in people furnishing favorable foci. In order to test this hypothesis it was decided to explore the possibility that tissues affording good conditions for growth of brucella organisms might actually harbor them. Since brucella are known

1 Parsons, P. B., and Poston, M. A., *South. Med. J.*, 1939, **32**, 7; Forbus, W. D., and Gunter, J. N., *South. Med. J.*, 1941, **34**, 376.

2 Mettier, S. R., and Kerr, W. J., *Arch. Int. Med.*, 1934, **54**, 702; Chaikin, N. W., and Schwinner, David, *Rev. Gastroenterol.*, 1943, **10**, 130; Amoss, H. L., *Internat. Clin.*, 1931, **4**, 93.