

Therapeutic Effects of Extracorporeal Shock Wave Therapy on Patients with Spastic Cerebral Palsy and Rett Syndrome

Ting-Yu Su, Yu-chi Huang, Jih-Yang Ko, Yi-Jung Hsin, Min-Yuan Yu, Pi-Lien Hung

Department of Pediatric Neurology; Department of Physical Medicine and Rehabilitation; Department of Orthopedic Surgery; Center for Shockwave Medicine and Tissue Engineering, Kaohsiung Chang Gung Memorial Hospital, Kaohsiung, Taiwan

Material and Methods

Patients diagnosed with spastic CP and Rett syndrome received 1500 impulses of ESWT at 4 Hz and 0.1 mJ/mm², on their spastic legs once weekly for a total of 12 weeks. Outcomes were assessed before and 4 and 12 weeks after ESWT [Figure 2]. Clinical assessments included the Modified Ashworth Scale (MAS), passive range of motion (PROM), and Gross Motor Function Measure 88 (GMFM-88). Ultrasonographic assessments included muscle thickness, acoustic radiation force impulse (ARFI), and strain elastography [Figure 3].

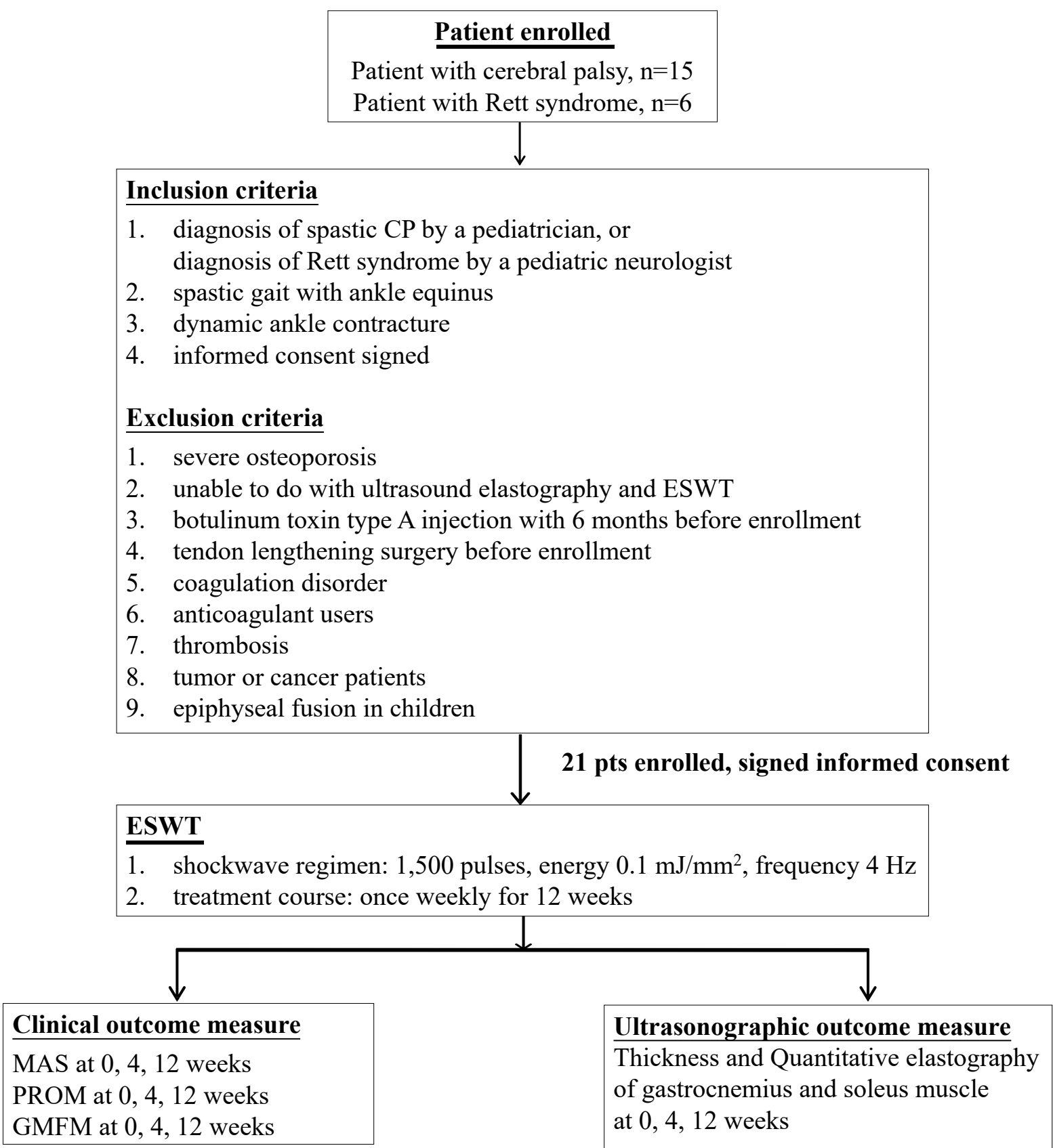
Results

Fifteen patients with CP and six with Rett syndrome were enrolled in this study. After ESWT, patients with CP showed significant clinical improvement in the MAS ($P = 0.011$), ankle PROM ($P = 0.002$), walking /running/jumping function ($P = 0.003$), and total function ($P < 0.001$) of the GMFM-88. The patients with Rett syndrome showed improved MAS scores ($P = 0.061$) and significantly improved total gross motor function ($P = 0.030$) [Table 2, Figure 4]. Under ARFI, patients with CP demonstrated decreased shear wave speed in the gastrocnemius medial head ($P = 0.038$). Conversely, patients with Rett syndrome show increased shear-wave speeds after ESWT [Table 3].

Conclusions

Our study provides evidence that a weekly course of low-dose ESWT for 12 weeks is beneficial for children with both CP and Rett syndrome, with the clinical effects of reducing spasticity and improving the gross motor function of the lower limbs. The ARFI sonoelastography reveals improvement of muscle stiffness in patients with CP after ESWT, but deteriorated in patients with Rett syndrome. The diverse therapeutic response to ESWT may be caused by the MECP2 mutation in Rett syndrome, having a continuous impact and driving the pathophysiology differently as compared to CP, which is secondary to a static insult.

Study Design



CP, Cerebral Palsy; ESWT, Extracorporeal Shockwave Therapy; MAS, Modified Ashworth Scale; PROM, Passive Range of Motion; GMFM, Gross Motor Function Measure

Fig. 1 The illustrative presentation of the study design for ESWT therapy

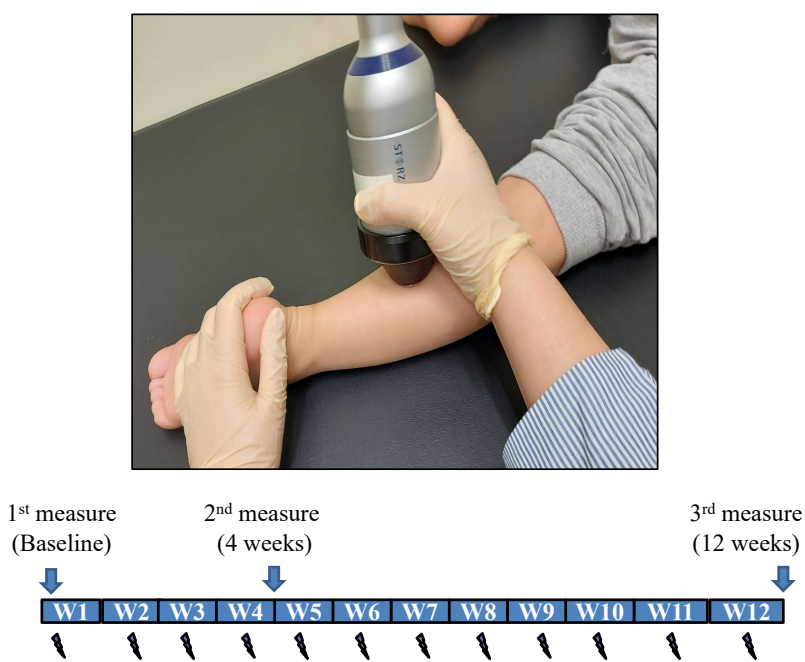


Fig. 2 The ESWT stimulating site and the time course of ESWT and outcome measurement

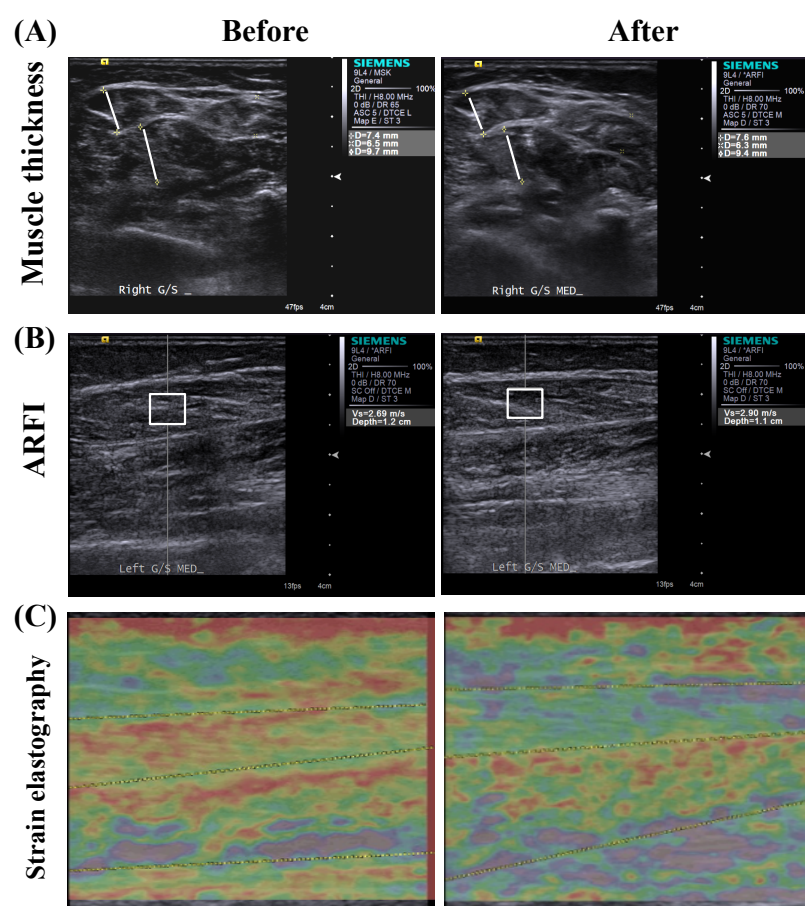


Fig. 3 The ultrasonographic images recorded before and after ESWT. A muscle thickness, B ARFI, and C strain elastography

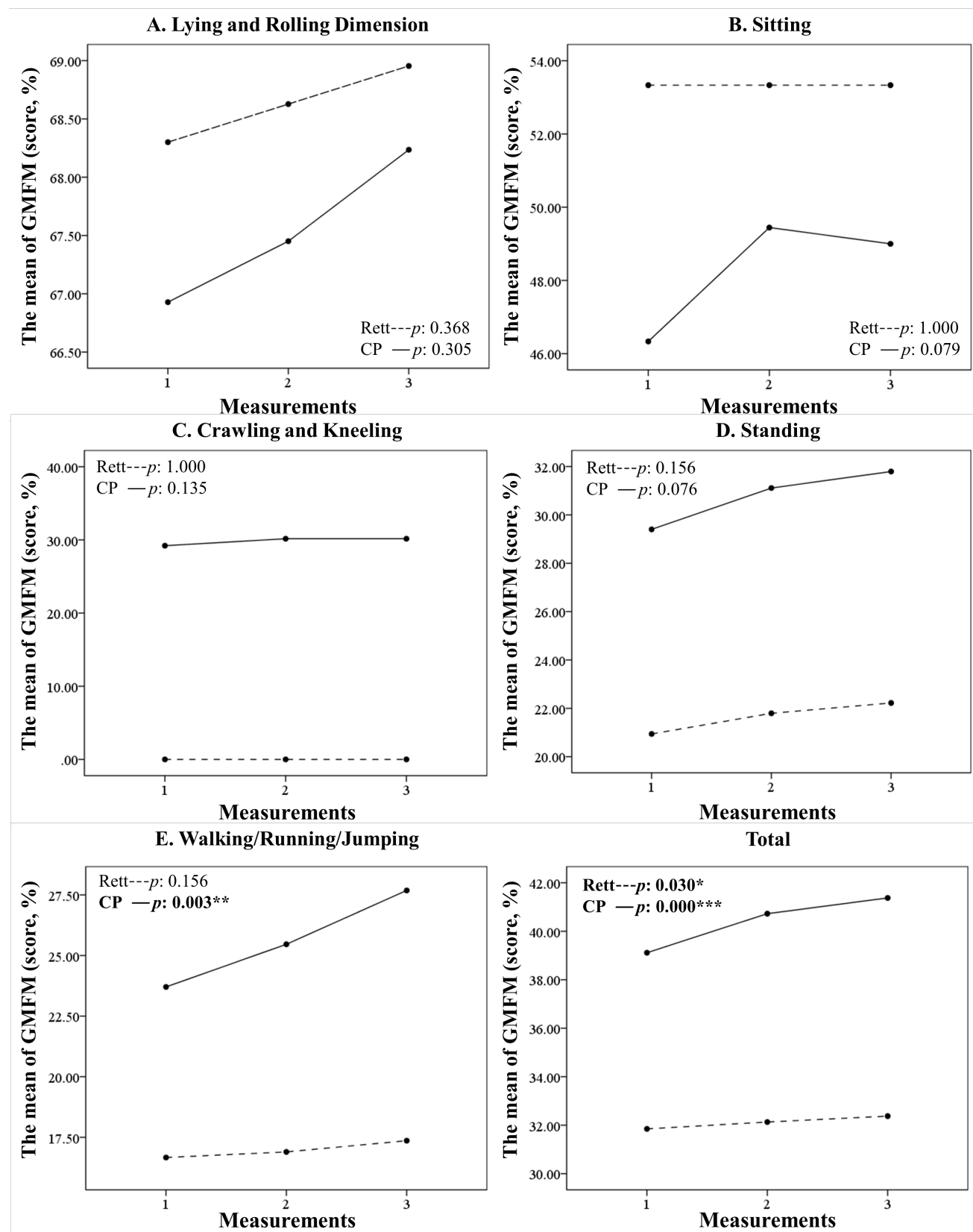


Fig. 4 The GMFM-88 of lower extremities before and after ESWT in patients with CP and Rett syndrome. The walking/running/jumping function score increased significantly in the CP group (E), and the total function score increased significantly in both groups (F).

Table 2. Clinical measurement results at baseline and after 4 weeks and 12 weeks of ESWT

Variables (Mean±SEM)	RETT Measurements				CP Measurements				Comparison of two groups	
	1 (Baseline)	2 (4 weeks)	3 (12 weeks)	p^a	1 (Baseline)	2 (4 weeks)	3 (12 weeks)	p^a	p^b	p^c
MAS of ankle plantar-flexors										
	4.00±0.26	3.50±0.43	3.33±0.49	0.061	2.20±0.30§	1.63±0.31	1.50±0.28§	0.011*	0.003**	0.930
Ankle PROM (°)										
	57.08±3.68	58.33±3.07	58.33±3.07	0.135	47.50±3.88	55.00±2.20	55.50±2.07	0.002**	0.177	0.020*

Table 3. Ultrasonographic measurement results at baseline and after 4 weeks and 12 weeks of ESWT

Variables (Mean±SEM)	RETT Measurement				CP Measurement				Comparison of two groups	
	1 (Baseline)	2 (4 weeks)	3 (12 weeks)	p^a	1 (Baseline)	2 (4 weeks)	3 (12 weeks)	p^a	p^b	p^c
Muscle thickness (mm)										
GCM-M	10.12±0.41	11.8±0.84	11.28±0.77	0.260	10.24±1.14	11.29±0.95	11.52±0.90	0.145	0.726	0.886
SOL	11.31±1.17	10.78±0.81	9.77±0.88	0.154	11.17±1.19	10.60±0.85	10.58±0.78	0.158	0.938	0.426
GCM-L	8.41±0.87	7.26±0.71	8.06±0.55	0.223	7.64±0.69	8.13±0.68	7.93±0.60	0.617	0.586	0.361
ARFI shear wave speed (m/s)										
GCM-M	1.46±0.35§	1.96±0.23	2.42±0.14§	0.030*	2.59±0.13	2.40±0.14	2.35±0.11	0.038*	0.010*	0.000***
SOL	1.24±0.18§	1.71±0.19	1.97±0.13§	0.030*	2.00±0.12	1.87±0.10	1.87±0.09	0.189	0.008**	0.000***
GCM-L	1.50±0.24	1.93±0.21	2.11±0.11	0.115	2.29±0.10	2.21±0.14	2.20±0.11	0.766	0.009**	0.000***

p -value: * <0.05 , ** <0.01 , *** <0.001

p^a : Comparison between three assessing time points, Friedman's two-way analysis of variance

p^b : Comparison between the group of Rett syndrome and CP at baseline, Mann-Whitney Test

p^c : Comparison of the alteration from baseline to 12 weeks between the group of Rett syndrome and CP, GEE

§: Comparison between baseline and 12th week, p -value: <0.05 , multiple comparison of Friedman's two-way analysis of variance

CP: Cerebral palsy; RETT: Rett syndrome; SEM: standard error of the mean; GCM-M: gastrocnemius medial head; SOL: soleus muscle; GCM-L: gastrocnemius lateral head

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