Isometric muscle activation of the serratus anterior and trapezius muscles varies by arm position: a pilot study with healthy volunteers with implications for rehabilitation

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背景

肩甲骨周囲筋のバランスとしてUT/SA、UT/MT、UT/LT比が使用されている。それぞれの比を低くするトレーニング方法が報告されているが、肩関節疾患患者には負荷が強いもの多い。

そこで、等尺性運動の評価を、上肢の肢位を変えて調査することで、UTの活動を抑制し、SA、MT、LTを活動させる肢位を検討した。

方法

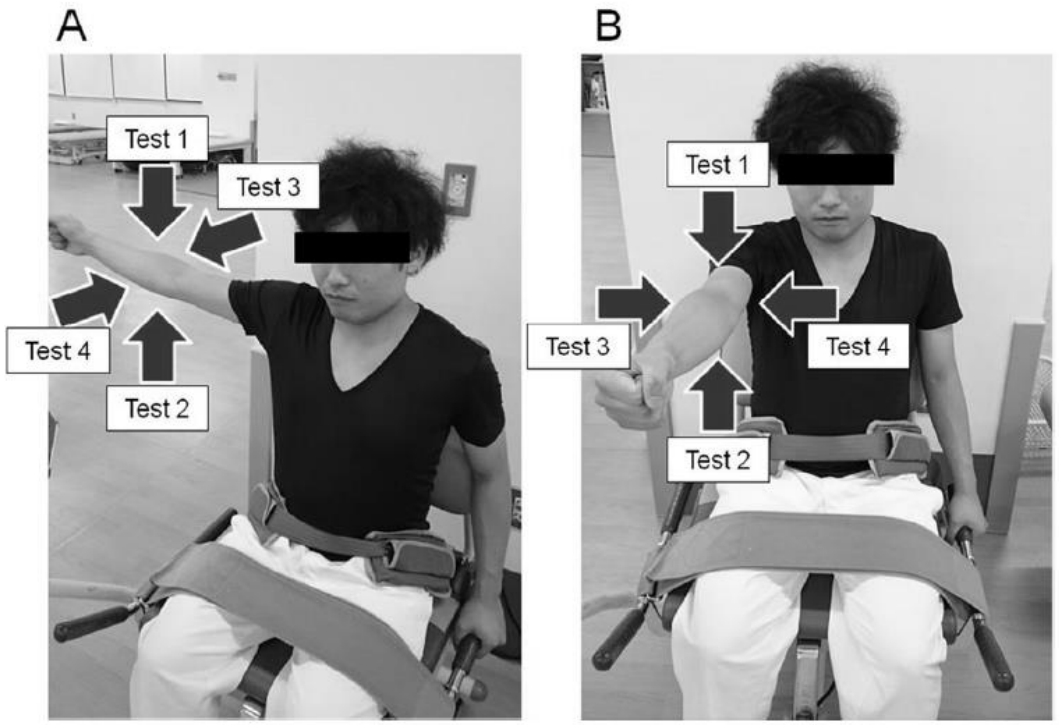

Figure 1 Tests 1 through 4 performed in the sitting position in the frontal plane (at the 90° elevated position) **(A)** and in the sagittal plane (at the 90° elevated position) **(B)**. The *arrows* indicate the directions of the applied forces.

結果

Table I Electromyographic activities in frontal plane

Humeral elevation	% MVIC, mean ± SD				*P* value		
	Test 1	Test 2	Test 3	Test 4	Angle effect	Test effect	Interaction
Serratus anterior							
30°	87.0 ± 43.6	43.6 ± 31.7	45.7 ± 55.5	70.5 ± 24.8			
60°	109.7 ± 49.9	48.6 ± 46.4	40.3 ± 51.9	86.1 ± 43.9			
90°	133.1 ± 82.5	38.9 ± 36.7	35.2 ± 55.3	77.9 ± 35.9	.713	<.001	.417
120°	124.1 ± 57.3	34.9 ± 35.3	27.3 ± 41.8	60.0 ± 38.2			
150°	111.4 ± 48.3	32.9 ± 34.0	58.6 ± 56.9	46.3 ± 31.0			
Upper trapezius							
30°	78.6 ± 25.5	3.7 ± 1.1	34.4 ± 19.0	22.7 ± 18.3			
60°	87.4 ± 13.1	6.8 ± 7.5	51.8 ± 21.8	16.8 ± 17.5			
90°	89.3 ± 18.7	6.2 ± 8.4	55.7 ± 18.1	13.9 ± 15.0	.037	<.001	<.001
120°	82.0 ± 17.3	6.1 ± 10.4	72.9 ± 23.7	13.6 ± 19.4			
150°	82.9 ± 21.2	5.9 ± 9.0	88.8 ± 19.6	5.1 ± 6.3			
Middle trapezius							
30°	66.8 ± 21.2	15.8 ± 8.7	61.1 ± 18.3	24.4 ± 12.0			
60°	69.2 ± 21.0	17.8 ± 9.4	69.7 ± 20.8	13.6 ± 6.0			
90°	61.0 ± 24.8	13.0 ± 6.0	80.2 ± 29.6	8.2 ± 4.5	.229	<.001	<.001
120°	44.1 ± 23.0	9.8 ± 6.5	78.9 ± 26.7	7.1 ± 5.7			
150°	35.6 ± 22.6	16.1 ± 12.0	93.3 ± 27.7	6.1 ± 3.7			
Lower trapezius							
30°	52.8 ± 25.3	25.4 ± 17.5	33.4 ± 19.4	43.3 ± 13.3			
60°	59.6 ± 25.4	26.4 ± 22.7	44.1 ± 27.0	24.6 ± 13.9			
90°	53.3 ± 20.7	16.6 ± 11.2	50.4 ± 35.0	13.4 ± 8.0	.743	<.001	<.001
120°	61.9 ± 32.3	17.8 ± 12.1	64.7 ± 33.6	10.5 ± 8.9			
150°	40.2 ± 19.1	20.9 ± 12.2	85.9 ± 40.5	7.6 ± 3.9			

Test 1 applied force to the arm from the upper to lower side; test 2, from the lower to upper side; test 3, from the lateral to medial side; and test 4, from the medial to lateral side.
MVIC, maximal voluntary isometric contraction.

結果

Table III Balance ratio in frontal plane

Humeral elevation	Balance ratio, mean ± SD			
	Test 1	Test 2	Test 3	Test 4
UT/SA				
30°	110.3 ± 66.5	14.4 ± 9.6	206.2 ± 181.1	35.0 ± 32.1
60°	89.7 ± 30.6	57.6 ± 117.1	321.7 ± 236.7	20.4 ± 22.2
90°	82.6 ± 39.3	48.3 ± 98.1	450.5 ± 383.7	22.1 ± 22.5
120°	84.9 ± 48.9	56.9 ± 140.0	747.9 ± 629.4	24.9 ± 30.7
150°	102.2 ± 82.5	43.4 ± 75.5	394.6 ± 423.1	18.9 ± 32.8
UT/MT				
30°	124.7 ± 41.2	28.8 ± 15.6	61.3 ± 39.6	88.8 ± 49.4
60°	135.1 ± 36.6	58.5 ± 96.5	77.6 ± 29.3	104.9 ± 72.5
90°	176.3 ± 105.1	40.5 ± 31.5	79.3 ± 39.9	160.6 ± 111.5
120°	223.2 ± 102.6	50.4 ± 37.3	112.7 ± 83.2	158.4 ± 133.7
150°	305.7 ± 199.3	36.7 ± 29.8	104.7 ± 45.4	85.7 ± 52.0
UT/LT				
30°	202.3 ± 191.4	22.7 ± 19.0	139.4 ± 110.5	49.1 ± 34.6
60°	180.5 ± 97.6	51.3 ± 88.6	149.6 ± 84.5	67.8 ± 55.3
90°	203.2 ± 115.5	33.4 ± 19.9	145.5 ± 71.5	106.7 ± 92.7
120°	181.1 ± 116.9	32.1 ± 27.8	148.8 ± 90.8	167.0 ± 305.5
150°	357.7 ± 457.8	29.2 ± 26.1	125.0 ± 61.0	59.1 ± 29.6

LT, lower trapezius; MT, middle trapezius; UT, upper trapezius.

結果のまとめ

SA：150度前方挙上位以外で、水平内転運動
MT：90度屈曲位で水平外転運動
LT：特定の肢位と運動は見いだせなかった

上記の肢位、運動がUTの活動を抑制し、それぞれの筋を強く収縮させることができると考えられる。