RECIPROCAL INHIBITION IN YOUNG AND OLD ADULTS

LAB REPORT

NEUROMUSCULAR CONTROL OF MOVEMENT
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INTRODUCTION

The H-Reflex can be defined as a reflex brief contraction of the calf muscle which is produced by an electrical stimulation of Ia sensory fibers. When an Ia fiber of a muscle is stimulated to provoque the H-Reflex and simultaneously the antagonist muscle is contracted isometrically there is a reciprocal inhibition of the H-Reflex which produce a decrease in its amplitud. This reciprocal inhibition is different in young and old adults and its analysis can, in part, explain some differences in controlling the movement.

METHODOLOGY

Persons:

10 persons less than 20 years old

10 persons over 65 years old

Experimental Conditions:

_.The tibial nerve was stimulated to produce the H-Reflex on the Soleus muscle.

_.1 ms electrical pulse was used.

_.The recording electro (EMG) was placed over the Soleus muscle

_.The stimulating electrodes are placed on the dorso-ventral axis (stimulating behind the knee).

_.At first, 5 trials of maximal voluntary contraction are done on the tibial anterior muscle.

_. Maximal H-wave (H-Reflex) is measured. 10 trials. Maximal M-wave is also recorded. (H-Reflex for Soleus muscle).

_. By using an osciloscope the person sustained a Tibial Anterior contraction at 10% of its maximal coluntary contraction and simultaneuosly the electrical stimulation was given to produce the H-Reflex of the Soleus muscle. Same condition at 20% of its maximal voluntary contraction.

RESULTS

See a more detailed information on the next pages.

Young Max.	Young Max. M		Young Cont	Young Control		Young 10%	Young 10%		Young 20%	Young 20%		RATIO	RATIO
3,2			1,5			0,9			0,8			0,46875	0,365854
5,6	Mean	7,19	2,3	Mean	3,79	1,2	Mean	1,61	1,1	Mean	0,78	0,410714	0,435484
5,9	Standard I	0,93	4,9	Standard	0,578	2,1	Standard I	0,24	0,9	Standard I	0,1	0,830508	0,313725
6,2	Median	6,05	3,4	Median	3,55	1,4	Median	1,4	0,7	Median	0,85	0,548387	0,392405
12,6	Mode	#N/A	7,5	Mode	4,9	3,2	Mode	2,1	1,2	Mode	0,9	0,595238	0,287129
5,1	Standard I	2,94	2,1	Standard	1,828	0,8	Standard I	0,758	0,6	Standard I	0,31	0,411765	0,457746
5,7	Sample Va	8,64	2,5	Sample Va	3,343	0,9	Sample Va	0,574	0,2	Sample Va	0,1	0,438596	0,344086
6,8	Kurtosis	-0,36	3,7	Kurtosis	0,324	1,4	Kurtosis	0,646	0,4	Kurtosis	-0,2	0,544118	0,338843
10,2	Skewness	0,78	4,9	Skewness	0,766	2,1	Skewness	0,969	0,9	Skewness	-0,62	0,480392	0,386139
10,6	Range	9,4	5,1	Range	6	2,1	Range	2,4	1	Range	1	0,481132	0,184932
	Minimum	3,2		Minimum	1,5		Minimum	0,8		Minimum	0,2		
	Maximum	12,6		Maximum	7,5		Maximum	3,2		Maximum	1,2		
	Sum	71,9		Sum	37,9		Sum	16,1		Sum	7,8		
	Count	10		Count	10		Count	10		Count	10		
	Confidenc	1,82		Confidenc	1,133		Confidenc	0,47		Confidenc	0,19		

t-Test: Two-Sample Assuming Equ

	RATIO	RATIO
Mean	0,52096	0,350634
Variance	0,015494	0,006105
Observatio	10	10
Pooled Var	0,010799	
Hypothesiz	0	
df	18	
t Stat	3,664929	
P(T<=t) one	0,000886	
t Critical on	1,734063	
P(T<=t) two	0,001772	
t Critical tw	2,100924	

t-Test: Two-Sample Assuming Unequal Variance

	RATIO	RATIO
Mean	0,52096	0,350634
Variance	0,015494	0,006105
Observatio	10	10
Hypothesiz	0	
df	15	
t Stat	3,664929	
P(T<=t) on	0,001149	
t Critical on	1,753051	
P(T<=t) tw	0,002298	
t Critical tw	2,131451	

Old Max.M	Old Max.M		Old Contro	Old Control		Old 10%	Old 10%		Old 20%	Old 20%	
4,1			1,5			1,4			1,1		
6,2	Mean	9,37	2,7	Mean	3,22	2,3	Mean	2,74	1,6	Mean	2,01
5,1	Standard I	1,14	1,6	Standard	0,45	1,6	Standard I	0,338	0,8	Standard I	0,28
7,9	Median	9,7	3,1	Median	3	3	Median	2,65	2,4	Median	2
10,1	Mode	10,1	2,9	Mode	2,7	2,2	Mode	3	1,6	Mode	1,6
14,2	Standard I	3,61	6,5	Standard	1,423	5,1	Standard I	1,069	4,1	Standard I	0,9
9,3	Sample Va	13	3,2	Sample Va	2,026	3	Sample Va	1,143	2,1	Sample Va	0,81
12,1	Kurtosis	-1,06	4,1	Kurtosis	2,697	3,5	Kurtosis	1,762	1,9	Kurtosis	2,98
10,1	Skewness	0,05	3,9	Skewness	1,282	3,1	Skewness	1,066	2,3	Skewness	1,25
14,6	Range	10,5	2,7	Range	5	2,2	Range	3,7	2,2	Range	3,3
	Minimum	4,1		Minimum	1,5		Minimum	1,4		Minimum	0,8
	Maximum	14,6		Maximum	6,5		Maximum	5,1		Maximum	4,1
	Sum	93,7		Sum	32,2		Sum	27,4		Sum	20,1
	Count	10		Count	10		Count	10		Count	10
	Confidenc	2,24		Confidenc	0,882		Confidenc	0,663		Confidenc	0,56

oung Max.	Old Max.M
3,2	4,1
5,6	6,2
5,9	5,1
6,2	7,9
12,6	10,1
5,1	14,2
5,7	9,3
6,8	12,1
10,2	10,1
10,6	14,6

t-Test: Two-Sample Assuming Equ

	Young Max. i	Old Max.M
Mean	7,19	9,37
Variance	8,643222	13,04678
Observatio	10	10
Pooled Var	10,845	
Hypothesiz	0	
df	18	
t Stat	-1,48022	
P(T<=t) one	0,078053	
t Critical on	1,734063	
P(T<=t) two	0,156105	
t Critical tw	2,100924	

t-Test: Two-Sample Assuming Unequal Variance

	Young Max. i	Old Max.M
Mean	7,19	9,37
Variance	8,643222	13,04678
Observatio	10	10
Hypothesiz	0	
df	17	
t Stat	-1,48022	
P(T<=t) on	0,078554	
t Critical on	1,739606	
P(T<=t) tw	0,157109	
t Critical tw	2,109819	

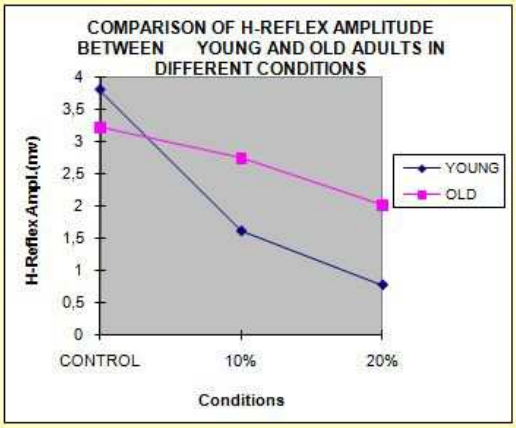
Young Max.	Old Max.M	Young Cont	Old Control		Young 10%	Old 10%		Young 20%	Old 20%	
3,2	4,1	1,5	1,5		0,9	1,4		0,8	1,1	
5,6	6,2	2,3	2,7		1,2	2,3		1,1	1,6	
5,9	5,1	4,9	1,6		2,1	1,6		0,9	0,8	
6,2	7,9	3,4	3,1		1,4	3		0,7	2,4	
12,6	10,1	7,5	2,9		3,2	2,2		1,2	1,6	
5,1	14,2	2,1	6,5		0,8	5,1		0,6	4,1	
5,7	9,3	2,5	3,2		0,9	3		0,2	2,1	
6,8	12,1	3,7	4,1		1,4	3,5		0,4	1,9	
10,2	10,1	4,9	3,9		2,1	3,1		0,9	2,3	
10,6	14,6	5,1	2,7		2,1	2,2		1	2,2	

	Young Max.	d Max.M	Young Contr	d Control	Young 10%	Old 10%	3	Young 20%	Old 20%
Young M	1		Young C	1	Young 1	1		Young 2	1	
Old Max.	0,48086	1	Old Contr	-0,16	1	Old 10%	-0,36813	1	Old 20%	-0,31976	1

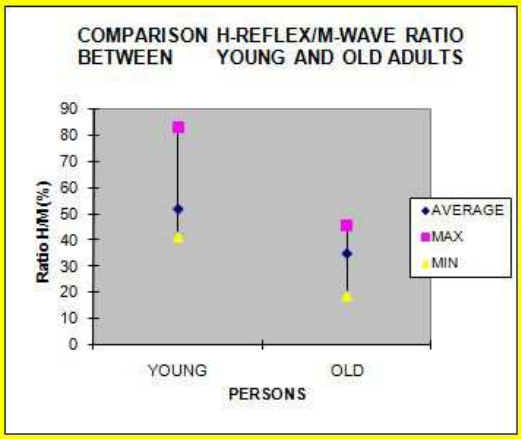
Young Contr	oung Max.	RATIO	H/M %
1,5	3,2	0,46875	46,875
2,3	5,6	0,410714	41,07143
4,9	5,9	0,830508	83,05085
3,4	6,2	0,548387	54,83871
7,5	12,6	0,595238	59,52381
2,1	5,1	0,411765	41,17647
2,5	5,7	0,438596	43,85965
3,7	6,8	0,544118	54,41176
4,9	10,2	0,480392	48,03922
5,1	10,6	0,481132	48,11321
	AVERAGE	0,52096	52,09601
	MAX	0,830508	83,05085
	MIN	0,410714	41,07143

Old Control	Old Max.M	RATIO	H/M %
1,5	4,1	0,365854	36,58537
2,7	6,2	0,435484	43,54839
1,6	5,1	0,313725	31,37255
3,1	7,9	0,392405	39,24051
2,9	10,1	0,287129	28,71287
6,5	14,2	0,457746	45,77465
3,2	9,3	0,344086	34,4086
4,1	12,1	0,338843	33,8843
3,9	10,1	0,386139	38,61386
2,7	14,6	0,184932	18,49315
	AVERAGE	0,350634	35,06342
	MAX	0,457746	45,77465
	MIN	0,184932	18,49315

	CONTROL	10%	20%
YOUNG	3,79	1,61	0,78
OLD	3,22	2,74	2,01



	YOUNG	OLD
AVERAGE	52,096	####
MAX	83,0508	####
MIN	41,0714	####



Young Contr	Old Control
1,5	1,5
2,3	2,7
4,9	1,6
3,4	3,1
7,5	2,9
2,1	6,5
2,5	3,2
3,7	4,1
4,9	3,9
5,1	2,7

t-Test: Two-Sample Assuming Eq

	Young Contr	*Old Control*
Mean	3,79	3,22
Variance	3,343222	2,026222
Observatio	10	10
Pooled Var	2,684722	
Hypothesiz	0	
df	18	
t Stat	0,777876	
P(T<=t) one	0,223373	
t Critical on	1,734063	
P(T<=t) tw	0,446747	
t Critical tw	2,100924	

t-Test: Two-Sample Assuming Un

	Young Contr	*Old Control*
Mean	3,79	3,22
Variance	3,343222	2,026222
Observatio	10	10
Hypothesiz	0	
df	17	
t Stat	0,777876	
P(T<=t) on	0,223667	
t Critical on	1,739606	
P(T<=t) tw	0,447334	
t Critical tw	2,109819	

Young 10%	Old 10%
0,9	1,4
1,2	2,3
2,1	1,6
1,4	3
3,2	2,2
0,8	5,1
0,9	3
1,4	3,5
2,1	3,1
2,1	2,2

t-Test: Two-Sample Assuming Eq

	Young 10%	*Old 10%*
Mean	1,61	2,74
Variance	0,574333	1,142667
Observatio	10	10
Pooled Var	0,8585	
Hypothesiz	0	
df	18	
t Stat	-2,72705	
P(T<=t) one	0,006916	
t Critical on	1,734063	
P(T<=t) tw	0,013833	
t Critical tw	2,100924	

t-Test: Two-Sample Assuming Un

	Young 10%	*Old 10%*
Mean	1,61	2,74
Variance	0,574333	1,142667
Observatio	10	10
Hypothesiz	0	
df	16	
t Stat	-2,72705	
P(T<=t) on	0,007461	
t Critical on	1,745884	
P(T<=t) tw	0,014921	
t Critical tw	2,119905	

Young 20%	Old 20%
0,8	1,1
1,1	1,6
0,9	0,8
0,7	2,4
1,2	1,6
0,6	4,1
0,2	2,1
0,4	1,9
0,9	2,3
1	2,2

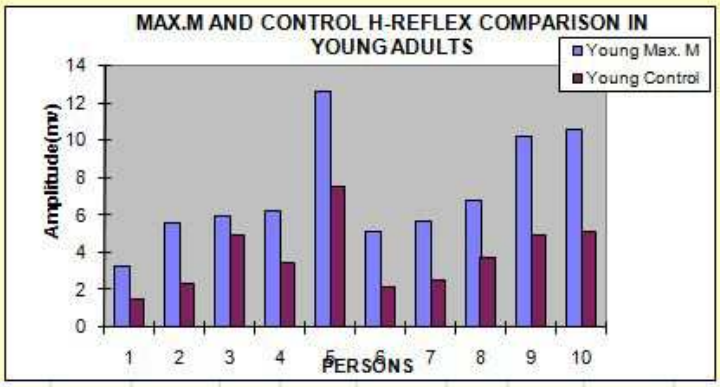
t-Test: Two-Sample Assuming Eq

	Young 20%	*Old 20%*
Mean	0,78	2,01
Variance	0,097333	0,809889
Observatio	10	10
Pooled Var	0,453611	
Hypothesiz	0	
df	18	
t Stat	-4,08365	
P(T<=t) one	0,000349	
t Critical on	1,734063	
P(T<=t) tw	0,000697	
t Critical tw	2,100924	

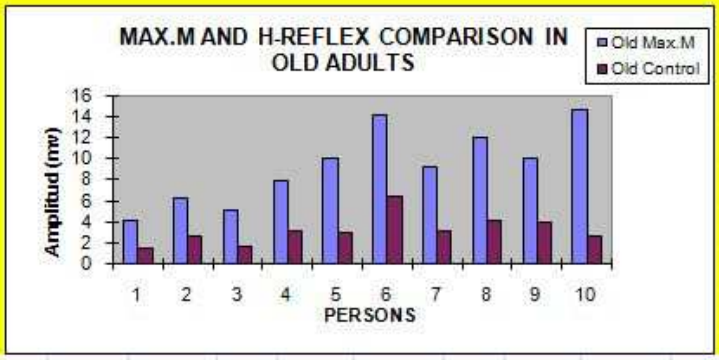
t-Test: Two-Sample Assuming Un

	Young 20%	*Old 20%*
Mean	0,78	2,01
Variance	0,097333	0,809889
Observatio	10	10
Hypothesiz	0	
df	11	
t Stat	-4,08365	
P(T<=t) on	0,000904	
t Critical on	1,795884	
P(T<=t) tw	0,001809	
t Critical tw	2,200986	

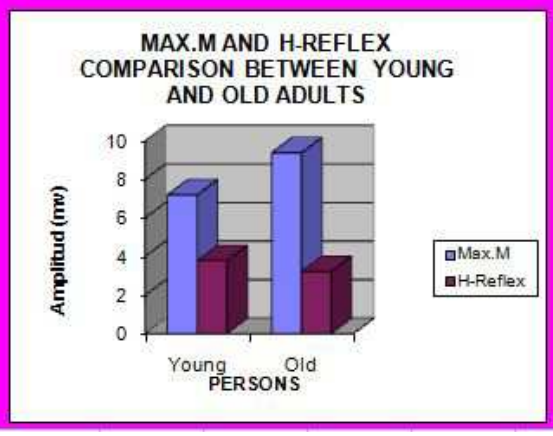
ung Max.	oung Control
3,2	1,5
5,6	2,3
5,9	4,9
6,2	3,4
12,6	7,5
5,1	2,1
5,7	2,5
6,8	3,7
10,2	4,9
10,6	5,1



Old Max.M	Old Control
4,1	1,5
6,2	2,7
5,1	1,6
7,9	3,1
10,1	2,9
14,2	6,5
9,3	3,2
12,1	4,1
10,1	3,9
14,6	2,7



	Max.M	H-Reflex
Young	7,19	3,79
Old	9,37	3,22



Young Max.	oung Contr	Young 10%	Young 20%
3,2	1,5	0,9	0,8
5,6	2,3	1,2	1,1
5,9	4,9	2,1	0,9
6,2	3,4	1,4	0,7
12,6	7,5	3,2	1,2
5,1	2,1	0,8	0,6
5,7	2,5	0,9	0,2
6,8	3,7	1,4	0,4
10,2	4,9	2,1	0,9
10,6	5,1	2,1	1

	Young Max.	*oung Contr*	*Young 10%*	*Young 20%*
Young Ma	1			
Young Cor	0,905938	1		
Young 10%	0,879753	0,982346	1	
Young 20%	0,497645	0,527464	0,658859	1

DISCUSSION

The data shows how the control H-Reflex is of higher amplitude in young adults and can be explained by a better conexion of Ia fiber to the motoneurone pool. On the other hand when a 10 or 20% isometric contraction is performed in the antagonist muscle whilw stimulating Ia fiber, the H-Reflex is bigger in old adults. This leads to lower ratios of H/M in old adults. This means that young adults have more reciprocal inhibition and, thus, they are more sensitive to antagonistic contractions and, thus, they have a more precise information for controlling the movement.

This results might explain, partially, possible extra difficulties that “old adults” may have controlling movements in which agonist muscles must contract while antagonist ones must maintain an isometric contraction, in comparison to “young adults”. Less sensitivity of muscle spindle and golgi organs, some problems on the Ia fibers when arrivint at the motoneuron pool (for example reduced % of conexions) andlost of control of Renshall cells might be some of the neuromuscular factors that explain this problem in controlling the movements.

In a more practical approach we could test this capacity of differential relaxing or tone control with skills used in Phisical Education and Sport training. Much better if simultaneously to this segmentry tone control skills we could measure parameters as the ones measured in this experiment. Moreover, for training this segmentary tone control (differential relaxing) we should consider:

-Dynamic-Static positions and changes from dynamic to static.

-Skills that hyperstimultes differentially the Kinestesic system, the

Vestibular system and the Visual system.

-Include this type of coordination skill within skills that emphasize the segmentary tone control, such as (Seirul-lo Vargas, F.):

-Local muscular contraction(or hypersontraction) and quick change to no or little contraction during maintaining a position.

-During global execution of a global skill of certain degre of difficulty, introduce different areas of relaxation.

-Segmentary accelerations and deaccelerations during the execution of a global movement.

-Progressive change from a local movement to a global movement and viceversa (differential tone).

-Execute and accelerated movement or a balistic ones and within the same path perform and undulating movement.

-Undulating movements.

-To let a movement incomplete and complete it with the homologe(other) segment or with the following.

In summary we can emphasize the global or segmentary tone control.

For other applied skill of throwing or kicking we can introduce another classification of skills:

-Global tone control.

-Differential tone control (very important in development phases in which there are important changes in limbs)

-Constant tone control (variation of perceptions).

-Rapid tone control.

(1988)

REFERENCES

HUGON, M. (1973). Methodoloy of the Hoffmann Reflex in Man. New Developments in Electromyography and Chimical Neurophysiology. Edt. J.E. Desmedt, 3, 277- 293.

KOCEJA, D.M. (1995). Class notes of Neuromuscular Control of Movement. HPER, Indiana University.

RIBERA NEBOT, D. (1988). Valoracion del Control Tonico Segementario. Beca de Investigación del INEF de Barcelona. Documento INEF Barcelona.

("Evaluation of Segmentary Tone Control")

SEIRUL-LO VARGAS, Fco. (1987-1988). Apuntes de Clase de Educacion Física de Base INEF de Barcelona.

("Class Notes of Basic's Physical Education")