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Biological Regeneration as a Factor for Muscle Strength Optimization in Upper Limbs of Disabled Weight lifters with Cerebral Palsy

by

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Currently the sport of disabled goes through a particular renaissance. It is not only a universal method for an effective rehabilitation, but also a stimulant for physical and motor development for disabled, especially those with infantile cerebral palsy. Due to a constant increase of training loads in disabled sport, the role of physical exertion efficiency in regeneration is very important. The rational usage of biological regeneration is an important factor for increasing the functional abilities and an inseparable part of training exercises.

The aim of this research was to determine the influence of a complex biological regeneration program over the upper limb muscle tonus and muscle strength of disabled power-lifters with infantile cerebral palsy (classes CP 4,5,6,7,8).

Twenty disabled power-lifters with infantile cerebral palsy and normal function of upper limbs were examined.

The measurements were taken twice: at the beginning of the training cycle and after 5 months.

The results showed that local massage after trainings caused a decrease in muscle tonus in every case.

The combination of a local massage and a physical regeneration program led to major training effects and muscle tonus decrease up to 75-80%.

The results indicate a complex biological regeneration program strongly contributed to optimization of upper limbs muscle tonus and considerably supported training progress of physically disabled sportsmen with cerebral palsy.

Key words: *muscle strength, weight lift, celebral palsy*

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Introduction

The sport of the disabled undergoes through a real renaissance, as it is not only a universal method for efficient rehabilitation, but also a stimulant for physical and motor development for disabled subjects and people with infantile cerebral palsy. Indeed sport activity is not only an important rehabilitation factor, but also it integrates healthy and disabled people.

Thereby scientific research involving disabled people, especially with motor dysfunctions are very important and allows to formulate a number of specific instructions for the process of rehabilitation and revalidation.

Sport training programs for disabled with cerebral palsy includes training, contests and biological regeneration (Płatonow & Sozański 1991, Uilmor & Kostil 19971). The prevailing role in planning the structure and character of training loads for disabled weight lifters with cerebral palsy depends on the specificity of the competitions and the athletes' physical and mental abilities. Training loads should be safe and adapted to the efficiency of cardiovascular, respiratory and motor systems. It is also necessary to incorporate rest periods during the training cycle.

Nowadays, qualified sport for the disabled, especially for weight lifters is characterized by:

- growing rivalry at the international level; 20-30 years ago the best participants in weight lifting were mostly competitors from highly developed countries of the world and from Poland as well, now they recruit from Iran, Egypt, Nigeria, China, Ukraine and Russia.
- significant progress in results of Paraolympics' winners; for example: the winners' results during the XII Special Olympics in Athens are 100% higher than those of the winners' of the VI Special Olympics in Arnhem.
- maximization of training loads, which annually add up to 700-800h and vary with the weight category, type of disability and qualification level, and are continuously approaching to healthy weight lifters' training loads.

Those tendencies in the sport of disabled require searching for new means of enhancing sport results. One of the most important aspects of qualified sport is a complex biological regeneration program during training and competition. It is an indispensable element of the general sport preparation. (Ważny 1977, Płatonow 1997, Zotow 1990, Ronikier 1997).

The disabled athletes in weight lifting include subjects with lower limb amputations, various motor dysfunctions and also are paraplegic with cerebral palsy. They compete in two weight categories. The competitors of class 3/4/5 and 6 make a unified group at every international competition. The Polish

Championships are organized in two groups: group I- competitors of class 3/4 and 5 and group II- competitors of class 6 (Mysłakowski 2001).

Characteristic features of cerebral palsy include: pathological muscle tonus, problems with static and dynamic balance, limited motion abilities (Śliwiński & Halat 2001, Czochańska 1985, Koziawkin et al. 1999, Simons & Mense 1999, Matyja et al. 1996).

The efficiency of restitution is very important in connection with increasing training loads in sport of disabled. A rational restitution program is important for increasing the competitors' functional abilities and it is also an inseparable element of the training process (Jethon 1982). Various methods are used in sport practice during training process and during competition (Gieremek & Dec 2000). Nowadays, biological regeneration should reinforce the training process, optimize relaxation (regeneration), diminish effects of strained muscles and also should stimulate the healing process after sport traumas (rehabilitation).

Biological regeneration program includes an extensive range of biological, pedagogical and psychological methods. The most essential of them are physiotherapeutic methods (kinezotheraphy and physiotherapy) of biological treatments with the use of natural and artificial sources of energy (e.g. heat, light, electric streams, motion) need competent, planned and programmed dosage (Walaszczak & Kasperczyk 2000, Pąchalski 1985).

Scientific research confirms the positive influence of complex biological regeneration program on human body (Wierycz i wsp. 2002, Śliwiński & Halat 2001, Straburzyńska-Lupa & Straburzyński 2003, Sawicki 1999), but its efficiency in disabled weight lifters training process is not sufficiently documented. It was the reason to investigate the influence of complex biological regeneration program on the upper limb muscle tension and strength of disabled weight lifters (class CP 4/5/6/7/8). It was assumed that complex regeneration program would have an influence on peak muscle strength and upper limb muscle tension decrease and enhancement of training process. This should also improve sport results of disabled weight lifters with cerebral palsy. They require constant biological regeneration, applying significant training loads and the necessity of keeping general good body condition due to cerebral palsy.

Material and Methods

20 disabled weight lifters with infantile cerebral palsy and normal function of upper limbs – the competitors from "Start Impel" Sports Club in Wroclaw (table 1), were examined. This unique centre is located only in Wroclaw, where disabled weight lifters with infantile cerebral palsy are trained, and at the same time this is the biggest section of disabled weight lifters in Poland. Every com-

petitor signed a consent form for participation in the research. They were verified according to "General Medical Classification for Disabled Sport" (Mysłakowski 2001, Sawicki 1999). Two research groups were created: group A; included 10 competitors with lower limb spastic paresis, causing considerable motor problems and with the need of orthopedic support (two competitors of class CP 4 and eight with class CP 5), and group B; also composed of 10 competitors with minimal lower limbs spastic paresis and good motor abilities with no need for orthopedic support (4 competitors of class CP 6, one of class CP 7 and five of class CP 8).

Table 1

Disabled weight lifters with infantile cerebral palsy from Sport club "Start Impel" in Wroclaw

Nr	Initials	Start Class	Weight category	Age	Body height	Body mass	Sport training
				Group A			
1	KT	CP5	56	23	170	55,2	6
2	SR	CP5	60	23	180	60,0	4
3	SJ	CP4	48	18	156	44,0	3
4	KD	CP4	52	23	156	51,2	7
5	CG	CP5	56	28	155	55,7	11
6	BA	CP5	75	28	170	71,7	9
7	OA	CP5	82,5	29	168	75,6	6
8	ŻM	CP5	48	23	153	46,6	8
9	WK	CP5	60	30	165	59,0	14
10	KT	CP5	67,5	22	168	67,4	6
				Group B			
1	TR	CP8	82,5	23	175	81,9	7
2	BD	CP8	67,5	22	160	67,5	7
3	BDa	CP8	82,5	23	183	82,0	14
4	ŁP	CP6	90	23	193	85,3	10
5	SS	CP8	48	18	125	43,0	5
6	KP	CP8	75	21	175	72,0	5
7	JM	CP7	67,5	25	175	58,5	4
8	TM	CP6	60	27	156	57,5	12
9	LW	CP6	67,5	21	162	64,2	10
10	DM	CP6	56	20	155	54,0	8

The measurements were taken twice: at the beginning of the training cycle and after 5 months. Every cycle was composed of two mezocycles: traditional mezocycle training and the mezocycle training with biological regeneration program. Every mezocycle was composed of a-four-week microcycles. Each week the 90 min. training was performed before noon through the next 5 consecutive days (Monday-Friday), followed by the biological regeneration program. The simultaneous use of training and biological regeneration program during particular weekdays was characteristic for microcycles, which made the comparison of the research possible.

The mezocycle training consisted only of exercises strengthening shoulder girdle and a special weight training. A trainer individually devised every exercise taking into account the sort of illness, age, sport level and weight category.

The mezocycle with biological regeneration was based on repetition of the same exercises, but followed by biological regeneration treatment: classic dry massage of upper limbs for 15 minutes every day after training; sauna - once a week; upper limbs and shoulders girdle water massage with hand manipulated nozzle - twice a week and showers with varied temperature - twice a week.

Every measurement was taken in a sitting position due to infantile cerebral palsy. The biceps (biceps brachii) and triceps (triceps brachii) dynamometric measurements were taken bilaterally three times in every cycle with "Biodex" apparatus: before and after the mezocycle training, and the last one after the mezocycle training with biological regeneration. There was a-two-day break between both mezocycles.

The purpose of the research was the evaluation of variables of the upper limbs extensor and flexor muscles force and velocity by determination of the peak torque with angular velocity of 180°/s. The initial results were confronted with the parallel results taken after 5 months.

Exercise test consisted of a number of trials (tree sub maximal trials and one maximal to instruct the subject), and the measurement of the flexor and extensor torque with angular velocity of 180°/s. Both flexion and extension measurements with maximum force were repeated five times. The miotonometer "Tonus 1" produced by "Rema" company was used for measurements. The device allows estimating the muscle tonus in contraction and decontraction. The triceps and biceps of upper limb maximal tonus and decrease of tonus were also registered.

The measurements in miotons demonstrate the force needed for skin flexion over the muscle with constant bolt/pin area of 0,7 cm^2; the permissible error is ±0,03 of mioton. The sensor was placed in perpendicular position to the muscle

maximum girth plane and the value pointed by the indicator at the device scale was taken. The measurements were made daily before and after training.

During the training mezocycle with the biological regeneration the measurements were taken before and after training and as well as after the dry massage and hydrotherapeutic procedures. The force test was conducted in each cycle before and after the mezocycle training and after the mezocycle training with biological regeneration, during the contests. The contests were conducted according to the disabled weight lifters contest regulations (Mysłakowski 2001).

Three tests were taken during every cycle, as there was a-two-day break between the mezocycle without with biological regeneration. The force test evaluation was based on maximal weight lift in accordance with weight category. Every competitor had tree attempts - the best result was registered (personal record). The score conversion rate based on O'Carroll table enabled a comparison of each athlete regardless of the weight category (Mysłakowski 2001).

The calculations were conducted with the use of "Statistica" software. The basic statistical variables were calculated: average (x), standard deviation (s) variation coefficient (v). The relevant differences between the compared groups' average were evaluated by the Student t-test, and for a bigger number of averages with one-way analysis of variance (ANOVA) and NIR test (the minimal significant difference) (Stanisz 1998).

Results

The measurements of maximal force moment allowed for finding the significant disproportions between the right and left arm flexors maximal force moment both during the first and the second mezocycle training. The parallel disproportions of maximal force moment were also significant in the left and right arm extensors of both sportsmen groups. They were revealed not only during the initial stage of trainings without biological regeneration, but also after the cycle of training with the use of the biological regeneration.

Significant disproportions were noticed between the flexors and extensors maximal force moment, e.g. in group A, the maximal force of right hand flexors moment in comparison to the extensors of the same arm was smaller both during I and II mezocycle training.

The results obtained in the second cycle of the research confirmed that the combination of training and a complex biological regeneration highly increase sports potential of the disabled weight lifters with infantile cerebral palsy.

The isokinetic force measurements of disabled sportsmen' taken during the two cycles of research revealed some tendencies of wavy dynamic changes of

isokinetic force both flexors and extensors. However, it should be marked, that the changes after the mezocycle training with biological regeneration were not always statistically significant.

The training program might have caused a specific adaptation for weight lifting in the lying position. Nevertheless, it does not mean that there is no possibility of using the isokinetic tests for physical training diagnosis of disabled weight lifters at the subsequent training stages (Woźniewski et al 2001, Zimmer et al 2001, Prystupa et al 2002).

In the first and second cycle of the study in both groups a tendency of increased flexor and extensors muscle tonus during the training mezocycle without biological regeneration was noticed, both in stretched and relaxed muscle.

The dynamics of muscle tonus during the mezocycle with biological regeneration was different. Through the first microcycle with biological regeneration the variables of muscle tonus were close to those registered in mezocycle without the biological regeneration. Whereas, during the second, third and fourth training microcycle with biological regeneration significant reduction of muscle tonus was noticed, both in stretched and relaxed muscle. The changes of muscle tonus are symptomatic during the second, third and fourth training microcycle with the biological regeneration but with no growing tendencies.

The study showed that the local massage after an applied training was always causing decrease in muscle tonus, but only in 20-30% cases it was statistically significant. The combination of local massage and physical regeneration procedure caused better training effects, in this case the muscle tonus decrease was statistically significant and came up to 75-80% of cases.

The comparative analysis of muscle tonus in two groups of disabled weight lifters during the second cycle shows tendencies that were close to those registered during the first cycle:

- muscle tonus during relaxation was significantly smaller then during tension, muscle tonus after the training (both during relaxation and tension) was always significantly higher then the muscle tonus before the training,
- extensors muscle tonus (both during relaxation and tension) was in most cases higher then flexors tonus, which could be the effect of specialization,
- in both groups the disproportions of parameters of the same muscles of the right and the left hand were noticed, which can be explained by the illness specificity,
- during the first training mezocycle without biological regeneration the tendency of significant muscle tonus increase was confirmed (both

during relaxation and tension) at the beginning and at the end of every microcycle without biological regeneration,

- the muscle tonus dynamics changes during the first mezocycle training without biological regeneration was characterized by a wave tendency,
- the passive form of repose (Saturday, Sunday) during the first mezocycle training without biological regeneration resulted in a significant muscle tonus decrease,
- during the first mezocycle training with biological regeneration muscle tonus was within the limits typical for the first mezocycle training without biological regeneration, which can be caused by long lasting adaptation,
- during the second mezocycle with biological regeneration muscle tonus after training was higher than before,
- during the second mezocycle with biological regeneration, after local massage muscle tonus (both during relaxation and tension) was always decreasing, and the statistically significant reduction was registered in 30% of cases,
- the reduction of muscle tonus after hydrotherapeutic treatment was recorded in all cases,
- the organic combination of local massage and hydrotherapeutic treatment in comparison to the state just after the weight training in 83% of cases caused statistically significant muscle tonus reduction, (Prystupa et al 2002, Prystupa 2002)
- the muscle tonus dynamics parameter during the second, third and fourth microcycle training with biological regeneration had a wave character, but within some limits, and the statistically insignificant muscle tonus differences between the beginning and the end of the mezocycle training with biological regeneration confirmed that,

Therefore, the use of complex biological regeneration after weight training may have a significant contribution to muscles tonus optimization (Śliwiński & Halat 2001, Śliwiński et al 2000, Klimek & Frączek 2004)

The sport result is the major indicator of training effectivness. The crucial factors of this effectivness are the functioning of the individual human body systems and the adequate morphological and physiological changes after training (Steadward & Walsh 1986, Witczak & Sozański 1979, Zatoń 1979).

Our study showed that regular training during the mezocycle without biological regeneration caused an improvement of sport results of every disabled weight lifter. However, this tendency during the first and the repeated cycle in

training mezocycle without biological regeneration was not statistically significant.

On the other hand, a significant personal record improvement was noticed after the complited training mezocycles with biological regeneration (table 2). Therefore, training without biological regeneration produced only a slight progress in sport results, but analogical training combined with complex biological regeneration caused a significant improvement of personal records. It can be noticed particularly after application of O'Carroll conversion rate, which gave the possibility of personal sport records confrontation for disabled weight lifters with different body mass (Mysłakowski 2001)

It is vital to underline, that the improvement of personal sport records in weight lifters occurred both after finishing the first and the second cycle of research during the mezocycle trainings with biological regeneration.

Table 2

Arithmetical averages (x) and standard declinations (s) of weight lifting by disabled weight-lifters in lying position (kg)

Measurement period	Group A			Group B			t	p
	x	s	v	x	s	v		
cycle I								
Before research	90,2	32,11	35,58	111,0	23	21	-1,64	0,118
After mezocycle without biological regeneration	91,10	32,55	35,73	113,1	23,68	20,92	-1,73	0,1
After mezocycle with biological regeneration	95,25	32,16	33,76	116,5	24,84	21,32	-1,65	0,115
cycle II								
Before research	99,50	33,93	34,10	116,50	21,48	18,44	-1,34	0,197
After mezocycle without biological regeneration	101,25	33,95	33,53	117,25	19,59	16,71	-1,29	0,213
After mezocycle with biological regeneration	107,75	33,43	31,02	120,02	18,54	15,42	-1,03	0,315

Table 3

Arithmetical averages (x) and standard declinations (s)in weight lifting by disabled weight-lifters in lying position (kg)after application O'Carroll grading scale

Measurement period	Group A			Group B			t	p
	x	s	v	x	s	v		
cycle I								
Before research	107,42	32,78	30,52	127,46	40,14	31,49	-1,22	0,237
After mezocycle without biological regeneration	108,50	33,47	30,85	129,71	39,80	30,68	-1,29	0,213
After mezocycle with biological regeneration	115,12	32,78	28,48	135,80	44,46	32,74	-1,18	0,252
cycle II								
Before research	120,26	34,78	28,92	135,83	41,84	30,80	-0,91	0,377
After mezocycle without biological regeneration	124,81	36,35	29,13	137,15	39,12	28,53	-0,73	0,474
After mezocycle with biological regeneration	133,28	37,11	27,85	140,67	39,52	28,09	-0,43	0,671

Conclusions

1. The increase of upper limbs flexor and extensor muscles izokinetic force during the training mezocycles with biological regeneration was not always statistically significant and in two cases its decrease was noticed. The reason was probably the variability and heterogeneity of izokinetic force parameter dynamics of disabled weight lifters coming from the specificity of infantile cerebral palsy. The analysis confirmed positive influence of the complex biological regeneration on muscles izokinetic force during both training mezocycles.
2. The complex biological regeneration highly contributed to upper limbs muscle tonus optimization, which was demonstrated by its decrease after the restitutional intervention. Training mezocycle without biological regeneration was characterized by little muscle tonus increase at the end of every microcycle, especially at the end of the full training mezocycle. In-

significant muscle tonus changes were noticed during the next training mezocycles.

3. The complex biological regeneration is an essential factor supporting disabled weight lifters training, because it greatly affects the progress of personal sport results at the end of every training mezocycle with biological regeneration.
4. The disabled weight lifters need constant biological regeneration due to infantile cerebral palsy, big training loads (high frequency of intensive exercises) and the necessity of maintaining generally good physical condition.
5.

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