

Low Back Pain in Weightlifters: Personalised Exercise Protocols for Elite Athletes

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SUMMARY

Background. Most of us has experienced low back pain (LBP) at least one time during his life, but there is no knowledge on weightlifting athletes. Indeed, LBP is one of the most complained injuries, usually caused by disc herniation. The athlete needs to know the correct training technique to reduce stress on joints and to avoid severe injuries. But once the injury has happened, the role of rehabilitation is crucial, because the athlete needs to return to the sport as soon as possible in an optimal condition.

Objective. To analyze if the personalized protocol and the specific therapeutic exercises adopted are effective in amateur weightlifters.

Patients and methods. LBP has been diagnosed on seven amateur weightlifters out of fifty athletes. We proposed a personalized rehabilitation treatment based on the symptoms of the patients, adapting it to their needs, following them until their return to the sport practice.

Results. All patients returned to the sport practice, most of them at the same level as before the injury. One of them returned to the sport practice gradually, but not yet at the same level, and the last one is getting better results compared to the ones before the injury.

Conclusions. In our experience, personalizing the rehabilitation on the symptoms of the patient is the key point of the rehabilitation program, as long as choosing the right therapeutic exercises for each patient. Pain and load management is the starting point; the specific exercise selection should be decided upon the level of discomfort the patient can work with.

KEY WORDS

Core stability; disc herniation; protrusion; low back pain; weightlifting; powerlifting; rehabilitation protocol.

INTRODUCTION

Low back pain (LBP) is an issue as common as complex, impacting the life of the people negatively, which about 80% of adults experience in their lives (1). Despite the huge amount of source in literature, little is known about LBP and its management occurring in elite sport like weightlifting. Weightlifting has its roots in ancient Greece, a culture that is well known for celebrating strength and for competition involving weights. It was included in modern Olympics in 1896 and it is the only barbell sport in the Olympic program. It consists of two events: the snatch and the clean and jerk (2) (figure 1).



Figure 1. An athlete performing the snatch.

Powerlifting is a similar competitive sport, which includes weightlifting movements, as matter of fact the goal is to lift as much weight as possible. It differs from weightlifting since this sport is made up of three actions: the squat, the bench press and deadlift (3).

CrossFit was defined by researchers as a high-intensity training program and a strength-building conditioning. This sport uses the main elements of gymnastics, weightlifting exercises, and cardiovascular activities as exercise task, to be executed quickly, repetitively, and with little or no recovery time between sets (4).

All these sports are strength sports which require excellent flexibility, balance, and coordination, besides strength. In these sports the spine is exposed to an enormous amount of weight, and if the body is not well prepared, it can lead to injuries. This means that it is essential to learn the correct technique to reduce stress and pressure on the joints and to avoid severe injuries. This could appear as a common issue, but it is challenging to manage in super trained elite athletes (5).

In lifting-weight sports, the musculoskeletal injuries are the most common, due to inadequate strength, technique, insufficient warm-up or stretching, loss of balance (6). LBP is considered one of the most common complaints among weightlifters with incidence rates reaching 40.8%. It is estimated to affect weightlifters with a lifetime incidence of 23% (7).

The two most common injuries leading to LBP in this sport are muscle strains and intervertebral disc bulge or herniation (8). The most common injuries are resumed in table I, divided per anatomical locations.

Table I. Injuries and overuse syndromes in powerlifting (9).

Body part	Damage
Cervical spine	NOS, myogelosis, arthrosis, herniated vertebral discs/protrusion, spinal stenosis, and sliding vertebrae
Thoracic spine and thorax	Sliding vertebra, arthrosis, herniated disc/protrusion, hyperkyphosis
Lumbar spine	Disc herniation, sciatica, hyperlordosis and myogelosis
Shoulder	NOS, inflammation
Elbow	NOS, inflammation, arthrosis, dislocation and instability, bursitis. Muscle, tendon, or nerve disorders, epicondylitis
Hand/wrist	Tenosynovitis, arthrosis, ganglion cysts. Fracture, rheumatic disease, ligament instability
Hip	Arthrosis, inflammation, impingement, and strain
Knee	Patellar disorders, meniscus injury, arthrosis, inflammation, cruciate ligament rupture, and ligament instability
Ankle/foot	Flatfoot and splayfoot. Ligament, toe dislocation

PATIENTS AND METHODS

This is a prospective study on case series which analyses the therapeutic rehabilitation protocols among seven amateur weightlifters, powerlifters and CrossFit athletes, with an age range from 25 to 40 years old with a recognized disk protrusion or herniation. We treated seven symptomatic patients out of fifty patients that came to our clinic. All patients gave their signed informed consent to participate according to the Declaration of Helsinki of 1946. The **table II** shows the data of the patients.

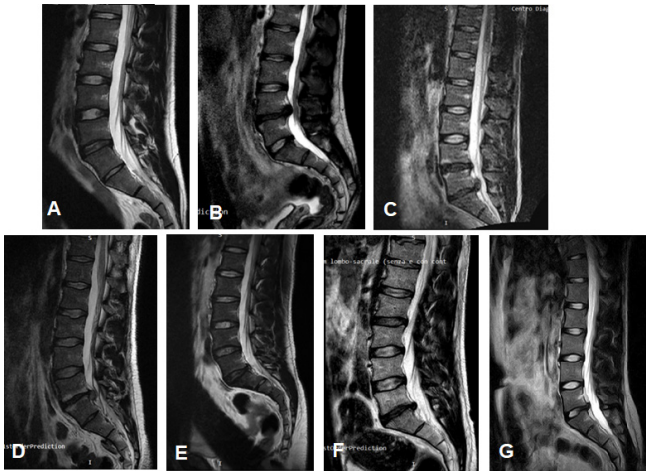


Figure 2. MRI of the patients.

(A) AC protrusion at L4-L5 level; (B) GA herniation at L4-L5 level; (C) PL protrusion at L4-L5, herniation at L5-S1; (D) DP herniation at L5-S1 level; (E) VM herniation at L5-S1 level; (F) FDF herniation at L5-S1 level; (G) MI herniation at L5-S1 level.

Table II. Information about the patients.

Variables	Data						
Name	AC	GA	PL	DP	VM	FDF	MI
Age*	25	28	31	34	29	40	29
Sport	Powerlifting	CrossFit	CrossFit	CrossFit	Powerlifting	CrossFit	CrossFit
Diagnosis	Protrusion	Herniation	Protrusion/herniation	Herniation	Herniation	Herniation	Herniation
Level	L4-L5	L4-L5	L4-L5 (p) L5-S1 (h)	L5-S1	L5-S1	L5-S1	L5-S1
Time MRI	After 2 weeks	1 month	2 days	1 year	1 week	2 months	1 months
Pain duration	1-2 months	5-6 months	1 months	6 months	2 weeks	8 months	6 months
Stop**	6-7 months	6-7 months	2 weeks	No stop	3 mo	1 year	2-3 weeks
Drugs	Cortisone	-Medrol 16, 1 x4 days; ½ x4 days, ¼ x6 days -Xinepa easy 2/ die x1 month	Ozone injection therapy + cortisone, from 4 mg x5 days to 0.5 mg	None	None	Cortisone 1 mg	4 injections of Voltaren and muscoril Brufen 600 mg 2/ die x5 days

*Age at the time of the injury; **stop refers to the time the athlete has not practiced any sport.

For each athlete a MRI was made, showing a disc protrusion or a disc herniation. They are shown in the following **figure 2**. The diagnosis was made by physiatrists or orthopedists, and the athletes came to our observation for the rehabilitation program. In order to get full background of the patients, we executed a physiotherapeutic assessment:

- Data and features of the patients, as shown in **table II**.
- Local examination: palpation, ROM, strength.
- Neurological examination: sensitivity, reflexes, motility.
- Clinical tests: SLR, crossed SLR, slump test. These tests should elicit familiar symptoms to patients.

These tests were positive for all patients. Depending on the symptoms of the patient and pain characteristics, a different rehabilitation treatment or specific instrumental physical therapy may be added to the program when needed. The general rehabilitation protocol was divided in three parts, and then each part was personalized on the patient:

1. Tolerable and modified training (when possible, depending on the symptoms).
2. Physical therapy.
3. Life and training recommendations and contraindications.

The rehabilitation treatment is described in the following **table III**, divided per patients.

We chose different therapeutic exercises for each patient, but there were common basic exercises, essential to the rehabilitation of all of the athletes:

- Hip thruster.
- Lunges (crossed, with one knee up, moving the hip onward...).

- Deadlifts (Romanian, one leg deadlift...).
 - Spine mobility: spine twist (lower trunk rotation, associated with breathing, or in different positions...).
 - Squat (Bulgarian s., isometric wall s., goblet s...).
- Fast walking and running, and TRX exercises were selected and added to the rehabilitation treatment.

Table III. The rehabilitation treatment for each patient.

Time	Therapeutic exercises	Repetitions	Intensity
Patient AC			
1 st day	Barbell row	10-15 reps x 3-4 sets	5-6 RPE
	Hip thruster	2' recovery	
	Frontal plank and Chinese plank	20-30" + 20-30" x 4-6 sets	
	Arm and leg extension from the quadrupedal position on instable surfaces (bird dog)	20 x 3 s	
	Lateral plank with extended and staggered legs	10-15 for each side	
	From a lunge position, move the hip onward	3-4 sets 1' x 4-5 sets	5-6 RPE
	””	””	
3 rd week	Before training From a push up position to triple flexion with an elastic band on feet	20 x 3 s	7-8 RPE
5 th week	Before training Hip flexion banded high plank	20 x 3 s	7-8 RPE
	Kettlebell swing and elastic band swing	5 + 20 reps x 3-4 s, 1' recovery	
2 months	Before training Scapular abduction against elastic band resistance	12 x 3 sets, 15" recovery	7-8 RPE
	Hip flexion banded high plank	20 x 3 s	
	Standing lateral barbell inclinations	4-6 x 3 sets, 15" recovery	
	Kettlebell swing	5+20 x 3-4 s, 1' recovery	
	Hip thruster	10-15 x 3-4 s, 2' rest	
	Frontal plank + Chinese plank	20-30" + 20-30" x 4-6 s	
	Post-training Lateral plank with extended and staggered legs	6-8 each side x 4 s	
Trunk rotation with breathing training, pushing the face with the hand	30" + 30" x 4 s		
Patient DP			
1 st day	Lateral plank with bent knees	30" each side x 3-4 s	
10 th day	Lateral plank with bent knees and elastic band around them (opening the legs)	30" each side x3-4s per day	20-30% of 1RM
	Hip thrust with one leg bent to the chest with an elastic band	“	3-4 RPE
	Triple flexion with elastic band on feet and with kb on the belly	40" x 3-4 s per day	1-2' recovery

Time	Therapeutic exercises	Repetitions	Intensity
3 rd week	Lateral plank with extended knees with hip lift + one leg lift	3-6 each side x 3-4 s per day, 3" pause	20-30% of 1RM
	Hip thruster within lumbar flexion	6-8 x 4	3-4 RPE
	Spine flexion-extension on foam roller + Jefferson curl	2' + 3 x 4-5 s	1-2' recovery
5 th week	Lateral plank with extended knees and hip lift + one leg lift + other leg lift with one weight up	3" stop between movements 3-6 each side x 3-4 s	20-30% of 1RM
	Hip thruster in lumbar flexion	30" x side x 3-4	3-4 RPE
	Spine flexion-extension with the thorax blocked and foam roller + Jefferson curl	2' + 3 x 4-5 s	1-2' recovery
7 th week	Lateral plank with extended knees and hip lift + one leg lift + other leg lift	3" stop between movements 3-6 each side x 3-4 s 3" pause	
	Hip thruster with load and with the spine in neutral position	30" each side x 4 s	
	Triple flexion with elastic band on feet and kb on the belly, starting with lifted legs OR light hip flexion with stuck feet and light load (around 5 kg)	40" x 4 s	
3 rd month	Hip thruster with load and with the spine in neutral position (feel the gluteus activation)	14 + 12 + 10 + 8 + 6, 1' recovery	
	Triple flexion with elastic band on feet and kb on the belly, starting with lifted legs OR light hip flexion with stuck feet and light load (around 5 kg)	12 x 3 s	
Patient GA			
1 st day	Odd days		
	Asymmetrical push-up	10 each side x 3 s	
	Squat	20 x 3 s, 30" recovery	
	Lunge with high knee	12 each side x 3 s 30" rec	
	Hip thruster	15 x 3 s, 30" rec	
	Even days		
	Pull ups with prone grip	5 x 5 s, 2' rec	
On leg deadlift (don't cross the legs)	12 each leg x s, 30" rec		
Frontal plank, raise one leg per time	10-14 x 3 s, 30" rec		
Lateral plank with bent knees	8-12 each side x 3 s, 30" rec		

Time	Therapeutic exercises	Repetitions	Intensity
1 st month	Odd days		
	EMOM with 4 rings push up	15'	
	5' recovery		
	EMOM with 5 overhead squats with barbell and 4 kg each side	20'	
	Crossed lunge with weight	10 each side x 3-4 s, 1' rec	
	Even days		
	Pull ups with prone grip	5 x 5 s, 2' rec	
	5' recovery		
	AMRAP with 15-20 deadlift with 1 kg each side + 8 lunges + 15-20 deadlifts with 30 kg + 20" frontal isometric plank + 20" lateral plank with bent knees	10'	
	5' recovery		
Lying glute stretch	20" x 6 s		
Bike	20' at constant and lowest velocity		
2 nd month	Odd days (2 days)		
	EMOM + 3-4 hang power snatch with 30 kg barbell	10'	
	5' rec		
	EMOM + 4 squat clean with 2 barbells (6-8 kg)	10'	
	5' rec		
	Romanian deadlifts + TRX pullover	8-12 + 8-12 x 3-4 s, 30" rec	
	Lateral plank and band pull	6-8 each side x 3-4 s, 30" rec	
	Hip flexion banded high plank	8-12 x 3-4 s, 30" rec	
	Twist flexibility with a ball between the knees	1' x 3-4 s, 30" rec	
	Lying glute stretch	20" each side x 6s	
	Even days (2 days)		
	EMOM + 2 hang power clean + 2 barbell push jerk (40 kg)	10'	
	5' rec		
	EMOM + 2-5 chest to the bar (be careful when going down, control the movement)	10'	
	5' rec		
AMRAP +10 TRX row + 10 TRX push-ups + 15 TRX squat + frontal plank walking + 10 hip thruster	20'20-30" + 20-30" x 4 s		
5' rec			
Chinese plank + frontal plank (with weight)	1' x 3-4 s, 30" rec		
Twist flexibility with a ball between knees	20" x 6 s		
Lying glute stretch			

Time	Therapeutic exercises	Repetitions	Intensity
4 th month	Wall plank	14-20 each side x 2-3 s, no rec	
	Tennis ball massage at wall (optional) From lunge position, move the load sideways	30" each side x 2 s 10-15 each side x 2-3 s, no rest	
	Odd days (2 days)		
	From lunge position, move the load sideways	10-15 each side x 2-3 s, no rest	
	Alternate grill pull ups 5" rec	5 x 5, 60-90" rec	
	One arm TRX rotation 3' rec	6-8 each side x 4-5 s, 30" rec	
	EMOM + 3-4 hang snatch with 30 kg barbell 5' rec	10'	
	TRX Australian pull ups with supine grip 1' rec	Till exhausted x 3 s, 30" rec	
	Bar arch 1' rec	30-60" x 3-4 s, 30" rec	
	Frontal plank + Chinese plank	20-30" + 20-30" x 4-6 s	
	Twist flexibility with a ball between knees	1' x 3-4 s, 30" rec	
	Lying glute stretch	20" x 6 s	
	Even days (2 days)		
5 th month	From lunge position, move the load sideways	10-15 each side x 2-3 s, no rest	
	Row/bike 3' rec	Constant velocity, 20" + 5" rec at lowest velocity, x 5 s	
	EMOM + 3-4 hang clean with 40 kg barbell 5' rec	10'	
	TRX fly chest with BFR 5' rec	30+15+15+15, 30" rec	
	Push up with narrow elbows	Till exhausted, x 3 s, 30" rec	
	Twist flexibility with a ball between knees	1' x 3-4 s, 30" rec	
	Lying glute stretch	20" x 6 s	
	Indications for the 5th or 6th day		
	From lunge position, move the load sideways	10-15 each side x 2-3 s, no rest	
	Row/bike + 4 renegade row with push ups 5' rec	2' x 7 s	
	Walk climb	4 x 4-5 s, 1' rec	
	Twist flexibility with a ball between knees	1' x 3-4 s, 30" rec	
	Lying glute stretch	20" x 6 s	

Time	Therapeutic exercises	Repetitions	Intensity
6 th month	Before training		
	From lunge position, move the load sideways	6-8 each side x 3 s, no rest	
	Crossed lunge	6-8 each side x 4 s, no rest	
	After training (odd days)		
	TRX standing side bands	6-8 each side x 4 s, no rest	
7 th month	Half kneeling t-spine rotation	1' each side x 4 s, no rest	
	After training (even days)		
	Lying glute stretch (start with hands, then take them off)	8-12 each side x 4 s, no rest	
	Before training		
	Bear squat	6-8 each side x 3 s, no rest	
9 th month	Crossed lunge (increase the lunge gradually)	"	
	After training (odd days)		
	TRX standing side bands	6-8 each side x 4 s, no rest	
	Single arm back row with spine rotation at TRX	" + 30" rec	
	After training (even days)		
Lying glute stretch with the hip 90/90	6-8 each side x 4 s, no rest		
Ban thread the needle	"		
1 st day	Before training		
	Bear squat	6-8 each side x 3, no rest	
	Bird dog drag diagonally	6-10 x 3 s, 30" rec	
	After training (odd days)		
	Ab wheel roll	4-12 x 4 s, 30" rec	
	TRX standing side bands	6-8 each side x 4, no rest	
	Band oblique twist	10-14 each side x 4, no rest	
	After training (even days)		
Medicine ball side throw	6-10 each side x 4, 1' rec		
Lying glute stretch with the hip 90/90	6-10 each side x 4		
Thread the needle on foam roller	8-12 each side x 4 s, no rest		
Patient PL			
1 st day	Windmill (for coordination)	4 per each side x 3-4 s	
	From frontal plank to lateral plank	12 x 3 s, 15" recovery	
	Lateral plank with bent knees	6-8 each side x 3-4 s, 30" recovery	
	Lateral plank	8-12 each side x 3-4 s, 30" recovery	
	In supine position, bend the knee to the chest and open the legs against elastic band		
	Post training		
	Chinese plank	20" + 20" x 4 s, 30" recovery	
	Frontal plank	"	
Spine twist supine	12 x 3 s		

Time	Therapeutic exercises	Repetitions	Intensity
	Before training		
	From frontal plank to lateral plank	12 x 3 s, 15" recovery	
5 th week	Post-training		
	Romanian deadlifts	6-8 x 3-4 s, 30" recovery	
	Lateral plank at the isometric ghd	20" each side x 4 s	
	Frontal plank with weight + Chinese plank	30" + 30" x 4 s	
	Patient VM		
	Dead-bug	20 x 3-4 s	
	Lateral plank with knee flexed	20 each side x 3-4 s	
1 st day	Isometric quad contraction with a support under the heel	20" contract. + 20" relax x 5 s	
	Hip extension and heel slides	5-8 x 4 s	
	Hip extension with bent legs and one leg flexed at the chest	8-12 x 4-5 s	
	Hip extension with bent legs and one leg on a chair	"	
	Reclining twist	8-10 x 4-5 s	
4 th week	Lateral plank with bent knees	20 each side x 3-4 s	
	Isometric quad contraction	20" contract + 20" relax x 5 s	
	Hip extension with one heel slides	5 each leg x 4-5 s	
	Modified step-up (eccentric + concentric without rest)	"	
	Isotonic lateral plank with extended legs	5 each side x 4-5 s	
8 th month	Leg twist	5 x 3-4 s	
	Sit-up with hands behind the back + Jefferson curl	4-5 each x 4-5 s	
	From quadrupedal position, inspiration and expiration + vacuum	"	
	Modified step-up	5 each leg x 4-5 s	
	Patient FDF		
	Odd days		
	Hip flexion banded high plank	8 each leg x 3 s	
	Lateral plank with flexed knees	10 each side x 3 s	
1 st day	Isometric wall squat + squat	20" + 10 x 3 s	
	Even days		
	Lunges	8 each side x 4 s	
	Glute bridge with one knee to chest	10 each leg x 3 s	
	From lateral position, abduction of the superior leg and later of the inferior one	10 each leg x 3 s	

Time	Therapeutic exercises	Repetitions	Intensity
	Odd days		
	Goblet squat + squat	12 + 14 x 4 s	
	From plank position, move the knee to the homolateral elbow	12 x 4 s	
3 rd week	Lateral plank	10 each side x 4s	
	Even days		
	Lateral lunge	10 x 4 s	
	Glute bridge with one knee to chest and arms up	10 each leg x 3 s	
	From lateral position, abduction of the superior leg and later of the inferior one	10 each leg x 3 s	
	Odd days		
	Squat	12 x 3 s	
	Lunges with barbell	8 each leg x 3 s	
	Bulgarian split squat	“	
	Cossack lunge with arms up	12 x 3 s	
	- hip thruster	“	
6 th week	Cyclette at medium velocity + low velocity	1' + 2'	
	Even days		
	Bench press	12 x 3 s	
	Barbell roll	“	
	Pull up with elastic band	“	
	Lateral plank	10 each side x 4 s	
	Row at medium velocity + low velocity	1' + 2'	
	One leg squat, with the hand pushing on the knee	4-5 each side x 3 s	
3 rd month	Lateral plank	30” each side	
	Jefferson curl	1' x 3-4s	
	In supine position, one leg flexion with the other crossed	20” each leg x 4 s	
	“		
5 th month	+ from the frog position, move the hip onward and backward	30” x 4 s	
	“		
	Crossed lunge	8-12 each side x 4 s	
7 th month	+ Fast walking	1'	
	Running 1-2 x week	2' x 10s	
	Lateral inclination at 45° hyperextension	8-12 each side x 3-4 s	
9 th month	Lateral inclination at crunch	8-12 each side, 3-4 s, no rec	
	Lumbar rotation with one leg crossed	1' each side x 3 s	
	Fast walking & running	1' + 2' x 10 s	

Time	Therapeutic exercises	Repetitions	Intensity
11 th month	Crossed lunge with lateral inclination	6-8 each side x 3-4 s	
	Trapezius and SCM self-massage	1' each side x 2 s	
	Spine mobility with lunge	6-8 each side x 3-4 s	
	TRX hip drop	1' x 3 s	
	Lumbar rotation with one knee flexed		
	Fast walking & running	1' + 2' x 10 s	
12 th month	Odd days		
	TRX hip drop	6-8 each side x 3-4 s	
	Single arm back row at TRX	1' each side x 3 s	
	Even days		
	TRX hip drop	1' each side x 3 s, 30" recovery	
	TRX T-spine rotation	"	
Patient MI			
1 st day	Self-massage with foam roller on the lumbar tract, glutes, hamstrings, calf	2' x 2 s	
	Lateral plank with constant breathing	6-8 each side x 3-4 s	
	Bulgarian split squat with constant breathing	"	
	One leg Romanian deadlifts + contralateral hand that touches the floor	"	
	Curl up with the knees bend with constant breathing	10-16 x 3-4 s	
3 rd week	Odd days		
	(Optional) self-massage with foam roller on the lumbar tract, glutes, hamstrings, calf	2' x 2 s	
	Jefferson curl	6-8 x 3-4 s	
	Deadlifts and Romanian deadlifts with barbell	6-8 + 6-8 x 3-4 s	
	Lateral plank with constant breathing	6-8 each side x 3-4 s	
	Even days		
	(Optional) self-massage with foam roller on the lumbar tract, glutes, hamstrings, calf	2' x 2 s	
	Lower trunk rotation	6-8 x 3-4 s	
	Frontal plank and trunk rotation	"	
	Curl up with the knees bend with constant breathing	10-16 x 3-4 s	
7 th week	Odd days		
	(optional) self-massage...	6-8 + 6-8 x 4 s	
	Romanian deadlifts with barbell + deadlifts	"	
	From lateral plank to Copenhagen position with extended knees and constant breathing	6-8 each side x 4 s	
	One-leg hip thruster	"	
	Even days		
(Optional) self-massage	2' x 2 s		
Romanian deadlifts + roman bench	10-15 each side x 4 s		

Time	Therapeutic exercises	Repetitions	Intensity
9 th week	Odd days		
	(Optional) self-massage...	2' x 2 s	
	Crossed lunge with trunk inclination	4 each side x 4-5 s	
	One-leg hip thruster with trunk retroversion	6-8 each side x 4 s	
	Even days		
	(Optional) self-massage...	2' x 2 s	
12 th week	Before training		
	From side bridge put a step under the knees and the elbow so that the hip goes down	6 each side x 4-5 s	
	Post training		
	Crossed lunge with trunk and arm inclination	6 each side x 4-5 s	
	One-leg deadlifts with lateral support	6-8 each side x 3-4 s	
	Pistol squat with extended arms on a support	4 each side x 3-4 s	
After 7 months	Before training		
	(Optional) self-massage	1' each side x 2 s	
	One-leg hip thruster + Nordic hamstrings exercise reverse	4-6 each side + 4-5 x 3-4 s	
	Post training		
	From side bridge put a step under the knees and the elbow so that the hip goes down	6 each side x 4-5 s	
	Active sagittal trunk flexion	4 each side x 3-4 s	

RESULTS

Each patient suffered from LBP due to the herniated disc, but the pain duration changed between the athletes, and it lasted from weeks to many months (table II). Every patient went back to the sport practice with different timings: 5 patients out of 7 (71.4%) returned to the sport at the same level as before the injury, and 2 of them (40%) had to change the frequency of their training, being careful to the stretching, mobility and warm-up phases. These two patients had the longest time of pain duration (table III). 1 patient (14.3%) out of 7 went back

to the sport practice gradually, but not yet at the same level as before. The last patient (14.3%) returned to the sport practice with better results compared to the ones before the injury. Our findings are resumed in the following table IV.

DISCUSSION

In our study, we have proposed a rehabilitation treatment for weightlifting elite athletes with LBP: super trained patients like them may be challenging to manage,

Table IV. Results after the rehabilitation treatment.

Variables							
Name	AC	GA	PL	DP	VM	FDF	MI
Time*	3 months after complete recovery	7 months	2 weeks For 6 months monitored training	Training without interruption, removing some exercises	3 months	1 year changing from 6 to 4 times a week training	2-3 weeks The training was adjusted on the symptoms
Level	Higher	Lower	Same	Same	Same	Same with modified frequency and more careful training	Same with modified frequency and more careful training

*After how much time the patient went back to the sport practice.

especially for a first approach and since the literature available is lacking.

According to some studies, lower limb muscle is impaired in patients with LBP: muscle inefficiency (especially the hip muscles), lack of coordination and imbalance can contribute to the develop of LBP, because if the pelvis is unstable, the lumbar spine does not perform the movements properly. In lifting-weight sports the mechanical concept result more relevant with the sport-specific task (10). For this reason, we aim to improve the coordination and the stabilization of the lumbar spine and of the pelvis, and to decrease the spine stiffness.

We should always consider that in sports like weightlifting, the athlete adapts his posture on the exercise and on his sensations, “always making adjustment to the lumbar spine” to execute every rep accurately. This may imply that developing disc herniations is subjective, and does not derive from the lumbar spine position, because every athlete has his own movement’s biomechanics. In any case, improving the back muscles strength – as the whole body, too – by using gradual loads provides to a major lumbar stabilization and decrease the risk of LBP and herniations (11).

Our first goal is to ensure that the patient gains confidence in performing movements. We can help him by managing the loads and the pain, and by informing him that most of the disc and hernial phenomena resolve spontaneously. Pain decreases the quality of life, and it should not be considered as an obstacle to undertaking the rehabilitation program, but it must be managed as well as the loads. Approaching exercise with a positive attitude is extremely important and it is going to help during the rehabilitation program. In a first phase pain killers can be suggested in accord with the medical team. The exercises chosen above were made unique for each athlete and adapted to the symptoms, and they changed almost every two weeks, according to the feeling of the patient. These therapeutic exercises work on the erector spinae, core and hip muscles. An atrophy of these muscles can exist in highly active and elite athletes with LBP (12).

Concerning the deadlift exercise, according to the literature available, it is not bad for LBP as it could appear; instead, it seems to significantly reduce pain intensity and increase strength and endurance (13). Our tissues adapt to mechanical stimuli by getting stronger, not weaker. An enhanced muscles and bone strength promote a greater structural support (13). The exercises have been modified in execution, repetitions, and intensity for each patient. Also, we gave a range of repetitions (a minimum and a maximum number of exercise repetition) so that

the patient could adjust the exercise, and so his training, on his pain and sensations.

Fast walking and running were selected: there is strong evidence in literature that this practice is associated with better hydration and proteoglycan content in the intervertebral disc (IVD) (14). Disc damage in sports like weightlifting, where there is a huge axial loading on the spine, can be present, and as the time passes it can lead to disc degeneration (15). Running and fast walking have an effect on the muscles, too: they strengthen the back muscles by increasing their activation through an isometric contraction, and this can be also used for the prevention of LBP (14, 16).

Additionally, we recommend the TRX exercises, such as: TRX hip drop, back row, T-spine rotation, standing side bands, which promote the balance, strength and flexibility develop, especially in the athletes. The whole-body benefit from this training, so it is decisive to choose the most suitable and significant exercise for the patient.

However, it is indispensable to keep in mind that having good muscle activity is certainly a positive aspect, especially for these kind of athletes with a high-demanding spine stability: a lumbar spine lacking of any muscular activity is highly unstable, even under low-entity loads (17, 18).

Focusing on the results, every patient went back to the sport practice. Clearly, the time changes depending on the patient, and so the rehabilitation treatment should change: personalizing the rehabilitation and the training to the patient seems to be necessary, particularly when it comes to alike situations, where the pain is not tolerable anymore and forces the athlete to stop his training and competitions.

Before choosing the surgical management, the physiotherapy intervention should be considered as the first step to enhance the patient condition. The rehabilitation treatment of the elite athlete is characteristic and challenging: in most situations we are dealing with already super trained and strong patients, so knowing where and how to manage the situation is essential. The athlete needs to get back to the sport practice as soon as possible in an excellent condition. First of all, a specific intervention is needed: we suggest to start from the reduction of the symptoms and the muscular control of loads. Progressively, we start with the therapeutic exercises and their variations, choosing the best one and customizing it to the needs of the patient. When it is time for the athlete to go back to the sport practice, we have to ensure his safety: giving the athlete some recommendations and contraindications can guide him during the sport train-

ing. He should be aware of his abilities, strength and limits, and above all to stop (or not) when needed.

Limitations

Our patients were nonuniform for age, weight and morphological type. They were only 7. Also, we did not have a control group.

CONCLUSIONS

The key points of our rehabilitation protocols are:

- Pain education and load management.
- Therapeutic personalized exercises (adapted in execution, repetitions and intensity).
- Training recommendations and contraindications.

But we should be careful: pain does not always indicate a tissue damage; not every anatomical alteration induces pain. Since there is not a one single best exercise, patients could not follow the cookie-cutter approach. Every therapeutic exercise has its own different effectiveness, and no single mode of exercise is superior to another. Also, the exercise selection should be decided upon the level of discomfort the patient can work with. The ultimate goal is the self-care management:

when the patient is able to auto correct when executing the exercises.

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DATA AVAILABILITY

Data are available under reasonable request to the corresponding author.

CONTRIBUTIONS

FO, MNA: writing, revising, study selection, data collection, data extraction. FO: synthesis methods, final approval. MCV: study selection, data collection, data extraction, supervising. NM: revising, final approval. All authors read and approved the final manuscript.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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