

# THE ROLE OF HYDROTHERAPY AFTER ACL RECONSTRUCTION

– Written by Mansour Otayek, Qatar

## INTRODUCTION

The early phase (first 12 weeks) of rehabilitation after ACL Reconstruction is crucial for laying the groundwork for a successful recovery. During this phase, the primary goals are to manage pain and swelling, restore range of motion (ROM), regain basic movement patterns, and improve overall function. Hydrotherapy plays a valuable role during this phase by providing a safe, low-impact environment that aids in pain and swelling management, facilitates controlled movement, and offers a unique form of resistance training that land-based exercises cannot replicate as effectively.

## THE BENEFITS OF HYDROTHERAPY IN ACL REHABILITATION

### 1. Reduced Weight-Bearing Stress

One of the primary advantages of hydrotherapy is its ability to provide a low-impact environment for rehabilitation. The buoyancy of water supports the body, reducing the amount of weight borne by the injured knee. This allows for early mobilization and weight-bearing exercises, which are critical for restoring normal joint

function without exacerbating the injury<sup>4</sup>.

When a person is immersed in water at different levels, their apparent weight (the perceived weight they feel) changes due to the buoyant force exerted by the water. An approximate estimation of the percentage of a person's weight they would feel at different immersion levels:

1. Shoulder Level (Approx. 10-20% of Body Weight).
2. Chest Level (Approx. 30-40 % of Body Weight).
3. Waist Level (Approx. 50-60 % of Body Weight).

These are approximate percentages and can vary depending on individual factors such as body composition, water density, and specific body positioning.

### 2. Hydrostatic pressure

In the context of hydrotherapy for ACL patients, hydrostatic pressure is relevant because it affects the body when immersed in water. When a person is submerged, the water exerts pressure on their body from all directions. This pressure increases with depth. It helps in:

- Reducing Oedema and Swelling: The

pressure from the water can help reduce swelling and edema (accumulation of fluid in body tissues), especially in the extremities. This is due to the increased venous return and improved lymphatic drainage.

- Reducing Muscle Tension: The pressure of the water can have a massaging effect on muscles, helping them to relax. This can be particularly useful for individuals with increased muscle tone either due to pain or movement compensation.

### 3. Improved Range of Motion

The warm water in hydrotherapy helps to relax muscles and increase joint flexibility. The supportive nature of water combined with hydrostatic pressure also allows for increased range of motion in joints. This is particularly crucial for ACL injury rehabilitation as regaining a full range of motion in the knee is essential for functional recovery<sup>2</sup>.

### 4. Enhanced Muscle Strength and Endurance

Hydrotherapy provides resistance in multiple directions, engaging a wide range of muscles. This allows for targeted

**TABLE 1**

<i>Safe environment</i>
<i>Safe progression</i>
<i>One step ahead of land therapy (do exercise in pool first then on land)</i>
<i>Reduced pain</i>
<i>Re-education and encouragement of normal movement</i>
<i>Facilitates partial weight bearing in those with post-operative precautions</i>
<i>Improved gait</i>
<i>Improved balance and coordination</i>
<i>Increased muscle strength</i>
<i>Improved self-confidence and independence</i>
<i>Improved circulation</i>
<i>Improved ROM and flexibility</i>
<i>Early introduction to running</i>

**Table 1:** Benefits of Hydrotherapy in ACL Rehabilitation.

strengthening exercises for the quadriceps, hamstrings, and other stabilizing muscles around the knee joint. These exercises aid in restoring muscle balance and overall stability<sup>3</sup>.

#### 5. Neuromuscular Re-education

The water resistance creates an unstable environment, challenging proprioception and balance. This promotes neuromuscular re-education, training the body to respond effectively to dynamic movements, which is crucial for ACL injury recovery<sup>1</sup>.

#### 6. Conditioning

Conditioning in the context of hydrotherapy refers to the use of water-based exercises and activities to improve strength, flexibility, and overall physical fitness. This approach combines the benefits of water buoyancy and resistance with targeted exercises to enhance an individual's physical condition.

#### HYDROTHERAPY EXERCISES FOR ACL REHABILITATION

There are a number of potential exercise streams that can be included in hydrotherapy as part of the ACL rehabilitation process:

#### 1. Gait Re-education:

Walking in waist-deep water is an excellent low-impact exercise for early-stage rehabilitation. It allows the patient to begin weight-bearing activities while providing resistance for muscle engagement<sup>5</sup>.

#### 2. Strength:

Leg raises performed in the water target the quadriceps and hip flexors. These exercises enhance strength and stability in the knee joint (Hetz et al., 2018). Leg press and Hamstring exercises with the noodles also helps in muscle activation and lower limb strength.

#### 4. Balance:

Standing on one leg in the water challenges balance and proprioception. Variations of this exercise can be performed to progressively increase difficulty.

#### 5. Motor control:

Hydrotherapy, can provide several benefits for motor control, which refers to the ability to coordinate movements and control muscle actions. Here are some of the advantages of incorporating hydrotherapy

into motor control rehabilitation: Reduced Gravity Effect, Increased Proprioception, Enhanced Balance and Stability, Facilitation of Functional Movements, Sensory Stimulation.

#### 6. Jumps and Plyometrics:

In later stages of rehabilitation, plyometric exercises like jumping and hopping can be incorporated into the hydrotherapy program. These activities help regain explosive strength and agility<sup>3</sup>.

#### 7. Running:

Safely and confidently using the underwater treadmill is a very important criteria to reach in the progression towards discharge from hydrotherapy and running on land. As a low impact, and relatively safe exercise, we note a great improvement in patient confidence when completing this milestone during rehabilitation while still protecting the operated knee.

#### CREATING AN EFFECTIVE HYDROTHERAPY PROTOCOL

A personalized hydrotherapy program should be designed based on the individual's specific ACL injury or operation and stage of rehabilitation. It is essential to design a protocol that is aligned with the land protocol so we can progress in a safe and consistent way.

Screening for any medical issues which may impact the safety of hydrotherapy sessions should be completed prior to commencing treatment. In addition, for any post-surgical patient to be referred to Hydro it is mandatory for the wound to be dry and clean.

#### HYDROTHERAPY ASPETAR ACL PROTOCOL:

Hydrotherapy provides a unique setting for rehabilitation due to the buoyancy and resistance properties of water. These properties allow for reduced weight-bearing stress on the joints while providing a supportive environment for targeted exercises.

This protocol outlines a progressive series of exercises and activities tailored to the stages of ACL rehabilitation. It includes a multi-phase approach, each phase designed to address specific goals and challenges encountered during the rehabilitation process.

TABLE 2

Weeks	3	4	5	6	7-8	9-10	11-12
Quadriceps	<ul style="list-style-type: none"> <li>Respecting the ROM</li> <li>Mini Squat,</li> <li>Slow front kick while walking (water resistance),</li> <li>Knee flexion/extension hip flexed</li> </ul>		<ul style="list-style-type: none"> <li>Continue previous exercise and start progression,</li> <li>Leg press with 2-3 noodles,</li> <li>Front kick while walking (water resistance),</li> <li>Knee flexion/extension hip flexed,</li> <li>Lunges.</li> <li>Step up/down progression, Side steps.</li> <li>Squat progress to single leg squat in water</li> </ul>			<ul style="list-style-type: none"> <li>Continue previous exercises with Increasing the load to reach the max by week 12.</li> <li>Leg press with 3 noodles,</li> <li>Front kick while skipping (with fins),</li> </ul>	
Hamstring	<ul style="list-style-type: none"> <li>Walking with butt-kick (water resistance)</li> <li>Leg extension and push down(water resistance) with 1 noodle,</li> <li>Knee flexion extension while standing</li> </ul>		<ul style="list-style-type: none"> <li>Walking with butt-kick (water resistance),</li> <li>With 2 Noodles start leg extension and push down,</li> <li>Knee flexion extension while standing</li> </ul>			<ul style="list-style-type: none"> <li>With 2-3 Noodles do leg extension and push down</li> <li>Use while doing diver exercises while standing on unstable floor</li> </ul>	
Hip	<ul style="list-style-type: none"> <li>Hip flexion/extension</li> <li>High kick</li> <li>Hip lateral adduction / abduction to mid line</li> <li>Hip horizontal adduction /abduction knee bent</li> </ul>		<ul style="list-style-type: none"> <li>Progress the previous exercises by adding hydro-tones mini fins progress from slow to fast exercises (knee in full extension)</li> </ul>			<ul style="list-style-type: none"> <li>Doing front – side - backward kicks with knee in full extension while putting the theraband (ankle level) to create resistance</li> </ul>	
Calf	<ul style="list-style-type: none"> <li>Heel raises bilateral/ unilateral standing (progress by going up steps),</li> <li>Toe walking forward backward and sideways</li> </ul>		<ul style="list-style-type: none"> <li>Start calf exercises on the steps (progress from 1st till 3rd step to gradually have less bodyweight support from the water)</li> </ul>	<ul style="list-style-type: none"> <li>Calf exercises on the steps (progress from 1st till 3rd step)</li> </ul>		<ul style="list-style-type: none"> <li>Calf exercises on the steps (progress from 1st till 3rd step)</li> </ul>	
Jumping	No jumping yet		No jumping yet		<ul style="list-style-type: none"> <li>Hopping on toes with knee extended.</li> <li>Jumping jacks</li> </ul>	<ul style="list-style-type: none"> <li>Progress to jump from squat</li> <li>Start high Jumps</li> <li>Start plyometric exercises.</li> <li>Begin low intensity sports specific exercises based on activity/sports</li> </ul>	
Balance	<ul style="list-style-type: none"> <li>Standing with 1 leg on stable surface use wave to create turbulence.</li> </ul>		<ul style="list-style-type: none"> <li>Standing with 1 leg on unstable surface while throwing a ball to the wall.</li> <li>Walking on the L-shaped bar while keeping balance forward/backward/ sideways. Progress to dynamic balance exercises.</li> </ul>	<ul style="list-style-type: none"> <li>Progress with previous exercises to balance exercises by creating waves and the patient will be asked not to use hands to maintain balance</li> </ul>		<ul style="list-style-type: none"> <li>Progress with previous exercises to balance exercises related to sports / activity,</li> <li>neuromuscular control and proprioception exercises using the water flow and a wobble board to create a challenging balance exercises</li> </ul>	
Gait to Running Progression	<ul style="list-style-type: none"> <li>Gait (forwards, backwards, sideways)</li> <li>Walk on the treadmill speed 2-3 km/h for 10 min</li> </ul>		<ul style="list-style-type: none"> <li>Gait (forwards, backwards, sideways)</li> <li>Walk on the treadmill speed 3 km/h for 15 min</li> <li>Stationary skip ( 30 sec – 10 sec rest)</li> <li>Skipping in the pool (forwards, backwards, sideways)</li> </ul>	<ul style="list-style-type: none"> <li>Start running progression in the pool.</li> <li>water treadmill running speed 5-6 km/h for 10 min.</li> <li>Fast skipping forward/ backward /sideways.</li> <li>Bicycle within available ROM (low speed/resistance) for 5 min.</li> </ul>		<ul style="list-style-type: none"> <li>Running progression in the pool, water treadmill running (speed 7-8) for 15 min.</li> </ul>	<ul style="list-style-type: none"> <li>Running progression in the pool, water treadmill running (speed 9-10) for 15 min.</li> </ul>

Table 2: Hydrotherapy ACL rehabilitation protocol.

### Running progression

5 weeks	6 weeks	7 weeks	8 weeks
<b>Stationary skips</b>	<b>Stationary skips</b>	<b>Skipping in pool</b>	<b>Running on the treadmill</b>
30 sec - 10 sec	<b>Skipping in pool</b>		Speed 7/8
x 10	x 2	x 2	10-15 min
	FWD - BWD - Side	FWD - BWD - Side	
		<b>Running on the treadmill</b>	
		Speed 6/7	
		10 min	
20-30% body weight	20-30% body weight	20-30% body weight	30-40% body weight

### Jumping progression

7 weeks	8 weeks	9 weeks	10 weeks
<b>Stationary hops</b>	<b>Stationary hops</b>	<b>FWD Hops</b>	<b>Stationary jumps</b>
Double leg	Double leg	2 x the pool	Shoulder under water to waist water level
20 x 3 Sets	20 x 3 Sets		20 x double leg 10 x single leg 3 sets
	Single leg	<b>Small stationary jumps</b>	
	10 x each / 3 Sets	10 x 3 sets	
20-30% body weight	20-30% body weight	30-40% body weight	30-40% body weight

THE DISCHARGE CRITERIA (APPROXIMATELY 12 WEEKS POST SURGERY DEPENDING ON EARLY POST-OPERATIVE PRECAUTIONS RE WEIGHT BEARING AND ROM):

In the water the athlete should be able to:

- Run on the treadmill speed 8-10 km/h for 15 min. pain free 40-50% body weight
- Stationary deep high jumps – double and single leg
- No pain reported during and the second day from the discharge day

At the end of the Hydrotherapy rehab phase the patient should be able to start running on the AlterG and start progress to more than 50% body weight. If there is any flare up during this early running phase the patient may referred back for a running progression in the pool for 2 weeks. After finishing the hydrotherapy protocol patient can be referred to hydro for recovery as part of his path to discharge.

### CONCLUSION

Hydrotherapy is a valuable tool in the rehabilitation after ACL reconstruction. Its benefits in reducing weight-bearing stress, improving range of motion, enhancing muscle strength, promoting neuromuscular re-education, and reducing pain which makes it an integral component of a comprehensive rehabilitation program. When implemented under the guidance of a qualified healthcare professional, hydrotherapy can significantly expedite the recovery process and facilitate a safe return to sport and daily activities for individuals with ACL injuries.

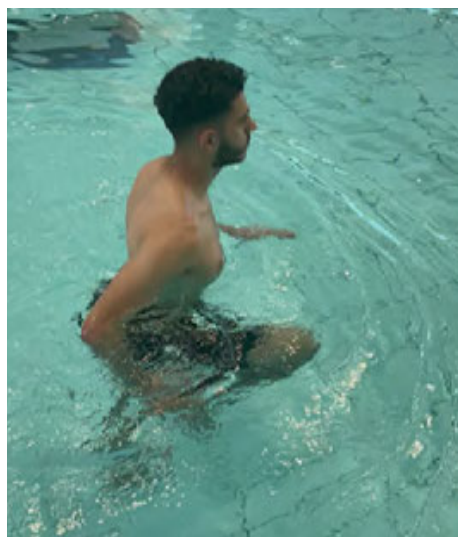


Figure 1a and b: Balance.



Figure 2a and b: Leg Press.

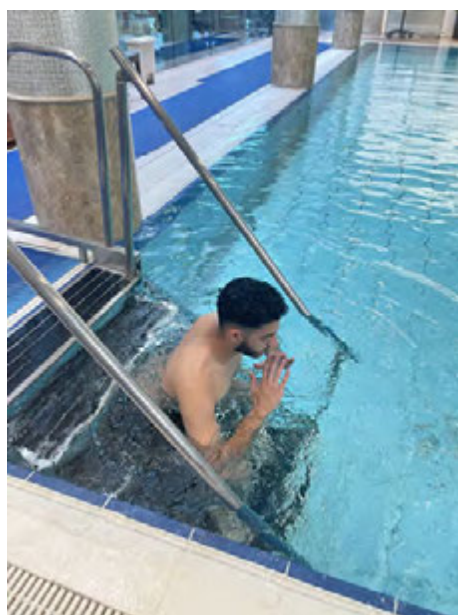
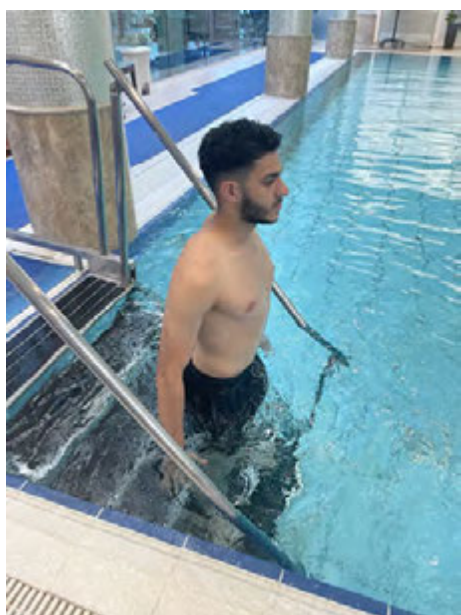




**Figure 3a and b:** Running.



**Figure 4a and b:** Diver.



**Figure 5a and b:** Squat.

## References

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Mansour Otayek P.T.

Physiotherapist

Aspetar Orthopedic and Sports Medicine  
Hospital

Doha, Qatar

Contact: [Mansour.Otayek@aspetar.com](mailto:Mansour.Otayek@aspetar.com)