

# The Bad Ragaz Ring Method

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# Chapter 4

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## The Bad Ragaz Ring Method

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### CHAPTER OBJECTIVES

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- Understand the relationship between the Bad Ragaz Ring Method (BRRM) and Proprioceptive Neuromuscular Facilitation
- Learn the connection between the properties of water and the manner in which BRRM makes use of them
- Understand the specific clinical uses of BRRM in patient management within the rehabilitative continuum
- Understand the limitations of BRRM within the International Classification of Disability (ICD) system

The Bad Ragaz Ring Method is an active one to one aquatic physical therapy concept. The therapist provides the resisting fix points to the patients. The technique requires high skill and accuracy of the therapists. Therefore, the therapist must have the exact knowledge of the concept and must show a refined gripping technique. Both are compulsory for the success of the method.

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### BACKGROUND

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The Bad Ragaz Ring Method (BRRM) is a strengthening and mobilizing resistive exercise model based on the principles of proprioceptive neuromuscular facilitation techniques (PNF) (Kabat 1952, 1953 and Knott & Voss 1968). This specific treatment concept was developed by physiotherapists in Bad Ragaz, Switzerland and published by Davies (1967). This publication is well known worldwide but included some inefficient patterns for strengthening and mobilization. Egger expanded the method with new patterns and published the new Bad Ragaz Method with Rings in 1990. In this publication, the patterns are very well described, but at that time, the therapists did not use the method with implementation of exercise physiology and with implementation of contemporary PNF- techniques to optimize the effect of the method.

The BRRM isn't just a strengthening and mobilizing technique, but a complete physiotherapeutic treatment concept, which can be focused on modulation of pain and muscular relaxation. To achieve this, specific techniques are used.

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**PHYSIOTHERAPEUTIC AND MECHANICAL PRINCIPLES**

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Biomechanical, hydrodynamic and neurophysiologic knowledge provide the most important fundamentals for the resistive therapy of the Bad Ragaz Ring Method. When the properties of a movement in one joint such as its direction, intensity, and velocity influence neighboring joints, a continuous movement develops (Klein-Vogelbach 1981). Every continuous movement changes the equilibrium, forcing the body to react to find a position of stable equilibrium. These reactions occur in two steps:

1. The client stops the continuous movement with a counter-activity, which is called active counter force (or thrust).
2. The client uses some body part(s) as a counterweight to restrict the continuous movement effects. This is called an activated passive counter force.



**Figure 4-1. Active counterforce: The primary movement of the left hand is reaching forward to ring the ring to the noodle. This movement automatically induces an extension of the spine to limit the movement of reaching forwards. In this example, it is not enough, to maintain the balance, it needs more counter weight. Activated passive counterforce: The movement of the right leg in extension and right arm in flexion and abduction, out of the water.**

In the BRRM, both active and activated passive counter forces are used. From an exercise physiological point of view, just the active counter forces are important. Knowledge and proper activation of these counter forces are of utmost importance in order to use the BRRM patterns in a correct manner. For example, when using a unilateral reciprocal pattern, the center of gravity moves away from the midline, causing the body to roll. To prevent this, counter activities have to be followed exactly. Movements which occur as an activated passive counter force have a large therapeutic value because these are automatic, reactive movements of which the patient may be unaware. These automatic movements occur with a small amount of force, occur slowly and can be easily controlled by the therapist.

**Table 4-1.** Example of the pattern flexion - abduction internal rotation with knee flexion and the automatic counterforce reaction. If we have assymetrical rotation in both legs the body is instable and rolls in the water to the side of the external rotation.

Primary Movement in the Right Hip Joint	Effect	Counteraction in the Left Hip Joint
Flexion	Pelvic Sinks	Extension
Abduction in Flexion	Body Rolls to the Right	External Rotation
Internal Rotation in Flexion	Body Rolls to the Right	Abduction

Therapeutically activated passive counterforce reactions are also important. In this case, the automatic reactions are desired and automatic for the patient. These types of movements are economically and helpful when patients has pain or will not allow movement of the affected extremity.

When a free floating body in water experiences traction on one side (distraction) and approximation at the other side of its extremities or trunk, a torque exists that moves the body toward the traction side. This movement is supported through the various mechanical forces of water giving the body a general mobilization in a specific direction. Before the body starts to move, the inertia of the water must be overcome. Once in motion, the body increases its speed gradually which creates increased turbulent flow behind the body, increasingly providing more drag. In addition, frontal pressure due to the water's viscosity also increases. Drag forces in water are dependent on the relationship between the differences in density and viscosity between air and water. At rest, the difference between water and air is 1:14. Therefore, drag or resistance to movement is at the least 14 times greater in water than in air as faster movement increases resistance due to turbulent flow. The Bad Ragaz Ring Method uses these fluidmechanical forces as a resistance. That is why it is important that the patient always floats at the water surface during BRRM treatments.



**Figure 4-2.** Turbulent flow provides drag at the left side of the patient (negative pressure) and gives resistance to the patient.

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## PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION AND BRRM

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In the previous section, we explained that BRRM incorporates various therapeutic concepts. However, since BRRM is regarded as “PNF in water”, a comparison of both concepts is important. Proprioceptive Neuromuscular Facilitation (PNF) is defined as a method of promoting or hastening the response of the neuromuscular mechanism through stimulation of the proprioceptors (Knott and Voss 1968). PNF is a specific collection of land-based techniques promoting the response of the neuromuscular system through stimulation of the proprioceptors. The patient always uses the physiotherapist’s resistance with a relatively fixed base of support, so equilibrium / balance is guaranteed more or less continuously. Gravity allows the maximal distance of origin and insertion of muscles by using slow stretch reflexes whereby movements can be initiated. The therapist’s resistance stays present throughout the movement excursion.

Likewise, when the human body is floating in water, it is in stable equilibrium. However, a single small movement can change the relationship between the center of gravity and the center of buoyancy and the body will lose its stable position. Equilibrium can be restored in the BRRM in two ways:

1. A small support for stabilization, using flotation aids
2. The therapist, whose hands form the only real points of fixation.

In a free floating, non moving body in water, it is impossible to maximally stretch / tear apart origin and insertion, because the intramuscular tension cannot be overridden in this position of free float. Therefore, unlike PNF, the stretch reflex cannot be used to initiate a movement in water. The resistance effects in the BRRM exist because of the therapist hands and of the drag due to the movement through water. This subtle balance makes it impossible to move to the end of the range of motion in all patterns. Often, only parts of patterns are used in the BRRM.

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## INDICATIONS

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The BRRM is a strengthening and mobilizing resistive exercise model in a one to one situation with a variety of excellent characteristics (see section on treatment goals). It is a specific therapeutic regimen with well-defined indications. The BRRM cannot be used for strengthening in aquatic fitness group treatments. When training with a volunteer-partner, he must know the pattern, the resistance, the techniques and have adequate knowledge of exercise physiology. The BRRM is an ideal part of the complex treatment concept of aquatic therapy. Aquatic strengthening without using the BRRM or resistance equipments can maximally increase strength up to force 3, with the BRRM up to force 5 (Peterson Kendall 2005), when using the asymmetrical reciprocal patterns. However, also BRRM is particularly indicated for relatively weak patients. By using BRRM for stronger patients, the strength and stability of the therapist is the limiting factor of the strengthening process.

The functional therapeutic abilities and limitations are analyzed precisely by the therapist and the most suitable patterns chosen by the knowledgeable aquatic practitioner. Patients who need to improve strength, mobility, stability or function can benefit from BRRM. The technique is useful with:

- peripheral joint problems like osteoarthritis,
- inflammatory diseases like rheumatoid arthritis or ankylosing spondylitis,

**Table 4-2.** The basic principles of the PNF concept that are utilized in the BRRM.

Adapted resistance	Isotonic and isometric resistance are applied during the whole movement and adapted to the capabilities of the patient. The therapist feels the patient's quality of movement during dynamic work and is able to influence the quality by adapting the resistance given.
Stimuli: tactile, verbal	Correct holding and tactile cueing by the therapist helps to stimulate the skin, muscle and joint proprioceptors to facilitate the movement. Short, precise commands by the therapist stimulate the active movement.
Traction/approximation	Traction and approximation at joints stimulate sensory nerve endings and initiate reflexive co-contraction (through approximation) or support an isotonic contraction (through traction)
Stretch	Stretch can be used as a technique only through the pattern and not at its beginning.
Irradiation	A facilitation of strong muscles provides irradiation to the weaker ones and increases their activity.
Patterns	Three-dimensional diagonal movements has the most effective strengthening effect A change from a proximal to a distal hold increases difficulty to execute correct patterns.
Timing	The movements always start distally.
Body mechanics	Immersion destabilizes the therapist. He should not immerse deeper than TH9, otherwise the correct execute of the Method is not guaranteed.

- chronic spine problems,
- general weakness or motor control deficit from neurological diseases like stroke, peripheral nerve lesions, polyneuropathies, or
- impairments post surgery, like trauma, and joint replacement.

In general, patterns that directly focus on the area of the functional problem are used in a later stage. At first the effects are created with a detour: indirect strengthening as a reactive effect. For example, spinal stabilization is facilitated by bilateral reciprocal leg patterns. The therapeutic goal often is obtained 'reactively'. The activities are economical, efficient and must be maximal to the patient's possibilities. Therefore a general strengthening program can be performed with correct dosage.

The BRRM however isn't just a strengthening technique, but a complete physiotherapeutic treatment concept, which can be focused on modulation of pain and muscular relaxation. To achieve this, specific techniques are used (see Table 11.)

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## TREATMENT GOALS

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The World Health Organization (WHO, 2001) has classified descriptions of health problems into 4 components, which are being used widely in rehabilitation. These 4 components are in-

terrelated, although an increase at one level does not necessarily lead to an increase at another level. For example, improvements at the function level do not automatically lead to changes at the activity and participation levels. The advantage of this classification is that the patient's treatment goals can be defined accordingly.

The levels are:

- Body structure and body function
- Activity
- Participation
- Contextual factors

All goals of the BRRM, as listed in Table 2, can be found at the level of body function. The goals are used for patients with neurological, orthopedic, and rheumatological problems and serve as a preparation for therapy at the levels of activity or participation. In general, the BRRM is mostly used in an early stage of rehabilitation.

**Table 4-3.** Indication of BRRM and relationship to ICF

<b>Increasing</b>	<b>ICF Body Function</b>	<b>Decreasing</b>	<b>ICF Body Function</b>
Strength	Muscle power functions	Muscular tone	Muscle tone functions
Coordination	Involuntary movement reaction functions	Pain	Sensation of pain
Joint stability	Stability of joint functions		
Range of motion	Mobility of joint functions		
Local muscle endurance	Muscle endurance functions		
Preparing lower extremities for weight-bearing	Gait pattern functions		

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## APPLICATION OF TECHNIQUES

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BRRM is not simply a matter of working against the resistance of water and adding a fixed point to a patient floating in supine with buoyancy rings and then asking for active movements (in straight planes). The patient must be evaluated with an emphasis on determining the intervention needs. As a result, the therapist chooses the adequate patterns and parameters. Physiological parameters differ depending upon the therapeutic goal such as increasing mobility, endurance or strength. The amount of resistance is carefully graded in timing and intensity. The patient must be educated about the procedure and when necessary, mental adjustment (Halliwick Concept) has to precede BRRM. This mental preparation is an important component of the BRRM treatment program. When the patient is uncomfortable in a supine position and has difficulty with breath control, equilibrium reactions and/or stiffness will interfere with treatment.

The exercise program of the BRRM requires flotation aids that provide patient safety and stabilization in the water. These flotation aids also slow down rotation of the body in the pool. The neck and hips are supported by rings preferably filled with air, and depending on the exercise, a third ring may support one or both ankles.

The positioning and inflation of the flotation aids are quite specific. The flotation aids should be placed in such a way that movement is not restricted. Rings around the ankles and hip should have a limited amount of air. When the rings are over-inflated, the body becomes unstable and rises too high out of the water. Consequently less force development can be expected (*Harrison 1982*).

The ring at the hips should support the center of gravity at S2 rather than the waist. A collar around the neck facilitates cervical spine neutral alignment, and allows the patient to hear the therapist's instructions. In addition, in some leg patterns, the neck collar serves to create the counter thrust. The therapist is the point of fixation for the patient during all BRRM exercise. This means that the therapist must be in stable equilibrium, avoiding excessive movement. Consequently, water depth for the therapist should maximally be at approximately the 9<sup>th</sup> thoracic vertebrae; deeper water significantly decreases the therapist's stability.

Muscular activity elicited with BRRM includes both variable and isometric contractions. The variable contraction type is commonly referred to as isotonic or isokinetic. This contraction type is utilized when the therapist's external resistance varies to match the torque produced by the patient. This allows near maximum force production at any joint angle. The muscle adjusts its tension depending upon its length and changes in movement velocity and external leverage. This is how the dynamic patterns of the BRRM function. By using specific treatment techniques during a BRRM session, isotonic muscular contractions can be divided into isotonic concentric contractions and isotonic eccentric contractions. These techniques are derived from PNF. Because of the fluid mechanic influences, only a portion of the treatment techniques that are used in PNF can be integrated in the BRRM. An overview is given in Table 4.

**Table 4-4.** Treatment Techniques from PNF Utilized in BRRM

Treatment Techniques	
Rhythmic initiation	The therapist starts with the pattern passively, and then he asks the patient to help more and more. At the end, the patient moves in the exact pattern himself.
Reversal of antagonists	Change from one pattern to the opposite without break and without relaxing in between patterns.
Repeated contractions or stretch	Repeated stretch through the range, resist the pattern and stretch the active muscles and ask for increased contraction.
Combination of isotonic	In the desired movement combine isotonic concentric work with isometrics and isotonic eccentric work. There is no relaxation between the different types of muscle activity.
Timing for emphasis	Change the normal timing of the movement to applied timing in other joints. Stabilize the strong joints and move the weak one.
Hold relax	Bring the body in the desired position and increase slowly the resistance without any movement. Ask for hold the position.
Contract relax	Bring the body in the desired position and ask to pull the body in a desired direction. Resist the movement.



The second type of muscle contraction is isometric. In this situation, the patient maintains a certain position while being moved by the therapist through the water. The hydrodynamic forces are used as the resistance. The patient can also be asked to hold a certain position in one part of the body while another part moves. Specifically at the bilateral asymmetrical reciprocal leg patterns, one leg will stabilize the body in an isometric contraction and the other one will move isotonicly.

It may be necessary, before starting the actual BRRM treatment to integrate a short passive movement session to work on relaxation, regulation of tone and traction of the spine. This is an ideal preparation for the specific resistance training of BRRM. Relaxation during the patterns can be achieved by incorporating the neurophysiologic phenomena of reciprocal inhibition and post-facilitation inhibition.

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## TREATMENT

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Treatment time in the BRRM depends on the treatment goals. The minimum time should not be shorter than 15 minutes, especially with those patients having significant weakness. Strengthening exercises in these patients should not exceed a few minutes in each interval, because fatigue at high load (more than 80% of one repetition maximum) contractions is rapid. In these cases, start with 6 contractions for the weak muscles and 12-16 contractions should be possible for the stronger groups (Mc Ardle 2000).

Consider the rest period in-between each set of exercises. This period should be 1.5-3 minutes when using high load contractions. Only then can a second set can be applied to the same group of muscles, but in a decreasing fashion. Six contractions in the first set, five contractions in the second set, and, when applicable, four contractions in the third set is typically a good starting dosage. In exercise physiology, this procedure is called an inverted pyramid (Ehrlenz 1983).

Somewhat longer periods of treatment are needed to train aerobic capacity or local muscular endurance. In this case, a treatment should last at most 30 minutes. Muscular contractions should be more than twenty submaximal contractions per series, with a break of one minute or less between two sets. During this break other muscle groups are exercised while relaxing the muscles previously exercised.

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## EXERCISE PROGRESSION

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Exercises are progressed capitalizing on the water's hydrodynamic forces. Faster movement through the water creates greater drag because of turbulent flow. This drag increases in a squared function to the velocity of the patient. This principle results in a self-regulation of resistance, depending on the abilities of the patient. The resistance exercises thus adapt to the capabilities of the patient. Resistance equipment such as hand paddles can be used to increase resistance. It is better not to focus directly on the affected area, particularly in patients who are weak or who have chronic pain. If performed properly, beginning the exercises in distal body parts produces irradiation to the affected areas.

A progression of exercises can be accomplished as follows:

1. Move through increasing range of motion.
2. Change hand holds from proximal to distal.

3. Increase the speed of motion.
4. Change the body shape to lengthen the lever.
5. Include techniques like combination of isotonic or repeated contractions.
6. Increase resistance by using hand paddles or other resistive equipment.
7. Use less flotation in the rings (patient lies deeper in the water.)
8. Change the frontal surface area.

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## MOVEMENT PATTERNS

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The BRRM can be divided into patterns that work on the body through the legs, through the trunk or through the arms. Patterns can also be classified as unilateral or bilateral. The bilateral patterns have symmetrical and asymmetrical options. All movement patterns are applied in supine position.

### *Lower Extremities*

To understand the principles of how the BRRM function, it is necessary to analyze how chains of movements in the body function as well as how they influence equilibrium. This is especially important for the bilateral asymmetric reciprocal leg patterns.

An example of this concept is the bilateral asymmetric reciprocal leg pattern, with knee flexion of the isotonic leg. In this pattern, the extended right leg is moved while the patient is in the supine position. The hip joint starts in extension, adduction, and external rotation, and moves into hip flexion, abduction, and internal rotation with knee flexion. The abduction in the flexed end position of the right hip produces a chain of movements across the pelvis causing the left hip joint to externally rotate. The internal rotation of the flexed right hip produces abduction in the left hip. This sequence results in the final position of:

Right hip: *flexion – abduction – internal rotation*  
 Left hip: *extension – abduction – external rotation*

The result of the position of the hips is as follows:

The right hip flexion and the left hip extension stabilize the body.

- The abduction of both legs stabilizes the body.
- The right hip internal rotation and the left hip external rotation destabilize the body causing the body to roll to the left.

Table 5 summarizes the primary movement, its effects and the counteraction that occurs in the opposite extremity.

In order to have a stabilizing pattern working on the body, the left sided external rotation must be replaced by an internal rotation. The stabilizing pattern in the left leg is *extension, abduction, and internal rotation*.

The abduction of the flexed hip transfers a large mass towards the right side, partly to be compensated by a lateral trunk flexion to the left side. This results in an increase of abduction in the left hip, which contributes to stabilizing in the body position. But now the movement might not occur in the diagonal plane, which is important in the BRRM. To ensure appropriate

**Table 4-5.** Bilateral Reciprocal Leg Pattern

Primary Movement: Right Leg (Hip) with Knee Flexion	Effect	Reaction Left Leg (Hip)
<b>Flexion</b>	Lowering the Pelvis	<b>Extension</b>
<b>Internal Rotation*</b> in flexion	Rolling to the Right Side Loss of Volume	<b>Abduction</b>
<b>Abduction</b> in flexion	Rolling to the Right Side	<b>External Rotation*</b>

stabilization for the isotonically moving right hip, the left hip needs to be held isometrically in the extension, abduction, and internal rotation pattern (Egger 1990). The resulting pattern is:

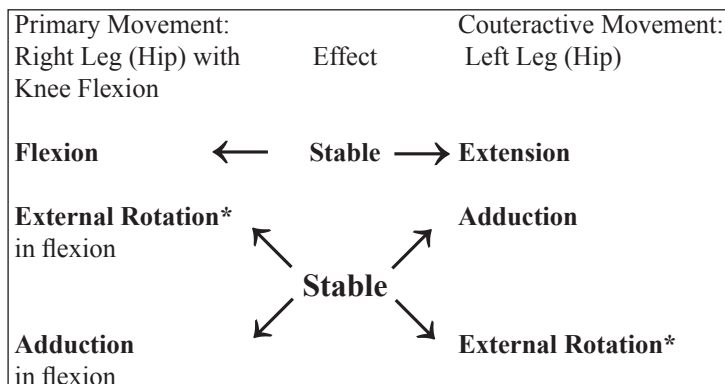
Right hip isotonically: *flexion – abduction – internal rotation with knee flexion*  
 Left hip isometrically: *extension – abduction – internal rotation with knee extension*

Bilateral symmetrical patterns can be performed with and without knee flexion. The pattern stops when the legs close in the symmetrical adduction. These patterns are characterized by the fact that a transversal rotation is more prevalent than a longitudinal rotation. The trunk takes part in the flexion and extension of the hip joints because in these patterns the proximal lever (trunk) also moves.







Table 6 shows the primary movement, it’s effects and the counteraction that occurs in the opposite extremity.

The proper starting position at the bilateral reciprocal patterns is difficult. Patients are very unstable because of the narrow supine position and they easily rotate around the longitudinal axis. To find the proper starting position, move the patient through the water gently. The dynamic forces of the water help to achieve the good adduction or abduction in the hip joint. A slight traction at one side and a slight approximation at the opposite side of the body will facilitate the starting position. In order to get the correct starting position, it may be helpful to achieve this position with an eccentric contraction, starting in the end position. By starting in the end position, all counter forces are balanced, so the body doesn’t experience a torque.

**Table 4-6.** The Counteraction









**Table 4-7.** Reciprocal Pattern of the Lower Extremity

<b>Leg Pattern</b>		
<b>Bilateral Reciprocal</b>		
	<b>End Positions (hip components)</b>	<b>Starting Postions</b>
isotonic isometric	<b>Flexion – adduction - external rotation</b> knee flexion, dorsal extension - inversion <b>Extension – adduction – external rotation</b> knee extended, plantar flexion – inversion	Extension – abduction – internal rotation knee extended, plantar flexion - eversion Extension – adduction – external rotation knee extended, plantar flexion, inversion
		
isotonic isometric	<b>Flexion – abduction – internal rotation</b> knee flexion, dorsal extension - eversion <b>Extension – abduction – internal rotation</b> knee extended, plantar flexion – eversion	Extension – adduction – external rotation knee extended, plantar flexion - inversion Extension – abduction – internal rotation knee extended, plantar flexion – eversion
		
isotonic isometric	<b>Extension – adduction – external rotation</b> Knee flexion, plantar flexion - inversion <b>Flexion – adduction – external rotation</b> knee extended, dorsal extension – inversion	Flexion – abduction – internal rotation knee extended, dorsal extension - eversion Flexion – adduction – external rotation knee extended, dorsal extension – inversion
		







(continued)

**Table 4-7. Reciprocal Pattern of the Lower Extremity - *continued***

<b>Leg Pattern</b>		
Bilateral Reciprocal		
	<b>End Positions (hip components)</b>	<b>Starting Postions</b>
isotonic isometric	<b>Extension – abduction – internal rotation</b> knee flexion, plantar flexion - eversion <b>Flexion –abduction – internal rotation</b> knee extended, dorsal extension – eversion	Flexion – adduction – external rotation knee extended, dorsal extension - inversion Flexion –abduction – internal rotation knee extended, dorsal extension – eversion
		
isotonic isotonic	<b>Flexion – abduction – internal rotation</b> knee extended, dorsal extension - eversion <b>Extension – abduction – internal rotation</b> knee extended, plantar flexion – eversion	Extension – adduction – external rotation knee extended, plantar flexion - inversion Flexion – adduction – external rotation knee extended, dorsal flexion – inversion
		
isotonic isotonic	<b>Extension – adduction – external rotation</b> knee extended, plantar flexion - inversion <b>Flexion – adduction – external rotation</b> knee extended, dorsal extension – inversion	Flexion – abduction – internal rotation knee extended, dorsal extension - eversion Extension – abduction – internal rotation knee extended, plantar flexion – eversion
		







(continued)

**Table 4-8.** Symmetrical Pattern of the Lower Extremity

<b>Leg Pattern</b>		
<b>Bilateral Symmetrical</b>		
	<b>End Positions (hip components)</b>	<b>Starting Postions</b>
isotonic	<b>Flexion – adduction – external rotation</b> knee flexion and trunk flexion, dorsal extension – inversion	Extension – abduction – internal rotation knee and trunk extended, plantar flexion – eversion
		
isotonic	<b>Extension – abduction – internal rotation</b> knee and trunk extended, plantar flexion – eversion	Flexion - adduction – external rotation knee flexion and trunk flexion, dorsal extension – inversion
		
isotonic	<b>Flexion – adduction – external rotation</b> knee extended and trunk flexion, dorsal extension – inversion	Extension – abduction – internal rotation knee and trunk extended, plantar flexion – eversion
		



*(continued)*

**Table 4-8.** Symmetrical Pattern of the Lower Extremity - *continued*

<b>Leg Pattern</b>		
<b>Bilateral Symmetrical</b>		
	<b>End Positions (hip components)</b>	<b>Starting Postions</b>
isotonic	<b>Extension – abduction – internal rotation</b> knee and trunk extended, plantar flexion – eversion	Flexion - adduction – external rotation knee extended and trunk flexion, dorsal extension – inversion
		
isotonic	<b>Flexion – abduction – internal rotation</b> knee and trunk flexion, dorsal extension – eversion	Extension – adduction – external rotation knee and trunk extended, plantar flexion – inversion
		
isotonic	<b>Extension – adduction – external rotation</b> knee and trunk extended, plantar flexion – inversion	Flexion – abduction – internal rotation knee and trunk flexion, dorsal extension – eversion
		

*(continued)*

**Table 4-8.** Symmetrical Pattern of the Lower Extremity - *continued*

<b>Leg Pattern</b>		
Bilateral Symmetrical		
	<b>End Positions</b> (hip components)	Starting Postions
isotonic	<b>Flexion – abduction – internal rotation</b> knee and trunk extended, dorsal extension – eversion	Extension – adduction – external rotation knee and trunk extended, plantar flexion – inversion
		

**Trunk**



Traction and approximation are used simultaneously through the extremities or the trunk when working. The body experiences an acceleration because of hydrodynamic forces which then leads to a lateral flexion. This lateral flexion is fully passive. The patient is asked to actively pull his/her feet along the surface to the opposite side. When the traction and approximation forces work through the shoulder girdle, a pre-activation muscle contraction at the shoulder joint is necessary in order to stabilize safely. This pre-activation can be elicited through a bilateral approximation in both shoulder joints. Progress the pre-activation muscle contraction by using a longer lever arm for approximation and traction (i.e. through the patient’s extended arms).

When applying the traction and approximation forces through the lower extremities, the therapist stands in between the abducted legs of the patient. The forces can be applied at the pelvis, the upper legs or the lower legs. The simultaneous traction on one side with approximation on the contra-lateral side results in a passive lateral flexion of the trunk. The patient is asked to bring arms or elbows actively to the opposite lateral side. For example, simultaneous traction at the right side with approximation at the left side results in a lateral flexion to the left side. Progress the exercise by increasing the lever arm. The most difficult activity is applying forces at the lower legs with maximal elevation of the patient’s arms.

Another possibility is to work on the trunk through two ipsilateral extremities. When the patient moves the stretched leg to extension, abduction, and internal rotation, the trunk is activated in extension and lateral flexion. An ipsilateral extension, abduction, and internal rotation of the arm also facilitates extension and lateral flexion of the trunk.









**Table 4-9.** Pattern of the Trunk

<b>Trunk Pattern</b>		
Acting through lower and upper extremity		
	<b>End Positions</b> (trunk components)	<b>Starting Postions</b>
isotonic	<b>Lateral flexion</b> Feet in dorsal extension	Straight-line Feet in plantar flexion
		



*(continued)*

**Table 4-9.** Pattern of the Trunk - *continued*

<b>Trunk Pattern</b>		
Acting through lower and upper extremity		
	<b>End Positions (trunk components)</b>	<b>Starting Postions</b>
isotonic	<b>Flexion - lateral flexion – rotation</b> Feet in dorsal extension	Straight-line – pelvic or trunk rotation 30° Feet in plantar flexion Straight-line – pelvic or trunk rotation 30° Feet plantar flexion
	  	  





*(continued)*

**Table 4-9.** Pattern of the Trunk - *continued*

<b>Trunk Pattern</b>		
Acting through lower and upper extremity		
	<b>End Positions</b> (trunk components)	<b>Starting Postions</b>
isotonic	<b>Extension – lateral flexion – rotation</b> Feet in plantar flexion	Straight-line – pelvic or trunk rotation 30° Feet in dorsal extension
		

*(continued)*

**Table 4-9.** Pattern of the Trunk - *continued*





<b>Trunk Pattern</b>		
Acting through ipsilateral extremities		
	<b>End Positions</b>	<b>Starting Positions</b>
isotonic	<p><b>Extension – rotation</b> (trunk components)                      Arm: Extension – abduction – internal rotation fingers and wrist extension, elbow extended                      Leg: Extension – abduction – internal rotation with plantar flexion – evasion, knee extended</p> 	<p>Straight-line                      Arm: Flexion –adduction – external rotation fingers and wrist flexion, elbow extended                      Leg: Flexion – adduction – external rotation dorsal extension – inversion, knee extended</p> 
isotonic	<p><b>Return to straight line</b> (trunk components)                      Arm: Flexion – adduction – external rotation fingers and wrist flexion, elbow extended                      Leg: Flexion – adduction –external rotation Dorsal extension – inversion, knee extended</p> 	<p>Extension – rotation (trunk components)                      Arm: Extension – abduction – internal rotation fingers and wrist extension, elbow extended                      Leg: Extension – abduction – internal rotation plantar flexion – evasion, knee extended</p> 

***Upper Extremities***

The complexity of the shoulder joint, the hydrodynamics, and the specific dimensions of the levers involved limit the possibilities to treat shoulders according the BRRM. Only one unilateral pattern has been found to be effective. Recently, a variation in the prone position using a mask and snorkel has increased the possibility to incorporate the arm patterns (Becker 1997).

Movements in flexion and extension are not considered, because these are not easily performed under water when in supine. The movements in abduction and adduction, including their rotations can be performed. Therapeutically one has to focus on increasing range of motion. The arm moves away from the trunk in abduction and external rotation to full flexion/elevation. The glenohumeral joint is the pivot for both arm and trunk with the trunk laterally flexing toward the opposite side. At the end of the pattern, stabilize in the new position and initiate the second phase of the movement, which is bringing the arm and trunk toward each other with shoulder adduction and internal rotation.

**Table 4-10.** Pattern of the Upper Extremity

Arm Pattern		
	End Positions (gleno-humeral components)	Starting Postions
isotonic	<b>Abduction – external rotation – flexion</b> Fingers, wrist and elbow extended 	Adduction – internal rotation – extension Finger and wrist flexion, elbow extended 
isotonic	<b>Adduction – internal rotation –extension</b> fingers and wrist flexion, elbow extended 	Abduction – external rotation – flexion fingers, wrist and elbow extended 

**APPLICATION OF TECHNIQUES**

Accurate knowledge of techniques in BRRM is very important for a specific treatment. Different techniques help to treat pain, force, mobility or local muscular endurance. Only 7 techniques are used in BRRM. Not all techniques can be applied in each pattern.

For learning or to initiate a movement, rhythmic initiation and combinations of isotonic movements can be used. If the treatment goal is pain inhibition, hold / relax is the first technique to utilize. If increasing strength is the aim, repeated contraction, accompanied by timing for emphasis with combinations of isotonics should be used. Contract / relax and hold / relax are techniques to treat mobility.

**SUMMARY**

The Bad Ragaz Ring Method concept is most useful for aquatic rehabilitation in the early rehabilitative stages of patient care. The Method focuses upon using the patient’s muscular force, which should be less than the therapist’s force. The treatment goals in Bad Ragaz Ring Method are always at the level of body functions. So Bad Ragaz Ring Method has to combine with other aquatic rehabilitation concepts whose focus to increase activities and participation like the water specific therapy of the Halliwick concept.

**Table 4-11.** Application of Techniques

Patterns	Rhythmic Initiation	Reversal of Antagonists	Combination of Isotonics	Repeated Contraction	Hold Relax	Contract-Relax	Timing for Emphasis
<b>Trunk</b>							
Pure lateral flexion	X	X	X		X		
Flexion - lateral flexion - rotation	X	X	X		X		
Extension – lateral flexion - rotation	X	X	X		X		
<b>Arm</b>							
Flexion – abduction – external rotation	X	X	X	X	X	X	X
Extension – adduction – internal rotation	X	X	X	X	X	X	X
<b>Leg Bilateral Symmetrical</b>							
Flexion – adduction – external rotation	X	X					
Extension – abduction – internal rotation	X	X					
Flexion – abduction – internal rotation	X	X					
Extension – adduction – external rotation	X	X					
<b>Leg bilateral Reciprocal Knee Flexion</b>							
Flexion – adduction – external rotation (isotonic)	X		X	X	X	X	X
Extension – adduction – external rotation (isometric)							
Flexion – abduction – internal rotation (isotonic)	X		X	X	X	X	X
Extension – abduction – internal rotation (isometric)							
Extension – adduction – external rotation (isotonic)	X		X	X	X	X	X
Flexion – adduction – external rotation (isometric)							
Extension – abduction – internal rotation (isotonic)	X		X	X	X	X	X
Flexion – abduction – internal rotation (isometric)							
<b>Leg Bilateral Reciprocal Knee Extension</b>							
Flexion – abduction – internal rotation (isotonic)	X	X					
Extension – abduction – internal rotation (isotonic)							
Extension – adduction – external rotation (isotonic)	X	X					
Flexion – adduction – external rotation (isotonic)							

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## CASE STUDY

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A 33-year-old teacher was referred to aquatic therapy after a 4-week history of lumbar and leg pain, starting acutely after one day of garden work involving much bending. The pain was most severe across the low back and irradiating into the right leg, laterally to the knee. With painkillers the back pain decreased about 50%, but in the leg was unchanged. Forward bending of the torso caused pain in the back with radiation up to the knee. At the lateral edge of foot the patient indicated a slight numb feeling for the past 2 weeks. MRI done 2 days previous to the visit showed a lateral disk herniation at L4/L5 constricting the L5 root. He was still continuing to work, but participating in the volleyball team of teachers is impossible.

When sitting longer than 15 minutes, he had trouble rising, needing his hands and only with difficulty can slowly come to full extension of the lumbar spine. In the morning his back was completely rigid and sore, improving only after a warm shower. The morning stiffness lasts an hour. He was taking 50 mg diclofenac 3 times a day, which helped to relieve pain. The back exercises given by the family doctor as a brochure did not help and actually worsened symptoms of his legs.

### **Investigation / Initial examination**

The patient moves about guardedly. In particular when undressing and bending forward, returning upright is difficult. In upright stance he shows a lumbar shift with lumbar deviation / scoliosis to the left and any attempt to correct this increases the pain in the R leg and back. When bending forward, he can touch the upper rim of his patella with both hands, but pain increases in his back and right leg. The low back is held rigidly, and the spinous processes seem fixed. A backwards lean of his torso is exquisitely uncomfortable. The patient just reaches the straight neutral position. The R SLR test is positive at 45°. The L5 dermatome is slightly numb, and the myotome is likewise involved, with the M. gluteus medius and M. extensor hallucis longus both weak. The Patellar Tendon Reflex and Achilles Tendon Reflex are normal.

### **Clinical Reasoning**

The patient shows the classical symptoms of a discopathy with nerve root compression with involvement of both the myotome and the dermatome. The dermatome symptomatology only started in the course of the disease. Pain in the back has diminished. Leg pain is persisting however with a consecutive clear shift of the torso away from the herniated side. The local (inflammation) reaction to the discopathy (event) seems to follow the spontaneous (physiological) healing process.

The effects of the discopathy and shift seem to be unfavorably affected by longer sitting activities. For this reason first a shift correction must be achieved, before extension and flexion can be improved. The patient has continued to work as a teacher during this event. At present there do not appear to be any psychological red flags.

### **Assessment**

- Finger to ground distance during forward bend was to the upper patella edge)
- Numeric rating scale for pain in the back (6 /10), as well as morning stiffness (8/10)
- Numeric rating scale for leg pain (8/10)
- Extension of the lumbar spine in standing (0°)

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## AQUATIC INTERVENTION PLAN

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We plan a treatment protocol for 2 times per week.

### **1st Treatment**

We begin with this patient in the pool with positioning of the rings at the position of minimized pain. As the first pattern we select the R arm in Extension - Adduction - internal rotation. We apply this pattern with relatively small energy expenditure; we use 20 repetitions done in 3 sets. The 1-minute break in between the sets is used for the left arm Flexion- Abduction – external rotation pattern. In order to manage the shift correction, we select now the trunk pattern in pure lateral flexion, applied through the lower extremities. We select the lateral flexion on the right first to see the extent of the low pain or pain-free movement. The patterns are performed in this range of motion. We then try to hold at the pain threshold for 6-10 seconds as an isometric hold. This intervention would repeat 10 times in 3 series, followed of a series break of 2 minutes. During this break we would again exercise the arm movements Extension - Adduction - internal rotation.

#### *Instructions to the patient:*

The correct execution of the shift correction on land is instructed and the patient is asked to do lumbar shift (or lumbar deviation / scoliosis) correction in standing all waking hours during the day 10 times. The patient is coached to avoid long sitting periods: teaching should be done when standing and he shouldn't sit watching TV.

#### *Information for the patient*

We expect that the leg pain will decrease, but the low back pain might increase temporarily. The latter would be a normal and fairly common reaction.

### **2nd Treatment**

#### *Patient short report:*

The pain in the R leg goes only to center thigh. The back pain is the same (6/10), but the morning stiffness is reduced (6/10).

#### *Examination:*

Finger - ground distance reach is to the upper patellar margin.

After the first 3 series of the trunk assessment pure lateral flexion was accomplished on the right for 6-10 seconds isometrically holding at the pain threshold, repeating the same patterns with the Combination of Isotonics technique. Again one works only in pain-free or very light pain range. Isometric work is always used between the concentric and eccentric muscle work. The movement limit goes in each case to the pain threshold in the correction of direction of the shift. Also we would use this technique during 10 repetitions in 3 series. The series breaks can be kept short. The treatment is ended with the bilateral reciprocal leg patterns:

1. flexion – adduction - external rotation isotonically with knee flexion
2. extension - adduction - external rotation isometrically with knee extension.

We let this pattern remain isometric in the central position for 10 seconds in each case.



At both legs we would move through 10 repetitions in 3 series. With this pattern we aim at strengthening the weak leg musculature, as well as isometric activation of the multifidus and abdominal musculature.

*Instructions to the patient:*

Home exercises and sitting precautions should continue.

### **3rd Treatment**

*Patient complaints:*

No more distal leg pain, pain radiating only up to the R trochanter, back pain (5/10), morning stiffness (4/10).

*Examination:*

The patient shows no lumbar shift (or lumbar deviation / scoliosis) to the left, finger ground distance is to the center of calf, SLR RH 70°.

We begin the therapy with the bilateral reciprocal leg patterns in isotonic flexion - adduction - external rotation with knee flexion and extension - adduction - external rotation with knee extension isometrically. This pattern is accomplished over the entire movement extent with an intensity of 70-80% of the maximum force. Twelve repetitions per leg are performed in 4 series, the speed of the movement timed so that the 12 repetitions take place in one minute. We then work immediately with the other leg. This results in a break for the previous activated musculature, because the opposite side works.

The movement pattern of pure lateral flexion to the right is likewise accomplished now with 12 repetitions in 4 series. The movement extent is as far as possible, and is aimed at the end position. As at the first we select the application through the lower extremities, followed from the application through the upper extremities. Both patterns are supplemented with the Combination of Isotonics technique. On the left side now the arm patterns of flexion - abduction - external rotation and extension - adduction - internal rotation are accomplished with the technique of reversals of antagonists likewise with 12 repetitions in 4 series. In the series break we work with the R arm in the pattern extension - adduction - internal rotation. The technique of repeated contractions is used. The treatment ends finally with the bilateral stretched leg pattern extension - abduction - internal rotation. We select these patterns in order to increase the extension in the lumbar spine.

*Instruction to the patient:*

The patient is instructed to move into extension of the lumbar spine while standing each hour while up.

### **4th Treatment**

*Patient complaints:*

He has only low back pain (2/10), and mild morning stiffness of 15 minutes (2/10).

*Examination:*

Finger ground distance to ankle, Extension 20°, SLR R 80°.

Repeat the treatments of the previous session with the trunk pattern of extension - lateral flex-

ion - rotation applied from the upper extremity now incorporated. First the movement extent is carefully assessed, and then the movement is achieved with 10 repetitions in 3 series. The side is changed regularly.

*Instructions to the patient:*

Sitting restrictions slowly released Again sitting is to begin at school increased as tolerated and start to watch TV as before. Extension exercises when up hourly.

### **5th Treatment**

*Patient complaints:*

No lumbar pain and no morning stiffness.

*Examination:*

Finger – floor 0 cm, full Extension of the lumbar spine. SLR 90° and equal at both sides.

We begin pure lateral flexion applied through the outstretched arms with the technique involving reversals for antagonists from right to left vice versa. We would proceed through 20 repetitions on each side in 3 series. Between the series the bilateral symmetrical leg pattern extension - abduction - internal rotation with lumbar extension accomplished with in each case through 20 repetitions in 3 series. The trunk pattern of extension – lateral flexion - rotation is accomplished with 20 repetitions in 3 series over the outstretched arms. The patterns are subjectively perceived by the patient as somewhat hard. In the breaks the bilateral symmetrical leg patterns of flexion – adduction - external rotation and extension - abduction - internal rotation with the technique of reversals for antagonists, 20 repetitions for each series. Subsequently, the trunk patterns flexion – lateral flexion - rotation and extension - lateral flexion - rotation with the techniques of reversals for antagonists and combination of isotonic are accomplished. The repetition number amounts to 20 in 4 series. The session concludes with bilateral reciprocal leg pattern of isotonic flexion - abduction - internal rotation and extension - abduction - internal rotation isometrically with 25 repetitions in 4 series.

### **6th Treatment**

*Patient complaints:*

All goes well, no more complaints.

*Assessments:*

Back pain (0/10), leg pain (0/10), morning stiffness (0/10) absent. SLR 90°, finger – floor 0 cm. Extension lumbar spine 30°.

Resembles treatment as treatment 5, additionally instruction of breaststroke and front crawl with fins. During the crawl, the primary stabilizing muscle systems are the multifidi and transversus abdominis. Training of these systems is to help to avoid recurrence of symptoms.

Instructions to the patient: When swimming, use the crawl if possible. With future garden work combine bending activities with extensions for the lumbar spine. Further special measures are not necessary any longer.

The treatment is completed.

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**REVIEW QUESTIONS**

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1. In BRRM, the most significant point of stabilization is
  - a. The large floatation ring that is applied to the trunk
  - b. The counterforce of the water as movement occurs
  - c. The therapist's holding positions
  - d. Muscular contraction of the ipsilateral extremity
  
2. A major method of movement initiation in BRRM is
  - a. Utilization of the tonic stretch reflex
  - b. Voice commands to the patient
  - c. The weakest muscles which are first recruited
  - d. Joint restrictions causing passive movement
  
3. In BRRM, the therapists position should always be
  - a. At the head of the patient
  - b. With feet placed at approximately hip width
  - c. Immersed to levels below T9
  - d. With shoulders and elbows in neutral rotation
  
4. Within the ICD system, the goals of BRRM fall
  - a. At the level of body structure and function
  - b. At the level of patient activity
  - c. At the level of clinical participation
  - d. At the level of social integration
  
5. BRRM is best practiced
  - a. In large group formats
  - b. In small group formats, never exceeding 2-3 patients per therapist
  - c. With careful on-deck guidance of patient movements
  - d. With one-on-one patient contact
  
6. When using a trunk ring, placement should be at
  - a. The level of the umbilicus
  - b. The level of the bottom of the buttocks
  - c. The level of the upper pelvis
  - d. The level of xiphoid
  
7. In BRRM
  - a. There is more emphasis upon concentric contractions
  - b. There is more emphasis upon eccentric contractions
  - c. There is more emphasis upon passive stretch
  - d. Eccentric and concentric contractions are both used extensively

8. BRRM treatment for initiating strengthening in a very weak patient should be
  - a. 15 minutes or longer to start
  - b. Always less than 15 minutes
  - c. Focusing on multiple repetitions of single muscle movements, 12-16 at least
  - d. Sufficient to go to significant fatigue and then add 5-8 more repetitions
  
9. Of the physical principles of water, the most important in BRRM is
  - a. Buoyancy
  - b. Thermal conductivity
  - c. Density
  - d. Viscosity and turbulence
  
10. The BRRM is most useful for
  - a. Aquatic therapy in patients early into rehabilitation
  - b. Specific muscle strengthening in high level athletes
  - c. Joint range of motion in acute arthritis patients
  - d. Balance and coordination training for cerebral palsy