

## **Bone Stress Injury (BSI) Return to Sport Protocol Patient Guideline**

Bone stress injuries (BSIs) are common with research showing they can occur in more than 20% of runners. BSIs are classified into high and low risk categories based on location, severity, time to heal, the make-up of bone, and risk of delayed or incomplete healing. BSIs may be graded on a scale of 1-4 (1 being least severe to 4 being most severe) based on the appearance on MRI. Many factors impact the recovery from a BSI, and ideal treatment usually involves many medical disciplines that could include physicians, physical therapists, athletic trainers, dietitians, sport psychologists, and more. Return to high-level sport or activity occurs around **2-6 months** in most cases but depends on severity and location of injury and other risk factors.

This document is designed to improve your understanding of the phases of rehabilitation following a BSI, with clear criteria for progression through each phase. The timeframes are broad and will depend on your unique injury and body, so you may progress slower or quicker through certain phases. Your orthopedic or sports medicine physician and physical therapist will work together to determine an appropriate timeline for you to return to sport.

We understand that it can be very challenging to not be able to perform the sport that you love. This protocol is designed to keep you active through your recovery while gradually re-introducing impact from running. Creating clear milestones with your physical therapist to advance in your return to running can be helpful in maintaining a goal-oriented mindset throughout the process. You may consider keeping an exercise log to track progress and improve your commitment to the process. Our goal is for you to make a full return to your sport stronger than you were before and with reduced risk for sustaining a future BSI.

## Program Overview

| Phase                               | Activity                                                                                                   | Criteria to complete phase                                                                                                                                                  |
|-------------------------------------|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1- non-weight bearing               | Total rest, swimming, cycling                                                                              | Pain free walking without an assistive device for 3 continuous days                                                                                                         |
| 2- light loading                    | Walking, swimming, deep-water running, antigravity treadmill, elliptical, stair climber, strength training | <ul style="list-style-type: none"> <li>● Pain free walking for 30 minutes</li> <li>● Pain free 10 single leg jumps aiming for quick ground contacts (pogo jumps)</li> </ul> |
| 3 - progressive loading             | Progressive jogging program, plus activities from prior phases to maintain cardiovascular fitness          | Pain free jogging for 30 minutes                                                                                                                                            |
| 4 - Return to run/sport preparation | Progressive jogging program, plus activities from prior phases to maintain cardiovascular fitness          | Pain free following progressive sport specific training. Ready to return to full team practice                                                                              |

### Phase 1: Non-weight bearing (0-6 weeks)

You, your physician and physical therapist will work together to determine the best course of treatment during this phase. During this phase you may require an assistive device such as a CAM boot or crutches to decrease loading of the injured site.

**Exercise:** You may be cleared to perform low impact activities such as biking and swimming to maintain cardiovascular fitness. If you experience pain during these low impact activities, immediately end the exercise session and wait a minimum of 3 days before attempting again.

**Criteria to move to phase 2:** Pain free daily activities including walking without an assistive device for 3 continuous days.

## Phase 2: Light Loading (2-8 weeks)

**Walking Program:** Now that you can walk pain free, you will build walking tolerance up to 30 minutes at an easy to medium walking pace. Activity during this phase should continue to remain pain-free at the injury site. If you remain pain free during the dedicated walking session and with usual daily activities, continue to progress. If you do have pain during a walking session take a rest day and drop back to repeat the last walking session where you did NOT experience pain. If you have pain during the session you dropped down to, take 3 days of rest/low impact cross training before attempting the same session again. If you still experience pain take 3 additional rest days and drop down two levels. Contact your care provider if pain persists after dropping down two levels.

**Cross training:** You may continue low-impact cross training including cycling, swimming, deep-water running, elliptical, and antigravity treadmill training sessions up to 45-60 minutes. On designated walk days it is recommended to choose cycling, swimming, or deep water running as your cross training activity.

**Functional Pain testing:** Every Sunday and Wednesday you will electronically record whether you have pain at night, during walking, during double leg jumping, and single leg jumping. To determine if you are able to attempt single leg jumping you must progress through the below exercises with no pain. **Do NOT attempt heel raises if you have pain walking. If pain is experienced while attempting the exercises below, stop immediately and do not complete the remaining repetitions. Do not progress to the next exercise if pain is experienced.**

- 2 sets 20 single leg heel raises on each side
- 10 single leg squats each side (touch butt to chair)
- 20 double leg jumps (quick ground contacts)
- 10 single leg jumps (quick ground contacts)

Pain during the functional tests does NOT prohibit you from progressing through the walking program as long as walking remains pain free. However, if you have NO pain during single leg hopping following Cycle 1, day 7 progress to Cycle 3, day 1.

**Criteria to move to phase 3:** Walk 30 minutes with no pain and complete 10 pain free single leg hops.

**Phase 2:** Light  
loading

| Cycle | Day 1 | Day 2                                                                          | Day 3                                                  | Day 4                                                                          | Day 5                                                  | Day 6                                                                          | Day 7                                                  |
|-------|-------|--------------------------------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------|
| 1     | Off   | Walk x<br>15 min<br><br>Optional<br>Low<br>impact<br>cross<br>train <60<br>min | Optional<br>Low<br>impact<br>cross<br>train <60<br>min | Walk X<br>20 min<br><br>Optional<br>Low<br>impact<br>cross<br>train <60<br>min | Optional<br>Low<br>impact<br>cross<br>train <60<br>min | Walk X<br>20 min<br><br>Optional<br>Low<br>impact<br>cross<br>train <60<br>min | Optional<br>Low<br>impact<br>cross<br>train <60<br>min |
| 2     | Off   | Walk x<br>20 min<br><br>Optional<br>Low<br>impact<br>cross<br>train <60<br>min | Optional<br>Low<br>impact<br>cross<br>train <60<br>min | Walk x<br>25 min<br><br>Optional<br>Low<br>impact<br>cross<br>train <60<br>min | Optional<br>Low<br>impact<br>cross<br>train <60<br>min | Walk x<br>25 min<br><br>Optional<br>Low<br>impact<br>cross<br>train <60<br>min | Optional<br>Low<br>impact<br>cross<br>train <60<br>min |
| 3     | Off   | Walk x<br>25 min<br><br>Optional<br>Low<br>impact<br>cross<br>train <60<br>min | Optional<br>Low<br>impact<br>cross<br>train <60<br>min | Walk x<br>30 min<br><br>Optional<br>Low<br>impact<br>cross<br>train <60<br>min | Optional<br>Low<br>impact<br>cross<br>train <60<br>min | Walk x<br>30 min<br><br>Optional<br>Low<br>impact<br>cross<br>train <60<br>min | Optional<br>Low<br>impact<br>cross<br>train <60<br>min |

### Phase 3: Progressive loading (3-12 weeks)

#### Running Pace:

**Level 1:** At least 1-2 minutes per mile slower than pre-injury easy pace

**Level 2:** 30 seconds-1 minute per mile slower than pre-injury easy pace

**Level 3.** Easy pace-30 seconds per mile slower than pre-injury easy pace

**Level 4:** Easy pace to 30 seconds per mile faster than easy pace

**Walk to Jog Program:** All jogging in this phase should be performed at Level 1 pace. Warm up with a 5-minute walk at medium pace followed by a short dynamic warm up that should include:

- 10-20 x hip bridges
- 5 x per side lateral lunges
- 5 x per side walking lunge with a twist
- 5 x per side knee to chest walking
- 15 x per side jogging butt kicks.

If you remain pain free during the dedicated walk/jog session and with usual daily activities, continue to progress. If you do have pain during a walk/jog session take a rest day and drop back to repeat the last walk/jog session where you did NOT experience pain. If you have pain during the session you dropped down to, take 3 days of rest/low impact cross training before attempting the same session again. If you still experience pain take 3 additional rest days and drop down two levels. Contact your care provider if pain persists after dropping down two levels.

**Cross Training:** Continue with low impact cross training. Sessions should be limited to 60 minutes. On designated jog/walk days it is recommended to choose cycling, swimming, or deep water running as your cross training activity.

**Criteria to move to phase 4:** Jog 30 minutes at Level 1 pace with no pain.

| Phase 3: Progressive loading |       |                                                      |                              |                                                     |                              |                                                      |                              |
|------------------------------|-------|------------------------------------------------------|------------------------------|-----------------------------------------------------|------------------------------|------------------------------------------------------|------------------------------|
| Cycle                        | Day 1 | Day 2                                                | Day 3                        | Day 4                                               | Day 5                        | Day 6                                                | Day 7                        |
| 1                            | Off   | 1 min jog/2 min walk X 5<br><br>Optional cross train | PT + optional cross training | 1 min jog/1min walk X 8<br><br>Optional cross train | PT + optional cross training | 2 min jog/1 min walk X 6<br><br>Optional cross train | PT + optional cross training |

|   |     |                                                                     |                                       |                                                                     |                                       |                                                                     |                                       |
|---|-----|---------------------------------------------------------------------|---------------------------------------|---------------------------------------------------------------------|---------------------------------------|---------------------------------------------------------------------|---------------------------------------|
| 2 | Off | 3 min<br>jog/1<br>min walk<br>X 5<br><br>Optional<br>cross<br>train | PT +<br>optional<br>cross<br>training | 4 min<br>jog/1<br>min walk<br>X 4<br><br>Optional<br>cross<br>train | PT +<br>optional<br>cross<br>training | 5 min<br>jog/1<br>min walk<br>X 4<br><br>Optional<br>cross<br>train | PT +<br>optional<br>cross<br>training |
| 3 | Off | 7 min<br>jog/1<br>min walk<br>X 3<br><br>Optional<br>cross<br>train | PT +<br>optional<br>cross<br>training | 9 min<br>jog/1<br>min walk<br>X 3<br><br>Optional<br>cross<br>train | PT +<br>optional<br>cross<br>training | 30 min<br>jog                                                       | PT +<br>optional<br>cross<br>training |

## Phase 4: Return to running/sport preparation

### Running Pace:

**Level 1:** At least 1-2 minutes per mile slower than pre-injury easy pace

**Level 2:** 30 seconds-1 minute per mile slower than pre-injury easy pace

**Level 3:** Easy pace-30 seconds per mile slower than pre-injury easy pace

**Level 4:** Easy pace to 30 seconds per mile faster than easy pace

**Running Program:** Running pace during this phase will gradually increase from Level 1 to Level 4. Warm up with a 5-minute walk at medium pace followed by a short dynamic warm up that should include:

- 10-20 x hip bridges
- 5 x per side lateral lunges
- 5 x per side walking lunge with a twist
- 5 x per side knee to chest walking
- 15 x per side jogging butt kicks.

If you remain pain free during the dedicated jog/run session and with usual daily activities, continue to progress. If you do have pain during a jog/run session take a rest day and drop back to repeat the last jog/run session where you did NOT experience pain. If you have pain during the session you dropped down to, take 3 days of rest/low impact cross training before attempting the same session again. If you still experience pain take 3 additional rest days and drop down two levels. Contact your care provider if pain persists after dropping down two levels.

**Cross Training:** Low impact cross training is encouraged on non-running days

**Criteria to complete phase 4:** pain free completion of the progression

| Phase 4: Return to Run |       |                                                                             |                                             |                                                                           |                                             |                                                                          |                                                             |
|------------------------|-------|-----------------------------------------------------------------------------|---------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------|
| Cycle                  | Day 1 | Day 2                                                                       | Day 3                                       | Day 4                                                                     | Day 5                                       | Day 6                                                                    | Day 7                                                       |
| 1                      | Off   | 30 min jog @ Level 1 pace<br><br>Optional cross training                    | Strength training + optional cross training | 30 min jog @ Level 1 pace<br><br>Optional cross training                  | Strength training + optional cross training | 30 min jog @ Level 1 pace<br><br>Optional cross train                    | 35 min jog @ Level 2 pace<br><br>Optional cross training    |
| 2                      | Off   | 30 min jog @ Level 2 pace + 4 X 100m strides<br><br>Optional cross training | Strength training + optional cross training | 30 min jog @ Level 2 pace on hilly terrain<br><br>Optional cross training | Strength training + optional cross training | 30 min jog @ Level 2 pace + 4 X 100m strides<br><br>Optional cross train | 35-40 min jog @ Level 2 pace<br><br>Optional cross training |
| 3                      | Off   | 30 min jog @ Level 3 pace + 6 X 100m                                        | Strength training + optional cross          | 30 min jog @ Level 3 pace on hilly                                        | Strength training + optional cross          | 30 min jog @ Level 3 pace + 6 X 100m                                     | 35-40 min jog @ Level 3 pace                                |

|   |     |                                                                                                  |                                                            |                                                                                                  |                                                            |                                                             |                                                                            |
|---|-----|--------------------------------------------------------------------------------------------------|------------------------------------------------------------|--------------------------------------------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|----------------------------------------------------------------------------|
|   |     | strides<br><br>Optional<br>cross<br>training                                                     | training                                                   | terrain<br><br>Optional<br>cross<br>training                                                     | training                                                   | strides<br><br>Optional<br>cross<br>train                   | Optional<br>cross<br>training                                              |
| 4 | Off | 30 min<br>jog @<br>Level 4<br>pace + 6<br>X 100m<br>strides<br><br>Optional<br>cross<br>training | Strength<br>training<br>+<br>optional<br>cross<br>training | 30 min<br>jog @<br>Level 4<br>pace + 6<br>X 100m<br>strides<br><br>Optional<br>cross<br>training | Strength<br>training<br>+<br>optional<br>cross<br>training | 30 min<br>jog @<br>Level 4<br>pace + 6<br>X 100m<br>strides | 35-50<br>min jog<br>@ Level<br>4 pace<br><br>Optional<br>cross<br>training |

### Appendix: Strength Training Exercises

*Note: Please check with your physician and/or physical therapist prior to initiating any strength training into your return to run program. These are meant to be performed alongside the designated phase of the return to run progression.*

#### **Phase 2: Light Loading (2-8 weeks)**

##### **Strength Training:**

It is safe to begin strengthening exercises early in the rehab process. A complete program can help you build strength, balance, and endurance. All exercises should be performed without pain at the injury site. Begin with bodyweight or banded exercises to familiarize yourself with the movements. Then work with your physical therapist to progress the program by increasing resistance or adding weights. Below is a sample program, to be completed 3-4x/week as part of your cross training:

| Easier Exercises |       | Harder Exercises   |       |
|------------------|-------|--------------------|-------|
| Foot Core Seated | 5 min | Foot Core Standing | 5 min |

|                    |            |                        |            |
|--------------------|------------|------------------------|------------|
| Double Leg Bridges | 3x20       | Single Leg Bridges     | 3x20       |
| Forearm Plank      | 3x30 sec   | Plank Walk Outs        | 3x30 sec   |
| Band Side Steps    | 3x20 steps | Double Band Side Steps | 3x20 steps |
| Air Squats         | 5x10       | Goblet Squats          | 4x15       |
| Hip Hinges         | 5x10       | Nordic Hamstring Curls | 3x10       |

### **Phase 3: Progressive Loading (3-12 weeks)**

#### **Strength Training:**

You should now be familiar with the movements from the previous phase and ready for more challenging exercises. Strength training with an external load such as dumbbells, barbells, or machines can help increase performance for multiple muscle groups and improve resiliency to injury. Plyometrics will be introduced after a few sessions of strength work and should also be tolerated without pain. Work with your physical therapist to determine the appropriate exercises, rest intervals, and intensity for your program to incorporate in your cross training days.

#### *Suggested Lifting Program:*

| <b>Day A</b>           |              | <b>Day B</b>           |              |
|------------------------|--------------|------------------------|--------------|
| Back Squats            | 4x10 @ RPE 6 | Deadlifts              | 4x10 @ RPE 6 |
| Single Leg Deadlift    | 4x8 @ RPE 7  | Split Squats           | 4x8 @ RPE 7  |
| Calf Raises            | 3x20         | Single Leg Calf Raises | 3x15         |
| Nordic Hamstring Curls | 4x8          | Nordic Hamstring Curls | 4x8          |
| Curtsy Lunge           | 3x10 @ RPE 7 | Lateral Lunge          | 3x10 @ RPE 7 |

#### *Rate of Perceived Exertion (RPE):*

| <b>Rate of<br/>Perceived<br/>Exertion (RPE)</b> | <b>RPE for Weight Training</b> | <b>RPE for Running</b> |
|-------------------------------------------------|--------------------------------|------------------------|
|-------------------------------------------------|--------------------------------|------------------------|

|    |                                          |                                                   |
|----|------------------------------------------|---------------------------------------------------|
| 10 | Maximum effort, at or very near 1RM      | Max effort. Unable to speak. For 20-30 sec        |
| 9  | Very hard effort, definitely 1 more rep  | Very, very hard. Maybe 1-2 words. For ~1 min      |
| 8  | Very challenging, definitely 2 more reps | Very hard. Maybe a sentence. 5K PR pace           |
| 7  | Moderate, definitely 3 more reps         | Hard. Short sentences with effort. 10K pace       |
| 6  | Light resistance, definitely 4 more reps | Moderately hard. Breathing hard. 30-60 mins       |
| 5  | Warm-up weight                           | Moderate. Some pushing and effort. Can still talk |

*Sample Plyometric Exercises:*

| Low Intensity                            | Moderate Intensity                                    | High Intensity                           |
|------------------------------------------|-------------------------------------------------------|------------------------------------------|
| Squat Jumps<br>Split Squat Jumps         | Jump and Reach<br>Medial and Lateral Jumps            | Depth Jumps<br>Box Jumps                 |
| Skipping<br>Shuffling                    | Anterior and Posterior Jumps<br>Double Leg Tuck Jumps | Single Leg Hops<br>Single Leg Tuck Jumps |
| Lateral Bounding                         | Pike Jumps<br>Box Jumps                               | Drop Jump to 2nd Box                     |
| Ankle Bounces<br>Single Leg Push Off Box | Drop Jumps                                            | Single Leg Drops<br>2-1 Leg Depth Jumps  |

Reminder: Work with your physical therapist on exercises and intensity during your sessions

**Phase 4: Return to Running (8-12 weeks)****Strength Training:**

Progress strength training and plyometrics, adjusting weight or intensity to maintain appropriate RPE as you get stronger. Check in with your physical therapist to keep your program challenging.

### **Acknowledgement**

We would like to extend our heartfelt thanks to Erin and Salinda for their invaluable contributions in creating the original document that served as the foundation for this Return to Run Protocol. Their expertise, dedication, and hard work have been instrumental in developing a comprehensive and effective guide that supports the recovery and safe return to running for our athletes.

Thank you, Erin and Salinda, for your commitment and for laying the groundwork that has enabled us to build upon and enhance this protocol. Your efforts are deeply appreciated and have made a significant impact on our program.