



INTERMEDIATE EXERCISES FOR THE LOWER BACK

PRACTITIONER NOTES

These Evidence for Exercise™ practitioner notes provide you with specific guidelines to prescribe intermediate exercises for the lower back. They include detailed summaries of the latest research and notes regarding the neurophysiological effects of each exercise. Through practice you will be able to effectively and efficiently prescribe these exercises while also communicating their many benefits.

What to prescribe them for

The following conditions can respond favourably to this series of exercises:

- Annular tears, disc bulges and herniations
- Facet joint sprains
- Sacroiliac joint sprains

If you have identified any of the following during your physical examination these exercises may be appropriate:

- Faulty bending technique¹
- Poor side bridge endurance²
- Poor back extensor endurance^{3,4}
- Weak lower limb muscles
- Reduced walking endurance⁵

You can use these exercises to:

- Reduce pain
- Improve movement behaviours
- Reduce any anxiety or fear avoidance behaviours
- Reduce the risk of repeat episodes

There has been increasing but at times conflicting evidence that trunk muscle function is an important consideration in cases of lower back pain. Factors considered in the literature include:

- Extensor muscle endurance
- Altered patterns of activation of multifidus^{6,7}
- Multifidus muscle atrophy⁸
- Altered feed forward muscle activity of transversus abdominis^{9,10}
- Poor proprioception¹¹
- Altered ability to produce appropriate intra-abdominal pressure that contributes to trunk stability while simultaneously minimising compressive loading¹²⁻¹⁷
- Excessive long-term trunk stiffness^{18,19}
- Postural dysfunction^{20,21,22}

In chronic lower back pain (where a specific cause cannot be identified) many types of regular muscle training have been shown to have positive outcomes for reducing pain and improving function.^{23,24} This may be due to direct effects and/or secondary effects such as increased endorphin levels²⁵ or improved coping strategies.²⁶ Systematic reviews generally find that, in the long term, stabilisation or 'core stability' exercises are as effective, but not necessarily more effective than other forms of active exercise.*²⁷⁻³¹ Therefore, in this exercise prescription we have incorporated both stabilisation exercises that address trunk muscle function as well as those that improve a patient's capabilities to perform activities of daily living.

These exercises build upon those prescribed in beginner exercises for the lower back.

*Laird et al. provide a possible explanation for this outcome suggesting: "As there is no standardisation in the reporting of exercise type, intensity, duration or frequency, one possibility is that some exercises are effective, but when trial outcomes are pooled, method heterogeneity in included studies precludes identification of trial-specific effectiveness."⁸

How to prescribe them

These exercises can be prescribed in a 20-minute, one-on-one consultation. Following the consultation they can be incorporated into a group session or performed as home exercises. Follow-up consultations are recommended to assess technique and outcomes. For optimal results they should be performed once per day.

What the patient can expect

This series of exercises progresses from beginner exercises for the lower back. Patients should continue to experience improvement in their condition and gain further confidence in their daily activities. For optimal results they should be performed for a minimum of four to six weeks and ideally incorporated into a long-term daily routine.

While the patient may feel some discomfort after performing these exercises they should not aggravate the patient's condition. If they do it is either a technique problem or they are not quite suitable for their particular condition.

BIRD DOG

Teaching points

Please refer to beginner exercises for the lower back, all-fours leg slide, for an extensive review of teaching points. This is a complex coordination exercise that requires an awareness of the entire body. Ensure the patient has mastered all-fours leg slide before progressing to bird dog. The addition of the arm movement in bird dog makes it more likely the patient will have poor scapula control.

If you choose to use the abdominal hollowing manoeuvre it is important the patient does not lose their natural lumbar curve. Keeping the spine in a neutral position ensures lower spinal load levels compared with a posteriorly or anteriorly tilted pelvis.³² If you wish to increase the muscle activity have the patient draw circles or squares with the hand or foot.³³

Key teaching phrases

- "Don't drop your head, keep it in line with your body."
- "Push the floor away with your hands so that your shoulder blades are flat on your back."
- "Keep your elbows straight."
- "Do not round your upper back."
- "Maintain the natural curve in your lower back."

- "Avoid twisting."
- "Don't lift the leg too far. This is to avoid over-arching of the lower back."
- "Try to perform the exercise slowly and smoothly."

Contraindications

Patients with wrist or knee pain in this position. For wrist pain you can try placing the hands on some weights to reduce the angle of extension. You can place a pillow under the knees.

Evidence

Exercises in the all-fours position result in the complex recruitment of trunk and limb muscles.³⁴ This includes transversus abdominis, internal and external oblique, rectus abdominis, iliocostalis lumborum, multifidus and gluteus maximus. Due to the additional instability the bird dog position results in higher activation of internal oblique and multifidus compared to all-fours leg slide.³⁵ Raising both the arm and the leg increases extensor muscle activity while keeping the spinal load within acceptable limits (3000N).³⁴

Compared with prone trunk extension, the bird dog has a lower level of activity of both multifidus and erector spinae. However, it has a greater EMG activity ratio of multifidus to erector spinae.³⁶ Many consider

this to be favourable for a few reasons: the lower extensor muscle activity reduces the risk of excessive load and both global and local muscles are working in a more harmonious fashion to stabilise the spine. In addition, the multifidus muscle contains a large portion of type I fibres (slow twitch fibres)³⁷⁻³⁹ reflecting its postural role and it is thought large contractions are not required to improve its function. # Interestingly, in healthy populations the multifidus muscle is mainly composed of type I fibres, whereas in some studies patients with lower back pain have a higher percentage of type II fibres.*⁴⁰⁻² This could result in greater fatigability during prolonged contractions⁴³ and increase the risk of injury.⁴⁴

The only muscle that is possibly activated at levels considered appropriate for strength training during bird dog is the gluteus maximus.⁴⁵

When using abdominal hollowing, all-fours position is a more effective position for activating transversus abdominis and internal oblique than the prone position.⁴⁶⁻⁴⁸ There is some evidence that the abdominal hollowing manoeuvre when performed correctly can result in a reduction of pain and disability in chronic lower back pain patients.⁴⁹ Please refer to Intermediate Pilates for the abdominals for a more detailed discussion of abdominal hollowing.

#It should be noted that high intensity lumbar extension programs have also been shown to be beneficial for chronic lower back pain.⁵⁰⁻⁵²

*It is unclear if this composition of fibre types is a cause or consequence of lower back pain or if it is inherited genetically and therefore predisposes to lower back pain.^{40,41}

Neuro tip

Altered muscle fibre composition and multifidus atrophy has been observed in those with lower back pain. Changes have been shown to happen in as little as 24 hours following an acute episode.⁵³ A study conducted on pigs confirmed that the changes could occur rapidly and be confined to a single segment but have a different distribution following denervation.⁵⁴ The authors considered other possible mechanisms and stated: "Regardless of the mechanism for reduced activity (tenotomy, immobilization, unloading), atrophy has been argued to be mediated by changes in neural drive to a muscle.⁵⁵ Thus, it is likely that the rapid changes in the multifidus may be due to reduced neural drive, but the basis for the change in drive is unclear. One possibility is that there is disuse of the muscle fascicles crossing the injured segment due to splinting, potentially by activity of larger more superficial muscles...This is likely to be significant as recent data suggest that the recurrence of lower back pain is greater in people who do not undertake specific exercise strategies aimed at restoring the activity of the multifidus."⁵⁶

Once again, it remains unclear if preexisting changes in multifidus cross-sectional area exist in humans.⁵⁴

What to say to patients

"This exercise is a complex coordination exercise that results in activity of key muscles of the spine that may have reduced function or even size."

STRAIGHT-LEGS SIDE BRIDGE

Teaching points

This exercise recruits a number of lumbar stabilising muscles including the quadratus lumborum and is aimed at increasing endurance. Men should be able to hold straight-legs side bridge for 83 seconds and women for 64 seconds.⁵⁷

Key Teaching Phrases

- “You can use your top hand to push you up into the position.”
- “Don’t squeeze your buttocks too much as they can take over.”
- “If you are shaking too much then reduce the amount of time you hold the exercise and slowly build up.”

Contraindications

Patients with shoulder pain in this position.

Evidence

The quadratus lumborum has an important stabilising function for the lumbar spine.⁵⁸ The goal of this exercise is to recruit the quadratus lumborum in such a way that it improves its stabilising role without loading the spine excessively. This is because it increases the endurance capacity of the muscle and does not lead to an excessive contraction of other

muscles that could load the lumbar spine.⁵⁹ It has been shown that poor endurance in this position can be an indicator of a future episode of lower back pain.^{57,60} This is particularly so if one side is worse than the other.⁶¹ In addition, those who train the side bridge show improvements with balance in the upright posture.⁶²

The side bridge can also result in high levels of gluteus medius activation,⁴⁵ a muscle in which weakness has been associated with chronic lower back pain.^{63,64}

Neuro tip

Navalgund et al⁶⁵ noted that those with lower back pain display delayed trunk muscle responses to perturbations induced by sudden changes in external loading conditions,⁶⁶⁻⁶⁸ delayed muscle shut-off times after an external load has been removed⁶⁹ and increased co-activation during complex tasks.⁷⁰ These responses may result in excessive motion in the spinal segments increasing the risk of further injury.

What to say to patients

“We know that people who are unable to hold this position for a certain period of time are more likely to experience back pain. This is particularly so if one side is worse than the other. Practising this exercise will not only reduce your risk of having another episode of back pain, it will also improve your balance while standing.”

MODIFIED SIT-UP

Teaching points

It is most important that the patient does not pull on the head with the hands.⁷¹ Before the patient starts the exercise instruct them to place backwards pressure with their head into their hands and then relax. This will assist the patient to relax the head into the hands. If the patient continues to pull they can place their hands by their side or underneath their lumbar spine. If you use this technique avoid chin poking or tucking. The centre of the rotation is at the thoracic spine.

If internal and external oblique are the focus of this exercise the patient can breathe out during the curl-up and use an abdominal hollowing technique. If you wish to emphasise rectus abdominis activity it is advisable to use the abdominal brace.⁷² For further information

regarding abdominal hollowing and bracing please refer to intermediate Pilates for the abdominals.

While performing traditional sit-ups at greater speed results in greater activation of external oblique⁷³ this could be at the expense of technique and spinal stability and we do not recommend it for patients with lower back pain.

Key Teaching Phrases

- “Imagine that your head, neck and upper back is a rigid block that can only move as one.”

Contraindications

Back or neck pain during this exercise.

Evidence

A number of studies indicate that traditional exercises such as the sit-up are beneficial for lower back pain.⁷⁴⁻⁷⁶ However, Stuart McGill advocates the use of a modified curl-up that minimises spinal loading but still challenges a number of abdominal muscles.^{77,78} In McGill's study traditional sit-ups imposed 3300N of compression on the spine compared with 1991N for a curl-up.⁷⁷ The National Institute for Occupational Safety and Health recommended an action limit of 3400 N for low back compression based on expert opinion and a number of studies. It is acknowledged that there are limitations and uncertainties to the biomechanical models that attempt to predict compressive force on the lumbar spine.⁷⁹

Neuro tip

A small pilot study found that a 10-week stabilisation exercise program resulted in increased reflex amplitudes in lower back pain patients. The authors suggested that increased reflex amplitudes could limit excessive movement of the spine when perturbed, "potentially helping prevent recurrence."⁶⁵

What to say to patients

"Sit-ups can be beneficial for lower back pain; however it is important we perform this modified version to minimise the load on your spine."

FORWARD LUNGE

Teaching points

Although it is advisable to avoid excessive forward movement of the knee it is not considered detrimental if it goes past the toes slightly. Keep the knees in line with the toes so that they are moving in the same direction as the ankles. The patient can observe themselves in a mirror.

Have the patient recall the technique they used during Swiss ball squats to maintain a relaxed, natural lumbar lordosis.

To increase the difficulty of the forward lunge patients can hold weights in their hands. With increasing weight the most common technique error is to reduce the depth of lunge.⁸⁰

You can also increase the difficulty of the exercise by introducing a five-second hold in the lunge phase.⁴⁵

Key teaching phrases

- "Maintain a natural curve in your lower back."
- "Relax your shoulders and upper body."
- "This should not hurt your lower back – if it does you may be too tense."

Contraindications

- Excessive pain in the knees, hips or ankles.
- Limitations in hip, knee or ankle range of motion.*⁸⁰

* In healthy subjects the percentage of flexion during the forward lunge relative to the normal available range of motion for each joint are as follows: hip (approximately 69%), knee (approximately 70%), ankle (approximately 60%).⁸⁰

Evidence

Despite its common use as a rehabilitation exercise the forward lunge has not been studied extensively. It results in co-activation of the hamstrings and quadriceps – although quadriceps is more dominant.^{81,82} The hip extensors are dominant during this exercise⁸⁰⁻⁴⁵ with the hip providing the greatest percentage of the support impulse compared with the knee and ankle.⁸⁵

The forward lunge promotes muscle activation patterns that are functionally associated with upright gait.⁸⁶ It is a relatively safe exercise for older adults⁸⁵ and even for those with patellofemoral pain⁸⁷ or post anterior cruciate ligament reconstruction.^{80,86,88}

Patients with lower back pain may present with a fear of movement due to pain (kinesiophobia) and this can be a factor in back pain severity and perceived disability.^{89,90} This may lead to an aversion to physical activity consequently worsening functional limitations.⁵ In particular, functional changes to the important anti-gravity muscle, can be expected^{91,92} and reduced quadriceps strength has been associated with chronic lower back pain.⁹³ It is thought that performing exercises such as lunges in a safe controlled manner will improve any underlying weaknesses if present while simultaneously overcoming kinesiophobia, if present.

Gluteus medius weakness and co-activation has been associated with chronic lower back pain and this seems particularly relevant to patients who develop lower back pain while standing.^{# 63,64} The forward lunge is a good functional exercise for activating gluteus medius⁴⁵ and gluteus maximus although other exercises such as side bridge,⁴⁵ unilateral squat⁹⁶ and lateral step-up⁹⁶ are more effective at targeting these muscles (a smaller base of support results in greater activation.)^{84 45} If strength of the gluteal musculature is the goal the forward lunge is an appropriate starting point before the patient progresses to exercises with a smaller base of support. However, not all exercises in the standing posture are prescribed for strength training, and the forward lunge is also considered important for improving functional capacity.⁹⁷

*If you wish to increase the activity of the hamstrings during forward lunge have the patient lean their trunk forward rather than remain upright.⁹⁸

#It is unclear if this is causal or if gluteus medius strengthening exercises can improve the condition.^{2,63,64,94,95}

Neuro tip

Central pattern generators are neural networks in the spinal cord that are capable of producing rhythmic movements such as walking even when separated from the brain and sensory inputs. However, the ability to produce both purposeful and adaptive locomotive behaviours relies on the interplay among central pattern generators and other areas of the nervous system.⁹⁹⁻¹⁰¹ MacKay notes that “Supra-spinal inputs play a major role not only in initiating locomotion but also in adapting the locomotor pattern to environmental and motivational conditions. Sensory afferents involved in muscle and cutaneous reflexes have important regulatory functions in preserving balance and ensuring stable phase transitions in the locomotor cycle.”¹⁰¹

What to say to patients

“There are a number of reasons to perform this exercise: improving your confidence with lunging activities, increasing your agility for daily activities, improving strength through your buttock and thigh muscles and challenging your balance and coordination.”

SWISS BALL SMALL ROLL-OUT

Teaching points

It is common for patients to elevate their shoulders or protrude the chin when performing this exercise. Ensure they maintain a natural lumbar curve. Excessive lordosis is an indication they are not ready to perform this exercise.

You can choose to use abdominal hollowing or bracing during this exercise. Refer to Intermediate Pilates for the abdominals for further information regarding these techniques.

Key teaching phrases

- “Don’t hold your breath – breathe naturally.”

Contraindications

- Knee or wrist pain during this exercise.

Evidence

Although a commonly prescribed exercise research about the effects of Swiss ball small roll-out is limited and abdominal exercise studies generally lack consistency.⁷¹ It is unclear if this type of exercise is as effective at activating the abdominals compared with a traditional trunk curl.¹⁰²⁻¹⁰⁵ Whether or not the abdominal muscles are comparably activated, the goal of the exercise is to challenge a variety of muscles to adequately stabilise the spine in this inherently unstable position without excessive compressive forces on the spine. This exercise allows for a neutral spinal position which is ideal for patients with lower back pain.

Neuro tip

While practitioners often consider pain to have an influencing factor on motor functions this is frequently attributed to kinesiophobia or movement-related pain alone rather than alterations in the motor cortex. There is emerging evidence that cortical changes can occur. Mercier et al. conclude in their review: “Acute experimental pain has been clearly shown to exert an inhibitory influence on the motor cortex. This inhibition can hamper proper motor-cortex activation and not only limit the immediate ability to perform a motor task but also interfere with the ability to learn a new one. Current evidence also suggests that there is a relationship between chronic pain and motor-cortex reorganization, but the causality of this relationship remains unclear.”¹⁰⁶

What to say to patients

“This exercise challenges your abdominal muscles, posture and balance but in a safe position for your lower back.”

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