Learning Objectives

1) The biomechanics of the straight leg deadlift
2) The risk of lumbar disc injury with loaded flexion exercises
3) Exercise progressions prior to performing deadlifts

As a physiotherapist with a fitness industry background, I treat many gym and exercise related injuries. I also have the opportunity to both teach and learn from a variety of different physiotherapists, personal trainers and exercise physiologists. I recently observed a female exercise science graduate performing a stiff legged deadlift off a step to the floor, lifting 20kg and going into full lumbar flexion at the bottom of the lift. She stated that she was doing it for her hamstrings. Having also treated two clients this year whom injured their lumbar spine performing a straight, or stiff, legged deadlift, I thought it pertinent to put forward some concerns I have about this exercise.

The straight leg deadlift (SLDL) has been included in many clients’ programs as an exercise that is purported to strengthen the hamstrings. Some instructors claim that it is a good way to maximally exhaust the hamstrings and hypertrophy the muscle. Clients often get a good “burn” from the exercise. I have also seen the exercise included in the programs of gym novices and older clients.

Let us first examine the biomechanics of the exercise. When done correctly, the lumbar spine should and must be maintained in a neutral (or at least near neutral) position for the duration of the eccentric and concentric phases. Remember that neutral position is not keeping the back flat but maintaining a shallow concave curve (lordosis) right down to the sacrum. (And also remember that you cannot tell if a client is maintaining neutral position if they have a t-shirt on – ask if you can lift it up at the back to observe spinal position).

Lumbar flexion results in a 200% increase in disc pressures compared to relaxed standing—add a 20kg load (barbell) with a rounded back and the discs pressure increase by almost 500% (Wilke et al, 1999). Lifting 20kg with bent knees resulted in a 300% increase. We assume that an increase in intra-discal pressures increases the risk of disc injury. Remember also that, due to poor innervation by pain nerves (nociceptors) that your client will not always feel a disc injury at the time. You can seriously injury a disc, such as a tear or protrusion, and not feel it until one to two days later. Of the two clients, one felt “something go” on the bottom of the lift while the other felt no pain at the time but woke with severe low back pain the next morning.
The core stability muscles (transverses abdominus, pelvic floor and multifidus) along with the erector spinae muscles work together to maintain this neutral position of the spine and pelvis. As the weight is lowered the action of the hamstrings and gluteals contracting to control hip flexion (eccentric action) will attempt to posteriorly tilt the pelvis, and therefore flex the lumbar spine. Not to mention the barbell the client is holding which will also create a flexion load. The core stabilisers and erector spinae then have to work very hard to maintain neutral position. The heavier the weight they have to work to maintain lumbar neutral.

And which muscles are likely to fatigue first during the exercise? The erector spinae have a smaller lever length and cross sectional area than the longer larger hamstrings and therefore will fatigue first. Once they fatigue, along with the TA and multifidus, the lumbar spine will flex and the risk of back injury is potentially increased.

And have we worked our hamstrings to exhaustion? EMG studies do demonstrate similar hamstring activity levels to leg curls and perhaps more so than squats (Ebben et al, 2006). But, because they are the larger muscle of the exercise and they therefore will likely fatigue last. Without working towards exhaustion there will be less of a training effect.

The other risky part of the exercise is picking the bar off the ground instead of a rack. Image 1 below is a young client of mine demonstrating his initial lift.

![Figure 1: Spine is loaded in full flexion.](image)

The distance a client is able to lower the barbell toward the ground and maintain neutral spine position is dependant on hamstring length. Someone with tight hammies, like me, will only be able to lower the weight to just above kneecap level without compromising the lumbar spine. A client with really long hamstrings may be able to lower it to around mid or upper-shin level but unless you are working with gymnasts or circus performers, no one can lower the barbell to the ground (with straight legs) and maintain a true neutral spine position. I have had various trainers demonstrate to me their technique only to learn that their low lumbar spine is fully flexed at the bottom of the lift. What they thought was “keeping their back straight” was actually extension through the low thoracic spine with full flexion of the low lumbar spine. You may have done this exercise for years and gotten away with it but remember, lumbar discs have almost no capacity to heal. Only the outer part has any blood supply so their healing capacity is very limited. A disc injury is often a lifelong problem that can reduce your capacity to work and play.
The feeling of hamstring “burn” that you get during this exercise is possibly due to a neural (sciatic nerve) stretch and loading than the hamstrings themselves. Try it yourself and see if you feel a pull right down into the calf muscles. The calves are not on stretch at all in this position so is the sensation neural?

The pre-requisites prior to giving a client this exercise are:

1) Never give it to a beginner.
2) Ensure client has a good perception of neutral spine and can maintain it during a barbell squat.
3) Never give it to a client who has had a flexion related back injury or a history of disc problems
4) Start with only a small weight and small range of movement and encourage people to stop at the top of the kneecap.
5) Pick the bar up initially off a squat rack, not off the ground.
6) Monitor for back pain during the exercises and warn your client to cease at the first sign of any pain – re-evaluate their technique.

A good set of progressions to teach hip/knee flexion with a neutral lumbar position is:

a) Teach lumbo-pelvic dissociation – essentially anterior and posterior pelvic tilts with the thorax remaining still relatively.

b) Seated hip flexion – find lumbar neutral in sitting on the edge of a bench or fitball and practice flexing from the hips to around 20 degrees. I use the cues to “keep the arch of the back” or “keep your bum stuck out”. If they cant get this then try in standing with the whole body flat against a wall. Ask them to bend forward by sliding their bum up the wall – this works a treat.

c) Chair squats – now add in knee flexion by teaching correct squatting technique. Put a bench or chair about 20cm behind the heel and ask them to squat maintaining lumbar neutral until their bum just touches the chair.

d) Progress to real squats

I am comfortable with the comments that we don’t spend our whole lives in lumbar neutral so we should train out of neutral also. I think we should start by training new clients in a relatively neutral position, build up endurance, and then progress to more tri-planar movements and perhaps some flexion. But how much loaded flexion is safe? And do you want to run the risk of causing injury?

An excellent alternative to the SLDL is performing a bent leg dead lift. In this position the gluteals will switch on more effectively than with the knees locked. In particular the deeper part of gluteus maximus will contribute to pelvic stability. The same rule applies of only taking the bar as low as you can control the lumbar neutral position.
What are the other alternatives? The hamstrings get a pretty good workout during lunges and squats, but if your client really wants that feeling of burn, try them on the single leg bridge and curl with the fitball. The Nordic drop is also becoming popular in the rehabilitation and prevention of hamstring injuries in Aussie Rules Footballers.

Many of my clients have adequate or overactive hamstrings and the glutes are the weak area so consider also prescribing glut max and med exercises instead of hamstrings.

The SLDL is obviously a popular exercise in some circles (I recently read a comment by Eva Mendes’s trainer that it is her favourite exercise) but trainers need to seriously consider the principle of “first do no harm” before prescribing it.

References

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Electromyographical Analysis of Hamstring Resistance Training Exercises


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