





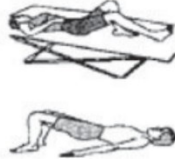


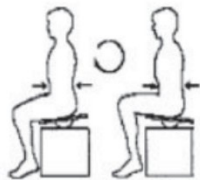

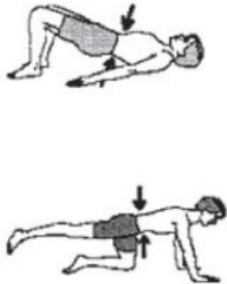
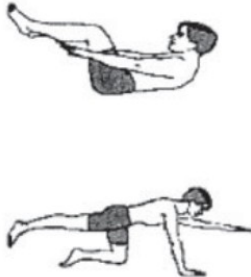


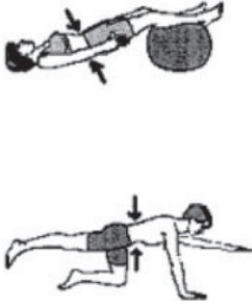
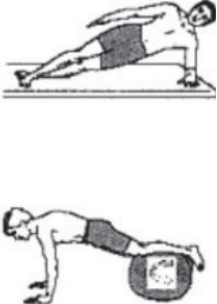

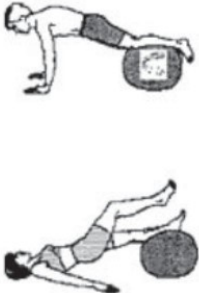
# Appendix:

Stage 1		
Session	Core Stability Group <i>Isolated lumbar stabilizing muscle training</i>	General Exercise Group <i>Classic abdominal and back extensor training</i>
1-2	<p>Development of the perception of the isolated isometric specific contraction of the stabilizing muscles</p> <p>Transversus abdominis muscle from: 4-point kneeling and lying positions, trying to hollow the lower abdomen</p>  <p>Multifidus muscle from: stepping activity while standing and raising contralateral arm, trying to feel the contraction of the opposite-side multifidus muscle or from sitting position with therapist's hands over the muscle</p> 	<p>Upper and oblique abdominals from lying position: with knees straight (hands filling space between low back and exercise mat) and knees bent</p>  <p>Back extensors: lifting trunk to neutral from prone position with pillow under stomach and arms by the side Coordination: pelvic tilting from lying, sitting, and standing positions</p> 
3-4	<p>Precise repetition of the isolated isometric-specific co-contraction of the stabilizing muscles, increasing their contraction time</p> <p>Transversus abdominis and multifidus muscles together from: sitting and standing positions</p> 	<p>Upper and oblique abdominals from lying position: with knees straight, knees bent</p> <p>Back extensors: lifting trunk to neutral from prone position with pillow under stomach and arms by the side Exercises performed as illustrated for sessions 1 and 2</p>

Stage 2

Session	<p><b>Core Stability Group</b>  <i>Integration of lumbar stabilizing muscle activity into light dynamic functional tasks</i></p>	<p><b>General Exercise Group</b>  <i>Classic abdominal and back extensor training</i></p>
<p>5-6</p>	<p>Control of neutral lumbopelvic postures                      Isolated movement of adjacent body areas, maintaining lumbar spine stability (ie, moving only hip or thoracic spine)</p> 	<p>Abdominals from lying position: heel slides, lower abdominal crunches</p> <p>Back extensors: bridging, lifting trunk to neutral from prone position and arms in elevation</p> 
<p>7-8</p>	<p>Control of neutral lumbopelvic postures and aggravating postures</p> <p>Stabilizing muscle isometric co-contractions with addition of external load to lumbar spine</p> <p>Hip horizontal abduction, heel slides, leg slides from crook-lying position</p> <p>Aggravating postures</p> 	<p>Abdominals from lying: heel slides, leg slides, lower abdominal crunches</p> <p>Back extensors: bridging, lifting trunk to neutral( prone position with arms elevated), single-leg extensions from prone and 4-point kneeling positions</p> 
<p>9-10</p>	<p>Lumbopelvic control during movements and aggravating movements</p> <p>Sitting on unstable base of support (hip extension movement only, lumbar spine only, thoracic only), 3-plane movement, co-contractions during normal-speed walking and other activities</p> 	<p>Abdominals from lying position: straight leg lifts toward ceiling, cycling exercises, leg slides, lower abdominal crunches</p> <p>Obliques: hip lift from side-lying position</p> <p>Back extensors: as in sessions 7-8</p> 

Stage 3		
Session	Core Stability Group Integration of lumbar stabilizing muscle activity into heavy-load dynamic functional tasks	General Exercise Group Classic abdominal and back extensor training
11-12	<p>Isometric co-contractions with addition of heavier external loads to lumbar spine</p> <p>Bridging exercise, co-contractions during leg cycling from supine position, single-leg extensions from 4-point kneeling position</p> 	<p>Abdominals from lying position: full abdominal crunches, straight leg lifts toward ceiling, cycling exercises, leg slides</p> <p>Obliques: hip lift from side-lying position</p> <p>Back extensors: alternate arm/leg extensions from 4-point kneeling and lying positions, single-leg bridging</p> <p>Swiss ball coordination exercises: alternate arm/leg lifts sitting on ball</p> 
13-14	<p>Increasing complexity and load of exercises maintaining lumbar spine stability</p> <p>Single-leg bridging exercise, bridging exercise with an unstable base of support</p> <p>Alternate arms/leg extensions from 4-point kneeling and lying positions and arm/leg lifts sitting on Swiss ball</p> <p>Functional co-contractions during walking (increasing speed) and other activities</p>	<p>Abdominals from lying position: same leg and arm lifting-lowering, full abdominal crunches, straight leg lifts toward ceiling, cycling exercises, leg slides</p> <p>Obliques: advanced hip lift from side-lying position</p> <p>Back extensors: as in sessions 11-12</p> <p>Swiss ball coordination exercises: abdominal curls on ball from prone position, pulling legs toward chest</p>

13-14		
15-16	<p><i>Coordination exercises</i></p> <p>Single-leg bridging exercise with an unstable base of support, bridging exercise with rotator self-resistance, simultaneous arm and leg movements from supine position maintaining lumbar spine stability, functional co-contractions during walking (changing speeds) and other activities</p> 	<p>Abdominals from lying position: same leg and arm lifting-lowering, cycling exercises</p> <p>Obliques: full oblique abdominal crunches, lift from side-lying position</p> <p>Back extensors: as in sessions 11-12</p> <p>Swiss ball co-ordination exercises: oblique abdominal curls on ball from prone position, single-leg bridging</p> 

This protocol has been adopted from Shamsi et al. [37].