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A return to running program for the postpartum client: A case report

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The purpose of this case report is to present a return to running program for a postpartum client who had delivered via cesarean section. The client, a 29-year-old female health care professional who was 8 months postcesarean section, was referred to physical therapy for a return to running exercise program. The client had three live births during a 30-month time period (February 2004 to August 2006). During her last labor she underwent an emergency cesarean section because of a low fetal heart rate. Since her surgery the client had not participated in an exercise routine. Following an 8-week training program the client was able to demonstrate both quantitative and qualitative functional improvements, including running a 12-minute mile. This case describes a successful return to running program for a postpartum client who delivered her child via cesarean section. Future research is warranted to determine the optimal evaluation strategy and exercise training programs for this population.

Introduction

Women in the postpartum period are at risk for low back pain (Goldman, Ishigami, Raynovich, and Chiarello, 2000; Nilsson-Wikmar, Pilo, Pahlback, and Harms-Ringdahl, 2003; Ostgaard and Anderson, 1992; Ostgaard, Zetherstrom, and Roos-Hansson, 1997), lower extremity pain (Vullo, Richardson, and Hurvitz, 1996), headaches (Beck, 1973; Marcus, Scharff, and Turk, 1999), dyspareunia (Goetsch, 1999), urinary (Dimpfl, Hesse, and Schussler, 1992; Farrell, Allen, and Baskett, 2001; Mason, Glenn, Walton, and Appleton, 1999) and fecal incontinence (Chaliha et al, 1999; Chaliha et al, 2001; MacArthur et al, 2001), varicosities (Stansby, 2000), and weight gain (Linney, Dye, Barkeling, and Rossner, 2004; Parker, 1994; Pivarnik et al, 2006; Rooney and Schauberger, 2002). Exercise has been promoted as one intervention that may help prevent the onset or alleviate the symptoms associated with these conditions (Figuers et al, 2003).

The postpartum period begins immediately after the birth of the child. During the postpartum period there are, understandably, new time constraints and demands that may affect a mother's ability to be as physically active as she was prior to conceiving (Albright, Maddock, and Nigg, 2005; Calfas and Marcus, 2007). Albright, Maddock, and Nigg (2005) surveyed women to identify their physical activity levels prior to conceiving and after delivering. Almost two-thirds (64.5%) of all new mothers identified themselves as "inactive" after childbirth. Of the women who had identified themselves as active prior to childbirth, 43% classified themselves as "inactive" or "irregularly active" after giving birth. New mothers felt they were unable to return to their previous level of activity because of personal issues, lack of support from their spouses, and their parenting responsibilities (Albright, Maddock, and Nigg, 2005; Downs and Hausenblas, 2004).

A lack of physical activity may contribute to women becoming overweight or obese. Pivarnik

et al (2006) reported as many as 20% of all women retain at least 5 kilograms (9 pounds) of their pregnancy weight for a period of 6–18 months after delivering. This is significant in light of the fact that excess weight gain during pregnancy (Rooney and Schauberger, 2002) and weight retention (Linney, Dye, Barkeling, and Rossner, 2004) 1 year after giving birth may increase one's risk of being overweight during the next decade. Individuals who are overweight or obese have an increased risk of cardiovascular disease, hypertension, diabetes, hyperlipidemia, cancer, gallbladder disease, musculoskeletal disorders, diverticulits, and incontinence (El-Serag, 2005; Mensah et al, 2004; Pender and Pories, 2005).

The American College of Obstetricians and Gynecologists (ACOG) has published guidelines for exercise during pregnancy and the immediate postpartum period (ACOG Committee, 2002). The exercise guidelines provided by ACOG during the immediate postpartum period are less descriptive than those presented for women who are pregnant (ACOG Committee, 2002). The committee's opinion is that women may begin their prepregnancy exercise programs as tolerated and when determined to be medically safe (ACOG Committee, 2002; Figuers et al, 2003).

One common medical complication that delays a woman's ability to resume exercise and return to sport is a cesarean section. Potential complications from a cesarean section include postpartum hemorrhage, blood transfusions, endometritis, deep venous thrombosis, pulmonary embolism, urinary tract infection, intraoperative complications, and pneumonia (Burrows, Meyn, and Weber, 2004). A minimum recovery period of 6 weeks is generally ordered by physicians and certified nurse midwifes prior to allowing their patients to resume strenuous activity (Tulman and Fawcett, 1988). Unfortunately, there is paucity in the literature to guide professionals in developing effective and safe exercise programs for postpartum clients who have undergone a cesarean section. There is also paucity in the literature related to program design for the postpartum client whose goal is to return to sport.

The purpose of this case report is to present a return to running program for a postpartum client who delivered via cesarean section. This case report presents an evaluation strategy designed to screen the client for potential musculoskeletal dysfunction and assess the client's baseline functional status. This case will also present an evidence-based approach to exercise program design.

Case description

History

The client, a 29-year-old female health care professional, who was 8 months postcesarean section, was referred to physical therapy for a return to running exercise program. She had three live births during a 30-month time period (February 2004 to August 2006). During her last labor, her certified nurse midwife (CNM) determined that a cesarean section was required due to a low fetal heart rate. The on-call obstetrician-gynecologist (OB-GYN) medical doctor performed a primary low transverse cesarean section. Other than her cesarean surgery, her medical history was unremarkable.

Postpartum period: Day 1 to Week 12

The client reported that she experienced "intense" postoperative pain (8 of 10) the first 2 weeks after delivering. She was ordered by her CNM to avoid all strenuous activities for 6 weeks and was prescribed Oxycodone and Ibuprofen to help decrease her postoperative pain. Her pain level improved during the third postoperative week, lowering to a constant 2 to 3 of 10. Her pain level gradually decreased to 0 of 10 by postoperative week 12. She was allowed to resume walking as tolerated for short, "functional" distances beginning the third postoperative week.

The client denied experiencing urinary or fecal incontinence postcesarean section. The client, a health care provider, was aware of the signs and symptoms associated with incontinence and pelvic floor dysfunction.

Exercise history

Prior to her first pregnancy, the client reported that she participated in an unsupervised exercise program consisting of aerobic exercise (elliptical machine or jogging) and weight machines for at least 30 minutes 3–5 days a

week. During her first pregnancy she was unable to maintain a consistent exercise regimen. With each subsequent conception, she found that it was "all but impossible" to perform her training program. She was also unable to resume her exercise program after her last labor and delivery due to family duties, work responsibilities, and fear of pain.

The client was referred to physical therapy with a general goal to resume her previous recreational and sport pursuits. She expressed a specific goal of resuming a running program so that she would be able to participate in 5 k and 10 k runs.

Evaluation: The functional assessment

An evaluation tool for the endurance athlete has been used by the author, developed and modified from previous clinical commentary reports (Figure 1) (Braly, Beall, and Martin, 2006; Fredericson and Moore, 2005; Plastaras et al, 2005). This assessment tool has been developed to assist the evaluator when screening endurance athletes for common sport-related musculoskeletal dysfunctions and to identify the individual's baseline strength and flexibility measures (Braly, Beall, and Martin, 2006; Fredericson and Moore, 2005; Plastaras et al, 2005). This evaluation tool consists of tests that provide both quantitative and qualitative information (Table 1).

Several "functional" tests (Table 1) are used when evaluating either an endurance athlete or one who wishes to initiate a running program. A "functional" test is an analytical tool that is used to assess a client's ability to perform basic movement patterns (Cook, Burton, and Hoogenboom, 2006; DiMattia et al, 2005). Researchers are attempting to identify reliability and validity for "functional" tests (DiMattia et al, 2005; Hertel, Miller, and Denegar, 2000; Manske, Smith, and Wyatt, 2003), but further studies are warranted to determine their quantitative value. These tests do provide qualitative information that may direct the professional to conduct additional quantitative tests.

Prior to conducting the evaluation and the subsequent prescription of the exercise program, a thorough history was collected (see the aforementioned history sections). It should be highlighted that a physical therapist must question the postpartum client regarding issues related to incontinence. Had this client experienced incontinence, she would have been referred to a physical therapist that specialized in women's heath.

The client demonstrated symmetrical active range of motion bilaterally at the hips, knees, and ankles. The range of motion appeared to be within normal limits. The straight leg raise test revealed hamstring flexibility to 90° bilaterally. The Thomas test, Ober's Test, and Ely's Test did not demonstrate flexibility asymmetries.

Table 2 presents the relevant qualitative findings from the selected functional tests. Biomechanical faults were observed during each of the listed functional tests, suggesting core weakness in the lumbar musculature, the hip musculature, or both. Quantitative assessment of the client's core strength was warranted to identify asymmetries or gross weakness. A growing body of research suggests that core weakness may contribute to the onset of lower quadrant pain or injury in athletes (Fredericson and Moore, 2005; Fredericson et al, 2000; Leetun et al, 2004; Nadler et al, 2000, 2001, 2002a,b; Niemuth, Johnson, Myers, and Thieman, 2005). Hip strength was assessed by using a handheld dynamometer, and trunk endurance capacity was assessed with positional isometric tests. Findings from these tests guided specific exercise interventions for the primary purpose of reducing injury risk.

Handheld dynamometry offers the ability to measure in pounds the peak force generated by a muscle. The use of a handheld dynamometer has demonstrated moderate to strong test-retest reliability (Bohannon and Andrews, 1987; Wang, Olson, and Protas, 2002). A Microfet (Hogan Industries, Draper, UT) handheld dynamometer was used to record peak force for hip flexion, abduction, extension, external rotation, and internal rotation. The testing position for each muscle group was based on the manufacturer's recommendations. A break test method of muscle testing was used, in which the evaluator applies a force to "break" the isometric hold of the client. Three trials were performed for each position with the average score recorded. Pretest and posttest scores are summarized in Table 3.

Possessing adequate endurance capacity of the trunk musculature is believed to be protective

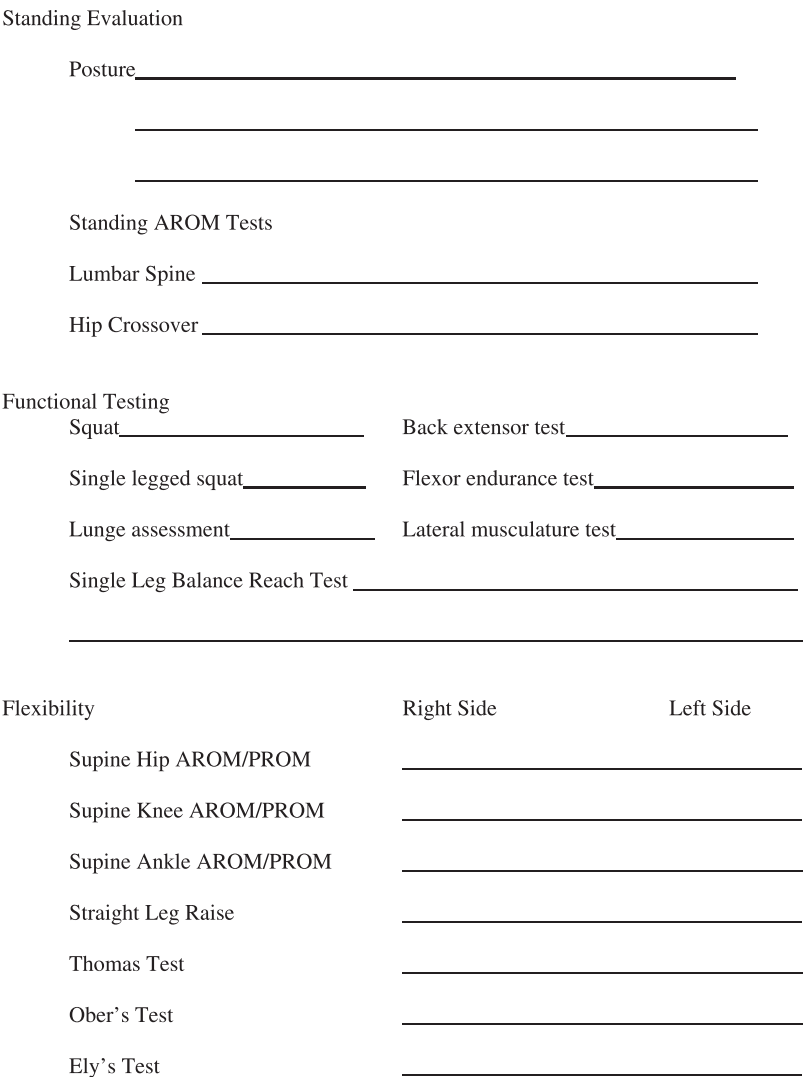

Figure 1. Functional testing and assessment of the endurance athlete.

against the onset of low back injury (Biering-Sorensen, 1984). Three tests were conducted to measure the client's torso muscular endurance capacity: 1) the back extensor; 2) the lateral endurance; and 3) the flexor endurance test (McGill, 2002, 2004). Normative data have been presented for 21-year old males and females, but we must be careful not to compare this data with other athletes or clients of different ages (McGill, 2002, 2004). Rather than expecting clients to have comparable endurance times, it has been suggested that clinicians should analyze the ratios between the scores (McGill, 2002). The ratio between each lateral test should be less than 0.05, between the flexion and extension test should be less than 1.0, and between the lateral test and the extensor test should be less than 0.75 (McGill, 2002).

The client presented with poor trunk endurance capacity and poor endurance ratios (Tables 4 and 5). In general, her hold times were very short: 6 seconds for the back extensor test; 19 seconds for flexor endurance test; and 0 seconds for the lateral endurance tests bilaterally. She

Table 1. Description of selected special tests.

Hip Crossover Tests (Plastaras et al, 2005)	The client is instructed to cross one lower extremity (adducting and internally rotating the leg) in front of the other, then reversing the direction by abducting and externally rotating the leg away from the body. Symmetry of movement should be compared bilaterally.
Squat	Observe the client performing a squat from both the front and from the side. From the front, watch for symmetry of movement as the client lowers his or her body. When viewing the client from the side, observe the position of the spine in relation to the pelvis.
Single-legged Squat Test (Plastaras et al, 2005)	The client is instructed to squat on one leg, flexing the knee to approximately 60°, and then returning to the starting position. The client must maintain his or her balance throughout the squatting motion.
Single Leg Balance Reach Test (Plastaras et al, 2005)	The client assumes the starting position by standing on one leg. Instruct your client to reach with their contralateral leg, in one motion, as far as they can to the front, to the side, and to the rear. The client must not touch the ground during the reaching motion. Compare for symmetry of motion bilaterally. This test may also reveal weakness in the gluteal muscles if the athlete demonstrates a pelvic drop.
Lunge Assessment	Instruct the client to perform a forward lunge. Core weakness may be demonstrated by trunk side bending, hip (femoral) adduction and internal rotation, and knee valgus (knee crossing midline).
Back Extensor Test (Biering-Sorensen, 1984; McGill, 2002)	The extensor endurance test is performed with the client positioned prone with his or her torso unsupported off the end of the table. Treatment tables utilizing a strap or a belt have been used in order to stabilize the lower extremities. Instruct the client to fold his or her arms across the chest with the hands resting on the opposite shoulders. Once the client assumes the testing position record (in seconds) how long he or she is able to hold the position. The test ends once athlete's body drops below the horizon. You or an assistant will need to use your body weight to stabilize the lower extremity when a belt or strap is not available. Helpful hint: Athletes and some clients are very competitive and will attempt to maintain the testing position as long as possible. Watch for the athlete as he or she attempts to maintain the test position by repeatedly performing back extension or hyperextension motions. Stop testing at this point.
Flexor Endurance Test (McGill, 2002)	This position tests the endurance capacity of the core anterior musculature (rectus abdominus). McGill (McGill, 2002) describes conducting this test by positioning the client in a reclined posture with their back initially resting against a bolster or a jig that is angled 60° from the surface. Ask your athlete to position themself with both hips and knees bent to 90° and the arms folded across the chest. A strap or belt may be

(*Continued*)

Table 1. Description of selected special tests (Continued).

	used again to help stabilize the body when placed over the feet. To initiate the test, remove the supporting object, sliding it back approximately 10 centimeters and ask the client to hold this position. Record how long in seconds, the client is able to maintain this position. The test is stopped when any part of the athlete's back comes in contact with the bolster or jig. I have found success using a slight variation to this test when lacking all of the necessary equipment. It is important to have some sort of support object (like McGill's jig or a bolster) in order to identify when failure has occurred. In lieu of straps, you may stabilize the client by holding them at their ankles.
Lateral Musculature Test (McGill, 2002)	To conduct the lateral musculature test, have the athlete assume the classic side plank (or side bridge) pose. Maintaining form is crucial here, as athletes and clients alike will demonstrate many compensatory or "cheating" strategies. To perform the test correctly the athlete will assume the position as shown (Figure 10) with the top leg placed in front of the lower leg. The athlete uses the lower forearm and his or her feet to support themself. Watch first for the inability to assume the testing position. Many athletes and clients are just physically unable to assume the position demonstrating gross weakness of the lateral core muscles. Others, once the position has been assumed, are unable to maintain a straight posture. You will quickly see their hips begin to drift toward the table top. Also, in order to maintain the position, the athlete may cheat by rolling either forward or backwards.

Table 2. Qualitative findings from the initial client evaluation.

Functional tests	Qualitative assessment
Squat	Excessive flexion of the spine during the eccentric phase of the squat
Single-legged squat test	Demonstrated excessive knee valgum
Single leg balance reach test	Demonstrated bilateral pelvic drop
Lunge	Demonstrated excessive knee valgum with the lead leg and Trendelenburg sign on rear leg side

scored 0 seconds for the lateral endurance tests because she was unable to assume the testing position. Although normative data have not been established for 29-year-old females, these scores demonstrate overall poor endurance capacity (and a muscular imbalance) of the torso muscles.

Table 3. Pretest and posttest hip peak force scores (measured in pounds).

	Day 1 (Week 1)		Day 56 (Week 8)	
	Right	Left	Right	Left
Hip flexion	44.5	50.5	52	55
Hip extension	2.5	5.0	40	50
Hip abduction	49	52.5	58	56
Hip external rotation	23.5	21	26	22
Hip internal rotation	35	41	48	53

Diagnosis/prognosis

In summary, the client presented with decreased muscular endurance capacity in her core muscles, impaired dynamic mobility with functional movement patterns, and decreased and/or asymmetrical hip strength. Per the American Physical Therapy Association's *Guide to Physical Therapist Practice*

Table 4. Pretest and posttest core endurance test scores (seconds).

	Day 1 (Week 1) Time (sec)	Day 56 (Week 8) Time (sec)
Extensor	6	61
Lateral		
Right	0	29
Left	0	31
Flexor	19	42

Table 5. Pretest and posttest core endurance ratios.

	Day 1 (Week 1)	Day 56 (Week 8)
Flexor/Extension ratio	3.16	0.69
Right lateral/Left lateral ratio	0**	0.93
Right lateral/Extension ratio	0**	0.48
Left lateral/Extension ratio	0**	0.51

**Subject unable to assume lateral endurance test position.

Figure 2. Front Plank (modified position) Initiated: Week #1. *Exercise Technique Description*: Have the patient assume a plank position with the body supported by the knees and the forearms. Instruct the client to perform the abdominal brace. The subject holds the position for 10 seconds for the desired number of repetitions.

Figure 3. Wall Lean Initiated: Week #1. *Exercise Technique Description*: Instruct the client to lean against the wall supporting the body with the ipsilateral forearm. The client performs an abdominal brace while maintaining the body in alignment. Hold the position for 10 seconds for the desired number of repetitions.

Figure 4. Clamshell Initiated: Week #1. *Exercise Technique Description*: The client assumes a sidelying position with the hips slightly flexed and the knees bent to approximately 90°. Instruct the client to raise the top knee off of their bottom knee as if a clamshell was opening.

Figure 5. Back Bridge Initiated: Week #1. *Exercise Technique Description*: Instruct the client to assume a supine posture with the hips and knees in a hooklying position (hips flexed to 45° and the knees flexed to 90°). The feet should be positioned flat on the ground shoulder width apart. Instruct the client to squeeze the glutes and lift (bridge) the hips toward the ceiling. The client should raise the hips to the point in which the thighs, hips, and back are all in a straight line.

Figure 6. Side-lying Straight Leg Raises Initiated: Week #2. *Exercise Technique Description*: The client is positioned in side-lying with both lower extremities extended. The client is instructed to abduct (raise) the top leg from the bottom leg. The top leg should be placed into slight external rotation (10°–20°). The leg is elevated as high as possible, with the movement occurring at the hip joint and the torso position maintained in neutral.

(American Physical Therapy Association, 2003), the preferred practice pattern for this client is the "Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated with Bony or Soft Tissue Surgery"

Figure 7. Front Plank Initiated: Week #3. *Exercise Technique Description*: Progress the client from the modified position to the front plank. The client should now be able to support her body with her forearms and feet. The client will again perform an abdominal brace while holding the position for the desired number of repetitions.

classification. It was anticipated by the author that the client would be able to demonstrate strength gains (both quantitative and qualitative) within 2 months and be able to initiate a running program.

Intervention

Exercise selection choice

A challenge of clinical practice is determining a safe and appropriate starting point for exercise prescription. Many clinics or gyms (such as the author's) lack expensive, high-tech testing equipment that would aid in this endeavor. The Centers for Disease Control (CDC) and the American College of Sports Medicine (ACSM) have published recommendations for increasing physical activity based on one's current activity level (Ainsworth et al, 1993; U.S. Department of Health and Human Services, 1999).

Because the client was not currently participating in an exercise program, she was progressed slowly with the goal of advancing gradually to 20–30 minutes or more of moderate- to vigorous-intensity exercise. Moderate-intensity physical activity refers to any activity that burns 3.5–7 calories per minute (Ainsworth et al, 1993). Walking briskly, swimming for recreation, or bicycling are examples of exercises that would meet that definition (Ainsworth et al, 1993;

Figure 8. Prone Hip Extension (w/knee flexed to 90°) Initiated: Week #3. *Exercise Technique Description*: Subject is positioned prone with both legs extended. Instruct the client to bend (flex) one leg at the knee to 90°. The client will contract her gluteus maximus and lift the foot toward the ceiling by extending at the hip.

Figure 9. Side Bridge (Assisted Position) Initiated: Week #3. *Exercise Technique Description*: Client assumes a position on their side with their body in the presupport position (on forearm, hip, and thigh). Instruct the client to perform an abdominal brace, raising their hip and thigh off of the training surface (table or floor). In the terminal position, the forearm, knee, and leg will be the supporting points of contact.

Haskell et al, 2007). It is recommended that one should perform moderate-intensity physical activity for 30 minutes or more on 5 or more days of the week or perform vigorous-intensity physical activity for 20 minutes or more on 3 or more days of the week (Ainsworth et al, 1993; U.S. Department of Health and Human Services, 1999; Haskell et al, 2007). Vigorous-intensity

Figure 10. Side Bridge Initiated: Week #4. *Exercise Technique Description*: Client begins by side-lying on one side with the forearm and elbow positioned under the shoulder. Instruct the client to raise their body off the ground supporting themselves with only their forearm and feet. The client may rest their top arm on their torso. Observe the client to ensure that their head, torso, and legs are in alignment.

physical activity refers to any activity that burns more than 7 calories per minute (Ainsworth et al, 1993; Haskell et al, 2007; U.S. Department of Health and Human Services, 1999). Jogging, high-impact aerobic dancing, swimming continuous laps, or intense bicycling are example of vigorous-intensity physical activity (Ainsworth et al, 1993; Haskell et al, 2007; U.S. Department of Health and Human Services, 1999).

The ACSM and the American Heart Association also recommend that adults should perform at least 2 days a week activities or exercises to maintain or increase muscular strength and endurance (Haskell et al, 2007). Recreational endurance athletes would likely benefit from the inclusion of strengthening exercises into their training program. As previously mentioned, muscular imbalance of the core and/or poor endurance capacity of the torso muscles may contribute to the onset of lower quadrant pain or injury. In this case, exercises were selected for the client to address weakness of her hip and torso musculature (Figures 2–19).[1] For example,

[1]**Note on Abdominal Bracing:** The abdominal brace is an isometric contraction of the abdominal wall musculature (with no inward or outward movement of the abdominal wall) with co-contraction of the lumbar musculature (McGill, 2002). The client received instruction in this technique and was encouraged to perform the brace with each core stability exercise.

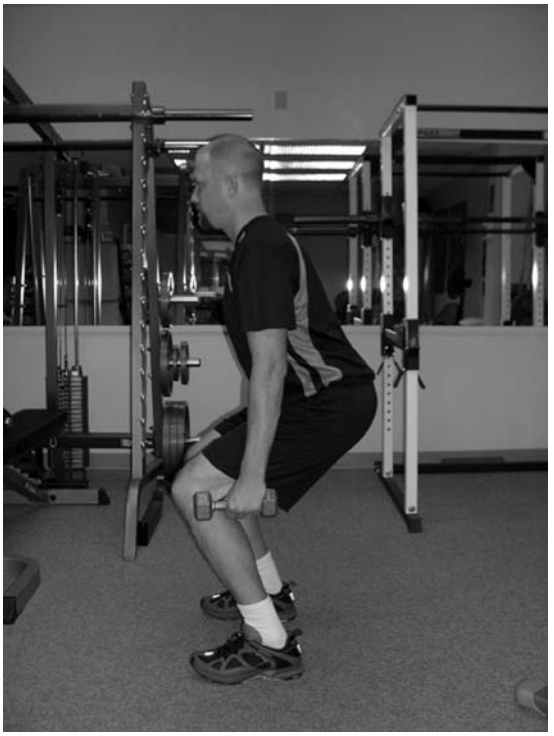

Figure 11. Squats Initiated: Week #5. *Exercise Technique Description*: The subject begins standing with the feet shoulder width apart. The squat may be performed with or without weights. Instruct the client to lower their body by bending at their hips and knees. The motion should be initiated by extending the hips posteriorly. The knees should not fall in front of the feet. The client squats lowering to a position of almost full hip and knee flexion and thighs parallel to the floor. A neutral spine posture must be maintained throughout the squat. Subject returns to the starting position by extending the hips and knees.

Figure 12. Step Up/Step Down. Initiated: Week #5 Forward Step Up, Week #7 Lateral Step Down. *Exercise Technique Description*: Select a 2″ to 4″ step for the client. The client starts with one foot on the step. To perform the step up, instruct the client to use the weight bearing leg to ''step up'' on to the block. Encourage the client to use the ipsilateral leg to perform the motion. There will be a tendency for the client to use the contralateral leg to assist the movement. To perform the step down, have the client position the body as shown. Instruct the client to lower the contralateral leg toward the floor without placing weight through the leg. The weightbearing leg then returns the client the starting position by extending at the hip and knee.

quadruped with arm raise (Figure 16), quadruped with leg extension (Figure 17), and the bird dog (Figure 19) were prescribed to address weakness in her back extensors. Figures 2 through 19 present the strength training exercises, technique descriptions, and the point in time that each exercise was prescribed. Tables 6 and 7 present the strength training program and aerobic training goals for each week.

Frequency of one-on-one appointments

Because of the client's work demands, she was able to only schedule two additional one-on-one sessions after the initial evaluation. The client scheduled a follow-up visit at the midpoint of the training program (end of week 4) and at the end of the 8-week training program. She received instruction for each exercise and was encouraged to maintain a training log. Each week the author contacted the client via phone or email to assess her responses to that week's program. Table 8 presents a week-by-week summary of the client's compliance with the prescribed exercise routine and her level of participation.

Figure 13. Front Plank with Lower Extremity Hip Extension Initiated: Week #5. *Exercise Technique Description*: The client assumes the same position as the front plank exercise. The movement is performed when the client lifts (extends) on lower extremity 3″ to 5″ from neutral. Instruct the client to perform bilaterally for the desired number of repetitions.

Figures 14. Crunches Initiated: Week #5. Starting Position. *Exercise Technique Description*: Instruct the client to contract the rectus abdominis while bending (crunching) through the midback region. Perform for the desired number of repetitions.

Figures 15. Crunches Initiated: Week #5. Crunch Movement. *Exercise Technique Description*: Instruct the client to contract the rectus abdominis while bending (crunching) through the midback region. Perform for the desired number of repetitions.

Figure 16. Quadruped with Arm Raise Initiated: Week #5. *Exercise Technique Description*: The client assumes a quadruped position with weight distributed equally among the four points of contact. Instruct the client to perform the abdominal brace followed by raising one arm in line with the torso. Hold for a count for 5–10 seconds, return to the starting position, and alternate sides.

Outcomes

A reevaluation was performed at the end of the 8-week training period. The client demonstrated improved biomechanical movement patterns with the functional tests. She was able to now demonstrate a $\frac{1}{2}$-squat while maintaining proper technique. The client continued to demonstrate a valgus moment at her knee during the eccentric phase of the single-legged squat, but the degree of angulation had decreased. The client demonstrated a $\frac{1}{2}$-lunge in place with good technique (no knee valgum), which is an improvement from her initial performance.

The client demonstrated improved scores with each of the four core endurance tests (Table 4). As well, each of the four endurance ratios

Figure 17. Quadruped with Leg Extension Initiated: Week #6. *Exercise Technique Description*: Instruct the client to contract the glutes on one side, followed by lifting their knee off the ground and extending their leg straight back. The goal is for the client to be able to extend their leg in line with the trunk while maintaining a neutral spine position.

improved to protective levels as described by McGill (Table 5) (McGill, 2002, 2004).

The client also demonstrated improved peak force scores with dynamometry (Table 3). Her scores improved for each muscle group, especially demonstrating dramatic improvement with hip extension.

By the end of the 8-week training program the client had resumed a running program (12-minute mile). She reported that she was pleased with her overall progress, but she wished she would have had more time in her schedule for additional exercise sessions. She reported an additional positive side effect from the training program: weight loss. She was pleased with her outcomes and reported that she was going to continue with the training program.

Discussion

The purpose of this case report was to describe a return to running training program for a client who had delivered via cesarean section. Specifically, the case presented an evaluation strategy for runners (or those returning to running) to assess movement pattern dysfunctions, functional weakness of the lower quadrant, and lower quadrant muscular flexibility.

Figure 18. Lunges Initiated: Week #7. *Exercise Technique Description*: The client steps (lunges) forward flexing the lead hip and knee. The lead knee should be in alignment with the hip and foot, and the thigh parallel to the ground. The body is lowered towards the floor to the point that the trailing knee almost contacts the ground. The client reverses the position returning to the starting position. The lunging sequence is repeated with the opposite leg stepping forward. Cue the client to maintain ideal posture at the pelvis and low back. Observe the entire chain for technique errors.

The positive results described in this case report demonstrate that addressing core and hip weakness with a home-based exercise program and a gradual aerobic training regimen would lead to improvements in functional measures and the ability to resume a running program. There does not appear to be any alternative explanation for the positive outcomes experienced by the client.

The training program implemented for this client allowed her to gradually increase her training mileage without causing her excessive delayed onset muscle soreness or contribute to the onset of an injury. The client's long-term goal was to continue with her running program so that she could participate in weekend 5 k to 10 k runs. She reported that she was going to

Figure 19. Bird Dog Initiated: Week 7. *Exercise Technique Description*: Client assumes the quadruped position, finding their neutral spine and performing an abdominal brace. Instruct the client to simultaneously raise one arm and their opposite lower extremity. Hold each movement for 5–10 seconds. Repetitions should be performed to each side.

Table 6. 8-week strength training program.

Training goal: Perform full exercise routine 3 + a week
Week 1
- Front Plank (modified position) 2 sets × 10-second holds
- Wall Lean 2 sets × 10-second holds
- Clamshell 2 sets × 15 repetitions
- Back bridge × 20 seconds

Week 2
- Front Plank (modified position) 3 sets × 10-second holds
- Wall Lean 3 sets × 10-second holds
- Back bridge × 20 repetitions
- Clamshell 2 sets × 15 repetitions
- Side-lying straight leg raise 3 sets × 15 repetitions

Week 3
- Front Plank 2 sets × 10-second holds
- Side bridge (beginner's) 2 sets × 10-second holds
- Back bridge × 20 repetitions
- Side-lying straight leg raise 3 sets × 15 repetitions
- Prone hip extension (w/knee flexed to 90°) 2 sets × 10 repetitions

Week 4
- Front Plank 3 sets × 10-second holds
- Side bridge 2 sets × 10-second holds
- Back bridge 2 sets × 20 repetitions
- Side-lying straight leg raise 3 sets × 15 repetitions
- Prone hip extension (w/knee flexed to 90°) 3 sets × 15 repetitions

Week 5
- Squats 2 sets × 10 repetitions
- Forward Step Ups 2 × 10 repetitions
- Front Plank with LE hip extension 2 sets × 10 repetitions
- Side bridge 3 sets × 10 seconds
- Crunches to fatigue
- Quadruped arm raise × 10 repetitions

Week 6
- Squats 2 sets × 10 repetitions
- Forward Step Ups 2 × 10 repetitions
- Front Plank with LE hip extension 3 sets × 10 repetitions
- Side bridge 3 sets × 10-second holds
- Crunches to fatigue
- Quadruped with leg extension × 10 repetitions

Week 7
- Squats 3 sets × 10 repetitions
- Lunges 2 sets × 10 repetitions
- Lateral Step Down 2 sets × 10 repetitions
- Side bridge 3 sets × 10 repetitions
- Bird dog × 10
- Crunches to fatigue

Week 8
- Squats 3 sets × 15 repetitions
- Lunges 3 sets × 15 repetitions
- Lateral Step Downs 3 sets × 15 repetitions
- Side Bridge 2 sets × 10-second holds
- Bird dog × 10 repetitions
- Crunches to fatigue

train toward that goal, increasing her mileage by $\frac{1}{4}$- to $\frac{1}{2}$-mile a week with the established training program.

Although the client was able to make functional improvements with the particular training program, further studies are warranted.

As previously mentioned, the evaluation strategy used in this case has been developed from the author's clinical experience and published clinical reports (Braly, Beall, and Martin, 2006; Fredericson and Moore, 2005; Plastaras et al, 2005). Evaluation tools for the postpartum client need to be developed and tested for reliability and validity. Further research studies

Table 7. Weekly aerobic exercise training goals.

Week 1: Perform 20 minutes of continuous aerobic exercise for 3 or more days during the week.
Week 2: Perform 20 minutes of continuous aerobic exercise for 5 or more days during the week.
Week 3: Perform 20 minutes of continuous aerobic exercise for 3 or more days during the week including jogging for $\frac{1}{4}$ mile during two sessions.
Week 4: Perform 25 minutes of continuous aerobic exercise for 3 or more days during the week including jogging for $\frac{1}{4}$ mile during three sessions.
Week 5: Perform 25 minutes of continuous aerobic exercise for 3 or more days during the week including jogging for $\frac{1}{2}$ mile during two sessions.
Week 6: Perform 25 minutes of continuous aerobic exercise for 3 or more days during the week including jogging for $\frac{1}{2}$ mile during three sessions.
Week 7: Perform 30 minutes of continuous aerobic exercise for 3 or more days during the week including jogging for $\frac{3}{4}$ mile during three sessions.
Week 8: Perform 30 minutes of continuous aerobic exercise for 3 or more days during the week including jogging for 1 mile during two to three sessions.

Table 8. Week-by-week summary of client's exercise performance.

Week	Number of training sessions	Aerobic exercise training program (see Table 7)	Strength training program (see Table 6)
1	4	Walking: 3 sessions for 20 minutes	Performed prescribed routine for 3 sessions
2	2	Elliptical machine: 2 sessions for 20 minutes	Performed prescribed routine for 1 session
3	3	3 sessions consisting of: (1) treadmill jogging for $\frac{1}{4}$-mile followed by (2) elliptical machine for the remainder of her 20-minute training period	Performed prescribed routine for 3 sessions
4	4	3 sessions consisting of: (1) treadmill jogging for $\frac{1}{4}$-mile followed by (2) elliptical machine for the remainder of her 25-minute training period. 1 session: walking for 30 minutes	Performed prescribed routine for 4 sessions
5	3	3 sessions consisting of: (1) treadmill jogging for $\frac{1}{2}$-mile followed by (2) elliptical machine for the remainder of her 25-minute training period	Performed prescribed routine for 3 sessions
6	3	3 sessions consisting of: (1) treadmill jogging for $\frac{1}{2}$-mile followed by (2) elliptical machine for the remainder of her 25-minute training period	Performed prescribed routine for 3 sessions
7	4	3 sessions consisting of: (1) treadmill jogging for $\frac{3}{4}$-mile followed by (2) elliptical machine for the remainder of her 30-minute training period 1 session: elliptical machine for 30 minutes	Performed prescribed exercise routine for 4 sessions
8	2	2 sessions consisting of: (1) treadmill jogging for 1-mile followed by (2) elliptical machine for the remainder of her 30-minute training period	Performed prescribed exercise routine for 3 sessions

are also necessary to identify the reliability and validity of "functional" tests.

Additional studies are necessary to determine appropriate return to exercise guidelines for postpartum clients who have undergone a cesarean section. On the basis of the paucity in the literature, this is a population that has been underserved. Case reports detailing return to sport training programs for other sport and recreation pursuits will add to the body of knowledge and help researchers design experimental research studies.

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