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Potential Dysfunctions Occurring in the Postpartum Years

Rebecca Olson
University of North Dakota

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POTENTIAL DYSFUNCTIONS OCCURRING IN THE POSTPARTUM YEARS

by

Rebecca Olson
Bachelor of Science in Physical Therapy
University of North Dakota, 2000

An Independent Study

Submitted to the Graduate Faculty of the

Department of Physical Therapy

School of Medicine

University of North Dakota

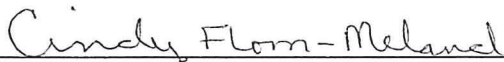
in partial fulfillment of the requirements

for the degree of Master of Physical Therapy

Grand Forks, North Dakota
May
2001




This Independent Study, submitted by Rebecca S. Olson in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.



(Faculty Preceptor)



(Graduate School Advisor)



(Chairperson, Physical Therapy)

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Title: Potential Dysfunctions Occuring in the Postpartum Years

Department: Physical Therapy

Degree: Master of Physical Therapy

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ABSTRACT

There are several dysfunctions that may affect a woman after childbirth. Women often accept the physical changes that occur after delivering a baby and are unaware that treatment is available. The purpose of this literature review is to educate women in the postpartum period on the dysfunctions that may occur, and possible treatment options. An educational pamphlet describing these dysfunctions and treatments was designed to be given to these women before they leave the hospital.

First, the anatomy and physiology of the female pelvic floor is reviewed. This is followed by a description of several physical dysfunctions occurring in the postpartum period and possible treatment options in physical therapy. Pelvic floor dysfunctions, incontinence, episiotomy and cesarean scars, and musculoskeletal dysfunctions are common problems women experience after having a baby, and are addressed in this literature review.

The hope for this literature review is to educate women about the physical dysfunctions that may occur after giving birth and inform them of possible treatment options. Distribution of the pamphlet to women before they leave the hospital will help them to recognize problems in their early stages and seek timely treatment to avoid lifelong problems.

CHAPTER I

INTRODUCTION

Normally, pregnancy is a wonderful time in a woman's life; however, it also creates anatomical and physical changes in a woman's body. Adjusting to these changes is often difficult and many women accept them as a part of the childbearing experience.

Problem Statements

1. There is an abundance of information on postpartum exercises and care available, but the information is rarely utilized in the clinical setting.
2. Often, information regarding these dysfunctions does not reach postpartum women, and so many women are unaware of them and their treatment options.
3. Weakness of the pelvic floor caused by relaxation of ligaments and stretching of supporting structures is the main reason for incontinence and other pelvic floor dysfunctions in women after giving birth.
4. Scars from episiotomies and cesarean sections may lead to adhesions causing pain, poor posture, and decreased mobility as well as other musculoskeletal problems.
5. Pregnancy can cause disruption in the way that joints and muscles work together, causing painful conditions of the musculoskeletal system.

Purpose

The purpose of this literature review is to educate postpartum women on the dysfunctions that may occur, and possible treatment options. We designed an educational

pamphlet, (See Appendix B) describing these dysfunctions and treatments, to be given to postpartum women before they leave the hospital.

Significance of Study

Information on postpartum dysfunction is rarely given to women immediately after giving birth. This project provides a pamphlet that can be given to a woman before she leaves the hospital. This pamphlet empowers a woman to seek her own treatment, as it outlines signs and symptoms that require a visit to a physician and covers treatment options available.

Potential dysfunctions that a woman may experience are explained more in depth in the five following chapters. First, the anatomy and physiology of the female pelvic floor is reviewed. This is followed by a description of several physical dysfunctions occurring in the postpartum period and possible treatment options in physical therapy.

Research Questions

1. What anatomical structures are affected by pregnancy and childbirth?
2. Describe pelvic floor dysfunctions and how they may be treated.
3. What are the four prominent types of incontinence and their treatment options?
4. What is the impact of cesarean and episiotomy scarring after childbirth, and what can be done to prevent dysfunction due to scar adhesion?
5. What effect does pregnancy have on the musculoskeletal system?

We hope that this information will educate women about the physical dysfunctions that may occur and their treatment options. Through prevention and/or early treatment, physical therapy can assist to restore healthy movement, function, and comfort so that the mother can focus on her new baby. Treatment in the postpartum period may also prevent problems that may develop later in life.

CHAPTER II

PELVIC ANATOMY

The pelvis, including its bony structure, muscles, and connective tissues serves to support and protect the pelvic organs.¹ This section will focus on the anatomy and function of the human pelvis. The bony pelvis consists of the ilium, ischium, and pubic bones. These three bones meet at the cup shaped acetabulum on the lateral aspect of the pelvis bilaterally.² The acetabulum articulates with the head of the femur of the thigh. Posteriorly, the pelvic bones meet the sacrum and coccyx of the spine. Anteriorly, the pubic bones join at the pubic symphysis. Tough ligaments connect the pelvic bones, sacroiliac joints, and pubic symphysis.

There are several differences that exist between the male and female pelvis.² The hip bones and ischial tuberosities are further apart in females to create a broader birth canal. The female sacrum is less curved, and the obturator foramina are oval in females as compared to the round obturator foramen in males. The female pelvis is also broader, shallower, and has larger superior and inferior pelvic apertures than the male pelvis. In some females the pelvis displays characteristics of the male pelvis that may lead to difficulty with vaginal delivery. The anatomy of the female pelvis will be the focus of the remainder of this chapter.

There are four walls that make up the female pelvis which are the anterior, lateral, posterior, and the floor.² The anterior wall is formed by the pubic bones, obturator internus muscle, and the pubic symphysis. The function and insertions of the obturator

internus are described in the chart following this section. The lateral walls of the pelvis are covered by the obturator internus muscles. Medial to this muscle is the obturator nerve and branches of the internal iliac artery. The sacrum, parts of the ilium, and sacroiliac joints form the posterior wall of the pelvis. The piriformis muscle lines the posterolateral wall, forming a muscular bed for the sacral plexus and internal iliac vessels.² Finally, the pelvic floor consists of three layers of muscles that form a funnel shaped hammock for support of the pelvic contents.

The urogenital triangle is composed of two layers, the superficial urogenital triangle and the urogenital diaphragm. The third layer of muscle is the pelvic diaphragm. The most superficial layer of muscles is the urogenital triangle. The most anterior and posterior fibers of these muscles run transversely, while the middle fibers form a sphincter to surround the urethra. The superficial urogenital triangle consists of the ischiocavernosus, bulbocavernosus, and superficial transverse perineal muscles. Refer to table 2.1 for further description of these muscles, and Appendix A, figure one for a picture of these muscles. Just deep to this layer is the urogenital diaphragm. The compressor urethrae, urethrovaginal sphincter, and sphincter urethrae are included in this layer. These muscles are described in table 2.2, and a picture is contained in Appendix A, figure two. The final layer of muscle in the pelvic floor lies approximately six centimeters deep and is called the pelvic diaphragm.² The largest and most important muscle of the pelvic floor is within this layer and is called the levator ani. This is a broad muscle that forms a hammock between the pubis and coccyx, and also between the two lateral pelvic walls. The levator ani is divided into four muscles, which are the puborectalis, pubococcygeus, iliococcygeus, and pubovaginalis. Other muscles of the

pelvic diaphragm include the coccygeus, obturator internus, and the piriformis. The origins, insertions, and actions are described in table 2.3 later in the chapter, and these muscles are illustrated in Appendix A figure three.

Innervation to the pelvic diaphragm differs between its layers.¹ The entire urogenital triangle is innervated by the perineal branch of the pudendal nerve, which contains branches from sacral nerves two through four. Within the pelvic diaphragm, the levator ani is innervated by the inferior rectal nerve S3,4. The coccygeus is innervated by the ventral rami of the 4th and 5th sacral nerves. Lastly, the obturator internus is innervated by the nerve to the obturator internus, and nerve roots L5 and S1, whereas the piriformis is innervated by the ventral rami of S1 and S2.

The following tables show the origin, insertion, and action of the muscles in each of the three layers that have been described. Diagrams depicting the anatomy of these muscles are also included.

Table 2.1: Superficial Layer of the Urogenital Triangle

MUSCLE	ORIGIN	INSERTION	ACTION
Superficial transverse perineal muscles	Ischial tuberosity	Central perineal body	Stabilizes the perineal body
Bulbocavernosus (Bulbospongiosus)	Central perineal body	Fascia of corpus cavernosum of the clitoris	Assist in erection of the clitoris
Ischiocavernosus	Ischial tuberosity and ramus	Crus of the clitoris	Maintains clitoral erection

Superficial fascia of this layer is continuous with the abdominal fascia.

Adapted from: Moore KL. Clinically Oriented Anatomy. Baltimore, MD: Williams &Wilkins, 1992.²

Table 2.2: Deep Layer of the Urogenital Triangle
(Urogenital Diaphragm)

MUSCLE	ORIGIN	INSERTION	ACTION
Urethrovaginal Sphincter	Vaginal wall	Ventral surface of the urethra	Assists in maintaining continence
Compressor Urethrae	Ischiopubic ramus	Vaginal wall and urethra	Assists in maintaining continence
Sphincter Urethrae	Inferior pubic ramus, blends with vaginal walls	Fibers converge to form the urethrovaginal sphincter	Compresses the urethra and vagina

The urogenital diaphragm contains the inferior fascia, which is continuous with the superior fascia to provide support for the bladder and urethra.

Adapted from: Moore KL. Clinically Oriented Anatomy. Baltimore, MD: Williams & Wilkins, 1992.²

Table 2.3: Pelvic Diaphragm

MUSCLE	ORIGIN	INSERTION	ACTION
LEVATOR ANI			
1. pubococcygeus	Pubic bone and obturator internus fascia	Anococcygeal body, perineal body, and coccyx	Encircles urethra, vagina, and anus. Supports pelvic viscera.
2. puborectalis	Posterior pubis	Anococcygeal body and lateral walls of anus and rectum to form a sling around the anorectal junction	Maintain anorectal flexion to prevent unwanted passage of feces
3. pubovaginalis	Pubic groove	Perineal body and lateral vaginal walls	Sphincter of vagina and urethra
4. iliococcygeus	Each side of the levator ani from a tendinous arch of the ischial spine and obturator fascia	Coccyx and anococcygeal body	Supports pelvic viscera, pulls vagina and rectum anteriorly
Coccygeus	Pelvic surface of the ischial spine and sacrospinous lig.	Lateral/caudal portion of the coccyx and S5 vertebra	Support pelvic viscera, pulls coccyx anteriorly elevating the floor of the pelvis, stabilizes the SI joint
Obturator Internus	Pelvic brim, obturator membrane and foramen	Medial greater trochanter	External Rotation of the hip
Piriformis	Anterior sacrum and coccyx	Superior greater trochanter	External Rotation of the hip, abducts hip when hip is flexed.

Adapted from: Moore KL. Clinically Oriented Anatomy. Baltimore, MD: Williams & Wilkins, 1992.²

CHAPTER III

PELVIC FLOOR DYSFUNCTIONS

This chapter will review the types of dysfunctions that may occur within the pelvic floor. The female pelvic floor serves three main functions which include the following: supportive, sphincteric, and sexual.³ The pelvic floor muscles must support the pelvic organs, including the vagina, uterus, bladder, urethra, rectum, and small intestines.¹ Muscles must support these organs against both gravitational and intra-abdominal forces.⁴

The sphincteric function of the floor ensures continence through control of the perineal openings.³ The sphincter muscles contract to control flatus and keep the anorectal angle closed. The muscles then relax to allow defecation. The third function of the pelvic floor is sexual. The muscles around the vagina contract in order to enhance sexual pleasure.

There are many causes for dysfunction within the pelvic floor. These dysfunctions are divided into the following four categories: supportive, hypertonus/pain, disuse, and incoordination dysfunction.³ There are several methods for preventing and treating each of these dysfunctions, and physical therapy plays a vital role in the treatment of these disorders as the focus on women's health issues becomes more prominent within the medical community.

Supportive Dysfunction

Supportive dysfunction is caused by weakness in the pelvic floor musculature, which may be developed or inherited.³ Causes for this dysfunction include birth trauma, injury to muscles or connective tissues, pudendal nerve injury, long labor, high birth weight, instrument-assisted deliveries, and inadequate postpartum strengthening.^{3,4} Stretching and relaxation of the pelvic floor musculature occur during a normal vaginal delivery. Incisions from episiotomies may lead to scar tissue that interferes with normal muscle contraction. Post incision pain may also discourage women from contracting the pelvic floor musculature, leading to atrophy of the supportive musculature.

Diagnoses that may occur as a result of this dysfunction are urinary stress and fecal incontinence, cystocele, rectocele, enterocele, and uterine and vaginal vault prolapse.³ An example of these diagnoses is prolapse. This occurs when one or more of the pelvic organs fall below their normal positions.¹ The organ does not cause the prolapse to happen; rather, it is caused by a weakness or fault in the supportive tissue. Women with a prolapse may complain of a “heaviness or falling out,” a backache which worsens throughout the day, or stress incontinence.

Signs and symptoms of supportive dysfunction may be particularly apparent in postpartum women, as they are most at risk for developing pelvic floor weakness. Many women consider some degree of pelvic weakness to be normal after having a baby and are unlikely to report incontinence or other problems.⁴ Common symptoms include “back pain, pelvic heaviness, sensation of suprapubic pressure, heaviness or a ‘falling out’ feeling in the perineum, urination difficulties, constipation or bowel elimination difficulties, recurrent urinary tract infections, urinary frequency, and lack of sexual

orgasmic appreciation.”³ These symptoms may form a vicious cycle, as pelvic weakness leads to chronic constipation and excessive valsalva. This causes further weakness due to muscle stretch, making bowel elimination more difficult and causing constipation.

It is important to recognize and treat supportive dysfunction early, as rehabilitation potential may decrease with the passage of time.⁴ It is interesting to note that the treatment of supportive dysfunctions dates back to the time of Hippocrates.¹ For prolapse, treatment consisted of suspending a woman from her feet and shaking her until the uterus was in the correct position. Another treatment method included irrigating a prolapsed uterus with wine, then reducing and maintaining the correct uterine position through use of a pomegranate. Thankfully, today we have more effective methods in treating supportive dysfunctions.

There are three main treatment methods for reversing supportive dysfunctions, which are pelvic muscle (Kegel) exercises, use of vaginal cones, and electrical stimulation.³ During Kegel exercises, a woman concentrates on contraction of the pelvic floor muscles, pulling upwards during a contraction. These exercises help to strengthen and normalize muscle tone. They also help the woman to recognize the difference between a contracted and relaxed state of the muscles. During exercises, the patient must be sure that she is not “bearing down” during a contraction, because this places stress on the muscles and may cause further weakness. Biofeedback may be used to ensure correct use of pelvic floor muscles during exercise through use of visual or auditory feedback during a correct contraction. If the muscles are extremely weak, the patient may start her exercises in supine in order to eliminate gravity. She may then progress to lying at an

incline, sitting, and finally doing her Kegel exercises while in functional positions such as standing.

Vaginal cones and electrical stimulation are two other methods for treating pelvic floor weakness. Vaginal cones may be used to assess and strengthen pelvic floor muscles.³ The cones consist of a set of weights which are used for resistance to the pelvic floor muscles. A lifting contraction is necessary to maintain the weights in their proper position, therefore ensuring correct contraction. Wallace³ recommends no more than 15 minutes of weight exercise per session, as extended contractions may encourage chronic holding patterns. The final method of treatment is through electrical stimulation.³ Stimulation may be performed to the pelvic floor muscles or to their nerve supply. This method is used for neuromuscular re-education, and to enhance motor learning. Through these methods, supportive dysfunction may be reversed or prevented if a treatment program is started within a reasonable amount of time.

Hypertonus/Pain Dysfunction

According to Wallace,¹ hypertonus dysfunction is marked by an increase in pelvic floor muscle tension or spasm which leads to pain and dysfunction. There are two categories of hypertonus dysfunction, which are musculoskeletal hypertonus and true hypertonus.

Musculoskeletal hypertonus includes that caused by trauma to the pelvic bones or muscular structure, inappropriate use, psychological trauma, pelvic surgeries, sexual abuse, stress, and abnormal movement. This creates a vicious cycle in which muscle tension causes pain, and this then leads to more muscle tension.¹ The category of true hypertonus includes the myofascial pain syndromes. Any muscle of the pelvic floor may

cause pain if trigger points develop within the fibers.¹ The differentiation of these two types of hypertonus is very unclear in the literature.

There are five factors which may contribute to hypertonus dysfunction.¹ The cause may be musculoskeletal where joint, connective tissue, and muscle problems or movement dysfunctions such as chronic holding lead to muscle tension and pain. Psychogenic factors such as stress and abuse may lead to habitual holding. Causative factors from the viscera, such as a history of inflammation or infection may lead to chronic holding patterns. The fourth category is iatrogenic cause. Incisions, scar tissue, and adhesions create guarding of abdominal and pelvic muscles. Finally, the cause may be neurological. People with neurologic diseases such as fibromyalgia may present with this syndrome. Many of these factors may combine to create hypertonus dysfunction in a female postpartum.

During an evaluation, there are several aspects one must pay attention to. First, it is important that a woman who is suspected of having this syndrome have a complete medical exam to rule out any serious pathology.¹ An adequate history, including a sexual history should be taken, as women with this syndrome may experience dyspareunia, (pain during intercourse).⁴ Women often present with a classic "pelvic pain posture" including anterior pelvic tilt, increased lordosis, hyperextension of the knees, and a line of gravity generally displaced anteriorly in the lower extremities. Surface electromyography biofeedback may be used to evaluate muscle activity, which would be above normal in a patient with hypertonus dysfunction. Finally, a manual pelvic floor exam may aid in identifying increased muscle tone, and determine which of the pelvic musculature are affected.¹

Symptoms often expressed by individuals with hypertonus dysfunction include pain around the vagina and rectum, lower abdominal quadrants, suprapubic region, coccyx, and posterior thigh.³ Patients may also experience vulvar or clitoral burning.

Vaginismus is one of many diagnoses under the larger classification of hypertonus dysfunction. This diagnosis consists of "recurrent or persistent involuntary muscle spasm of the musculature of the outer one-third of the vagina that interferes with coitus and sexual function."³ Other diagnoses include piriformis syndrome, spasm of a particular muscle, low back pain, endometriosis, chronic pelvic pain, coccygodynia, and sphincter dyssynergia.

Treatment of hypertonus may include manual therapy such as myofascial release, trigger point massage, and joint mobilizations.^{1,3} Relaxation techniques may be taught, and assisted through the use of biofeedback to identify the relaxation of certain muscles. Correct postural alignment and postural exercises should be instructed to ensure correct use of muscles. Hot or cold modalities, pharmacologic interventions, and electrotherapy may be used initially for pain relief. Electrotherapy can also be utilized to stimulate muscles that are fatigued from chronic holding and spasm. Finally, the muscles which are antagonists to those with hypertonus should be strengthened along with the pelvic floor. The therapist should instruct the patient on these exercises and develop a home program to ensure carry over throughout the sessions.

Disuse Dysfunction

Disuse Dysfunction simply stated is the lack of awareness, knowledge, or use of the pelvic floor's function.³ The prevalence of this dysfunction is unknown, but it is estimated that 30-50% of women have weak or no ability to contract the pelvic floor.

Disuse may be asymptomatic or it may contribute to problems with the urogynecologic systems. Making women aware of the pelvic floor through strengthening exercises may prevent these problems. Kathe Wallace³ has five suggestions that would increase awareness.

1. Teach children that muscles control urine flow. This should be taught during toilet training.
2. Teach female athletes involved in high impact sports to use the pelvic floor muscles upon impact and to do pelvic floor exercises.
3. During health and sex education, teach females about the pelvic floor anatomy and exercises
4. Fitness classes for adults should include pelvic floor exercises.
5. During routine pelvic exams, pelvic muscle strength should be assessed.

Through these techniques, women could potentially become educated about their pelvic floor and prevent problems. Pelvic floor exercises should be prescribed only after a muscle evaluation.

Incoordination Dysfunction

Difficulties with muscle relaxation and contraction lead to dyssynergia; defined as incoordination or difficulty with micturition and defecation.³ Causes of incoordination include damage to muscles or the pudendal nerve during birth, and improper exercise technique. Studies show that 53% of women do Kegel's exercises incorrectly.³ A common mistake is "bearing down" during exercises, while the patient should be concentrating on a lifting contraction. This bearing down valsalva maneuver causes

increased pressure on the pelvic floor, leading to weakness. Complaints due to incoordination include voiding problems, or a patient may be asymptomatic.

Pelvic muscle biofeedback may be used to train muscles to work independently. Electrical stimulation can also help in the recognition of specific muscle contraction. In order to coordinate muscle contractions a therapist may teach breathing techniques along with muscle contraction, instructing a patient to contract the pelvic floor during exhalation, and relax with inhalation.

The keys to treating any of these dysfunctions are timely treatment and a thorough evaluation. A physical therapist plays a critical role in education and treatment for patients with any type of pelvic floor dysfunction. During a history, there are several important questions to ask a patient in order to determine a dysfunction diagnosis including:³

1. Do you ever unintentionally lose urine?
2. While laughing, sneezing coughing jumping or exercising, do you have trouble maintaining urine control?
3. Are Kegel's exercises included in your exercise routine? (Assess if they are performed correctly)
4. Do you have trouble controlling flatus?
5. Are you aware of excess tension or holding of your pelvic floor muscles?
6. Are you aware of decreased sexual feelings in the vagina or increased pain during intercourse? (especially after childbirth)

These questions assist the therapist in making a diagnosis of a pelvic floor dysfunction. As mentioned earlier a prompt evaluation and problem identification is necessary because the rehabilitation potential is greatest immediately following the onset of symptoms. Since many women do accept abnormal symptoms after delivery as normal, educational pamphlets such as the one put together in this project should be given to new mothers in order for them to recognize symptoms of dysfunction as they come up, and enable them to seek proper treatment.

CHAPTER IV

INCONTINENCE

Between 15 and 60 years of age, the prevalence of urinary incontinence in women is estimated to range between 10 and 30 percent.⁵ Urinary incontinence is defined as an involuntary loss of urine. Physical and hormonal changes associated with pregnancy and childbirth place women at risk for developing incontinence. During birth, the perineum is stretched, loosening support mechanisms for the urethra and bladder.⁶ Unfortunately, many women accept some degree of incontinence as normal. However, incontinence is not a part of normal functioning of the human body, and there is much that can be done to treat and prevent incontinence in women. This chapter will focus on the four main types of incontinence: urge, stress, mixed, and overflow. Physiology and treatment of each of type will be covered.

In order to understand incontinence it is important to have an overview of the mechanism of urination. The micturition reflex coordinates the process of urination.⁷ As the bladder fills with urine, stretch receptors in the bladder wall are stimulated to send messages along afferent nerves to the sacral base, and then are sent to the thalamus and cerebral cortex where the signal is recognized as an urge to urinate. Efferent nerves then carry signals to the detrusor muscle, a triple layered muscle surrounding the bladder, to contract. Contraction of the detrusor muscle increases pressure within the bladder, but urination will not occur unless both the external and internal urethral sphincters relax. This relaxation occurs volitionally, allowing control of the timing of urination.

Both the sympathetic and parasympathetic nervous systems play a role in the timing of urination.⁸ The parasympathetic nervous system stimulates the contraction of the detrusor muscle through acetylcholine, while the sympathetic nervous system inhibits detrusor contraction through activation of beta-adrenergic receptors. However, bladder function is also controlled voluntarily to inhibit the involuntary reflex arc.

Normally, a person is able to comfortably control their desire to urinate for about half an hour, and may be able to maintain control for up to two or three hours if necessary.⁹ In the situation of incontinence, one or more factors interfere with the ability to control this reflex. Pregnancy, vaginal delivery, episiotomy, and pelvic muscle weakness all serve as risk factors for urinary incontinence because the support mechanisms for the bladder and urethra are weakened during pregnancy and childbirth.¹⁰

Stress Incontinence

During a sudden increase of intra-abdominal pressure, such as with coughing, sneezing or laughing, incontinence may occur in the absence of a detrusor contraction. This is referred to as stress incontinence (SI). During these activities, intra-abdominal pressure exceeds that of urethral sphincter pressure. If the muscles, fascia, or ligaments supporting the bladder are too weak to withstand this force, leakage will occur.^{8,11} This is the most common form of incontinence in women because, as discussed earlier, childbirth puts great strain on the supportive structures of the urinary system. When these supportive structures are stretched and weakened, women are at risk for SI.⁹

A woman will remain continent if three key factors exist.⁵ First, the pelvic floor muscles reflexively contract during an increase in intra-abdominal pressure. Also, the urethra is in a retropubic position that is well supported. Finally, forces from stressors

such as a cough or a sneeze are normally experienced at the bladder base, which is better suited to withstand forces than the bladder neck.

In supine, urethral pressure ranges from 40 to 80 centimeters of water.⁵ With a cough or during stress that pressure is raised by as much as 100 centimeters of water so all mechanisms of control must be in working order to prevent leaking. In extreme cases, activities such as standing or walking may cause an incontinent episode.⁹ Four legged animals do not develop problems with SI because their anatomy is such that their bladders do not increase pressure on the urethral sphincters with gravity. When a weakness of the pelvic floor musculature exists, the bladder and urethra sag into the vagina, called a prolapse. The urethra then becomes hypermobile as the sphincter and other muscles are weakened, leading to stress incontinence.¹⁰

According to Lipsitz,⁵ the severity of stress incontinence is separated into four categories. With type zero, the patient complains of occasional leakage, but it cannot be reproduced during an assessment. Type I includes the typical symptoms, but the bladder neck and urethra have little hypermobility. When stressed, the urethra and bladder neck must descend more than two centimeters to be considered type II. For patients with type III SI, “the bladder neck and urethra are open all the time with or without bladder contractions. The sphincter is incapable of maintaining a water tight seal, and leakage occurs even without provocation”.

There is much that can be done for treatment of stress incontinence. A physical therapist specially trained in women’s health issues can offer many options to the patient dealing with urinary stress incontinence. A brief explanation of several types of treatment will be covered.

Pelvic floor exercises are an effective way of strengthening the muscles of support for the bladder and urethra.^{9,10,11} These exercises should consist of an upward lifting of the pelvic floor muscles. The therapist should make sure that the woman is not bearing down during these exercises. Attempting to stop urine flow in mid-stream can assist the patient in identifying these muscles.¹¹ This should not be done as an exercise, only to identify how to contract the proper muscles in order to avoid urinary retention problems.

A therapist should recommend that a patient complete a home exercise program of both short and prolonged contractions to strengthen the pelvic floor. For example, a home exercise program might include five repetitions of pelvic floor contractions held for ten seconds each, completed ten times each day. As the patient is able to elicit a stronger contraction vaginal weights may be added, but should not be used if prolapse is present.¹⁰ These weights, which are placed in the vagina, may be used for 15 minutes at a time, twice each day. Use of vaginal weights for longer periods of time may lead to chronic holding patterns and hypertonus. It is important to educate the patient that it may take up to six months for the exercises to have their maximum effect.

Biofeedback is helpful in identifying and assuring use of correct musculature. If contractions are particularly weak, electrical stimulation can be used to the afferent sacral and pudendal nerves to strengthen and improve the muscle contractions.¹⁰ Contraindications to electrical stimulation; however, include constipation, vaginal soreness, and presence of a hematoma.

Pharmacological treatment is used in some cases, but the results are typically disappointing.⁵ Alpha-adrenergics such as pseudoephedrine are used to stimulate both

striated and smooth muscle tone.^{8,9,10} The goal of this is to increase tone in the urethral sphincters and prevent leakage.

As a last resort, surgery is sometimes used to treat SI. Six procedures are covered in other literature on SI.⁹ One of the more common surgeries is the pubovaginal sling. In this procedure, a strip of fascia is surgically removed and made to form a sling around the urethra and sphincter muscles. A second type of procedure is retropubic operation. During this operation tissues of the urethra are attached to the pubis forming a sling much like that in the pubovaginal sling. This gives the urethra support to prevent leaking. Sometimes, “needle” bladder neck suspensions are performed, where needle puncture incisions are made to pass sutures around the urethra for a sling. A fourth procedure is a vaginal operation. Tissue from both sides of the urethra is gathered underneath for a support block. The long-term benefits of vaginal operation are not as consistent as those of some other surgeries, but vaginal operation has few risks of complications, so this may be used as a preliminary procedure. There is also an option of replacing the weak sphincter muscle with a mechanical device. The device is not activated for about six weeks so that tissues have a chance to heal before activation. Finally, a periurethral injection may be given, which involves injection of a material around the urethra to compress it. These injections are given as a short-term solution, as they do not last very long.

Urge Incontinence

Urge incontinence (UI) is often described as a strong urge to void followed by an uncontrolled loss of urine.^{8,11} It occurs because of an involuntary contraction of the detrusor muscle, which overrides urethral pressure causing the sphincters to relax and

release urine. Incontinent episodes many times occur on the way to the bathroom, leading to a nickname of the “garage door syndrome.”⁹ For example, a woman may not feel an urge to void until the garage door opens or her key is in the lock, and then experiences a strong urge with a resultant incontinent episode. It is thought that one reason for this occurrence is due to a conditioned reflex. In many situations, a woman may feel an urge while in the car or running errands, but waits until she gets home to use the bathroom. In time she may associate arriving home with using the bathroom leading to a reflexive void once the garage door is up or the key is in the lock.

There are two main causes of involuntary detrusor contraction, which are detrusor hyperreflexia and detrusor instability.⁸ Detrusor hyperreflexia is characterized by an innervation abnormality, or failure to inhibit the normal reflexive detrusor contractions. Detrusor instability, on the other hand is simply abnormal involuntary detrusor contractions associated with other factors. Causes of instability are thought to include bladder irritants such as an obstruction, infection, caffeine, or alcohol.

There are three main treatment approaches to UI. Preferable methods of treatment are those that are least invasive. Treating the underlying cause, behavioral modification, and medications are three methods used. If an underlying cause such as a urinary tract infection is present it should be treated first.

Behavioral modification is the second, and often most effective, method of treatment.^{9,10} Behaviors are changed in order to avoid symptoms in the future. Patients are often asked to keep a “bladder diary” to track causes and influences of incontinent episodes. The patient keeps track of her time of voids, episodes of leaking, amount of leaking, situations surrounding leak, fluid intake, etc. The therapist can then work with

the patient in finding ways of limiting incontinent episodes. Helpful changes can include a decrease in fluid intake (particularly those with caffeine), stress relaxation, and teaching muscle contractions for control. These behavioral treatments are an easy and uninvasive way to treat urge incontinence.

A third way to treat UI is through pharmacological therapy. Anticholinergics are used to block the detrusor-stimulating drug acetylcholine.^{9,10} Side effects of this drug include dry mouth, constipation, blurred vision, increased heart rate, decreased sweating, and drowsiness. Antispasmodics may also work directly on the bladder to decrease detrusor contractions.

There are also a few supplementary treatment measures that may be used for the woman with UI.^{9,10} Biofeedback is combined with behavior modification to help women identify and contract pelvic musculature for control of continence. Electric stimulation can also be used to stimulate and increase muscle tone, and to strengthen supportive muscles. While undergoing treatment, a woman may want to use absorbent pads to avoid wet clothing if she continues to experience incontinent episodes.

Surgery should be used only as a last resort. The surgical procedure for controlling UI involves cutting of the nerve supply to prevent unwanted contraction, or adding part of the intestine to the bladder to increase its capacity. Blaivas⁹ does not recommend surgery because although it is 90% effective, many patients are unable to urinate naturally post surgery and must resort to intermittent self-catheterization.

Mixed Incontinence

Simply stated, mixed incontinence is a combination of stress and urge incontinence.¹⁰ This condition may be brought on by a variety of factors that include all

those described earlier. One type of incontinence is usually more severe than the other, and this condition is treated by methods described in the stress and urge incontinence sections. Concentration is placed first on the dominant type of the patient's incontinence.

Overflow Incontinence

The final type of incontinence is overflow incontinence. The condition is caused by detrusor hypotonicity or inability to contract.^{8,10,11} The patient may complain of frequent or constant dribbling, frequent urge to urinate, or a weak stream during urination. Pathophysiology involving pregnancy and labor involves disruption of motor innervation of the detrusor during delivery, or pregnancy induced diabetic neuropathy. Other causes include fecal impaction and drugs. Treatment for overflow incontinence is similar to other types of incontinence because the least invasive methods are used first. Behavioral modifications and pharmacotherapy are often the most common approaches taken.^{10,11}

Assessment

The most important aspect in any evaluation of a patient with the condition of incontinence is to protect the patient's dignity and allow them to feel comfortable with the examination.¹¹ The following list of questions is one way of separating out the symptoms of incontinence, and was taken from Walters and Realini.¹²

1. Do you ever leak urine when you cough, sneeze, or laugh?
2. Do you ever have such an uncomfortably strong need to urinate that if you don't reach the toilet you will leak?
3. If "yes" to 2, do you ever leak before you reach the toilet?
4. How many times during the day do you urinate?

5. How many times do you void (urinate) during the night after going to bed?
6. Have you wet the bed in the past year?
7. Do you develop an urgent need to urinate when you are nervous, under stress, or in a hurry?
8. Do you ever leak urine during or after sexual intercourse?
9. Do you find it necessary to wear a pad because of your leaking?
10. How often do you leak urine?
11. Have you had bladder, urine, or kidney infections?
12. Are you troubled by pain or discomfort when you urinate?
13. Have you had blood in your urine?
14. Do find it hard to begin urinating?
15. Do you have a slow urine stream?
16. Do you have to strain to pass your urine?
17. After you urinate, do you have dribbling, or a feeling that your bladder is still full?

These questions help an experienced therapist determine the type and cause of a patient's incontinence.¹ Question 1 determines a diagnosis of stress incontinence. Detrusor instability is evaluated in questions 2 through 9. Urgency is determined in questions 2 through 7. Assessment of the severity of the problem is completed in questions 9 and 10. Finally, questions 14 through 17 may indicate a voiding dysfunction, such as overflow incontinence. A thorough history should also include information as to the number a pregnancies a woman has had, number of births, episiotomy or tearing, and

symptoms with urination. If there is pain associated with the patient's condition, it should be rated on a 0-10 scale for objective measure.

In many cases, a patient is assigned a bladder diary to track various aspects of micturition.^{1,10} In this diary, a woman tracks her voiding frequency, timing, and amount. When she has an incontinent episode, she should write down the activities and events surrounding the episode, and the amount of urine leaked.

A neurological examination of all nerve roots and sacral reflexes should be completed prior to treatment to rule out any neurological dysfunction. Before completing any perineal or pelvic muscle examination, a therapist should also educate the patient on the purpose and process of the examination.¹ Tools such as anatomical models and charts may be used to help the patient visualize her anatomy. The therapist should explain that she will be assessing the pelvic floor tone and muscle strength during the evaluation. Permission for a pelvic examination should always be obtained from the patient.

Before a pelvic exam, the patient should empty her bladder completely, and remove clothing from the waist down.¹ The patient should lie in a hooklying position and may be draped with a cloth or given a hand held mirror to observe the examination. The examiner should always follow universal precautions and sterile techniques while performing the evaluation.

First, an external exam of the perineum is completed. The therapist should look at skin color, symmetry of structures, any edema, scarring, and the resting position of the structures. The internal exam begins with an assessment of the pelvic floor musculature. The ischiocavernosus, bulbocavernosus, superficial transverse perineal, deep transverse perineal and levatores ani muscles (see chapter two) should be evaluated on each side.¹

Muscles should be evaluated for hypertonicity, hypotonicity. A manual muscle test may be given to test muscle strength on a scale of zero to five. A grade zero is given to a muscle with no contraction. Grade one is a muscle able to produce a flicker contraction. A grade two muscle is able to produce a weak two-second hold. A muscle is given grade three if it produces a squeeze with a definite lift. A grade four muscle produces a good lifting squeeze, which the patient is able to hold and repeat a few times. A muscle is given grade five if it produces a strong squeeze, a good lift, and is able to repeat this. Finally, the examiner should assess for prolapse and pelvic masses.¹⁰

The several types of incontinence may seem to intermix and the symptoms of one type of incontinence blur with those of another. According to Blaivas,⁹ there are only five sets of symptoms that encompass all known problems of the bladder. These symptoms are: frequent urination, urgency, or nocturia, incontinence, pain, difficulty or inability to urinate, and blood in the urine. With so few symptoms correlating to so many bladder problems, it is crucial to obtain a thorough assessment and history. In the hands of a trained therapist, many of the symptoms of incontinence may be greatly lessened, and in some cases even cured.

CHAPTER V

CESAREAN AND EPISIOTOMY SCARS

The use of episiotomy and cesarean section to hasten the delivery of a baby has steadily increased over the past 20-25 years.¹³ While many physicians feel that these procedures lessen the danger and work of birth, these surgeries can actually lead to further problems down the road for the new mother. Scar tissue from these incisions may lead to adhesions causing pain, poor posture, and decreased mobility, as well as other problems which will be discussed throughout this chapter.

Since there are so many women who have either perineal or abdominal scarring after delivery, it is important that they are educated on the problems that may occur and the options they have for treatment. This chapter will focus on the dysfunctions associated with scarring and the treatment measures, both acutely and after scar maturity, which may be taken to prevent dysfunction.

To understand the treatment methods involved in scar care, it is important to have at least a basic understanding of the process of wound healing. Healing of a dermal wound is divided into three stages.¹⁴ The first stage is the inflammatory phase. During inflammation, debris is cleared away by macrophages and the wound is prepared for healing. The second stage of healing is the fibroplastic phase, which adds strength to the wound by rebuilding damaged structures. During the final stage, termed remodeling, the immature scar transitions to becoming a mature scar, and the final form of the wound is complete. The primary goal of physical therapy is to provide the patient with a fully

functional, mobile scar free of dysfunction. This is achieved in different ways for both perineal scars and abdominal scars.

Episiotomy

Episiotomy refers to an incision made to the perineum to enlarge the vaginal opening during birth. The incision may be made in the midline or the mediolateral aspect of the vagina. Proponents of this procedure believe that it avoids over stretching and tearing of the perineum, quickens the delivery of the baby, and facilitates delivery of distressed or premature babies.¹⁵ There is much debate in the literature on whether this procedure is used appropriately in the United States. According to Noble,¹³ an episiotomy is justified in situations of fetal distress to “get the baby out” but otherwise the procedure is performed on the basis of what “might” happen, for example tearing or stretching. She states, “Exercises to prepare and restore a temporarily stretched – but intact – perineum are preferable” to an incision.

One of the arguments advocating the use of episiotomy has stated that a cut from an incision is easier to suture and will heal better than a laceration. Fleming¹⁶ contradicts this in her research. She found that 30% of women who have had an episiotomy during birth continue to report mild discomfort during intercourse six months postpartum. This was not true of the women who tore naturally.

If the perineum does tear during delivery there are four degrees, or stages, under which the tear is categorized.^{1,8} A first degree tear involves the skin and mucous membrane superficial to the muscles. Second degree tears extend into the underlying muscles. An episiotomy by definition is a second degree tear. During a third degree tear, the laceration involves the anal sphincter. The final category is the fourth degree tear.

These tears extend through the anterior rectum and through the rectal mucosa to expose the lumen of the rectum. Tearing occurs if the perineum is stretched too quickly during delivery. It has been reported that regular perineal massage prior to delivery may help a woman decrease her chances of sustaining a tear.⁸

Women are often very sore the first few days after undergoing an episiotomy, and physical therapy interventions can do much to relieve her discomfort. Ice pack and local analgesics are the most common modalities used for pain relief.¹⁵ The acutely postpartum woman should also rest in bed frequently to elevate the traumatized tissue and avoid edema. Another way to reduce edema in the acute phase is to initiate pelvic floor exercises within the first 24 hours to activate a pump mechanism from the pelvic floor muscles. These exercises must be initiated immediately in order to prevent future problems of incontinence, painful intercourse, and constipation.¹³ Finally, the patient should be educated on proper defecation techniques to avoid stress on the wound. A pressure pad is held against the wound to brace against increased pressure during defecation.

If a scar does not heal properly, it will lead to pelvic pain, weakness, and decreased function of the pelvic floor.¹ These problems often lead women to a physical therapist specially trained in women's health issues. Treatment of a perineal scar will depend on the degree of trauma and stage of repair of the tissue. Before treatment, the therapist will conduct a thorough evaluation of the scar.

According to Jenkyns and Shelly,¹ an evaluation of episiotomy scar tissue should include pain, trigger points, mobility, extensibility, density, age, color, and length of the

scar. Pain during intercourse and defecation should also be assessed. Throughout the evaluation, good handwashing techniques and gloves should be used to maintain sterility.

Goals for the outcome of therapy generally include decreased pain, increased tissue extensibility, increased healing, decreased swelling and spasm, and the resumption of functional activities such as intercourse.¹ Two main interventions in addition to pelvic floor exercises are used to address these goals. These are ultrasound and perineal massage.

Ultrasound is used to promote healing in the beginning stages, or to prepare tissues for perineal massage. Both the thermal and nonthermal effects of ultrasound are used in the treatment of scar tissue. This modality is used to stimulate tissue regeneration and soft tissue repair, decrease pain, increase extensibility of collagen-rich structures, and increase blood flow and nerve conduction velocity.¹

In the perineal area, ultrasound is generally applied through water immersion, use of gel, or a water or gel filled condom. With the water immersion technique, a woman sits in waist high water to be treated. The soundhead of the ultrasound machine is held 1/2 inch away from the scar and moved up and down over the lacerated area. This technique is used during the first one to two days after delivery.

The other methods are used once the scar is more mature, or at least six weeks postpartum to allow adequate healing.¹ The direct ultrasound method involves application of gel couplant directly to the scar. The soundhead is placed directly on the perineum to apply ultrasound. Use of a probe cover is recommended to decrease risk of infection. The soundhead may be applied to a water filled condom as well. A condom is filled with water and knotted at the end to prevent leakage of the couplant. Gel is applied

to both sides of the condom and the patient is instructed to hold the condom in place over her scar. With water being used as the couplant inside the condom, a lower frequency of one MHz should be used to allow penetration of both the condom and the water by the soundhead. A final method of ultrasound application is through a gel filled condom. With this method, a condom is filled 1/3 full with gel, and the soundhead is placed inside the condom. Gel is applied to the perineum as well, and the condom-covered soundhead is moved over the scar. Since the soundhead is immersed in gel during the entire process, it may be picked up and moved without harm.

The second method for treatment of perineal scars is perineal massage. A therapist, the patient, or the patient's partner may perform this type of massage.¹ To begin perineal massage, the therapist should wash her hands and don gloves for sterility. Massage should move from one end of the scar to the other to find tender points, moving slowly over them without sliding over the skin. Friction massage at right angles or pressure held on a nodule, then released may also help to increase scar mobility.¹³ (See Appendix A, figure four for an illustration of episiotomy scar mobilization.) During the first few treatments, a patient's tolerance for massage may only be five minutes because of pain. This tolerance should gradually be built up to 20 minutes per treatment session. A patient's tolerance may be increased by use of a hot pack or ultrasound prior to treatment for pain relief.

Perineal massage can be instructed as a home exercise program as well. The patient or her partner may perform the massage.¹ If the patient chooses self perineal massage, she should position herself in a half seated, half kneel, or sidelying position. The patient then uses her two index fingers or thumbs to perform the massage the same

way as her therapist. It is often difficult for a patient to inflict pain upon herself, so she may want to consider partner massage. If the partner is to perform the massage, he should come to the physical therapy session to be instructed on correct performance. This way, the woman can compare the massage of her partner and her therapist to ensure that her partner is performing the massage correctly.

It is important for women who have undergone an episiotomy to be educated on their options for treatment immediately after undergoing the procedure. With timely treatment, the residual effects of perineal scarring may be prevented or relieved. Through perineal massage, a patient is empowered to treat her own scar and avoid future problems. Physical therapy plays an integral part in education and intervention for episiotomy. A woman's health physical therapist will be able to offer suggestions and treatments to relieve the pain and dysfunction associated with an episiotomy.

Cesarean Section

In 1993, 23 percent of babies were delivered through cesarean section.¹³ Prior to 1970 there was only a five percent cesarean delivery rate. According to Noble,¹³ far more cesarean sections (c-sections) are performed today than are medically necessary. In fact, cesarean section has been the "most frequently performed major surgery in the United States" since 1985. In many cases a c-section is necessary, but scarring of the abdomen can cause dysfunction long after delivery.

As mentioned previously, there are many situations that warrant a c-section. If the mother has a systemic dysfunction such as high blood pressure or diabetes, it may become necessary to perform a c-section to ensure the mother's health.¹³ Dangerous uterine conditions may also prompt birth through c-section. One such condition is termed

placenta previa, in which the placenta is positioned across the cervix blocking birth, and may be life threatening. Fetal distress and failure to progress are other reasons given for performing a cesarean section.

Most often, a c-section is performed through a transverse incision in the lower uterine section.¹⁵ A c-section may be performed because of patient choice or due to an emergency.¹³ If the surgery is performed because of an emergency (such as those listed previously), general anesthesia is used because of a need for a speedy delivery. An epidural may be given to mothers having a c-section who want to be awake during the birth of their child.

In the post-cesarean acute phase, it is important that the new mother is mobilized within the first 12-18 hours to prevent problems.⁸ Active assisted or active range of motion exercises for the lower extremities should be performed in order to decrease stiffness, edema, and risk of a deep vein thrombosis.¹⁵ New moms should also be instructed in deep breathing techniques and huffing, a technique utilizing forced exhalation of air to clear the lungs that is less painful than a cough. Breathing and huffing techniques help keep the lungs well ventilated and free of mucous build up.^{13,15} Finally, the therapist may fit the post-cesarean patient with an abdominal binder to help support her abdomen and incision.

Abdominal scarring after a cesarean section may lead to several dysfunctions down the road. Muscle imbalance, poor posture, and inappropriate healing can cause the scar to bind down into the surrounding soft tissue.^{1,8,15} This causes the tissue to be shortened and bound down placing abnormal pressure on surrounding structures, and leading to increased pain, altered sensation, and poor function of organs and muscles.¹

The primary physical therapy treatment for immobile scars is scar massage. A physical therapist trained in this particular form of massage can help a patient reach goals of decreased pain, increased scar mobility, normal posture, increased trunk range of motion, and normal organ mobility. The first step in treating abdominal scars is an evaluation.

During an evaluation of a c-section scar, the therapist should note the location, length, and integrity of the scar.¹ The therapist then palpates the scar for tenderness and tests it for mobility. Scar restrictions should be documented as to whether they are to the right or left and superior or inferior. This will provide a baseline from which to work, enabling the therapist and patient to track progress.

Cesarean scar massage is similar to perineal massage in that the incision should be well healed before massage is initiated.¹ All scabs should have fallen off naturally before initiation. During abdominal massage no lubricant should be used because the fingers are not allowed to slide over the skin with this technique.

There are four stages involved in abdominal massage.¹ See Appendix A, figure five for pictures of these methods. The first stage is desensitization. When a woman first enters the physical therapy clinic for treatment of her scar, it may be extremely hypersensitive to the touch. This first stage is designed to help a woman overcome this hypersensitivity. The therapist starts by rubbing a soft cloth in all directions over the scar. This is then progressed to using a rougher wet towel, and finally a dry towel until the woman feels comfortable with touching her scar.

Stage two is the push and pull massage method.¹ Two fingers should be used to push the scar in one direction until it stops moving. The scar should then be held at this

point for one to two minutes to allow a good stretch to the tissue. More time should be spent on a particular area if it seems particularly “stuck.”

The third stage, skin rolling, is begun two to four weeks post surgery, and is used to begin treating the three dimensional aspect of a scar.¹ With this technique, skin is pinched between two fingers on one side of the scar or the other. The skin is raised with the thumb and forefinger, and the fingers are rolled from side to side for one to two minutes. This initiates the process of breaking the adhesions that bind the scar to the surrounding soft tissue.

Finally, the “plucking” stage begins four to eight weeks post surgery.¹ The therapist attempts to pull up the scar with the thumb and index finger on either side. Again, the skin is picked up, and the fingers are rolled from side to side for one to two minutes to further break the binding adhesions.

These techniques will promote proper healing to progress to a free and mobile scar. Massage should be performed in conjunction with instruction on proper posture, as a flexed posture promotes shortening of scar tissue. A hot pack and effleurage may warm the tissues prior to massage and enable the woman to have an increased tolerance for massage.

Whether the woman receives physical therapy treatment for a perineal scar or an abdominal scar, home instruction is the key to successful treatment. If a woman is instructed on how to perform the massage techniques at home, there will be more carryover from treatment, and decreased pain and dysfunction for the new mother. The physical therapist provides the education and techniques for treating dysfunctional scar

tissue, and the patient provides the follow through necessary to decrease scar pain and other related problems.

CHAPTER VI

MUSCULOSKELETAL DYSFUNCTIONS

Pregnancy causes great stress to be placed on the musculoskeletal system. Excess weight, faulty posture, fluid retention, pelvic floor weakness, and hormones such as estrogen and relaxin that soften ligaments may lead to pelvic and low back pain.

According to Patricia King,⁶ musculoskeletal dysfunctions caused by pregnancy include sprains, strains, degenerative conditions, abnormal strength, and abnormal flexibility.

Many musculoskeletal structures share innervation with urogenital structures, which is why chronic pelvic pain is so closely related to musculoskeletal dysfunction.

Practitioners dealing with chronic pelvic pain need to have a good knowledge base of musculoskeletal problems in order to effectively diagnose and treat patients.

Some common reports of pain that are caused by musculoskeletal imbalances are low back pain, neck pain, headaches, coccydynia, sacroiliac pain, and symphysis pubis pain. The focus of this chapter is on the many different dysfunctions stemming from musculoskeletal origin such as postural problems, diastasis rectus abdominus, pubic separation and strains, sacro-iliac sprains/strains, and coccydynia.

Posture

The posture of a pregnant woman may be a primary cause of musculoskeletal dysfunction. An anterior pelvic tilt, increased lumbar lordosis, hyperextension of the knees, and a line of gravity displaced anteriorly in the lower extremities and pelvis all describe typical posture during pregnancy.⁶ This posture may also be retained after the

pregnancy is over, which leads to problems throughout a woman's life if not properly addressed. Problems include shortening and hypertonus of the hip external rotators, strain on the iliofemoral ligaments, degenerative joint disease of the hips, lengthening of abdominal muscles, weakness, trigger points, and hypermobility of the thoracolumbar facets. See Appendix A, figure six for a posture checklist for a woman both during and after her pregnancy.

An increased lordotic posture leads to low back pain for pregnant women.^{6,17} As the fetus grows, weight is concentrated in the lower pelvis with a tendency for the abdomen to protrude anteriorly.¹⁷ This causes the woman's posture to fall forward, bringing the line of gravity anterior to the pelvis and lower extremities. This shift in posture leads to disc herniation and low back pain due to strain on the structures of the low back and pelvis.

Anterior malfunctions also play a role in postpartum back pain.⁶ As discussed in an earlier chapter, scarring of the abdominal wall causes adhesions, leading to poor posture and back pain. Muscles, such as the hip flexors, can also develop tightness during pregnancy leading to referred pain through the low back and pelvis. A thorough evaluation is imperative in determining the cause of low back pain in the postpartum woman.

An evaluation should include screening of posture, range of motion and flexibility, strength and stability, palpation, special tests, and neurologic factors such as sensation.⁶ Posture should be observed from all planes to observe bony symmetry, faulty weight bearing habits, postural deviations, and muscular hypertrophy or atrophy. Both passive and active range of motion of the spine and lower extremities should be noted,

paying careful attention to areas and motions causing pain. Strength should also be assessed through manual muscle testing and functional activities. Finally, the neurologic system should be tested to rule out a problem of a more serious nature.

Treatment primarily focuses on the lengthening of contracted structures and the shortening of structures which have become stretched.⁶ The focus on specific muscles is determined through evaluation. Treatment for muscles with increased tone includes massage, myofascial release, soft tissue manipulation, and relaxation training. Methods which may be used for stretched or weakened muscles include muscle re-education through biofeedback, external supports for use early in the rehabilitation process, and strengthening activities. Postural training is also extremely important in the treatment regimen. An understanding of the patient's activities throughout the day will provide the therapist with a good idea of the types of positions that the patient should be instructed in. Generally, postural training includes the positions of standing, sitting, and lying.

Another area of concern for the therapist treating women in the postpartum period is the hips.^{6,18} During pregnancy, the ilium flares outward in order to accommodate the growing fetus. Because of this outflare, the hips rotate externally causing a loss of internal rotation and hip extension motion. With the hips in external rotation the pelvis is more stable, but this position eventually leads to pain in the deep buttock due to contracture of the piriformis muscle. If this posture of the hip joints becomes chronic it can lead to degenerative joint disease of the hips, which is an irreversible condition. It is therefore extremely important for a therapist to recommend stretching exercises for the hip musculature in order to avoid stiffness of the muscles and degeneration of the joints.

Abdominals

The main functions of the abdominal musculature are to support the pelvic viscera and maintain the normal lordotic posture of the spine.⁶ Due to the expanding uterus and excessive anterior pelvic tilt during pregnancy, the abdominal muscles are weakened and stretched. The linea alba, connective tissue that binds the two sides of the rectus abdominus muscle, is also weakened due to hormonal influences during pregnancy.⁸ The muscle bellies of the rectus abdominus will often separate due to their weakened connection. This condition is termed diastasis recti, or separation of the rectus. The condition may develop during pregnancy or the second stage of labor.

Women being treated for postpartum dysfunctions should be tested for diastasis recti (See Appendix A, figure seven for an illustration). The following steps for testing diastasis are taken from “Obstetric and Gynecologic Care in Physical Therapy”⁸:

1. The woman lies flat on her back with her knees bent.
2. She raises her head and shoulders until her neck is about eight inches off the surface, her chin should be tucked and her arms stretched out front.
3. The therapist should check the presence of a bulge in the central abdominal area, which is evident when the muscles have parted.
4. The number of the therapist’s fingers inserted horizontally into the gap at the level of the umbilicus defines the amount of separation between the taut rectus muscles. The therapist should also test for diastases two inches above the umbilicus and at two inches below the umbilicus to get a clear picture of the extent of separation.

If a separation greater than two fingers widths is found upon evaluation, exercises for the diastasis should begin. This exercise is performed by assuming a hooklying position. The patient's arms should then be crossed over the abdominals, pulling the muscle bellies of the rectus together from each side. A sheet or towel may also be used for this purpose. Head lifts progressing to small abdominal curls are then done in this position, bringing the separation of the muscle to a close. Appendix A, figure eight is a picture of this corrective exercise. The process of healing a separation can take several months as the two sides of the linea alba reunite to form a connection between muscle bellies.

Pubic Separation and Strain

The extra load during pregnancy combined with weak ligaments can lead to a separation of the symphysis pubis joint.¹⁸ During labor, this separation is sometimes increased to accommodate for the baby moving through the birth canal.⁶ If this condition is not treated, it may lead to low back pain or tension myalgia of the pelvic floor and hip musculature. Poor posture, acute trauma, and adaptive muscle shortening can also lead to superior/inferior shifts of the pubis. Pain due to separation is manifested in the extreme during movement of the pelvic girdle, and is exacerbated with weight bearing activities.¹⁸

Physical therapists can assist the patient by performing muscle energy techniques to gain proper alignment of the pubic bones. There are also a few precautions a woman can follow to avoid further separation and maintain alignment.¹⁸ She should avoid using stairs in a reciprocal pattern, widely separating her legs, bouncing or one-legged activities, and abdominal exercises. Women are also taught to move with both legs together when rolling in bed, and that when sitting down in a car seat they should sit

down first, then assist with the hands by lifting the legs. Some therapists advocate the use of a lumbosacral brace to decrease pelvic movements during daily activities.

Sacroiliac Joint Pain

Several factors contribute to injury of the sacroiliac joint during pregnancy. Hormones cause relaxation of the ligaments and can lead to a rotation of the innominate in relationship to each other.¹⁸ The sacrum may be displaced from the ilium during labor and delivery because of constant strain from faulty posture, or due to a fall directly on the ischium. The sacrum may also rotate in relationship to the ilium because of imbalance between muscles that connect to the ilium. Dysfunctions of the sacroiliac joint may also cause anterior pain because they can lead to a separation of the symphysis pubis joint.

An evaluation of the sacroiliac joint may include assessment of leg lengths, sacral movement, ligament laxity, pelvic alignment, trigger points, and pain referral patterns.¹⁸ Once the therapist has assessed the cause of dysfunction, treatment can begin by utilizing postural training, strengthening, muscle energy techniques, and mobilization to regain optimum stability and avoid further stretching because of faulty posture.^{6,18} Between physical therapy treatments, there are a few guidelines a woman should follow. The patient should avoid widely separated legs, walking on uneven terrain, doing frog kicks while swimming, climbing more than one step at a time, and swinging one leg out of the bed when getting up. By avoiding these activities, pelvic alignment can be better maintained from session to session.

Coccydynia

Coccydynia refers to pain of the coccyx, which is the most distal segment of the vertebra. This pain is caused by displacement of the bone during pregnancy or childbirth.¹⁸ Often, this occurs when delivery takes place on a hard surface that does not allow the adequate sacrococcygeal extension required to widen the canal during birth.⁶ Normally, the coccyx flexes in standing and extends in sitting. After childbirth; however, the coccyx may sublux and become hypomobile in extension.¹⁸ This hypomobility causes tone and length changes of the pelvic floor, and can lead to pelvic pain.

A therapist can screen for sprain of the coccyx through resisted hip extension. The gluteal muscles have tendinous attachments to the coccyx, and resisted motion causes pain in a positive test for sprain.⁶ Treatment for coccyx sprain generally includes coccyx mobilizations and iontophoresis to decrease swelling and pain.¹⁸ Patients can also be educated on sitting and standing postures that relieve coccyx pain.

Pregnancy and childbirth places women at a great risk of developing musculoskeletal dysfunction. Faulty posture, weight gain, ligament laxity, fluid retention, abdominal relaxation, and birth trauma may all lead to painful dysfunctions. Education on these musculoskeletal problems and their treatments may help to decrease or even eliminate these painful dysfunctions after delivery. Physical therapists are skilled in treating the musculoskeletal system, and play an integral role in the treatment of these women. Through stretching, strengthening, joint mobilization, posture training, massage, myofascial release, external supports, and modalities, therapists help women to regain their pre-pregnancy function and lead normal, and hopefully painfree lives.

CHAPTER VII

CONCLUSION

Throughout this paper, we have discussed many dysfunctions that potentially occur in the postpartum period. This paper gives women a brief description of these problems and offers some potential treatment options through physical therapy. Although there is an abundance of information of postpartum dysfunction and its treatment, this information is rarely received by new mothers. This literature review, along with the pamphlet, provides a medium through which this information can reach the mother before leaving the hospital. Anatomical and physiological changes of the female pelvic floor were reviewed, as well as pelvic floor dysfunctions, incontinence, cesarean and episiotomy scarring, and musculoskeletal problems are addressed as dysfunctions related to pregnancy and childbirth

Many muscles of the pelvic floor are affected by pregnancy and childbirth. The pelvis, including its bony structure, muscles, and connective tissues serves to support and protect the pelvic organs. Knowledge of the pelvic anatomy is necessary in order to treat dysfunctions of these structures, and was covered in the first chapter of this literature review.

The three main functions of the pelvic floor are that of support, sphincteric control, and sexual pleasure. There are several factors that may contribute to changes within the pelvic floor, leading to four types of dysfunction. These four types of dysfunction are supportive, hypertonus/pain, disuse, and incoordination. There are

several treatment options to address each type of dysfunction. A physical therapist trained in women's health issues can help a woman to achieve a pain free, functional pelvic floor.

Incontinence is another prominent problem within the postpartum population. This may occur either in the immediate postpartum period, or in the later years of life. Many women accept some degree of incontinence as a normal symptom accompanying childbirth and the aging process. We addressed the four main types of incontinence: stress, urge, mixed, and overflow. The pamphlet will educate women about incontinence and the treatments available for these problems to help them realize that incontinence is not normal in any period of the life cycle.

Episiotomies and cesarean sections often produce scars, which lead to adhesions causing musculoskeletal dysfunctions and pain. Again, education is lacking that provides women with information on potential harmful effects of scars. The goals of physical therapy are first to educate women on scar mobility to prevent future problems, and second to decrease pain and increase extensibility of the scar tissue to improve general mobility of musculoskeletal structures.

Lastly, pregnancy and labor can place great strain on musculoskeletal structures. Increased weight gain, hormonal changes, postural changes, fluid retention, ligament laxity, structural bony changes, abdominal weakness, and pelvic floor weakness increase a woman's susceptibility to musculoskeletal problems. The disruption of the way these structures work together causes postural changes leading to pain and dysfunction of other joints. The hips, abdominals, sacroiliac joint, pubic symphysis, and coccyx may all be

affected. Treatment of musculoskeletal dysfunction includes strengthening, postural training, stretching, muscle energy techniques, and joint mobilizations.

Education is the key to solving these postpartum dysfunctions. Women need to know what signs and symptoms are abnormal after pregnancy in order to seek treatment for their conditions. It is also a health care provider's job to possess knowledge of these conditions so that women may be screened during regular physical exams. Many women are embarrassed or unwilling to voluntarily talk about these problems discussed previously. Medical professionals need to create an atmosphere open to discussion of these female issues, and routinely screen for postpartum dysfunctions. Preventative measures such as earlier education in health education courses, sports programs, and exercise classes as well as pre and postpartum classes could help promote the importance of pelvic floor exercises, increase the understanding of the anatomy, and decrease the prevalence of these dysfunctions.

APPENDIX A

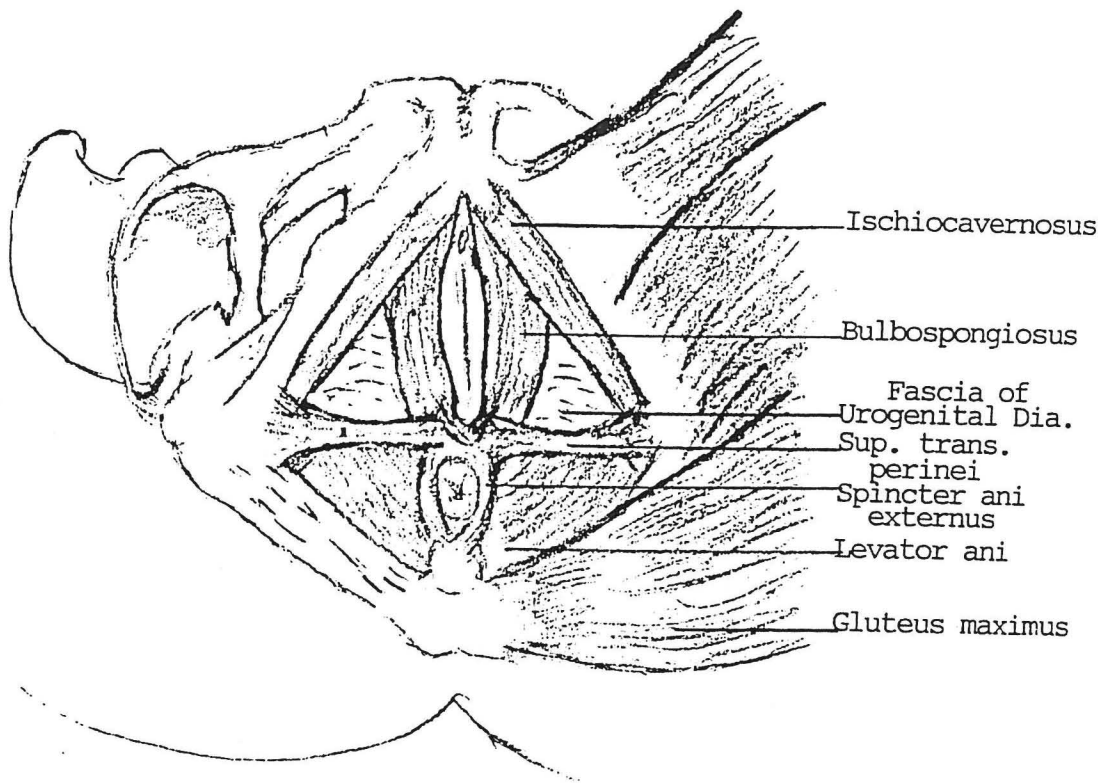


Figure 1. Superficial layer of the urogenital triangle. From Salentiny RJ. *Mechanical Biofeedback for Treatment of Female Urinary Incontinence*. Thesis (M.P.T.)—University of North Dakota, 1997:9.¹⁹

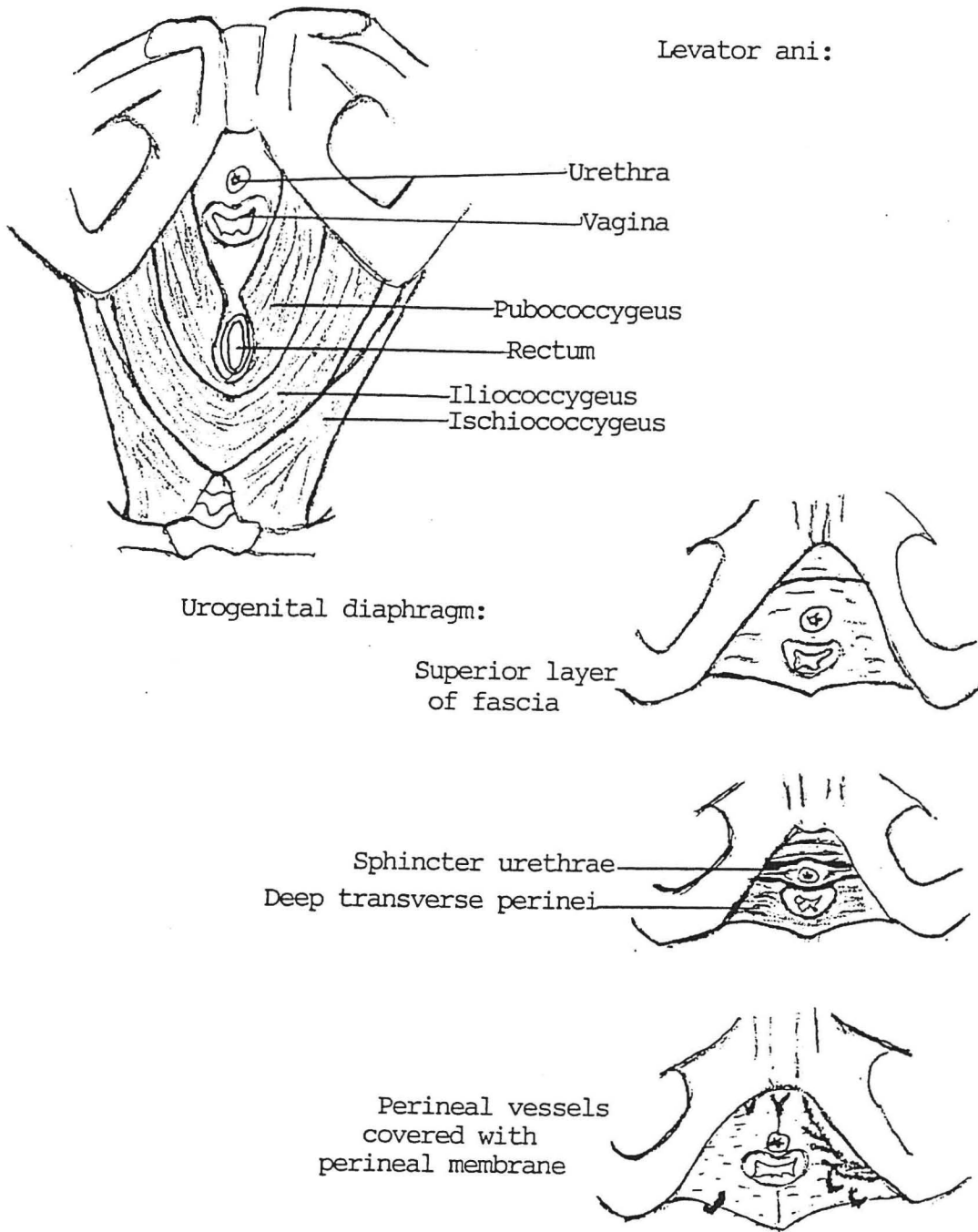


Figure 2. Deep layer of the urogenital triangle. From Salentiny RJ. *Mechanical Biofeedback for Treatment of Female Urinary Incontinence*. Thesis (M.P.T.)—University of North Dakota, 1997:10.¹⁹

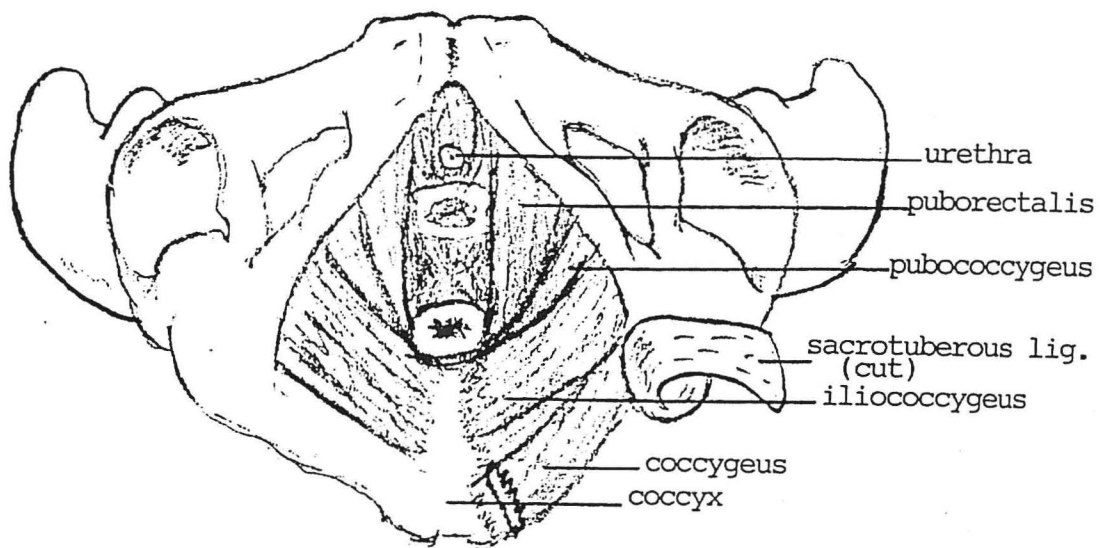


Figure 3. Pelvic diaphragm. From Salentiny RJ. *Mechanical Biofeedback for Treatment of Female Urinary Incontinence*. Thesis (M.P.T.)—University of North Dakota, 1997:9.¹⁹

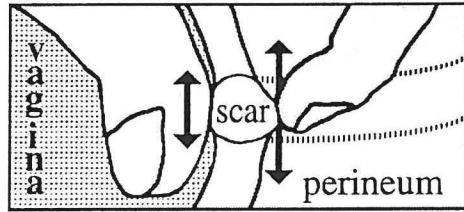
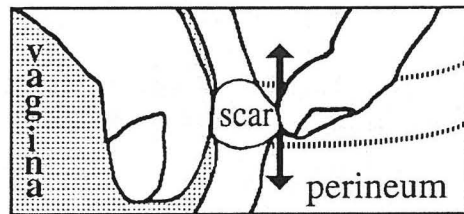
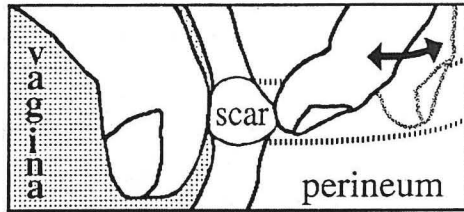
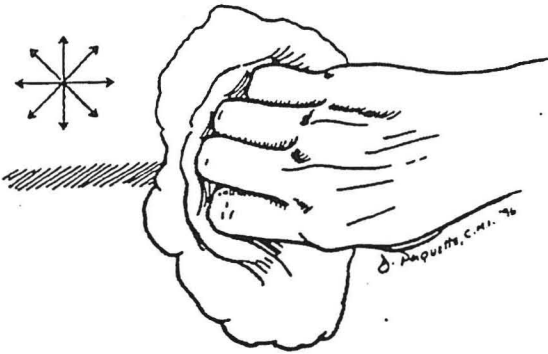
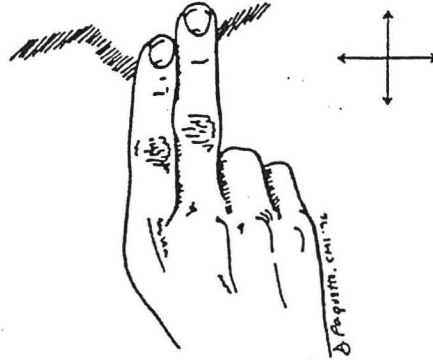


Figure 4. Perineal scar mobilization. Reprinted with permission from Pirie A, Herman H. *How to Raise Children Without Breaking Your Back*. W. Somersville, MA: IBIS Publications; 1995:5.²⁰

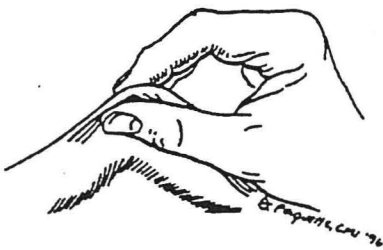
1. SCAR DESENSITIZATION



2. PUSH AND PULL



3. SKIN ROLLING



4. PLUCKING

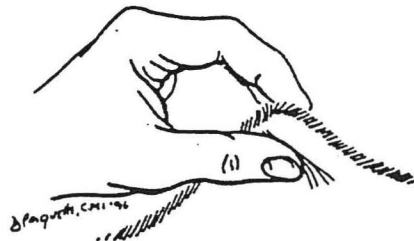


Figure 5. Cesarean section scar mobilizations. From Wilder E, ed. *The Gynecological Manual*. American Physical Therapy Association Section on Women's Health: 1997:281.¹

Exercise 1. Posture Check

Purpose: Prevent or reduce unnecessary strain and injury of joints and muscles.

Position: Stand with feet shoulder-width apart, knees slightly bent, and shoulders relaxed.

Method: Tighten abdominal muscles and tuck gluteals to rotate pelvis to neutral. Lower shoulders and roll arms out. Straighten neck and tuck chin to align ears over shoulders. Breathe regularly, hold for count of 5, relax, and repeat.

Progression: Perform with eyes closed or while ambulating.

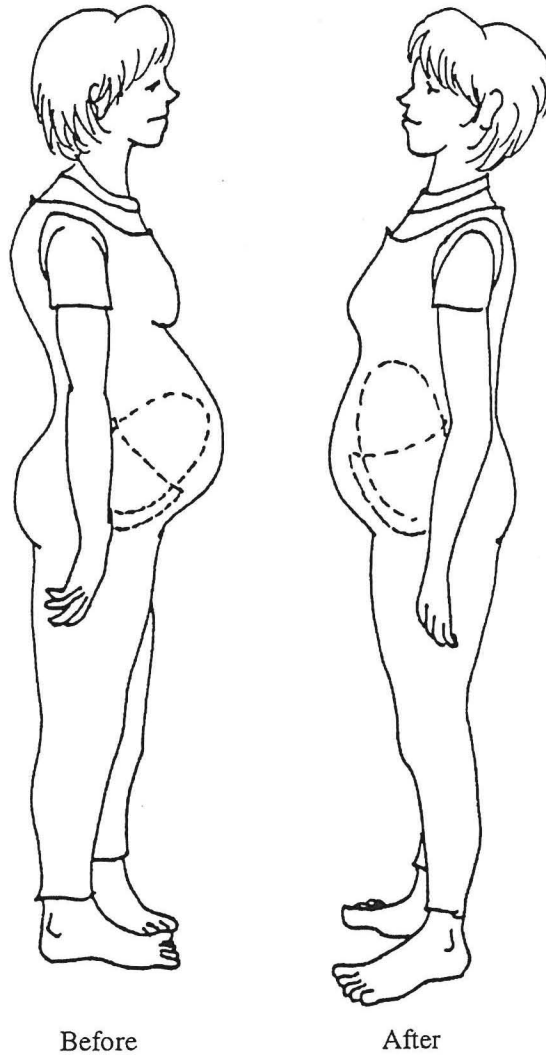


Figure 6. Posture checklist. From Ripplinger SL. *Exercise and Pregnancy: A Guide for Health Care Professionals*. Thesis (M.P.T.) – University of North Dakota, 1998:40.²¹

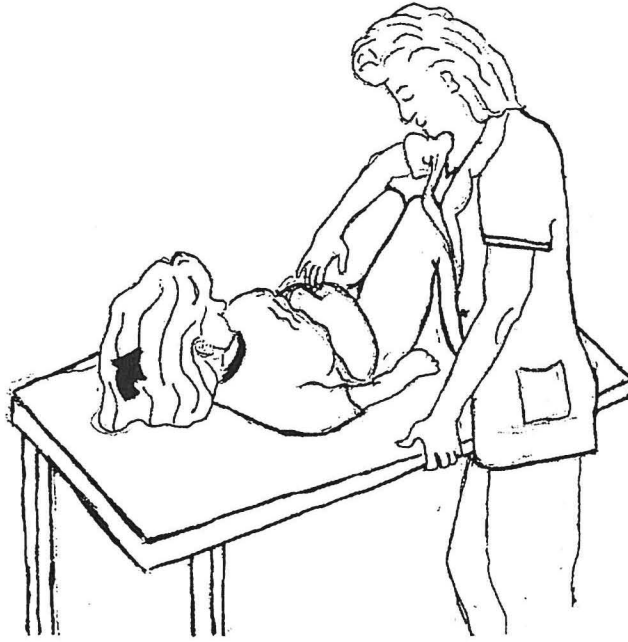


Figure 7. Check for diastasis rectus abdominis.



Figure 8. Corrective exercise for diastasis rectus abdominis.

APPENDIX B

Labioplasty & Cesarean Scars

Scars from these two surgical procedures can lead to adhesions in the soft tissue. These adhesions promote painful musculoskeletal dysfunctions if left untreated. Scarring can lead to:

- Pain over incision
- Low back pain
- Pelvic floor pain
- Poor posture

Treatments

Your physical therapist can offer a wide variety of treatment options based on your specific needs.

Treatments may include:

- Pelvic floor strengthening
- Postural training
- Scar mobilizations
- Ultrasound
- Stretching & strengthening exercises
- Muscle energy techniques

POSTPARTUM DYSFUNCTION



THE POSTPARTUM PERIOD

Pregnancy can impose many changes on a woman's body. These changes may lead to dysfunctions of the musculoskeletal system. Many women seem to accept some of these problems as a natural result of childbirth, and assume these conditions are untreatable. However, this is untrue because many of these conditions are highly curable when addressed by a physical therapist specializing in women's health. Some anatomical and physiological changes that may lead to dysfunctions are:

- Postural changes
- Hormonal changes
- Ligament laxity
- Muscle weakness
- Weight gain
- Fluid retention

INCONTINENCE

Incontinence is an involuntary leakage of urine. Pelvic floor structures which support the bladder are stretched and weakened during pregnancy. This weakness can lead to incontinence immediately in the postpartum period, or years down the road if strengthening is not addressed. The four main types of incontinence are:

Stress incontinence:

A type of incontinence that occurs with an increase in abdominal pressure such as with coughing, sneezing, laughing, or straining.

Urge Incontinence:

Characterized by a strong uncontrollable urge to urinate followed by a loss of urine.

Overflow Incontinence:

Weakness of the bladder muscles leads to overdistention, which results in constant leakage.

Mixed Incontinence:

A combination of stress and urge incontinence.

MUSCULOSKELETAL PROBLEMS

The anatomical and physiological changes that occur as a result of pregnancy can disturb the way that structures in your body work together.

Pelvic Floor Dysfunctions:

The functions of the pelvic are to support the pelvic contents, maintain sphincteric control, and enhance sexual function. Damage from pregnancy and trauma from childbirth can interfere with pelvic floor function and lead to pain, incontinence, prolapse, constipation, and lack of sexual appreciation.

Diastasis Rectus Abdominus:

Separation of the abdominal muscles due to increase weight gain and abdominal muscle weakness during pregnancy.

Other Musculoskeletal Problems:

- Coccydynia (tailbone pain)
- Sacroiliac pain & dysfunction
- Pubic symphysis separation & pain
- Poor posture

APPENDIX C

September 26, 2000

Alex Pirie
7 St. James Ave.
Sommerville, MA 02144

Dear Alex Pirie,

We, Kara Kukuchka, Becky Olson, Tami Parker and Christel Parvey, graduate students of the University of North Dakota Department of Physical Therapy, request permission to photocopy or reproduce figures from the text, How To Raise Children Without Breaking Your Back, by Alex Pirie and Hollis Herman.

The figures are located on pages 5, 17, and 63. Copies of these figures will be used in our independent studies for making written explanations easier to understand via illustration. Our topic focuses on musculoskeletal dysfunctions surrounding pregnancy and childbirth. These figures and explanations nicely demonstrate our topics.

Credit for the figures will be given to Pirie A and Herman H: How to Raise Children Without Breaking Your Back: A body manual for new mothers and the parents of small children. IBIS Publications, Somerville, MA 02144. 1995.

We sincerely thank you for your time and attention to this request.

Sincerely,



Becky Olson
Physical Therapy Graduate Student
University of North Dakota

Approval is given to Kara Kukuchka, Becky Olson, Tami Parker, and Christel Parvey, graduate students of the University of North Dakota Department of Physical Therapy, to reproduce figures from the above publication for use within their independent studies.



Alex Pirie
IBIS Publications

Please sign and return in the self addressed envelope provided.

REFERENCES

1. Wilder E, ed. *The Gynecological Manual*. American Physical Therapy Association Section on Women's Health; 1997.
2. Moore KL. *Clinically Oriented Anatomy*. 3rd Ed. Baltimore, MD: Williams & Wilkins; 1992:243-318.
3. Wallace K. Female Pelvic Floor Functions, Dysfunctions, and Behavioral Approaches to Treatment. *Clin sports Med*. 1994;13(2):459-481.
4. King P. Musculoskeletal Problems. In: Steege PA, Metzger BS, Levy, eds. *Chronic Pain: an Integrated Approach*. Philadelphia, PA: WB Saunders Company; 1998:215-240.
5. Lipsitz DU, Snyder JA. Evaluation of Female Urinary Incontinence. *Urol Clin North Am*. 1991;18:197-199.
6. Stephenson RG, O'Connor LJ. *Obstetric and Gynecologic Care in Physical Therapy*. 2nd Ed. Thorofare, NJ: SLACK Inc; 2000.
7. Martini FH. *Fundamentals fo Anatomy and Physiology*. 4th Ed. Upper Saddle River, NJ: Prentice Hall; 1998:997.
8. Mold JW. Pharmacotherapy of Urinary Incontinence. *Am Fam Physician*. 1996;54(2):673-680.
9. Blaivas JG. *Conquering Bladder and Prostate Problems: The Authoritive Guide for Men and Women*. New York, NY: Plenum Trade; 1998.

10. Fantl JA, Newman DK, Colling J, et al. *Managing Acute and Chronic Urinary Incontinence*. Clinical Practice Guideline. Quick Reference Guide for Clinicians, No. 2, 1996 Update. Rockville, MD: US Department of Health and Human Services. Public Health Service, Agency for Health Care Policy and Research. AHCPR Pub. No. 96-0686. March, 1996.
11. Castleden CM, Iqbal P. Management of Urinary Incontinence. *Gerontology*. 1997;43:151-215.
12. Walters MD, Realini JD. The Evaluation and Treatment of Urinary Incontinence in Women: A Primary Care Approach. *J Am Board Fam Pract*. 1992;5(3):289-301.
13. Noble E. *Essential Exercises for the Childbearing Year: A Guide to Health and Comfort Before and After Your Baby is Born*. 4th Ed. Harwich, MA: New Life Images; 1995.
14. Gogia PP. *Clinical Wound Management*. Thorofare, NJ: SLACK Inc; 1995:2-3.
15. Sapsford R, Bullock-Saxton J, Markwell S, eds. *Women's Health: A Textbook for Physiotherapists*. London, England: WB Saunders Company Ltd; 1998.
16. Fleming N. Can the Suturing Methods Make a Difference in Postpartum Perineal Pain? *J Nurse Midwifery*. 1990;35(1):19-25.
17. MacEvily M, Buggy D. Back Pain and Pregnancy: A review. *Pain*. 1996;64(3):405-414.
18. Ob/Gyn News. *Physical Therapy in Action*. 1997;3(5).
19. Salentiny RJ. *Mechanical Biofeedback for Treatment of Female Urinary Incontinence*. Thesis (M.P.T.) – University of North Dakota; 1997:9-10.

20. Pirie A, Herman H. *How to Raise Children Without Breaking Your Back*. W. Somersville, MA: IBIS Publications; 1995:5.
21. Ripplinger SL. *Exercise and Pregnancy: A Guide for Health Care Professionals*. Thesis (M.P.T.) – University of North Dakota; 1997:40.