



2001

Potential Dysfunctions Occurring in the Postpartum Years

Kara Kukuchka
University of North Dakota

Follow this and additional works at: <https://commons.und.edu/pt-grad>

 Part of the [Physical Therapy Commons](#)

Recommended Citation

Kukuchka, Kara, "Potential Dysfunctions Occurring in the Postpartum Years" (2001). *Physical Therapy Scholarly Projects*. 270.
<https://commons.und.edu/pt-grad/270>

This Scholarly Project is brought to you for free and open access by the Department of Physical Therapy at UND Scholarly Commons. It has been accepted for inclusion in Physical Therapy Scholarly Projects by an authorized administrator of UND Scholarly Commons. For more information, please contact zeinebyousif@library.und.edu.

POTENTIAL DYSFUNCTIONS OCCURRING IN THE POSTPARTUM YEARS

By

Kara Kukuchka
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 Kara Kukuchka 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.

Cindy Florn-Meland
(Faculty Preceptor)

Beverly Johnson
(Graduate School Advisor)

Thomas Moran
(Chairperson, Physical Therapy)

PERMISSION

Title Potential Dysfunctions Occurring in the Postpartum Years

Department Physical Therapy

Degree Master of Physical Therapy

In presenting this Independent Study Report in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I agree that the Department of Physical Therapy shall make it freely available for inspection. I further agree that permission for extensive copying for scholarly purposes be granted by the professor who supervised my work or, in her absence, by the Chairperson of the department. It is understood that any copying or publication or other use of this independent study or part thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and the University of North Dakota in any scholarly use which may be made of any material in my Independent Study Report.

Signature Kara Kukuchka

Date 12-7-00

TABLE OF CONTENTS

LIST OF FIGURES	v
LIST OF TABLES	vi
ACKNOWLEDGEMENTS	vii
ABSTRACT	viii
CHAPTER	
I. INTRODUCTION	1
II. ANATOMY	3
III. PELVIC FLOOR DYSFUNCTIONS	8
IV. INCONTINENCE	15
V. CESAREAN SECTION & EPISIOTOMY SCARS	29
VI. MUSCULOSKELETAL PROBLEMS	38
VII. CONCLUSION	46
APPENDIX A	49
APPENDIX B	57
APPENDIX C	60
REFERENCES	62

LIST OF FIGURES

Figure	Page
1. Superficial and deep layers of the urogenital triangle.....	50
2. Deep layer of the urogenital triangle.....	51
3. The pelvic diaphragm.....	52
4. Perineal scar mobilization.....	53
5. Cesarean section scar mobilizations.....	54
6. Posture checklist.....	55
7. Check for diastasis rectus abdominus.....	56
8. Correction exercise for diastasis recti.....	56

LIST OF TABLES

Table	Page
2.1 Superficial Layer of the Urogenital Triangle.....	6
2.2 Deep Layer of the Urogenital Triangle	6
2.3 Pelvic Diaphragm.....	7

ACKNOWLEDGEMENTS

I would like to thank my parents for all of their love and support. You have always been there for me and encouraged me to strive for the best; I could not have made it without you. Nicholas, thank you for always being there when I needed someone to talk too and for being my best friend. Thank you to the entire Physical Therapy Department, especially Cindy Flom-Meland for all of your time and dedication. Thanks to my partner Becky Olson for working on this project with me I can not believe we finally got it finished. Finally, thanks to all of the great friends I made here who made this a fun and memorable experience.

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 their postpartum years on the dysfunctions that may occur, and possible treatment options. An educational pamphlet describing these dysfunctions and treatments was designed to be given to 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, describing these dysfunctions and treatments, to be given to postpartum women before they leave the hospital. (See Appendix B)

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

ANATOMY

The pelvis, along with muscles and connective tissues, support the pelvic organs and their contents as well as withstand intrabdominal pressure that occurs with activities such as laughing, coughing, and lifting.¹ The bony pelvis is made up of three bones, the ilium, ischium, and pubis that all meet at the acetabulum. The ilium contains the acetabulum, which is a cup shaped surface that the head of the femur articulates with on the lateral side of the pelvis. The sacrum, coccyx, and inferior levels of the lumbar spine articulate with the pelvis posteriorly, and the pubic symphysis is where the pelvis joins anteriorly. The pelvic bones are bound together by strong ligaments at the sacroiliac joints and pubic symphysis.

The female pelvis differs from the male pelvis in adaptation for childbirth.² The male pelvis is heavier, thicker and has prominent bone markings; whereas the female pelvis is wider and more shallow. This review focuses on the anatomical differences of the female pelvis. The female's hips and ischial tuberosities are positioned further apart, the sacrum tends to be less curved and the obturator foramina are rounder as compared to the male's pelvis. These anatomical differences attempt to increase the size of the inferior pelvic aperture and the diameter of the birth canal. Even though there are clear anatomical differences between the male and female pelvis it is also possible for a woman's pelvis to have male characteristics, which could make a vaginal delivery very difficult.

The pelvis can be described as having anterior, lateral and posterior walls and a floor. These are collectively made up of muscles, bones and ligaments.² The anterior wall is made of the bodies of the pubic bones, the obturator internus, and the pubic symphysis. The lateral walls are covered mostly by the obturator internus muscle. The obturator nerve and branches of the internal iliac artery run medial to this muscle. The sacrum, ilium, sacroiliac joints (SI), and their ligaments compose the posterior pelvic wall. The piriformis runs laterally against these bony structures and is a key muscle in the gluteal region. The sacral plexus and internal iliac vessels run medial to the piriformis. The pelvic floor consists of several layers of muscles that stretch like a tight hammock from the pubic bone in front to the base of the spine in back.

The pelvic floor muscles can be divided into three layers that are surrounded superiorly and inferiorly by fascia.¹ The urogenital triangle composes the two groups of muscles, the superficial layer and the urogenital diaphragm. The superficial transverse perineal muscles, bulbocavernosus, and ischiocavernosus muscles form the most superficial layer of the urogenital triangle. The layers of muscles just distal to the superficial muscles are referred to as the urogenital diaphragm and include; the deep transverse perineal muscles, urethrovaginal sphincter, compressor urethrae, and the sphincter urethrae muscles.² Refer to Tables 2.1 and 2.2 at the end of the chapter.

The pelvic diaphragm is the third and deepest layer of muscles in the pelvic floor.¹ The pelvic diaphragm is slung like a funnel shaped hammock between the pelvis anteriorly to the coccyx posteriorly and attaches to the obturator fascia laterally. This layer separates the pelvic cavity from the perineum and is penetrated by the rectum and

urethra to reach the exterior. The pelvic diaphragm is formed mainly by the levator ani muscles, which are the largest and most important group of muscles in the pelvic floor.

The levator ani muscles can be divided into three layers: pubococcygeus, puborectalis, pubovaginalis, and the illiococcygeus, which work together to support the viscera.¹ The pubococcygeus muscle is the main part of the levator and encircles the urethra, vagina, and anus. It also merges into the perineal body.² During childbirth this muscle is most likely to be damaged. Injury to this muscle and the pelvic fascia can lead to a condition known as cystocele, a herniation of the urinary bladder into the vagina. If the urethra is also involved the condition is called cystourethrocele. The coccygeus muscle is posterior to the levator ani and forms the posterior smaller part of the pelvic diaphragm. Other muscles of the pelvic diaphragm include the obturator internus and the piriformis which are discussed in more detail Table 2.3 at the end of the chapter.

The pelvis is innervated mainly by the sacral and coccygeal nerves.² The perineal branch of the pudendal nerve, containing nerve roots S2-S4, innervates the muscles of the urogenital triangle. In the pelvic diaphragm, the levator ani is innervated by the inferior rectal nerve (S3, S4), and the coccygeus is innervated by the ventral rami of S4 and S5. The obturator internus is innervated by the obturator internus nerve containing nerve roots L5, S1. Lastly the piriformis is innervated by the ventral rami of sacral roots S1 and S2.

The following charts display the three layers of muscles included in the pelvic floor in addition to their origin, insertion and action. Diagrams displaying the anatomy of these muscles can be seen in Appendix A.

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

The pelvic floor muscles serve three main functions. First, they serve as support to the pelvic organs, which include the bladder, uterus, and bowel.³ These muscles must be able to withstand the intra-abdominal pressure that occurs due to gravity as well as the increased pressure resulting from pregnancy and childbirth. The muscles also provide sphincter control to the bladder, rectum, and vagina and assist with sexual pleasure. Problems involving the pelvic floor muscles may lead to weakness contributing to a decline in any of these three functions. Pelvic floor dysfunctions are divided into four categories: supportive, hypertonus, disuse, and incoordination dysfunctions.

Supportive Dysfunction

Supportive dysfunction is a loss of strength or integrity of supportive structures of the pelvic floor's connective tissue and muscles.³ These structures can be damaged during pregnancies, vaginal deliveries, hysterectomies, episiotomies, muscular and skeletal imbalances and pelvic fractures. The pelvic floor muscles are also influenced by the effects of inadequate postpartum strengthening, menopause, and aging.^{3,4} The muscles are not always damaged with pregnancy and delivery but still undergo relaxation and stretching to help with the delivery.³ Injuries that occur during childbirth, such as spontaneous tearing or an episiotomy, will result in scar tissue formation that may reduce the contractility of the muscles. Lastly, pain from the incisions in the perineal area may also limit the use of the pelvic floor in the postnatal period causing muscle weakness.

Relaxation, stretching, tearing, and pain can all contribute to disuse and muscle weakness affecting their supportive function.

Common complaints of women with supportive dysfunction include back pain, pelvic heaviness, sensation of suprapubic pressure, heaviness or a "falling out" feeling in the perineum, recurrent urinary tract infections, bladder and/or bowel difficulties, urinary frequency, and a lack of sexual orgasm.³ Urinary stress incontinence, fecal incontinence and uterine prolapse are just a few of the diagnoses that can be associated with supportive dysfunction of the pelvic floor musculature.

There are several influencing factors that can damage the pelvic floor's integrity. Joint dysfunction, hormonal change, pregnancy and labor can all contribute to pelvic floor weakness. Joint dysfunction may contribute to muscle imbalances and interrupt their normal function.¹ Asymmetries such as pubic, ilium, or sacral shears, and ilium or sacral rotations can induce abnormal pulling on the muscles leading to muscle weakness; thus, decreasing the amount of support they can provide. Hormonal changes can also influence ligament laxity, which in turn often leads to joint dysfunctions. This causes muscle imbalances that can disturb the pelvic floor's strength. Two situations in which ligaments are known to become more slack are in pregnancy and post-menopausal women. In pregnancy, the slackening is the result of increased production of the hormone relaxin, whereas in post-menopause, it is the result of decreased amounts of estrogen. During these two periods of time, the pelvis is more susceptible to injury because of ligament laxity. Acute or chronic trauma to the pelvic region may also create ligament laxity contributing to excess movement of the pelvic bones and increasing the likelihood of malalignment. Research has not shown that swelling and pain in a joint from

malalignment can inhibit nearby muscles. However, one source postulated that the pain resulting from the pelvic joint dysfunction could inhibit the pelvic floor muscles and contribute to muscular weakness.¹

Treatment for supportive dysfunction includes, but is not limited to, pelvic muscle exercises with or without biofeedback, vaginal cones, and electrical stimulation.³ Pelvic muscle exercises are an easy non-invasive way to increase strength and endurance of the muscles. Kegel exercises, in conjunction with biofeedback, help the patient realize, with visual or audio feedback, when she is using the correct pelvic muscles or inappropriate abdominal muscles. Vaginal cones are another behavioral technique that uses weights as pelvic muscle resistive exercise training. The weights promote a proper lifting contraction in order to hold the cone in place. The cones are not only a good resistive exercise but are also used to assess pelvic muscle strength. Lastly, electrical stimulation is used to stimulate the muscles or nerve supply to the muscles. The stimulation forces muscle contraction that can eventually strengthen the muscle. These treatments are frequently used for pelvic floor dysfunctions but are also very effective in the treatment of incontinence. This will be discussed in more detail in a later chapter.

With appropriate training, muscles tend to recover their strength postpartum. Early training can correct some relaxation dysfunctions preventing weakness from occurring. Postpartum fitness programs should make these muscles and the disuse of them a top priority in their programs.⁴ If rehab is not initiated early, the physiology and length of the muscles may reach a point where rehabilitation may have little effect. Practitioners need to ask specific questions about the woman's history to identify

symptoms of relaxation, because many women accept some degree of incontinence from pelvic floor relaxation as normal.

Disuse Dysfunction

A lack of normal exercise of the pelvic muscles can lead to disuse atrophy and weakness of the muscles.¹ Lack of awareness of the muscles and their function, physical or emotional trauma, scar tissue, and sensory or motor nerve damage may be reasons why the muscles are not used. The prevalence of this dysfunction is difficult to determine, but it is estimated that between thirty to fifty percent of adult women have limited or no ability to contract the pelvic floor.³ Disuse atrophy may be asymptomatic, or problems may occur with the urogynecologic system. This dysfunction could be prevented if strengthening information regarding pelvic floor exercises was given in routine health exams to make women more aware of the muscles. According to Wallace,³ ways to increase women's awareness of the pelvic floor muscles in an attempt to prevent dysfunction include the following:

1. Teach female athletes involved in high-impact sports pelvic floor exercises and how to use the muscles on impact.
2. Teach females about the pelvic floor anatomy and muscle function in health and sex education classes.
3. Include pelvic floor exercises into adult fitness classes.
5. Assess pelvic muscle strength during routine pelvic exams.

Hypertonus Dysfunction

Hypertonus dysfunction is often labeled levator ani syndrome and can be characterized as tension or active spasm of the pelvic floor muscles causing pain or dysfunction of the urogenital system.³ The pain is poorly localized in the lower pelvic region. Specific symptoms of this dysfunction often include pelvic pain, dysmenorrhea, dyspareunia, constipation, sexual dysfunction, and frequency and urgency to urinate. Other diagnoses that can indicate a type of hypertonus dysfunction include: piriformis syndrome, levator ani syndrome, vaginismus, low back pain, and chronic pelvic pain. Injuries to the pelvic muscles from infections or disease, vaginal delivery and episiotomy, pelvic inflammation, and past surgeries can also contribute to this dysfunction.

Hypertonus dysfunction can be divided into two categories, true hypertonus of the pelvic floor muscles or hypertonus from musculoskeletal disorders.³ Pain from direct physical trauma to the pelvis, abnormal use patterns or psychogenic trauma that can lead to muscle hypertonus is classified as true hypertonus. Vaginal delivery and episiotomy as well as other gynecological surgeries can cause similar hypertonus symptoms. In avoidance of pain, muscles tense leading to a continuous pain-tension cycle. The pain cycle usually occurs due to physical trauma where muscle guarding takes place to protect the injured muscles. The injured muscles retain metabolites causing inflammation and ischemia. This results in pain, thus, creating a vicious cycle in which muscle tension causes pain that leads to more muscle tension. The body avoids the pain by decreasing activity which leads to muscle weakness.

The second category includes hypertonus from musculoskeletal disorders. This group involves injuries such as fractures to the sacroiliac joint, lumbar spine, coccyx,

pubic symphysis or injuries to the coccyx or pelvis that cause malalignment.³

Malalignment can alter the length and tension of pelvic muscles which can promote hypertonus of the muscles. Hypertonus is treated best with a wide variety of physical therapy techniques including: soft tissue mobilizations, myofascial release techniques, spinal and pelvic realignment, postural education, biofeedback, relaxation exercises, and pelvic floor exercises for strengthening. Treatment with hot and cold modalities may also help decrease pain and promote relaxation initially.

Incoordination Dysfunction

Incoordination dysfunction is classified as the difficulty of muscles to relax and contract in a coordinated fashion.³ Often, it is difficult for the patient and health care worker to classify or recognize incoordination dysfunctions, because the problem is so asymptomatic. Most often patients will complain of difficulties when voiding. This dysfunction can result from a damaged pudendal nerve or injury to the supportive musculature in the pelvic region making coordinated processes such as micturition and defecation difficult. Improper exercise techniques such as bearing down rather than lifting the muscles up, neurologic disease and the inability to isolate the pelvic muscle contraction from the abdominal contraction can cause problems. As stated earlier, this dysfunction can be treated with biofeedback and electrical stimulation to re-educate the muscles to work in a coordinated fashion.

It is important that health care providers ask pertinent questions involving pelvic floor function in routine health exams. Some suggested screening and awareness questions healthcare providers should ask are the following:³ "Do you ever unintentionally loose urine? While laughing, sneezing, coughing, jumping, or exercise do

you have trouble maintaining urine control? Are Kegel exercises included in your exercise routine? Do you have trouble controlling flatus? Are you aware of excess tension or holding of your pelvic floor muscles? Are you aware of decreased sexual feelings in the vagina, especially after childbirth?" Answering yes to any of these questions could imply some indication of pelvic floor weakness. Determining the type of dysfunction could be helpful in designing a treatment program of pelvic floor exercises. Following a comprehensive muscle evaluation an active exercise program for the pelvic floor can be started. The exercise program can prevent disuse and maintain normal muscle function.

Improvements and even total recovery may be made with any pelvic floor dysfunction. With early diagnosis and treatment, the dysfunction is easier to treat. However, it is never too late to receive treatment. A thorough history and musculoskeletal examination can assist the therapist in diagnosing the patient's specific pelvic floor dysfunction. With an accurate diagnosis, the therapist can prescribe the appropriate treatment plan.

CHAPTER IV

INCONTINENCE

Urinary incontinence is the involuntary leakage of urine resulting in a social or hygienic problem.⁵ Urinary incontinence is an universal health problem affecting an estimated 10 million adult Americans and costing an astounding 10 billion dollars a year in the United States alone.^{6,7} It is estimated that at least 8.5% of females suffer from some form of urinary incontinence.⁶ The problem is more common in women than men and has been proven to increase with age. In fact, the prevalence may be as high as 37% in elderly females. Urinary incontinence not only affects elderly women but also young and middle-aged female populations. It is very difficult to measure the prevalence of the condition, due to the varying definitions of incontinence, differences in urine sample sizes during testing, and inconsistent methods of collecting and interpreting data. In addition, few people feel comfortable discussing incontinence. "Surveys reveal that between a half to three-quarters of incontinent patients are too embarrassed to consult a doctor or nurse."⁵ Most assume that incontinence is untreatable and something that accompanies age and is unavoidable. This is untrue; in fact, approximately 80% of those experiencing incontinence can be cured or improved through treatment.⁸ Changes as simple as diet and medication modifications can cure or improve symptoms of incontinence. Treatment for this condition generally includes pelvic floor exercise, medicine, biofeedback, collection devices, and absorbent products.

As stated earlier, incontinence is estimated to cost 10 billion dollars a year in the U.S. alone.⁶ The average cost per individual, per year in special incontinence products averages between \$100 to \$365. Incontinence is a major reason for institutionalization, and is quite expensive when you consider the cost of products such as diapers, nursing time, and medications used to treat urinary infections, skin breakdown, and time consumed changing bed linens. Finding better ways to prevent and treat urinary incontinence could save millions of dollars.

Urinary incontinence not only imposes a physical impact on patients, but also affects them both psychologically and socially. The resulting emotional stress not only affects the patient but also the family, friends, and care providers. Some psychological responses to incontinence include: shame, depression, withdrawal, guilt, denial, regression, anxiety, indignation, secretiveness, fear, and preoccupation.⁶ Many patients find it difficult or embarrassing to discuss their problem with others so they begin to feel socially isolated. Some examples of common complaints include: "I can't go on trips with my family, I'm afraid I will smell of urine, I have to plan ahead so I can be near the bathroom, I don't go anywhere anymore, I'm always in the bathroom, I can't do aerobics or any sports or even dance, I always feel dirty."⁶ The smell of urine is quite strong and often implies uncleanness. Women with this dysfunction are aware of this, and withdraw from social situations in fear of smelling like urine or embarrassing themselves in front of others. Therefore, incontinence can affect a woman in all aspects of her life, both physically, personally, and with everyone she associates with.

An understanding of the anatomy and function of the female bladder and urethra is necessary to understand the normal process of continence. Various muscles, connective

tissue, and neurological structures within the pelvic floor play crucial roles in the maintenance of both urinary and fecal continence. Urine is made by the kidneys and delivered to the bladder by ureters.⁶ Once the urine is in the bladder, it is stored until it is expelled through voiding.

The micturition reflex coordinates the process of urination.⁹ The urinary bladder contains stretch receptors within its walls, which are stimulated as the bladder fills with urine. These stretch receptors send messages along afferent nerves to the sacral spinal cord, to the thalamus, and cerebral cortex where the signal is recognized as the urge to urinate at about 200ml of urine. Efferent nerves then send a message back to the bladder that stimulates contraction of the three-layered detrusor muscle that surrounds the bladder. Detrusor muscle contraction increases fluid pressures within the bladder, but urination does not actually occur until both the internal and external urethral sphincters are relaxed. Relaxation of the internal sphincter is directly controlled by the external sphincter, which is voluntarily controlled. Trauma to the internal or external sphincters may contribute to incontinence, in which you lose the voluntary control over urination.

In order for bladder and urethral function to occur one must have an intact cerebrum for all voluntary actions to occur.⁶ Voluntary actions of the cerebral function include being able to perceive a full bladder, holding one's urine, and voiding at the appropriate time. Voiding can occur without cerebral control but a person cannot have voluntary control over the process.

This chapter will focus on four main classifications of incontinence: urge, stress, overflow, and mixed. The implications of pregnancy on incontinence, and the physiology and treatment of each type will also be addressed.

Urge Urinary Incontinence

Urge urinary incontinence is the involuntary loss of urine associated with a strong abrupt urge to urinate.^{5,6} Involuntary detrusor contractions result in urinary incontinence. The bladder contracts unpredictably at relatively small volumes, resulting in urgency and having to rush to the toilet.⁵ Symptoms of urge incontinence are generally worse in the morning but the severity of symptoms varies day to day and occurs at different times of the day.

Involuntary detrusor contraction occurs for two main reasons, detrusor hyperreflexia and detrusor instability.¹⁰ Detrusor hyperreflexia is explained as an innervation abnormality, or failure to inhibit the normal reflexive detrusor contraction; whereas, detrusor instability is involuntary detrusor contractions. Bladder instability occurs in neurological patients with conditions such as multiple sclerosis or stroke. These patients cannot sense urgency, therefore; incontinence occurs due to involuntary detrusor contractions.

Treatment of Urge Incontinence

Treatment for urge incontinence begins with educating the patient on her condition and her choices of treatment.⁵ Most often treatment involves a combination of treatment options including bladder training or habit retraining, medications, biofeedback, exercise, and surgery. These treatment options are not only used to treat urge incontinence, but combinations of them are used to treat the other three types of incontinence. Treatment should begin with the least invasive method and surgery should be considered a last resort.

Bladder training or habit retraining is a technique used to promote behavior modification to help alleviate urgency and frequency. The goal of this technique is to increase bladder capacity or prolong the time between voiding. This method involves scheduled toileting where the time between bathroom trips is gradually increased. A success rate of 60 percent has been reported in patients with bladder instability that undergo habit retraining.⁵ Habit retraining involves a baseline assessment to determine the most likely times for incontinence to occur. Next, the program defines specific objectives such as determining the symptoms that affect the patient the most. After objectives have been defined a plan of intervention is developed. This can include changing the patient's routine, drinking more fluids, or using the toilet more frequently throughout the day and at particular times of the day. Once a patient can maintain dryness by using some of the techniques, she will then try to extend the amount of time between toileting. The final step in habit retraining is evaluating the effects of training.

The success of treatment ultimately relies on the patient's ability to re-learn the process of inhibiting the detrusor muscle contraction, which is normally an unconscious task.⁵ Sometimes having a patient schedule her fluid intake can help her control symptoms. Charting often shows consumption of tea or coffee, which act as diuretics and promote incontinence. Also, most people tend to think that decreasing fluid intake would decrease the occurrence of incontinence; however, the opposite is actually true. Decreasing fluid intake does decrease the volume of urine but the urine then becomes more concentrated, which is irritating to the surface of the bladder, and increases the occurrence of urination. Bacteria thrives more in concentrated urine, causing infections

that can promote incontinence. Therefore, increasing fluid intake, particularly water intake can actually help relieve incontinence.

Advances in drug therapy have helped control symptoms of urinary incontinence. Sometimes taking a patient off a drug that may contribute to incontinence can improve patient's symptoms. Pharmacological treatment includes: anticholinergic drugs, beta sympathomimetic agonists, musculotropic drugs, tricyclic antidepressants, and dopamine agonists that attempt to relax the detrusor muscle.⁵ Imipramine, terodiline, and oxybutynin are three different drugs that are used commonly to control frequency and urgency. These drugs act by blocking acetylcholine receptors. Acetylcholine is a neurotransmitter that stimulates muscle contraction. All three drugs act by blocking the actions of acetylcholine, which helps alleviate unwanted detrusor muscle contraction that causes urgency and frequency.

Biofeedback is another treatment option used in complicated cases that tries to improve cortical control over bladder activity. This technique is also used with patients that have weak pelvic floor contractions. Patients with weak pelvic floor muscles often recruit accessory muscle groups such as the abdominals, gluteals, and adductors when they attempt to contract voluntarily.¹¹ Biofeedback is a therapeutic technique that helps teach pelvic floor exercises by reinforcing the use of appropriate muscle groups and inhibits the use of inappropriate muscle groups to make the pelvic floor stronger. Biofeedback uses surface electromyography (EMG) electrodes that are placed on the patient to help them isolate and contract the pelvic floor muscles while relaxing the accessory muscle groups. Biofeedback has been shown in previous experiments conducted by Burgio, Robinson and Engel,¹¹ to decrease episodes of incontinence by

82%. Lastly, surgical procedures can be completed to regain bladder function. All non-surgical treatments should be tried before deciding on surgery. Bladder denervation is one procedure that can be done to improve urge incontinence. With this technique they cut the innervation to the detrusor muscle to decrease hyperactive detrusor contractions.

Stress Urinary Incontinence

Stress urinary incontinence is the involuntary loss of urine occurring with simple activities such as laughing, coughing, sneezing, lifting, or sudden movements that increase intra-abdominal pressure.^{5,6} This occurs when sphincters or pelvic muscles have been damaged. This should not be confused with genuine stress incontinence, a diagnosis given to patients who have leakage even without an increase in bladder pressure. Stress incontinence is the most common type of incontinence with rates ranging from 15-52% of the general population.⁷ Stress incontinence is the primary type of incontinence that affects elderly women. Childbirth can also promote weakness of the pelvic floor, and may encourage stress incontinence. Women may not always experience the effects of a weakened pelvic musculature from childbirth until later in life. Symptoms usually become more noticeable after menopause due to hormonal changes and pelvic floor relaxation that occurs with the aging process.

When the bladder is subjected to external pressures such as laughing or sneezing, the bladder pressure can exceed the urethral pressure and incontinence can occur.⁵ It is difficult to distinguish between stress and urge incontinence; therefore, a thorough medical history and evaluation is key in determining the correct treatment.

There are many causes of stress incontinence that can weaken or damage the pelvic floor or urethral sphincters.¹² Overall weakness of the pelvic floor muscles,

pregnancy, damage from childbirth, genetic factors that result in weakened connective tissue, persistent chronic cough usually from smoking, and excessive abdominal fat all can increase intra-abdominal pressure and cause stress incontinence.

Treatment of Stress Incontinence

Treatment for stress incontinence may include medical therapy, physical therapy, intravaginal devices, and surgical therapy.⁵ After menopause decreases in estrogen can cause thinning of the estrogen-sensitive outer third of the urethra making it difficult to maintain closure. Estrogen replacement can be prescribed to help increase urethral closing pressure and improve incontinence.

Physical therapy promotes pelvic muscle exercises (Kegel exercises), as well as postural corrections, to help improve the pelvic floor's muscular tone. Correction of pelvic abnormalities, strengthening of the lower abdominals, and correction of muscle imbalances between the trunk and hip musculature can increase strength of the pelvic floor.¹ In addition, every woman's health care routine should include pelvic floor exercises, not only those who experience stress incontinence. These exercises help improve pelvic muscle strength so they are able to support the urethra especially during increased abdominal pressure.

A large number of women are not instructed on how to perform Kegels exercises initially, so they end up doing them wrong, which can only make their symptoms worse.¹ When performing the exercise correctly, the pubococcygeus muscle should be the only muscle contracting. Instead of isolating just the pubococcygeus muscle they use their abdominals, thighs, and/or buttocks at the same time. Using accessory muscles can actually do more harm, and can actually increase intra-abdominal pressure making the

problem worse. The correct way to perform Kegel exercises are to squeeze the pubococcygeous muscle, which is the muscle used to stop urine. Hold the contraction for a count of three, and then relax for a count of five. The goal is to hold for a count of ten and to complete five sets, three times a day. It takes approximately six to eight weeks to notice results.

Intravaginal devices, such as weighted cones, are also used to strengthen the pelvic floor muscles.⁵ The patient must contract the proper pelvic muscles to maintain the weighted cones placement and thus increase strength. Weighted cones have been shown to produce positive results and progress can be charted easily. Throughout treatment the patient gradually increases the weight of the cones. Once the patient is able to place the cone in the vagina, stand up, and retain the cone for a certain amount of time they can then increase the weight of the cone, thus demonstrating improved muscle tone. If conservative treatments such as medical therapy, pelvic floor exercises, and intravaginal devices cease to produce positive results, surgery may be performed to improve pelvic floor strength.

Stress urinary incontinence is often treated successfully through surgical procedures. There are several surgical approaches and the following are some of the most frequently performed. One of the most common surgeries is the pubovaginal sling.¹³ A sling is made from a strip of fascia to form around the urethra and sphincter muscles to increase support of the pelvic floor. Another similar operation is the rectopubic operation in which tissues from the urethra are connected to the pubis forming a sling, much like the previous procedure. The vaginal operation is another technique that uses tissues gathered from both sides of the urethra and pulls them underneath the urethra

to provide more support. Mechanical devices can also be used to replace weak sphincters and lastly, as a short-term solution, periurethral injections can be made into the urethra to improve compression of the sphincter.

Overflow Incontinence

Overflow incontinence is the term used to describe the bladder when the quantity of urine produced exceeds the bladder's holding capacity and urine eventually leaks.⁵

Overflow incontinence is the loss of urine caused by poor bladder emptying that eventually leads to detrusor muscle weakness. Over time the detrusor muscle becomes stretched out and weak, making it difficult to contract and completely empty urine. As the bladder fills, the pressure begins to rise until it reaches a point that is greater than the urethra pressure and urine begins to leak. Symptoms of overflow incontinence include: difficulty voiding, constant dribbling, frequent urge to urinate, or a weak stream of urine.

Detrusor areflexia or a hypotonic bladder may be possible causes of overflow incontinence.⁵ A hypotonic bladder means the bladder muscle has decreased muscular tone, which makes contraction of the bladder difficult. Decreased bladder muscle tone can occur from diabetes, pelvic trauma, pelvic surgery, spinal cord injuries, multiple sclerosis, or polio. Also, innervations to the detrusor muscle can be damaged from pregnancy and labor or a diabetic neuropathy induced by pregnancy. Overflow incontinence may also occur when something obstructs the outflow of urine. A patient may have an obstructive disorder if they have a poor stream, must strain when voiding, retain urine, or are unable to empty the bladder completely.

Treatment of Overflow Incontinence

The management of urinary retention is different from stress and urge incontinence, so it is very important that the condition is diagnosed correctly.⁵ Anti-cholinergic agents that are used to treat urge incontinence are contra-indicated, and instead drugs that facilitate bladder emptying are indicated. Drugs such as cholinergic agents, that increase the power of the detrusor muscle contraction, and alpha-1 adrenergic blockers that help the urethral sphincter relax are used to help reduce retention.

Mixed Incontinence

It is not unusual for patients to experience a combination of the different types of incontinence.⁶ Most patients will experience a combination of urge and stress incontinence. The cause can vary for each type and can involve dysfunction of the bladder, urethra, or both. For this reason, a thorough medical history and complete physical evaluation is important in determining the appropriate treatment. The type of incontinence that is most dominant is treated first by methods described earlier with stress and urge incontinence.

Implications of Pregnancy

Pregnancy, and more specifically vaginal birth, have been shown to cause injury to the pelvic floor muscles and their innervations, which can eventually lead to urinary incontinence.¹⁴ Among all four types of incontinence, stress urinary incontinence has consistently showed the strongest association with childbirth. During pregnancy incontinence is very common with an estimated prevalence between 30-60%.⁷ Stress urinary incontinence results most likely from the trauma to the pelvic floor during delivery. Many anatomic changes such as alterations in connective tissue, increased

pressure on the uterus, and increases in the production of progesterone which causes relaxation of smooth muscle may all promote stress incontinence.¹⁵ Stress incontinence can often become worse after giving birth, but a women rarely experiences incontinence for the first time after delivery. A study conducted by Foldspang et al,¹⁴ added to the existing evidence suggesting a strong association between urinary incontinence and vaginal birth. This study focussed on the possible role the processes during delivery (forceps delivery/vacuum extraction, episiotomy, and perineal suturing) had on incontinence. They found that episiotomy and perineal suturing correlated to urinary incontinence immediately following childbirth. They were unable to find a correlation with forceps delivery/vacuum extraction at that time. They found the strongest predictor of urinary incontinence after childbirth to be urinary incontinence during pregnancy. Overall, there are several reasons vaginal delivery may cause stress incontinence such as connective tissue injury, mechanical disruption of the muscles and sphincters, and denervation of the nerves serving the pelvic floor muscles that become stretched during birth.¹⁵

Vaginal birth has been linked as a strong predictor in the development of urinary incontinence, as well as, associated with a decrease in pelvic floor strength by as much as 22% to 35% between pregnancy and the postpartum period.¹⁶ Sampsel et al,¹⁶ studied the effect of pelvic muscle exercise on incontinence symptoms and pelvic muscle strength in primiparas through 12 months postpartum. The pelvic floor exercise protocol included strengthening exercises performed 30 times a day, at maximum to near-maximum intensity. Results demonstrated that pelvic muscle exercises lead to less self-reported incontinence in late pregnancy, and benefits in their continence status up to six

months after giving birth. They also found that the pelvic floor exercises done pre-birth helped rehabilitate the pelvic floor more quickly after birth and that women's strength seemed to return earlier in the groups who performed the exercise protocol. They also found that women with stronger pelvic muscles initially, were less likely to experience incontinence symptoms. Another possible explanation for decreased symptoms was that the pelvic muscle exercises actually increased the women's awareness of the muscles so they increased the use of the muscles therefore increasing their strength.

Results from the previous studies have proven that teaching pelvic muscle exercises both pre and postpartum should be implemented in pre and postpartum classes to help decrease potential incontinence problems. Performing pelvic floor exercises throughout pregnancy and the postpartum period will not only help maintain pelvic muscle strength, but also help regain the strength sooner after delivery, and decrease the chances of incontinence later in life.

As stated earlier incontinence is a world wide problem that needs to be addressed. The subject cannot be avoided because too many people experience incontinence. To determine the course of treatment, physicians must assess the overall physical condition and age of the patient, their medical history, and the severity of the incontinence. Depending on the patient's condition the physician can then determine the correct course of therapy.

Physicians and other health care workers need to receive continuing education on this condition. Considering most patients claim they are unwilling to bring the subject up voluntarily, health care providers need to promote open discussions with the assistance of health screenings. Keeping in mind the increasing numbers of aging adults, this topic

should not remain a taboo subject. Ongoing education of the health care community and the overall population would promote preventative measures, as well as earlier diagnoses, ultimately costing our nation less dollars.

In addition, preventive measures such as earlier education in health education courses, sports, and exercise classes could help promote the importance of pelvic floor exercises, increase the understanding of the anatomy, and possible causes of incontinence; thus, decreasing occurrences. Educating patients that the condition does not have to be an inevitable part of aging and that symptoms can be relieved with treatment are important messages that need to be sent out to the general population.

CHAPTER V

EPISIOTOMY AND CESAREAN SECTION SCARS

The use of cesarean sections and episiotomies have become a large part of the birth experience.¹⁷ Many physicians feel these procedures protect the lives of mothers and infants, as well as decrease injury to the mother during delivery. This is true; however, these procedures are being overused and can lead to many problems for the mother in the future, if not addressed right away.¹ The scars from these procedures can lead to painful adhesions that promote poor posture, decreased mobility and many other musculoskeletal problems.

Management of scars is a prime area of focus in obstetrical and gynecological physical therapy. Scar tissue can cause pain and dysfunction both locally and to referred areas of the body. Women who have had an episiotomy or cesarean section need to be aware of the potential problems that may occur in the future. Physical therapists understand basic principles of connective tissue and muscle tissue physiology, in addition to the process of soft tissue injury and repair, and can use this information to help treat scars.

In order to treat a scar effectively, it is important to understand the basic process of wound healing. The process of wound healing has three stages: the inflammatory phase, fibroplastic phase, and the remodeling phase.¹⁸ The inflammatory phase cleans up debris and prepares the wound for healing. Inflammation lasts approximately 24-48 hours and is completed in approximately two weeks where the fibroplastic phase then

begins. The fibroplastic phase, also known as the proliferative phase, is where rebuilding of damaged tissues begins and strength of the scar is increased. This stage continues throughout the process of healing. The final stage of healing is the remodeling phase, or maturation phase, where the immature scar becomes mature. It takes approximately 2 to 4 weeks to reach this stage of healing depending on the wound. Changes in the scars bulk, form, and strength occur in this phase as the scar matures.

Soft tissue mobilization is a technique performed by therapists on scars to maximize the repair process, promote tissue healing, and restore function of the tissue and the surrounding area.¹⁹ Soft tissue mobilization is defined as the manual technique that uses physical forces to improve tissue healing by encouraging circulation of fluids and stimulating mechanoreceptors to help control pain. Two specific populations of women who can benefit from soft tissue mobilization are those who have had an episiotomy or a cesarean section. This chapter will focus on defining an episiotomy and cesarean section, as well as evaluation and treatment options for both procedures.

Episiotomy

An incision that is commonly cut to enlarge the birth outlet and decrease the stretch on the perineal tissues is called an episiotomy.¹ A midline or mediolateral incision is made through the perineal tissue around the time the baby's head is crowning. Episiotomies are the most common obstetrical surgery, and are performed to minimize stretching and nerve damage, prevent perineal tears, reduce compression of the baby's head, and facilitate delivery during second stage labor. Many women heal quickly after an episiotomy or tearing and will not require treatment; however, some women do experience problems with scar tissue formation. An episiotomy or tear that requires

stitches will leave a scar that can produce both local and referred pain and dysfunctions if not treated appropriately.

Perineal lacerations can be classified as first, second, third, or fourth-degree lacerations. An episiotomy by definition is at least a second-degree laceration.¹ A first-degree laceration affects the skin and vaginal mucous membrane of the perineum. In a second-degree laceration, the underlying muscles of the perineal body are damaged. The more severe, third degree laceration extends into the anal sphincter. Finally, a fourth degree incision extends into the anal sphincter and through the rectal mucosa, where the lumen of the rectum is exposed. Perineal massage, performed before delivery, may help a woman decrease her chances of sustaining a tear during delivery.

Swelling and bruising from an episiotomy can cause a lot of pain; therefore, after delivery different modalities can be applied to decrease pain. Ice, cold baths, warm baths, and ultrasound are several therapies that can be used to decrease acute pain.¹⁷ Acutely, the mother is encouraged to spend time resting in bed, to help elevate the injured tissue and decrease edema. Ice is applied immediately after delivery, and pelvic floor exercises are taught to increase circulation, decrease edema, and begin to increase strength of the pelvic floor. The exercises help to prevent incontinence, painful intercourse, and constipation that can occur in the future. The new mother is also encouraged to wear close fitting underwear to ensure placement of a pad that decreases rubbing against the incision. Electrotherapy can be applied to decrease pain, and proper defecation techniques are also taught to avoid stress to the wound. The laceration generally heals in 5-7 days, where an evaluation of the scar can then be performed.

Since the most common obstetrical surgery is the episiotomy, it would make sense that most scars seen in the perineum are from episiotomies.¹⁷ Most women will not have problems with scar adhesions, however some will. Most commonly, patients will notice pain with intercourse, difficulty inserting a diaphragm or tampon, soreness between the vagina and rectum and discomfort with bowel movements if they have adhesions. If left untreated, the scar can result in pain and weakness of the pelvic floor that often can result in pelvic floor dysfunctions. Physical therapists that specialize in woman's health are trained to treat women who have these specific dysfunctions.

Evaluation of the perineal area includes history taking, observation, and palpation with special attention to the perineal body and posterior vaginal wall. According to the Gynecological Manual,¹ commonly asked questions in an evaluation include; 1) Was an episiotomy performed? 2) Where forceps used? 3) Did tearing occur? 4) What degree of lacerations occurred? 5) Is pain constant? 6) Is pain present with intercourse? These questions help the therapist determine the degree of trauma and the stage of soft tissue repair, which is helpful when establishing the appropriate treatment approach. Prior to massaging the scar, the therapist needs to observe and document the characteristics of the scar, the patient's skin integrity, and any redness or edema surrounding the area. The scar's mobility, extensibility, and density should also be documented as well as trigger points that are found around the scar. The goals of scar mobilizations for perineal scars are to decrease pain, increase healing, increase extensibility of tissues, and for the patient to return to activities of daily living pain free.

Scar mobilizations can be performed by the therapist, by the patient, or by the patient's partner. Scar mobilizations that are performed by the therapist are done in a

hook-lying position.¹ The therapist dons gloves and uses the index finger to find trigger points. Trigger points can be recognized by the feel of the tissue, which is more resistant and hard, and the patient will usually give feedback of pain when on the trigger point. Gradually, the therapist works from the superficial tissue to deeper structures, where deep stationary pressure or friction massage at right angles can be applied. The therapist then moves slowly back and forth over the point without sliding over the skin. (See Appendix A, figure 4) One to three minutes should be spent on each trigger point and the entire length of the scar should be covered. Treatment time will vary and depends on the patient's pain tolerance. The goal is to increase treatment time with each session, and work up to twenty minutes. Heating modalities such as hot pack and ultrasound can be used prior to treatment to decrease pain, stimulate tissue regeneration and soft tissue repair, increase extensibility, and increase blood flow to increase the effectiveness of massage.

Perineal massage can be done by the patient at home as well. The self perineal massage can be done in many positions such as half seated, half kneeling, standing with one leg up on a stool, or in the side lying position.¹ The patient uses her two index fingers or thumbs to perform the massage, just as the therapist does, and should perform the massage daily. Sometimes it may be hard for the patient to reach the perineal area to perform the massage efficiently, or it may be difficult for them to afflict pain on themselves. For this reason, partner perineal massage may be helpful. It is important that the partner come to therapy to be instructed on the massage technique.

A new mother who has undergone an episiotomy should be educated on treatment options immediately. If the scar is treated effectively in a timely manner, the risks of

potential problems in the future are diminished. A physical therapist can educate the patient on potential risks and teach the patient how to treat the scar at home.

Cesarean Section

Cesarean section has been reported to be the most frequently performed major surgical procedure since 1985.²⁰ The surgical procedure may be an elective procedure or performed in an emergency. Approximately one third of the cesareans performed are elective. There is a saying that states once you have had a cesarean you will always have one, but this is untrue. In fact, the College of Obstetricians and Gynecologists²⁰ stated that 80% of women who give birth by cesarean could deliver vaginally the next time but instead only about 25% do.

There are many reasons for which a cesarean may be performed. For instance, if the mother has a systemic dysfunction, such as high blood pressure or diabetes, or if the mother's health is in danger then a cesarean is indicated.²⁰ Dangerous uterine conditions, as well as fetal distress and failure to progress are other indications which prompt a cesarean section.

A cesarean section is a surgical technique where the baby is delivered from an incision through the uterus and abdomen instead of the vagina.²⁰ The transverse incision is usually made through the lower uterine wall. A woman who delivers her baby with a cesarean section will have many of the same problems that accompany a major abdominal surgery or a vaginal delivery. The same changes occur to the uterus, pelvic floor and urinary system as do with a vaginal delivery, except the physical recovery is traditionally longer.²¹ Early treatment begins in the first 12-18 hours by getting the mothers up and walking to increase intestinal mobility, decrease muscle stiffness and

prevent deep vein thrombosis. Initially, post-cesarean mothers tend to have a forward, slouching posture to protect the abdominal incision. Physical therapists must promote good posture in the very beginning to avoid poor posture problems later on. One way to prevent poor posture is to teach the mother how to splint her incision correctly. Splinting can be accomplished by overlapping the hands over the incision, or by placing a pillow over the incision to make the area feel more secure. Activity should also be emphasized to increase circulation and promote healing to the injured area. A post-cesarean exercise program usually includes breathing exercises, abdominal and pelvic floor exercises, as well as general conditioning. Proper training on posture and body mechanics are also crucial to avoid future injury.

A cesarean section is a major surgery and the abdominal incisions need to be addressed because abdominal scars affect many areas of the body.¹ These scars play a large role in pelvic dysfunctions that may occur later on and for this reason must be treated effectively in the beginning. This section will explain several scar massage techniques that can be used to prevent future dysfunctions.

Abdominal scars can be treated effectively with scar mobilizations. In order to treat the scar effectively assessment of the scar mobility, extensibility, and pain needs to be completed initially.¹ The goals of scar mobilizations in the abdominal area are to decrease pain, increase extensibility and mobility of the scar, regain or maintain normal mobility of the pelvic organs, maintain full trunk range of motion (ROM), maintain full strength and ROM of the iliopsoas muscle, and encourage normal posture.

The techniques of abdominal scar mobilizations are similar to perineal massage that has already been described previously. Prior to performing therapy on the scar all

scabs should have fallen off naturally, and the wound should be free of infection and any seepage.¹ Massage can generally be initiated two weeks after surgery. Once the patient feels comfortable with the massage techniques they can perform them on their own at home. The patient should start gently and progress to a deeper and stronger massage as they tolerate. A light burning or pulling sensation is often felt but the patient should never feel a sharp stabbing pain. The finger pads should be used and the massage should last 5-15 minutes and be performed daily.

There are four main massage techniques that work well with abdominal scars.¹ These techniques are desensitization, push and pull, skin rolling, and plucking. (See Appendix A, figure 5) Desensitization is a technique used initially to help decrease sensitivity of the scar. With this technique a wet towel is rubbed across the scar in all directions and if tolerated the patient can perform the same procedure using a dry towel. Once the patient can tolerate this technique they can move to the push and pull technique. This technique uses two fingers to grab the scar directly. The scar is pulled up, down, and then to the right and left, and each position is held for 1-2 minutes. A pulling sensation is normal but a sharp pain should never be felt when applying this technique. Two to four weeks after surgery skin rolling can be initiated. With skin rolling, the skin is pinched on either side of the scar and pulled up. The scar is moved in a forward and backward motion while rolling and raising the scar as movement is made along the length of the scar. This technique begins to treat the three-dimensional aspect of the scar and break the adhesions that bind the scar to surrounding soft tissue. At approximately four to eight weeks after surgery, the plucking technique can be started. With this method the index finger and thumb pick up the scar and separate it from the other tissues. Once the scar is

separated, the fingers roll back and forth and progress from the edge of the scar to the center. A scar that is stuck will dimple inward, while a scar free from adhesions will bulge upward.

Scar mobilization is an effective way to treat both abdominal and perineal adherent scar tissue. In conjunction with massage and modalities, proper posture training should be implemented, because a flexed posture will promote shortening of the scar tissue. Physical therapists can help decrease the incidence of future dysfunctions with treatment and education that the mother can actually do for herself at home.

CHAPTER VI

MUSCULOSKELETAL PROBLEMS

Pregnancy and delivery can create anatomical and physiological changes in a woman's body. Changes that increase a woman's susceptibility to musculoskeletal problems include: postural changes, ligament laxity, weight gain, fluid retention, structural bony changes, abdominal weakness, and pelvic floor weakness. Weight gain and elevated levels of the hormones relaxin and estrogen tend to promote ligament laxity, which makes joints more mobile and more susceptible to injury.²² Consequently, the disruption of joints and muscles, and the associated biomechanics, causes painful musculoskeletal dysfunctions. Musculoskeletal dysfunctions include, but are not limited to: sprains, strains, degenerative conditions, abnormal strength, and flexibility.⁴ Common complaints that occur due to musculoskeletal imbalances are: low back pain, sacro-iliac pain, sciatica, coccydynia, costal margin pain, neck pain, headaches, and pubic symphysis pain. This chapter focuses on bony and muscular changes that can occur in the postpartum period. Posture, abdominal strength, anatomical changes in hip and pelvic alignment, as well as sprains and fractures to the bony pelvic structures and connective tissue, can all contribute to musculoskeletal problems.

Posture

Postural changes that occur due to pregnancy play a crucial role in musculoskeletal dysfunctions. During pregnancy a typical posture includes a forward head, rounded shoulders, protruded belly, anterior tilted pelvis, increased lumbar curve,

hyperextended knees, and flattened feet.⁴ (See Appendix A, figure 6) In fact, chronic pelvic pain has been observed with non-pregnant patients who have a lordosis or a kyphosis-lordosis posture, which is the same posture pattern associated with pregnancy.

Musculoskeletal dysfunctions that result due to the poor posture include: shortening and hypertonus of the iliopsoas muscle and external hip rotators, lengthening of the iliofemoral ligaments and anterior capsule of the hip, stretching of the abdominals, sacroiliac strain, and hypermobility of the thoracolumbar facets.⁴ It is not uncommon for many of the previously mentioned dysfunctions to refer pain to the low back and pelvis. Postural changes such as an increased lumbar lordosis that occurs in pregnancy can contribute to low back pain. To maintain their center of gravity, pregnant women have a tendency to lean back over the pelvis to compensate for increased abdominal weight. The increased lumbar lordosis can increase the shearing pressure on the vertebral disc; therefore, increasing the chances of disc herniation

Back pain may not always originate in posterior structures, but instead may be referred from anterior structures.⁴ For example, shortening and increased tone in the anterior hip muscles can refer pain posteriorly to the low back and to the pelvis. Another example is when untreated abdominal scars adhere to abdominal contents altering the normal tension of the abdomen, also referring pain to the low back. For this reason, it is important that a physical therapist perform a thorough evaluation of both anterior and posterior structures.

During the initial evaluation, the therapist must first determine if the pain is muscular, skeletal or discogenic.⁴ A rehabilitation program can then be prescribed to treat the particular structure that is involved. To restore muscle function and normal skeletal

alignment, therapists can perform mobilization and myofascial techniques. Physical therapists also instruct patients on stretching, strengthening, and lumbar stabilization exercises. They also educate patients on proper posture and body mechanics to regain and maintain normal alignment of muscular and skeletal structures to improve posture.

Correction of poor posture plays a significant role in the treatment of incontinence and can relieve referred pain from musculoskeletal dysfunctions. The pelvic floor functions best when it is in correct anatomic position.¹¹ Kyphosis, scoliosis, unequal leg length, and muscle imbalances of the hips and pelvis can alter the position of the pelvis and cause problems. Muscles that are tight may tilt the pelvis anteriorly or posteriorly, and must be stretched to regain normal alignment. Once a muscle is stretched, its antagonist must be strengthened to maintain normal length and strength. For example, a kyphotic posture can lead to an anteriorly rotated pelvis because the abdominals become slack. In order to address this problem, a therapist could use postural exercises to reduce the kyphosis and must then strengthen the abdominals to regain normal alignment of the pelvis. Other areas of the body that can be strengthened to improve posture are the upper, mid and low back and buttocks.

The hips are another area of concern in the postpartum period. Posture during pregnancy can change the mechanics of the hips.⁴ In order to accommodate for an enlarged abdominal cavity during pregnancy, the ilium rotate posteriorly and flare outwards. External rotation of the hips accompanies an outflare of the ilium. Often the hips are in external rotation throughout pregnancy, and in turn lose internal range of motion of the hips in the postpartum period. A loss of internal rotation of the hips has been associated with pelvic pain as well as low back pain. Special attention must be paid

to postpartum stretching of hip musculature to prevent chronic stiffness that may develop after pregnancy.

Abdominal strength plays a crucial role in maintaining correct posture and also aids in maintaining intra-abdominal pressure.^{4,11,15} The abdominals assist in stabilization of the trunk and work together with the levator ani to support the pelvic floor. During pregnancy the abdominals are weakened from sustained stretching and an excessive anteriorly tilted pelvis.⁴ If the abdominals are weak and relaxed, posture is affected, and the abdominals are unable to maintain equilibrium that is necessary to distribute the intra-abdominal pressure. Unequal distribution of intra-abdominal pressure can cause increased pressure downward on the pelvic floor, which eventually can cause weakness of the pelvic floor muscles and connective tissue.¹¹ Thus, proper instruction on abdominal strengthening should be included in the postpartum exercise routine. The patient should be screened for diastasis recti, a condition that occurs after delivery in some women, before initiating an abdominal routine.

Diastasis Recti

During pregnancy the abdominals can become so strained that the rectus abdominis can separate.^{4,17} Diastasis recti is the medical term given when the rectus abdominis, an abdominal muscle, separates between its two muscle bellies. The rectus abdominis muscle runs right down the center of the abdomen and is composed of two muscle bellies that have a slight separation between them. The linea alba joins the two muscle bellies of the rectus and is directly affected when separation occurs. Throughout pregnancy abdominal weakness, weight gain, hormonal changes, poor posture, and body mechanics can cause the rectus to separate more than normal. Diastasis recti promotes

abdominal weakness, and needs to be addressed in treatment in order to regain abdominal strength.^{11,15}

The severity of the separation can be assessed very easily by the patient or a therapist. (See Appendix A, figure 7) The patient lies flat on her back with knees bent.²¹ She then raises her head and shoulders off the mat to get an abdominal contraction. If a bulge appears in the center of the abdomen, it is a positive indication that the rectus muscle has separated. The therapist using two fingers, places their fingers at the level of the umbilicus and pushes down between the two muscle bellies. The separation is tested two inches above and below the umbilicus also. A separation of more than two finger widths indicates the need for proper instruction on abdominal strengthening prior to returning to a normal abdominal workout.

To begin exercises for the separation, the woman criss-crosses her hands across the abdomen to approximate the diastasis recti.²¹ A sheet or towel can also be used in a criss-crossed fashion to perform the exercise. Small curl-ups to the front, left, and right, in coordination with pelvic floor contractions, can increase abdominal strength while approximating the rectus muscle. Leg slides can also be completed to decrease the separation with the help of a sheet or towel to increase abdominal strength safely. (See Appendix A, figure 8)

Pubic Separation and Sprains

Hormonal and biomechanical changes that occur during pregnancy can cause the pubis symphysis to separate, especially during labor and delivery.⁴ If this problem is overlooked it can lead to chronic lower abdominal discomfort, low back pain, and possibly tension myalgia in the hips and pelvic floor in the postpartum period. Abnormal

superior/inferior separation of the pubis may also occur with strain or adaptive shortening of the hip adductors from acute trauma or long-term adaptive shortening. Other dysfunctions such as unilateral pelvic floor tension, sacroiliac dysfunction, and other gynecologic and psychological problems can produce unwanted strain on the pubis symphysis. A patient with a separated pubic symphysis may have a painful gait with an externally rotated hip and ilial outflare. Severe pain in the symphysis pubis and sacroiliac joint may be described by the patient, as well as reports of bloody urine from injury to the bladder neck and uterus.²¹ The area will also be very tender to touch and movement may be noticeable with weight shifting.

Physical therapists can perform muscle energy techniques to reduce the amount of strain on the compromised pelvis and decrease the amount of separation.¹ Meanwhile, to reduce the amount of strain on the pelvis, one should avoid using stairs in a step over step fashion, avoid widely separating the legs, bouncing, or one-legged activities.¹⁷ In order to reduce the amount of strain placed on the pelvis, patients can be taught to roll with their legs together and to avoid active contractions of the abdominals throughout the day. Hot and cold modalities, as well as a tight pelvic binder to decrease movement of the pubis symphysis, can be used to decrease pain.

Sacroiliac Sprains, Strains, and Displacements

During pregnancy and pre-menstrual periods, hormonal changes can relax sacroiliac (SI) ligaments.²³ Relaxation of ligaments can cause instability and lead to innominate rotations of the pelvis. Trauma from labor and delivery, repetitive strain due to faulty posture or falls on the ischium may sprain or displace the sacrum from the ilium. Muscles connected to the ilium, that have increased tone, can also cause rotations of the

ilium in relation to the sacrum. In addition, sacroiliac dysfunctions can alter the alignment of the pubic symphysis and separation can occur.

Tests to evaluate the SI joint include measuring leg lengths, sacral movement, ligament laxity, pelvic alignment, and palpation of musculoskeletal structures. Patients can experience referred pain to the posterior thigh and leg, ventral surface of the foot, and pelvic floor with SI injuries.²³ Therapists often use mobilization and muscle energy techniques to regain normal alignment of the ilium in relation to the sacrum. Once normal alignment is restored between the structures, strengthening and modalities can be initiated.

Coccydynia

The coccyx is a small bone that is attached to the end of the sacrum. The coccyx can be injured through direct trauma from a fall on the buttocks or during labor.¹ The coccyx can be fractured or sprained when a woman delivers a baby supine on a hard surface. The hard surface can limit normal sacrococcygeal extension that attempts to increase the diameter of the birth canal during labor. A fractured or sprained coccyx often refers pain to the low back and pelvic floor causing length and tone changes of the pelvic floor muscles. There is only so much one can do for a fractured bone, especially the coccyx since it cannot be immobilized. Physical therapists, however can aid in the recovery process by educating patients on how to sit and stand properly to avoid pain with an injured coccyx. They can also utilize soft tissue mobilization, massage, and myofascial techniques to help restore normal movement and decrease pain.

Pregnancy increases a woman's susceptibility to musculoskeletal injury due to increased weight gain, ligament laxity, postural changes, fluid retention, structural bony

changes, abdominal weakness, and pelvic floor relaxation. New mothers must be educated about possible dysfunctions that may occur. Being aware of possible dysfunctions and possible treatments that are available could help eliminate, if not decrease, the occurrence of some of these dysfunctions. Physical therapists are trained in treating all of the changes and can be very effective in the treatment of musculoskeletal dysfunctions. Therapeutic exercise as well as stretching, strengthening, posture training, joint mobilizations, massage, myofascial release, biofeedback, and external supports are all therapeutic interventions that can be utilized to relieve all associated musculoskeletal dysfunctions.

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 woman'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.

We feel that 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

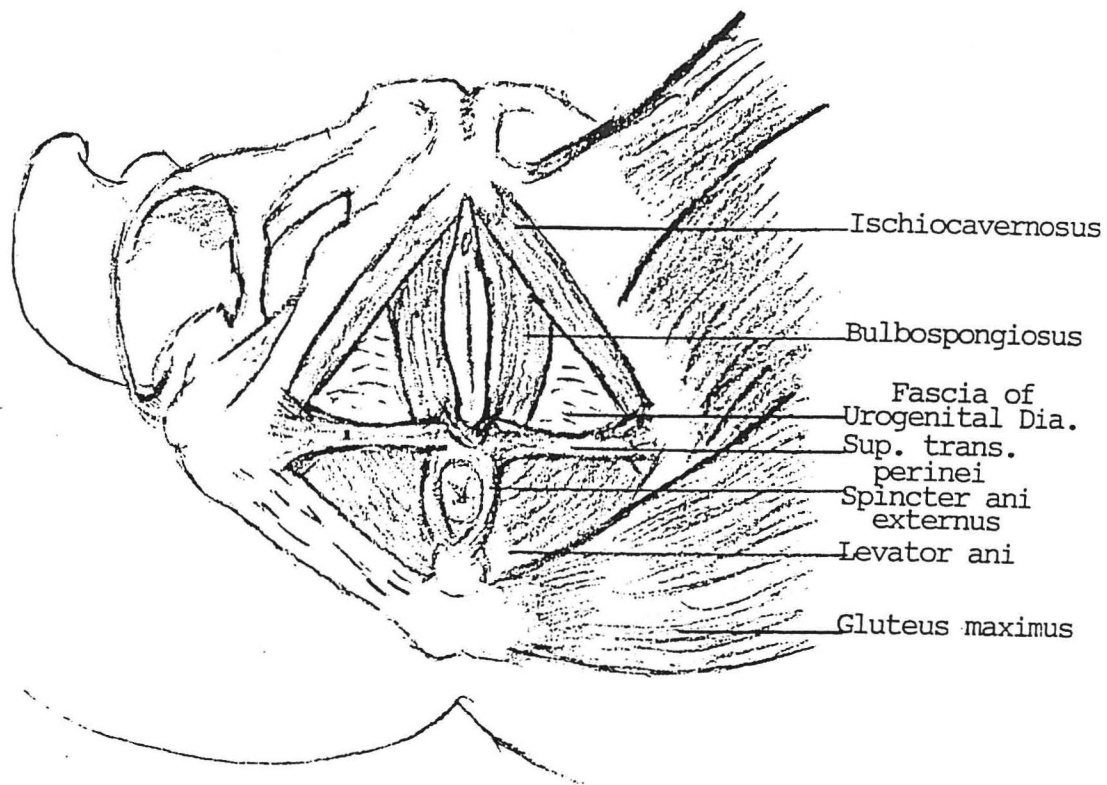


Figure 1. Superficial layer of the urogenital triangle. From Salentiny RJ. *Mechanical Biofeedback for Treatment of Female Urinary Incontinence*. Thesis (M.P.T.)—University of North Dakota, 1997:9.²⁴

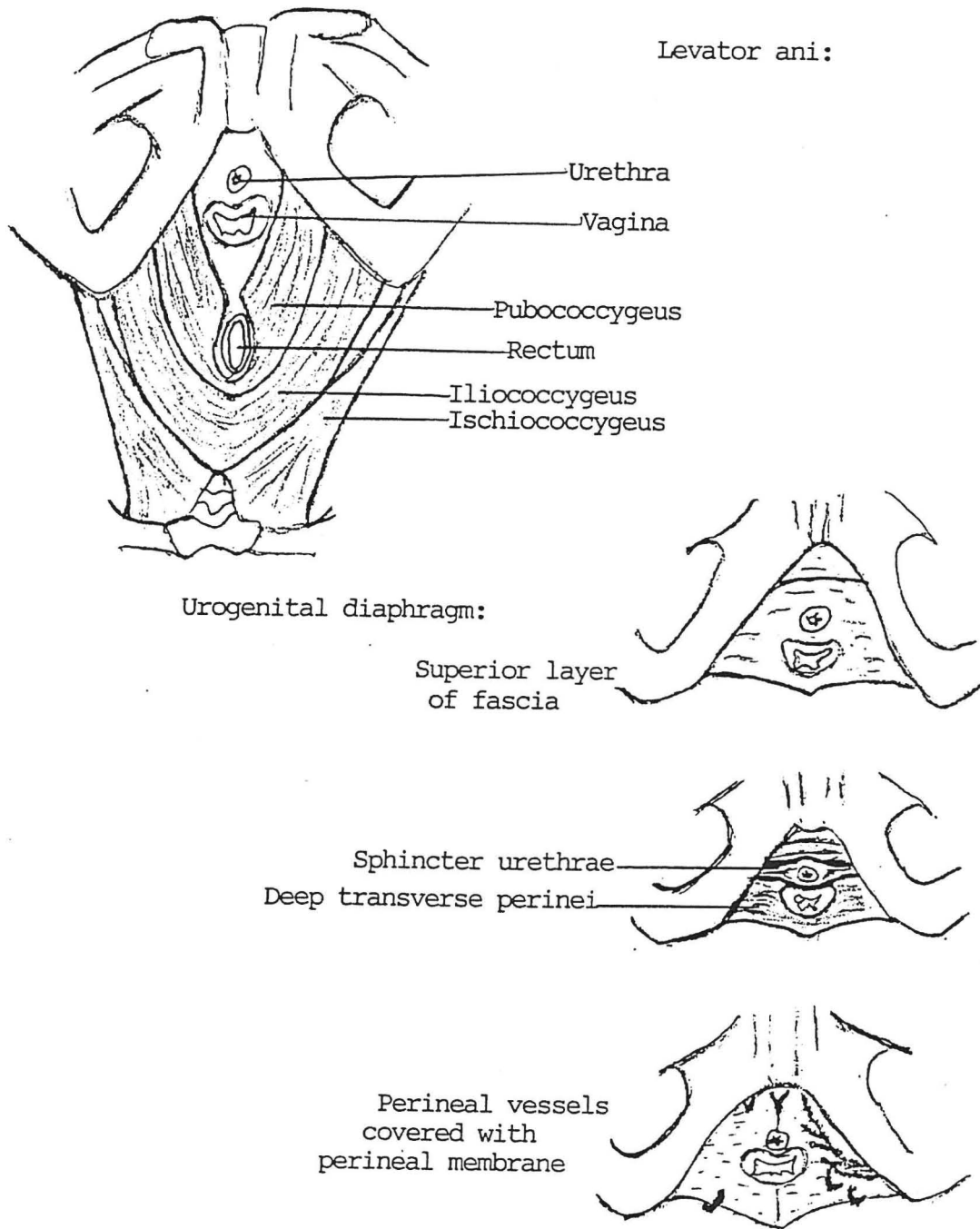


Figure 2. Deep layer of the urogenital triangle. From Salentiny RJ. *Mechanical Biofeedback for Treatment of Female Urinary Incontinence*. Thesis (M.P.T.)—University of North Dakota, 1997:10.²⁴

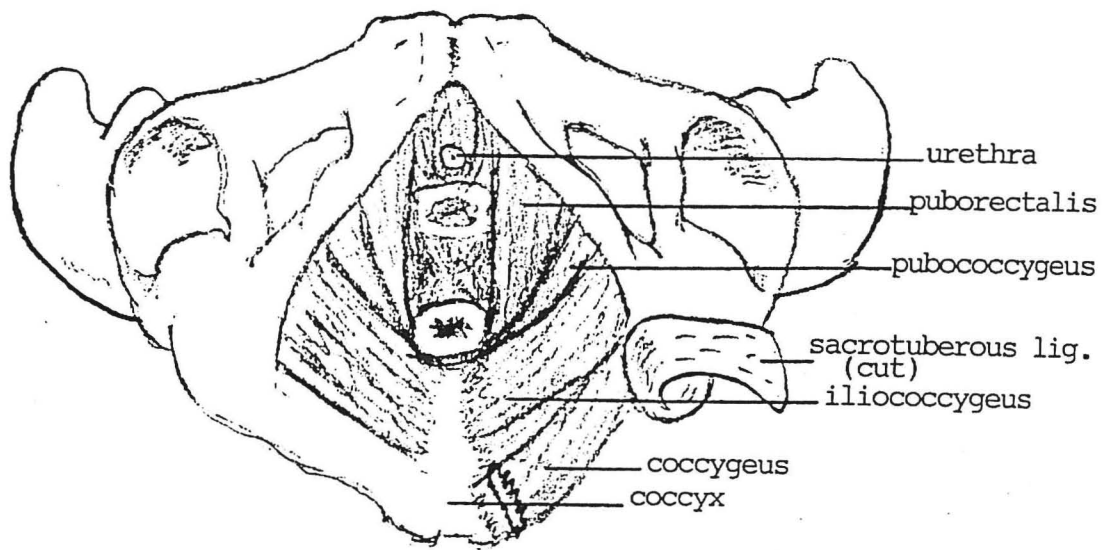


Figure 3. Pelvic diaphragm. From Salentiny RJ. *Mechanical Biofeedback for Treatment of Female Urinary Incontinence*. Thesis (M.P.T.)—University of North Dakota, 1997:9.²⁴

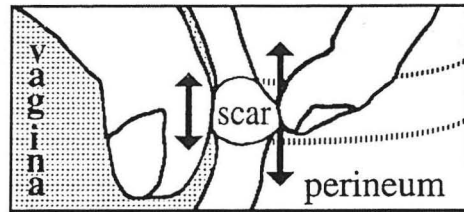
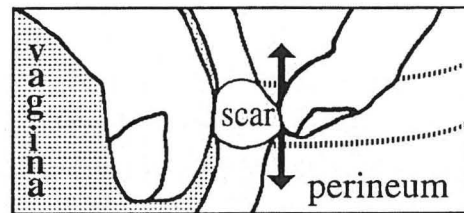
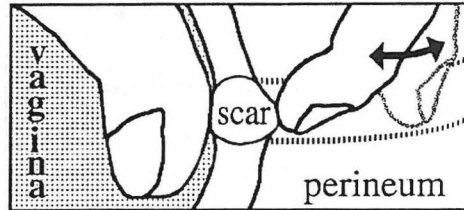
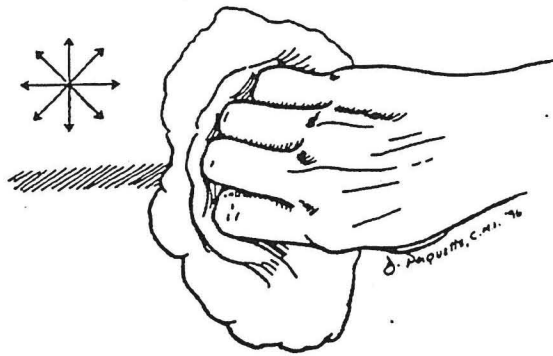
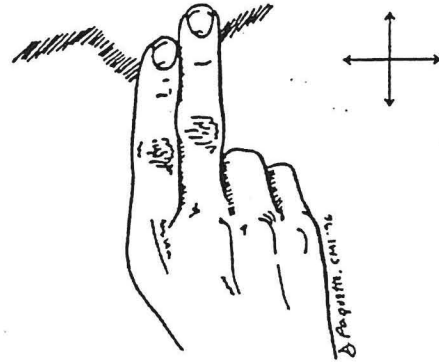


Figure 4. Perineal scar mobilization. Reprinted with permission from Pirie A, Herman H. *How to Raise Children Without Breaking Your Back*. W. Somersville, MA: IBIS Publications; 1995:5.¹⁷

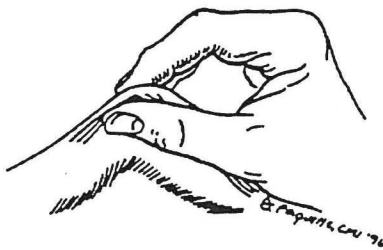
1. SCAR DESENSITIZATION



2. PUSH AND PULL



3. SKIN ROLLING



4. PLUCKING

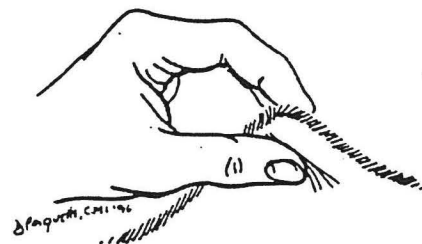


Figure 5. Cesarean section scar mobilizations. From Wilder E, ed. *The Gynecological Manual*. American Physical Therapy Association Section on Women's Health: 1997:281.¹

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.

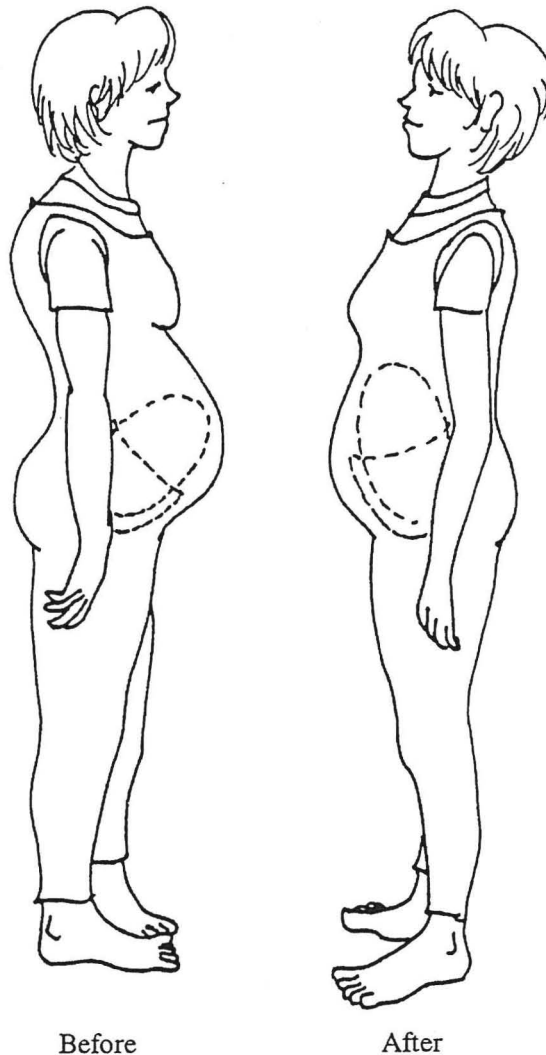


Figure 6. Posture checklist. From Ripplinger SL. *Exercise and Pregnancy: A Guide for Health Care Professionals*. Thesis (M.P.T.) – University of North Dakota, 1998:40.²⁵



Figure 7. Check for diastasis rectus abdominis.

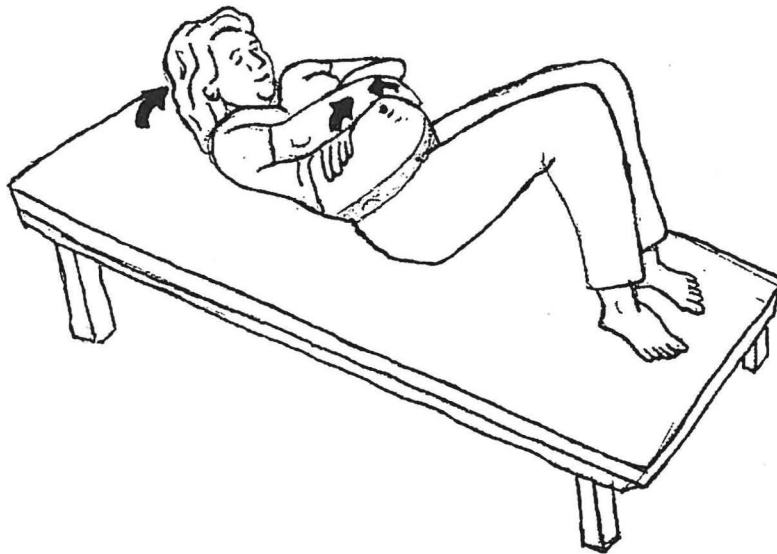


Figure 8. Corrective exercise for diastasis rectus abdominis.

APPENDIX B

Episiotomy & 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 Post-partum 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:

59

- 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*. APTA. Section on Woman's Health. 1997.
2. Moore KL. *Clinical Orientated 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 Pelvic Pain: An Integrated Approach*. Philadelphia. PA: WB Saunders Company; 1998:215-240.
5. Smith N, Clamp M. *Continence Promotion in General Practice*. New York, NY: Oxford University Press; 1991.
6. Thiede HA. Urinary Incontinence. In: Benson JT, ed. *Female Pelvic Floor Disorders: Investigation and Management*. New York, NY: W.W. Norton & Company; 1992:179-189.
7. Meyer S, Schreyer A, DeGrande P, Hohlfield P. The Effects of Birth on Urinary Continence Mechanisms and Other Pelvic Floor Characteristics. *Obstet Gynecol*. 1998;92:613-618.
8. National Association for Continence. Take Control of Your Incontinence. *NAFC*. 1999;3(5)
9. Martini FH. *Fundamentals of Anatomy & Physiology*. 4th Ed. Upper Saddle River, NJ: Practice Hall, Inc; 1998.

10. Mold JW. Pharmacotherapy of Urinary Incontinence. *Am Fam Physician*. 1996;54(2):673-680.
11. Kotarinos R, Brubaker LT. Role of Physical Therapy. In: Brubaker LT, Saclarides TJ. *The Female Pelvic Floor; Disorders of Function & Support*. Philadelphia, PA: F.A. Davis Company; 1996:240-246.
12. Northrup C. *Woman's Bodies, Women's Wisdom*. New York, NY: Bantam Books; 1998.
13. Blaivas JG. *Conquering Bladder and Prostate Problems: The Authoritative Guide For Men and Women*. New York, NY: Plenum Trade; 1998.
14. Foldspang A, Mommsen S, Djurhuus JC. Correlate of Pregnancy, Vaginal Childbirth, and Obstetric Techniques. *Am J Public Health*. 1999;89:209-212.
15. Brubaker LT, Saclareides TJ. *The Female Pelvic Floor: Disorders of Function and Support*. Philadelphia, PA: F.A. Davis Company; 1996.
16. Sampsel CM, Miller JM, Mims BL, Delancey JL, Ashton-Miller JA, Antonakos CL. Effect of Pelvic Muscle Exercise on Transient Incontinence During Pregnancy and After Birth. *Obstet Gynecol*. 1998;91:406-412.
17. Pirie A, Herman H. *How to Raise Children Without Breaking Your Back*. W. Somersville, MA: IBIS Publications; 1995.
18. Gogia, P. *Clinical Wound Management*. Thorotare, NJ: SLACK Incorporated; 1995.
19. Spoerl JJ, Benner EK, Mottice MD. *Soft Tissue Mobilization Techniques*. 2nd Ed. USA: JEMD Publications; 1994.

20. 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.
21. Stephenson RG, O'Connor LJ. *Obstetric and Gynecologic Care in Physical Therapy*. 2nd Ed. Thorofare, NJ: SLACK Inc; 2000.
22. Vullo VJ, Richardson JK, Hurvitz EA. Hip, Knee, and Foot Pain During Pregnancy and the Postpartum Period. *J Fam Pract*. 1996;43:63-68.
23. OB/GYN News. *Physical Therapy In Action*. 1997;3(5).
24. Salentiny RJ. *Mechanical Biofeedback for Treatment of Female Urinary Incontinence*. Thesis (M.P.T.)—University of North Dakota, 1997:9.
25. Ripplinger SL. *Exercise and Pregnancy: A Guide for Health Care Professionals*. Thesis (M.P.T.) – University of North Dakota, 1998:40.