

Pregnancy and Postpartum: A Guide for Singers

by

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A Research Paper Presented in Partial Fulfillment  
of the Requirements for the Degree  
Doctor of Musical Arts

Approved March 2013 by the  
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May 2013

## ABSTRACT

The trained singer utilizes an awareness of her body as an instrument. When she becomes pregnant, her body changes in numerous ways to support the pregnancy. Many of these changes have great impact on her ability to sing during the pregnancy and postpartum periods.

The voice may be altered positively or negatively by the release of hormones. The body undergoes many changes that affect the posture and breathing required for singing. Most notably, the abdominal muscles are greatly impacted by the pregnancy. They are stretched by the growing uterus, and this affects their function. In addition, the *linea alba* (the connective tissue between the halves of the rectus abdominis) is softened by hormonal increases and subject to stretching as the uterus grows, predisposing it to weakness. Since the other abdominal muscles attach to the linea alba via connective tissue, maintaining the integrity of the linea alba during pregnancy and postpartum is vital to the operational function of the abdominal muscles.

Protecting the vulnerable linea alba must be deliberately undertaken in two parts. First, conscious exercise is needed to preserve the linea alba during pregnancy and to rehabilitate it after pregnancy. Targeted exercises strengthen the transverse abdominis and shorten and approximate the two halves of the rectus abdominis. Second, modifications in daily movement are necessary to protect the linea alba while performing routine activities.

Cesarean sections present additional surgical concerns for singers, including abdominal incisions, use of medication, and the rare need for general anesthesia via intubation. Recovery from a cesarean can be difficult due to abdominal pain, yet steps may be taken to speed healing at the hospital and at home.

This paper provides an overview of how pregnancy affects the singer, discusses the effects of pregnancy and cesarean section, and provides a plan to protect the abdominal muscles during pregnancy and rehabilitate them in the postpartum period. It combines information from the fields of physical therapy, medicine, and surgery into a guide for the singer and voice teacher.

## ACKNOWLEDGEMENTS

First, I wish to thank Anne Elgar Kopta, without whose encouragement I would not have undertaken the doctoral degree. For the last eight years, she has served as my voice teacher, mentor, champion, and friend, and I cannot thank her enough for her contributions to my life as a singer and teacher. She was also an integral asset as I continued to sing and study through both of my pregnancies.

Dr. Jerry Doan served as an inspiration for the subject matter of this dissertation project, both through his excellent graduate vocal pedagogy class and as a private resource. His willingness to guide me through the doctoral degree and this paper in particular was very much appreciated. I benefited greatly from his invaluable assistance and pedagogical knowledge in writing and revising this document.

Dale Dreyfoos was a constant source of encouragement and support throughout this degree as well as my undergraduate degree. I am so thankful to have had his guidance through all these years, as I have grown from a freshman to a doctoral candidate.

Dr. Robert Mills offered extremely helpful advice on the details and minutiae of completing the doctoral degree. Dr. Robert Oldani helped to improve my writing through the many history classes I took under his tutelage, in both my undergraduate and doctoral degrees. Both were extremely encouraging and were always available to meet with me to discuss ideas.

Laura Burkhart Coons was my initial inspiration for investigating diastasis recti, and provided a sounding board during the long process of researching and writing this

document. April Nesham and Brandy Sanders provided excellent physical therapy during and after my pregnancies. My obstetrician, Dr. Tiersa Damore, exhibited patience and kindness when faced with my many questions in routine prenatal and postnatal appointments, and her colleagues, Dr. Paul Tamanaha and Dr. Kim Balk, took great care with me and my babies during both cesarean sections.

Finally, I must thank those in my personal life who have made this degree possible. My parents have always believed in my abilities and encouraged me to continue striving for my personal best. They were a constant source of love, encouragement, and even childcare! My sister and parents-in-law were also extremely helpful and supportive in so many ways.

I cannot describe the many ways in which my husband, Andrew, has contributed to my ability to earn my doctorate. For seven years, he shared the responsibilities at home and with our children as I took classes, continued performing and teaching, and finished all requirements for the degree. His support, respect, and love mean so much to me, and I never could have accomplished this without him. Finally, my sons John and Daniel are the true inspirations, for this document and in my life. My life holds so much happiness and laughter with them in it.

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## CHAPTER 1

### INTRODUCTION

This paper provides an overview of how pregnancy affects the singer, discusses the effects of pregnancy and cesarean section on the abdominal muscles, and provides a plan to protect the abdominal core during pregnancy and rehabilitate the core muscles postpartum. It combines information drawn from the fields of physical therapy, medicine, and surgery into a single document, written from a singer's perspective, for use by the singer and voice teacher.

This document is for informational purposes only. Although the author has taken care to ensure that the information in this text is accurate and up-to-date, readers are strongly encouraged to confirm the material with other sources, since the use of specific treatments and procedures changes frequently. This paper is not meant to replace the medical advice of a physician, midwife, nurse or physical therapist, and readers would be wise to review the information with their health-care provider or therapist.

#### **Topic Selection**

I became pregnant with my first child while in my second year of doctoral coursework. Like many singers, I was slightly anxious in spite of my excitement, as I did not know to what extent the pregnancy would affect my voice. I was able to sing throughout my pregnancy until a week before I had my son. My labor was long and difficult, and after twenty-one hours, my doctor recommended delivery by cesarean section.<sup>1</sup> I was distraught and uninformed; until that moment, I had ignored the

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<sup>1</sup> In this document, the terms “cesarean section,” “cesarean” and “C-section” will be used interchangeably.

possibility that a cesarean could become necessary. I had rationalized that I simply could not have one because I was a singer and needed my abdominal muscles intact, thereby convincing myself that there would be no need for one. When a cesarean became medically necessary, fear turned to panic as I realized I had done myself a great disservice by not gathering any information about the surgery or recovery. At that moment I truly believed the C-section would ruin my abdominal muscles for singing, and yet I felt I had no choice but to comply, for my son's health and my own. After seven weeks of healing, I returned to singing and was surprised and pleased to discover that although my core muscles were weak and did not function as efficiently, they were intact and would heal.

Around nine months postpartum, I noticed some residual inefficiency in abdominal muscle function. I experienced pain when sitting up from a lying position, and when I attempted to do traditional abdominal exercises to address the weakness, the pain increased greatly and forced me to discontinue the exercises.

A friend was the first to inform me about diastasis recti (the separation of the rectus abdominis muscles) and to suggest I see a physical therapist. Through my obstetrician, I was referred to a physical therapist specializing in women's health. I presented to physical therapy with a moderate diastasis at thirteen months postpartum. In a few short weeks, I had closed the gap to a mere depression. My therapist marveled at my quick progress, theorizing that it was partially due to having a singer's body awareness and muscle memory. My voice teacher noticed a difference in my breath and vocal production almost immediately.

I was inspired by an offhand comment made by my therapist. She was troubled by the large number of women who try to rehabilitate their postpartum core muscles by doing hundreds of standard abdominal exercises, not realizing that without the reinforcement of the transverse abdominis, they would be pulling the muscles of the rectus abdominis apart and actually making a separation worse. I realized that many singers would fall into this category, and became conscious of the need to make the information available to singers.

In the years after my abdominal physical therapy, I occasionally noticed the mention of the transverse abdominis in popular magazines,<sup>2</sup> often in an article promising to help a new mom return her body to its previous shape. While I was heartened to see the transverse abdominis being mentioned in postpartum abdominal rehabilitation, I believed that the exercise programs recommended by the magazines were too advanced, too general, and even potentially harmful.

When I started researching pregnancy and childbirth in preparation for any future pregnancies, I found a dearth of information on these subjects in the standard literature read by singers and voice teachers. With the encouragement of my doctoral committee, I decided to make this the subject of my dissertation project. This document will begin with an overview of the changes pregnancy brings to the singer's body and voice, as well as the specific effects of pregnancy on the abdominal muscles. Recommendations from physical therapy sources are brought together to inform singers about the necessity of

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<sup>2</sup> Rachel Morris, "5 Moves for Flat Abs," *Parents*, September 2011, <http://www.parents.com/parenting/moms/healthy-mom/flat-abs-exercises/> (accessed February 9, 2013); Sharon Liao, "6 Easy Lower Abdominal Exercises," *Real Simple*, August 2011, <http://www.realsimple.com/health/fitness-exercise/workouts/lower-abdominal-exercises-0010000062453/index.html> (accessed February 9, 2013).

preserving and rehabilitating the abdominal muscles. I also felt it imperative to include information on cesarean sections, as I believe many singers fear this procedure to an extent that may be unwarranted.

Three years after having my first child, I became pregnant with my second child and purposefully put my research into action during the pregnancy to ease my physical symptoms and prepare for a second C-section. I also used the pregnancy to continue informing my research, finding the answers to questions that arose as I experienced my own second pregnancy and postpartum period. After my second son was born via repeat cesarean, I returned to the document with a new perspective on the subject.

My purpose in writing this paper is to combine information from the fields of physical therapy, medicine, and surgery into a guide written from a singer's perspective, for use by the singer and her voice teacher. This topic may also be of interest to those who have had other gynecologic or abdominal surgery, or singers who may benefit from abdominal rehabilitation after a significant weight loss.

### **Literature Review**

The effects of pregnancy on the singing voice have not been thoroughly assayed. For years, Jahn's article in *Classical Singer* remained the only non-anecdotal piece in the commonly read literature of professional voice users.<sup>3</sup> The website OperaMom.com published Emerich's overview of pregnancy and the voice.<sup>4</sup>

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<sup>3</sup> Anthony Jahn, "Pregnancy: Singing Your Way Through," *Classical Singer*, December 1999.

<sup>4</sup> Kate Emerich, "Pregnancy and the Voice," <http://web.archive.org/web/20010413004222/http://www.operamom.com/voiceandpregnancy.html> (accessed February 26, 2013).

Recent years have seen a surge of interest in the subject. In 2009, Hamdan et al. reported on the characteristics of the speaking voice in pregnant women in *Journal of Voice*.<sup>5</sup> In 2012, Adrian's case study<sup>6</sup> in *Journal of Singing* was an important step in analyzing a singer's response to pregnancy, as were the study on the third-trimester voice by Cassiraga et al.<sup>7</sup> and the case study undertaken by Lã and Sundberg,<sup>8</sup> both published in *Journal of Voice*.

Sataloff briefly addressed the issue of abdominal muscle function during pregnancy and the impact on the professional voice user.<sup>9</sup> Wicklund's guide to abdominal surgery for the singer<sup>10</sup> is easily extrapolated to cover cesareans, and the articles by Jahn<sup>11</sup> and Ragan and Gangopadhyay<sup>12</sup> provide important information about intubation for singers that could be useful in the event of an emergency cesarean.

Other sources include both scientific studies and instructional books from the medical and physical therapy fields, giving an overview of pregnancy, the effects of

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<sup>5</sup> Abdul-Latif Hamdan et al., "Effect of Pregnancy on the Speaking Voice," *Journal of Voice* 23, no. 4 (2009): 490-493.

<sup>6</sup> Stephanie Adrian, "The Impact of Pregnancy on the Singing Voice: A Case Study," *Journal of Singing* 68, no. 3 (January/February 2012): 265-271.

<sup>7</sup> Verónica L. Cassiraga et al., "Pregnancy and Voice: Changes during the Third Trimester," *Journal of Voice* 26, no. 5 (September 2012): 584-586.

<sup>8</sup> Filipa Martins Baptista Lã and Johan Sundberg, "Pregnancy and the Singing Voice: Reports from a Case Study," *Journal of Voice* 26, no. 4 (2012): 431-439.

<sup>9</sup> Robert Thayer Sataloff, "Evaluation of Professional Singers," *Otolaryngologic Clinics of North America* 33, no. 5 (October 2000): 923-949.

<sup>10</sup> Karen Wicklund, "Singers and Abdominal Surgery: Recovery and Rehabilitation of the Respiratory Processes," *Journal of Singing* 57, no. 3 (January/February 2001): 7-14.

<sup>11</sup> Anthony Jahn, "Anesthesia for Singers," *Journal of Singing* 61, no.3 (January/February 2005): 271-272; Anthony Jahn, "Intubation and Alternatives," *Classical Singer*, March 2003, 14-15.

<sup>12</sup> Kari Ragan and Kunal Gangopadhyay, "Intubation Considerations for Singers," *Journal of Singing* 69, no. 1 (September/October 2012): 43-46.

pregnancy and cesarean section on the abdominal muscles, and abdominal preservation and rehabilitation during pregnancy and postpartum.

### **Delimitations**

This document will not discuss different childbirth methods or techniques. There will be no advocating for or against natural or medicated births, cesarean sections, vaginal birth after cesarean (VBAC), planned or repeat cesareans, nor will there be judgment on which reasons for a cesarean are “right” or “wrong.” The risks of cesareans will also be avoided. These options are best discussed with a medical doctor, nurse, or midwife, and each woman must choose the option she feels is best for her pregnancy and her baby.

Other effects of pregnancy, such as pelvic floor trauma during delivery or diastasis of the pubis bone (pubis symphysis), will not be addressed in this document. Neither will there be a lengthy discussion of breastfeeding or its effect on singing in the postpartum period. While a logical parallel is suggested, this paper does not consider in detail those persons with nonpregnant obesity or surgeries other than cesarean section, which may impact the integrity and strength of the abdominal muscles.

This document is intended as an introduction to the subject. Since medical knowledge is constantly changing, singers and voice teachers should take steps to corroborate these ideas with other sources. This paper should not replace the counsel of a physician, midwife, nurse, or physical therapist, and readers would be wise to review the information with their health care provider or therapist.

## CHAPTER 2

### THE EFFECTS OF PREGNANCY ON THE BODY AND THEIR IMPACT ON THE SINGER

#### **Introduction**

Many women struggle with the physical changes pregnancy brings to the body, but these changes are even more daunting for the singer. The singer's body is her instrument, and alterations in the body may also affect her vocal technique, livelihood, and self-image. Surging hormonal levels, structural changes, and other pregnancy-related symptoms can cause difficulties in singing, yet many women have found ways to sing through pregnancy and the postpartum period by making some adjustments.

#### **Vocal Changes**

During the course of their lives, women's bodies are subject to varying hormonal levels of estrogen and progesterone. Upon conception, these hormones increase to support the pregnancy, causing new symptoms in the pregnant woman, many of which are of great import to the singer.

Both estrogen and progesterone levels increase and act directly on the larynx,<sup>13</sup> which may cause edema, or swelling, of mucosal membranes in the vocal folds. This swelling may cause vocal problems similar to those occurring premenstrually. The voice can seem muffled, breathy or hoarse, or limited in range.<sup>14</sup> In the third trimester,

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<sup>13</sup> Cassiraga et al., 585.

<sup>14</sup> Emerich, "Pregnancy and the Voice."



progesterone levels are especially elevated, which may result in more vocal fatigue.<sup>15</sup>

“From videoscopic examinations of the larynx, small submucous hemorrhages, redness and swelling were observed during pregnancy, a condition named as ‘*Laryngopathia gravidarum*.’ Women presenting these symptoms have been advised to avoid vocal strain.”<sup>16</sup>

Rarely, a normal pregnancy may also produce androgens that may alter the voice permanently, lowering the singer's range and changing the vocal quality. However, Emerich asserts, “It has been possible in some cases to return singers with androgenic voice changes to a professional singing career.”<sup>17</sup>

The vocal folds appeared to remain consistent in structure during pregnancy, according to Adrian's case study. Videostroboscopic assessment showed little evidence of change in the vocal folds,<sup>18</sup> and all acoustic, harmonic, and aerodynamic measurements were within normal levels, though not without some variations within those parameters.<sup>19</sup> Lã and Sundberg found evidence to support their hypothesis that vocal fold motility is reduced during pregnancy, as “elevated concentrations of estrogen and progesterone, as during the last trimester of pregnancy, have been reported to be associated with changes in vocal fold tissue: (1) estrogen increases vocal fold epithelium thickness;

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<sup>15</sup> Hamdan et al., 493.

<sup>16</sup> Lã and Sundberg, 431.

<sup>17</sup> Emerich, “Pregnancy and the Voice.”

<sup>18</sup> Adrian, 267.

<sup>19</sup> Ibid., 268.

(2) progesterone leads to changes in the intermediate layer, causing dryness and increased tissue viscosity.”<sup>20</sup>

Hamdan et al. studied the effects of pregnancy on the speaking voice, although the subjects of the study were limited to women already in labor who presented to the hospital labor and delivery suite, and so were in some distress. These pregnant women were more likely to complain of vocal symptoms, with 12% complaining of vocal fatigue, and 8% complaining of hoarseness.<sup>21</sup> They also showed decreased maximum phonation time (MPT)<sup>22</sup> compared to non-pregnant women. Immediately after delivery, the MPT increased.<sup>23</sup> The researchers reached the conclusion that “pregnancy has limited effect on the speaking voice”<sup>24</sup> and “poor breathing support is considered the main cause of vocal fatigue in addition to dehydration and other factors.”<sup>25</sup> Cassiraga et al. compared their findings to those of Hamdan et al.:

In the present study, similar [fundamental frequency] values, perturbation rates, and isolated vowel intensity were observed. These results match with the experience of Hamdan et al. However, unlike this research, we found abnormal acoustic parameters, with the presence of breathiness and hoarseness as registered in the spectrogram analysis. Furthermore, main intensity of the read phase, the presence of [gastroesophageal reflux], and the MPT varied significantly in both groups. Therefore, there are changes in voice quality during pregnancy, which usually revert after labor.<sup>26</sup>

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<sup>20</sup> Lã and Sundberg, 435.

<sup>21</sup> Hamdan et al., 491.

<sup>22</sup> Adrian, 270. Maximum phonation time refers to the maximum time a person can sustain a singing tone.

<sup>23</sup> Hamdan et al., 491.

<sup>24</sup> Ibid., 493.

<sup>25</sup> Ibid., 492.

<sup>26</sup> Cassiraga et al., 585.

Though pregnancy inevitably causes some alteration of the voice, the changes may in fact be positive. “Throughout the first and second trimesters of gestation, the voice has been described as rounded, well carried with good vibration. This has been attributed to the perfect lubrication of the vocal folds during this period.”<sup>27</sup> A 1984 survey asked singers who had been pregnant to evaluate whether they had experienced vocal changes during pregnancy. According to the singers' self-assessments, many singers experienced improved vocal quality at some point during the pregnancy. In the first trimester, 16% felt vocal improvements, 62% felt no change, and 22% reported negative effects, with most singers attributing the change to morning sickness. In the second trimester, 45% reported a positive vocal change, 40% did not notice a change in vocal quality, and 15% experienced negative change. In the third trimester, most singers (47%) reported a positive effect on the voice, while 26% experienced no change and 26% felt their voices had changed negatively.<sup>28</sup> “In some cases, [voice] alterations produced by pregnancy are permanent.”<sup>29</sup>

### **Physiological Changes**

Elevated levels of progesterone and the hormone relaxin cause laxity in the joints and soft tissues in order to prepare the body for the growing uterus and for childbirth.<sup>30</sup>

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<sup>27</sup> Hamdan et al., 490.

<sup>28</sup> A. L. Abramson et al., “Estrogen Receptors in the Human Larynx: Clinical Study of the Singing Voice,” in *Transcripts of the Thirteenth Symposium Care of the Professional Voice*, ed. Van Lawrence (New York: The Voice Foundation, 1985), 411.

<sup>29</sup> Sataloff, 935.

<sup>30</sup> Roger Hammer, Jan Perkins, and Richard Parr, “Exercise during the Childbearing Year,” *The Journal of Perinatal Education* 9, no. 1 (2000): 6.

These hormones also act inside the muscles of the rectus abdominis and on the connective tissue between them (the linea alba), causing the two halves of the rectus abdominis to drift apart from their normally parallel position.<sup>31</sup> This separation of the two halves of the rectus abdominis is known as diastasis recti, and will be further discussed in subsequent chapters.

The singer's breathing may become problematic as the pregnancy progresses. "As a result of body changes at the thoracic and abdominal level, breathing becomes clavicular (upper portion of the lungs), providing poor respiratory support and making breathing laborious, which results in the lowering of MPT. Consequently, the patient finds it hard to control both myoelastic laryngeal forces and aerodynamic lung forces."<sup>32</sup>

As the fetus grows, both inhalation and exhalation are directly affected by the growth of the uterus. Since the uterus is located underneath the diaphragm, it is therefore subject to the inspirational forces of the diaphragm. For the singer, the more concerning aspect would be the reverse: the inspirational force of the diaphragm is subject to the size of the uterus. Experts in both the vocal field (Jahn) and physical therapy field (Noble) explain breathing difficulty during pregnancy as attributable to the descent of the diaphragm being directly limited by the growing size of the uterus.<sup>33</sup> However, research shows that the fundamental level of the diaphragm actually rises in the chest cavity by four centimeters as the pregnancy progresses. This change allows the total descent of the

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<sup>31</sup> Andrea Lemos et al., "Pregnancy Inter-Recti Abdominis Distance Has No Impact on Respiratory Strength," *Journal of Physical Therapy Science* 23 (2011): 757.

<sup>32</sup> Cassiraga et al., 585.

<sup>33</sup> Jahn, "Pregnancy," 22; Elizabeth Noble, *Essential Exercises for the Childbearing Year*, 4th ed. (Harwich, MA: New Life Images, 2003), 149.

diaphragm to increase by one to two centimeters during pregnancy.<sup>34</sup> This adjustment serves only to maintain breathing function by compensating for the growing uterus, however, as many measures of breath capacity and function still show compromise. Functional residual capacity, expiratory reserve volume, total lung capacity,<sup>35</sup> and MPT all decrease during pregnancy.<sup>36</sup>

As there is only a finite amount of room in a woman's abdominal and chest cavities, the available capacity for inspiration is decreased as the uterus expands to fill it. “A pregnant woman breathes slightly faster and more deeply to exhale more carbon dioxide and keep the carbon dioxide level low. She may breathe deeper and faster also because the enlarging uterus limits how much the lungs can expand when she breathes in. The circumference of the woman's chest enlarges slightly.”<sup>37</sup>

The uterus achieves its highest position around the eighth month, reaching up to the sternum. After this peak, the baby descends into the pelvic cavity (a process known as engagement), finally giving the mother some breathing relief, but not without compromising other pelvic organs or the lower abdominal muscles.<sup>38</sup>

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<sup>34</sup> Hamdan et al., 492.

<sup>35</sup> Johan Sundberg, *The Science of the Singing Voice* (DeKalb, IL: Northern Illinois University Press, 1987), 32-33. Functional residual capacity is the amount of air in the lungs when passive inspirational and expirational forces are at equilibrium. Expiratory reserve volume is the amount of air remaining in the lung after maximal exhalation. Total lung capacity is the entire volume of the lung when filled with maximal inhalation.

<sup>36</sup> Hamdan et al., 492.

<sup>37</sup>The Merck Manual Home Health Handbook, “Physical Changes during Pregnancy,” [http://www.merckmanuals.com/home/womens\\_health\\_issues/normal\\_pregnancy/physical\\_changes\\_during\\_pregnancy.html?qt=&sc=&alt=](http://www.merckmanuals.com/home/womens_health_issues/normal_pregnancy/physical_changes_during_pregnancy.html?qt=&sc=&alt=) (accessed January 7, 2013).

<sup>38</sup> Noble, 149.

The growing fetus also compromises exhalation. The diaphragm must work against resistance from the growing uterus and other abdominal organs,<sup>39</sup> which may make it more difficult for the pregnant singer to delay the ascent of the diaphragm, causing a lack of control over the rate of exhalation. The singer may find it possible to delay the diaphragm's ascent by feeling the diaphragm against the uterus, as a way of monitoring the lowered position of the diaphragm. When used as a term describing a breathing technique for singers, *appoggio* means that the diaphragm “leans down upon the abdominal viscera to control the rate of air flow during singing,”<sup>40</sup> while also working in conjunction with the competing isometric force of the abdominal wall against the viscera. During pregnancy, the uterus is a part of the abdominal viscera; consequently, some singers may use the *appoggio* technique easily during pregnancy, as the quantity of abdominal viscera to press downward upon is substantially greater.

Another daunting aspect of exhalation for the pregnant singer is the lengthening of the abdominal muscles. As the uterus grows, the abdominal muscles (rectus abdominis, external and internal obliques, and transverse abdominis) must stretch and give way so that the uterus can grow outwards and upwards. “Abdominal distention during pregnancy also interferes with abdominal muscle function”<sup>41</sup> and “in the later months of pregnancy, it becomes more difficult to flex the abdominal muscles because of the size of the fetus.”<sup>42</sup> The abdominal muscles must support the weight of the growing

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<sup>39</sup> Ibid.

<sup>40</sup> Paul Kiesgen, “Breathing,” *Journal of Singing* 62, no. 2 (November/December 2005): 169.

<sup>41</sup> Sataloff, 936.

<sup>42</sup> Heidi Waleson, “Full Cry: Divas as Moms,” *Wall Street Journal*, April 27, 1990.

fetus and work with the lower back muscles to stabilize the body's core, all the while becoming weaker due to stretching, disuse, or misuse in exercise or daily activities.<sup>43</sup> The stretching of these muscles impairs their function, and also negatively affects posture and alignment.<sup>44</sup> Due to the attachment of the obliques and transverse abdominis to the linea alba through connective tissue, the stretching and softening of this tissue may further compromise the abdominal muscles.<sup>45</sup>

In addition to fundamental changes in the diaphragm and abdominal muscles, singers must also be aware of postural changes during pregnancy. Posture is affected by hormonal increases that loosen the joints, creating instability in alignment and balance. In addition, the body's changes cause the center of gravity to move forward as the uterus grows.<sup>46</sup> As the abdominal muscles stretch, the muscles in the lower back shorten and become tighter.<sup>47</sup> The natural curves of the spine become even more S-shaped, and the body requires more muscular support to maintain good posture.<sup>48</sup>

### **Other Pregnancy-Related Concerns for Singers**

In the first trimester, the most significant pregnancy symptoms are those that affect the woman's feeling of well-being, most notably nausea and fatigue. These are not

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<sup>43</sup> Noble, 23.

<sup>44</sup> Emerich, "Pregnancy and the Voice."

<sup>45</sup> Jill Schiff Boissonnault and Rhonda K. Kotarinos, "Diastasis Recti," in *Obstetric and Gynecologic Physical Therapy*, ed. Elaine Wilder (New York: Churchill Livingstone, 1988), 76.

<sup>46</sup> Noble, 27.

<sup>47</sup> *Ibid.*, 28.

<sup>48</sup> *Ibid.*, 23.

inconsequential, however, as their severity can range quite broadly and directly affect the singer's instrument—her body. The second trimester usually brings relief, as the pregnant woman experiences a surge of energy and a decrease in nausea and fatigue.<sup>49</sup>

At any time during pregnancy, the mother can experience the onset of pregnancy-induced rhinitis (nasal congestion),<sup>50</sup> caused by swelling in the mucosa of the nasal cavities.<sup>51</sup> Pregnancy rhinitis is reported to be experienced by 22% of pregnant women. The condition usually resolves after giving birth.<sup>52</sup>

Gastroesophageal reflux is common during pregnancy, with 40-85% of pregnant women reporting symptoms. The onset can begin as early as the first trimester, with the likelihood of onset increasing as the pregnancy progresses. Women who experienced reflux before pregnancy also have a higher risk of suffering from pregnancy reflux. Symptoms manifest as heartburn, nausea, regurgitation, stomach pain, and even vomiting.<sup>53</sup>

Both pregnancy rhinitis and reflux may present problems for the pregnant singer, especially since over-the-counter and prescription medications are heavily restricted during pregnancy to protect the developing fetus. Whether nasal symptoms are caused by pregnancy rhinitis, allergies, or an upper respiratory infection, Jahn recommends the use

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<sup>49</sup> Julie Bishop, "Singing and Pregnancy — A Singer's Perspective," *Classical Singer*, February 2011.

<sup>50</sup> Eva Ellegård et al., "The Incidence of Pregnancy Rhinitis," *Gynecologic and Obstetric Investigation* 49, no. 2 (2000): 100.

<sup>51</sup> Hamdan et al., 491.

<sup>52</sup> Ellegård et al., 100.

<sup>53</sup> Raja Affendi Raja Ali and Laurence J. Egan, "Gastroesophageal Reflux Disease in Pregnancy," *Best Practice & Research: Clinical Gastroenterology* 21, no. 5 (October 2007): 794.



of saline spray to provide some relief. For vocal fold edema, salt restriction is recommended.<sup>54</sup>

For reflux, Ali and Egan recommend that lifestyle and dietary changes should be the first steps taken. Restricting all eating three hours before bedtime, as well as avoidance of caffeine, alcohol, fatty or spicy foods, chocolate, mints, citrus, tomato products, and carbonated beverages can decrease the incidence of reflux. Sleeping on the left side is also recommended for reflux.<sup>55</sup>

Finally, hydration must be mindfully maintained during pregnancy, as dehydration can cause preterm labor.<sup>56</sup> Noble notes that a pregnant woman needs ten to sixteen glasses of water a day, perhaps more depending on her activity level and climate.<sup>57</sup>

### **Singing through Pregnancy**

Many singers wish to continue singing throughout their pregnancy, and may do so while keeping certain considerations in mind. Some anecdotal information may be of value.

From a purely physical standpoint, some singers report that singing while pregnant was not as difficult as they expected. Susannah Glanville<sup>58</sup> performed the role of

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<sup>54</sup> Jahn, "Pregnancy," 22.

<sup>55</sup> Ali and Egan, 796.

<sup>56</sup> Tupler, *Maternal Fitness*, 78.

<sup>57</sup> Noble, 39.

<sup>58</sup> English soprano with international opera career.

Pamina with the English National Opera while seven months pregnant with her first child. “Initially, I was fine, then I had a rest around three to four months when I felt tired. I then went through a time when I was blooming and worked again; months five to seven have been the best time, and I’ve not put on too much weight. I thought that moving about on stage would be a potential problem, but it’s not been the case.”<sup>59</sup> Erin Wall<sup>60</sup> was also worried about the effects of pregnancy on her singing. “But once I learned how to cope with the sickness, it was fine.”<sup>61</sup>

Many singers report positive vocal changes during pregnancy. The voice’s timbre and range may be positively affected. Wall expressed, “The hormones seem to give an extra richness and womanliness. It’s helped me with my middle and low range.”<sup>62</sup> Juliana Gondek<sup>63</sup> asserted that her voice became “clearer, with less distortion around the tone.”<sup>64</sup> American soprano Janai Brugger<sup>65</sup> made her debut at the Metropolitan Opera while 6½ months pregnant, and felt especially good in the second trimester, saying “My voice has gotten fuller and mature. It’s easier to sing through my middle voice.”<sup>66</sup> Frederica von

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<sup>59</sup> Jayne Comins, “Voice Clinic: Great Expectations,” *The Singer*, February/March 1998, 27.

<sup>60</sup> Canadian soprano with international opera career.

<sup>61</sup> Katherine Boyle, “Pregnant Artists Continue to Perform with Precision,” *The Washington Post*, [http://www.washingtonpost.com/entertainment/music/2013/01/04/d5af2b3e-4899-11e2-ad54-580638ede391\\_story.html](http://www.washingtonpost.com/entertainment/music/2013/01/04/d5af2b3e-4899-11e2-ad54-580638ede391_story.html) (accessed January 7, 2013).

<sup>62</sup> Boyle, “Pregnant Artists.”

<sup>63</sup> American soprano turned mezzo-soprano with international opera career, professor of voice.

<sup>64</sup> Waleson, “Full Cry.”

<sup>65</sup> American soprano, Metropolitan Opera debut October 30, 2012.

<sup>66</sup> Boyle, “Pregnant Artists.”

Stade<sup>67</sup> recorded a song recital just forty-eight hours before giving birth to her first child,<sup>68</sup> and Austrian contralto Ernestine Schumann-Heink (1861-1936) maintained that she added a note at each end of her range with the birth of each child.<sup>69</sup>

Other singers reported negative vocal changes during pregnancy. As Sheri Greenawald<sup>70</sup> noted in an interview with Heidi Waleson, she believes many singers “go through a vocal crisis because of the change in the body. Things get either better or worse.”<sup>71</sup> Contemporary singer Judy Rees was one singer who did not find it easy. “As far as my voice was concerned, the top didn't work as well, even though I felt fine throughout my pregnancy.”<sup>72</sup>

It is important for the pregnant singer to monitor any changes in her voice from edema in the vocal folds, and to avoid the development of compensatory techniques or tension in an attempt to sing normally in spite of the swelling.<sup>73</sup> As Hamdan et al. noted,

Professional voice users may complain of vocal fatigue, decrease in vocal agility, and a contracted range. Operatic singers may have problems in performing certain frequencies in pianissimo but not in forte, and also in changing from one harmonic to another and in transition between various registers. . . .

. . . The prevalence of vocal fatigue and the decrease in MPT [maximum phonation time] should prompt women in their last trimester to decrease strain on

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<sup>67</sup> American mezzo-soprano (b. 1945) of international fame.

<sup>68</sup> The recital included works by Purcell, Debussy, Canteloube, Dowland, Liszt, and Carol Hall, and featured Martin Katz at the piano. Robert Jacobson, untitled essay on vinyl record jacket, *Frederica von Stade—Song Recital* performed by Frederica von Stade and Martin Katz, Columbia Records 35127, 1978, vinyl LP.

<sup>69</sup> Waleson, “Full Cry.”

<sup>70</sup> American soprano with international performing credits, professor of voice, San Francisco Opera Center director.

<sup>71</sup> Waleson, “Full Cry.”

<sup>72</sup> Comins, 28.

<sup>73</sup> Emerich, “Pregnancy and the Voice.”

their phonatory apparatus, probably by abiding to healthy vocal habits and hygiene. A reduction in the ability to sustain phonation may be compensated for by breathing exercises for better support and control.<sup>74</sup>

In addition to laryngeal symptoms, abdominal support must be monitored closely during pregnancy to confirm the breath is sufficient to support the desired tone and range. The danger of insufficient support is compensatory tension in the neck, tongue, jaw, or throat. Sataloff unequivocally states, “Abdominal distention during pregnancy also interferes with abdominal muscle function. Any high-performing voice user whose abdominal support is compromised substantially should be discouraged from performing until the abdominal impairment is resolved.”<sup>75</sup> He warned of possible detriments to the voice in an interview with Waleson: “If women sing through this period, without support, they often start using bad technique, which can damage the vocal folds and establish bad habits that persist beyond pregnancy.”<sup>76</sup> Emerich notes that caution should not be limited to the final trimester. “Some singers sing through their entire pregnancy with adequate support, and others run into difficulties in the fourth and fifth month of pregnancy.”<sup>77</sup> The singer may not even be aware her abdominal muscles are becoming compromised, since “the abdominal muscles feel deceptively fit during pregnancy because they are continuously stretched over the enlarging uterus—the resistance keeps them taut and

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<sup>74</sup> Hamdan et al., 493.

<sup>75</sup> Sataloff, 936.

<sup>76</sup> Waleson, “Full Cry.”

<sup>77</sup> Emerich, “Pregnancy and the Voice.”

responsive.”<sup>78</sup> Vigilant observation of the breath by the singer and her voice teacher is imperative.

As one singer noted regarding breathing during pregnancy, “There seem to be two major persuasions: 1) I couldn't breathe because the baby was in the way. 2) Singing while pregnant was a dream. Having the baby there gave me something to push against and made my breath feel more buoyant.”<sup>79</sup> Rees certainly agreed with the former statement:

Some singers find they have better breath support for their voice when they're pregnant, and that they feel happier singing. This wasn't my own experience because I felt that the bump got in the way, and I couldn't enjoy singing towards the end. It was more tiring to sing, especially finishing a concert late, and standing was very fatiguing. . . . I also found it important to strengthen my abdominal muscles to help regain full breath support for my voice.<sup>80</sup>

Wall concurred: “Breathing is the hardest part. The baby is sharing so much oxygen, it's harder to sing those really long phrases.”<sup>81</sup> Renee Fleming<sup>82</sup> had a different experience. “During the pregnancy it's really easy – the baby provides support naturally, so you have to work a lot less, though as the pregnancy gets later you don't have as much room to breathe.”<sup>83</sup>

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<sup>78</sup> Noble, 83.

<sup>79</sup> Anonybrette [pseud.], comment on “Singing while Pregnant?” The New Forum for Classical Singers, comment posted October 20, 2002, <http://www.network54.com/Forum/172914/thread/1034295948/Singing+while+pregnant-> (accessed March 2, 2012).

<sup>80</sup> Comins, 27-28.

<sup>81</sup> Boyle, “Pregnant Artists.”

<sup>82</sup> American soprano (b. 1959) of international fame.

<sup>83</sup> Melanie Rehak, “The Way We Live Now: 8-29-99: Questions for Renee Fleming; Lullabye Diva,” *New York Times Magazine*, August 29, 1999, <http://www.nytimes.com/1999/08/29/magazine/the-way-we-live-now-8-29-99-questions-for-renee-fleming-lullabye-diva.html> (accessed January 26, 2013).

Though the breath capacity may be lessened, adjustments may be made to maximize the available breath. Singers may need to incorporate more lateral or thoracic expansion upon inhalation. Shortening phrase lengths or taking additional breaths when necessary may also prove beneficial.<sup>84</sup>

Although the voice may be unchanged or even improved, opera companies may be concerned with the aesthetic effect of a visibly pregnant singer. As Katherine Boyle reported in *The Washington Post*,

[Erin] Wall notes that a company asked her to drop out of a role over the summer because her character could not appear pregnant. (She declined to name the company or role.) Some companies are more flexible, though, masking pregnancies with elaborate costumes. In July [2012], Wall played the title role of the Santa Fe Opera's production of Richard Strauss's "Arabella." She hid her pregnancy under a fur-trimmed coat and loose-fitting gowns with elaborate details.<sup>85</sup>

One opera administrator expressed a willingness to hire pregnant singers due to the positive effects of the pregnancy on the voice, opining, "The experience we've had is that the voice blooms, and singers can continue performing right up until the eighth month. . . . Providing the singer feels well and is guided by their voice coach, there's no reason why they shouldn't continue performing throughout their pregnancy."<sup>86</sup> Adding a note of caution, Jahn agrees: "This is normally not a time to extend your range or learn challenging new repertoire. Nonetheless, there is no reason to stop singing, always remaining within the limits of comfort and reason."<sup>87</sup>

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<sup>84</sup> Jahn, "Pregnancy," 22.

<sup>85</sup> Boyle, "Pregnant Artists."

<sup>86</sup> Comins, 28.

<sup>87</sup> Jahn, "Pregnancy," 23.

## **Singing after Pregnancy: The Postpartum Return**

As the experience of pregnancy varies between singers, so does the length of time before a singer is able to return to singing. Some women have no trouble with recovery, and return to the stage relatively quickly after giving birth. Susanne Mentzer<sup>88</sup> was back to work two months after giving birth, singing a pants role.<sup>89</sup> Renee Fleming went back to work two weeks after her second daughter was born, with a performance at five weeks postpartum, yet still recognized the challenges of doing so. “After you’ve had the baby, all of those abdominal muscles are stretched out and tired.”<sup>90</sup>

Dawn Upshaw<sup>91</sup> started singing at four weeks postpartum and remembers, “The cords weren’t vibrating. There was no sound.”<sup>92</sup> She waited another four weeks to resume singing, and consequently had to change the program for a recital at ten weeks postpartum. Upshaw felt that taking time off after the birth of her daughter was ultimately beneficial, as she was able to eliminate bad habits, and concluded that her voice sounded “older, more mature.”<sup>93</sup>

Sataloff recommends that women wait to resume singing until they are free of pain, usually about four to six weeks after delivery, with the goal of returning to

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<sup>88</sup> American mezzo-soprano (b. 1957) with international opera career, professor of voice.

<sup>89</sup> Susanne Mentzer, “Singing for Two: Carrying More Than Just a Tune,” The Huffington Post Blog, entry posted August 6, 2012, [http://www.huffingtonpost.com/susanne-mentzer/more-than-a-tune\\_b\\_1745471.html](http://www.huffingtonpost.com/susanne-mentzer/more-than-a-tune_b_1745471.html) (accessed October 24, 2012).

<sup>90</sup> Rehak, “The Way We Live Now.”

<sup>91</sup> American soprano (b. 1960) of international fame, professor of voice.

<sup>92</sup> Waleson, “Full Cry.”

<sup>93</sup> Ibid.

performance condition around three months postpartum.<sup>94</sup> More time may be needed if the birth was difficult or resulted in a cesarean section, or if the mother struggles with postpartum depression or has difficulty adjusting to the new family dynamic. Soprano and voice teacher Ellen Faull<sup>95</sup> advocated that singers should allow themselves two to three months of rest after birth, citing the need to psychologically adjust to their new lives.<sup>96</sup> In addition, though many vocal symptoms of pregnancy subside after birth, hormonal changes linger in mothers who choose to breastfeed, causing a longer delay in the return to the normal voice.<sup>97</sup> Singing is an excellent isometric exercise targeting the weak postpartum abdominal muscles,<sup>98</sup> and so singing can rehabilitate both the body and the spirit when the new mother feels ready to do so.

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<sup>94</sup> Ibid.

<sup>95</sup> American soprano (1918-2008), professor of voice.

<sup>96</sup> Waleson, "Full Cry."

<sup>97</sup> Jahn, "Pregnancy," 23.

<sup>98</sup> Emerich, "Pregnancy and the Voice."



## CHAPTER 3

### THE EFFECTS OF PREGNANCY AND CESAREAN SECTION ON THE ABDOMINAL MUSCLES

#### **Introduction**

When contemplating the effects of pregnancy on the abdominal muscles, many singers consider only two aspects: the ability to sing during pregnancy and the rehabilitation of stretched abdominal muscles after birth. Though these components are important, this focus may indicate a lack of awareness of the importance of strengthening and shortening the abdominal muscles before and during pregnancy. In addition, many singers are unaware of the possibility of developing diastasis recti during a normal pregnancy and the effects of this condition on the abdominal muscles. Surgical delivery via cesarean section presents another set of concerns for the pregnant singer.

#### **Anatomy of the Abdominal Muscles and the Importance of the Transverse**

##### **Abdominis**

The abdominal muscles serve several functions: retaining the proper position of bodily organs; providing support in speaking, singing and other expiratory functions such as coughing and sneezing; assisting in excretory functions; flexing the trunk in a variety of directions; controlling the angle of the pelvis; stabilizing the muscles of the lower back; and giving birth.<sup>99</sup> “Their major contribution in breathing is to compress the viscera

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<sup>99</sup> Noble, 82.

that push up on the diaphragm to displace 60 to 80 percent of the volume of air exhaled.<sup>100</sup>

There are four layers of abdominal muscles: the rectus abdominis, the external obliques, the internal obliques, and the transverse abdominis (see fig. 1). Each pair of muscles has its own function within the body and, in its own way, affects exhalation for singing.

### Muscles of the Trunk

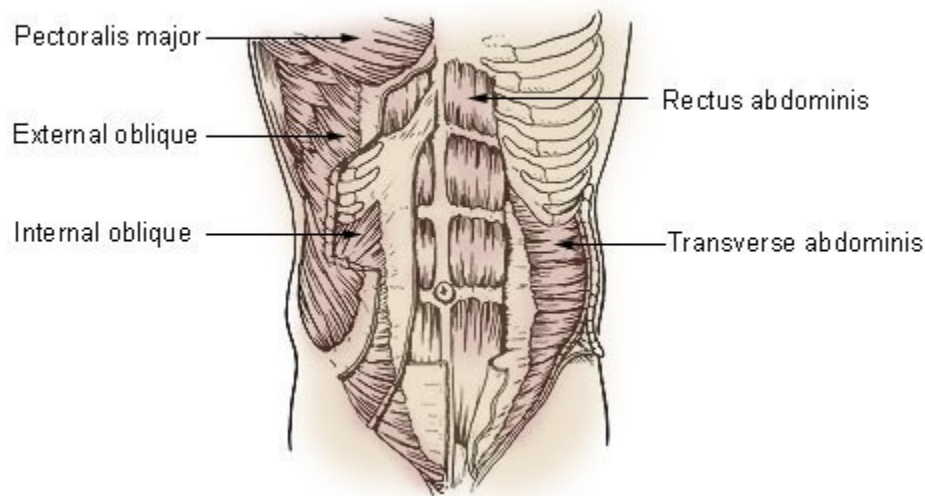


Figure 1. Muscles of the trunk. *Source:* National Cancer Institute, [http://training.seer.cancer.gov/images/anatomy/muscular/trunk\\_muscles.jpg](http://training.seer.cancer.gov/images/anatomy/muscular/trunk_muscles.jpg) (accessed April 4, 2013).

The rectus abdominis is the outermost layer of muscle, which extends vertically down the body from the sternum to the pelvis, and consists of four pairs of muscles divided lengthwise by the linea alba (the connective tissue between the left and right

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<sup>100</sup> William H. Perkins and Raymond D. Kent, *Functional Anatomy of Speech, Language and Hearing* (San Diego: College-Hill Press, 1986), 32.

halves of the rectus abdominis muscles). Below the umbilicus (belly button), the two halves of the rectus abdominis are closely approximated with a narrower linea alba; above the umbilicus, the rectus halves are further apart, where the linea alba is around two centimeters wide.<sup>101</sup> The rectus abdominis acts as the front wall of the abdominal cavity and holds in the viscera. Contraction of the rectus abdominis causes the torso to bend. Consequently, the role of the rectus abdominis in singing is limited, as bending the body at the waist would not produce a posture conducive to singing.<sup>102</sup>

The external obliques originate at the lower eight ribs and attach to the pelvis and the rectus abdominis, specifically the abdominal aponeurosis.<sup>103</sup> Located directly beneath the external obliques, the internal obliques originate at the thoracolumbar fascia and the pelvis, and attach to the rectus abdominis and cartilage of the lower ribs.

Both sets of obliques attach to the linea alba at the center of the rectus abdominis through the tendon-like aponeuroses at the end of each muscle. The external obliques attach to the anterior (front) of the linea alba, via the aponeurosis, for their entire length. The aponeurosis of the internal obliques divides into two sheaths above the umbilicus, with one passing in front of the rectus abdominis and inserting into the linea alba from the anterior, while the other passes behind the rectus abdominis and inserts into the linea alba from the posterior (back)<sup>104</sup> (see fig. 2). Below the umbilicus, the aponeurosis of the

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<sup>101</sup> Boissonnault and Kotarinos, 65-66.

<sup>102</sup> Marvin Keenze and Donald Bell, "Teaching Breathing: Breathing for Singing," *Journal of Singing* 61, no. 4 (March/April 2005): 375.

<sup>103</sup> aponeurosis: a flat sheet of tendon-like connective tissue which joins muscles; here, joining several abdominal muscles.

<sup>104</sup> Boissonnault and Kotarinos, 66.

internal obliques does not split, and simply joins the external obliques in attaching to the front of the linea alba<sup>105</sup> (see fig. 3). The obliques compress the viscera and work in conjunction with the transverse abdominis.<sup>106</sup>

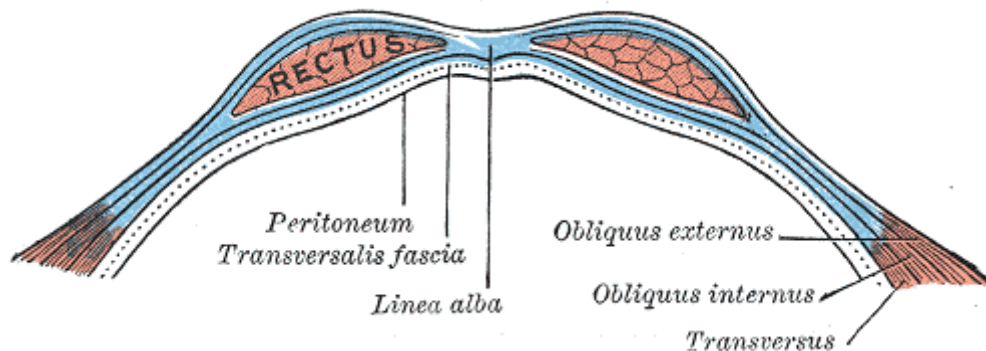


Figure 2. The sheath of the rectus abdominis muscle above the umbilicus, composed of the aponeuroses of the external obliques, internal obliques, and transverse abdominis, which attach to the linea alba from the anterior and posterior positions. *Source:* Gray's Anatomy, plate 399, <http://education.yahoo.com/reference/gray/illustrations/figure?id=399> (accessed April 4, 2013).

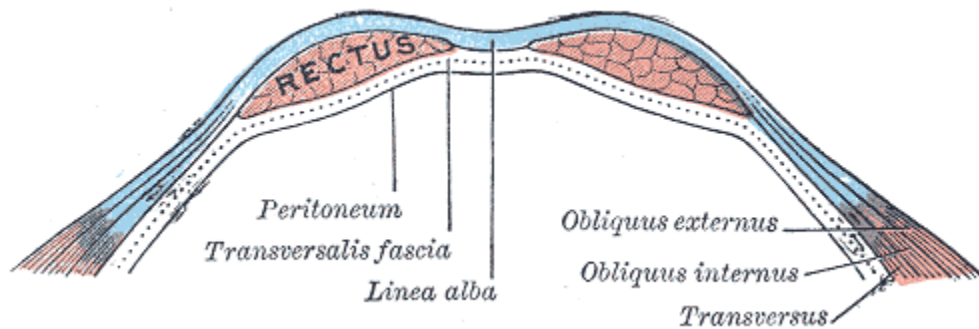


Figure 3. The sheath of the rectus abdominis muscle below the umbilicus, composed of the aponeuroses of the external obliques, internal obliques, and transverse abdominis, which pass in front of the rectus abdominis muscle and attach to the linea alba from the anterior position. *Source:* Gray's Anatomy, plate 400, <http://education.yahoo.com/reference/gray/illustrations/figure?id=400> (accessed April 4, 2013).

<sup>105</sup> *Ibid.*, 67.

<sup>106</sup> Perkins and Kent, 32.

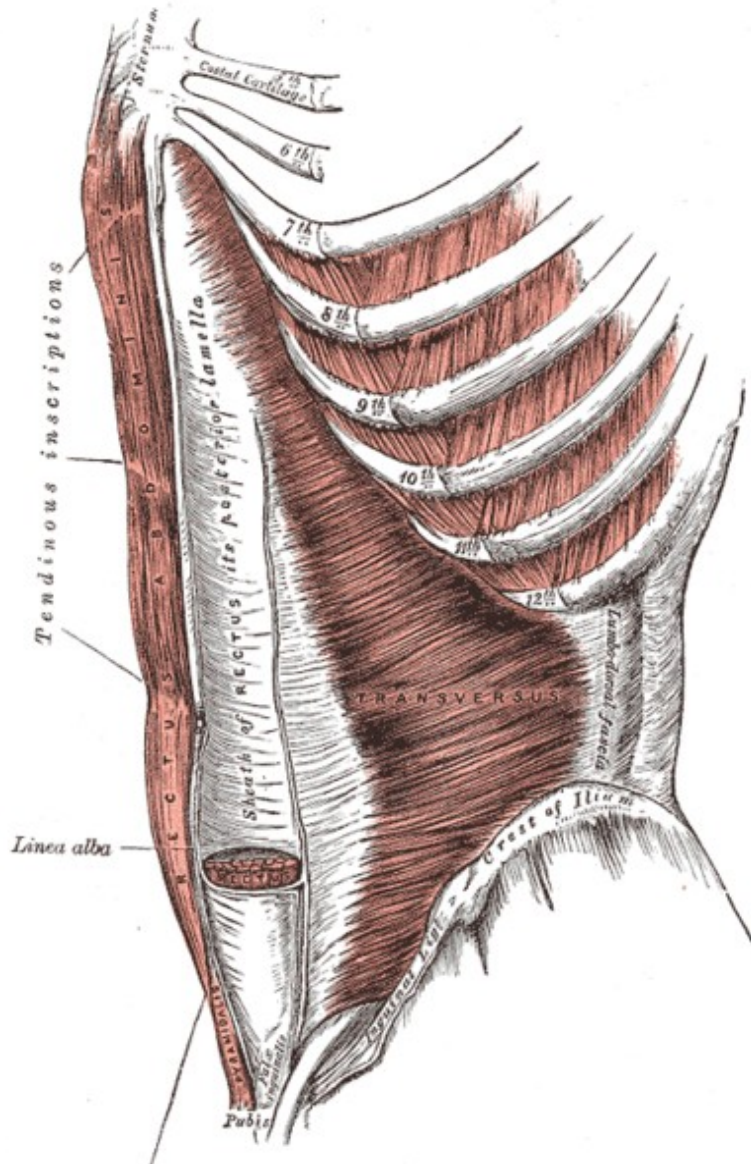


Figure 4. The transverse abdominis and its attachments. *Source:* Gray's Anatomy, plate 397, <http://education.yahoo.com/reference/gray/illustrations/figure?id=397> (accessed April 4, 2013).

The transverse abdominis<sup>107</sup> is the deepest of the lower abdominal muscles. It originates at the vertebrae through the thoracolumbar fascia, the lower six ribs, and the

<sup>107</sup> In this document, “transverse abdominis,” “transverse,” and “transversus” refer to the same muscle, and will be used interchangeably.

iliac crest of the pelvis, and wraps around the body laterally before attaching to the rectus abdominis<sup>108</sup> (see fig. 4). Above the umbilicus, the aponeurosis of the transverse inserts into the linea alba from the posterior position (see fig. 2). Below the umbilicus, it joins the external and internal obliques in attaching to the linea alba from the anterior position<sup>109</sup> (see fig. 3).

The aponeuroses of the external and internal obliques and transverse abdominis create an anterior and a posterior sheath that encloses each half of the rectus abdominis muscle. “Both sheaths surround the vertically oriented rectus abdominis muscle and continue medially to fuse with identical connective tissues from the other side of the abdomen. The connective tissues thicken and crisscross as they traverse the midline, forming the *linea alba*.”<sup>110</sup>

The enclosure of the viscera by the transverse provides a great contribution to the support of the abdominal contents, as well as greatly affecting the power of exhalation. “Contraction of the abdominal muscles—especially the transversus abdominis—increases intra-abdominal pressure and compresses the abdominal viscera . . . to help expel air from the thorax.”<sup>111</sup> The transverse abdominis acts as a corset for the abdomen, and “can compress the viscera with more power than any other muscle. This corset action, to

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<sup>108</sup> Carolyn Richardson et al., *Therapeutic Exercise for Spinal Segmental Stabilization in Low Back Pain: Scientific Basis and Clinical Approach* (United Kingdom: Churchill Livingstone, 1999), 31.

<sup>109</sup> Boissonault and Kotarinos, 66-67.

<sup>110</sup> Donald A. Neumann, *Kinesiology of the Musculoskeletal System*. 2nd ed. (St Louis: Mosby Elsevier, 2010), 390.

<sup>111</sup> Neumann, 447.

which the fibers of the internal and external oblique muscles contribute, is made possible by their attachment to the abdominal aponeurosis.”<sup>112</sup>

Strengthening the transverse abdominis is not only conducive to the breathing mechanism, it is essential during pregnancy. It must be strong to help hold in the abdominal contents, since its inherent structure as it wraps around the body makes it the most effective muscle to do so.<sup>113</sup> A strong transverse is also crucial during labor, as it is extremely helpful when pushing out the baby.<sup>114</sup> In addition, singers may wish to return to their former shape as quickly as possible, due to the aesthetic aspect of onstage performance. Tupler asserts, “Transverse work helps to give you flat abdominals. . . . Because the more diligently you strengthen the muscle during pregnancy, the faster you'll get your shape back afterward.”<sup>115</sup>

A strong transverse is the key to maintaining abdominal integrity during pregnancy and postpartum. “The transversus also plays a role in stabilizing the linea alba due to its course and attachments,”<sup>116</sup> as most of the muscle fibers pass “transversely and medially to the midline, where they decussate<sup>117</sup> and blend with the linea alba.”<sup>118</sup>

“Bilateral activation of the transversus abdominis can stabilize the ribs, linea alba and

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<sup>112</sup> Perkins and Kent, 32.

<sup>113</sup> Richardson et al., 33.

<sup>114</sup> Julie Tupler, *Maternal Fitness* (New York: Simon and Schuster, 1996), 21.

<sup>115</sup> *Ibid.*, 22.

<sup>116</sup> Boissonnault and Kotarinos, 67.

<sup>117</sup> decussate: to intersect in the form of an X, to cross.

<sup>118</sup> Richardson et al., 31.

thoracolumbar fascia—areas that serve as attachments for the internal or external oblique muscles.”<sup>119</sup>

When the transverse abdominis is engaged, this shortens the rectus abdominis muscles and brings together the gap at the linea alba. “All of the abdominal muscles are connected, so that whenever you work the transverse, you're also working the recti—shortening it from the middle and closing up the separation.”<sup>120</sup> If abdominal movement occurs without first engaging the transverse, “you're making that muscle pop out, and that means it's getting longer and weaker.”<sup>121</sup> In addition, abdominal work without transverse engagement can cause strain against the weakened midline of the rectus abdominis.<sup>122</sup> In other words, failure to engage the transverse may cause a gap at the midline, whereas engaging it helps to prevent this from happening or worsening. Modern everyday life, consisting mostly of sitting, standing, and walking at a normal pace, does not provide enough exertion to strengthen these core muscles. Specific resistance exercises are needed.<sup>123</sup>

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<sup>119</sup> Neumann, 392.

<sup>120</sup> Tupler, *Maternal Fitness*, 69.

<sup>121</sup> *Ibid.*, 22.

<sup>122</sup> *Ibid.*, 23.

<sup>123</sup> Noble, 82.



## Diastasis Recti

The separation of the connective tissue at the linea alba is called diastasis recti.<sup>124</sup> The abdomen is naturally weakest at this point, as the linea alba is merely connective tissue between muscles, and “any abdominal strain during pregnancy or labor will be registered at the central junction, just as a seam in your clothes will split before the fabric.”<sup>125</sup> “Coupled with the hormonal softening of the linea alba is the continually increasing stretch placed on the abdominal wall by the growing fetus. As a result, the great amount of tension on an already weakened structure produces a predisposition to separation.”<sup>126</sup>

The presence of a diastasis has negative consequences for any pregnant woman, especially the singing mother-to-be who requires adequate function of the support mechanism. “Functionally, a diastasis of any significance . . . will likely impair both the strength and effectiveness of the rectus abdominis and perhaps do the same to the other muscles of the abdominal wall as well, since their aponeuroses decussate at the linea alba.”<sup>127</sup>

It is important to know if a diastasis is present, as specific exercises can prevent worsening of the condition. Pregnant women should frequently check their midlines for diastasis throughout the pregnancy. To do so, the woman should lie on her back with

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<sup>124</sup> The word *diastasis* means a separation of parts of the body which normally are joined together. *Diastasis recti* refers to the separation of the rectus abdominis. For brevity, diastasis recti will be shortened to “diastasis” in this document, as it is the only diastasis discussed herein.

<sup>125</sup> Noble, 89.

<sup>126</sup> Jill Schiff Boissonnault and Mary Jo Blaschak, “Incidence of Diastasis Recti Abdominis during the Childbearing Year,” *Physical Therapy* 68, no. 7 (July 1988): 1082.

<sup>127</sup> Boissonnault and Kotarinos, 76.

knees bent, placing the fingers of one hand horizontally into the softened area at the navel. Then she should slowly raise her head and then shoulders off the ground toward the knees, and note how many fingers fit horizontally into the gap. This check should be performed above and below the navel as well. A gap wider than the width of two fingers requires rehabilitation.<sup>128</sup>

### *Incidence of Diastasis*

Diastasis may appear at any time during a pregnancy. Boissonault and Blaschak found that nearly one-third of first-time mothers had a diastasis in the second trimester, and two-thirds developed one in the third trimester,<sup>129</sup> while Hannaford and Tozer found that all women in their study exhibited a diastasis wider than that exhibited in the control group.<sup>130</sup> In the former study, most women showed a diastasis at the umbilicus (52%) or above it (36%), with fewer diastases present below the umbilicus (11%). Many women had diastasis in more than one location.<sup>131</sup>

Women pregnant for a second time may show a diastasis even earlier if a gap was present in a previous pregnancy.<sup>132</sup> Noble indicates that multiple pregnancy (two or more fetuses), excess amniotic fluid, a large baby, or obesity in the mother may increase the

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<sup>128</sup> Noble, 90.

<sup>129</sup> Boissonault and Blaschak, 1085.

<sup>130</sup> Ruth Hannaford and Julie Tozer, "An Investigation of the Incidence, Degree, and Possible Predisposing Factors of Rectus Diastasis in the Immediate Post Partum Period," *Journal of the National Group in Obstetrics and Gynaecology* 4, no. 2 (1985): 34.

<sup>131</sup> Boissonault and Blaschak, 1085.

<sup>132</sup> Noble, 89.

risk and severity of a diastasis.<sup>133</sup> Boissonnault and Blaschak theorize, “The multiparous<sup>134</sup> woman would probably be at a greater risk for development of diastasis recti abdominis simply by virtue of the repeated stretch on the abdominal wall.”<sup>135</sup> Other research shows no evidence that diastasis is predisposed by the number of previous pregnancies, mother’s age or weight gain, or the weight of the baby.<sup>136</sup>

In the first few days postpartum, research indicates that all women will have some degree of separation, and the majority will have a significant gap of two fingers-width or more.<sup>137</sup> The most improvement comes in the first two weeks postpartum,<sup>138</sup> but in most women, the gap simply will not close on its own, nor will the muscles return to their previous length or thickness. Some improvement does occur naturally, but even at a year postpartum, one study showed both thinner rectus muscles and a gap of more than twice the width of nulliparous<sup>139</sup> women.<sup>140</sup>

“[Diastasis] does not necessarily resolve itself spontaneously, and the condition should not be thought normal. Rather, it should be treated as a pathologic condition.”<sup>141</sup>

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<sup>133</sup> Ibid., 90.

<sup>134</sup> multiparous: referring to a woman who has borne more than one child.

<sup>135</sup> Boissonnault and Blaschak, 1086.

<sup>136</sup> Hannaford and Tozer, 34.

<sup>137</sup> S. Gail Bursch, “Interrater Reliability of Diastasis Recti Abdominis Measurement,” *Physical Therapy* 67, no. 7 (July 1987): 1079.

<sup>138</sup> Yvonne Coldron et al., “Postpartum Characteristics of Rectus Abdominis on Ultrasound Imaging,” *Manual Therapy* 13 (2008): 116.

<sup>139</sup> nulliparous: referring to a woman who has never borne children.

<sup>140</sup> Coldron et al., 116.

<sup>141</sup> Boissonnault and Kotarinos, 75.

Only in rare cases will the diastasis be severe enough to require surgery. “The relaxations which result from extreme stretching of the abdominal wall during nine months of pregnancy, or during repeated pregnancies, are seldom repaired by gynecologists or surgeons, unless they are severe—when they become primary indications for operations. Such patients are relatively few in number.”<sup>142</sup>

### *Diastasis Reduction and Prevention*

The only factor that has been shown to reduce the incidence of diastasis is exercise before and during pregnancy. Women who exercised regularly before pregnancy showed a decreased incidence of diastasis.<sup>143</sup> In addition, diastasis was wider in women who did not exercise regularly during pregnancy.<sup>144</sup> It appears that the type of exercise performed is important, as regular aerobic exercise alone may not prevent diastasis.<sup>145</sup>

Exercises specifically targeting the transverse abdominis showed the greatest impact. In a study specifically designed to test the efficacy of transverse exercises, only 12.5% of exercising pregnant women showed a diastasis, as opposed to 90% of non-exercising pregnant women in the control group.<sup>146</sup> Chiarello et al. reported, “We believe that the exercises performed by the pregnant women in this study may have prevented the

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<sup>142</sup> Brooks Ranney, “Diastasis Recti and Umbilical Hernia Causes, Recognition and Repair,” *South Dakota Journal of Medicine* 43, no. 10 (October 1990): 8.

<sup>143</sup> Boissonnault and Blaschak, 1085.

<sup>144</sup> Hannaford and Tozer, 34.

<sup>145</sup> Wendy L. Gillear and J. Mark M. Brown, “Structure and Function of the Abdominal Muscles in Primigravid Subjects during Pregnancy and the Immediate Postbirth Period,” *Physical Therapy* 76, no. 7 (July 1996): 761.

<sup>146</sup> Cynthia M. Chiarello et al., “The Effects of an Exercise Program on Diastasis Recti Abdominis in Pregnant Women,” *Journal of Women’s Health Physical Therapy* 29, no. 1 (Spring 2005): 11.

onset of [diastasis] because the exercises targeted the transversus abdominis as well as the internal and external obliques, thus strengthening the integrity of the linea alba as well as providing abdominal strengthening.”<sup>147</sup>

Many women are not screened for diastasis during or after pregnancy, and so are receiving contraindicated instructions for exercise.<sup>148</sup> This is a great disservice, as “exercises that target the return of normal IRD [inter-recti distance], RA [rectus abdominis] width, thickness and length...are required.”<sup>149</sup> According to Tupler, transverse exercises “can prevent a diastasis if you start early in your pregnancy. If you already have one, they will help stop it from getting bigger and may even close it up.”<sup>150</sup>

Some gap occurs in all pregnancies, so a one to two finger-widths separation (about two centimeters) is normal.<sup>151</sup> A gap with three or more finger-widths is considered problematic, and so certain exercises and movements should be avoided, while other exercises should be undertaken to close the gap or at least maintain the current width. The presence of a diastasis means that many traditional abdominal exercises should be avoided until the gap is closed.<sup>152</sup> Many exercises (including those discussed in the next chapter) are still safe.<sup>153</sup> When performing an abdominal exercise, the woman with a diastasis should manually hold the two halves of the rectus abdominis

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<sup>147</sup> Ibid., 15.

<sup>148</sup> Bursch, 1079.

<sup>149</sup> Coldron et al., 120.

<sup>150</sup> Tupler, *Maternal Fitness*, 30.

<sup>151</sup> Noble, 90.

<sup>152</sup> Ibid., 92-93.

<sup>153</sup> Ibid., 90.

together by crossing her wrists over her abdomen and using her hands to splint the abdominals together.<sup>154</sup> “A gross [diastasis] may be widened farther by routine postnatal exercises which are not modified to ensure the rectus bellies approximate.”<sup>155</sup>

### *Diastasis and the Singer*

The singer with a diastasis may find abdominal support for singing quite compromised, and even uncomfortable, especially in subsequent pregnancies. Noble does not recommend regular use of artificial supports during or after pregnancy, as she believes wearing a support allows the abdominal muscles to remain passive instead of actively strengthening with the pregnancy. However, she allows that a supportive girdle-like garment (often labeled as a maternity or postpartum support) may be helpful when used sparingly and for short periods of time, in cases where the abdominal muscles are more likely to be pulled apart, such as obesity, multiple pregnancy, or diastasis recti.<sup>156</sup> Thus, the use of a girdle or similar supportive wrap while singing may help bring the halves of the rectus abdominis closer together and may improve muscle function.

Another option for external diastasis support is kinesiology tape, also known as elastic therapeutic tape. This can be used to alleviate multiple symptoms of pregnancy,<sup>157</sup> and one physical therapist found it helpful in treating patients with diastasis recti.<sup>158</sup>

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<sup>154</sup> Helen Byrne, “Diastasis Recti,” [http://www.befitmom.com/diastasis\\_recti.html](http://www.befitmom.com/diastasis_recti.html) (accessed February 11, 2013).

<sup>155</sup> Sally Sheppard, “Case Study: The Role of the Transversus Abdominus in Post Partum Correction of Gross Divarication Recti,” *Manual Therapy* 1, no. 4 (September 1996): 214.

<sup>156</sup> Noble, 139.

<sup>157</sup> Theratape.com, “Pregnancy Tape for Moms,” <http://www.theratape.com/education-center/wp-content/uploads/2010/08/rocktape-pregnancy-poster1.pdf> (accessed November 1, 2012).

Singers may be concerned that abdominal exercises during pregnancy or postpartum will impede flexibility or restrict breath capacity. In truth, developing abdominal strength will only help the vocal instrument. Friedlander advised,

You need to build strength and flexibility throughout the torso, so that your abs do not become chronically tight. Overstretched abs that let your belly pooch out do not help breath technique. On the contrary, excessive weakness in the abs leads to excessive tightness in the muscles of the spine and lower ribs, which will cause you to arch your lower back and restrict rib movement – and this *will* significantly decrease your breath capacity. . . .<sup>159</sup>

The more supple and resilient our muscles of respiration, the better they respond to the demands of singing.<sup>160</sup>

### Cesarean Section

It is important for singers to know exactly what a cesarean entails, from the reasons for and incidence of the surgery, to the types of anesthesia used, to the different types of abdominal incisions. Despite Noble’s assertion that “birth is as safe as life will ever be,”<sup>161</sup> the experience of many doctors is that “when something goes wrong during labor, it generally doesn't go just a little bit wrong. Things can go from bad to tragic in a matter of minutes.”<sup>162</sup> If a cesarean section becomes necessary during labor, the woman

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<sup>158</sup> Myrna Parmentier, “Diastasis Recti: A Solution,” Kinesiotaping.com, <http://www.kinesiotaping.com/images/kinesio-association/pdf/research/2003-1.pdf> (accessed November 1, 2012).

<sup>159</sup> Claudia Friedlander, “Sports-Specific Training for the Vocal Athlete, Part 1: How Exercise Can Support Your Vocal Technique,” *Classical Singer*, February 2005, 20.

<sup>160</sup> *Ibid.*, 21.

<sup>161</sup> Noble, 173.

<sup>162</sup> Maureen Connolly and Dana Sullivan, *The Essential C-section Guide* (New York: Broadway Books, 2004), 7.

is better equipped to make educated decisions if she has amassed the appropriate knowledge ahead of time.

### *Reasons for Cesarean Section*

There are three categories of cesarean section, defined by the reasons for the surgery. The planned (or elective) cesarean is performed for medical reasons that become apparent during pregnancy, causing the surgery to be scheduled before the estimated due date. The unplanned (or emergency) cesarean is caused by medical problems that present during labor (or occasionally during pregnancy), and is used to safeguard the well-being or life of the mother or baby. Patient-choice cesareans are scheduled for reasons of convenience or status, and are not to be confused with the planned/elective cesarean, as the latter are not medically necessary.<sup>163</sup>

Elective C-sections may be planned in advance for several reasons. A twin pregnancy increases the risk for C-section, accounting for half of all twin deliveries.<sup>164</sup> With higher order multiples, “the likelihood of having a cesarean birth increases with the number of babies a woman is carrying.”<sup>165</sup> In single or multiple pregnancies, improper fetal presentation is another cause for an elective cesarean. If the baby is feet or buttocks down (breech), lying horizontally or at an angle (transverse), or presenting forehead first (brow), many physicians will not allow even a trial of labor, as they consider the risk to

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<sup>163</sup> Ibid., 21-22.

<sup>164</sup> Rita Rubin, *What If I Have a C-section? How to Prepare, How to Decide, How to Recover Quickly* (Emmaus, PA: Rodale, 2004), 34.

<sup>165</sup> American College of Obstetricians and Gynecologists, “Frequently Asked Questions: Cesarean Birth,” <http://www.acog.org/~media/For%20Patients/faq006.pdf?dmc=1&ts=20121217T1213232164> (accessed December 17, 2012).



the baby to be too great.<sup>166</sup> In addition, several medical conditions in the mother, such as high blood pressure, diabetes, HIV, or herpes, may cause the physician to recommend an elective cesarean.<sup>167</sup>

The size of the baby can be another reason for scheduling a planned C-section. Cephalopelvic disproportion refers to the difference between the size of the baby's head and the size of the mother's pelvis. Almost all women diagnosed with cephalopelvic disproportion have cesareans.<sup>168</sup> Macrosomia is another size-related cause of planned C-sections. The term means "big body," and refers to babies who are predicted to be large for their gestational age.<sup>169</sup>

Some medical conditions arise so quickly or are severe enough that an emergency cesarean becomes necessary. Pregnancy-induced high blood pressure in the mother, called preeclampsia or toxemia, affects one in twenty women, usually first-time mothers, and may cause restriction of growth in the baby and organ damage in the mother. The only cure is delivery of the baby, but some measures may be taken to extend the pregnancy until the baby is mature enough to be delivered.<sup>170</sup>

Placental problems also account for a large portion of cesareans. Most women with placenta previa (a condition in which the placenta is partially or completely covering

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<sup>166</sup> Connolly and Sullivan, 15.

<sup>167</sup> ACOG, "Cesarean Birth."

<sup>168</sup> Rubin, 5.

<sup>169</sup> *Ibid.*, 23.

<sup>170</sup> *Ibid.*, 39-41.

the cervix) will deliver via C-section, as the birth canal is blocked by the placenta<sup>171</sup> and the risk of maternal hemorrhage during labor or after birth is potentially life-threatening.<sup>172</sup> Placenta abruptio refers to the partial or total detachment of the placenta from the uterine wall. A small detachment may only result in prescribed bed rest but severe detachments are extremely dangerous and require an emergency C-section.<sup>173</sup>

Finally, many unplanned (emergency) cesareans are performed after hours of labor. Concern for the baby is paramount. If the physician has reason to believe that the fetal heart rate is abnormal, a cesarean is likely to be recommended, even if only to err on the side of caution, and is reliant upon a judgment call by the doctor and patient.<sup>174</sup>

Many justifications for cesareans are grouped together under the classification of dystocia, which refers to an unusually slow or difficult labor, or failure to progress,<sup>175</sup> to such an extent that the safety of the mother or baby is in question.<sup>176</sup> “Because many repeat cesarean sections are performed after primary operations for dystocia, an estimated 60% of all cesarean deliveries in the United States are attributable to the diagnosis of dystocia. . . . Dystocia is the leading cause of . . . cesarean delivery and [its] accompanying complications.”<sup>177</sup> Sometimes uterine contractions are too weak or

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<sup>171</sup> Ibid., 38-39.

<sup>172</sup> Connolly and Sullivan, 17.

<sup>173</sup> Ibid., 17.

<sup>174</sup> Ibid., 13-14.

<sup>175</sup> Rubin, 28-29.

<sup>176</sup> Connolly and Sullivan, 11.

<sup>177</sup> American College of Obstetricians and Gynecologists, “ACOG Practice Bulletin, Number 49, December 2003: Dystocia and Augmentation of Labor,” *Obstetrics and Gynecology* 102, no. 6 (December 2003): 1445.

inconsistent to open the cervix. In these cases, some techniques may be used to encourage labor to progress, including rest, positional change, induction drugs, and artificial rupture of the amniotic sac. These techniques are often referred to as “active management of labor,” and when they fail to achieve the desired result (again, a judgment call by the attending physician), a cesarean is usually necessary.<sup>178</sup>

### *Incidence of Cesarean Section*

In 2011, nearly one-third of all deliveries in the United States were via cesarean section.<sup>179</sup> When considering the number of total cesareans, one must take into account the fact that 89% of women with a previous cesarean choose a repeat cesarean for subsequent children,<sup>180</sup> meaning that many cesareans are elective and not emergency. Also contributing to the number of total cesareans is the fact that the number of women giving birth in their thirties and forties is increasing,<sup>181</sup> and their age puts them at greater risk for a C-section due to the age-related risks of the pregnancy itself.<sup>182</sup>

Connolly and Sullivan believe that “medical advances during the last several decades have made C-section surgery much safer, so today many physicians will opt for a

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<sup>178</sup> Connolly and Sullivan, 12.

<sup>179</sup> Brady E. Hamilton, Joyce A. Martin and Stephanie J. Ventura, “Births: Preliminary Data for 2011,” *National Vital Statistics Reports* 61, no. 5 (October 3, 2012): 4, [http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61\\_05.pdf](http://www.cdc.gov/nchs/data/nvsr/nvsr61/nvsr61_05.pdf) (accessed February 2, 2013).

<sup>180</sup> Fay Menacker, “Trends in Cesarean Rates for First Births and Repeat Cesarean Rates for Low-Risk Women: United States, 1990-2003,” *National Vital Statistics Reports* 54, no. 4 (September 22, 2005): 3, [http://www.cdc.gov/nchs/data/nvsr/nvsr54/nvsr54\\_04.pdf](http://www.cdc.gov/nchs/data/nvsr/nvsr54/nvsr54_04.pdf) (accessed February 2, 2013).

<sup>181</sup> Hamilton, Martin and Ventura, “Births 2011,” 3.

<sup>182</sup> Connolly and Sullivan, 7.

cesarean birth well before the situation becomes desperate,”<sup>183</sup> and continue to reassure mothers-to-be:

While a C-section is thought of as a significant surgical procedure, most OBs [obstetricians] consider it to be less complicated than a hysterectomy or breast augmentation. Due to the frequency with which Cesarean surgeries are performed, you can be assured that your OB's skills won't get rusty. While there are risks involved with a Cesarean, in many circumstances it is still safer for both mother and baby than forceps delivery, which used to be the only option for delivering a baby in a “difficult” situation.<sup>184</sup>

### *Surgical Considerations for the Singer*

When contemplating any abdominal surgery, the singer is likely to have two major concerns: intubation and abdominal muscle incision. These may be necessary in a cesarean section, though not in all cases.

Two types of anesthesia are used for C-sections: regional anesthesia (a spinal block or an epidural) and general anesthesia. General anesthesia is used only in extreme emergency C-sections, as it takes effect so quickly that the surgeon can begin operating within minutes. Use of general anesthesia for a cesarean section is rare, because even in unplanned cesareans there is usually still time to place a spinal block or epidural instead of general anesthesia.<sup>185</sup> In cases of emergency cesareans, when there is not enough time to administer the epidural or spinal block, general anesthesia is administered on two fronts—intravenous medication and intubation to provide inhalation of sedating gases. It

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<sup>183</sup> Ibid., 6.

<sup>184</sup> Ibid., 26-27.

<sup>185</sup> Ibid., 27.

takes effect within seconds, putting the patient to sleep so she is not awake when the baby is born.<sup>186</sup>

If it becomes clear that general anesthesia via intubation is necessary, the singer should take some precautions to best protect her larynx. A discussion with the anesthesiologist is paramount. It should be clearly stated that the woman is a professional voice user and that extreme care must be taken during the procedure. Ragan and Gangopadhyay caution the singer,

One must not underestimate the importance of making it clear in advance of surgery that you are a singer. . . . Singers should be particularly communicative with physicians and anesthesiologists who are not specialists in issues of the larynx. . . . Make assurances that the most experienced person in the room is responsible for the intubation procedure. It is your right to do so.<sup>187</sup>

During intubation, the anesthesiologist should use the smallest tube that can still be effective. The woman should be as relaxed as possible during the placement and removal of the tube as well as during the surgery, so that the vocal folds do not move involuntarily.<sup>188</sup> The tube should be well secured to prevent any movement of the tube against the vocal folds or mucosa during surgery.<sup>189</sup> Finally, the risk of post-surgical vomiting or reflux should be mitigated by postoperative anti-nausea and antireflux (or proton pump inhibiting) medications to protect the larynx from additional trauma.<sup>190</sup> Jahn reminds singers, “Although one needs to be aware of all options, in serious cases the

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<sup>186</sup> Ibid., 30.

<sup>187</sup> Ragan and Gangopadhyay, 44.

<sup>188</sup> Jahn, “Anesthesia,” 272.

<sup>189</sup> Ragan and Gangopadhyay, 44.

<sup>190</sup> Ibid., 45.

patient naturally needs to defer to the doctor's experience; one's life and well-being take precedence over a temporary encumbrance to one's voice. . . . While there are occasional incidents of significant trauma to the larynx, in most situations these are truly rare."<sup>191</sup>

Regarding abdominal incisions, the surgeon will likely choose from three kinds of abdominal incisions: two horizontal incisions (the Pfannenstiel and the Maylard) and the vertical incision. The Pfannenstiel incision, or "bikini cut," is the most common type of abdominal incision used in nonemergency cesareans, planned or unplanned. The Maylard incision is located a bit higher, and is used to deliver a very large baby, or when there is substantial scarring from a previous Pfannenstiel incision. The vertical incision allows for quick entry and minimal blood loss, and so is often used in emergency cesareans, in obese women, or in the case of a side-lying baby.<sup>192</sup>

This initial abdominal incision cuts through the skin and layers of fat, and is followed by the cutting of the sheathing surrounding the abdominal muscles.<sup>193</sup> In two of the three incisions, the abdominal muscles themselves are not cut. The Pfannenstiel and vertical incisions leave the muscles intact, with the surgeon simply separating the two halves of the rectus muscle gently by hand.<sup>194</sup>

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<sup>191</sup> Jahn, "Anesthesia," 272.

<sup>192</sup> Connolly and Sullivan, 36.

<sup>193</sup> Ibid.

<sup>194</sup> Patnaik, V.V.G., Raglan K. Singla, and V. K. Bansal, "Surgical Incisions—Their Anatomical Basis: Part IV-Abdomen," *Journal of the Anatomical Society of India* 50, no. 2 (2001): 171-175, <http://medind.nic.in/jae/t01/i2/jaet01i2p170.pdf> (accessed December 18, 2012).

In the case of the Maylard incision, the rectus muscles are cut from side to side.<sup>195</sup> While this would understandably make the singer nervous about the future function of her abdominal muscles, there may be no reason for alarm. One study comparing the Pfannenstiel and Maylard incisions found that the Maylard incision did not cause more pain in the patient or increase the number of postoperative complications. Even more reassuring was the conclusion that there was no significant difference in postoperative rectus abdominis strength between the two, even as early as one month postpartum.<sup>196</sup>

Upon transfer from the postsurgical recovery room to the standard hospital room, the process of recovery from a cesarean section begins. First, the immediate aftermath of surgery must be managed. As soon as possible, the mother should begin deep breathing, which will help rid the body of any lingering anesthesia. Diaphragmatic breathing used by singers is extremely helpful in this process,<sup>197</sup> although it may feel more comfortable to support the incision area with a pillow.<sup>198</sup> Other types of breathing not normally used in singing, such as lower chest expansion and upper chest expansion, should also be utilized.<sup>199</sup>

Pain medication may be given in the form of ibuprofen (a nonsteroidal anti-inflammatory [NSAID]). Some singers may be wary of taking NSAIDs due to fear of vocal fold hemorrhage. However, the recommendation from The National Center for

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<sup>195</sup> Pierre-Ludovic Giacalone et al., "Pfannenstiel Versus Maylard Incision for Cesarean Delivery: A Randomized Controlled Trial," *Obstetrics and Gynecology* 99, no. 5, part 1 (May 2002): 745.

<sup>196</sup> Ibid.

<sup>197</sup> Connolly and Sullivan, 52.

<sup>198</sup> Wicklund, 11.

<sup>199</sup> Connolly and Sullivan, 53.

Voice and Speech limits the warning to times of intense singing: “Those who use their voices rigorously should be cautious about using medications that decrease platelet function during periods of strenuous voicing demands, due to an increased possibility of vocal fold hemorrhage.”<sup>200</sup> Taking ibuprofen during a cesarean recovery would not run counter to this guideline, as it is unlikely that there will be any strenuous singing for several weeks, or even months, after surgery.

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<sup>200</sup> The National Center for Voice and Speech, “Check Your Meds: Do They Affect Your Voice?” <http://www.ncvs.org/rx.html> (accessed December 26, 2012).



## CHAPTER 4

### PROTECTING AND REHABILITATING THE ABDOMINAL CORE DURING THE PREGNANCY AND POSTPARTUM PERIODS

#### Introduction

During pregnancy, prevention is the key to avoiding disorders. The commitment to a regular exercise regimen for the abdominal muscles will enable a quicker recovery from pregnancy because “supple muscles, which have maintained optimal contractile ability and blood circulation with exercise, will lengthen easily during pregnancy, and shorten more quickly afterward”<sup>201</sup> and “a healthy, active muscle regains its shape, elasticity, and function much sooner than a neglected one.”<sup>202</sup> In addition, the muscles weakened by pregnancy that contribute to postural discomfort and breathing inefficiency are the same muscles that need to be rehabilitated after pregnancy.<sup>203</sup> In short, regular abdominal work benefits the singer in both the pregnancy and postpartum periods.

Singers are accustomed to self-analysis, regularly assessing weaknesses in muscle strength and coordination, and are able to develop a plan of action for correcting these imbalances. This awareness and problem-solving skill should be used during pregnancy to sense weakness or stress in the muscles of the body and either strengthen or stretch to counteract the natural effects of pregnancy.<sup>204</sup> The pregnant body needs exercise to stretch muscles that are shortening, such as the lower back muscles, and to shorten and

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<sup>201</sup> Noble, 83.

<sup>202</sup> Ibid., 32.

<sup>203</sup> Ibid., 26.

<sup>204</sup> Ibid.

strengthen muscles that are lengthening and working harder during pregnancy, such as the abdominal muscles.<sup>205</sup> Noble recommends that women begin a targeted exercise program even before becoming pregnant. “The essential exercises can be begun at any time and continued throughout life as they also will maintain your health and comfort through the coming decades. Ideally, begin exercising as soon as possible, even before conception.”<sup>206</sup>

Modifications of movement in daily activities are also imperative. “Lifting, twisting, bending, and standing . . . put a tremendous strain on your back and can make your abdominal separation bigger if you do these movements incorrectly.”<sup>207</sup>

Recovery from cesarean section requires even more modification in movement as the mother contends with pain in the abdomen. Specific exercises are used to gradually transition the recovering cesarean patient from the immediate postsurgical period to a time of continued healing and rehabilitation at home.

### **Guidelines for Exercise**

In these abdominal exercises, as in any exercise, exhalation should occur on the exertion. There may be an inclination to use the Valsalva maneuver, which “occurs when the person attempts to breathe out against tightly adducted (closed) vocal cords.”<sup>208</sup> This technique does achieve stabilization of the torso and increase pushing power, but

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<sup>205</sup> Tupler, *Maternal Fitness*, 29-30.

<sup>206</sup> Noble, 31.

<sup>207</sup> Julie Tupler, *Lose Your Mummy Tummy* (New York: Da Capo Press, 2005), 77.

<sup>208</sup> Marilee David, “Designing a Program of Vocal Hygiene for Singers,” *Journal of Singing* 53, no. 1 (September 1996): 17.

adversely affects the vocal cords, by creating the habit of over-adducting the vocal folds rather than allowing steady air flow to bring the cords together.<sup>209</sup> “It is important for the singer to avoid those activities which may elicit the Valsalva response,”<sup>210</sup> because “any exercises that call for heavy breathing or sudden closures of the vocal cords are not conducive to good vocal condition.”<sup>211</sup>

In addition to the detriments to the larynx, holding the breath while using the Valsalva maneuver decreases blood flow and oxygen supply to the fetus, and so should be avoided during pregnancy and labor.<sup>212</sup> Finally, this technique also “distends the abdominal wall outward and forms a closed pressure system. This strain puts great stress on the abdominal muscles and the vulnerable midline uniting them.”<sup>213</sup>

Each exercise should begin with a diaphragmatic breath through the nose. During the exertion, a steady exhalation through the mouth should be maintained while engaging the transverse.<sup>214</sup> Any exercise that requires holding the breath to complete the exercise is too taxing.<sup>215</sup>

If an artificial support of any kind is used, such as a wrap or kinesiology tape, it should be removed during exercise sessions, allowing the muscles to perform the desired

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<sup>209</sup> Friedlander, 67.

<sup>210</sup> David, 17.

<sup>211</sup> William Ernest Ross, *Secrets of Singing* (Bloomington: Indiana University Book Store, 1959), 92.

<sup>212</sup> Noble, 156.

<sup>213</sup> *Ibid.*, 155.

<sup>214</sup> Tupler, *Maternal Fitness*, 47.

<sup>215</sup> Noble, 38.

exercise without additional assistance from the support.<sup>216</sup> In addition, the mother should check for diastasis frequently,<sup>217</sup> and if a diastasis develops, she should use her hands to pull the two halves of the rectus abdominis together when performing every single exercise.<sup>218</sup>

Basic movements may progress to more difficult exercises.<sup>219</sup> As the pregnancy progresses and the abdominal muscles are stretched and taxed, especially in the third trimester, certain exercises may become too difficult, necessitating a return to basic movements.<sup>220</sup> Consistent exercise is still necessary to maintain core strength, even though the abdominal muscles may feel taut and strong due to the firmness of the underlying uterus.<sup>221</sup>

During pregnancy and postpartum periods, “if you find you cannot hold the transverse . . . when you are doing any exercise, do not proceed with that activity.”<sup>222</sup> This applies not only to specific exercises, but also to many movements made as a part of daily activity. Modifications in everyday movement will be discussed later in the chapter, but should be kept in mind at all times, as the vulnerable midline needs to be protected with constant vigilance.<sup>223</sup>

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<sup>216</sup> Ibid., 139.

<sup>217</sup> For instructions on performing a diastasis check, see page 32 of this document.

<sup>218</sup> Byrne, “Diastasis Recti.”

<sup>219</sup> Noble, 95-96.

<sup>220</sup> Ibid., 45.

<sup>221</sup> Ibid., 83.

<sup>222</sup> Tupler, *Maternal Fitness*, 89.

<sup>223</sup> Tupler, *Lose Your Mummy Tummy*, 78.

## Supine Exercise during Pregnancy

Many of the exercises which target the transverse abdominis are intended to be performed in the supine (back-lying) position, with the body completely reclined, and the head and shoulders flat, without resting on pillows.<sup>224</sup> This is the most effective position for transverse work because, as Tupler asserts, “the higher you lift your head above your hips, the harder it is to engage your transverse. In fact, it's impossible!”<sup>225</sup> The transverse abdominis and other abdominal muscles are completely inactive while supine,<sup>226</sup> thereby allowing for a full range of motion since “the abdominal muscles work during the first 45 degrees of trunk raising.”<sup>227</sup>

Many guidelines for exercise during pregnancy advise that supine exercises be discontinued after the first trimester.<sup>228</sup> The rationale behind this recommendation is that the weight of the uterus may compress the vena cava, impeding blood return to the heart.<sup>229</sup> This results in supine hypotension (low blood pressure).<sup>230</sup> Many of these limits

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<sup>224</sup> Noble, 83.

<sup>225</sup> Tupler, *Lose Your Mummy Tummy*, 78.

<sup>226</sup> Richardson et al., 33.

<sup>227</sup> Noble, 83.

<sup>228</sup> Canadian Society for Exercise Physiology, “PARmed-X for Pregnancy: Physical Activity Readiness Medical Examination,” <http://www.csep.ca/cmfiles/publications/parq/parmed-xpreg.pdf> (accessed November 1, 2012); American College of Sports Medicine, *ACSM's Guidelines for Exercise Testing and Prescription*. 6th ed., ed. Barry A. Franklin, Mitchell H. Whaley and Edward T. Howley (Philadelphia: Lippincott Williams and Wilkins, 2000), 231; American College of Obstetricians and Gynecologists, “Frequently Asked Questions: Exercise during Pregnancy,” <http://www.acog.org/~media/For%20Patients/faq119.pdf?dmc=1&ts=20120313T1729416964> (accessed November 1, 2012).

<sup>229</sup> Steven L. Clark et al., “Position Change and Central Hemodynamic Profile during Normal Third-Trimester Pregnancy and Post Partum,” *American Journal of Obstetrics and Gynecology* 164, no. 3 (March 1991): 887.

<sup>230</sup> Noble, 43.

are based on the official committee opinion of the American Congress of Obstetricians and Gynecologists,<sup>231</sup> who in turn cite a study of cardiac output in pregnant women. This study was conducted on ten women who were nearly full-term at thirty-six to thirty-eight weeks' gestation, meaning that the uterus was much bigger than the uterus at only three months pregnant, when supine exercise is recommended to cease. Cardiac output was decreased by 9% in the supine position, as compared to lying on the left side. The decrease of cardiac output was even greater in the standing position, by 18%.<sup>232</sup> The authors of the study remarked,

It was surprising that cardiac output during the late phase of pregnancy was actually lower in the standing position than that in the supine position. Whereas avoidance of the supine position has long been a mainstay of the management of the late phase of pregnancy, these results have significant negative implications . . . for working women who must stand motionless for long periods of time.<sup>233</sup>

Some prenatal exercise experts have concluded that the supine position is relatively safe for use during pregnancy.<sup>234</sup> Women experiencing supine hypotension are usually warned by feeling dizzy or light-headed, enabling them to change positions.<sup>235</sup>

Clapp opines,

Floor exercises on the back appear to be OK unless the woman gets dizzy or the fetal heart rate response is abnormal. If one of these problems occurs, the woman should turn on her left side. Remember, lying still under the weight of the womb is what causes the problem, because the weight of the enlarged womb compresses and blocks the large vein that returns blood to the heart (inferior vena cava). My

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<sup>231</sup> American College of Obstetricians and Gynecologists, "Committee Opinion: Exercise during Pregnancy and the Postpartum Period," *Obstetrics and Gynecology* 99 (2002): 172.

<sup>232</sup> Clark et al., 883.

<sup>233</sup> *Ibid.*, 886.

<sup>234</sup> James F. Clapp III, *Exercising through Your Pregnancy* (Omaha, NE: Addicus Books, 2002), 201; Noble, 44; Tupler, *Maternal Fitness*, 48.

<sup>235</sup> Noble, 44.

experience indicates that as long as the legs and torso are moving, interference with blood flow back to the heart should not be a problem.<sup>236</sup>

As this is a contested debate, some caution is warranted. The pregnant woman can find a middle ground between exercising in the supine position for long periods of time and avoiding it altogether to the detriment of her abdominal muscles. She may choose to limit supine exercises to a few minutes at a time, alternating with non-supine exercises or simply resting on one side in between.<sup>237</sup>

Dizziness can also occur from rising too quickly from a lying position (orthostatic hypotension), so care should be taken when rising after concluding a supine exercise.<sup>238</sup> Women would also be wise to avoid motionless standing, as this also decreases cardiac output.<sup>239</sup>

## **Exercise and Movement during Pregnancy**

### *Abdominal Exercises*

These abdominal exercises are based on the recommendations of physical therapists and prenatal exercise experts. Although exercises can be easily performed at home, it would be most beneficial to first consult with a physical therapist trained in women's health issues to check for diastasis and to provide additional information, as

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<sup>236</sup> Clapp, 201.

<sup>237</sup> Noble, 44.

<sup>238</sup> *Ibid.*, 38.

<sup>239</sup> ACOG, "Exercise During Pregnancy," 172.

well as to confirm the correct performance of exercises.<sup>240</sup> Women should also discuss their plans with their health care provider before beginning any new exercise program. If a diastasis is present, the two halves of the rectus abdominis should be splinted together manually when performing each exercise.<sup>241</sup> Tupler reminds pregnant women to perform these exercises “each day, even when you’re short on time, low on energy, or out of motivation.”<sup>242</sup>

*Exercise 1—Pulling in the abdomen with the transverse abdominis*

Lie on the back, with head and feet on the floor and knees bent (the so-called “hook-lying” position). Inhale through the nose, then on exhalation through the lips, pull in the lower abdominal muscles with the transverse, and hold before releasing.<sup>243</sup> Perform five to twenty repetitions.<sup>244</sup>

Releasing the abdominal wall upon inhalation is crucial, as it “gives you a running start on moving the muscle you want to move. It also puts the muscle in the proper starting position. When you take a belly breath, the transverse comes forward passively, so the only way it can go *in* is when you do the work part of the exercise, and that’s where you want it, *in*.”<sup>245</sup>

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<sup>240</sup> More information on the Section on Women's Health of the American Physical Therapy Association, including a tool for locating a physical therapist trained in women's health issues, can be found at <https://www.womenshealthapta.org/plp/index.cfm>.

<sup>241</sup> Byrne, “Diastasis Recti.”

<sup>242</sup> Tupler, *Maternal Fitness*, 63.

<sup>243</sup> Noble, 95; Tupler, *Maternal Fitness*, 118.

<sup>244</sup> Noble, 227; Tupler, *Maternal Fitness*, 118.

<sup>245</sup> Tupler, *Maternal Fitness*, 70.



Engaging the transverse can and should be done in many positions in addition to lying on the back. Tupler opines, “The sitting transverse exercises are the missing link in all abdominal work,” and in fact recommends that women begin transverse exercises in the sitting position (with the back supported) before progressing to the hook-lying position.<sup>246</sup> However, Noble is firm in her recommendation that the supine hook-lying position is the most effective position to allow the transverse a full range of motion.<sup>247</sup> Sheppard agrees, “Supine [h]ook-lying. . . or side lying are more suitable early positions.”<sup>248</sup>

Finally, this exercise can also be done on all fours (the prone kneeling position). It may prove to be too difficult to work against gravity when beginning transverse exercises, so this position should be reserved as a progression of exercise rather than a starting point.<sup>249</sup>

### Exercise 2 — Pelvic tilting

In the hook-lying position, engage the transverse abdominis and pull in the lower abdomen. While continuing to engage the transverse, tilt the pelvis so that the lower back becomes flat against the floor. Hold the pelvic tilt before releasing.<sup>250</sup> Perform five to ten repetitions.<sup>251</sup>

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<sup>246</sup> Ibid.

<sup>247</sup> Noble, 83.

<sup>248</sup> Sheppard, 215.

<sup>249</sup> Ibid.

<sup>250</sup> Noble, 96.

<sup>251</sup> Noble, 227; Tupler, *Maternal Fitness*, 77.

Pelvic tilting can also be done in a variety of positions: side-lying (with legs bent), sitting,<sup>252</sup> partially standing with hands on knees, or standing upright.<sup>253</sup> This exercise is also very effective on a balance ball, as it allows for pelvic tilt in all directions—back and forth and side to side, as well as in a circular motion.<sup>254</sup> Pelvic tilting on all fours is another effective use of the muscle against the pull of gravity, although one must be careful to tilt only to the degree that the back goes flat, and not any further into a rounded back.<sup>255</sup>

In addition, familiarity with the pelvic tilt can be beneficial in everyday pregnant life. Back pain or discomfort is common during pregnancy, and is the result of the lengthening of the abdominal muscles and shortening of the lower back muscles. “Pelvic tilts help reverse the process by shortening the recti from the bottom of the muscle and lengthening the lower back muscles, which keep getting shorter.”<sup>256</sup>

### Exercise 3 — Heel slides

In the hook-lying position, engage the transverse abdominis and pull in the lower abdomen. Slowly slide one heel away from the body, then return to the original position and release the transverse. Repeat with the other heel. Perform five to ten repetitions with each leg.<sup>257</sup> In the progression of this exercise, both heels slide at the same time.<sup>258</sup>

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<sup>252</sup> Noble, 97.

<sup>253</sup> Tupler, *Maternal Fitness*, 67-68.

<sup>254</sup> Noble, 97.

<sup>255</sup> *Ibid.*, 98.

<sup>256</sup> Tupler, *Maternal Fitness*, 66.

<sup>257</sup> Connolly and Sullivan, 154.

<sup>258</sup> Noble, 96.

#### Exercise 4 — Diastasis correction: head raises

In the hook-lying position, use the hands to pull the two halves of the rectus abdominis together. Exhale while engaging the transverse abdominis, and slowly raise the head off the ground, stopping before the shoulders come off the ground. Slowly return to the original position. Repeat a few times, twice a day. Raising the head and not the shoulders activates just the rectus abdominis muscles, as opposed to activating the other abdominal muscles that insert into the linea alba.<sup>259</sup> A study by Fransman-van Santen showed that this exercise was more effective when incorporating a pelvic tilt before raising the head from the ground.<sup>260</sup>

#### *Other Exercises*

Pelvic floor exercises, also known as Kegel exercises, are an important part of pregnancy and postpartum health. The pelvic floor must be strong to support the abdominal and pelvic organs, including a growing uterus.<sup>261</sup> Noble recommends isolating the pelvic floor muscles and strengthening them before incorporating them into the above abdominal exercises. The two muscle groups working together will stabilize the pelvis and protect the lower back, and can be used to brace the body in everyday activities.<sup>262</sup>

Postural changes are significant in the pregnant woman, and it would be beneficial for singers to address the muscle imbalances caused by pregnancy. The natural

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<sup>259</sup> Noble, 91.

<sup>260</sup> T. Fransman-Van Santen, "Strengthening of the Abdominal Muscles for the Patient with a Diastasis Recti," *Nederlands tijdschrift voor Fysiotherapie*, 94, no. 4 (April 1984): 93.

<sup>261</sup> Tupler, *Maternal Fitness*, 31.

<sup>262</sup> Noble, 73.

S-curve of the spine becomes exaggerated during pregnancy,<sup>263</sup> with the upper curve of the spine affected as the chest collapses under increased weight and the changing center of gravity.<sup>264</sup> Therefore, it would be wise to incorporate chest stretches so that the muscles of the upper back shorten and the chest muscles lengthen.<sup>265</sup>

Finally, the muscles of the lower body must be strong to support increased weight. Squatting strengthens muscles in the knees, thighs, and buttocks, all of which are load-bearing and are required to support a heavier body during pregnancy. Practicing the squat will also enable greater balance and coordination in daily activities. Squats should be performed frequently, with the knees and ankles aligned and the weight on the outside of the feet. They can be either unsupported or in a supported position by holding on to a short table or chair. If the heels will not stay on the ground during a squat, low-heeled shoes may be worn, or a book may be put under the heels. Instead of standing up directly from a squat, which can be stressful on the knees, it is more beneficial to lower to a sitting or all-fours position before standing.<sup>266</sup>

Many abdominal exercises that are part of a standard workout before pregnancy should be avoided during pregnancy, as they can worsen the width of a diastasis. Such exercises include double-leg raising, straight-leg lowering, and full sit-ups. In addition,

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<sup>263</sup> Ibid., 23.

<sup>264</sup> Tupler, *Maternal Fitness*, 26.

<sup>265</sup> Ibid., 85.

<sup>266</sup> Noble, 129-133.

many exercises targeting the oblique muscles will pull the halves of the rectus abdominis apart.<sup>267</sup>

Any exercise that lifts the head above the hips will prevent full use of the transverse and therefore contribute to weakened and separated abdominal muscles. Mindfulness should be exercised while doing certain Pilates maneuvers,<sup>268</sup> as well as in some traditional abdominal exercises.<sup>269</sup> When in doubt, if the exercise is not easily performed while engaging the transverse abdominis, the exercise should be omitted.<sup>270</sup>

### *Modifications in Daily Movement*

The vulnerable midline must be protected at all times. “The other abdominal muscles are indirectly attached to the recti; therefore, the recti will be pulled further apart when other components of the corset shorten.”<sup>271</sup> Transverse exercises will slow the development of a diastasis, but the midline is so vulnerable that seemingly innocuous everyday movements can split the recti quite easily. As Tupler explains, “It's hard to get a diastasis back together, but it's a cinch to make it bigger. One wrong move can undo weeks of transverse exercises.”<sup>272</sup>

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<sup>267</sup> Tupler, *Lose Your Mummy Tummy*, 2.

<sup>268</sup> Pilates: a system of physical and mental exercise using breathing and the stretching and lengthening of muscles to improve flexibility and core strength, named after its founder, Joseph H. Pilates.

<sup>269</sup> Tupler, *Lose Your Mummy Tummy*, 8.

<sup>270</sup> Tupler, *Maternal Fitness*, 89.

<sup>271</sup> Noble, 92.

<sup>272</sup> Tupler, *Lose Your Mummy Tummy*, 78.

Getting into and out of a supine position is especially problematic. Moving from lying down to sitting (or vice versa) using only the abdominal muscles is aptly named “jack-knifing,” and should be avoided at all costs due to the terrible strain it causes on the abdominal muscles. Instead, one should utilize the side-lying position as an intermediate position between lying down and sitting up. To get up from a lying position, one should roll to the side and use the arms to push up to a sitting position, all while engaging and holding the transverse. The process should be reversed for lying down.<sup>273</sup>

A similar technique should be used for getting into and out of a chair or couch. Instead of using the abdominals to lever oneself out of a sitting position, it is best to slide to the edge of the seat before lifting up out of the chair, again holding the transverse in at all times.<sup>274</sup> When getting into or out of the car, the mother-to-be should keep her knees together and transverse abdominis engaged, and pivot in the seat to get in or out, rather than separating the legs and leaning into position.<sup>275</sup>

Bending at the waist is also discouraged. Instead, squatting should be used in situations such as picking things up from the floor or putting things away in lower drawers or shelves. Heavy lifting should not be performed while pregnant, and even light lifting should be done from a squatting position. If the pregnant woman has other children who need to be picked up, she should have them climb onto a stool, if possible, so she does not have to lift them all the way from the ground.<sup>276</sup> She should also exhale

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<sup>273</sup> Ibid., 48.

<sup>274</sup> Ibid., 80.

<sup>275</sup> Ibid., 93.

<sup>276</sup> Noble, 130-133.

and engage the transverse when lifting. In addition, movements that twist the torso should be avoided; instead the entire body should be turned.<sup>277</sup>

## **Exercise and Movement in the Postpartum Period**

### *Postpartum Abdominal Exercise*

After birth, the uterus contracts down to normal size naturally, and stretched ligaments also return gradually to their normal state. In contrast, abdominal muscles are stretched and lax without the uterus to fill them out, and must be actively returned to prepregnancy size and function through exercise.<sup>278</sup>

Noble is explicit in her recommendations for initiating postpartum exercise:

Exercise after delivery should be begun as soon as possible – certainly within 24 hours. The greatest changes occur in the first week. In the immediate postpartum you must return the muscles to their normal length and later, strength. Patients who have had major surgery do such exercises on the first day. You must exercise for short periods and often, to coax the stretched muscles back to their former length and tone. **This initial step must be achieved before starting any strengthening programs involving resistive exercises.** If you pull in your abdominal muscles isometrically, and consistently, you will be ready to advance to actual trunk movements after the first few days. . . . Women can take up to another nine months [to fully recover] if they ignore the **early** postpartum phase.<sup>279</sup>

To regain muscle function, the first step is to shorten the abdominal muscles, which are stretched to the point of flaccidity, and which must be shortened before they can be strengthened. The first exercise listed above, pulling in the abdominal wall by engaging the transverse abdominis, should be performed often in the first few days after

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<sup>277</sup> Sara Hambidge, “Protecting Your Back: Use Proper Body Mechanics when Caring for Baby,” BabyFit.com, <http://babyfit.sparkpeople.com/articles.asp?id=649> (accessed February 12, 2013).

<sup>278</sup> Noble, 88.

<sup>279</sup> *Ibid.*, 32.

birth.<sup>280</sup> Again, the most effective abdominal exercises should be done while in the supine (back-lying) position, completely reclined and not resting the head and shoulders on pillows, especially after birth when supine hypotension is no longer a concern.

Before progressing to stronger exercises, the abdominal muscles and pelvic floor should be assessed as to whether they are strong enough to support abdominal work.<sup>281</sup> Impact exercises, such as an aerobics class, running, or jogging, should be avoided until after the six-week postpartum mark, as the uterus is still returning to its normal size and weighs too heavily on the pelvic floor before that time.<sup>282</sup> In addition, abdominal exercises can further weaken the pelvic floor unless it is strong enough to withstand increased pressure.<sup>283</sup> Pelvic floor exercises are safe to perform in the immediate postpartum period and will even encourage healing.<sup>284</sup>

A postpartum support wrap may provide comfort and support in the first few days after birth,<sup>285</sup> especially for mothers who have given birth via cesarean section.<sup>286</sup> The use of such supports should be temporary, so that the unsupported core muscles can regain their strength. As during pregnancy, supports should be removed during exercise sessions.<sup>287</sup>

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<sup>280</sup> Ibid., 88.

<sup>281</sup> Ibid.

<sup>282</sup> Ibid., 50.

<sup>283</sup> Ibid., 33.

<sup>284</sup> Tupler, *Lose Your Mummy Tummy*, 51.

<sup>285</sup> Noble, 139.

<sup>286</sup> Rubin, 65.

<sup>287</sup> Noble, 139.



The diastasis check can be performed around the third day after birth, but not before, as the abdominal area is too slack before this time. A small gap the width of one or two fingers is tissue looseness and will come together naturally. A separation of three or more finger-widths requires targeted exercise.<sup>288</sup>

The diastasis correction exercise is executed in the same way after birth as during pregnancy. Noble recommends at least fifty repetitions a day, and if possible, ten each hour. “Daily improvement will be noted if you are conscientious, and the gap should be back to the normal half-inch **within a week**. Even in the rare cases when a whole hand can be placed sideways in the gap, diligent exercise can close the gap in ten days! If you exercise less consistently, it will take longer.”<sup>289</sup>

Until the gap is closed, stressors to the abdominal muscles should be avoided, including anything that twists the hips or trunk. Head raises should be continued until the rectus muscles are able to support the head raise without the additional support of the hands. The central seam must be strong enough to resist the pull of the other abdominal muscles. At that point, the shoulders may be raised as well.<sup>290</sup>

If a diastasis remains from a previous pregnancy, it should be rehabilitated before a subsequent pregnancy, or it will only become larger.<sup>291</sup> Even years after giving birth, this exercise may still be used to close the gap. Women who exercise regularly can still have a midline gap, perhaps even one that may have worsened from performing strong

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<sup>288</sup> Ibid., 91.

<sup>289</sup> Ibid., 92.

<sup>290</sup> Ibid.

<sup>291</sup> Tupler, *Maternal Fitness*, 62.

abdominal exercises without the requisite foundational strength. In spite of the current level of fitness, head raises are always the first step.<sup>292</sup>

In addition, women may find it necessary to continue targeted abdominal exercises for years after giving birth in order to prevent recurrence of a diastasis. Sheppard provided successful physical therapy for a patient who had initially closed a diastasis at eight months postpartum, but presented with a diastasis again at two years postpartum. Sheppard suggested that “the deterioration of the muscle closure from eight months to two years postpartum was attributed to decreased time allocated daily to maintenance exercises combined with the increasing weight of the patient's growing child to lift.”<sup>293</sup>

As the transverse abdominis regains strength and the abdominal muscles shorten, exercise can progress to pelvic tilting and heel slides.<sup>294</sup> When the diastasis is closed to less than three fingers wide, and no strain is felt in the pelvic floor, an additional exercise may be included. Curl-ups originate in the hook-lying position with outstretched arms, and the range of motion should be only to a forty-five degree angle from the floor, keeping the waist on the floor.<sup>295</sup> Holding or restraining the feet can activate the hip flexors and can conceal residual core weakness.<sup>296</sup>

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<sup>292</sup> Noble, 93.

<sup>293</sup> Sheppard, 214.

<sup>294</sup> Noble, 229.

<sup>295</sup> *Ibid.*, 101.

<sup>296</sup> *Ibid.*, 102.

### *Modifications in Postpartum Daily Movement*

As during pregnancy, the transverse abdominis should be engaged during most daily activities.<sup>297</sup> All of the modifications used during pregnancy should be retained during the postpartum phase, especially the avoidance of “jack-knifing” into a sitting position.<sup>298</sup>

The addition of a new baby creates the need for additional movement adaptations. At the changing table, avoid twisting the torso at the same time as lifting or lowering the baby. Supplies should be kept at waist-height so as to minimize bending from the waist.<sup>299</sup> When picking the baby up from the floor, first kneel on one knee and bring the baby to the knee and rest for a moment there, before bringing the baby to the shoulder and supporting him or her with one arm. Use the other hand to support the body on the bent knee before standing. The transverse should be engaged at all times.<sup>300</sup>

When carrying the baby, the transverse should continually be held. Front-loading baby carriers can pull the abdominal muscles apart and should be avoided while a diastasis is still present. Back carriers present a similar, though lesser, risk.<sup>301</sup> Extra care should be taken to engage the transverse abdominis when moving the baby to or from the bathtub, crib, playpen, swing, bouncy seat, and high chair.<sup>302</sup>

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<sup>297</sup> Tupler, *Lose Your Mummy Tummy*, 78.

<sup>298</sup> Hambidge, “Protecting Your Back.”

<sup>299</sup> Tupler, *Lose Your Mummy Tummy*, 83.

<sup>300</sup> *Ibid.*, 85.

<sup>301</sup> *Ibid.*, 88.

<sup>302</sup> *Ibid.*, 87-91.

Getting the baby into and out of the car can be problematic, as the tendency to lift and twist the torso at the same time is hard to resist. Keeping the torso straight while lifting will help prevent damage to the core. Tupler particularly discourages new mothers from carrying infants in portable car seats, as they must be carried awkwardly away from the body, but if necessary, recommends alternating sides frequently.<sup>303</sup>

### *Exercise after Cesarean*

Walking the halls of the hospital after a cesarean is imperative, as it helps prevent blood clots (deep vein thrombosis)<sup>304</sup> and frees painful trapped gas which entered the abdominal cavity during surgery.<sup>305</sup> In addition, other exercises should begin while the mother is still bedridden, to prepare the body for standing and walking. Noble opines:

It is essential for your comfort that you bridge the gap between the operating room and what is known as early ambulation (walking as soon as possible). Otherwise you will be hauled to your feet the following day without the transition of gradual exercise or body movement to prepare you. Pain may make it hard for you to stand tall; apprehension will cause you to lean protectively over the incision. . . . If circulation is allowed to stagnate, the area will stiffen, the ache becomes worse, and later movement is even more painful. Isometric exercises encourage the edges of the incision to come together.<sup>306</sup>

She goes on to assert, “Simple, safe exercises will condition you for other activities, such as going home. . . . Such exercises have been routinely given to abdominal surgery patients for decades in other countries, yet Cesarean mothers rarely

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<sup>303</sup> Ibid., 89-90.

<sup>304</sup> Rubin, 65.

<sup>305</sup> Ibid., 68.

<sup>306</sup> Noble, 197.

receive this postoperative care in the U.S.”<sup>307</sup> As always, the decision to exercise should be made by the woman and her doctor. Connolly and Sullivan caution, “The following exercises are very gentle, but we urge you to talk with your physician before you begin. If you had a complicated delivery, or lost a significant amount of blood, [your doctor] may discourage you from doing anything other than Kegel exercises and taking very short walks for a few weeks.”<sup>308</sup>

Deep breathing should be employed to help rid the body of residual anesthesia. Additionally, the motion of exhalation will begin the process of shortening the abdominal muscles. The new mother should remember to pull in the abdominal muscles on outward breath, with increasing strength as pain decreases. In addition, she may feel the need to cough, as it is common for mucus to collect in the lungs after surgery. Coughing requires the closure of the vocal folds, causing strain in the abdomen and pelvic floor, which is not advisable after abdominal surgery. Instead, Noble recommends huffing (the use of a fast, forced exhalation in conjunction with bringing in the abdominal wall) to replace coughing in the postoperative patient.<sup>309</sup> Since coughing is also discouraged in singers, Jahn concurs: “A forceful clearing of the airway without approximating the vocal folds, or a single strong cough, is better than repeated paroxysms of coughing.”<sup>310</sup>

Movement of the feet and legs is also imperative. Stretching and circling the feet at the ankles improves circulation and helps prevent thrombosis. Bending and

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<sup>307</sup> Ibid.

<sup>308</sup> Connolly and Sullivan, 150.

<sup>309</sup> Noble, 197-198.

<sup>310</sup> Jahn, “Intubation,” 15.

straightening alternate knees, first one at a time, then progressing to bending one knee while at the same time straightening the other, can also help prepare for early ambulation.<sup>311</sup>

Isometric exercises are useful to help the lower half of the body prepare for standing and walking. While sitting or lying down, the mother should cross her ankles, then engage the muscles from the waist down—flexing her feet, pushing her legs down against the bed, and bringing the buttock muscles together.<sup>312</sup>

The mother should not try to get out of bed unassisted for the first few attempts, as it is best to have a nurse present for physical support and coaching.<sup>313</sup> Movement may feel more comfortable when the hands or a pillow are used to support the incision area.<sup>314</sup> Alternatively, the hands may be used to splint the abdominal muscles, helping provide a supportive corset for the body. Also, the use of a postpartum support wrap can help provide an artificial corset for the body<sup>315</sup> and protect the incision.<sup>316</sup>

When progressing to getting out of bed unassisted, careful movements and form should still be observed. First, move the body as close to the edge of the bed as possible (and lower the motorized bed if still at the hospital).<sup>317</sup> Engage the transverse muscle, bend both knees, and roll to the side without lifting the head and while keeping the knees

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<sup>311</sup> Noble, 199.

<sup>312</sup> Ibid.

<sup>313</sup> Connolly and Sullivan, 62.

<sup>314</sup> Rubin, 65.

<sup>315</sup> Noble, 201.

<sup>316</sup> Rubin, 65.

<sup>317</sup> Noble, 201.

together. Place both hands and one elbow on the bed, then use the hands and arms to push up as far as possible, or use one hand to support the incision. Continue this movement by swinging the legs off the side of the bed while pushing with the arms to an upright sitting position.<sup>318</sup> Remain seated for a moment, breathing and allowing the change in position to become comfortable, and move to the edge of the bed. Then, engage the transverse, brace the abdominals or incision if necessary, and use the legs and buttock muscles to stand.<sup>319</sup> This process should be reversed to get back into bed.<sup>320</sup>

Abdominal exercises should be continued at the hospital in the early days of healing from the cesarean. As with all abdominal exercises, the action should occur on the outward breath, and the muscles will be shortened and pulled together. The first step in restoring abdominal integrity is simply drawing in the abdominal wall by engaging the transverse, as it shortens the abdominal muscles.<sup>321</sup> Another exercise, pelvic rocking, is similar to pelvic tilting as performed during pregnancy, but is done more quickly and uses more assistance from the leg and buttock muscles. This stimulates the gastrointestinal tract after surgery, helping it return to normal function more quickly.<sup>322</sup>

The incision may cause pain for up to six weeks postpartum, after which there may still be a pulling sensation due to scar tissue. Massage can be utilized to break down

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<sup>318</sup> Tupler, *Lose Your Mummy Tummy*, 48-49.

<sup>319</sup> Noble, 201.

<sup>320</sup> Tupler, *Lose Your Mummy Tummy*, 48-49.

<sup>321</sup> Noble, 197.

<sup>322</sup> *Ibid.*, 200.

the scar tissue and maximize healing, beginning when the incision is fully healed.<sup>323</sup>

Kinesiology tape may also be used to pull the skin off the muscle and to put pressure on the scar to advocate healing.<sup>324</sup> Some numbness or itching of the scar is also normal, as the severed nerves take time to regenerate.<sup>325</sup>

The check for diastasis may be performed any time after the third day post-surgery.<sup>326</sup> If a diastasis is present, strengthening of the transverse and avoidance of stress to the vulnerable midline must be continued.

In either case, abdominal exercises should be continued at home. Noble feels that most C-section patients will be physically capable of following the same abdominal rehabilitation timetable as mothers recovering from vaginal births.<sup>327</sup> The recommendations of Connolly and Sullivan are more cautious, only adding in heel slides and head raises around a week after the surgery.<sup>328</sup> Whenever standard postpartum exercises (as described in Chapter 4) are resumed, the abdominal muscles should still be splinted with both hands in the case of a diastasis, and any exercises that raise the shoulders off the ground should be avoided until the diastasis is closed.<sup>329</sup>

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<sup>323</sup> Connolly and Sullivan, 164.

<sup>324</sup> Tupler, "Lose Your Mummy Tummy," 49.

<sup>325</sup> Ibid.

<sup>326</sup> Noble, 201.

<sup>327</sup> Ibid.

<sup>328</sup> Connolly and Sullivan, 153.

<sup>329</sup> Ibid., 155.



Aerobic exercise should be avoided until six weeks after the surgery, when return to normal activity is permitted.<sup>330</sup>

### *Singing after Cesarean*

After any major surgery, it is most important for the body to heal and regain function before attempting to resume normal singing activity. For the first six to eight weeks after surgery, the singer should limit her physical exercise to walking and breathing exercises, while being sure to listen to her body and rest when necessary.<sup>331</sup>

If the singer was intubated with general anesthesia, Jahn advises, “My personal recommendation is that you do not speak at all for forty-eight hours. After that time, you can start to speak softly, with minimal pressure to the larynx.”<sup>332</sup> The recovering mother should expect some residual effects to the voice, including hoarseness, cough, and throat clearing. These should resolve within twenty-four to seventy-two hours. Even in rare cases of actual injury to the vocal folds, they should heal by one month postpartum. Still, Sataloff recommends an otolaryngological consult for any hoarseness after surgery.<sup>333</sup> Jahn concurs, recommending that “if after 12 days the voice is not normal, the larynx should be examined by a laryngologist to make sure there is no evidence of hemorrhage or trauma. Once the singer has a clear bill of health, full vocal activity may be resumed.

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<sup>330</sup> Noble, 50.

<sup>331</sup> Wicklund, 11.

<sup>332</sup> Jahn, “Anesthesia,” 272.

<sup>333</sup> Ragan and Gangopadhyay, 45.

Mild residual edema may create difficulty at the top of the range, and this need not be a cause for concern.”<sup>334</sup>

From six weeks postpartum, the singer may resume singing in short intervals, limiting these sessions to ten to fifteen minutes daily. Preferably, she should work in conjunction with her voice teacher to avoid creating bad habits due to dysfunction or inadequate healing. A return to work may also occur around six weeks postpartum, though perhaps with a reduced workload.<sup>335</sup>

Around eight to twelve weeks postpartum, and “with increasing abdominal post-op strength, singing practice periods and vocal range can be also gradually increased. The singer may feel ready to return to full-time non-singing work after about eight weeks, with return to the jobs of full-time voice teaching at about eight to ten weeks, and singing of recitals and roles at about four to six months post-op.”<sup>336</sup>

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<sup>334</sup> Jahn, “Intubation,” 15.

<sup>335</sup> Wicklund, 11.

<sup>336</sup> Ibid.

## CHAPTER 5

### PERSONAL EXPERIENCES AND CONCLUSION

The conclusions reached in this chapter are the author's, and are included as anecdotal information in the hope that they may inspire new ideas in singers or voice teachers. They are not recommendations or medical advice, and should not be acted upon without the advice of a qualified health professional.

#### **Personal Experiences**

In choosing this subject for my dissertation project, I was motivated to compile information I did not know during my first pregnancy, and bring it to a wider audience of singers. Perhaps some personal experiences will shed light on additional challenges that might be faced by the pregnant singer that have not been addressed in this document thus far.

During my first pregnancy, I experienced pregnancy rhinitis from ten weeks' gestation until after giving birth. This made it difficult to breathe through the nose for singing, and nearly impossible to breathe through the nose while sleeping, causing even more fatigue in addition to the usual fatigue of pregnancy. I found relief at night by using nasal breathing strips, such as those manufactured by Breathe Right<sup>®</sup>.

My first pregnancy was largely characterized by a condition of which I was unaware until the last few days. The day before I had my first son, I was diagnosed with polyhydramnios, an excessive amount of amniotic fluid. Noble indicates that this

condition makes a diastasis more likely to occur.<sup>337</sup> I believe this was the case in my first pregnancy, as my abdomen was more distended than expected for my size and the baby's gestational age. I also had more trouble singing through my pregnancy than I expected, which I believe was attributable to the greater stretch on my abdominal muscles from the additional amniotic fluid.

I did not know to check for or rehabilitate diastasis until around a year postpartum, when I presented to physical therapy with a diastasis the width of two fingers. According to Noble, one to two finger-widths is normal,<sup>338</sup> and yet I was able to close the gap to what my therapist described as “a depression” by using targeted transverse abdominis exercises. This reduction of my already “normal” diastasis resolved many of the troubles I had been having with abdominal and back pain and decreased abdominal function. In addition, my voice teacher and I agreed that my singing truly benefited from the exercises I learned in physical therapy.

During my physical therapy sessions, I was given a method to confirm activation of the transverse muscle. I was told that transverse action can be detected by gently pushing a finger or two under the front of the hipbone while lying in the supine position. When the transverse is relaxed, this area feels soft and pliable. When the transverse engages, this area becomes taut and pushes the finger up and out of place over the hipbone.

I found that I experienced abdominal problems earlier in my second pregnancy. At twelve weeks' gestation, I presented to physical therapy with a three finger-widths

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<sup>337</sup> Noble, 90.

<sup>338</sup> Ibid.

separation, which was greater than expected for so early in the pregnancy. In addition, I had already experienced problems with abdominal function while singing.

My physical therapist gave me a program of exercises similar to the one outlined in Chapter 4, and I performed the exercises faithfully, nearly every night for the remainder of the pregnancy. With this dedication, I maintained the three finger-widths diastasis until late in the third trimester, at which point I stopped measuring. This leads me to believe that the targeted abdominal exercises kept my diastasis from worsening. I noticed a marked increase in lower back pain during the times I lost motivation and stopped performing exercises for a few days. The pain ceased after resuming the program.

Singing with this diastasis was a continuing problem. Manually splinting the abdominals while singing helped improve function and alleviate discomfort, but was not practical for more than a few minutes. I found that wearing a maternity/postpartum support wrap over the diastasis replaced manual splinting, effectively holding the two halves of the rectus abdominis together and enabling proper abdominal function. I also found the use of kinesiology tape to be effective, though to a lesser degree. In this manner, I was able to continue to perform at nearly my normal level until late in my third trimester. I made certain to avoid motionless standing in rehearsals and while teaching lessons, so as not to decrease cardiac output. Finally, I was also able to utilize my knowledge of the correct pelvic tilt in a conscious manner while sitting or standing for long periods of time. Attention to these important concepts helped me to continue working until near the end of my pregnancy.

I found the use of a postpartum wrap to be crucial in helping alleviate pain after both cesareans, both to protect the incision site from the rubbing of clothes or bedding, and to provide an artificial corset for my abdomen. For my first (unplanned) cesarean, a family member purchased the wrap at a maternity store (labeled “postpartum support”) and brought it to the hospital. Before my second (planned) cesarean, I asked my doctor to prescribe a wrap, which was provided by the hospital. Even with my commitment to exercise during my second pregnancy, I found that the girdle was still integral to pain management in the first few days after the surgery.

Two weeks after having my second son, my diastasis had not closed in any noticeable measurement. I was still quite sore from the repeat cesarean and adjusting to life with two children, and so was unable to resume my usual abdominal exercises for a time. However, I did consciously engage my transverse abdominis with nearly every movement I made, and I believe this helped close my diastasis to 2½ finger-widths at one month postpartum. I resumed the abdominal exercise program at that time, and three weeks later, at seven weeks postpartum, I was back to a gap between one and two finger-widths wide, which was within normal parameters.

### **Conclusion**

An informal poll of friends and colleagues has led me to believe that troubles with abdominal support and diastasis are not universally experienced or even noticed by pregnant and postpartum singers. Perhaps the isometric exercise of singing, which utilizes the abdominal muscles (including the transverse), is able to work in the same manner as the exercises recommended by Noble and others, helping many singers to

rehabilitate their abdominal muscles gradually as they return to singing. It is also possible that many singers are unaware of the effects of pregnancy on the abdominal muscles and the targeted action necessary to rehabilitate the body, and continue to sing with a diastasis many years after pregnancy. There may be singers who would benefit from exercises targeting the transverse abdominis, even though their diastases would be classified as mild. Noble's recommendation to "begin exercising as soon as possible, even before conception"<sup>339</sup> would be extremely beneficial to the singer, both in preparation for pregnancy and for the possible benefits to her singing throughout her life.

This dissertation project has documented the many consequences of pregnancy on the body and their implications for the singer. Vocal quality may change during pregnancy, and the alterations may be positive or negative. The effects of pregnancy on the abdominal muscles must not be ignored, especially in the singer. The tissue of the linea alba softens during pregnancy and must be protected during the pregnancy and postpartum periods, due to its role as the point of attachment for the abdominal muscles. This protection of the linea alba must be undertaken in two parts—mindfulness in movement during daily activities, and targeted abdominal exercises that strengthen the transverse abdominis, shorten the rectus abdominis, and bring together a diastasis. It would also benefit the singer to consult a physical therapist who specializes in women's health.<sup>340</sup>

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<sup>339</sup> Noble, 31.

<sup>340</sup> More information on the Section on Women's Health of the American Physical Therapy Association, including a tool for locating a physical therapist specializing in women's health, can be found at <https://www.womenshealthapta.org/plp/index.cfm>.

If a cesarean section becomes necessary, the singer need not fear a deleterious effect on her abdominal muscles, as they are often gently separated instead of cut, and muscle incisions do not appear to affect muscular strength in the long term. Once the immediate aftermath of the surgery has been managed, standard postpartum abdominal rehabilitation may commence.

Although pregnancy may affect each woman differently, it is helpful for singers to be familiar with those changes brought on by pregnancy that may affect singing in general and breathing for singing specifically. They should also have the information needed to arrest, or at least improve, a diastasis. Information on vocal and physiological changes in the body may help the pregnant singer, or a singer contemplating pregnancy, know what to expect. Finally, knowledge about cesarean sections and recovery may prove helpful to singers who fear the possibility or need of such a surgery.



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