CNE SERIES

The Impact of Childbirth on the Pelvic Floor

Lianne F. Herbruck

Vaginal delivery is known to be associated with trauma to the pelvic floor (PF) and its muscles and ligaments. In some cases, this can lead to issues with urinary incontinence and pelvic organ descent postpartum, either immediately or in the woman's later years. Some factors during a vaginal delivery can be modified in attempts to preserve as much functional integrity to the PF as possible. A trend has evolved in recent years regarding maternal requests for primary cesarean section (CS), with one goal being the reduction in PF trauma. However, evidence to date refutes this as a foolproof practice in decreasing PF dysfunctions, including urinary incontinence.

Key Words: Pelvic floor, cesarean section, urinary incontinence, labor, childbirth, episiotomy.

Approximately 3 million women give birth vaginally every year, with many experiencing perineal trauma from episiotomy, spontaneous obstetric lacerations, or both. Genital tract lacerations weaken the pelvic floor (PF) muscles, thereby potentially affecting the bowel, urinary, and sexual function of women post-childbirth (Albers, Sedler, Bedrick, Teaf, & Peralta, 2005). Although episiotomy frequency has declined steadily since 1980, there has been a concordant increase of perineal laceration repair (Albers & Borders, 2007). Short-term sequelae of childbirth include hemorrhage, hematoma formation, nerve palsy, perineal discomfort, fistula, and dyspareunia; long-term sequelae include uterovaginal prolapse, and urinary and anal incontinence (Sultan & Fernando, 2001). The best techniques and methods to reduce severity of spontaneous genital tract lacerations with normal vaginal childbirth need to be determined (Albers et al., 2005; Albers & Borders, 2007).

In recent years, requests for primary cesarean sections (CSs) without medical indication have increased. In part, these requests stem from the desire to reduce the impact of vaginal childbirth on the PF and associated issues with urinary incontinence (UI) (Bettes et al., 2007; Leslie, 2004; Simm & Ramoutar, 2005). However, modifying procedures involved in a normal, vaginal delivery (such as operative assistance and maternal positioning) may reduce trauma to the PF in many deliveries.

VAGINAL DELIVERY

The preservation and promotion of the normalcy of labor and delivery, including the woman's active participation in the birth process to the extent it is possible and desirable, are issues that are integral to the philosophy of most certified nurse midwives (CNM) (Roberts, 2002). The safe birth of an infant in a manner that is as non-traumatic as possible to both mother and infant is a cornerstone of midwifery care and one that has been taught meticulously in midwifery education (Varney, Kriebs, & Gregor, 2004a). Looking at each woman holistically and focusing on her whole structures, abilities, and needs are critical pieces to promote the best possible postdelivery outcomes. Facilitating the best long and short-term outcomes for childbearing women includes addressing research that assesses the effects of labor on the PF, as well as methods that may reduce negative long-term impact on the PF. Utilizing findings from such studies could help decrease the potential consequences of reproduction and birth, including PF dysfunction and the burden of UI.

Incidence of UI after vaginal birth ranges from 22% in spontaneous vaginal births to 33% in forceps-assisted births (McFarlin, 2004). The majority of childbirth-

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***Note:** Objectives and CNE Evaluation Form appear on page 185.*

***Note:** The author reported no actual or potential conflict of interest in relation to this continuing nursing education article.*

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*All other **Urologic Nursing** Editorial Board members reported no actual or potential conflict of interest in relation to this continuing nursing education article.*

related injuries that have long-term affects on the PF occur significantly with the first vaginal delivery (Altman et al., 2006; Heit, Mudd, & Culligan, 2001; Viktrup, Rortveit, & Lose, 2006). Women with stress urinary incontinence (SUI) symptoms three months postpartum are placed at an even higher risk of severe incontinence in the long term (Nygaard, 2006). An understanding of the pelvic floor anatomy and physiology is important to successfully protect and/or repair perineal traumas, which can occur at or during delivery (Stepp, Siddiqui, Emery, & Barber, 2006).

The urethra lies on a "hammock" of ligaments and muscle. If this hammock is stretched, urethral compression weakens, and leaks can occur (Kelleher, 2003). Obstetric issues, including babies with high birth weight and prolonged second stage of labor, increase the risk of neural damage to the pelvic floor (Peeker & Peeker, 2003). UI symptoms may more likely be related to pudendal nerve damage and tissue stretching than supportive tissue damage (Altman et al., 2006).

Neural damage mirrors continence status, and pudendal neuropathy is specifically implicated in pathogenesis of pelvic organ prolapse (POP), and urinary and anal incontinence (Sultan & Fernando, 2001). Stretching of the pudendal nerve at the point where it curves around the ischial spine may cause damage and injury to the nerve during a vaginal delivery. This can lead to weakness and atrophy of the medial portions of the levator ani (LA) muscles, as well as the voluntary muscles of the perineum. These injuries further predispose the woman to vaginal support defects as well as reduction in fast twitch pelvic muscle contraction, both of which are factors that contribute to SUI (Lingam, 2001; Sultan & Fernando, 2001).

Altman et al. (2006) performed a 10-year prospective, observational cohort study to estimate the effects of the first delivery on bladder function, as well as to assess the effects of subsequent pregnancy and obstetric events. These authors found that the rate of UI episodes increased 5 to 6 times after the first vaginal delivery. Symptoms of UI at nine-month follow-up was strongly predictive of symptoms 10 years later. Subsequent pregnancies were not found to be as influential on UI development as the first (Altman et al., 2006; Viktrup et al., 2006).

Viktrup and colleagues (2006) performed a longitudinal cohort study of 241 women to assess SUI symptoms after first delivery and 12 years after first delivery. SUI within 3 months after the first delivery was a predictor of SUI both 5 and 12 years post-delivery. Among women who had resolution of SUI at 3 months postpartum in this study, 50% had symptoms at 12 years. In women without SUI at all with the first pregnancy, 30% had symptoms of SUI at 12 years post-delivery. SUI symptoms occurring in the postpartum period was the most significant indicator of long-term SUI 12 years after first delivery (Viktrup et al., 2006).

Figure 1.
Stages of Labor

Stage One
Begins with the onset of labor and ends when the cervix is 100% effaced (thinned out) and completely dilated to 10 centimeters. The average length for a first-time mother is from 10 to 14 hours. Stage one is often shorter in subsequent births.
Stage Two
Begins with complete effacement and dilation of the cervix ("complete"), and ends with delivery of the baby. Average length for a first-time mother ranges from 1 to 2 hours. This stage is often shorter for subsequent births.
Stage Three
Begins with the birth of the baby and ends with the delivery of the placenta. Average length for all vaginal deliveries ranges from five to fifteen minutes.
Stage Four
Begins with delivery of the placenta and ends 1 to 2 hours after delivery.

Second-Stage Labor

The second stage of labor generally begins when the cervix is fully dilated and ends with fetal expulsion (see Figure 1). Spontaneous maternal pushing efforts may begin just before or after complete dilatation (Roberts, 2002; Varney et al., 2004b). Women are traditionally encouraged to push when the cervix is fully complete (10 cm) and not to push before that time. Women are also encouraged to hold their breath and sustain each push for at least 10 seconds, a process that is usually repeated until each contraction ends. This directed pushing, especially when prolonged in such a sustained and strenuous manner, can lead to maternal fatigue, which increases the use of instrument-assisted deliveries, and therefore, perineal trauma. Directed pushing may also challenge a woman's confidence in her own body and ability to birth her child (Roberts, 2002; Roberts & Hanson, 2007).

Most importantly, the practice of routine, sustained, and strenuous active pushing during the second stage of labor contributes to long-term pressure on the pelvic floor, which increases

adverse pelvic floor and perineal outcomes (Roberts & Hanson, 2007). Being told to push "on complete" cervical dilation in the absence of maternal spontaneous effort results in prolonged maternal bearing down, which can invoke the physiologic consequences of the Valsalva maneuver. Women who use Valsalva pushing techniques have been shown to demonstrate unfavorable urodymanic indices after delivery, which may result in pelvic floor disorders (PFDs) from forceful pushing (Albers & Borders, 2007).

Prolonged, active second-stage labor (> 30 minutes) is associated with pudendal nerve damage (Heit et al., 2001; Sultan & Fernando, 2001) and has been found to correlate with pelvic organ descent (Deitz & Bennett, 2003). A further consequence of sustained bearing down is reduction of the oxygen load to the placenta, resulting in potential harm to the fetus (bradycardia, prolonged decelerations, hypoxia, and acidosis) (Albers & Borders, 2007; Roberts, 2002; Roberts & Hanson, 2007). Passive descent of the fetus has not been associated with these outcomes, and involuntary pushing has the potential to minimize perineal trauma (Albers & Borders, 2007; Roberts, 2002; Roberts & Hanson, 2007).

Early pushing in the absence of maternal urge, as well as pushing when the infant remains at a high station in the pelvis, is associated with increased damage to bladder fascia and the pelvic floor. Sometimes fetal station (marking descent into the pelvis) is not low enough to reasonably encourage pushing efforts (Roberts, 2002). Early pushing has not been found to enhance fetal descent (Mayberry, Hammer, Kelly, True-Driver, & De, 1999). Delaying pushing until fetal descent encourages the natural, spontaneous maternal urges and can shorten the active phase of pushing, which may decrease the risks of structural damage to tissue and nerves (Heit et al., 2001; Leslie, 2004). Increasing evidence supports that the exact timing of second-stage duration is not as important as its progression. During normal, uncoached labor, uterine contraction intensity increases to a point when an involuntary pushing urge is provoked. Women will naturally push several times over the duration of the contraction, taking a few breaths between each short push, and the force of the pushing will increase as fetal descent occurs (Roberts, 2002).

Preservation of the pelvic floor structures and functions may be best accomplished by a longer "passive" phase of second stage (Handa, Harris, & Ostergard, 1996). Spontaneous urge pushing has been associated with lower incidence of both perineal lacerations and episiotomies. This may be due to the fact that the slower fetal descent with spontaneous effort allows the pelvic and perineal tissues the time to comply with the demands of the passing fetus (Roberts, 2002). As a point of reference, precipitate deliveries can cause perineal lacerations because maternal tissues have not had enough time to adjust to the stretch of delivery forces (Sultan & Fernando, 2001).

Second-stage interventions have become synonymous with procedures. With procedures come increases in financial burden to the patient, as well as a new set of positive and negative outcomes (Roberts, 2002). In many instances, care during second-stage labor consists of providers wanting to help women achieve birth in a timely yet satisfactory manner (Roberts, 2002). However, as women become fatigued or procedures do not bring about delivery, the need for operative vaginal techniques can increase (Roberts & Hanson, 2007).

In the event of a deeply engaged fetal head and incomplete cervical dilatation, the practitioner should redirect the pushing efforts of the mother to spare the cervix from edema or tearing (Roberts, 2002). Pelvic structures also play a role in second-stage injury. Women with short obstetrical (OB) conjugates may incur more trauma to structures along the anterior sacrum, including origins of LA, uterosacral ligaments, and hypogastric nerve. The platypelloid pelvis, which is associated with deep transverse arrest in labor, may predispose these women to neuropathy, resulting from a prolonged second stage (Handa et al., 2003).

Fraser et al. (2000) randomized 1,862 nulliparous women at time of full dilatation to an early push group or delayed (waiting 2 hours after "complete" dilation) pushing group. All women in the study were undergoing continuous epidural analgesia. Delayed pushing was found to be associated with reduction in difficult deliveries, including CS, operative delivery from mid-pelvic position, and low-pelvic procedures. Episiotomy was performed in 75% of difficult deliveries, compared with 37.5% of non-difficult deliveries, with third and fourth-degree tears more likely in the difficult delivery group. However, in this study, delayed pushing was not found to be associated with reduction in enough difficult deliveries to produce better perineal outcomes (Fraser et al., 2000; Heit et al., 2001). It is valid to suggest, however, that the risks for serious PFD secondary to delivery may be minimized in women who have normal, spontaneous vaginal births without forced or early pushing, instrumental assistance, or episiotomy (Leslie, 2004).

Vaginal/Perineal Injury

Most women are willing to accept some risk to themselves for the benefit of their baby (Penna, 2004); as such, perineal injury is the most common form of maternal obstetric injury. Risk

factors for PF injury include increased fetal birth weight, malpresentation or malposition of the fetus, duration of labor and rate of delivery, episiotomy, instrumental delivery (especially forceps), and supine (lithotomy) birth position (Fernando & Sultan, 2004; Mayerhofer et al., 2002; Peeker & Peeker, 2003).

Up to 65% of women incur a laceration or episiotomy during vaginal delivery that will require repair (Stepp et al., 2006). Perineal trauma is associated with postpartum pain and morbidity, including bleeding and infection (McCandlish, 2001). Vaginal delivery is independently associated with significant long-term increases in SUI symptoms and urgency, regardless of maternal age or number of deliveries (parity), and PF damage is proportional to the perineal trauma sustained (Altman et al., 2006; Lukacz, Lawrence, Contreras, Nager, & Luber, 2006; McCandlish, 2001).

Increased birth weight of greater than 4,000 g is associated with perineal injury, including third and fourth-degree tears. Large babies may preclude women to longer second-stage labors and more instrumental deliveries. A larger baby may also disrupt the fascial support of the PF, causing stretch injury to pelvic and pudendal nerves (Sultan & Fernando, 2001). Fetal malposition and/or malpresentation present a larger fetal head diameter to the pelvis and are associated with difficult delivery (Sultan & Fernando, 2001). Pelvic nerve injury after delivery has been associated with instant or delayed SUI (Viktrup et al., 2006)

Delivery itself decreases the ability of the PF to contract, predisposing women to SUI, and evidence exists to suggest vaginal delivery may specifically cause the levator ani and PF soft tissues to be damaged (Handa et al., 2003). However, there may be potential for reinnervation (Peeker & Peeker, 2003).

Figure 2.
U.S. Preventive Services Task Force Ratings

Category A – The USPSTF strongly recommends that clinicians provide [the service] to eligible patients. *The USPSTF found good evidence that [the service] improves important health outcomes and concludes that benefits substantially outweigh harms.*
Category B – The USPSTF recommends that clinicians provide [this service] to eligible patients. *The USPSTF found at least fair evidence that [the service] improves important health outcomes and concludes that benefits outweigh harms.*
Category C – The USPSTF makes no recommendation for or against routine provision of [the service]. *The USPSTF found at least fair evidence that [the service] can improve health outcomes but concludes that the balance of benefits and harms is too close to justify a general recommendation.*
Category D – The USPSTF recommends against routinely providing [the service] to asymptomatic patients. *The USPSTF found at least fair evidence that [the service] is ineffective or that harms outweigh benefits.*
Category I – The USPSTF concludes that the evidence is insufficient to recommend for or against routinely providing [the service]. *Evidence that the [service] is effective is lacking, of poor quality, or conflicting and the balance of benefits and harms cannot be determined.*

The U.S. Preventive Services Task Force grades its recommendations according to one of five classifications (A, B, D, D, I) reflecting the strength of evidence and magnitude of net benefit (benefits minus harms).

Source: Agency for Healthcare Research and Quality (2003).

Perineal Management at Fetal Expulsion

Perineal trauma is directly related to use of oxytocin, mechanical maneuvers of perineal protection, delivery position, second-stage duration, and continuous fetal monitoring (Albers et al., 1996; Albers & Borders, 2007; Roberts & Hanson, 2007). Favorable results to the perineum may be associated with left lateral birth position, spontaneous pushing, non-use of oxytocin, support person of the woman's choice, and excellent CNM or provider care (Caroci de Costa & Riesco, 2006). Hands-on interventions contribute to a more interactive presence with the birth attendant, which women prefer, and these factors are sometimes more important than implementation of protective techniques for the perineum (Albers & Borders, 2007; Albers et al., 2005; Caroci de Costa & Riesco, 2006; Roberts, 2002).

Practitioners may implement techniques to guard against perineal trauma during delivery of the infant. At present, many perineal management techniques that are believed to reduce trauma are classified as category C (see Figure 2), or "practices with no sufficient evidence to support a clear recommendation and that should be used with caution until further research clarifies the issue" (Caroci de Costa & Riesco, 2006). Two techniques used by CNMs to reduce perineal damage during second-stage labor are warm compresses to the perineum and perineal massage with a lubricant. These methods have the potential to reduce perineal damage by increasing vasodilation to the area, which can help with tissue stretching, increasing muscle relaxation and altering pain perception (Albers et al., 2005).

Albers and colleagues (2005) performed a randomized con-

trolled trial (RCT) on 1,211 births to examine one of three perineal management techniques (warm compresses, perineal massage, no perineal touching until crowning of the fetal head) during late second-stage labor to determine if one method was more effective in reducing genital tract lacerations. The facility in which the study was performed had an overall episiotomy rate of less than 1% for all provider groups. Women who consented to be in the study were randomized into one of the three groups.

Results of the Albers et al. (2005) study showed that 23% of women experienced no perineal trauma. This was equal across the three management groups; spontaneous lacerations were no more or less frequent with any of the three methods. Women who received a warm compress or massage for a longer time period in second stage experienced more frequent genital tract trauma. However, other clinical factors may have contributed to a longer second stage, and no cause-effect could be identified to a specific perineal treatment.

Outcomes of the study showed that warm compresses and massage with lubricant provide no apparent advantage or disadvantage in reducing obstetric genital tract trauma, compared with hands-off management of second-stage labor. Strong predictors of genital tract trauma were found to be nulliparity and high infant birth weight. Two factors associated with lower risk of trauma were birthing in an upright position and delivering the fetal head between uterine contractions.

A study by Caroci de Costa and Riesco (2006) evaluated the hypothesis that maneuvers related to perineal protection (hands-poised or hands-on) may be associated with a greater frequency and degree of perineal laceration. Hands-poised delivery involves no touching of the perineum or the crowning head, and the infant's shoulders and body deliver spontaneously. Hands-on delivery includes pressure on the fetal head to increase flexion during delivery, while the second hand supports the perineum. Birth of shoulders is facilitated by lateral flexion of the fetal head with both hands and supporting the body as it is delivered (Caroci de Costa & Riesco, 2006; McCandlish, 2001). In their study, women responded to uterine contractions spontaneously during labor, with no direction in bearing-down efforts. Of the 70 women included in the study, none had oxytocin, and all delivered in a lateral position.

Severity of lacerations was similar between both groups, with 82.7% (hands-on) versus 82.2% (hands-poised) incurring first-degree lacerations, and 17.3% versus 17.8% incurring second-degree tears. The hands-on group had slight increase in the incidence of lacerations of the anterior region (clitoris, vestibular and urethra region, labia majora and minora, and vaginal mucosa), while the hands-poised group had slightly higher incidence of laceration in the posterior region (including fourchette) (Caroci de Costa & Riesco, 2006).

This study reflected results of McCandlish (2001), who also found essentially no difference in severity of lacerations and perineal trauma with hands-poised or hands-on methods. Both studies found that the hands- poised technique is associated with lower episiotomy rates, while the hands-on technique is associated with less pain 24-hours post-delivery. Manual support was found to be an effective intervention for perineal protection, but neither study supported enough empirical evidence to recommend hand-poised versus hands-on in reduction of perineal trauma (Albers & Borders, 2007; Caroci de Costa & Reisco, 2006; McCandlish, 2001).

In contrast to the traditional lithotomy position (supine with legs in stirrups), upright and lateral birthing positions have been found to have many benefits to the delivering mother. These include shorter second stages, reduction in assisted deliveries, fewer episiotomies, and reduced anterior and perineal tearing (Albers & Borders, 2007; Roberts, 2002; Roberts & Hanson, 2007). A study composed of 3,049 women with midwife-assisted births indicated that perineal support (including warm compresses and counter pressure against the fetal head) during delivery while maintaining the woman in left lateral lying position can reduce the frequency of degree of perineal laceration when compared to the more common lithotomy position (Albers et al., 1996). The lithotomy position is associated with factors that may predispose use of episiotomy, such as fetal bradycardia and prolonged second-stage labor.

The myth that strong pelvic floor muscles (PFMs) may actually obstruct labor and prolong fetal expulsion exists (Salvesen & Morkved, 2004). Using data from Morkved, Bo, Schei, and Salvesen (2003), Salvesen and Morkved (2004) performed a randomized study to evaluate the effectiveness and impact of pelvic floor exercises (PFEs) during pregnancy on labor and birth. They found that women randomized to intensive PFE training had a lower rate of prolonged second-stage labor, and theorize that PFEs and strong PFMs may actually facilitate labor. When the muscles of the PF and vaginal outlet are routinely exercised, they are more able to stretch and contract at the time of birth, thereby reducing the trauma to the muscles, which can result in lower incidence post-delivery UI (Saunders, 2004). PFEs may be beneficial antenatally, and may be a useful and inexpensive addition to routine prenatal care.

Episiotomy

Episiotomy was first de-

scribed in the 18th century, and by the 1970s, had become a widely used and accepted practice by CNMs and physicians around the world (Hayman, 2005). Liberal and routine use of episiotomy has been widely studied and has been determined to be a form of care that is likely to be ineffective and may actually produce harm (McCandlish, 2001). Evidence often refutes routine use of episiotomy (Albers & Borders, 2007; Heit et al., 2001; McCandlish, 2001).

One theory suggests that it may be better for the woman to sustain a laceration of her perineum that is repaired in a timely fashion than to incur an overly stretched but intact perineum that becomes too lax to adequately support the pelvic structures (McCandlish, 2001). However, episiotomy is often used as a routine practice during deliveries without medical indications. Restricting the use of episiotomy to times when it is necessary to facilitate the delivery of the fetus reduces perineal trauma that necessitates suturing. Restricted use of episiotomy is associated with reduced risk of posterior perineal trauma and has been found to be associated with an increase in anterior lacerations of the perineum; however, it is not associated with increased pain or urinary and pelvic symptoms (Hayman, 2005; Sultan & Fernando, 2001). Liberal use of episiotomy does not prevent perineal or anal sphincter tears (Heit et al., 2001).

Episiotomy does not entirely prevent damage to the PF, and more severe damage may result from an extension of the episiotomy (McCandlish, 2001). Midline episiotomy is associated with a 22-fold increase in the risk of third and fourth-degree tears, which are also 12% more likely to extend into the anal sphincter when compared with mediolateral episiotomy (Heit et al., 2001; Stepp et al., 2006; Sultan & Fernando, 2001).

Instrumental/Operative Vaginal Delivery

Descriptions of instrument-assisted deliveries exist dating to approximately 1500 BC. The Chamberlen family is credited with inventing the modern forceps in the late 1500s. Three generations of Chamberlen family men practiced obstetrics, and they managed to keep the invention completely secret for over a century. In the early 18th century, their secret was finally made public. The subsequent development and refinement of the forceps helped instrument-assisted deliveries become a widely accepted and practiced vaginal delivery intervention (Hayman, 2005; Varney et al., 2004a).

Two considerations when defining indications for instrumented-assisted vaginal delivery are fetal and maternal. Fetal indications may include malposition of the fetal head, fetal distress, and breech delivery (Piotrowski, 2004). Maternal indications include distress, exhaustion, prolonged second stage (> 2 hours in primigravida [> 3 hours with epidural] or > 1 hour in multipara [> 2 hours with epidural]), or development of medically significant conditions (Hayman, 2005; Varney et al., 2004b). Unfortunately, operative vaginal delivery has been identified as a major risk factor for fetal morbidity and mortality (Hayman, 2005).

Instrument-assisted vaginal deliveries are generally performed either by forceps or vacuum extraction. Both types of instrumental deliveries, especially in combination with episiotomy, are related to an increased risk of sphincter tears and also have a negative impact on pelvic organ support. Forceps delivery with episiotomy carries the highest risk, while vacuum with no episiotomy carries the lowest risk (Dandolu et al., 2005). Dietz and Bennett (2003) investigated the effects of instrument-assisted vaginal delivery on 169 women and found significant increases in organ mobility with Valsalva, particularly after forceps. Forceps use during delivery contributes to weaker PFMs post-delivery over women who deliver spontaneously, and women who deliver spontaneously have weaker PFMs post-delivery than women who undergo CS (Heit et al., 2001).

Forceps are more likely than vacuum extractors to cause PF injury for a number of reasons. The application of forceps and their shanks stretch the perineum and may cause injury to the anal sphincter during flexion of the head. They also expand the space in the pelvis by almost 10%, and excessive force may be unintentionally applied when the woman has epidural anesthesia. Episiotomy is routine with forceps, whereas most vacuum procedures can be performed without one (Sultan & Fernando, 2001). When necessary and indicated, vacuum delivery is the preferred method because it is better for the maternal PF (Fernando & Sultan, 2004; Piotrowski, 2004). However, birthing situations sometimes preclude use of one or the other instrument (such as with prematurity or face presentation) (Hayman, 2005; Sultan & Fernando, 2001).

The risk for an instrument-assisted delivery increases with use of epidural analgesia because it has been associated with longer first and second stages of labor, increased incidence of fetal malposition, and increased use of oxytocin. Further, difficult instrumental deliveries may be associated with shoulder dystocia after birth of the fetal head, which has its own potentially negative impacts on the PF and urinary structures (Hayman, 2005).

Anal Sphincter Trauma

Damage to pelvic nerves or direct muscle injury during birth can also interfere with the anal continence mechanism, leading to symptoms of fecal

urgency and anal incontinence. Anal sphincter laceration is a serious complication of vaginal delivery, and a large proportion (between 20% and 57%) of women with anal sphincter lacerations remain incontinent after primary repair (Borello-France et al., 2006; Dandolu et al., 2005; Heit et al., 2001; Stepp et al., 2006; Sultan & Fernando, 2001). The greatest incidence of sphincter trauma occurs during a woman's first vaginal delivery. Between 5% and 10% of primiparous women will develop impaired anal incontinence, and approximately one-third of women incur some anal trauma that is unrecognized during delivery (Sultan & Fernando, 2001). Persistent sphincter defects are the main cause of postpartum fecal incontinence (Hayman, 2005).

During delivery, mechanical disruption of the sphincter, and stretching of the pudendal nerve most likely contributes to anal incontinence (Lukacz et al., 2006). Perineal trauma that causes separation of the perineal body from the perineal membrane can result in perineal descent and contributes to defecatory dysfunction (DeLancey, 1999). Traumatic vaginal delivery, especially with instrumentation, is one of the most important risk factors for fecal incontinence post-delivery (Hayman, 2005). Women who deliver with forceps assistance have more anal sphincter trauma than women who deliver by vacuum extraction (Heit et al., 2001). To accurately assess repair and risk of anal incontinence, women may need to be referred to a specialist (Sultan & Fernando, 2001). Presently, no association has been found between UI and anal rupture (Altman et al., 2006).

Table 1.
Classification of Perineal Trauma During Vaginal Delivery

First-degree tear	Extends through the skin and structures to superficial muscles. Involves vaginal mucosa, posterior fourchette and perineal skin.
Second-degree tear	Extends through muscles of the perineal body. Involves first-degree plus perineal muscles, including pubococcygeus of the levator ani and superficial and deep transverse perineals (depending on depth of laceration).
Third-degree tear	Extends/continues through anal sphincter muscle. Includes second-degree plus the external anal sphincter.
Fourth-degree tear	Involves the anterior rectal wall. Involve third-degree plus anterior rectal wall Extends through both internal and external sphincters to the lumen.
Modifiable risk factors for third and fourth-degree perineal lacerations; includes decreasing use of instrumental vaginal delivery, particularly forceps, and midline episiotomies.	
Non-modifiable risk factors for third and fourth-degree perineal lacerations; includes a short perineal body, Asian race, occiput-posterior fetal presentation at delivery, fetal macrosomia, and parity of the mother.	

Sources: Dandolu et al. (2005); Piotrowski (2004); Varney et al. (2004c).

Suturing

Decreasing the risk of infection is one reason to suture the perineum; however, restoration of the function and integrity of the perineum is more important (McCandlish, 2001). The extent and complexity of genital tract trauma is directly related to the amount of suturing required (Albers & Borders, 2007). Although questions exist regarding which types of perineal trauma should be sutured, immediate repair of the perineum is important (see Table 1) (Fernando & Sultan, 2004). Though the creation of a third or fourth-degree perineal tear during birth is seldom culpable, missing such a tear post-delivery is considered to be negligent. A rectal examination must be performed before perineal repair to determine the full extent of perineal lacerations or episiotomy extensions (Sultan & Fernando, 2001).

Suturing is not always necessary for minor lacerations that can heal spontaneously. Labial lacerations and first-degree tears usually do not need to be sutured. Second-degree tears should be repaired after careful vaginal inspection to rule out third-degree or buttonhole tears (Fernando & Sultan, 2004; Sultan & Fernando, 2001). Third and fourth-degree tears demand careful and focused inspection and repair. Periurethral tears must be sutured with great care to maintain urethral patency (Varney et al., 2004c).

Though it has not yet been established as a completely effective method to reduce perineal trauma, regular antepartum perineal massage has the potential to reduce the amount of perineal trauma that requires suturing, (Albers & Borders, 2007; Heit et al., 2001; McCandlish, 2001). Level II evidence (see Figure 3) from 3 RCTs, including over 1,500 women, showed that perineal massage in the weeks before delivery can decrease incidence of perineal trauma in nulliparous women (Stepp et al., 2006). Studies have also found that antepartum perineal massage may contribute to less anal sphincter tearing.

All women should start PFEs as soon as possible after repair to improve muscle recovery

Figure 3.
Levels of Evidence Grading System

Levels of Evidence	
Level I	Evidence from a systematic review or meta-analysis of all RCTs or evidence-based clinical practice guidelines based on systematic reviews of RCTs.
Level II	Evidence obtained from at least one well-designed RCT.
Level III	Evidence obtained from well-designed controlled trials without randomization.
Level IV	Evidence from well-designed case-control and cohort studies.
Level V	Evidence from systematic reviews of descriptive and qualitative studies.
Level VI	Evidence from a single descriptive or qualitative study.
Level VII	Evidence from the opinion of authorities and/or reports of expert committees.

Source: Melnyk & Fineout-Overholt (2005).

(Fernando & Sultan, 2004; McCandlish, 2001). More research regarding proper repair of perineal trauma is necessary to determine if suturing or nonsuturing of first-degree tears results in a less painful recovery for the mother and which are specifically associated with PFDs or UI (Stepp et al., 2006).

CESAREAN SECTION DELIVERY

Background

In 2004, 1.2 million (29.1%) of live births in the U.S. were by CS, which is the highest rate ever reported (Bettes et al., 2007). In recent years, CS has become so safe that women are asking for it without medical indication (Bettes et al., 2007; DeLancey et al., 2007; Handa et al., 2003; Leslie, 2004; Simm & Ramoutar, 2005). The notion that vaginal delivery plays a significant role in UI development, along with the knowledge that CS may spare the denervation of the PF, has lead to a notable increase in elective CS rates in some areas of the country (Buchsbaum, Chin, Glantz, & Guzick, 2002; Handa et al., 2003; Lukacz et al., 2006; Peeker & Peeker, 2003). The current debate focuses on the impact of vaginal deliveries on the PF, and the long and short-term health effects that can be attributed to PFDs (Leslie, 2004).

Although a CS is considered safe, it is a major abdominal surgery that carries many risks, including hemorrhage, thromboembolic events, infection, and risks from anesthesia (McFarlin, 2004). When compared to CS recovery, women with vaginal births have no increased risks to the mother's safety.

Procedure and Risk

The CS procedure itself involves cutting through every abdominal layer to reach the gravid uterus, including separating the rectus abdominus muscles and its sheath of fascia. As the fetus is retrieved through an incision in the uterus, there is an added risk of laceration to the fetus (Simm & Ramoutar, 2005). There is also a risk of bladder injury because the organ must be manipulated when visualizing the uterus (Simm & Ramoutar, 2005). Women with CS births are at an increased risk for hemorrhage, uterine rupture, and urinary tract injury, and are twice as likely to be readmitted to the hospital for complications after birth (Declerq et al., 2007; Leslie, 2004; Visco et al., 2006).

Mothers with a CS delivery are also less likely to room-in with their babies, less likely to continue breastfeeding, and more likely to experience health concerns post-delivery, including abdominal pain, bladder and bowel difficulties, headaches, and backaches (Declerq, Sakala, Corry, Applebaum, & Risher, 2002; Leslie, 2004). Women with a prior CS delivery also have a 2.4% risk for a catastrophic complication (such as uterine rupture) in a subsequent pregnancy and are 2.6 times more likely to have placenta previa, with the risk increasing further with each subsequent CS (Bettes et al., 2007; Leslie, 2004, McFarlin, 2004).

Risk of death increases 4-fold in women with CS, as does the risk of future complications from abnormal placentation (placenta previa and placenta accreta) and uterine rupture. An estimated 130 annual excess maternal deaths in the U.S. are attributed to the high CS rate (Leslie, 2004; McFarlin, 2004; Nygaard, 2005; Visco et al., 2006). The United Kingdom Maternal Mortality Report of 2.2 million births from 1994 to 1998 found risk of maternal death due to CS to be 6 times greater than vaginal birth for all CSs performed and almost 3 times greater for elective CS (McFarlin, 2004). Side effects of CS include incisional pain long after the birth, UI in the first 2 months after the birth, and major bowel problems.

There is a myriad of potential risks to the neonate, which are beyond the scope of this discussion. A few risks include lacerations to the fetus, increases in respiratory issues, inadvertent preterm deliveries with scheduled CS, and inadequate transition to life outside the womb. Evidence to date suggests that the fetus benefits from undergoing a normal spontaneous vaginal birth, and labor is an important part of preparing the neonate for its transition to extrauterine life (Leslie, 2004; McFarlin, 2004; Nygaard, 2005).

Primary Elective Cesarean Section

The term *primary elective cesarean* refers to the scenario in which a woman without a medical indication chooses a CS as the

mode of delivery for her first birth (Leslie, 2004; McFarlin, 2004). The 2003 American College of Obstetricians and Gynecologists (ACOG) Ethics Committee's statement regarding elective CS is that a physician has an ethical right to offer elective CS if he or she believes it "promotes the overall health and welfare of the women and her fetus than does vaginal birth." However, the statement also affirms the right of the physician to "refrain from performing the surgery" if he or she believes it would be detrimental "to the overall health and welfare of the woman and her fetus." It also calls for the physician to refer the patient if the method of delivery cannot be determined (American College of Obstetricians and Gynecologists [ACOG], 2003; Bettes et al., 2007). The physician is not obligated by law to perform a service he or she does not feel is beneficial to the patient, which in the case of the obstetrician, could refer to either the mother or the baby (Penna, 2004).

Many physician benefits (reduced consultation time, possible avoidance of medicolegal issues, scheduling of births into "office" time, predictable course of "labor" and delivery) may not be considered as placing the best interests of the patient first (Penna, 2004). Bettes et al. (2007) surveyed ACOG fellows to examine obstetrician-gynecologists' knowledge, opinions, and practice pattern related to CS on maternal request. They found that about half of respondents believe women have the right to a CS on request, but most responded that their practices do not have a policy regarding this procedure.

However, when surveyed, many physicians responded that they would perform a CS for convenience, and nearly one-third preferred the idea of elective CS for their own pregnancies (Al-Mufti, McCarthy, & Fisk, 1997; Handa et al., 2003; Heit et al., 2001; Leslie, 2004). In a study by Al-Mufti and coauthors (1997), questionnaires were mailed to obstetricians to survey preferred mode of delivery for themselves or their partners. They found that 31% of female obstetricians would choose elective primary CS in absence of medical indication, with 88% of those respondents choosing elective CS for fear of perineal damage, including SUI and anal sphincter damage. Sixty-nine percent of obstetricians in England and Wales (155 respondents) indicated they would perform an elective CS on maternal request due to fear of litigation (McFarlin, 2004).

Although obstetricians believed that women have the right to request a CS, they still expressed discomfort with the procedure as a group overall (Bettes et al., 2007). Most (93.7%) believed that there are more risks, such as intraoperative risk to the mother, including bleeding and internal organ damage, than benefits. The suggested potential benefits involve reduced risk of perineal damage (76.2%), reduction in risk of long-term incontinence (54.8%), and reduced risk of pelvic organ prolapse (56.8%) (Bettes et al., 2007). As a group, physicians were more likely to perform a CS on maternal request in the context of previous third or fourth-degree laceration with first delivery. Overall, female physicians endorsed more risks ($p < 0.01$) and fewer benefits ($p < 0.01$) than male physicians, and all recognized an increase in requests for the procedure over the last year.

It is theorized that the prevention of UI development later in life is one reason women request CS on demand without a trial of labor. Other contributory reasons include fear of labor (tocophobia), fear of PFD (UI and POP), fear of sexual dysfunction, and ability to choose the delivery date and time (Bettes et al., 2007; Leslie, 2004; McFarlin, 2004; Nygaard, 2005). Although women may choose a CS for the convenience of scheduling the birth and avoiding the pain of labor and delivery, the woman is likely to deal with postoperative postpartum pain as she recovers from major abdominal CS surgery (Leslie, 2004).

CSs, which are performed before the onset of labor, have proven to be protective of pudendal nerve damage; however, it is not entirely protective of PFDs or UI (Borello-France et al., 2006; Heit et al., 2001; Lukacz et al., 2006; Sultan & Fernando, 2001). It is surmised that if all children were delivered by a CS, the overall incidence of severe female UI would be reduced from 10% to about 5%. However, it would not be totally eliminated because 10% of women undergoing elective CS still develop UI (Nygaard, 2005; Sultan & Fernando, 2001). Further, for every woman that may benefit in the long term from CS performed pre-labor, nine women may require major abdominal surgery (DeLancey et al., 2007).

One-fourth of primary CSs are performed in the second stage of labor (see Figure 1), which increases the risk of SUI, overactive bladder (OAB), and anal incontinence more than CS performed prior to first-stage labor (Alexander et al., 2007; Heit et al., 2001; Lukacz et al., 2006;). Little data focus on the healthy, full-term, primary elective CS, and therefore, there are not enough current data specific to primary elective CS to determine protective benefits to the PF (Bettes, et al., 2007; Leslie, 2004; McFarlin, 2004).

Using data from the National Institute of Child Health and Human Development Maternal Fetal-Medicine Units Network, Alexander et al. (2007) performed a prospective observational study of primary CS deliveries, comparing maternal outcomes of primary CS performed in second-stage labor and first-stage labor. Data were take from 11,981 CSs, with 9,265 performed during first-stage labor and 2,716 performed during second-stage labor. Dystocia was the most common indication for CS in both groups; however, fetal

distress was more common in women with CS performed during first-stage labor. CSs performed in second-stage labor were significantly longer procedures from initial skin incision to delivery ($p < 0.001$), which is likely because second-stage CSs are more difficult technically. Second-stage CSs can also cause complications for the mother. For example, the mother may suffer an inadvertent injury, such as cystotomy due to engagement of the fetal head, making bladder delineation difficult (Alexander et al., 2007).

It is difficult to justify primary elective CS without medical need on a cost-benefit basis (McFarlin, 2004; Penna, 2004). In 2003, the average cost of a vaginal delivery was $2,487, while planned CS costs estimated $4,372 (Declerq et al., 2007). Evidence does not support the benefit of CS as an elective, non-medically indicated procedure, and extra money could be spent on other health care needs (Penna, 2004). Within the private sector, insurance is becoming more stringent with CS indications and guidelines. Many companies are choosing to not pay for a CS if there is no medical indication (Penna, 2004).

Expectant mothers must understand the CS procedure and its associated risks (Lukacz et al., 2006; Simm & Ramoutar, 2005). Women who have had one CS tend to have subsequent pregnancies delivered the same way (Visco et al., 2006). Subsequent CS deliveries pose further risks for increased morbidity for the mother (abnormal placentation, hemorrhage), and ultimately, the infant. Visco et al. (2006) reviewed outcomes on the mother and infant with a CS delivery on maternal request. Their literature review concluded that there currently seems to be little to no differences between the two modalities of delivery—primary, planned CS and vaginal delivery. In the uncomplicated pregnancy, elective CS is unproven to have any short or long-term benefits to mother or baby, and current data are not sufficient to support or refute use of planned primary CS (Bettes et al., 2007; Penna, 2004).

Pregnancy and birth are normal physiological events in a woman's life. Women desire a safe birth experience, and data show that not only are CSs not safer than vaginal births, they may subject women to greater risks. Consumer demand for elective CSs may be rising as women see greater freedom in choice of childbirth; however, women ultimately must live with the outcome of their choices (Heit et al., 2001; Penna, 2004). The decision to undertake major surgery without medical indications for a normal physiological event must be taken with great concern (McFarlin, 2004). The issue may come down to harm versus good and the Hippocratic Oath to "first do no harm" (Penna, 2004; Visco et al., 2006). Continued research will continue to assess for specific obstetrical, biological, and environmental factors that are most likely to place certain women at higher risk for severe PFD and UI (Nygaard, 2005) because these are the women who truly may benefit from primary elective CS.

SUMMARY

Larger numbers of quality studies that critically examine the incidence and relationships between SUI and planned, primary CS in the healthy, full-term pregnancy would be beneficial. Further studies that compare the ongoing relationship between vaginal delivery and PFDs have the potential to add knowledge to the practice of elective CS (Buchsbaum et al., 2002). For instance, a study to compare the incidence of SUI in the short and long-term between the different types of CS (planned versus emergent, first-stage versus second stage) and the different types of vaginal deliveries (spontaneous, episiotomy, forceps, vacuum) is needed.

There is increasing evidence that antenatal and postpartum SUI increase the risks for long-term SUI, regardless of mode of delivery (Foldspang, Mommsen, & Djurhuus, 1999; Nygaard, 2006). Viktrup and colleagues (2006) performed a longitudinal study that found women who had the combination of SUI during pregnancy and delivered via CS were more likely to have long-term SUI than women who do not have antenatal SUI and delivered vaginally. Hvidman, Foldspang, Mommsen, and Nielson (2003) also discovered that the protective effect of CS on SUI was much lower in women who had SUI in the antepartum over those who did not leak at all during pregnancy. Women identified as having nonmodifiable risk factors, as well as those who may develop severe childbirth injuries to the PF after first vaginal delivery, may benefit from elective primary CS (Heit et al., 2001). Larger studies are needed to assess these effects.

Although vaginal delivery is correlated with increased risk of developing PFD, the conditions affect less than half of women who deliver vaginally (Lukacz et al., 2006). Even though all forms of CSs were found to be associated with less pelvic descent, which suggests a protective effect of CS on PFD, odds of PFD development, though lower, are increased if a CS is performed following a trial of labor (DeLancey et al., 2007; Dietz & Bennett, 2003; Lukacz et al., 2006). For every five to seven elective primary CSs performed, only one woman is protected from future PFD development (Lukacz et al., 2006). Therefore, avoidance of vaginal birth is not a comprehensive program for PFD prevention (DeLancey et al., 2007; Nyggard, 2005).

Investigation of different types of management during second-stage labor (hands-poised, hands-on, perineal massage, hot compress use) could add more to the total picture of labor management and its full effects on UI and PFD (Leslie, 2004). Many studies only provide information regarding

short-term follow up, which may provide results that are unnecessarily alarming. Few studies prospectively follow women beyond one year after delivery (Nygaard, 2006). While long-term studies can be difficult to perform because of rate and reason of subject drop out and recall bias, these types of studies are needed.

Much of the "danger" of vaginal-assisted delivery does not lie with the instruments themselves, but possibly, within sub-optimal skills of the practitioners. Rather than abandon safe, instrument-assisted vaginal deliveries for more abdominal surgeries, there could be a focus on ensuring practitioners have the necessary skills to adequately perform these procedures with lower incidences of perineal trauma. Management of second-stage labor with operative vaginal delivery should remain a safe and viable option because CSs are frequently traumatic, and associated with significant morbidity and mortality. Assisted vaginal deliveries should remain a reasonable option when practiced within safeguards and supervision (Hayman, 2005).

Reestablishment of women's confidence in vaginal delivery is critical to their natural role in the birthing process (Fernando & Sultan, 2004; Roberts, 2002). Present management of childbirth will be hard to change or influence until direct evidence exists that can identify specific obstetric factors independently responsible for neurophysio-logic damage sustained during childbirth (Heit et al., 2001). Directions in future research need to identify what specific OB factors are most deleterious to the PF and ultimately, UI. ◙

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