GYNECOLOGY

Evaluating maternal recovery from labor and delivery: bone and levator ani injuries

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OBJECTIVE: We sought to describe occurrence, recovery, and consequences of musculoskeletal (MSK) injuries in women at risk for childbirth-related pelvic floor injury at first vaginal birth.

STUDY DESIGN: Evaluating Maternal Recovery from Labor and Delivery is a longitudinal cohort design study of women recruited early postbirth and followed over time. We report here on 68 women who had birth-related risk factors for levator ani (LA) muscle injury, including long second stage, anal tears, and/or older maternal age, and who were evaluated by MSK magnetic resonance imaging at both 7 weeks and 8 months' postpartum. We categorized magnitude of injury by extent of bone marrow edema, pubic bone fracture, LA muscle edema, and LA muscle tear. We also measured the force of LA muscle contraction, urethral pressure, pelvic organ prolapse, and incontinence.

RESULTS: In this higher-risk sample, 66% (39/59) had pubic bone marrow edema, 29% (17/59) had subcortical fracture, 90% (53/59) had LA muscle edema, and 41% (28/68) had low-grade or greater LA tear 7 weeks' postpartum. The magnitude of LA muscle tear did not substantially change by 8 months' postpartum ($P = .86$), but LA muscle edema and bone injuries showed total or near total resolution ($P < .05$). The magnitude of unresolved MSK injuries correlated with magnitude of reduced LA muscle force and posterior vaginal wall descent ($P < .05$) but not with urethral pressure, volume of demonstrable stress incontinence, or self-report of incontinence severity ($P > .05$).

CONCLUSION: Pubic bone edema and subcortical fracture and LA muscle injury are common when studied in women with certain risk factors. The bony abnormalities resolve, but levator tear does not, and is associated with levator weakness and posterior-vaginal wall descent.

Key words: levator ani, magnetic resonance imaging, musculoskeletal injuries, pelvic floor, vaginal birth

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Childbirth is arguably one of the most dramatic musculoskeletal (MSK) events the human body undergoes. Passage of the newborn through the pelvis and its muscles requires an exceptional degree of soft-tissue stretch.[1]

EDITORS' ★ CHOICE

Childbirth exerts remarkable stresses on maternal pelvic bones from the pressures of the fetal head and the forces of abdominal muscles used during maternal pushing that originate from the pelvic bones. Such stretch and stress may produce injury in some women.

In the last decade, new imaging techniques have brought important new insights into understanding the mechanisms of soft-tissue and bony injury.[2] Special sequences in MSK magnetic resonance imaging (MRI) offer advantages over other imaging techniques for studying deep bony and soft-tissue changes. Fluid-sensitive sequences have the best combined specificity and sensitivity for revealing areas of injury and edema. Hence, they are the recommended diagnostic imaging test for stress injuries.[3,4] These sequences are commonly applied in evaluation of sports-related injury to allow for detection of injuries not seen with other MRI sequences or imaging modalities.[2,3,5-7]

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TABLE 1
Maternal demographics and birth variables among women with 7 wks and 8 mos' postpartum magnetic resonance images

Demographic	Total	Mean (SD) or frequency	Range or %
Maternal age, y	68	30.38 (5.48)	19–46
Maternal age >31 y		27	40
Race	66		
Black		2	3
White		58	88
Asian		3	5
Other		3	5
Non-Hispanic/Non-Latino		66	100
Education	66		
High school graduate or less		6	9
Some college		13	20
College/technical school graduate		17	26
Graduate school		29	44
Birth variables			
Infant weight, g	67	3411.90 (507.12)	2100–4550
Infant head circumference, cm	66	34.19 (1.62)	30–38
Second stage, min	67	154.91 (126.58)	6–518
Second stage >150 min		31	46
Active pushing, min	56	113.75 (84.65)	6–312
Passive second stage, min	56	44.45 (72.40)	0–307
Anal tear	68	22	32
Episiotomy	68	14	21
Vacuum	68	4	6
Forceps	68	2	3

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However, MSK-MRI fluid-sensitive sequences have only recently been applied to reveal the scope of childbirth-related pelvic injuries.[8-11]

Soon after beginning a study of levator ani (LA) muscle injury following vaginal birth, it became evident we should add these standard MSK-MRI fluid-sensitive sequences to our existing protocol of anatomical MRI sequences to better characterize the full scope of possible injuries and pattern of recovery.

The purpose of this study is to report on the occurrence and severity of bony and LA muscle injuries observed and how magnitude of tissue trauma relates to clinical consequences in the first 8 months' postpartum. Fluid-sensitive sequences are necessary for 3 of 4 indicators of bone and muscle injury evaluated in our study. The sequences show: (1) increased signal that indicates edema (extracellular fluid) in bone; (2) matched linear signal changes in bone that indicate a fracture; or (3) increased signal that indicates edema in muscle. The fourth indicator of injury, visual discontinuity of muscle seen with muscle tear, does not require fluid-sensitive sequences. However, use of fluid-sensitive sequences makes detection of tears and their magnitude much easier. The precision of these measures offered opportunity to assess more precisely the relationship between injury magnitude and relative consequences seen clinically in the first 8 months' postpartum.

Materials and Methods

Study design

The parent study Evaluating Maternal Recovery from Labor and Delivery (EMRLD) is an institutional review board–approved (University of Michigan Institutional Review Board HUM00051193) longitudinal cohort study following up primiparous women with recent history of childbirth. In this article, we report on those with higher-risk factors for LA injury. The first published reports from this work included: (1) details on EMRLD's sampling strategies and a Strengthening the Reporting of Observational Studies in Epidemiology diagram; (2) specifics of using MSK-MRI methods; (3) ensuing anatomical detail of pelvic floor structures at rest, during dynamic activity, and by LA muscle subdivision and line of action; and (4) predominant demographic or obstetric variables associated with LA tear when evaluated early postpartum.[8-12] EMRLD data collection occurred from June 13, 2005, through March 14, 2012, collecting data at approximately 7 weeks after a first vaginal birth and again at about 8 months after first vaginal birth. In this article, we report the 7 weeks to 8 months' postpartum longitudinal findings.

Sample

The enriched sampling relied on inclusion criteria of heuristically determined risk factors for LA tear (eg, prolonged second stage, anal sphincter tear, higher maternal age, forceps delivery) suggestive in 2005, the time of the study's start.[13] Women were excluded from EMRLD if aged <18 years, spoke a primary health care language other than English, delivered at <36 weeks' gestation, birthed >1 infant, or if the infant was admitted to neonatal intensive care.

Of the 90 women originally recruited into EMRLD, 22 women did not have a second MRI at 8 months' postpartum. Our analysis was based on the 68 women with MRI data at both 7 weeks and 8 months' postpartum.[9]