Assoziation zwischen der betroffenen Seite der Levatormuskelverletzung und der fetalen Position bei Geburt – eine prospektive Observationsstudie

Kimmich, Nina ; Birri, Jana ; Zimmermann, Roland ; Kreft, Martina

DOI: https://doi.org/10.1055/a-1153-9387

Other titles: Association between the side of levator Ani muscle trauma and fetal position at birth - a prospective observational study

Association between the side of levator ani muscle trauma and fetal position at birth – a prospective observational study

Assoziation zwischen der betroffenen Seite der Levatormuskelverletzung und der fetalen Position bei Geburt – eine prospektive Observationsstudie

Kimmich N, Birri J, Zimmermann R, Kreft M

Nina Kimmich, MD

Division of Obstetrics, University Hospital of Zurich

Frauenklinikstrasse 10, 8091 Zurich, Switzerland

Nina.Kimmich@usz.ch

Jana Birri, MD

Division of Obstetrics and Gynecology, Cantonal Hospital of Baden

Im Ergel 1, 5404 Baden, Switzerland

Jana.Birri@ksb.ch

Roland Zimmermann, Professor MD

Division of Obstetrics, University Hospital of Zurich

Frauenklinikstrasse 10, 8091 Zurich, Switzerland

Roland.Zimmermann@usz.ch

Martina Kreft, MD

Division of Obstetrics, University Hospital of Zurich

Frauenklinikstrasse 10, 8091 Zurich, Switzerland

martinakreft@gmx.de

Corresponding author:

Nina Kimmich, MD

Division of Obstetrics, University Hospital of Zurich

Frauenklinikstrasse 10, 8091 Zurich, Switzerland

Tel: 0041-44-255 1111

E-Mail: Nina.Kimmich@usz.ch

Abstract

Introduction

Trauma of the levator ani muscle (LAM) is common after vaginal birth and can most reliably be diagnosed by 3-dimensional (3D) translabial ultrasound (TLUS). Multiple risk factors are known in general, but not in association to a specific side of the body. Therefore, our aim was to evaluate different impact factors which cause LAM trauma on either side of the body or bilateral by focusing on the fetal position at birth.

Material and Methods

As part of a prospective cohort study between 3/2017 and 4/2019, we analyzed vaginal births of nulliparous women with singletons in vertex presentation ≥ 36+0 gestational weeks. We evaluated their pelvic floor for hematomas, partial and complete LAM avulsions by 3D TLUS 2-4 days postpartum and searched for an association between the affected body side and different fetal, maternal and obstetrical factors.

Results

71 out of 213 women (33.3%) suffered from LAM trauma - 17 (23.9%) on the right side, 20 (28.2%) on the left side and 34 (47.9%) bilateral. No association between the different evaluated factors and the affected body side could be identified, except for the quality of fetal heart rate tracing.

Conclusions

No significant impact factors of LAM trauma could be associated with a specific side of the body. Other possible mechanisms need investigation in the future, such as the time of the birth canal and the fetus to adapt to each other, including adequate time for the tissue to stretch and the fetus to rotate into the ideal position within the LAM hiatus.

Key words

Levator ani, birth trauma, avulsion, vaginal birth, pelvic floor

Zusammenfassung

Einleitung

Levatormuskelverletzungen sind häufig nach Vaginalgeburten und können zuverlässig mittels translabialem 3D-Ultraschall diagnostiziert werden. Diverse Risikofaktoren sind hierfür bekannt, allerdings keine hinsichtlich der Assoziation zu einer der beiden Körperseiten. Daher war das Ziel dieser Arbeit, verschiedene Einflussfaktoren im Rahmen vaginaler Geburten zu evaluieren, welche eine Levatorverletzung auf einer der beiden Körperseiten bzw. beidseitig begünstigen, v.a. hinsichtlich der Kindsposition im Geburtskanal.

Material und Methodik

In einer prospektiven Kohortenstudie analysierten wir von 3/2017-4/2019 Erstgebärende mit vaginalen Einlingsgeburten aus Schädellage ≥36+0 SSW. Wir evaluierten 2-4 Tage postpartal ihren Beckenboden mittels 3D-Ultraschall hinsichtlich Hämatomen sowie partiellen und kompletten Levatoravulsionen und suchten nach Assoziationen zwischen der betroffenen Körperseite und fetalen, maternalen und geburtshilflichen Einflussfaktoren.

Ergebnisse

Von 213 Frauen erlitten 71 (33.3%) eine Levatorverletzung – 17 (23.9%) rechtsseitig, 20 (28.2%) linksseitig und 34 (47.9%) beidseitig. Es wurden keine Assoziationen zwischen den untersuchten Einflussfaktoren und der betroffenen Körperseite gefunden, bis auf die Qualität der fetalen Herzfrequenz.

Diskussion

Es konnten keine signifikanten Einflussfaktoren für das Auftreten einer Levatorverletzung einer spezifischen Körperseite eruiert werden. Daher bedarf es in Zukunft der Untersuchung weiterer Mechanismen, wie der Adaptationsvorgänge von Geburtskanal und Fet und der adäquaten Zeit für das Gewebe zur notwendigen Dehnung, v.a. im Bereich der Levatoröffnung.

Schlüsselwörter

Levatormuskel, Geburtstrauma, Avulsion, Vaginalgeburt, Beckenboden

Fazit für die Praxis

Ein Drittel aller Erstgebärenden erleidet nach Vaginalgeburt irgendeine Form einer Levatorverletzung. Bisher lassen sich keine maternalen, fetalen oder geburtshilflichen Faktoren eruieren, welche die Verletzung einer bestimmten Seite des Levatormuskels erklären könnten. Vermutlich sind hierfür Abläufe und Adaptationsvorgänge im inneren des Geburtskanals verantwortlich

Main text

Introduction

Pelvic floor trauma after childbirth is a current topic of high interest and focus in current obstetrical research, as women are getting more and more concerned about their physical wellbeing and body integrity after vaginal birth. Trauma of the pelvic floor is mainly caused during the very first birth and often results with a widened genital hiatus, or in 6-63% as a partial or complete avulsion of the levator ani muscle (LAM) (1-9). These LAM avulsions can most reliably be diagnosed by 3-dimensional (3D) translabial ultrasound (TLUS), as described by Dietz et al (10-13). Women with pelvic floor damage frequently experience severe short- and long-term morbidity, such as pain, a widened vagina, urine or fecal incontinence, sexual disorders, psychological distress, uterine prolapse, or the need for repetitive surgeries with immense costs for the health system (3, 14-18). Common discussed risk factors for LAM avulsions are advanced maternal age, lower body mass index, a higher fetal weight and head circumference, a prolonged second stage of labor and vaginal-operative deliveries, especially forceps extractions (19-24). These mentioned factors are reported as risk factors for any kind of LAM avulsion. Those factors, however, cannot explain the specific side of LAM injury. The question arises which factors during the birth process cause the injury, which results in either the right or left side being affected, or even bilateral. Besides, scarce data is reported of other LAM trauma such as hematomas. However, hematomas at the LAM insertion sites at the pubic bones might be an indicator for LAM avulsion (25). Therefore, the aim of our study was to search for maternal, fetal or obstetrical factors, which might explain the occurrence of any kind of LAM trauma regarding the two different sides of the body. Taking into account that the fetus and the birth canal need to fit together like a key and a keyhole and that the fetus has to perform

rotational movements to adapt to the shape of the birth canal, the question arises, if a mismatch of these two components leads to a trauma on a specific side of the body. Regarding this question, we especially focused on the evaluation of the exact position of the fetal head and shoulders during fetal extraction in relation to the sustained LAM trauma.

Methods

In a prospective observational study between March 2017 and April 2019, we asked all full age nulliparous women ≥ 36+0 gestational weeks (gw), who carried singleton pregnancies with fetuses in vertex presentation and who planned a vaginal birth at our center to participate in our cohort study for the evaluation of LAM trauma after vaginal birth. The study was approved by the local ethical board and was performed according to the Declaration of Helsinki. For the evaluation of the association of maternal, fetal and obstetrical factors to the affected body side of LAM trauma, we included all women of our cohort with unilateral or bilateral partial or complete LAM avulsion or LAM hematoma for the final analysis. Women with intact LAM were excluded. Clinical data were extracted from the institutional obstetric database (Perinat version 6.1.9.45). Details of the fetal position during birth were extracted from a special documentation tool, as published by our group before (26). LAM injury was assessed by 3D TLUS 2 to 4 days after birth by two well-trained pelvic floor sonographers. Women were asked to empty their bladder prior to the examination and were placed in the lithotomy position. A covered 3D abdominal probe of 4 to 7-MHz (Voluson S10, GE Healthcare, Zipf, Austria) was placed between the labia. Acquisition of 3D tomographic volumes and their interpretation were performed according to the method by Dietz et al (10, 12). We documented each discontinuity (a break in the normal texture of the pubocoggygeal-puborectalis muscle, evident as an ultrasound hypo/anechogenic lesion interrupting the hyperechogenic course of muscle fibres) involving the pubococcygeus-puborectalis muscle, recognisable in the coronal C-plane slice (unilateral if the defect involves one side, bilateral if both sides are damaged). To standardize we decided to diagnose a partial avulsion if an abnormal insertion of the LAM on the pubic bone was evident in at least one slice and as LAM avulsion, when an abnormal insertion was found in all three central slices at the level of the plane of minimal hiatal dimension and at 2.5 and 5 mm above this plane as described by Dietz

et al (10, 12). We differentiated the abnormality into hematoma when the an-/hypoechogenic lesion was inside the muscle with intact muscle tissue on both sides, a partial avulsion when there was continuity of the muscle tissue on one side and avulsion when there was no intact muscle tissue seen in the slice.

LAM status was then classified into partial or complete avulsions or intact LAM, as described by Dietz et al (10, 11, 27). A univariate analysis was performed to evaluate the association of the body side of LAM injury to different possible risk factors of interest. We differentiated between right-sided LAM trauma, left-sided LAM trauma and bilateral LAM trauma. For continuous variables an ANOVA test was performed and for categorical variables a chi-squared test was done. Statistical significance was set at a level of <0.05. No power calculations were performed in advance, as this was a secondary analysis of the above mentioned main prospective study.

Results

362 nulliparous women agreed to take part in the main study regarding the evaluation of LAM trauma after vaginal birth. Of these, 149 had to be excluded from the study in the course because of delivery by cesarean, fetal breech position, women`s withdrawal from the study, preterm birth before 36 gw, delivery at or transmission to another hospital, or because they did not show up for the ultrasound evaluation 2-4 days postpartum. From the remaining 213 women with vaginal births, 71 (33.3%) suffered from any kind of LAM avulsion trauma and therefore remained for the final analysis in this study. Within these 71 women, we found 51 (23.9%) partial or complete LAM avulsions and 20 (9.4%) hematomas. The characteristics of these 71 women are shown in Table 1.

Of the 71 women with LAM trauma after vaginal birth, half suffered from a unilateral and half from a bilateral LAM trauma. The distribution of right- and left-sided trauma was almost equal. Seventeen women (23.9%) had a right-sided LAM trauma, 20 (28.2%) had a left-sided LAM trauma and 34 (47.9%) suffered from a bilateral LAM trauma, as can be seen in Table 1. No significant differences between the three groups could be evaluated in regards to the different maternal, fetal and obstetrical factors at birth, except for an abnormal fetal heart rate tracing. Most notably, we did not find any significant association between the position of the fetal head and shoulders in the birth

canal to the affected side of LAM trauma at birth, although there was a tendency towards a higher rate of infants with a bigger head circumference, with the head in non-vertical position and a lower rate of intravaginal gel application.

Discussion

The total rate of partial and complete avulsions after vaginal birth in our study was 23.9%. This rate is consistent to the rates reported in other studies (1-7). Besides, we found LAM hematomas in 9.4% of women. However, published studies only focus on complete LAM avulsions and do not evaluate any partial avulsions or hematomas.

The birth canal changes its shape from the pelvic inlet, the midplane and the outlet from a transverse oval shape to a round shape in the midplane and further on to a vertical oval shape at the outlet. Therefore, the fetus and the birth canal need to fit together like a key and a keyhole during the birth process, as the fetus has to perform rotational movements to adapt to the shape of the birth canal. We hypothesize that a mismatch of these two components might lead to a trauma of the LAM and that the side of LAM trauma might depend on the fetal position. Another hypothesis for trauma is that the birth canal and especially the LAM does not have enough time to slowly stretch and adapt to the size and position of the fetus as otherwise the fetus does not have enough time to rotate with its shoulder into a vertical position between the LAM insertion sites. No data can be found in the existing literature in regards to the occurrence of LAM trauma in connection to the position of the fetus during birth, especially its head and shoulders. We wondered if the exact position of the fetal head (reflected by the sagittal suture of the fetal head as an indicator for the exact rotational component) or the rotational position of the fetal shoulder might be crucial. One could speculate that the passage of the fetus through the insertion sites of the LAM at the pubic bones with shoulders in transverse position might raise the risk for LAM trauma. However, we could not find a predictable factor in regards to the position of the fetus for LAM trauma. The only factor being significantly associated to LAM trauma in our cohort was a difference in the rate of an abnormal fetal heart rate tracing. For the rate of an abnormal fetal heart rate tracing we are left without a concrete explanation, especially as the main difference was found between the right- and the left-sided LAM trauma and not between the unilateral and the bilateral one. Regarding the position of the fetus, we evaluated the position of the shoulders at the moment when the fetus

was born. Therefore, one problem could be that the fetal position, especially the position of the shoulders, could not be evaluated exactly at the moment of the passage through the LAM insertion sites and might have been slightly different from the moment at birth. Biomechanical finite element studies have shown, that the greatest stretch of the LAM is present at Hodge`s plane +4 (28). Additionally, TLUS examination of the pelvic floor during birth has revealed, that the plane of maximal dimension of the LAM hiatus is present at Hodge`s plane +4 as well (29). Therefore, it might be recommended to let the fetus pass slowly through the level of Hodge`s plane +4 and further on and to await the rotation of the shoulders into a vertical axis at the insertion sites of the LAM. One option is that birth attendants do not request women to push too strong and uncontrolled, when the fetal head is passing through the hiatus of the LAM, and that they take special care during vaginal-assisted births, in order to preserve LAM structures, even in situations with an abnormal fetal heart rate tracing.

A strength of our study is the longitudinal, prospective design with antenatal inclusion of the participants into the study, and the validated and very detailed assessment methods. Furthermore, our study adds important information to the current knowledge by evaluating the association of different fetal, maternal and obstetric factors to the affected body side of LAM trauma. A limitation is the relatively small cohort of women with LAM trauma with small numbers of cases for the different evaluated factors and that the study was not explicitly powered for the present study. Besides, the maternal component with a detailed assessment of the shape und size of the maternal pelvis during birth is missing as well. Further and adequately powered studies are needed to confirm our results.

Conclusions

So far, no significant impact factors could be associated to either a right-sided, left-sided or bilateral LAM trauma. Other possible mechanisms need investigation in the future, such as the time of the birth canal and the fetus to adapt to each other, including adequate time for the tissue to stretch and the fetus to rotate into the ideal position within the LAM hiatus.

Tables

Table 1: Characteristics of the 71 women with partial or complete levator ani muscle avulsions or muscle hematomas according to the affected side of the body

Conflict of Interests

The authors of this manuscript have no conflicts of interest to disclose.

Funding Sources

The study was supported by GE Healthcare, Zipf, Austria by providing the ultrasound device (Voluson S10) and probes for the ultrasound examinations during the whole study period.

The Heartbay Foundation (Vaduz, Liechtenstein) supported the project financially.

Ethical Approval

Approved by the Local Ethical Board of the District ("Kantonale Ethikkommission Zürich") under the registration BASEC-Nr.2016-00908. Besides, all study participants gave their written informed consent for the study.

References

1. van Delft K, Thakar R, Sultan AH, Schwertner-Tiepelmann N, Kluivers K. Levator ani muscle avulsion during childbirth: a risk prediction model. BJOG. 2014;121(9):1155-63; discussion 63.

2. van Delft KW, Thakar R, Sultan AH, IntHout J, Kluivers KB. The natural history of levator avulsion one year following childbirth: a prospective study. BJOG. 2015;122(9):1266-73.

3. Dietz HP. Pelvic floor trauma in childbirth. Aust N Z J Obstet Gynaecol. 2013;53(3):220-30.

4. Shek KL, Dietz HP. Intrapartum risk factors for levator trauma. BJOG. 2010;117(12):1485-92.

5. Kearney R, Fitzpatrick M, Brennan S, Behan M, Miller J, Keane D, et al. Levator ani injury in primiparous women with forceps delivery for fetal distress, forceps for second stage arrest, and spontaneous delivery. Int J Gynaecol Obstet. 2010;111(1):19-22.

6. Gonzalez-Diaz E, Garcia-Mejido JA, Martin-Martinez A, Fernandez-Fernandez C, Ortega I, Medina M, et al. Are there differences in the damage to the pelvic floor between malmstrom's and kiwi omnicup vacuums? A multicenter study. Neurourol Urodyn. 2019.

7. Garcia Mejido JA, De la Fuente Vaquero P, Fernandez Palacin A, Aquise Pino A, Bonomi Barby MJ, Sainz Bueno JA. Influence of difficulty of instrumentation with vacuum on the rate of levator ani muscle avulsion identified by 3-4 d transperineal ultrasound. J Matern Fetal Neonatal Med. 2018;31(5):591-6.

8. Kamisan Atan I, Gerges B, Shek KL, Dietz HP. The association between vaginal parity and hiatal dimensions: a retrospective observational study in a tertiary urogynaecological centre. BJOG. 2015;122(6):867-72.

9. Horak TA, Guzman-Rojas RA, Shek KL, Dietz HP. Pelvic floor trauma: does the second baby matter? Ultrasound Obstet Gynecol. 2014;44(1):90-4.

10. Dietz HP. Ultrasound imaging of the pelvic floor. Part II: three-dimensional or volume imaging. Ultrasound Obstet Gynecol. 2004;23(6):615-25.

11. Dietz HP, Abbu A, Shek KL. The levator-urethra gap measurement: a more objective means of determining levator avulsion? Ultrasound Obstet Gynecol. 2008;32(7):941-5.

12. Dietz HP, Bernardo MJ, Kirby A, Shek KL. Minimal criteria for the diagnosis of avulsion of the puborectalis muscle by tomographic ultrasound. Int Urogynecol J. 2011;22(6):699-704.

13. Dietz HP, Garnham AP, Rojas RG. Is the levator-urethra gap helpful for diagnosing avulsion? Int Urogynecol J. 2015.

14. Radestad I, Olsson A, Nissen E, Rubertsson C. Tears in the vagina, perineum, sphincter ani, and rectum and first sexual intercourse after childbirth: a nationwide follow-up. Birth. 2008;35(2):98-106.

15. Skinner EM, Barnett B, Dietz HP. Psychological consequences of pelvic floor trauma following vaginal birth: a qualitative study from two Australian tertiary maternity units. Arch Womens Ment Health. 2017.

16. Skinner EM, Dietz HP. Psychological and somatic sequelae of traumatic vaginal delivery: A literature review. Aust N Z J Obstet Gynaecol. 2015;55(4):309-14.

17. Dietz HP, Schierlitz L. Pelvic floor trauma in childbirth - myth or reality? Aust N Z J Obstet Gynaecol. 2005;45(1):3-11.

18. Dannecker C, Lienemann A, Fischer T, Anthuber C. Influence of spontaneous and instrumental vaginal delivery on objective measures of pelvic organ support: assessment with the pelvic organ prolapse quantification (POPQ) technique and functional cine magnetic resonance imaging. Eur J Obstet Gynecol Reprod Biol. 2004;115(1):32-8.

19. Valsky DV, Lipschuetz M, Bord A, Eldar I, Messing B, Hochner-Celnikier D, et al. Fetal head circumference and length of second stage of labor are risk factors for levator ani muscle injury, diagnosed by 3-dimensional transperineal ultrasound in primiparous women. Am J Obstet Gynecol. 2009;201(1):91 e1-7.

20. Aydin S, Tuncel MA, Aydin CA, Ark C. Do we protect the pelvic floor with non-elective cesarean? A study of 3-D/4-D pelvic floor ultrasound immediately after delivery. J Obstet Gynaecol Res. 2014.

21. Kearney R, Miller JM, Ashton-Miller JA, DeLancey JO. Obstetric factors associated with levator ani muscle injury after vaginal birth. Obstet Gynecol. 2006;107(1):144-9.

22. Falkert A, Endress E, Weigl M, Seelbach-Gobel B. Three-dimensional ultrasound of the pelvic floor 2 days after first delivery: influence of constitutional and obstetric factors. Ultrasound Obstet Gynecol. 2010;35(5):583-8.

23. Caudwell-Hall J, Kamisan Atan I, Brown C, Guzman Rojas R, Langer S, Shek KL, et al. Can pelvic floor trauma be predicted antenatally? Acta Obstet Gynecol Scand. 2018;97(6):751-7.

24. Caudwell-Hall J, Kamisan Atan I, Martin A, Guzman Rojas R, Langer S, Shek K, et al. Intrapartum predictors of maternal levator ani injury. Acta Obstet Gynecol Scand. 2017;96(4):426-31.

25. van Delft K, Thakar R, Shobeiri SA, Sultan AH. Levator hematoma at the attachment zone as an early marker for levator ani muscle avulsion. Ultrasound Obstet Gynecol. 2014;43(2):210-7.

26. Kimmich N, Burkhardt T, Kreft M, Zimmermann R. Reducing birth trauma by the implementation of novel monitoring and documentation tools. Acta Obstet Gynecol Scand. 2019;98(10):1223-6.

27. Dietz HP, Moegni F, Shek KL. Diagnosis of levator avulsion injury: a comparison of three methods. Ultrasound Obstet Gynecol. 2012;40(6):693-8.

28. Parente MP, Natal Jorge RM, Mascarenhas T, Silva-Filho AL. The influence of pelvic muscle activation during vaginal delivery. Obstet Gynecol. 2010;115(4):804-8.

29. Garcia Mejido JA, Suarez Serrano CM, Fernandez Palacin A, Aquise Pino A, Bonomi Barby MJ, Sainz Bueno JA. Evaluation of levator ani muscle throughout the different stages of labor by transperineal 3D ultrasound. Neurourol Urodyn. 2016.