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Levator ani avulsion and risk of recurrence after surgery for anterior compartment prolapse: Current status

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Abstract

Objective Avulsion seems to be associated with recurrence of pelvic organ prolapse (POP) following surgery. The overall prevalence of levator ani avulsion in female gender after vaginal delivery is 13-36% at the ultrasound examination (US) and 20% at MRI. Relationship between avulsion of levator ani muscle (LAM) and prolapse of pelvic floor organs is well established in literature, even if there are few studies in the current literature that investigate the relationship between LAM avulsion and risk of POP recurrence after pelvic floor surgery. The few literature reports on LAM avulsion and risk of recurrence after pelvic surgery for anterior compartment prolapse will be reviewed in this article.

Methods A systematic literature review was conducted using the PubMed database. The search keyword used was “levator avulsion”. In addition these articles were hand searched for additional citations.

Results This paper reviews the available data on LAM avulsion and risk of recurrence after pelvic floor surgery in 13 articles; 9 retrospective studies and 4 prospective studies.

Conclusions The reported results indicate that the presence of LAM avulsion increased the risk of recurrence after pelvic floor surgery.

Introduction

Pelvic organ prolapse (POP) is a common condition that occurs in 41% of women between 50 and 79 years and is one of the most common indications for gynecological surgery[1-2]. However recurrent prolapse after pelvic floor surgery is still quite common. The objective of this article is to understand the role of the levator ani muscle (LAM) injury in the recurrence of prolapse after pelvic floor surgery.

The first childbirth puborectalis muscle injury was documented in 1943 by Howard Gainey[3-4]. Later many studies have identified the trauma of the pelvic floor consequence to vaginal delivery as the main risk factor for LAM avulsion[5-6]. During vaginal delivery the levator ani muscle plays a crucial role, running into considerable distension that result in abnormal hiatal biometry and abnormal biomechanical properties of the muscle itself[7-9]. LAM avulsion is the main cause of prolapse of the anterior compartment[5-7,10]. Avulsion seems to be associated with the recurrence of prolapse after pelvic floor surgery[17-29]. The risk factors involved in trauma of the levator ani and the subsequent development of genital prolapse may be congenital or acquired, as shown in the **table 1**.

There are many clinical and instrumental definitions of levator ani injury and these are well reported in a recent review by Schwertner-Tiepelmann[10]. Commonly, LAM avulsion is a detachment of the puborectalis branch from its insertion on the inferior pubic ramus. The muscle tone decrease leads over time to an enlargement of the urogenital jatus “ballooning” with consequent prolapse of pelvic organs. Many studies in literature argue that a defect of the levator ani muscle is associated with an incidence of approximately double of genital prolapse[11-12]. It was observed that women with significant genital prolapse have a chance 4 times greater of LAM avulsion than women without prolapse[13-14]. In a recent Cochrane review are illustrated the different diagnostic techniques for LAM avulsion[15]. Diagnosis is possible with clinical examination or MRI but the gold standard remains ultrasound examination (2d transperineal ultrasound, 3D ultrasound / 4D transperineal 3D transvaginal ultrasound).

Nowadays surgical approach is divided in two big branches: the fascial surgery (native tissue repair such as colporrhaphy, colposuspension and sacrospinous fixation) and the mesh surgery (biological graft repair or synthetic meshes). Pelvic reconstructive surgery can be performed through the vagina or abdominally (via a traditional incision or through laparoscopy). A recent Cochrane review[16] shows that biological graft repair or absorbable mesh provides minimal advantage compared with native tissue repair. Graft repairs have an increased risk of SUI (stress urinary incontinence) and bladder injury; native tissue repairs have a high risk of recurrence. Some studies are going on to asses safety and efficacy of polypropylene meshes.

RISKS FACTORS OF LAM AVULSION	
CONGENITAL	**ACQUIRED**
Pelvic conformation	Pregnancy
Bone framework	Childbirth
Perineal muscle variations	Forceps delivery
Short ano-vulvar distance	Long second stage of labour
Collagen abnormalities	Fetal macrosomia
	Occipito-posterior position
	Multiparity
	Higher maternal age
	Lower BMI
	Caucasian race
	Epidural*
	Hormonal factors (menopause)
	Iatrogenic factors (hysterectomy)

Table 1 – Risks factors of LAM avulsion. *for some authors epidural analgesia seems to be a protective factor.

Methods

A systematic literature review was conducted using the PubMed database. The search keyword used was “levator avulsion”. The PubMed search revealed 66 articles, 7 articles met the selection criteria on correlation between LAM avulsion and recurrence after pelvic floor surgery for anterior compartment prolapse. Additional 6 studies were identified by cross-checking reference lists . Of the 13 articles included in this systematic review, 9 are retrospective studies and 4 are prospective studies.

Results

In the current literature, there are few studies investigating the risk of recurrence after pelvic floor surgery for anterior compartment prolapse in patients with LAM avulsion. Details on the published studies are described in **Table 2**.

Vakili et al. (New Orleans) correlated the levator ani contraction strength and genital hiatus measurement with failure of surgical procedures for prolapse in 358 patients with a median follow-up of 5 months. They concluded that diminished levator ani contraction strength and a genital hiatus 5 cm or greater correlate with an increase in surgical failures in the early post-operative period (p=0,015 and p=0.023)[17].

Diez-Itza et al. (Spain) analyzed the risk factors associated with the recurrence of pelvic organ prolapse in 134 women who underwent vaginal surgery (hysterectomy, anterior and/or posterior colporraphy) with a median follow-up of 5 years. They found that high body weight (> 65 Kg), younger women (< 60 years) and advanced preoperative prolapse correlate with recurrence. Levator muscle contraction < 3 (Oxford Classification Scale) had no correlation with recurrent prolapse (p=0.404)[18].

Dietz et al. (Australia) found a strong association (p<0.001) between levator avulsion and prolapse recurrence after cystocele repair (anterior colporrhapy) in 83 women with a median follow-up of 4.5 years. LAM injury was found in 29 patients and 23 of these patients had a recurrence. Total recurrent cases were 33[19].

Model et al. (Australia) in a series of 737 patients who underwent pelvic floor surgery (4 groups: hysterectomy, incontinence or prolapse procedure, anterior colporrhaphy and colposuspension) concluded that there was a significant association between objective prolapse after pelvic floor surgery and avulsion injury of the puborectalis muscle in all four groups (p<0.001; p<0.001; p=0.01; p=0.028)[20].
Weemhoff and colleagues (Netherlands) described in a prospective observational cohort study with a median follow-up of 2 years the relationship of recurrent cystocele with avulsion of puborectalis muscle and other risk factors. In a series of 152 patients who underwent anterior colporrhaphy they recorded 77 recurrence, of these 40 (52%) women had a complete LAM avulsion and 28 (36%) had a partial avulsion (p=0.08); only 9/77 women (12%) had recurrence and no LAM avulsion[21].
Morgan et al. (USA) in a retrospective study evaluated whether major levator ani muscle defects were associated with differences in postoperative vaginal support 6 weeks after primary surgery for POP in a series of 107 women. They concluded that women with normar levator ani muscle had better anterior vaginal support after prolapse surgery than those with major defects (p=0.042)[22].

Shek et al. (Australia) defined the incidence of failure of mesh fixation after anterior colporrhaphy with a median follow-up of 1.8 years. They observed that cystocele recurrence was statistically significant associated with avulsion (46% vs 32%, p=0.017) and with hiatal area (37.38 vs 30.8 cm^2, p<0.001)[23].

Notten et al. (Netherlands) in an abstract of a multicenter prospective cohort study concluded that major levator ani defects did not predict objective or subjective recurrence following anterior colporraphy (p=0.44 US, p=0.34 MRI). They enrolled 140 patients in 9 hospitals, diagnosis of LAM defects was available for 135 patients, follow-up was 1 year[24].

Wong et al. (Australia) investigated if levator avulsion is a risk factor for prolapse recurrence following anterior colporrhaphy with mesh.

They reported a series of 209 women with a median follow-up of 2.2 years. US cystocele recurrence was observed in 54 patients. In women with levator avulsion 35% (28/80) had recurrent cystocele on US compared with 19% (25/129) of women without levator avulsion (p=0.012)[25].

Rodrigo et al. (Australia) found that the state of the patient's levator ani muscle is the strongest predictor of prolapse recurrence (p=0.0006) after cystocele repair with or without mesh[26].
Svabik et al. (Czech Republic) in a recent single center randomized interventional prospective trial, compared the efficacy of two standard procedure (Prolift Total vs SacroSpinous fixation SSF) for post-hysterectomy vaginal vault prolapse in patients with LAM avulsion. In this study were enrolled 70 women randomized into two groups: 36 Prolift group and 34 SSF group, median follow-up was 1 years. They observed only 1 recurrence in the Prolift group and 22 (65%) in the SSF group so they concluded that in patient with prolapse after hysterectomy and LAM avulsion Prolift Total Procedure has a higher success than SSF Procedure (p<0.001)[27].

Cheung et al. (Hong Kong) investigated in a prospective observational study whether the presence of LAM avulsion is associated with expulsion of vaginal pessary within 1 year. In a series of 255 women, 108 (42,4%) had pessary expulsion, more of them had LAM avulsion (57% vs 27,2%; p<0.01)[28].

Jalil et al. (Chile) performed a study to determinate whether a diagnosis of LAM avulsion by US is equally valid before and after pelvic reconstructive surgery for POP. The odds ratio of prolapse recurrence in women with a preoperative diagnosis of avulsion was 2.5 and in those with a postoperative diagnosis was 2.3 so they concluded that both diagnosis show excellent agreement[29].

Conclusions

According to literature review LAM avulsion seems to be an important risk factor of recurrence or failure after pelvic floor surgery. The articles included in this review are few and consist in small series of patients. 9/13 studies are retrospective and 2 studies don't find out any correlation between LAM avulsion and recurrence.

We have not found italian studies. According to our experience in Italy the prevalence of LAM avulsion seems to be lower, this is probably due to a better primary prevention: prenatal courses, less use of forceps and a wider use of caesarean section if needed. Furthermore there is also an increasing awareness of the importance of pelvic floor rehabilitation.

According to literature we think that a correct pre-operative assessment is mandatory. All the patients should perform US examination to identify women with LAM avulsion that is known to have a low rate of success. It's our opinion that other studies turned to identify the best surgical technique in these patients at high risk of failure are needed.

In summary, even if the evidence is lacking and more prospective studies with large sample size are needed, the limited experiences available from the literature confirm that LAM avulsion have a strong association with recurrence of POP following surgery.

Table 2 – Reviewed article [17-29]

Author	Year	Study design	Tot pt	Pt with LAM avulsion	Total Recurrence Rate	Recurrence in LAM injuries	RR of recurrence in LAM avulsion	Median f-up
Vakili B. et al.	2005	Retrospective	358	NR	34.6%	35.8%	NR	5 months
Diez-Itza I. et al.	2007	Retrospective	134	99 (73.8%)	31.3%	78.6% (33/42)	NR	5 years
Dietz HP. et al.	2010	Retrospective	83	29 (35%)	41% (US)	79% (23/29)	3.9 (US criteria) 2.9 (clinical)	4.5 years
Model AN. et al.	2010	Retrospective	737	159 (22%)	50%		2.3-3.3	NR
Weemhoff M. et al.	2011	Prospective	152	122 (80%)	51%	88%	2.4	31 months
Morgan DM. et al.	2011	Retrospective	107	>50%	NR	NR	NR	6 weeks
Shek KL. et al.	2012	Retrospective	296	117 (39.5%)	43%	46%	NR	1,8 years
Notten K. et al.	2013	Prospective	140	49 (36%) US 41 (30%) MRI	55%	NR	1.3 (US) 1.4 (MRI)	12 months
Wong V. et al.	2013	Retrospective	209	80 (38%)	33%	35% (28/80)	2.24	2.2 years
Rodrigo N. et al.	2014	Retrospective	334	130 (39%)	42%	NR	3.45 (US) 2.19 (clinical)	2,5 years
Svabik K. et al.	2014	Prospective	142	70 (50 %) 36 Profit group 34 SSF group	NR	1 (3%) / 22 (65%)	NR	1 year
Cheung RYK. et al.	2015	Prospective	255	98 (38.4%)	42.4%	58/108 (53,7%)	3.1	1 year
Jalil SS. et al.	2016	Retrospective	207	111 (53,6%) preop 109 (52,7%) postop	NR	NR	2.5 preop / 2.3 postop	1,3 years

REFERENCES

1. DeLancey JO. *The hidden epidemic of pelvic floor dysfunction: achievable goals for improved prevention and treatment.* Am J Obstet Gynecol 2005;192(5):1488–95.

2. Patel DA, Xu X, Thomason AD, Ransom SB, Ivy JS, DeLancey JO. *Childbirth and pelvic floor dysfunction: an epidemiologic approach to the assessment of prevention opportunities at delivery.* Am J Obstet Gynecol 2006;195(1):23–8.

3. Gainey HL. *Post-partum observation of pelvic tissue damage.* Am J Obstet Gynecol 1943; 46: 457–466.

4. Gainey HL. *Postpartum observation of pelvic tissue damage: further studies.* Am J Obstet Gynecol 1955; 70: 800–807.

5. Dietz HP. *Pelvic floor trauma in childbirth.* Aus N Z J Obstet Gynaecol 2013; 53:220-230.

6. Dietz HP. *Pelvic floor trauma following vaginal delivery*. Curr Opin Obstet Gynecol 2006; 18: 528-37.

7. Lien KC, Mooney B, DeLancey JO, Ashton-Miller JA. *Levator ani muscle stretch induced by simulated vaginal birth.* Obstet Gynecol 2004; 103: 31–40.

8. Svabik K, Shek K, Dietz H. *How much does the levator hiatus have to stretch during childbirth?* BJOG 2009; 116: 1657–1662.

9. Brooks S, Zerba E, Faulkner J. *Injury to muscle fibres after single stretches of passive and maximally stimulated muscle in mice.* J Physiol 1995; 488: 459–469.

10. Schwertner-Tiepelmann N, Thakar N, Sultan AH, Tunn R. *Obstetric levator ani muscle injuries: current status.* Ultrasound Obstet Gynecol 2012; 39: 372–383

11. Dietz HP, Lanzarone V. *Levator trauma after vaginal delivery*. Obstet Gynecol 2005; 106: 707 – 712.

12. Shek KL, Dietz HP. Can levator avulsion be predicted antenatally? Am J Obstet Gynecol 2010; 202: 586.e1 – 6.

13. Shek KL, Dietz HP. *The effect of childbirth on hiatal dimensions.* Obstet Gynecol 2009; **113**: 1272 – 1278.

14. Shek K, Dietz HP. *Intrapartum risk factors for levator trauma.* BJOG 2010; 117: 1485–1492.

15. van Gruting IMA, Van Delft KWM, Thakar R, IntHout J, Sultan AH. *Accuracy of MRI, ultrasound and vaginal assessment for the diagnosis of levator ani muscle avulsion in women (Protocol).* Cochrane Library, 5 October 2015.

16. Maher C1, Feiner B, Baessler K, Christmann-Schmid C, Haya N, Brown J. *Surgery for women with anterior compartment prolapse. Cochrane Database Syst Rev.* 2016 Nov 30;11:CD004014.

17. Vakili B, Zheng YT, Loesch H, Echols KT, Franco N, Chesson RR. *Levator contraction strength and genital hiatus as risk factors for recurrent pelvic organ prolapse.* Am J Obstet Gynecol. 2005 May;192(5):1592-8.

18. Diez-Itza I, Aizpitarte I, Becerro A. *Risk factors for the recurrence of pelvic organ prolapse after vaginal surgery: a review at 5 years after surgery*. Int Urogynecol J Pelvic Floor Dysfunct. 2007 Nov;18(11):1317-24. Epub 2007 Feb 28.

19. Dietz HP, Chantarasorn V, Shek KL. *Levator avulsion is a risk factor for cystocele recurrence.* Ultrasound Obstet Gynecol 2010;36:76–80.

20. Model AN, Shek KL, Dietz HP. *Levator defects are associated with prolapse after pelvic floor surgery.* European Journal of Obstetrics & Gynecology and Reproductive Biology 153 (2010) 220–223.

21. Weemhoff M, Vergeldt T, Notten K, Serroyen J, Kampschoer P, Roumen F. *Avulsion of puborectalis muscle and other risk factors for cystocele recurrence: a 2-year follow-up study.* Int Urogynecol J 2012; 23: 65–71.

22. Morgan D, Larson K, Lewicky-Gaupp C, Fenner D, DeLancey J. *Vaginal support as determined by levator ani defect status 6 weeks after primary surgery for pelvic organ prolapse.* Int J Gynaecol Obstet 2011; 114: 141–144.

23. Shek KL, Wong V, Rane A, Goh J, Krause H, Lee J, Rosamilia A, Dietz HP. *How common is fixation failure after mesh kit surgery?* International Urogynecology Journal 23 (Suppl 2):S154-156 · September 2012.

24. Notten K, Weemhoff M, Kluivers K, Schweitzer K, van Gestel I, Kampschoër P, Gondrie E, Smits L, Bergmans , Roovers J P. *Do levator ani muscle defects predict recurrent pop after anteriore colporraphy.* Best Clinical Abstract (398), 2013.

25. Wong V, Shek K, Rane A, Goh J, Krause H, Dietz HP. *Is levator avulsion a predictor of cystocele recurrence following anterior vaginal mesh placement?* Ultrasound Obstet Gynecol.

2013 Aug;42(2):230-4.

26. Rodrigo N, Wong V, Shek KL, Martin A, Dietz HP. *The use of 3-dimensional ultrasound of the pelvic floor to predict recurrence risk after pelvic reconstructive surgery.* Aust N Z J Obstet Gynaecol. 2014 Jun;54(3):206-11.

27. Svabik K, Martan A, Masata J, El-Haddad R, Hubka P. *Comparison of vaginal mesh repair with sacrospinous vaginal colpopexy in the management of vaginal vault prolapse after hysterectomy in patients with levator ani avulsion: a randomized controlled trial.* Ultrasound Obstet Gynecol. 2014 Apr;43(4):365-71.

28. Cheung RY, Lee JH, Lee LL, Chung TK, Chan SS. *Levator ani muscle avulsion is a risk factor for vaginal pessary expulsion within 1 year for pelvic organ prolapse.* Ultrasound Obstet Gynecol. 2017 Jan 12.

29. Abdul Jalil SS, Guzman Rojas R, Dietz HP. *Does it matter whether levator avulsion is diagnosed pre- or postoperatively?* Ultrasound Obstet Gynecol. 2016 Oct;48(4):516-519.