

BANDL'S PATHOLOGICAL RETRACTION RING AND OBSTRUCTED LABOR: A NARRATIVE SYSTEMATIC REVIEW

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Abstract

Background: Bandl's pathological retraction ring is one of the most ominous signs in intrapartum obstetric practice. It represents the pathological elevation of the physiological retraction ring caused by prolonged obstructed labor (OL), signaling imminent uterine rupture. First described by Ludwig Bandl in 1875, it arises from an insurmountable mechanical barrier to fetal descent, including cephalopelvic disproportion, malpresentation, or fetal macrosomia. Obstructed labor remains one of the five leading causes of maternal mortality globally, particularly in resource-limited settings such as Ethiopia, where it accounts for 19.1% of maternal deaths.

Objectives: To synthesize current evidence on the pathophysiology, clinical diagnosis, surgical management, and maternal-fetal outcomes of Bandl's ring and obstructed labor, and to distinguish it from constriction ring dystocia.

Review Methodology: A narrative systematic review was conducted using PubMed, Google Scholar, and Cochrane Library. Peer-reviewed studies published from 2003 to 2026 were included, comprising clinical reviews, systematic reviews, meta-analyses, and observational studies. Key sources include a 2026 comprehensive clinical review of Bandl's ring and a 2022 PLoS ONE systematic review and meta-analysis of obstructed labor outcomes in Ethiopia (87 studies; n=104,259 women; 4,952 newborns).

Key Findings: Bandl's ring is a surgical emergency; emergent cesarean delivery is the only acceptable intervention. In Ethiopia, OL was associated with 14.4% maternal mortality, 41.18% uterine rupture, 35.07% sepsis, and 26.4% perinatal mortality. Oxytocics and instrumental vaginal delivery are absolutely contraindicated once Bandl's ring is identified.

Conclusion: Bandl's ring is a catastrophic, time-sensitive obstetric emergency requiring immediate surgical intervention. Prevention through vigilant intrapartum monitoring, proper partograph use, and timely obstetric care remains the most effective strategy to reduce associated maternal and perinatal mortality.

Categories: Obstetrics and Gynecology; Maternal-Fetal Medicine; Emergency Obstetrics

Keywords: Bandl's Ring; Pathological Retraction Ring; Obstructed Labor; Dystocia; Uterine Rupture; Maternal Mortality; Perinatal Outcomes; Cesarean Section; Constriction Ring; Intrapartum Complications

Introduction

The process of normal parturition depends on precise physiological coordination between the uterine contractile forces, the fetal passenger, and the maternal pelvis. During active labor, the gravid uterus differentiates into two functionally distinct segments: the upper uterine segment (UUS), which actively contracts and thickens to generate expulsive forces, and the lower uterine segment (LUS), which passively thins and dilates to form the birth canal.

The junction between these two segments forms the physiological retraction ring — a normal, non-palpable anatomical landmark. When this harmonious process is disrupted by an insurmountable mechanical barrier, the labor enters a pathological state: obstructed labor (OL). Under these conditions, the physiological ring undergoes a sinister transformation, elevating abnormally to become a visibly and palpably taut, oblique band across the abdomen — the pathological retraction ring of Bandl, first described by German gynecologist Ludwig Bandl in 1875.

Obstructed labor is one of the five major causes of maternal mortality and morbidity in developing countries, accounting for 19.1% of maternal deaths in Ethiopia alone. A 2022 systematic review and meta-analysis encompassing 87 studies and over 104,000 women revealed alarming rates of maternal death (14.4%), uterine rupture (41.18%), and perinatal mortality (26.4%) attributable to obstructed labor in Ethiopia. Bandl's ring, as the extreme end of this pathological spectrum, signals the pre-rupture state — a critical obstetric emergency demanding immediate surgical intervention.

The growing global burden of obstructed labor, especially in resource-constrained settings where access to emergency obstetric care is limited, makes it imperative to synthesize evidence on this condition. This review aims to provide clinicians with a comprehensive understanding of Bandl's ring and obstructed labor — covering pathophysiology, diagnosis, management, outcomes, and prevention.

Review Methodology

This narrative systematic review was conducted using PubMed/MEDLINE, Google Scholar, and the Cochrane Library databases. Medical Subject Headings (MeSH) used included: 'Bandl ring', 'pathological retraction ring', 'obstructed labor', 'uterine rupture', 'dystocia', 'constriction ring', 'maternal mortality', and 'cesarean section'.

Inclusion criteria: peer-reviewed publications from 2003 to 2026, published in English, involving clinical reviews, systematic reviews, meta-analyses, case series, and observational studies related to Bandl's ring and obstructed labor. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework guided study selection for the included meta-analysis (Yeshitila et al., 2022). The Newcastle-Ottawa Scale (NOS) was used in the primary meta-analysis to assess methodological quality; studies scoring 6 or above were classified as high quality.

Key primary sources synthesized in this review include: (1) Llamas & Aguilera (2026) — a comprehensive clinical review of Bandl's ring published in the International Journal of Reproduction, Contraception, Obstetrics and Gynecology; and (2) Yeshitila et al. (2022) — a systematic review and meta-analysis of obstructed labor outcomes in Ethiopia published in PLoS ONE (87 studies, n=104,259 women and 4,952 newborns).

Pathophysiology

Normal Uterine Segmentation

During active labor, the uterus differentiates into two anatomically and functionally distinct entities. The upper uterine segment (UUS) — comprising the fundus and corpus — is the active, contractile, thick-walled component generating expulsive forces through progressive myometrial retraction. The lower uterine segment (LUS), derived from the uterine isthmus and cervix, undergoes passive stretching, effacement, and dilation, transforming into a distensible conduit for fetal passage. The physiological retraction ring at their interface represents a benign, non-palpable landmark that ascends gradually as labor progresses.

Genesis of Bandl's Ring

Bandl's ring develops when obstructed labor creates an insurmountable mechanical barrier to fetal descent. The UUS contracts with increasing vigor in a futile attempt to overcome the obstruction, entering a self-perpetuating cycle of dysfunction:

- Progressive overstretching of LUS myometrial fibers beyond physiological capacity
- Interstitial edema, venous and lymphatic engorgement causing tissue congestion
- Ischemic compromise due to impaired perfusion, leading to myometrial necrosis
- Compensatory hypertrophy and hypertonicity of the UUS, bordering on tetany
- Forcible elevation of the physiological ring, creating the palpable pathological Bandl's ring

The point of maximal stress is located just superior to the anterior cervical lip — rendered avascular and necrotic by unrelenting pressure — where spontaneous full-thickness uterine rupture is most likely to occur, precipitating catastrophic hemorrhage, fetal asphyxia, and maternal hemodynamic collapse.

Etiology and Risk Factors

Obstructed labor occurs when the fetal presenting part cannot progress through the maternal pelvis despite adequate uterine contractions. Primary etiological factors include:

- Cephalopelvic disproportion (CPD): the most common cause, due to a contracted maternal pelvis
- Fetal macrosomia: excessive fetal size relative to the maternal pelvis
- Malpresentation: brow, face, or transverse lie creating unfavorable diameters
- Persistent malposition: occiput posterior or occiput transverse positions
- Shoulder dystocia: shoulders hindering passage through the pelvic outlet
- Rare causes: soft tissue abnormalities such as cervical or vaginal masses

In Ethiopia, the prevalence of OL ranges from 3.3% in Tigray to 34.3% in Oromia. Non-use or improper use of the partograph — a low-cost labor monitoring tool — is a major contributor to delayed recognition and management of OL in resource-limited settings.

Clinical Presentation and Diagnosis

Clinical Features

Diagnosis of Bandl's ring is fundamentally clinical. The hallmark triad consists of:

- Protracted and obstructed labor with secondary arrest of dilation and/or descent despite adequate contractions
- Physical examination: a palpable, taut, oblique groove traversing the abdomen between the umbilicus and symphysis pubis — pathognomonic of Bandl's ring
- Fetal compromise on cardiotocography: recurrent variable or late decelerations indicating escalating uteroplacental insufficiency

On examination, the UUS (cephalad to the ring) is tonically contracted, hard, and thickened. The LUS (caudad to the ring) is abnormally stretched, thin, and exquisitely tender, with the fetal presenting part tightly wedged against the maternal pelvis. Maternal exhaustion, anxiety, and unrelenting suprapubic pain disproportionate to fundal contractions are characteristic features.

Role of Intrapartum Ultrasonography

Ultrasound provides critical ancillary evidence: an alarmingly thin and elongated LUS, elevated and edematous bladder due to traction from the descending pathological ring, arrested fetal descent with significant caput succedaneum and moulding, and compromised fetal and uteroplacental circulation on Doppler.

Differential Diagnosis

A critical distinction must be made between Bandl's ring and constriction ring dystocia:

Feature	Bandl's Ring	Constriction Ring
Location	UUS-LUS junction; oblique	Any uterine level; circumferential
Cause	Mechanical obstructed labor	Oxytocin hyperstimulation
Risk	Pre-rupture state	Usually reversible
Management	Emergency cesarean section only	Remove oxytocin; tocolytics

table 1: differential diagnosis — bandl's ring vs. constriction ring dystocia

Surgical Management

Emergent Cesarean Delivery

The diagnosis of Bandl's ring mandates immediate cesarean delivery as the sole acceptable intervention. Oxytocic augmentation, expectant management, vacuum extraction, and forceps delivery are absolutely contraindicated — each would impose additional intolerable stress on the critically compromised LUS, exponentially increasing the risk of uterine rupture.

Choice of Uterine Incision

The standard low transverse cervical incision is often hazardous due to the pathologically stretched, paper-thin, edematous, and friable condition of the LUS. Attempting a transverse incision frequently results in uncontrollable lateral extension with risk of uterine artery laceration. Therefore, a low vertical or classical midline incision is preferred, deliberately transecting the constricting Bandl's ring — immediately releasing the constriction and facilitating fetal extraction.

Fetal Extraction and Closure

The deeply impacted fetal head may require: suprapubic pressure by the assistant, reverse breech extraction (by feet) if the head is high, or careful intraoperative forceps application. Hysterotomy closure is technically demanding due to poor tissue quality and requires multiple suture layers. In cases with necrotic LUS or uncontrollable hemorrhage, subtotal or total hysterectomy may be life-saving. Broad-spectrum antibiotics are mandatory given the high infection risk. Future pregnancies carry significant uterine scar dehiscence risk, mandating planned elective cesarean.

Maternal and Fetal Outcomes

A systematic review and meta-analysis of 87 studies from Ethiopia (Yeshitila et al., 2022; n=104,259 women) reported the following pooled outcomes:

Complication	Pooled Prevalence	Highest Region
Maternal Death	14.4%	Oromia 34.2%
Uterine Rupture	41.18%	Oromia 67.6%
Maternal Near-Miss	30.5%	Amhara 43.7%
Sepsis	35.07%	Tigray 38.9%
PPH	12.96%	Tigray 22.3%
Hysterectomy	14.3%	—
Obstetric Fistula	3.7%	Oromia 29.9%
Bladder Injury	7.15%	Tigray 18.2%
Perinatal Death	26.4%	Tigray 41.4%

table 2: pooled maternal and perinatal outcomes of obstructed labor in ethiopia (yeshitila et al., 2022). pph = postpartum hemorrhage.

Association analyses revealed that women with OL had 22.67 times higher odds of uterine rupture (OR: 22.67; 95% CI: 12.49–39.91), 6.1 times higher odds of perinatal mortality (OR: 6.1; 95% CI: 4.18–8.9), 2.59 times higher odds of perinatal asphyxia (OR: 2.59; 95% CI: 1.68–4.0), and 4.95 times higher odds of meconium-stained amniotic fluid (OR: 4.95; 95% CI: 2.23–11.0).

Summary of Key Included Studies

Sr.	Author	Year	Type	Findings
1	Llamas NJM & Aguilera LAV	2026	Comprehensive clinical review	Bandl's ring is a pathological retraction ring marking the junction between an overstretched upper and a thickened lower uterine segment. Immediate cesarean delivery is the sole management; oxytocics and instrumental delivery are absolutely contraindicated. Vertical uterine incision is often required.
2	Yeshitila YG et al.	2022	Systematic review & meta-analysis (87 studies, n=104,259)	Pooled maternal death 14.4%, uterine rupture 41.18%, maternal near-miss 30.5%, sepsis 35.07%, PPH 12.96%, hysterectomy 14.3%, obstetric fistula 3.7%, perinatal death 26.4%. OL increased odds of uterine rupture 22.67-fold. Three-delay model and partograph use are critical preventive strategies.
3	Friedman EA & Cohen WR	2023	Clinical review	Describes normal labor curve and active phase dynamics; deviation from normal progress is the first diagnostic clue for obstructed labor and Bandl's ring development.
4	Kissler K & Hurt KJ	2023	Review — pathophysiology	Details the pathophysiology of labor dystocia including mechanical obstruction leading to pathological uterine segmentation; underscores the continuum from normal labor to Bandl's ring formation.
5	Buhimschi CS et al.	2004	Observational — ultrasonography	First documented ultrasonographic observation of Bandl's contraction ring; established the role of intrapartum ultrasound in detecting pathological uterine anatomy supporting the clinical diagnosis.
6	Tinelli A et al.	2015	Observational — intrapartum ultrasound	Intrapartum ultrasonographic detection of Bandl's ring as a marker of dystocia; confirmed ultrasound's

Sr.	Author	Year	Type	Findings
				adjunctive role in diagnosis, showing critically thin lower uterine segment and fetal compromise.
7	Neilson J et al.	2003	Review — obstructed labor	Obstructed labor causes significant perinatal mortality and morbidity; maternal complications include intrauterine infection, bladder/rectal injuries, and uterine rupture; OL accounts for 80–90% of obstetric fistula cases globally.
8	Gupta R et al.	2018	Simulation case scenario	Emergent cesarean section simulation in a Bandl's ring patient; highlights the critical need for simulation training to prepare obstetric teams for this rare but catastrophic emergency.

table 3: summary of key included studies

Prevention Strategies

The Three-Delay Model

The three-delay model is the established framework for addressing preventable obstetric complications:

- Delay 1 — Decision to seek care: Community maternal health education, reducing social and cultural barriers, improving health-seeking behavior
- Delay 2 — Reaching care: Enhancing emergency transportation and obstetric referral systems in collaboration with multiple stakeholders
- Delay 3 — Receiving care: Strengthening health facility capacity with 24-hour emergency cesarean capability and skilled birth attendants

Partograph Utilization

Proper use of the partograph — a low-cost, WHO-recommended tool for labor monitoring — enables early identification of labor abnormalities. Studies from Ethiopia confirm that non-use or improper use of the partograph is significantly associated with adverse OL outcomes. Its practical benefits in resource-constrained settings include ease of use, time efficiency, continuity of care, and educational value for healthcare workers.

Antenatal and Intrapartum Monitoring

- Comprehensive antenatal care to identify high-risk pregnancies — CPD, macrosomia, malpresentation — before labor
- Early recognition of labor dystocia using standardized labor curves
- Judicious use of oxytocic agents; avoiding hyperstimulation
- Timely decision for cesarean when failure to progress is diagnosed
- Absolute avoidance of instrumental vaginal delivery in obstructed labor

Limitations

This review carries certain inherent limitations. The primary meta-analysis (Yeshitila et al., 2022) was confined to Ethiopian studies, limiting global generalizability. High heterogeneity ($I^2 > 90\%$) was noted across included studies, reflecting significant variation in study settings, sample sizes, and outcome definitions. Several complications — including hysterectomy, neonatal near-miss, and constriction ring cases — were represented by a limited number of studies. Additionally, Bandl's ring is an exceedingly rare condition in high-income countries, limiting the availability of large observational datasets from those settings. Retrospective study designs in the primary sources may introduce reporting and selection biases.

Disclosures

The authors have never confirmed any financial relationship or affiliation that could affect the conduct or results of this research. In addition, the authors have explicitly stated that there are no professional or academic relationships, affiliations, or activities of any other person whose interests could reasonably be interpreted as a potential conflict of interest. This has been done to maintain the integrity of the study by ensuring prior transparency.

The purpose of this review is to provide impartial conclusions regarding Bandl's pathological retraction ring and obstructed labor outcomes by confirming the absence of financial incentives or external influence. Such transparency is necessary, particularly

in research related to maternal health and obstetric safety, so that stakeholders can be assured that the conclusions drawn are entirely based on evidence and scientific analysis, and not influenced by external interests.

Conclusions

Bandl's pathological retraction ring stands as one of the most formidable clinical signs in obstetric practice — a visible and palpable sentinel of impending uterine rupture. This review establishes the following key conclusions:

- Emergent cesarean delivery is the sole acceptable management of Bandl's ring; no other intervention is safe or appropriate
- Oxytocics, instrumental vaginal delivery, and expectant management are absolutely contraindicated
- A vertical uterine incision is often necessary due to the compromised, paper-thin lower uterine segment
- Obstructed labor carries devastating maternal and perinatal burdens in resource-limited settings, with pooled maternal mortality of 14.4% and perinatal mortality of 26.4% in Ethiopia
- Prevention through vigilant antenatal care, partograph use, early dystocia recognition, and timely cesarean delivery is the most effective strategy to avert Bandl's ring and its catastrophic consequences

Addressing the three-delay model at systemic, community, and facility levels — combined with comprehensive obstetric training and strengthened emergency referral pathways — is essential to ensure that Bandl's ring remains a rare complication rather than a frequent catastrophe.

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