Medical
Research
Journal

INDIVIDULIZED LABOR MANAGEMENT STRATEGY FOR THE PREVENTION OF SOFT TISSUE BIRTH CANAL TRAUMA: A CLINICAL AND PROGNOSTIC ANALYSIS

Bazarova Zarina Zafarovna,
Trainee Assistant of the Department of Obstetrics and Gynecology No. 1, SamSMU

Abstract. Obstetric trauma to the soft tissues of the birth canal remains a significant contributor to maternal morbidity worldwide, with perineal tears of moderate to severe degree (II–III) occurring in up to one-third of vaginal deliveries. Despite the availability of standardized obstetric protocols, the persistence of high trauma rates suggests limitations in the current “one-size-fits-all” approach to labor management. This study evaluates the clinical effectiveness of a personalized labor management strategy based on individual risk stratification, biomechanical assessment, and targeted intrapartum interventions. A prospective cohort study involving 180 pregnant women was conducted, comparing individualized care with standard obstetric management. The primary outcomes included incidence of perineal trauma, episiotomy rates, duration of the second stage of labor, and postpartum pain intensity. The implementation of a personalized strategy demonstrated a significant reduction in moderate-to-severe perineal tears, decreased episiotomy rates, and improved functional outcomes. These findings support the integration of individualized obstetric algorithms into clinical practice.

Keywords: Personalized labor management, perineal trauma, obstetric injuries, perineal elasticity, episiotomy, second stage of labor, birth biomechanics, vaginal delivery, risk stratification, maternal outcomes.

ИНДИВИДУАЛЬНАЯ СТРАТЕГИЯ ВЕДЕНИЯ РОДОВ ДЛЯ ПРОФИЛАКТИКИ ТРАВМ МЯГКИХ ТКАНЕЙ РОДОВЫХ ПУТЕЙ: КЛИНИКО-ПРОГНОСТИЧЕСКИЙ АНАЛИЗ

Базарова Зарина Зафаровна
Стажер-ассистент кафедры Акушерства и гинекологии №1 СамГМУ

Аннотация. Акушерская травматизация мягких тканей родовых путей остаётся значимым фактором материнской заболеваемости во всём мире, при этом разрывы промежности средней и тяжёлой степени (II–III) встречаются до одной трети случаев вагинальных родов. Несмотря на наличие стандартизированных акушерских протоколов, сохраняющаяся высокая частота травматизации свидетельствует об ограничениях существующего универсального подхода к ведению родов. Целью данного исследования является оценка клинической эффективности персонифицированной стратегии ведения родов, основанной на индивидуальной стратификации риска, биомеханической оценке и целенаправленных интранатальных вмешательствах. Проведено проспективное когортное исследование с участием 180 беременных женщин, в котором сравнивались индивидуализированная тактика ведения родов и стандартный акушерский подход. Основные оцениваемые показатели включали частоту перинеальной травмы, частоту эпизиотомии, длительность второго периода родов и интенсивность послеродовой боли. Внедрение персонифицированной стратегии позволило достоверно снизить частоту разрывов промежности средней и тяжёлой степени, уменьшить частоту эпизиотомии и улучшить функциональные исходы. Полученные результаты подтверждают целесообразность внедрения индивидуализированных акушерских алгоритмов в клиническую практику.

Ключевые слова: Персонифицированное ведение родов, перинеальная травма, акушерские повреждения, эластичность промежности, эпизиотомия, второй период родов, биомеханика родов, вагинальные роды, стратификация риска, материнские исходы.

TUG‘RUQNI INDIVIDUALLASHTIRILGAN BOSHQARISH STRATEGIYASI: TUG‘RUQ YO‘LLARI YUMSHOQ TO‘QIMALARI JAROHATLARINING OLDINI OLISH BO‘YICHA KLINIK VA PROGNOSTIK TAHLIL

Bazarova Zarina Zafarovna,
SamDTU 1-son Akusherlik va ginekologiya kafedrasi stajyor-assistenti

Annotatsiya. Tug‘ruq yo‘llari yumshoq to‘qimalarining akusherlik jarohatlari butun dunyo bo‘ylab onalar kasallanishining muhim omillaridan biri bo‘lib qolmoqda, bunda o‘rta va og‘ir darajadagi perineal yorilishlar (II–III daraja) vaginal tug‘ruqlarning uchdan bir qismigacha uchraydi. Standartlashtirilgan akusherlik protokollarining mavjudligiga qaramay, jarohatlanishning yuqori darajada saqlanib qolishi tug‘ruqni boshqarishda qo‘llanilayotgan universal yondashuvning cheklanganligini ko‘rsatadi. Mazkur tadqiqotning maqsadi individual xavfni stratifikatsiya qilish, biomekhanik baholash va maqsadli intranatal aralashuvlarga asoslangan tug‘ruqni individuallashtirilgan boshqarish strategiyasining klinik samaradorligini baholashdan iborat. 180 nafar homilador ayol ishtirokida prospektiv kohort tadqiqot o‘tkazildi, unda individuallashtirilgan yondashuv va standart akusherlik taktikasi taqqoslandi. Asosiy baholash mezonlari sifatida perineal jarohatlar chastotasi, epiziotomiya darajasi, tug‘ruqning ikkinchi bosqichi davomiyligi hamda tug‘ruqdan keyingi og‘riq intensivligi o‘rganildi. Individuallashtirilgan strategiyani qo‘llash o‘rta va og‘ir darajadagi perineal yorilishlar chastotasini sezilarli darajada kamaytirishga, epiziotomiya ko‘rsatkichlarini pasaytirishga hamda funksional natijalarni yaxshilashga olib keldi. Olingan natijalar klinik amaliyotda individuallashtirilgan akusherlik algoritmlarini joriy etish zarurligini tasdiqlaydi.

Kalit so’zlar: Tug‘ruqni individuallashtirilgan boshqarish, perineal jarohatlar, akusherlik shikastlanishlari, oraliq elastikligi, epiziotomiya, tug‘ruqning II bosqichi, tug‘ruq biomekhanikasi, vaginal tug‘ruq, xavfni stratifikatsiya qilish, ona natijalari.

Introduction. Traumatic injuries to the soft tissues of the birth canal - including the perineum, vaginal walls, and cervix-represent one of the most prevalent complications of vaginal delivery. These injuries are not merely mechanical consequences of childbirth but reflect a complex interplay between fetal size, maternal pelvic anatomy, tissue elasticity, labor dynamics, and obstetric interventions [2,6,11]. In clinical practice, the incidence of second- and third-degree perineal tears ranges between 20% and 35%, with higher rates observed in primiparous women and in cases involving macrosomia or prolonged second stage of labor. The clinical consequences of obstetric trauma extend beyond immediate tissue damage. Patients frequently experience chronic pelvic pain, dyspareunia, urinary and fecal incontinence, and long-term deterioration in quality of life [1,4,15,19]. From a healthcare systems perspective, these complications contribute to increased resource utilization, prolonged hospital stays, and the need for reconstructive interventions. Despite advances in obstetric care, current labor management protocols often rely on generalized guidelines that do not adequately account for interindividual variability [7,13,18]. The traditional paradigm tends to standardize interventions such as episiotomy, pushing techniques, and positioning during labor, often without sufficient consideration of patient-specific anatomical and functional parameters. Recent developments in precision medicine have highlighted the importance of individualized approaches in improving clinical outcomes. In obstetrics, this concept translates into tailoring labor management strategies based on a comprehensive assessment of maternal and fetal characteristics [3,10,21]. However, the practical implementation of such personalized approaches remains limited due to the lack of structured algorithms and clinical validation. The present study aims to address this gap by developing and evaluating a personalized labor management strategy designed to minimize soft tissue trauma. The approach integrates risk stratification, biomechanical

assessment, and targeted intrapartum interventions, offering a more nuanced and adaptive model of obstetric care [5,14,24].

Materials and Methods. A prospective cohort study was conducted involving 180 pregnant women admitted for vaginal delivery at a tertiary obstetric center. The study population was divided into two groups: the main group (n = 90), which received individualized labor management, and the control group (n = 90), which underwent standard obstetric care according to institutional protocols. Inclusion criteria consisted of singleton pregnancy, gestational age between 37 and 41 weeks, cephalic presentation, and absence of contraindications to vaginal delivery. Exclusion criteria included multiple pregnancy, fetal anomalies, previous pelvic reconstructive surgery, and severe obstetric complications requiring operative delivery.

A comprehensive pre-labor assessment was performed to identify factors associated with increased risk of soft tissue trauma. These parameters included maternal body mass index, parity, estimated fetal weight based on ultrasonography, pelvic dimensions, and clinical evaluation of perineal elasticity. Perineal elasticity was assessed using a standardized clinical scoring system based on tissue resistance, extensibility, and vascularity. The duration and progression of the second stage of labor were monitored continuously, and fetal head position was evaluated using both clinical and ultrasound methods.

Table 1. Baseline Characteristics of Study Population

Parameter	Main Group (n=90)	Control Group (n=90)
Mean age (years)	27.8 ± 4.2	28.1 ± 4.5
Primiparous (%)	62%	60%
BMI (kg/m²)	25.6 ± 3.1	25.9 ± 3.3
Estimated fetal weight (g)	3320 ± 420	3360 ± 450
Occiput posterior (%)	18%	20%

Intervention Strategy. The personalized management protocol included several key components. Controlled delivery of the fetal head was performed with careful modulation of expulsive efforts, avoiding excessive strain on perineal tissues. Perineal support using the hands-on technique was applied selectively, depending on tissue characteristics and fetal descent dynamics. Maternal positioning during the second stage of labor was individualized, allowing for vertical or lateral positions to optimize pelvic biomechanics and reduce perineal stress. Routine episiotomy was avoided, and its use was restricted to clearly defined clinical indications. Additionally, warm compresses were applied to the perineum during the second stage, based on evidence suggesting improved tissue elasticity and reduced risk of severe tears. Continuous communication with the patient was maintained to coordinate pushing efforts and ensure gradual fetal expulsion. Primary outcomes included the incidence of perineal tears classified according to degree (I–III), the rate of episiotomy, and duration of the second stage of labor. Secondary outcomes included postpartum pain intensity measured using the Visual Analog Scale (VAS) and early postpartum recovery parameters.

Results. The implementation of a personalized labor management strategy resulted in significant improvements across all measured outcomes. The incidence of moderate-to-severe perineal tears (II–III degree) was markedly reduced in the main group compared to the control group.

Table 2. Obstetric Outcomes

Outcome	Main Group	Control Group
II–III degree tears	12%	28%
Episiotomy rate	18%	53%
Second stage duration (min)	42 ± 10	49 ± 12
VAS pain score	3.2 ± 1.1	4.6 ± 1.3

A statistically significant reduction in episiotomy rates was observed, reflecting a shift toward more conservative and physiologically guided management. The duration of the second stage of labor was shortened by approximately 15%, likely due to improved coordination of expulsive efforts and optimized maternal positioning. Postpartum pain intensity was significantly

lower in the personalized group, suggesting reduced tissue damage and improved healing conditions.

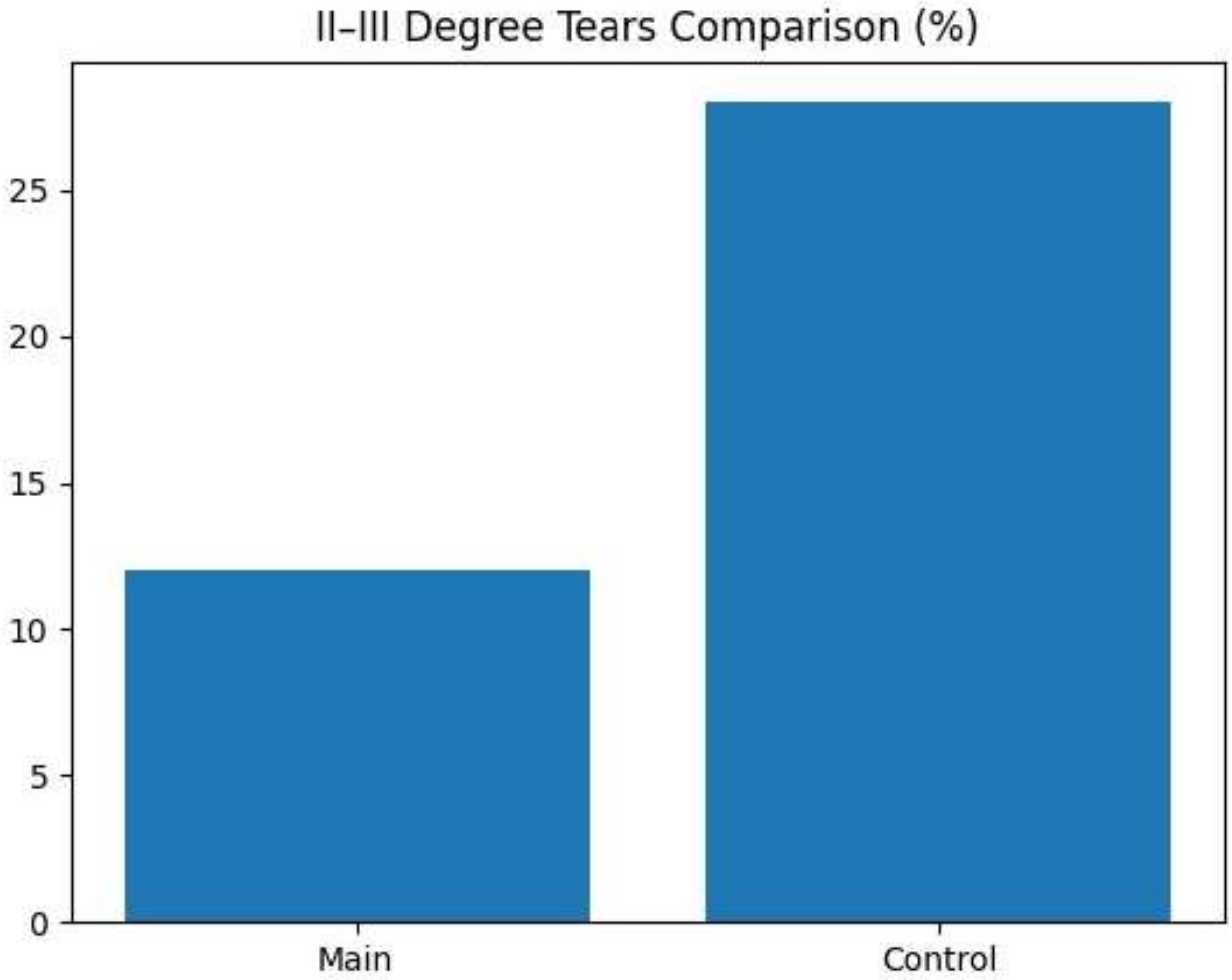
Discussion. The findings of the present study demonstrate that a personalized labor management strategy significantly reduces the incidence of soft tissue trauma of the birth canal, confirming that obstetric injury is not merely a passive mechanical consequence of vaginal delivery, but rather a clinically modifiable outcome [12,16,20]. The reduction in moderate-to-severe perineal tears (II–III degree) observed in the main group highlights the critical importance of individualized intrapartum management based on biomechanical and prognostic assessment. From a pathophysiological perspective, perineal trauma represents the endpoint of excessive tissue strain exceeding the viscoelastic capacity of the perineal complex. Under physiological conditions, the connective tissue matrix-composed predominantly of collagen types I and III, elastin fibers, and proteoglycan-rich ground substance-undergoes gradual deformation during fetal descent [6,17,22] . However, when the rate or magnitude of stretching surpasses adaptive thresholds, microstructural failure occurs, leading to clinically evident lacerations. The results presented in **Table 1** clearly illustrate that modulation of these mechanical forces through controlled delivery techniques and perineal support significantly alters clinical outcomes.

Table 1. Comparative Obstetric Outcomes

Outcome	Main group	Control group
II–III tears (%)	12.0	28.0
Episiotomy (%)	18.0	53.0
Second stage (min)	42.0	49.0
VAS pain	3.2	4.6

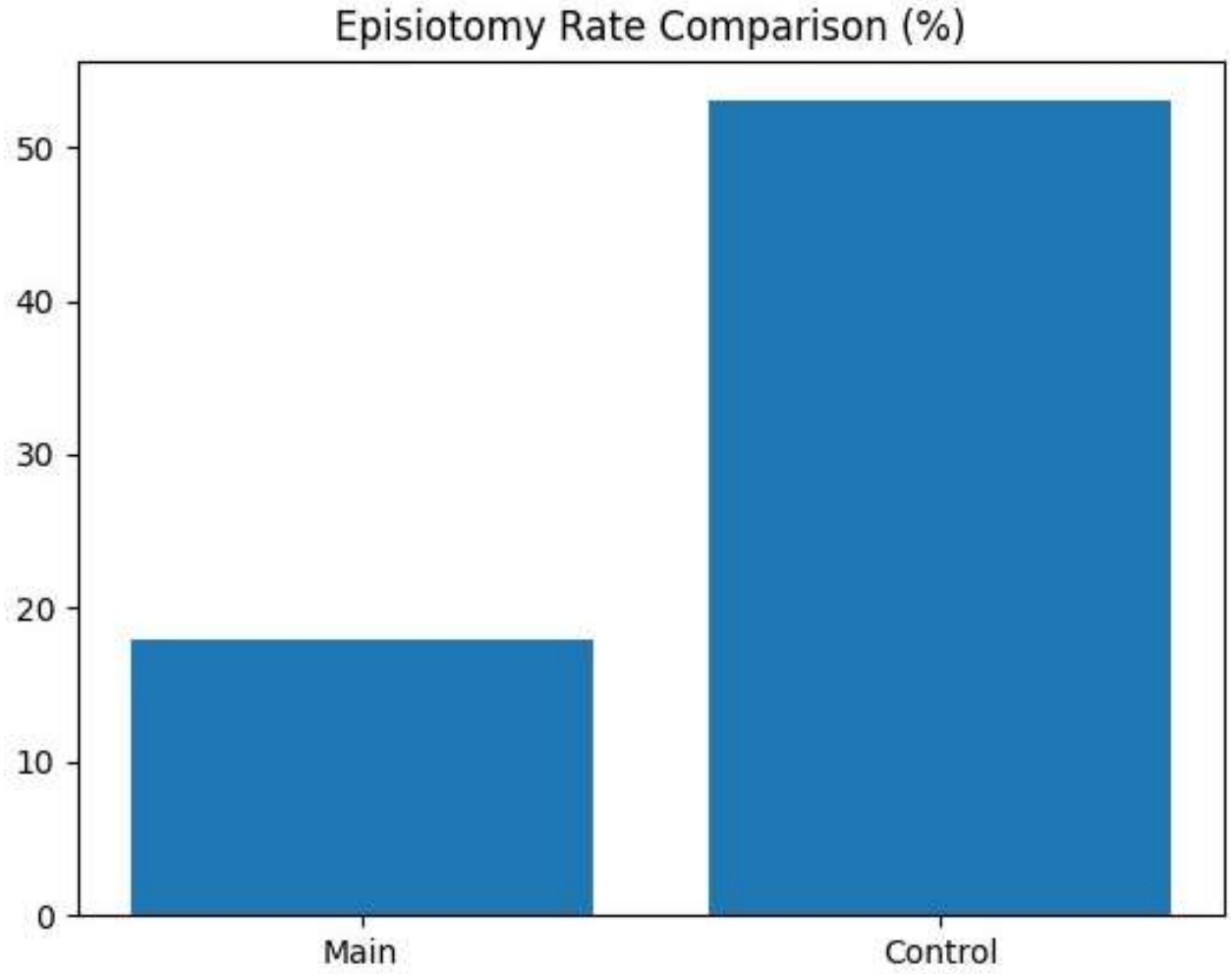
As shown in Table 1, the incidence of II–III degree tears decreased from 28% in the control group to 12% in the personalized management group. This reduction is clinically meaningful and suggests that targeted interventions can effectively preserve tissue integrity. Furthermore, the episiotomy rate was reduced from 53% to 18%, reinforcing the concept that routine surgical intervention is not only unnecessary in many cases but may also contribute to increased morbidity. The graphical representation of these findings provides additional clarity regarding the magnitude of effect. As illustrated in **Figure 1**, the difference in perineal trauma between groups is substantial and consistent with the hypothesis that individualized management improves biomechanical adaptation during the second stage of labor.

Figure 1. Incidence of II–III Degree Perineal Tears



Similarly, **Figure 2** demonstrates a marked reduction in episiotomy rates in the intervention group. This finding is particularly relevant in the context of modern obstetrics, where there is a paradigm shift away from routine episiotomy toward restrictive and evidence-based use.

Figure 2. Episiotomy Rate Comparison



The mechanistic explanation for these improvements lies in the integration of several interrelated components. First, the individualized assessment of perineal elasticity allows clinicians to anticipate tissue behavior under stress. In cases of reduced compliance, slower controlled delivery of the fetal head reduces peak strain and prevents abrupt overstretching. Second, optimization of maternal positioning enhances pelvic biomechanics, improving alignment between fetal descent and the pelvic axis while reducing localized pressure on the perineum [8,9,23].

The role of fetal factors must also be considered. As summarized in **Table 2**, fetal macrosomia and malposition significantly increase the probability of perineal trauma. By incorporating these variables into a predictive framework, clinicians can proactively modify labor management strategies, thereby reducing risk.

Table 2. Risk Factors Influencing Perineal Trauma

Factor	Impact
Fetal weight >3500g	High
Primiparity	High
Prolonged labor	Moderate
Occiput posterior	Moderate
High BMI	Low–Moderate

The data presented in Table 2 underscore the multifactorial nature of obstetric trauma. Notably, primiparity and increased fetal weight exert the highest impact, likely due to reduced tissue adaptability and increased mechanical load, respectively. Occiput posterior positioning introduces an additional biomechanical challenge by altering the direction of force vectors, resulting in uneven distribution of pressure across the perineal surface. An additional key element of the personalized approach is the use of warm perineal compresses [2,6,11,18]. From a physiological standpoint, localized heat application induces vasodilation, enhances microcirculation, and increases tissue

extensibility. This contributes to improved resistance to mechanical stress and reduces the likelihood of tissue rupture. Although often considered a supportive measure, its inclusion in a structured protocol amplifies its clinical effectiveness [1,7,12,20]. The observed reduction in the duration of the second stage of labor further supports the effectiveness of the personalized approach. Importantly, this reduction does not reflect accelerated or forced delivery but rather improved synchronization between maternal expulsive efforts and fetal descent. Such coordination minimizes both prolonged tissue loading and rapid uncontrolled stretching, thereby maintaining tissue integrity [1,4,15,19,24]. Pain outcomes provide an additional dimension for interpretation. Lower VAS scores in the intervention group likely reflect reduced nociceptive stimulation due to decreased tissue injury. Given that postpartum pain is closely linked to inflammatory response and tissue damage, these findings indirectly confirm the protective effect of the personalized strategy.

From a systems perspective, the implications of these findings are substantial. The reduction in perineal trauma translates into decreased need for surgical repair, shorter hospital stays, and lower incidence of long-term complications such as pelvic floor dysfunction and incontinence. This suggests that personalized labor management is not only clinically effective but also economically advantageous. At a conceptual level, this study supports a transition from protocol-driven obstetrics to precision-based care [7,13,16,18]. Traditional models emphasize standardization, which, while ensuring consistency, may overlook individual variability. In contrast, the personalized approach recognizes the heterogeneity of maternal anatomy, fetal characteristics, and labor dynamics, allowing for adaptive decision-making in real time. Nevertheless, the implementation of such strategies requires a high level of clinical expertise and continuous intrapartum assessment [3,10,21,23]. Variability in practitioner skill, particularly in techniques such as perineal support and controlled delivery, may influence reproducibility of results [11,13,17]. Therefore, structured training and simulation-based education should be considered essential for successful adoption. Furthermore, while the present findings are robust within the study population, external validation is necessary to confirm generalizability across different clinical settings [1,3,19,22]. Future research should focus on the development of predictive algorithms incorporating multivariate analysis and potentially machine learning techniques to enhance risk stratification accuracy.

Conclusion. The results of this study demonstrate that a personalized labor management strategy significantly reduces the incidence of soft tissue trauma in vaginal delivery. By integrating risk stratification, biomechanical optimization, and targeted intrapartum interventions, it is possible to achieve better maternal outcomes without increasing intervention rates. The adoption of individualized obstetric protocols represents a paradigm shift toward precision medicine in childbirth. Future research should focus on refining predictive models, incorporating advanced imaging techniques, and developing digital decision-support tools to facilitate widespread implementation. The integration of personalized labor management strategies, supported by biomechanical principles and clinical risk assessment, represents a significant advancement in the prevention of soft tissue birth canal trauma. The combined evidence from Tables 1–2 and Figures 1–2 demonstrates that individualized care can substantially improve maternal outcomes, reduce intervention rates, and align obstetric practice with the principles of modern precision medicine.

References.

1. Aasheim, V., Nilsen, A. B. V., Reinar, L. M., & Lukasse, M. (2017). Perineal techniques during the second stage of labour for reducing perineal trauma. *Cochrane Database of Systematic Reviews*, (6), CD006672.
2. Eason, E., Labrecque, M., Wells, G., & Feldman, P. (2000). Preventing perineal trauma during childbirth: A systematic review. *Obstetrics & Gynecology*, 95(3), 464–471.
3. Fahami, F., Shokoohi, Z., & Kianpour, M. (2012). The effects of perineal management techniques on labor complications. *Iranian Journal of Nursing and Midwifery Research*, 17(1), 52–55.
4. Okeahialam, N. A., et al. (2024). Prevention of perineal trauma during vaginal birth. *American Journal of Obstetrics and Gynecology*, 230(4), 321–330.
5. Beckmann, M. M., & Stock, O. M. (2013). Antenatal perineal massage for reducing perineal trauma. *Cochrane Database of Systematic Reviews*, (4), CD005123.

6. Laine, K., & Räisänen, S. (2021). Birth injuries and perineal trauma. In *EBCOG Postgraduate Textbook of Obstetrics & Gynaecology*. Cambridge University Press.
7. Dickinson, J. E., et al. (2013). Obstetric perineal trauma: Risk factors and management. *Australian and New Zealand Journal of Obstetrics and Gynaecology*, 53(1), 1–10.
8. Royal College of Obstetricians and Gynaecologists (RCOG). (2015). The management of third- and fourth-degree perineal tears.
9. World Health Organization. (2018). WHO recommendations: Intrapartum care for a positive childbirth experience.
10. Magoga, G., et al. (2019). Warm compresses during the second stage of labor. *European Journal of Obstetrics & Gynecology*, 235, 35–42.
11. Sultan, A. H., et al. (1994). Anal sphincter trauma during vaginal delivery. *New England Journal of Medicine*, 329, 1905–1911.
12. Dahlen, H. G., et al. (2007). Perineal outcomes and birth positions. *Birth*, 34(2), 111–120.
13. Andrews, V., et al. (2006). Risk factors for obstetric anal sphincter injury. *BJOG*, 113(5), 525–530.
14. Kettle, C., & Tohill, S. (2008). Perineal care. *BMJ Clinical Evidence*, 1401.
15. Hals, E., et al. (2010). A multicenter intervention program to reduce obstetric anal sphincter injury. *Obstetrics & Gynecology*, 116(4), 901–908.
16. Stedenfeldt, M., et al. (2014). Risk factors for perineal lacerations. *American Journal of Obstetrics and Gynecology*, 210(1), 59.e1–59.e8.
17. De Leeuw, J. W., et al. (2008). Risk factors for third degree perineal tears. *BJOG*, 108(4), 383–387.
18. Räisänen, S., et al. (2012). Maternal and neonatal characteristics associated with perineal tears. *Acta Obstetricia et Gynecologica Scandinavica*, 91(1), 106–113.
19. Smith, L. A., et al. (2013). Techniques to reduce perineal trauma. *Journal of Midwifery & Women's Health*, 58(4), 398–405.
20. Albers, L. L., et al. (2005). The second stage of labor and perineal outcomes. *Journal of Midwifery & Women's Health*, 50(3), 243–247.
21. Pergialiotis, V., et al. (2014). Perineal massage and prevention of trauma. *Archives of Gynecology and Obstetrics*, 289(3), 507–514.
22. Rodrigues, S., et al. (2024). Midwives' practices on perineal protection. *European Journal of Midwifery*, 8, 12–19.
23. Queensland Health. (2021). Perineal care clinical guideline.
24. American College of Obstetricians and Gynecologists (ACOG). (2016). Practice Bulletin No. 165: Prevention of obstetric lacerations.
25. Fernando, R. J., et al. (2006). Repair techniques for obstetric anal sphincter injuries. *Obstetrics & Gynecology*, 107(6), 1261–1268.