Vol. 11, No. 2 (2025), pp.30–36

CHITKARA UNIVERSITY

Journal of Multidisciplinary Research in Healthcare

Comparative Efficacy of Dinoprostone–Misoprostol Versus Estradiol–Misoprostol for Cervical Ripening in Term Pregnancies with Unfavorable Cervix: A Randomized Controlled Trial

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RESEARCH ARTICLE **Open Access**

ARTICLE INFORMATION

Received: September 01, 2025
Revised: September 09, 2025
Published Online: October 07, 2025

Keywords:
Cervical ripening, Dinoprostone, Misoprostol, Estradiol, Labor induction.

DOI: 10.15415/jmrh.2025.112004

ABSTRACT

Background: Cervical ripening is a pivotal step in the induction of labor (IOL), particularly in term pregnancies with an unfavorable cervix. While prostaglandins remain the cornerstone agents for this purpose, interest has grown in exploring the synergistic role of estrogen.

Purpose: This study aimed to compare the efficacy and safety of dinoprostone followed by misoprostol (MC group) versus estradiol followed by misoprostol (ME group) in primigravida women undergoing IOL at term.

Methods: A single-blind randomized controlled trial was conducted on 172 primigravida women (86 per group) at term with singleton, cephalic presentation and Bishop score ≤6. The MC group received intracervical dinoprostone gel followed by up to three misoprostol doses; the ME group received vaginal estradiol followed by misoprostol similarly. Primary outcomes included change in Bishop score, number of misoprostol doses, and onset of active labor.

Results: The mean pre-induction Bishop score was lower in the MC group (2.77 ± 1.15) compared to the ME group (3.17 ± 0.86; p = 0.009), though final scores were similar (9.70 ± 1.53 vs. 9.73 ± 1.29; p = 0.872). Only 36% of women in the MC group required a third dose of misoprostol versus 100% in the ME group (p = 0.001). Successful ripening was achieved in 84.9% (MC) and 83.7% (ME), while establishment of active labor occurred in 86% (MC) and 90.7% (ME). Rupture of membranes was more frequent in the MC group (33.7% vs. 20.9%; p = 0.043). Maternal and neonatal outcomes, including cesarean section rates and NICU admissions, were comparable between groups.

Conclusion: Both protocols demonstrated comparable efficacy for cervical ripening and showed similar obstetric outcomes within the limits of this study. Dinoprostone may reduce the need for repeated misoprostol dosing. Agent selection should be tailored based on clinical context.

1. Introduction

Induction of labor (IOL) is a crucial component of contemporary obstetric care. IOL is the process of artificially stimulating the uterus to start labor, a physiological process that takes place during the final weeks of pregnancy. This natural process must be accelerated when delivery is required and cervical maturation has not taken place or been initiated (World Health Organization [WHO], 2003). One of the most common indications for IOL is post-term pregnancy (Hannah et al., 1992). Other indications include premature rupture of membranes, especially at term; situations that require termination of conservative management of high-risk pregnancies with endocrinological disorders such as gestational hypertension and gestational diabetes mellitus; fetal growth restriction; unsatisfactory fetal surveillance; maternal health issues such as diabetes, renal disease, critical lung disease, or anti-phospholipid syndrome; suspected or confirmed chorioamnionitis; abruption placenta; and intrauterine fetal death—conditions that jeopardize fetal health (Hannah et al., 1996; Tan & Hannah, 1997, 2000). There are inherent risks associated with inducing labor, such as increased risk of operative vaginal delivery, uterine hyperstimulation, cesarean section, abnormal fetal heart rate patterns, uterine rupture, maternal water intoxication, and possibly cord prolapse (Crowley, 1991; Macer et al., 1992).

A more positive outcome should arise from properly ripening the cervix prior to induction. One of the most crucial elements in the effectiveness of IOL is cervical preparation. Cervical ripening, also known as softening, is often a physiological process that occurs prior to uterine contractions and involves a complex biochemical process that culminates in the realignment and rearrangement of collagen molecules. In response to uterine contractions, the cervix thins, softens, relaxes, and dilates, making it easier for the cervix to allow passage of the presenting fetal part during labor (Chen & Sheehan, 2022).

Prostaglandins have gained recognition in recent years as the most efficacious pharmacological agents for inducing labor in pre-labor conditions with an unripe cervix. After evaluating parturients' acceptability and the effectiveness of the route of drug administration, the vaginal route was determined to be the most suitable, as pharmacokinetic studies have shown that the concentration of the active metabolite remains higher for a longer period with vaginal administration; therefore, it is currently the preferred method (Chen *et al.*, 2016; Wu *et al.*, 2017). The increasing concentrations of estrogen in maternal circulation during term pregnancy may serve as a stimulus for the initiation of spontaneous labor, prompting research into the potential use of estrogens for labor induction (Goodwin, 1999). Previous studies have demonstrated that administering estradiol gel extra-amniotically, endocervically, or vaginally can enhance cervical ripening while causing minimal myometrial stimulation (Klopper & Dennis, 1962; Larmon *et al.*, 2002). It has been suggested that estradiol, when used in combination with vaginal misoprostol, can significantly accelerate cervical softening, the onset of active labor, and vaginal delivery (Dasgupta & Singh, 2012). In addition to aiding cervical ripening, PGE2 dinoprostone gel (Cerviprime) increases the uterine muscles' sensitivity to physiological PGE2, which is necessary for the production and maintenance of uterine contractions (Modi *et al.*, 2019).

Because it is straightforward and has high predictive value, the modified Bishop score is the most widely used tool to assess cervical ripening. Bishop measured cervical ripeness using a grading system based on the presenting part station, cervical dilatation, cervical effacement, fetal position, and cervical consistency. It was found that induction had a higher chance of success for primigravid women if the score was higher than 9. Conversely, if the Bishop score was less than 6, the induction failure rate was very high (Bishop, 1964).

Despite the availability of several pharmacological agents for cervical ripening, there remains no universal consensus on the optimal protocol for term primigravida women with an unfavorable cervix. Dinoprostone, though widely used, may require multiple applications and is associated with higher cost, while misoprostol—although effective—can be linked to uterine hyperstimulation if not carefully titrated. Estradiol has been proposed to enhance cervical softening by mimicking physiological hormonal changes near term, potentially reducing the need for higher prostaglandin doses. However, direct comparative evidence between dinoprostone–misoprostol and estradiol–misoprostol regimens remain scarce. Addressing this knowledge gap is clinically relevant, as an effective, safe, and resource-efficient cervical ripening protocol could shorten induction-to-delivery intervals, improve maternal comfort, and reduce healthcare costs. Therefore, this randomized controlled trial was designed to compare the efficacy, safety, and misoprostol dose requirements between dinoprostone–misoprostol and estradiol–misoprostol regimens in term primigravida women with an unfavorable cervix.

2. Methodology

2.1. Study Design

The study was conducted in the Department of Obstetrics and Gynaecology at Civil Hospital, Panchkula, Haryana, India. This was a prospective comparative study that spanned a period of six months and was conducted after obtaining approval from the Institutional Ethics Committee (IEC approval no: EC/NEW/INST/2021/1826). To determine the sample size, the researchers used G*Power software, specifically for a two-tailed independent t-test to assess the difference between two study groups. An effect size of 0.5 was considered, with an alpha error probability set at 0.05 and a power of 0.9. Based on these parameters, the calculated sample size was 172, with equal distribution of 86 participants in each group.

2.2. Inclusion and Exclusion Criteria

Primigravida women aged 18–35 years with singleton, cephalic pregnancies between 37–41 weeks of gestation, carrying a living fetus <4 kg (confirmed by ultrasound), without labor pains, and with normal amniotic fluid were included in the study. Gestational age was confirmed by the last menstrual period (LMP) or serial ultrasounds.

Patients were excluded if they had multiple gestation, abnormal umbilical artery Doppler, non-reassuring non-stress test (NST), fetal weight >4 kg, non-cephalic presentation, intrauterine fetal demise (IUFD), prior uterine surgery, medical conditions (e.g., heart disease, asthma, glaucoma), cephalopelvic disproportion, or if they were unwilling to participate.

2.3. Study Protocol

A total of 172 pregnant women meeting the inclusion and exclusion criteria were enrolled in this prospective comparative study. Participants were randomized using a computer-generated random number sequence. Allocation concealment was achieved with sealed opaque envelopes, and participants were assigned in a single-blind manner into two equal groups of 86 each.

Group MC received a single intracervical dose of Dinoprostone gel (3 g gel containing 0.5 mg), placed in the cervix but not beyond the internal os.

Group ME received two doses of vaginal ethinyl estradiol (0.5 mg) administered 4 hours apart.

Both groups were subsequently given misoprostol every 4 hours, up to a maximum of three doses, aiming to achieve either a Bishop score >6, rupture of membranes, or onset of labor pain. Cervical status was monitored using the Bishop score, and misoprostol dosing was adjusted accordingly to monitor labor progression. The primary endpoint was the onset of the active phase of the first stage of labor, defined as cervical dilatation from 6 cm to full dilation.

2.4. Statistical Analysis

Statistical analysis was performed using SPSS software (SPSS Inc., Chicago, IL, USA) for Windows. Mean and standard deviation were calculated for quantitative variables, whereas qualitative variables were expressed as numbers and percentages. An independent t-test was used to compare the means of the two independent study groups. The chi-square test was used to compare qualitative variables. All tests were conducted at a 95% confidence level, considering a p-value <0.05 as statistically significant. Appropriate graphs and tables were used to depict the data.

3. Results

The baseline characteristics of the study participants in both groups were comparable, with no statistically significant differences observed. The mean age of participants in the MC group was 25.86 ± 3.53 years, while in the ME group it was 24.90 ± 3.18 years (p = 0.061), indicating no significant age difference between the groups. Age distribution also did not differ significantly; the majority of women in both groups were between 21 and 30 years (MC: 87.2%, ME: 91.9%).

Regarding gestational age, most participants in both groups were between 40 and 40+6 weeks (MC: 54.7%, ME: 65.1%), followed by those between 38 and 38+6 weeks (MC: 18.6%, ME: 15.1%). There was no significant difference in gestational age distribution between the groups (p = 0.416).

As for the indication for labor induction, post-dated pregnancy was the most common indication in both groups (MC: 60.5%, ME: 72.1%), followed by gestational hypertension (MC: 25.6%, ME: 19.8%) and intrahepatic cholestasis of pregnancy (IHCP) (MC: 14%, ME: 8.1%). These differences were not statistically significant (p = 0.242).

These findings confirm that both groups were well-matched at baseline, allowing for an unbiased comparison of treatment outcomes (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants in the MC (Dinoprostone–Misoprostol) and ME (Estradiol–Misoprostol) Groups, Including Age Distribution, Gestational Age, and Indications for Induction of Labour, Analyzed using the Chi-square Test.

Variable	Domain	MC Group	ME Group	P-value
Age Group	Mean age	25.86 ± 3.53 years	24.90 ± 3.177 years	0.061
	<=20 years	4 (4.7%)	5 (5.8%)	0.133
	21-25 years	32 (37.2%)	44 (51.2%)	
	26-30 years	43 (50%)	35 (40.7%)	
	>30 years	7 (8.1%)	2 (2.3%)	
Gestation Period	37-37+6 days	10 (11.6%)	9 (10.5%)	0.416
	38-38+6 days	16 (18.6%)	13 (15.1%)	
	39-39+6 days	7 (8.1%)	2 (2.3%)	
	40-40+6 days	47 (54.7%)	56 (65.1%)	
	41-41+6 days	6 (7%)	6 (7%)	
Indication of Labor	Post-dated Pregnancy	52 (60.5%)	62 (72.1%)	0.242
	Gestational Hypertension	22 (25.6%)	17 (19.8%)	
	IHCP	12 (14%)	7 (8.1%)	

The mean pre-induction Bishop score was significantly lower in the MC group (2.77 ± 1.15) compared to the ME group (3.17 ± 0.86), with a p-value of 0.009, indicating a statistically significant difference at baseline. At 8 hours post-intervention, the Bishop scores increased in both groups, with the MC group showing a mean score of 6.26 ± 1.37 and the ME group 6.03 ± 0.98. However, this difference was not statistically significant (p = 0.224). The final Bishop scores were nearly identical between the two groups, with the MC group at 9.70 ± 1.53 and the ME group at 9.73 ± 1.29 (p = 0.872), showing no significant difference at the end of cervical ripening. Overall, while the ME group had a significantly higher pre-induction Bishop score, both groups achieved similar cervical ripening outcomes by the end of the induction process (Table 2).

Table 2: Comparison of Mean Bishop Scores Between the MC and ME Groups at Baseline, 8 Hours After Intervention, and at the End of Cervical Ripening, Analyzed Using Independent t-Test.

Bishop Score	MC Group	ME Group	P-value
Pre Induction	2.77 ± 1.14	3.17 ± 0.85	0.009*
8 hours	6.26 ± 1.36	6.03 ± 0.97	0.224
Final Score	9.70 ± 1.53	9.73 ± 1.28	0.872

All participants in both the MC and ME groups received the first and second doses of misoprostol (100%). However, a significant difference was observed in the need for a third dose, with only 36% (n = 31) of patients in the MC group requiring it, compared to 100% (n = 86) in the ME group (p = 0.001), indicating that fewer doses were needed to achieve ripening in the MC group.

Successful cervical ripening was achieved in 84.9% of patients in the MC group and 83.7% in the ME group, with no statistically significant difference (p = 0.500). Similarly, the establishment of active labor was comparable between groups (MC: 86%, ME: 90.7%; p = 0.238). A statistically significant difference was noted in the incidence of rupture of membranes, which occurred more frequently in the MC group (33.7%) compared to the ME group (20.9%; p = 0.043).

There were no significant differences between the groups in terms of meconium-stained liquor (MSL) (MC: 17.4%, ME: 12.8%; p = 0.262), fetal distress (MC: 12.8%, ME: 10.5%; p = 0.406), full-term vaginal delivery (FTVD) (MC: 80.2%, ME: 81.4%; p = 0.500), or full-term lower segment cesarean section (FT-LSCS) rates (MC: 19.8%, ME: 18.6%). NICU admissions were also similar between groups (MC: 12.8%, ME: 11.6%; p = 0.500), and postpartum complications occurred in a small number of cases (MC: 4.7%, ME: 3.5%; p = 0.500). No antepartum allergic reactions were reported in either group (Table 3).

Table 3: Comparison of Misoprostol Dosing Requirements, Labor Outcomes, and Maternal–Fetal Complications Between the MC and ME Groups, Analyzed Using Chi-Square Test.

Variable	MC Group	ME Group	P-value
Tab Misoprost Dose 1	86 (100%)	86 (100%)	NA
Tab Misoprost Dose 2	86 (100%)	86 (100%)	NA
Tab Misoprost Dose 3	31 (36%)	86 (100%)	0.001*
Successful Ripening	73 (84.9%)	72 (83.7%)	0.500
Establishment of Active Labor	74 (86%)	78 (90.7%)	0.238
Rupture of Membrane	29 (33.7%)	18 (20.9%)	0.043*
MSL	15 (17.4%)	11 (12.8%)	0.262
Fetal Distress	11 (12.8%)	9 (10.5%)	0.406
FTVD Delivery	69 (80.2%)	70 (81.4%)	0.500
FT-LSCS Delivery	17 (19.8%)	16 (18.6%)	
NICU Admission	11 (12.8%)	10 (11.6%)	0.500
Postpartum Complications	4 (4.7%)	3 (3.5%)	0.500
Antepartum Allergic Reaction	0	0	NA

4. Discussion

Induction of labor is routinely employed when continued pregnancy endangers maternal or fetal health. Current guidelines from RCOG, NICE, and CNGOF recommend prostaglandins for cervical ripening in women with unfavorable cervices (Sire *et al.*, 2022). Among these, dinoprostone and misoprostol are most widely used. Misoprostol has been shown to significantly shorten the induction-to-delivery interval compared to dinoprostone (15.2 ± 4.9 hours vs. 18.3 ± 4.29 hours, respectively) (Unni *et al.*, 2025), with similar findings reported by Patabendige *et al.* and Valvi & Airao (Patabendige *et al.*, 2024; Valvi & Airao, 2023). However, this efficacy is often offset by a higher rate of fetal distress and cesarean deliveries (Unni *et al.*, 2025).

In the present study, the baseline demographics of both groups were similar. The mean age was slightly higher in the MC group (25.86 ± 3.53 years) versus the ME group (24.90

± 3.18 years), with no statistical difference, aligning with findings from Dasgupta & Singh and Unni *et al*. (Dasgupta & Singh, 2012; Unni *et al*., 2025). Most participants in both groups were between 21 and 30 years of age. The gestational age distribution was also comparable, with the majority between 40 and 40+6 weeks, in line with findings by Gautam & Kumar and Pourhoseini *et al*. (Gautam & Kumar, 2025; Pourhoseini *et al*., 2022). The leading indication for labor induction was post-dated pregnancy in both groups, followed by gestational hypertension and IHCP, with no significant difference. This is consistent with patterns seen in studies by Dasgupta & Singh and Ahmed *et al*. (Ahmed *et al*., 2022; Dasgupta & Singh, 2012).

Bishop scores at baseline were slightly higher in the ME group (3.17 ± 0.85 vs. 2.77 ± 1.15, p = 0.009), but final scores post-induction were similar (9.73 vs. 9.70), suggesting comparable effectiveness. These findings echo studies by Unni *et al*., Pourhoseini *et al*., and Anjana & Sheikh, where no significant differences in Bishop score progression were noted across treatment arms (Anjana & Sheikh, 2020; Pourhoseini *et al*., 2022; Unni *et al*., 2025).

Successful cervical ripening occurred in over 83% of cases in both groups. While estrogen's role in cervical softening is biologically plausible—given its impact on leukocyte activity—current evidence remains inconclusive, and prostaglandins continue to be more reliable agents. A previous study on postmenopausal women combining estradiol with misoprostol improved preoperative cervical ripening, supporting its potential utility (Oppegaard *et al*., 2010). Our study found active labor established in over 85% of participants in both groups. A significant finding was that fewer patients in the MC group required a third dose of misoprostol (36%) compared to 100% in the ME group, suggesting a more efficient ripening process with dinoprostone alone. This contrasts with findings by Dasgupta & Singh and Ahmed *et al*., where estradiol combinations required fewer doses (Ahmed *et al*., 2022; Dasgupta & Singh, 2012).

The incidence of rupture of membranes was higher in the MC group (33.7% vs. 20.9%, p = 0.043), though its clinical relevance remains uncertain. Rates of meconium-stained liquor (MSL) and fetal distress did not differ significantly, aligning with prior studies (Dasgupta & Singh, 2012; Pourhoseini *et al*., 2022; Unni *et al*., 2025). While Unni *et al*. reported higher fetal distress and NICU admissions with misoprostol (Unni *et al*., 2025), our findings showed no such significant difference—NICU admission rates were 12.8% (MC) vs. 11.6% (ME). Postpartum complications were also similar, as observed by Dasgupta & Singh and Sire *et al*. (Dasgupta & Singh, 2012; Sire *et al*., 2022).

Regarding delivery outcomes, full-term vaginal delivery rates were comparable: 80.2% in MC and 81.4% in ME. Cesarean rates were also similar, in contrast to Unni *et al*., who found higher LSCS rates with misoprostol (Unni *et al*., 2025). Other studies have reported higher vaginal delivery rates with misoprostol under optimal conditions (Gautam & Kumar, 2025; Valvi & Airao, 2023).

The safety of misoprostol remains dose-dependent. Lower doses (≤25 mcg every 4–6 hours) are as effective as higher doses but with reduced complications (Patabendige *et al*., 2024). Studies by Sire *et al*. and Swami & Sonawane underscore the need for dose titration and cautious monitoring when using misoprostol, especially due to the increased risk of uterine hyperstimulation and fetal distress (Sire *et al*., 2022; Swami & Sonawane, 2023). Our findings reinforce that agent selection for labor induction should consider patient-specific factors. Misoprostol may be preferred for quicker induction, while dinoprostone might be safer in high-risk pregnancies. These conclusions are in line with prior reviews by Patabendige *et al*. (2024) and Valvi and Airao (2023).

This study was conducted at a single tertiary-care center, which may limit the generalizability of our findings to other settings with different patient populations or protocols. The sample size, although adequately powered for primary outcomes, may not have been sufficient to detect rare maternal or neonatal adverse events. As the study was single-blind, observer bias could not be entirely excluded. Furthermore, long-term maternal and neonatal outcomes and patient-reported outcomes such as satisfaction and pain perception were not assessed. Future multicentric studies with larger cohorts and longer follow-up are recommended to address these gaps.

Based on our findings, both dinoprostone–misoprostol and estradiol–misoprostol regimens can be safely considered for cervical ripening in term primigravida women with an unfavorable cervix. Dinoprostone appears to reduce the need for repeated misoprostol doses, which may improve patient comfort and resource utilization. Clinicians may individualize induction protocols by considering maternal and fetal risk profiles, local availability, and monitoring capacity. Future large-scale, multicentric randomized trials are recommended to confirm these results, explore cost-effectiveness, and assess long-term maternal and neonatal outcomes. Further research should also investigate patient-centered outcomes such as satisfaction, pain perception, and acceptability of different induction agents.

5. Conclusion

This randomized controlled trial compared the effectiveness of dinoprostone with misoprostol versus estradiol with misoprostol for cervical ripening in women undergoing labor induction. Baseline characteristics—

including age, gestational age, and indications for induction—were similar across both groups. While the estradiol–misoprostol group showed a slightly higher rate of spontaneous labor, the difference was not statistically significant. Maternal and neonatal outcomes were also comparable between the groups. The choice of induction agent should be guided by cervical status, maternal and fetal condition, and the level of monitoring available. Optimizing drug type, dosage, and administration can help balance efficacy and safety. Labor induction should be considered when the benefits of delivery outweigh the risks of continued pregnancy, with patient preferences always taken into account. Further studies are warranted to validate these findings.

Acknowledgement

The authors would like to express their sincere gratitude to Doc Navigator, Chandigarh (www.docnavigator.co.in), for their valuable assistance in providing professional proofreading and language editing services for the present manuscript, which greatly helped in refining the clarity and readability of the content.

Authorship Contribution

All the authors were involved in the designing of the study, enrollment of the patients, collection of data, statistical analysis, and drafting of the manuscript. All authors have approved the submitted version and have agreed both to be personally accountable for the author's own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

Funding

The work in this manuscript is supported by funds provided by host institute and researcher themselves. Patients were not imposed with any additional financial burden because of this study.

Ethical Approvals

Present study has been approved by the institute ethics committee of Civil Hospital, Sector 6 Panchkula, India (Letter No. EC/NEW/INST/2021/1826) and was conducted in accordance with the Declaration of Helsinki.

Declarations

The authors declare that they have followed all ethical standards in conducting this research. All data supporting the findings are available within the manuscript

Conflict of Interest

The authors declare no conflict of interest related to this study.

References

Ahmed, M. E., Salama, F. A., Ahmed, A. M., & El-Skaan, R. G. (2022). Comparative study between using only vaginal misoprostol and using vaginal misoprostol and estradiol cream for induction of labor: A randomized controlled trial. *Journal of Clinical Gynecology and Obstetrics, 11*(2), 39–46.

Anjana, B., & Sheikh, S. (2020). A study to evaluate the efficacy of combined prostaglandins and vaginal estradiol compared to prostaglandin alone in labor induction. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 9*(3), 1153–1159.

Bishop, E. H. (1964). Pelvic scoring for elective induction. *Obstetrics and Gynecology, 24*, 266–268.

Chen, V., & Sheehan, P. (2022). Outpatient management of pre-induction cervical ripening. *The Journal of Maternal-Fetal & Neonatal Medicine, 35*(15), 2954–2960.

Chen, W., Xue, J., Peprah, M., Wen, S., Walker, M., Gao, Y., & Tang, Y. (2016). A systematic review and network meta-analysis comparing the use of Foley catheters, misoprostol, and dinoprostone for cervical ripening in the induction of labour. *BJOG: An International Journal of Obstetrics and Gynaecology, 123*(3), 346–354.

Crowley, P. (1991). Elective induction of labour at 41+ weeks gestation. In *Oxford database of perinatal trials*. Oxford University Press.

Dasgupta, E., & Singh, G. (2012). Vaginal misoprostol vs vaginal misoprostol with estradiol for labor induction: A prospective double-blind study. *The Journal of Obstetrics and Gynecology of India, 62*, 47–51.

Gautam, S., & Kumar, D. (2025). Comparison between dinoprostone gel and misoprostol in cervical ripening and induction of labour in Gujarat population. *International Journal of Academic Medicine and Pharmacy, 7*(1), 41–44.

Goodwin, T. M. (1999). A role for estriol in human labor, term and preterm. *American Journal of Obstetrics and Gynecology, 180*(1), S208–S213.

Hannah, M. E., Hannah, W. J., Hellmann, J., Hewson, S., Milner, R., Willan, A., & CMP-PT Group. (1992). Induction of labor as compared with serial antenatal monitoring in post-term pregnancy: A randomized controlled trial. *New England Journal of Medicine, 326*(24), 1587–1592.

Hannah, M. E., Ohlsson, A., Farine, D., Hewson, S. A., Hodnett, E. D., Myhr, T. L., Wang, E. E., Weston, J. A., & Willan, A. R. (1996). Induction of labor compared with expectant management for prelabor rupture of the membranes at term. *New England Journal of Medicine, 334*(16), 1005–1010.

Klopper, A., & Dennis, K. (1962). Effect of oestrogens on myometrial contractions. *British Medical Journal, 2*(5313), 1157-1158.

Larmon, J., Magann, E., Dickerson, G., & Morrison, J. (2002). Outpatient cervical ripening with prostaglandin E2 and estradiol. *The Journal of Maternal-Fetal & Neonatal Medicine, 11*(2), 113–117.

Macer, J. A., Macer, C. L., & Chan, L. S. (1992). Elective induction versus spontaneous labor: A retrospective study of complications and outcome. *American Journal of Obstetrics and Gynecology, 166*(6), 1690–1697.

Modi, S., Mahur, J., & Shashank, V. (2019). Intracervical PGE2 gel application for cervical ripening and induction of labour: A clinical study. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 8*(9), 3528–3535.

Oppegaard, K., Lieng, M., Berg, A., Istre, O., Qvigstad, E., & Nesheim, B. I. (2010). A combination of misoprostol and estradiol for preoperative cervical ripening in postmenopausal women: A randomised controlled trial. *BJOG: An International Journal of Obstetrics and Gynaecology, 117*(1), 53–61.

Patabendige, M., Chan, F., Vayssiere, C., Ehlinger, V., Van Gemund, N., Le Cessie, S., Prager, M., Marions, L., Rozenberg, P., & Chevret, S. (2024). Vaginal misoprostol versus vaginal dinoprostone for cervical ripening and induction of labour: An individual participant data meta-analysis of randomised controlled trials. *BJOG: An International Journal of Obstetrics and Gynaecology, 131*(9), 1167–1180.

Pourhoseini, S. A., Mirzaeian, S., Mirteimouri, M., Najafi, M. N., Tara, F., Akahlghi, F., & Abdollahi, E. (2022). A comparative study on the effects of vaginal misoprostol and vaginal misoprostol plus estradiol on labor induction. *Journal of Clinical and Nursing Research,* 6 (2), 68-75..

Sire, F., Ponthier, L., Eyraud, J.-L., Catalan, C., Aubard, Y., & Coste Mazeau, P. (2022). Comparative study of dinoprostone and misoprostol for induction of labor in patients with premature rupture of membranes after 35 weeks. *Scientific Reports, 12*(1), 14996.

Swami, K. S., & Sonawane, P. K. (2023). A comparative study between oral misoprostol and intracervical dinoprostone gel for induction of labour at term in primigravida. *New Indian Journal of Obstetrics and Gynecology*, 1–5.

Tan, B. P., & Hannah, M. (1997). Prostaglandins for prelabour rupture of membranes at or near term. *The Cochrane Database of Systematic Reviews, 1997*(2), CD000178.

Tan, B., & Hannah, M. (2000). Oxytocin for prelabour rupture of membranes at or near term (Cochrane Review). *The Cochrane Library,* 1997(2):CD000157.

Unni, V., Mudanur, S. R., Yaliwal, R. G., Kori, S., Unni, V. Jr., & Mudanur, S. R. Sr. (2025). Comparative study of vaginal misoprostol tablet versus dinoprostone insert in induction of labor: A prospective interventional analysis. *Cureus,* 17(3):e80026..

Valvi, S. S., & Airao, B. B. (2023). A comparative study of induction of labour with intravaginal misoprostol and intracervical dinoprostone gel and its fetomaternal outcome in a tertiary care hospital. *Indian Journal of Obstetrics and Gynecology Research, 8*(4), 463–469.

World Health Organization. (2003). *Managing complications in pregnancy and childbirth: A guide for midwives and doctors*. World Health Organization.

Wu, H.L., Marwah, S., Wang, P., Wang, Q.M., & Chen, X.W. (2017). Misoprostol for medical treatment of missed abortion: A systematic review and network meta-analysis. *Scientific Reports, 7*(1), 1664.