MR Pelvimetry for Breech Presentation at Term—Interobserver Reliability, Incidental Findings and Reference Values

MR-Pelvimetrie bei persistierender Beckenendlage – Interobserver-Reliabilität, Nebenbefunde und Referenzwerte

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Key words
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ZUSAMMENFASSUNG


Ergebnisse Die Interobserver-Übereinstimmung war durchgehend stark (Reichweite der durchschnittlichen Intraklassen-Korrelationskoeffizienten: 0,889 – 0,968). Individuelle Messfehler rangierten zwischen 0 und 2 mm, durchschnittliche Übereinstimmungsgrenzen waren ± 3 mm. In Bezug auf den Geburtsmodus wies die Gruppe „Kaiserschnitt empfohlen“ (rCS) signifikant kleinere CV-Messungen auf (CV: 11,37 ± 0,73, p-Wert < 0,0001) als alle anderen Gruppen. Es wurde kein statistischer Unterschied in CV zwischen den Gruppen „vaginale Geburt“ und „ungeplanter Kaiserschnitt“ gefunden (p-Wert 0,902). Die DT-Messungen zeigten nur einen signifikanten Unterschied zwischen rCS und „elektrischer Kaiserschnitt“ (p-Wert 0,039). 134 Nebenbefunde wurden erfasst.

Schlussfolgerung Eine starke Interobserver-Übereinstimmung unabhängig von der Erfahrungsstufe des Auswerters bestätigt die MR-Pelvimetrie als eine verlässliche Methode, um ein fetopelvines Missverhältnis bei Schwangeren mit Fetus in Beckenendlage zu identifizieren. Für eine vollständige Erfassung der Nebenbefunde ist eine radiologische Expertise unabdingbar.

Kernaussagen:
• MR-Pelvimetrie ist eine verlässliche Methode unabhängig von der Erfahrungsstufe des Auswerters.
• Conjugata-vera-Messungen helfen in präpartaler Einschätzung zur Durchführbarkeit einer vaginalen Beckenendlagegeburten.
• Zufallsbefunde kommen relativ häufig vor.

ABSTRACT

Purpose Antepartal MR pelvimetry is used to assess the viability of vaginal breech delivery. We evaluated the reliability of MR pelvimetric measurements as well as incidental findings noted by different clinicians and assessed potential reference values.

Methods In this monocentric study, the radiologic database was searched for obstetric MR pelvimetries with singleton premature breeches and evaluated the interobserver reliability as well as incidental findings and reference values. Radiologic data were acquired and evaluated by six examiners with different degrees of medical experience in obstetrics and radiology.

Results The interobserver reliability regarding CV and DT was generally excellent (intraclass correlation coefficients ranging from 0.889 to 0.968). Individual measurement errors ranged from 0 to 2 mm, with an average range of ±3 mm. Concerning the mode of delivery, the group “recommend cesarean-section” (CS) showed significantly smaller CV measurements compared to all other groups (CV: 11.37 ± 0.73, p-value < 0.0001). No statistical difference in CV was found between the groups “vaginal delivery” and “unplanned cesarean-section” (p-value 0.902). DT measurements showed only a significant difference between CS and “elective cesarean-section” (p-value 0.039). 134 incidental findings were documented.

Conclusion A strong interobserver agreement independent of the examiner’s level of experience confirmed MR pelvimetry as a reliable method to identify a fetopelvic disproportion in pregnant women with breech presentation. For a complete documentation of incidental findings, radiologic expertise is indispensable.

Kernaussagen:
• MR-Pelvimetrie ist eine verlässliche Methode unabhängig von der Erfahrungsstufe des Auswerters.
• Conjugata-vera-Messungen helfen in präpartaler Einschätzung zur Durchführbarkeit einer vaginalen Beckenendlagegeburten.
• Zufallsbefunde kommen relativ häufig vor.
breech pregnancies between 1999 and 2016. 99 consecutive MR pelvimetries were included. A structured, independent review was performed by six observers with three clinical experience levels (attending, fellow, junior resident from the departments of radiology and obstetrics). Image analysis entailed the quantitative assessment of conjugata vera (CV) and diameter transversalis (DT), image quality and incidental findings. Obstetric data was retrieved from the obstetric database for reference value assessment.

Results Interobserver agreement was strong throughout (mean intraclass correlation coefficient range: 0.889 – 0.968). The individual measuring biases ranged between 0 – 2 mm, and the average limits of agreement were ± 3 mm. Regarding the mode of delivery, the recommended cesarean section (rCS) group showed significantly smaller CV measurements (CV: 11.37 ± 0.73, p-value < 0.0001) than any other delivery group. No statistical difference in CV between the vaginal delivery and unplanned cesarean section groups was found (p-value 0.902). DT measurements only showed a significant difference between rCS and elective cesarean section (p-value 0.039). 134 incidental findings were noted.

Conclusion Strong interobserver agreement irrespective of the reader’s experience level supports MR pelvimetry as a reliable method for identifying women with fetopelvic disproportion in breech presentation. For a comprehensive appraisal of incidental findings, radiologic expertise is vital.

Key points:
- MR pelvimetry is a reliable method irrespective of the reader’s experience level.
- Conjugata vera measurements aid in the prepartal viability assessment of vaginal breech delivery.
- Incidental findings are relatively common.

Citation Format

Introduction

Cesarean section (CS) rates in general and in cases with fetus in breech presentation in particular have risen steadily in the last decades [1]. Considering maternal and fetal morbidity in CS [2 – 4], the viability of vaginal breech delivery (VD) should be assessed. Seen as safe for mother and fetus [5], MR pelvimetry provides objective information about maternal pelvic capacity that cannot be as accurately obtained by manual examination [6] or ultrasound [7, 8]. Persistent breech presentation and suspected cephalopelvic disproportion (CPD) in vertex presentation constitute the primary reasons for prepartal MR pelvimetry referral. While skepticism regarding the usefulness of prepartal pelvimetry has been expressed [9], several studies have reported promising results. Berger et al. [10] calculated proportions between fetal breech and maternal pelvic diameters, which were significantly less favorable in women with failure to progress in labor than in women who delivered vaginally. A randomized controlled study [11] found a significantly higher VD rate in women with previous MR pelvimetry compared to women with only manual pelvic assessment (76% and 59%, respectively). The Term Breech Trial [12] acknowledged that only 9.8% of cases with a trial of labor (TOL) had previously been evaluated by prepartal radiologic pelvimetry; VD was successful in 591 (61%) out of 967 TOL candidates. Instead, the PREMODA study found that 1794 (71%) out of 2526 TOL cases delivered vaginally; the authors partly ascribed their favorable VD rate to the frequent use of prepartal pelvimetry, namely in 2064 TOL cases (82.5%) [13]. Also, several studies have described differences in mean pelvimetric measurements between groups of successful and failed TOL [6, 14, 15]. Yet, no unanimously accepted reference values for clinical application have been established.

MR pelvimetry and its interpretation represent a junction of radiologic and obstetric expertise. Korhonen et al. [16] retrospectively assessed MR pelvimetric measurements between radiologic and obstetric reports and found strong interobserver reliability, investigating threshold values in a subsequent study [17]. Keller et al. [15] prospectively analyzed inter- and intraobserver reliability among four radiologists and one obstetrician. However, both authors concentrated on CPD in vertex presentation and neglected experience levels. In our study, we aimed to investigate interobserver reliability and reference values as well as incidental findings of MR pelvimetry in breech presentation at term.

Materials and Methods

This study was approved by the institutional ethics committee (#44 – 16, 12.02.2016, amended 27.02.2017) and performed according to the standards of the Helsinki Declaration of 1964 (revised 2013). For this data analysis, informed consent was waived. Our institution is a tertiary center with 1600 deliveries per year on average, including 140 breech deliveries.

Data Analysis

At our hospital, it is the clinical standard to offer external cephalic version and, if unsuccessful, MR pelvimetry to patients with a fetus in persistent breech presentation and the wish for VD. The radiology information database (Syngo Imaging, Siemens, Germany) was retrospectively searched for MR pelvimetric referrals due to breech presentation between August 1999 and May 2016. All patients had been referred after persistent breech presentation was diagnosed by routine ultrasound examination. For the interobserver study, the inclusion criteria were uncomplicated singleton breech pregnancies and the retrievability of original MR sequences.

Subsequently, patient names were matched with the obstetric database (PIA, GE-Viewpoint, Germany) to identify all women who...
had delivered in-house. For the assessment of reference values, the inclusion criteria were documented breech presentation at birth and in-house delivery. Data were collected in a commercially available worksheet (Excel, Microsoft, USA) and analyzed in an anonymized fashion.

**MR pelvimetry**

MR pelvimetry was performed as previously described [18]. The woman was placed in a supine position in a 1.5-Tesla MR system with a body coil. In total, six different Siemens Magnetom systems were used in the 16-year period (between 2001 – 04: Vision, Harmony, Symphony; between 2005 – 16: Sonata, Avanto, Aera). T1-weighted turbo-spin-echo sequences with the following parameters were acquired: repetition time 450 – 890 ms, echo time 11 – 20 ms, slice thickness 4 – 10 mm, matrix 256 – 512 x 141 – 314, total examination time 5 – 15 minutes.

For standard pelvimetry, sequences were acquired in two orientations: in a sagittal and in a paratransverse or paracoronal (depending on the pelvic angulation; henceforth referred to as ‘transverse’) angulation. Subsequently, a sagittal slice through the cartilaginous symphysis pubis was identified and used to determine the conjugata vera (CV) as the shortest distance between the posterior border of the symphysis to the superior anterior aspect of the sacral promontory (Fig. 1a). In addition, a transverse slice through the femoral heads was identified and used to yield the diameter transversalis (DT) as the largest transverse distance of the pelvic inlet (Fig. 1b).

**Interobserver study**

Observers consisted of three readers from the departments of radiology and obstetrics, respectively: one attending (Rad./Obs.1), one fellow (Rad./Obs.2), and one junior resident (Rad./Obs.3). Initially, all observers completed the same five training cases according to a standardized protocol. Afterward, each observer independently evaluated the 99 breech study cases in a randomized order without knowledge of previous measurements or mode of delivery. Measurements were conducted at an integrated picture archiving and communication (PACS) work station (MMWP, Siemens Healthineers, Germany) with the same software package (Syngo Imaging, Siemens Healthineers, Germany).

Recorded variables were CV and DT, as they represent the standard parameters for obstetric pelvimetry in our hospital, and any incidental findings found while reviewing the MR sequences. To capture differences in DT measurement due to varying quality of MR sequences, the navigation tool was used to evaluate the angulation of the transverse sequence in relation to the CV. For correct DT measurement, the transverse plane should be parallel to the pelvic inlet; an excessive tilt may overestimate DT. Thus an angle of 0 – 20° was considered good, an angle >20° poor and the prevalent rating among observers was taken as ‘true’ quality of the sequence. Mean measuring errors were then compared between both angulation groups.

In the absence of a gold standard of measurement, the mean of all six observers served as the reference value.

As previously described [16], diagnostic accuracy was assessed by applying a limit for measurement error of 0.5 cm from the mean.

**Reference value assessment**

Study cases were screened for complete obstetric records and categorized according to mode of delivery. Documented characteristics comprised age, parity, height, pre-pregnancy weight and body mass index (BMI) of the mother and head circumference, length and five-minute APGAR of the neonate. Successful TOL resulting in VD represented the primary aim. Failed TOL resulting in a CS was termed unplanned CS (uCS). Recommended CS (rCS) was defined as intended CS due to inadequate pelvimetric results irrespective of any spontaneous onset of labor prior to the scheduled operation date. Elective CS (eCS) referred to women whose pelvimetric results had been judged adequate for TOL but who opted for a scheduled CS. In order to assess reference values, mean pelvimetric measurements were compared among modes of delivery.

**Statistics**

Statistical Package for Social Sciences (SPSS version 23, IBM, USA) was used for statistical analysis.

Continuous variables were displayed as means and standard deviation (± SD) and categorical data as percentages. Normality testing was performed with Shapiro-Wilk and a p-value < 0.05 was considered statistically significant. As most variables lacked distribution of normality, non-parametric testing (Kruskal-Wallis, Mann-Whitney-U-Test) was used throughout.

To assess interobserver agreement, the intraclass correlation coefficient (ICC) was calculated for continuous variables [19]. Assuming firstly an effect of both rater and case and secondly that both are drawn randomly from larger populations, the ‘two-way random, single measure’ ICC (2,1) was chosen. Since systematic variability was to be treated as relevant, the focus was set to absolute agreement among raters. The resulting ICC would represent the reliability of a single typical rater compared to the mean. Regarding interpretation, Lee et al. challenged the mean ICC as a sufficient score of agreement and suggested that ‘meaningful
agreement is attained if the lower limit of the 95 % confidence interval [...] is at least 0.75’ [20].

Modified Bland-Altman plots were drawn to illustrate individual deviance of raters from the mean, as outlined [21]. One-sample t-tests gave systematic bias (mean of differences) as well as standard deviation, from which limits of agreement were calculated, using the following equation: mean ± 1.96 × SD.

Results

Review of MR referrals revealed 115 MR pelvimetry reports. Yet, original DICOM (Digital Imaging and Communications in Medicine) images were only retrievable from May 2001 onward (n = 101). Twin pregnancies were excluded (n = 2). This yielded 99 eligible MR datasets with singleton in breech for the interobserver study.

For the assessment of reference values, women who had delivered externally (n = 9) and cases with spontaneous cephalic version (n = 3) were excluded. Thus 87 breech cases at birth and known mode of delivery were included in the retrospective reference value assessment.

Interobserver Agreement

Measurements of CV and DT were accurate in 98.1 % and 97.1 % of the cases, respectively. The total observation time ranged from 180 to 275 minutes. The mean evaluation time per case was similar for obstetricians and radiologists (2 min 16 s and 2 min 3 s, respectively). Inter-departmental comparison of CV and DT by all six raters yielded ICCs of 0.968 (0.953–0.979) for CV, 0.946 (0.920–0.963) for DT, respectively. Comparison between radiologists and obstetricians showed ICCs of 0.963 (0.946–0.979) for CV, 0.916 (0.890–0.938) for DT, respectively. Inter-departmental comparison of CV and DT measurements were accurate in 98.1 % and 97.1 % of the cases, respectively. The total observation time ranged from 180 to 275 minutes. The mean evaluation time per case was similar for obstetricians and radiologists (2 min 16 s and 2 min 3 s, respectively). In a second step, duplicate findings in the same case were removed, yielding 101 individual findings. When taken together, the four most frequent findings constituted 67 % of all findings: lumbar disc herniation or epidural lipomatosis. Obstetricians reported ‘coccygeal kink’, lumbar disc herniation and sacralization of LS; the 15 other findings were only reported by radiologists. Regarding clinical significance, none of the incidental findings was judged suspicious. Thus no further investigation or action was required. ► Table 3 lists all incidental findings and the number of cases identified.

Reference Value Assessment

The demographic data of the women and their neonates are shown in ► Table 4. Based on pelvimetric results, the obstetrician in charge had recommended CS (rCS) due to an inadequate pelvis...
in eleven cases and had offered the option of VD in 76 cases. Of these 76 women, nine opted for an eCS despite there being no pelvimetric objections and two had medical indications for CS, namely one case of placental insufficiency and one case of complicated gestational diabetes, and were subsequently counted in the eCS group. Of 65 women who decided on a TOL, 46 (71%) delivered vaginally and 19 (29%) ultimately had a uCS. The reasons for uCS were: nine (47%) cases of labor arrest in opening phase, seven (37%) cases of fetal distress, and three (16%) cases of suspected FPD.

Groups of different modes of delivery and their mean pelvimetric measurements are shown in ▶ Table 5. Summary, the group rCS showed significantly smaller CV measurements compared to all other groups (p-value < 0.0001). DT measurements only showed significant differences between rCS compared to eCS (p-value 0.039). We found no significant differences in pelvic inlet measurements among the groups VD, uCS and eCS.

### Discussion

In this study, we examined the interobserver reliability of prepartal MR pelvimetry among radiologists and obstetricians with different levels of experience. Having found strong interobserver agreement, we could confirm MR pelvimetry as a reliable tool for better patient selection for VD. Our study also revealed significant differences in CV measurements between TOL candidates and the group rCS, advancing the pursuit of clinically applicable reference values. The use of MR is generally limited by its availability, higher cost, and longer examination time compared to manual examination and ultrasound. However, previous studies indicated that prepartal MR pelvimetry is associated with lower rates of unplanned CS [11, 18]. Therefore, it could be argued that MR pelvimetry is justified when supposedly unnecessary CS and associated morbidity can be avoided.

### Interobserver Agreement

The diagnostic accuracy of observers’ measurements was > 97% for both CV and DT. These results correspond to Korhonen’s study of mixed vertex and breech presentations [16] who found accurate measurements in 96% of CV and in 99% of DT measurements. This validates the choice of CV and DT as reliable pelvimetric parameters.

Mean agreement among all observers was strong throughout and thus comparable to previous studies [15, 16]. In detail, radiologic measurements were slightly more reliable than obstetric ones and measurements of CV more reliable than those of DT. Interestingly, the mean agreement among clinicians with similar levels of experience was almost identical for attendings and junior residents of both departments; only the agreement among fellows was marginally lower. Also, all lower bounds of 95% confi-
Fig. 2 Bland-Altman plots of observers’ conjugata vera measurements. X-axis shows overall mean measurement, y-axis shows difference between overall mean and each individual observer’s measurement; systematic bias (bold line), variance (circles) and limits of agreement (dashed line). Obs./Rad. 1 = obstetric/radiologic attending, Obs./Rad. 2 = obstetric/radiologic fellow, Obs./Rad. 3 = obstetric/radiologic junior resident, CV = conjugata vera.

Abb. 2 Bland-Altman-Diagramme der Conjugata-vera-Messungen durch die Auswerter. X-Achse zeigt Durchschnittsmessung aller Auswerter, Y-Achse zeigt Differenz zwischen Durchschnittsmessung und Messungen der einzelnen Auswerter; systematischer Messfehler (kräftige Linie), Streuung (Kreise) und Übereinstimmungsgrenzen (gestrichelte Linie). Obs./Rad. 1 = geburtshilflicher/radiologischer Oberarzt, Obs./Rad. 2 = geburtshilflicher/radiologischer Facharzt, Obs./Rad. 3 = geburtshilflicher/radiologischer Assistenzarzt, CV = Conjugata vera.
Dence intervals were > 0.75, except for CV measurements by fellows (95 % CI: 0.685 – 0.984). This finding corresponded to results of our Bland-Altman analyses, which revealed small systematic biases per observer overall, but a comparatively larger systematic bias (-0.2 cm) with CV measurements by the obstetric fellow. While still within the acceptable range of error, further training might clarify potential uncertainties regarding correct measurement. Korhonen [16] found similar results with the greatest bias being 0.3 cm.

While variances in DT measurements did not show a statistically significant difference between well and poorly angulated transverse sequences, the p-value of 0.053 does leave room for speculation that with a larger sample size, the difference in variance may become significant. However, the relevance of small millimeter differences in measurement has been contested [16]. Still, we consider accurate acquisition of MR sequences an important prerequisite for valuable interpretation. Overall, our findings support the notion that, after adequate training, both radiologists and obstetricians can reliably evaluate MR pelvimetry.

<table>
<thead>
<tr>
<th>Incidental findings</th>
<th>N = 101</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumbar disc herniation or bulging</td>
<td>20</td>
</tr>
<tr>
<td>‘Coccygeal kink’ (suspected fracture)</td>
<td>20</td>
</tr>
<tr>
<td>Pelvic or genital varicosity</td>
<td>15</td>
</tr>
<tr>
<td>Epidural lipomatosis</td>
<td>12</td>
</tr>
<tr>
<td>Partial or total sacralization of L5</td>
<td>7</td>
</tr>
<tr>
<td>Signs of osteochondrosis</td>
<td>5</td>
</tr>
<tr>
<td>Perineural cyst</td>
<td>4</td>
</tr>
<tr>
<td>Enlarged inguinal lymph node</td>
<td>3</td>
</tr>
<tr>
<td>Disc herniation into vertebral body (persistent chorda dorsalis or suspected Scheuermann’s disease)</td>
<td>3</td>
</tr>
<tr>
<td>Suspected sacral fracture</td>
<td>2</td>
</tr>
<tr>
<td>End plate deformity</td>
<td>2</td>
</tr>
<tr>
<td>Labial cyst</td>
<td>2</td>
</tr>
<tr>
<td>Loosening of symphysis pubis (suspected symphysitis)</td>
<td>1</td>
</tr>
<tr>
<td>Suspected hypogenesis of L1</td>
<td>1</td>
</tr>
<tr>
<td>Large rectal ampulla of fetus</td>
<td>1</td>
</tr>
<tr>
<td>Focal liponecrosis</td>
<td>1</td>
</tr>
<tr>
<td>Spondylolysis</td>
<td>1</td>
</tr>
<tr>
<td>Fetal cephalic presentation (spontaneous version)</td>
<td>1</td>
</tr>
</tbody>
</table>

Incidental findings
Radiologists noted approximately 20 – 30 times more findings than their obstetric counterparts, demonstrating clear superiority of radiological perceptiveness for incidental findings. Yet, the incidental findings noted in our sample were of no direct clinical significance. While variances in DT measurements did not show a statistically significant difference between well and poorly angulated transverse sequences, the p-value of 0.053 does leave room for speculation that with a larger sample size, the difference in variance may become significant. However, the relevance of small millimeter differences in measurement has been contested [16]. Still, we consider accurate acquisition of MR sequences an important prerequisite for valuable interpretation. Overall, our findings support the notion that, after adequate training, both radiologists and obstetricians can reliably evaluate MR pelvimetry.

Reference Values
We found significantly smaller CV measurements in the rCS group compared to those of all other groups. Due to suspected pelvic inadequacy, CS was recommended to women with a mean CV of 11.37 ± 0.73 cm. We thus expect the majority of cases with suspected FPD to be found in the rCS group, rendering pelvicmetric comparison between VD and rCS most appropriate. Also, exclusion of most FPD cases from a TOL might explain the lack of pelvicmetric differences between successful and failed TOL.

Incidental findings N = 101
Lumbar disc herniation or bulging 20
’Coccygeal kink’ (suspected fracture) 20
Pelvic or genital varicosity 15
Epidural lipomatosis 12
Partial or total sacralization of L5 7
Signs of osteochondrosis 5
Perineural cyst 4
Enlarged inguinal lymph node 3
Disc herniation into vertebral body (persistent chorda dorsalis or suspected Scheuermann’s disease) 3
Suspected sacral fracture 2
End plate deformity 2
Labial cyst 2
Loosening of symphysis pubis (suspected symphysitis) 1
Suspected hypogenesis of L1 1
Large rectal ampulla of fetus 1
Focal liponecrosis 1
Spondylolysis 1
Fetal cephalic presentation (spontaneous version) 1

Table 3 List of incidental findings and times diagnosed.
Tab. 3 Liste der Nebenbefunde und Häufigkeiten.

Table 4 Demographic data of women and their neonates.
Tab. 4 Demografische Daten der Frauen und Neugeborenen.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n = 87</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age (mean, range) [years]</td>
<td>32 (22 – 43)</td>
</tr>
<tr>
<td>Parity, nulliparous/multiparous (n, %)</td>
<td>65/22 (75/25)</td>
</tr>
<tr>
<td>Maternal weight1 (mean, range) [kg]</td>
<td>67.6 (50 – 108)</td>
</tr>
<tr>
<td>Maternal height (mean, range) [m]</td>
<td>1.69 (1.56 – 1.80)</td>
</tr>
<tr>
<td>Maternal body mass index¹ (mean, range) [kg/m²]</td>
<td>23.7 (17.9 – 37.8)</td>
</tr>
<tr>
<td>Gestational age at MR (mean, range) [weeks]</td>
<td>37.1 (33.8 – 40.6)</td>
</tr>
<tr>
<td>Neonatal weight (mean, range) [g]</td>
<td>2222 (1940 – 4245)</td>
</tr>
<tr>
<td>Neonatal head circumference (mean, range) [cm]</td>
<td>35.0 (31.0 – 38.5)</td>
</tr>
<tr>
<td>Neonatal length (mean, range) [cm]</td>
<td>51.0 (45.0 – 57.0)</td>
</tr>
<tr>
<td>Five-minute APGAR (mean, range)</td>
<td>9.4 (4 – 10)</td>
</tr>
</tbody>
</table>

¹ before pregnancy.
vor der Schwangerschaft.
A limitation of our study was the selection bias due to the partially retrospective study design. For one, women who did not consider VD or had contraindications did not undergo MR pelvimetry in the first place; for another, MR pelvimetry was used to select women with small pelvimetric measurements for CS, avoiding a TOL.

Only three of 19 uCS cases (16 %) were due to FPD. Re-examination of these three cases revealed that two women had chosen a TOL despite the caution of poor pelvimetry results (CV: 10.70 cm and 11.61 cm, respectively), and a third woman, albeit with a favorable pelvic inlet (CV: 13.96 cm, DT: 14.05 cm), demonstrated a sacrum with notable lack of curvature and in turn a small midpelvis, allowing speculation of labor arrest due to midpelvic dystocia.

Finding a mean CV of 11.37 ± 0.73 cm in rCS cases corresponds to two studies investigating FDP in vertex presentation [14, 15] that found mean CV values for their respective dystocia groups of 11.3 ± 0.9 cm and 11.4 ± 1.0 cm. In comparison, a cut-off value of 11.0 cm for CV in van Loon’s study was rather permissive. Similarly, Maharaj et al. [8] stated threshold values for CV (average: 11 cm; contracted: < 10 cm) and DT (average: 13.5 cm; inadequate: < 12 cm) that hardly find application in our study collective. In contrast, a study assessing CT pelvimetry in the selection of breech cases for TOL defined CV > 12 cm as adequate [24]. Bearing in mind that our TOL candidates had a mean CV of 12.70 ± 0.87 cm and rCS cases had a mean CV of 11.37 ± 0.73 cm, a CV of 12.0 cm appears to be a likely borderline value.

In our study DT measurements added no information to the prognosis of VD. Therefore, studies on other pelvic distances and their potential as a selection marker for VD such as the midpelvic interspinous distance [25] should be further examined.

Conclusion

Strong interobserver agreement of pelvimetric measurements between and among radiologists and obstetricians with different levels of experience was found. MR pelvimetry seemed to be a reliable tool for identifying the risk for fetopelvic disproportion in women with a fetus in breech presentation. Radiologic expertise is vital for a comprehensive evaluation of incidental findings even though they were considered benign in this cohort. Our results support the usefulness of conjugata vera measurements for patient selection for vaginal breech delivery, while diameter transversalis measurements added no value. The proposed reference value of 12.0 cm for CV in our cohort should be interpreted as an approximation.

Table 5 Modes of delivery and pelvic measurements.

<table>
<thead>
<tr>
<th></th>
<th>Vaginal delivery (VD) (n = 46)</th>
<th>Unplanned cesarean section (uCS) (n = 19)</th>
<th>Elective cesarean section (eCS) (n = 11)</th>
<th>Recommended cesarean section (rCS) (n = 11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean CV ± SD [cm]</td>
<td>12.70 ± 0.88</td>
<td>12.71 ± 0.87</td>
<td>13.20 ± 0.81</td>
<td>11.37 ± 0.73</td>
</tr>
<tr>
<td>p-value1</td>
<td>(&lt; 0.0001)</td>
<td>(&lt; 0.0001)</td>
<td>(&lt; 0.0001)</td>
<td></td>
</tr>
<tr>
<td>Mean DT ± SD [cm]</td>
<td>13.39 ± 0.77</td>
<td>13.41 ± 0.73</td>
<td>13.70 ± 0.45</td>
<td>13.01 ± 0.82</td>
</tr>
<tr>
<td>p-value1</td>
<td>(0.257)</td>
<td>(0.149)</td>
<td>(0.039)</td>
<td></td>
</tr>
</tbody>
</table>

CV = conjugata vera, DT = diameter transversalis, SD = standard deviation. CV = Conjugata vera, DT = Diameter transversalis, SD = Standardabweichung. 1 compared to ‘recommended cesarean section’.

Conflict of Interest

The authors declare that they have no conflict of interest.

References


