

# Magnetic Resonance Pelvimetry for Trial of Labour after a Previous Caesarean Section

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## قياس الحوض بالرنين المغناطيسي في محاولة للولادة بعد عملية قيصرية سابقة

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**المخلص:** الهدف: التصنيف الطبقي لقياس أقطار الحوض بالرنين المغناطيسي حسب نوع الولادة لعمل قيم مرجعية لأقطار الحوض ومؤشر الخرج في محاولة الولادة بعد عملية قيصرية. الطريقة: هذه دراسة استيعابية شملت 125 مريضة في مستشفى جامعة السلطان قابوس (عمان). خضعن لقياس الحوض بالرنين المغناطيسي في محاولة للولادة عن طريق المهبل بعد عملية قيصرية، تم قياس المدخل السهمي، المدخل العرضي، قطر ما بين السنانين، الخرج السهمي، والخرج العرضي لكل المريضات، صنفنا متوسط قياسات الأقطار الى طيقات حسب طريقة الولادة (عن طريق المهبل أو بعملية قيصرية)، تمت مقارنة متوسط مؤشر الخرج (ناح جمع أقطار بين السنانين، الخرج السهمي وبين الخؤوب) وقطر بين الجداريين للجنين ومحيط رأسه عند النساء اللواتي ولدن بالعملية القيصرية أو عن طريق المهبل. النتائج: كل الأقطار ما عدا المدخل السهمي كانت أكبر عند النساء اللواتي ولدن عن طريق المهبل مقارنة بالنساء اللواتي ولدن بالعملية القيصرية لأي سبب كان. كان متوسط مؤشر الخرج في مجموعة الولادة التلقائية في حالة الجيء القمي هو (31.89±2.05) سم وهذا أكبر بشكل معتد إحصائيا من متوسط مؤشر الخرج في حالات العمليات القيصرية الطارئة والختارة، التي كانت (29.69±1.85) سم و(30.62±1.80) سم على التوالي. كان متوسط محيط الرأس أكبر بصورة معتدة إحصائيا في ولادات العملية القيصرية. الخلاصة: مؤشر الخرج (31.89±2.05) سم والأقطار التالية: المدخل العرضي (12.56±0.80) سم والخرج السهمي (10.54±1.00) سم وبين السنانين (10.46±0.89) سم وبين الخؤوب (الخرج العرضي) (10.89±1.02) سم حدود فاصلة مفيدة في الولادة عن طريق المهبل عند مريضاتنا.

**مفتاح الكلمات:** تصوير الرنين المغناطيسي، قياس الحوض، قيم طبيعية، عملية قيصرية، محيط.

**ABSTRACT: Objectives:** To stratify the magnetic resonance (MR) pelvimetric diameters according to mode of delivery and establish possible reference values for pelvic diameters and outlet index for trial of labor after a previous caesarean section. **Methods:** This is a retrospective study of 125 patients at Sultan Qaboos University Hospital who underwent MR pelvimetry prior to a trial of vaginal delivery after a previous caesarean section between May 2001 and October 2003. Sagittal inlet, Transverse inlet, interspinous diameter, sagittal outlet and transverse outlet diameters were measured in all patients. The mean diameters were stratified according to delivery modality (vaginal delivery or caesarean section). The outlet index (sum of interspinous, sagittal outlet and intertuberous diameters), biparietal diameter of the foetus and head circumference were compared in women who delivered by caesarean section or vaginally. **Results:** All the diameters except sagittal inlet, were significantly larger ( $P < 0.05$ ) in women who delivered normally as compared with those who had a caesarean section for any indication. The mean outlet index in the spontaneous delivery group with vertex presentation  $31.89 \pm 2.05$ , was significantly larger than that of the elective and emergency caesarean section, which were  $29.69 \pm 1.85$  &  $30.62 \pm 1.80$  respectively. The mean head circumference was also found to be significantly larger in the caesarean section deliveries. **Conclusion:** An outlet index of  $31.89 \pm 2.05$  and the pelvic diameters, transverse inlet  $12.56 \pm 0.80$ cm, sagittal outlet  $10.54 \pm 1.00$  cm, interspinous diameter  $10.46 \pm 0.89$ cm, and intertuberous diameter (transverse outlet)  $10.89 \pm 1.02$ cm are useful cut-off points for vaginal delivery in our population.

**Keywords:** MRI; Pelvimetry; Normal values; Caesarean section, Circumference.

### ADVANCES IN KNOWLEDGE:

1. This is the first study in the Middle East to describe magnetic resonance pelvimetry values in this population.
2. The pelvic diameters/outlet index are likely to provide reference values for this population.

### APPLICATION TO PATIENT CARE:

1. Trial of vaginal delivery after caesarean section has to be encouraged especially in this part of the world where the mean parity is high. The pelvic diameters and the outlet index suggested will help in decision making to choose the appropriate patients for trial of labour after caesarean section.

Radiographic pelvimetry has been in use for most of this century to predict obstetric outcomes, although there is considerable variation in practice and its use is now being criticised mainly due to the high radiation dose involved and the failure to assess the contributions of soft-tissues to outlet obstruction.<sup>1</sup> The advent of newer technologies like computerised tomography (CT) and magnetic resonance imaging (MR) scanning has increased interest in this area especially for MR pelvimetry which does not involve ionising radiation.<sup>2</sup> Antenatal X-ray pelvimetry in women with previous caesarean section could not predict the likelihood of vaginal delivery.<sup>3</sup> Pelvimetric dimensions by MR imaging were found to be smaller in women undergoing caesarean section or vacuum extraction than they were those in delivering vaginally.<sup>4</sup> Borell and Fernström described an index based on the sum of the transverse diameter of the mid pelvis, the transverse and sagittal diameters of the pelvic outlet, and pelvic contraction was defined as a sum of less than 29.5 cm for assessing pelvic adequacy, as reported by Sporri *et al.*<sup>5</sup>

A combination of antenatal ultrasound and MR pelvimetry dimensions has been suggested to be useful in predicting cephalopelvic disproportion in nulliparous women.<sup>6,7</sup> The cephalopelvic disproportion index compares the smallest pelvic diameter (either the sagittal diameter of the inlet or the transverse diameter of the mid pelvis) with the foetal biparietal diameter (BPD) and indicates how much wider the smallest pelvic diameter is than the biparietal diameter. A positive cephalopelvic disproportion index is present if the pelvic diameter is less than 9 mm wider than the biparietal diameter.<sup>8</sup>

In view of the desired high parity in this part of the world, and as caesarean section is known to be associated with reduced fertility, efforts are taken to avoid caesarean section as far as possible.<sup>9</sup> In this study, the absolute values of all pelvic diameters were compared with antenatal ultrasound for the foetal biparietal diameter near term and a decision for mode of delivery was made.

## Methods

This was a retrospective study of 182 patients who underwent MR pelvimetry from May 2001 to October 2003 at Sultan Qaboos University Hospital, Muscat,

Oman, for clinical indications. Of the 182 patients, the indication in 125 was a previous caesarean section. The foetus was in vertex presentation in all these 125 women. The indication in the remaining 57 patients was singleton breech presentation. Patients with bony pelvic abnormalities, pelvic masses and soft tissue anomalies were excluded. Only women with previous caesarean scar were included in the present study. MR pelvimetry was performed with the patient in the supine position on a 1.5 T MRI system (Siemens, Magnetom Symphony, Erlangen, Germany). Surface coils were placed over the pelvis and the patient appropriately placed within the gantry. T1 weighted spin-echo sequences were used with the following parameters: TR/TE 400/14 ms, FOV 330 mm, 6 slices, matrix 512x192, TA 1'46", to obtain midsagittal, oblique transverse (angulated along the superior border of the symphysis pubis and sacral promontory) and oblique coronal (through the ischial spines and tuberosities) sections of the pelvis. Electronic calipers were used to obtain the following measurements: midsagittal section, obstetric conjugate, from the sacral promontory to the top of the symphysis pubis; sagittal outlet, from the lower border of S5 to the bottom of the inner cortex of the symphysis pubis; oblique transverse section, largest transverse diameter of the pelvis; oblique coronal section, interspinous (narrowest) distance between the ischial spines, and the intertuberous (widest) distance between the ischial tuberosities. These five diameters (sagittal inlet, sagittal outlet, transverse inlet, interspinous and intertuberous) were measured in all patients in addition to the sacral configuration and any soft tissue anomalies. The mean of each of the five diameters  $\pm$  standard deviation was calculated for all 125 patients. The analysis of the data was done retrospectively. The diameters were stratified by mode of delivery in each group separately. The Statistical Package for the Social Sciences software, SPSS version 17, was used for the statistical analysis and a *P* value of .05 or less was considered as significant. The normality of the study variables was tested using the Kolmogorov Smirnov test and all the variables were found to follow a normal distribution pattern. Pearson's formula was used to obtain the coefficient of correlation and an independent sample t-test was applied to test the significance of difference between two sample means.

An index called outlet index (sum of interspinous,

**Table 1:** Mean diameters for all the patients

Name of the diameter	Mean $\pm$ SD
Sagittal inlet	10.92 $\pm$ 0.98 cm
Transverse inlet	12.32 $\pm$ 0.89 cm
Interspinous	10.26 $\pm$ 0.98 cm
Sagittal outlet	10.17 $\pm$ 0.86 cm
Intertuberous diameter	10.45 $\pm$ 1.10 cm

sagittal outlet and intertuberous diameter), as reported by Borell and Fernström, was calculated and an index of 29.5 was used as a cut off for allowing women with previous caesarean section a trial of labour. In addition, if the least pelvic diameter (sagittal inlet/interspinous diameter) was at least 9 mm wider than the BPD measured near term, the patient was allowed a trial of labour as described by Abitbol *et al.*<sup>8</sup>

## Results

The mean age and height of the patients was 27.7  $\pm$  5.06 years and 154.60  $\pm$  5.90 cms, respectively. The mean gestation was 37.69  $\pm$  1.19 weeks. Mean gravidity was 3 and parity 1.57. The mean values and standard deviations for the observed five diameters for all patients are presented in Table 1. Significant positive correlation was observed between the sagittal inlet diameter and the height of the women

( $r = .516, P < .001$ )

There was no significant difference in the sagittal inlet diameter between the spontaneous delivery and caesarean section groups, whereas the other four diameters (transverse inlet, interspinous, sagittal outlet and the intertuberous diameter) were significantly larger in the spontaneous delivery group compared to elective or emergency caesarean sections. The same four diameters were significantly smaller in patients who underwent emergency caesarean section for failure to progress compared with women who delivered vaginally [Table 2].

The mean outlet index of patients who had had a caesarean section for failure to progress was significantly smaller than the outlet index of patients who delivered vaginally [Table 2]. The mean values for all pelvic diameters and various modes of deliveries is shown in Table 3.

The mean birth weight of the babies was found to be significantly higher in the elective lower segment caesarean section (LSCS) deliveries of the vertex group (3430.0  $\pm$  421.8) compared to emergency LSCS (3236.8  $\pm$  512.1) and spontaneous vertex deliveries (3135.1  $\pm$  518.0) ( $P = 0.019$ ).

The mean BPD of the foetal head in the antenatal ultrasound was 9.09  $\pm$  0.39 cm for women who had elective caesarean section, 9.035  $\pm$  0.39 cm for emergency caesarean section and 8.9  $\pm$  0.37 cm for the spontaneous vaginal delivery group. Though the mean BPD was not significantly different between

**Table 2:** Comparison of diameters between women who had caesarean section for failure to progress and who delivered vaginally

	Mode of delivery	n	Mean	Std. Deviation	P value
Sagittal inlet	LSCS, FTP	18	10.6641	0.71956	.074
	SVD	56	11.0916	1.15938	
Transverse inlet	LSCS, FTP	18	12.0706	0.57961	.022
	SVD	56	12.5620	0.80011	
Sagittal outlet	LSCS, FTP	18	10.0211	0.59074	.010
	SVD	56	10.5380	0.99954	
Interspinous diameter	LSCS, FTP	18	9.9722	0.79668	.043
	SVD	56	10.4589	0.89201	
Intertuberous diameter	LSCS, FTP	18	10.2289	0.86855	.015
	SVD	56	10.8904	1.01720	
Outlet Index	LSCS, FTP	18	30.2222	1.37191	.002
	SVD	56	31.8873	2.05082	

Legend: LSCS = Lower segment caesarean section; FTP = failure to progress; SVD = spontaneous vertex delivery

**Table 3:** Diameters and mode of delivery.

Mode of delivery	Sagittal inlet cm (mean $\pm$ sd)	Transverse inlet cm (mean $\pm$ sd)	Interspinous (mean $\pm$ sd)	Sagittal outlet cm (mean $\pm$ sd)	Intertuberous cm (mean $\pm$ sd)
LSCS elective (41)	10.82 $\pm$ 0.78	12.07 $\pm$ 1.05	9.90 $\pm$ 0.82	9.92 $\pm$ 0.92	9.86 $\pm$ 1.04
LSCS foetal distress (10)	10.78 $\pm$ 0.95	12.24 $\pm$ 0.90	10.07 $\pm$ 0.47	10.53 $\pm$ 1.20	10.73 $\pm$ 1.14
LSCS, failure to progress (18)	10.66 $\pm$ 0.72	12.07 $\pm$ 0.58	9.98 $\pm$ 0.80	10.02 $\pm$ 0.59	10.23 $\pm$ 0.87
Spontaneous vaginal delivery (56)	11.09 $\pm$ 1.16	12.56 $\pm$ 0.80	10.46 $\pm$ 0.89	10.54 $\pm$ 1.00	10.89 $\pm$ 1.02

Legend: LSCS = Lower segment caesarean section.

the groups, the BPD in the elective caesarean section group was at least 9 mm more than the smallest pelvic diameter.

Postnatally, the mean head circumference of the neonate delivered by caesarean section (34.389  $\pm$  1.49 cm) was significantly more than the spontaneous delivery group 33.722  $\pm$  1.43cm ( $P$  = 0.019).

## Discussion

The standard values for normal or satisfactory pelvic dimensions are based on the work of Russell and Richards although these values are not universally accepted. One of the problems regarding the role of pelvimetry is that the studies have not always used the same pelvic dimensions or scoring systems to assess pelvic adequacy. X-ray pelvimetry has not been found to be useful in deciding the mode of delivery following a caesarean section.<sup>10</sup> In a randomised controlled trial, MR pelvimetry for breech presentation did not help to reduce significantly the overall caesarean section rate, but it did significantly lower the emergency caesarean section rate.<sup>11,12</sup> Some of the recent reports and studies on MR pelvimetry using fast MRI and measurement of foetal biparietal diameter and foetal shoulder measurement appear to offer more advantage over the conventional X-ray pelvimetry.<sup>13,14</sup>

The evaluation of the soft tissues of the maternal pelvis with least radiation is another advantage of MR pelvimetry. The main drawbacks are the relatively high cost and the limited availability of MR units. The absolute values in the present population are slightly different from the ones reported by

Keller *et al.*<sup>4</sup>

The pelvic diameters in the spontaneous delivery group (with fetuses in vertex presentation) were more than the emergency caesarean section for any indication and these results are likely to be useful for future applications. We did not find the index of 29.5 described by Borell and Fernström suitable for vaginal delivery as the mean index of women delivering normally was 32. As the caesarean section tends to limit the family size and repeated sections are associated with complications like placenta praevia, vaginal birth after caesarean section has to be given serious consideration in this part of the world.

## Conclusion

In conclusion, an outlet index of 32 cm, and the mean values of individual pelvic diameters of women who delivered vaginally, compared with antenatal BPD measurements may serve as useful reference values for allowing a trial of vaginal delivery.

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