

# Forceps or vacuum extraction: a comparison of maternal and neonatal morbidity

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استخراج الجنين بالملقط أو بالمحجم: مقارنة بين مراضة الأمهات والولدان  
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**خلاصة:** من أجل المقارنة بين مراضة الأمهات والولدان المصاحبة لتوليد بملقط الجنين (الجفت) وبالمحجم (تفريغ الهواء)، تمت مقارنة بيانات 150 سيدة جرى توليدهن بالملقط و420 سيدة تم توليدهن بالمحجم، فيما بين العامين 1995 و1999 بمستشفى الملكة علياء بالأردن. وشملت البيانات رقم الولادة والعمر الحمل ووزن الوليد عند الميلاد وأحراز أبغار، والمحيء ووضع رأس الجنين، ودواعي التوليد بالملقط أو بالمحجم، ومعدل نجاح الولادات، ومراضة الأمهات والولدان. ووجد أن تهيئات قناة الولادة والجهاز التناسلي للأم أكثر شيوعاً بدرجة يُعتد بها إحصائياً في حالة الولادة بالملقط، بينما كانت هناك زيادة يُعتد بها في مراضة الولدان الذين تم استخراجهم بالمحجم (الحديبة المصلية الدموية والبرقان والورم الدموي بالرأس). وكانت أمراض الوليد الوخيمة نادرة في المجموعتين. وهكذا، فنحن نقترح اعتبار استخراج الجنين بالمحجم (تفريغ الهواء)، وليس التوليد بالملقط، هو الأداة المفضلة في الولادات المهبلية المحتاجة للمساعدة.

**ABSTRACT** To compare maternal and neonatal morbidity associated with forceps and vacuum delivery, data on 150 women delivered by forceps and 420 delivered by vacuum extraction between 1995 and 1999 at Queen Alia Hospital, Jordan were compared. Data included parity, gestational age, infant birth weight, Apgar score, presentation and station of fetal head, indications for forceps and vacuum deliveries, delivery success rate, and maternal and neonatal morbidity. Maternal birth canal and genital tract lacerations were significantly more common in forceps delivery, and there was significantly increased morbidity in infants delivered by vacuum extraction (caput, jaundice, cephalohaematoma). Serious neonatal morbidity was rare for both groups.

## Forceps ou extraction par ventouse obstétricale : comparaison de la mortalité maternelle et néonatale

**RESUME** Afin de comparer la morbidité maternelle et néonatale associée à l'accouchement par application de forceps et par ventouse obstétricale, on a comparé des données concernant 150 femmes ayant accouché par forceps et 420 femmes ayant accouché par ventouse obstétricale entre 1995 et 1999 à l'Hôpital Reine Alia (Jordanie). Les données comprenaient le nombre d'enfants, l'âge gestationnel, le poids de naissance du nouveau-né, l'indice d'Apgar, la présentation et la position de la tête du fœtus, les indications pour des accouchements par application de forceps et par ventouse obstétricale, le taux de réussite pour les accouchements et la morbidité maternelle et néonatale. Les ruptures dans la filière pelvi-génitale et les voies génitales étaient significativement plus courantes dans l'accouchement par application de forceps, et il y avait une morbidité significativement accrue chez les nouveau nés mis au monde par application de ventouse obstétricale (caput, jaunisse, céphalématome). Une morbidité néonatale grave était rare pour les deux groupes.

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## Introduction

Forceps are recognized as the primary instrument for operative vaginal delivery in English-speaking countries [1]. Although most British obstetricians still prefer forceps for instrumental delivery, the popularity of vacuum extraction is increasing. From 1989 to 1993, the total instrumental vaginal delivery rate remained steady at about 10%. During this time, the ratio of vacuum to forceps procedures gradually changed from 1:6.29 to 1:1.89 [2]. The Audit Committee of the Royal College of Obstetricians and Gynaecologists has endorsed the view that the vacuum is the instrument of first choice for assisted delivery [3]. In the United States, between 1980 and 1987, the forceps rate fell to 8% and the vacuum rate rose to 3% [4]. Italy's forceps rate has dropped to 1.1% among primigravid women, while its vacuum rate remains steady at 3.7% [5].

Among Middle Eastern countries, one study has reported a rate of 10.89% for vacuum extraction, and a high rate of vacuum extraction failure (12.4%) associated with a high rate of neonatal birth trauma, of which subgaleal haemorrhage was the predominant form [6]. Another study reporting a rate of 3.34% for vacuum delivery and 1.79% for forceps delivery found that infants delivered by vacuum or forceps were not at risk of physical or cognitive impairment at 17 years [7].

Studies suggesting that vacuum extraction causes less maternal morbidity [8] and even less fetal morbidity than forceps [9] have prompted calls for the vacuum extractor to replace forceps as the instrument of first choice for assisted vaginal deliveries. Instrumental vaginal delivery trials comparing forceps with the vacuum extractor are not new. These trials have documented that the vacuum technique

offers lower rates of maternal trauma, such as genital tract lacerations and episiotomy extensions, but higher rates of cephalohaematoma and scalp trauma, than forceps [10,11]. In one American trial, soft tissue trauma was noted in 36% of the vacuum group and 49% of the forceps group [12]. Pumnoneu et al. [13] found all fetal complications were less common after forceps delivery. Johanson et al. [11] found no difference in superficial damage, but cephalohaematoma among 9% of the vacuum group, and 3% of the forceps group. Two trials comparing forceps to the soft cup vacuum extractor showed the vacuum extractor to be less effective than forceps in achieving vaginal delivery [11,12]. The design of forceps has not changed for decades, whereas the vacuum extractor has undergone modifications, most recently the introduction of soft cups [14] to reduce fetal trauma and increase the instrumental success rate.

Our study aimed to compare forceps and vacuum extraction deliveries in Jordanian women by assessing maternal and neonatal morbidity.

## Methods

This retrospective study included 150 forceps and 420 vacuum deliveries performed between 1995 and 1999 at the Department of Obstetrics and Gynaecology of Queen Alia Hospital. During this period, total deliveries numbered 12 232. Data on women giving birth by vacuum and forceps deliveries were analysed and compared in terms of parity distribution, gestational age, infant birth weight, Apgar scores, presentation and station of the fetal head at commencement of extraction, and indications for vacuum and forceps delivery. Maternal morbidity was analysed in terms of

perineal, vaginal and cervical lacerations. Metallic cup was used in vacuum extraction. Forceps deliveries were performed using outlet, low and mid-cavity forceps, except in seven (failed) cases of high forceps (-1 station) attempted by the resident. Blood loss during the procedure was estimated by the weight difference of pads and towels before and after instrumental delivery. Neonatal morbidity in vacuum and forceps groups, including scalp and facial injuries, Apgar scores, unexplained convulsion, intracranial haemorrhage, jaundice, Erb palsy and perinatal death, were investigated and compared. Continuous fetal heart monitoring was used for all patients. The diagnosis of fetal distress in labour was made by the presence of any of the following: late deceleration, decreased variability or fetal bradycardia. Fetal distress was assessed by measuring Apgar scores at 1 and 5 minutes after delivery. All infants were examined by a paediatrician immediately after delivery and followed for a period of at least 48 hours thereafter. Neonatal cerebral haemorrhage was diagnosed clinically, and by ultrasound and computed tomography scanning.

## Results

In terms of the distribution of parity among mothers delivered by instrumental deliveries (Table 1), the majority were primi-

gravae (74.76% in vacuum and 76.00% in forceps groups). In infants of gestation < 37 weeks and weight < 2500 g, the use of forceps was significantly more common ( $P < 0.01$ ) than vacuum extraction (Table 2). There were seven cases of forceps delivery attempted by a junior resident at -1 station, but not completed. Of these, four were finally delivered by vacuum extraction and three by caesarean section carried out by a specialist (Table 3).

Delay in the second stage of labour was the most common indication for vacuum extraction, while fetal distress was the most common reason for forceps delivery (Table 4). Severe birth canal injuries (3rd and 4th degree tears, extension to fornix), and lesser birth canal injuries (1st and 2nd degree tears, vaginal lacerations) were all significantly more common in the forceps delivery group ( $P < 0.01$ ), as were cervical tears ( $P < 0.05$ ). During the procedure, blood loss > 500 mL was significantly more likely to occur in the forceps delivery group ( $P < 0.01$ ). These data are shown in Table 5. Cephalohaematoma was significantly more common after vacuum extraction, as were neonatal jaundice and severe caput succedaneum at discharge (Table 6). Facial cuts were significantly more common after forceps deliveries as was facial nerve palsy (Table 6). Cerebral haemorrhage was diagnosed in two infants born by vacuum extraction, and in none in the forceps group

Table 1 Parity among mothers undergoing instrumental delivery. Queen Alia Hospital. Amman. Jordan, 1995-99

Parity	Vacuum (n = 420)		Forceps (n = 150)		$\chi^2$	P-value
	No.	%	No.	%		
Primigravida	314	74.76	114	76.00		
< 5	54	12.86	14	9.33	1.21	> 0.05 NS
≥ 5	52	12.38	17	11.33		

NS = not significant.

Table 2 Neonatal characteristics by type of instrumental delivery, Queen Alia Hospital, Amman, Jordan, 1995-99

Characteristic	Vacuum (n = 420)		Forceps (n = 150)		$\chi^2$	P-value
	No.	%	No.	%		
<i>Gestational age (weeks)</i>					23.04	< 0.01*
< 37	6	1.43	5	10.00		
37-40	369	87.86	122	81.33		
> 40	45	10.71	13	8.67		
<i>Infant birth weight (g)</i>					31.47	< 0.01*
< 2500	10	2.38	20	13.33		
2501-3000	31	7.38	18	12.00		
3001-3500	134	31.90	37	24.67		
3501-4000	155	36.90	45	30.00		
> 4000	90	21.43	30	20.00		
<i>Apgar score at 1 minute</i>					0.27	> 0.5
0-3	90	21.43	35	23.33		
4-6	55	13.10	20	13.33		
7-10	275	65.48	95	63.33		
<i>Apgar score at 5 minutes</i>					0.14	> 0.5
0-3	2	0.48	1	0.67		
4-6	13	3.10	4	2.67		
7-10	405	96.43	145	96.67		

\*Significant at P &lt; 0.05.

Table 3 Presentation and station of the fetal head at the start of extraction in forceps and vacuum delivery groups, Queen Alia Hospital, Amman, Jordan, 1995-99

Characteristic	Vacuum (n = 420)		Forceps (n = 150)		$\chi^2$	P-value
	No.	%	No.	%		
<i>Presentation</i>					6.024	< 0.04*
Normal	325	77.38	123	82.00		
Occiput posterior	73	17.38	26	17.33		
Deep transverse arrest	22	5.24	1	0.67		
<i>Station</i>					1.420	< 0.50
< 0	30	7.14	7	4.66		
+1, +2	170	40.48	65	43.33		
+3, +4	220	52.38	78	52.00		

\*Significant at P &lt; 0.05.

(Table 6). Two infants delivered by vacuum extraction died, one of respiratory distress syndrome and the other of intracranial haemorrhage. One infant in the

forceps group died because of meconium aspiration (Table 6).

The association of major maternal and fetal morbidity and mortality in instrumen-

Table 4 Indications for vacuum and forceps delivery, Queen Alia Hospital, Amman, Jordan, 1995-99

Indication	Vacuum (n = 420)		Forceps (n = 150)		$\chi^2$	P-value
	No.	%	No.	%		
Delay in second stage	190	45.24	56	37.33	9.29	< 0.02*
Fetal distress	160	38.10	67	44.67		
Delay and distress	50	11.90	12	8.00		
Shorten second stage	20	4.76	15	10.00		

\*Significant at P &lt; 0.05.

Table 5 Maternal morbidity in forceps and vacuum delivery groups, Queen Alia Hospital, Amman, Jordan, 1995-99

Morbidity	Vacuum (n = 420)		Forceps (n = 150)		$\chi^2$	P-value
	No.	%	No.	%		
<i>Perineum</i>					16.00	< 0.01*
Intact	35	8.33	7	4.67		
Episiotomy	302	71.90	130	86.67		
1st and 2nd degree tears	145	34.52	95	63.33		
3rd and 4th degree tears	10	2.38	12	8.00		
<i>Vagina</i>					22.04	< 0.01*
Side wall, periurethral tears	120	28.57	70	46.67		
Extension to fornix	5	1.19	6	4.00		
<i>Cervix</i>					5.19	< 0.05*
Cervical tears	6	1.43	7	4.67		
<i>Bleeding &gt; 500 mL</i>	17	4.05	18	12.00	12.13	< 0.01*

\*Significant at P &lt; 0.05.

tal deliveries to gestational age (< 37 weeks and > 40 weeks), and birth weight (> 4000 g and < 2500 g) is shown in Table 7. The incidence of fetal morbidity and mortality was high in all above-mentioned groups. The incidence of severe perineal, cervical and vaginal lacerations, blood loss > 500 mL, and Erb palsy was more common in infants > 4000 g and > 40 weeks gestation.

In the 25 cases when the vacuum extractor spontaneously released more than 3 times, forceps application was possible and resulted in successful vaginal delivery (Ta-

ble 8). There were 7 cases of failed vacuum extraction which were delivered by caesarean section without trying forceps. There were 7 cases of forceps deliveries attempted by the resident that failed because of high station (-1). Successful delivery was achieved by vacuum extraction in 4 of the 7 cases; in 3, vacuum delivery also failed and caesarian section was performed. Two women were delivered by caesarean section after failed forceps without trying vacuum extraction (Table 8). The most common cause of failure of

Table 6 Neonatal morbidity in forceps and vacuum delivery groups, Queen Alia Hospital, Amman, Jordan, 1995-99

Morbidity	Vacuum (n = 420)		Forceps (n = 150)		$\chi^2$	P-value
	No.	%	No.	%		
Scalp and facial injuries					43.30	< 0.01*
Abrasions	13	3.10	5	3.33		
Bruising	51	12.14	27	18.00		
Cephalohaematoma	20	4.76	1	1.67		
Facial cut	0		5	3.33		
Facial nerve palsy	0		2	1.33		
Severe caput at discharge	155	36.90	28	18.67		
Low Apgar score					0.08	> 0.50
< 3 at 1 minute	90	21.45	35	23.33		
< 7 at 5 minutes	15	3.57	5	3.33		
Unexplained convulsion	2	0.48	0		FET	> 0.50
Intracranial haemorrhage	2	0.48	0		FET	> 0.50
Jaundice	51	12.14	7	4.67	6.76	< 0.02*
Erb palsy	1	0.24	2	1.33	FET	> 0.30
Perinatal death	2	0.48	1	0.67	FET	> 0.30

\*Significant at P &lt; 0.05.

FET = Fischer exact test.

Table 7 Major neonatal and maternal morbidity and mortality according to gestational age and fetal weight in cases of instrumental delivery, Queen Alia Hospital, Amman, Jordan, 1995-99

Morbidity and mortality	Total No.	Gestational age (weeks)				Weight (g)			
		< 37 (n = 21)		> 40 (n = 58)		< 2500 (n = 30)		> 4000 (n = 120)	
		No.	%	No.	%	No.	%	No.	%
<i>Neonatal morbidity and mortality</i>									
Perinatal death	3	2	9.52	1	1.72	2	6.67	0	0.00
Intracranial haemorrhage	2	1	4.76	0	0.00	0	0.00	1	0.83
Erb palsy	3	0	0.00	1	1.72	0	0.00	3	2.50
<i>Low Apgar score</i>									
< 3 at 1 minutes	125	9	12.86	19	32.76	12	40.00	18	15.00
< 7 at 5 minutes	20	3	14.28	5	8.62	4	13.33	2	1.67
<i>Maternal morbidity</i>									
<i>3rd and 4th degree</i>									
perineal tear	22	0	0.00	2	3.45	0	0.00	8	6.67
Cervical laceration	13	1	4.76	1	1.72	0	0.00	5	4.17
Extension to the fornix	11	0	0.00	2	3.45	0	0.00	3	2.50
Bleeding > 500 mL	35	1	4.76	4	6.90	0	0.00	11	9.17

Table 8 Actual mode of delivery in forceps and vacuum groups, Queen Alia Hospital, Amman, Jordan, 1995-99

Mode of delivery	Vacuum (n = 420)		Forceps (n = 150)		$\chi^2$	P-value
	No.	%	No.	%		
Specified instrument	388	92.38	141	94.00	0.43	> 0.5 NS
Forceps after vacuum	25	5.95	0	0.00		
Vacuum after forceps	0	0.00	4	2.67		
Caesarean section after vacuum/forceps	7	1.67	5	3.33		

NS = not significant.

vacuum delivery (32 cases) (Table 9) was cup detachment (75.0% of vacuum failures) followed by cephalopelvic disproportion (18.7%) and leaking machine (6.2%). The most common cause of failure of forceps delivery (9 cases) was difficulty with application of the forceps (77.8%) and cephalopelvic disproportion (22.2%).

## Discussion

We found increased maternal birth trauma and estimated blood loss for forceps delivery versus vacuum delivery. In our data set, episiotomy was used much more often when performing forceps delivery (86.67%) compared to the vacuum group (71.90%). When properly applied, forceps add to the volume passing through the introitus, whereas the vacuum cup adds no extra volume. This may partly explain the tendency for more lacerations and episiotomies in the forceps group. Sphincter damage, 1st and 2nd degree tears, vaginal wall lacerations and cervical lacerations were all significantly more common with forceps delivery. Our study also confirms the findings of other studies, i.e. an increase in maternal genital tract lacerations should be expected when forceps are used compared with vacuum extraction [10-12,15]. Blood

loss of > 500 mL was also more common in the forceps group (12.00%) than in the vacuum group (4.05%), with significant statistical difference. This is due to the higher incidence of maternal birth canal injuries with forceps delivery. Johanson et al. found no difference in superficial damage but reported the incidence of cephalohaematoma was 9% among the vacuum group and 3% in the forceps groups [11]. Jaundice has been found more likely to occur after vacuum extraction. In Florida, a study reported 20% of babies delivered by vacuum extraction had raised bilirubin compared to 10% of forceps-delivered babies [16].

In our study, there were no significant differences between forceps-delivered and vacuum-delivered groups in the incidence of superficial injuries such as abrasions and bruising. There was, however, significantly increased incidence of jaundice, caput and cephalohaematoma in the vacuum-delivered group compared with the forceps-delivered group. When a ring of extrinsic pressure is applied to the fetal scalp, either from the dilating cervix, pelvic soft tissue or vacuum cup, interstitial fluid and microhaemorrhages accumulate to form the caput. Longer second stage labour and longer vacuum procedure apparently allow

time for accumulation of more interstitial scalp fluid, which in turn leaves the tissues more vulnerable to abrasions, lacerations and cephalohaematoma formation [17]. Forceps delivery was more likely to have resulted in facial cuts and facial nerve palsy than vacuum extraction, a significant difference. There was a significant increase in major neonatal morbidity and mortality in gestational age < 37 weeks and > 40 weeks, and in birth weight < 2500 g and > 4000 g. There was also a significant increase in maternal morbidity in patients with gestational age > 40 weeks and infants > 4000 g.

Many studies report vacuum extraction having less associated maternal trauma and similar neonatal morbidity, if stratified to the level of difficulty of the corresponding forceps delivery [18]. In our study, the indications for the procedures were different, with fetal distress a more common indication for forceps delivery. The use of forceps to shorten the second stage is also more common than vacuum extraction. The overall duration of compression on the fetal head is less marked for forceps than for normal delivery, due to the shorter delivery. With vacuum extraction, overall traction is significantly greater than that associated with forceps [19]. For these reasons, we used forceps much more frequently than vacuum extraction in the delivery of premature babies < 37 weeks and infants weighing < 2500 g.

In the 25 cases when the vacuum spontaneously released more than three times, forceps application was possible and resulted in successful vaginal delivery. In most cases of failed vacuum delivery, the fetal station had been brought to +3, +4 and sagittal rotation had decreased, possibly facilitating successful forceps application. Seven cases of failed vacuum extraction were delivered by caesarean section without trying forceps [13]. Where forceps delivery failed (9 cases), successful delivery was achieved by vacuum assistance in 4 of 7 cases attempted and two women were delivered by caesarean section without trying vacuum extraction. The use of alternate methods of assisted vaginal delivery obviated the need for caesarean section in 29 of 41 cases. Double application of forceps and vacuum delivery was not associated with serious maternal or neonatal injury, except in one case of 3rd degree perineal tear and two neonatal injuries in the form of unexplained convulsion and facial palsy.

Data from our study support the belief of Ayala et al. [17] that failed instrumental delivery performed using forceps and/or vacuum extraction in a setting where a caesarean section can follow promptly is not associated with increased morbidity of either mother or baby. We conclude that vacuum extraction should be considered over forceps in vaginal deliveries.

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