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# Analysis of the traction direction during a simulated forceps delivery

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## 1. Introduction

The use of forceps in deliveries has decreased significantly in favor of vacuum extraction (Leray & Lelong, 2021). However, when forceps are necessary, less experienced obstetricians may unintentionally cause serious and preventable perineal or foetal injuries (Coste Mazeau et al., 2020).

Despite the importance of training, there is a lack of clear recommendations on the specific techniques and postures to adopt during forceps deliveries.

Our previous study revealed that obstetricians used four different postures ("standing without trunk flexion", "standing with trunk flexion", "chevalier servant", "squatting") adopted when crossing the first plane and that very different pulling techniques were applied throughout delivery.

Some recommendations suggest that traction should follow the umbilico-coxygeal axis, which points downwards after crossing the first plane (Schaal, 2012). This raises questions about the compatibility of certain postures, such as "standing without trunk

flexion," with the recommended downward pull technique since the hands and forearms are not in this direction during this posture.

To address these concerns, the objective of this study was then to qualify, by means of a three-dimensional kinematic analysis, the direction of the force produced during foetal delivery in relation to the obstetricians' posture.

## 2. Methods

Fifty-seven volunteer obstetricians, 20 from the Limoges and 37 from the Poitiers University hospitals, were included in this multi-centric study. The posture and movements of the obstetricians were recorded using an optoelectronic motion capture system during simulated forceps births. 50 markers were placed on the subject following the Conventional Gait Model version 2.4.

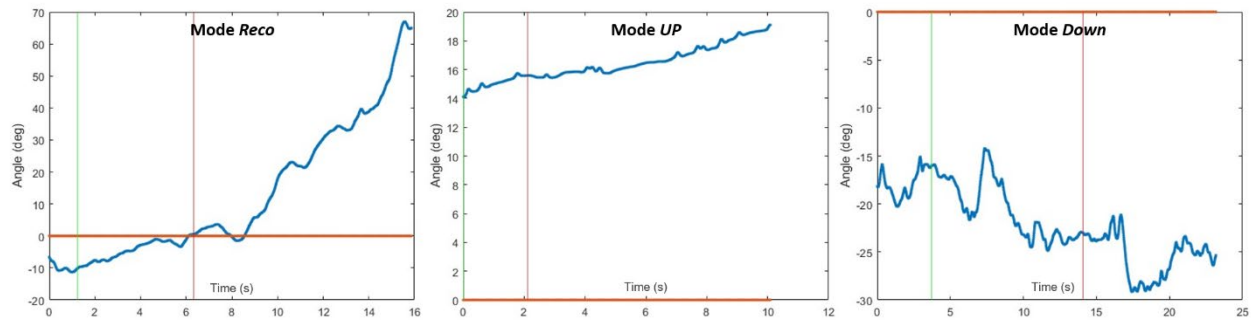
Six markers were also placed on the mannequin's board to define a technical coordinate system that identifies the anatomical landmarks of the maternal pelvis, which were not visible during the experiment. Similarly, a marker cluster was placed on the handle of each blade of the Suzor forceps to define a technical coordinate system that enables the position of the blade markers to be reconstructed throughout the intervention (Sorel et al., 2023).

Each obstetrician carried out the forceps delivery according to their usual practice: placing the two forceps blades on the foetal head, pulling the foetus, removing the instrument, and finalizing the simulated delivery.

The direction of the forceps traction was estimated as being in the same direction as the segment connecting the middle of the proximal ends of the forceps and the middle of the blades. Three phases of foetal traction were defined by considering the passage of the middle of the forceps blades through two anatomical planes: the mid-pelvis and the pelvic outlet. The first plane was defined by the lower border of the pubic symphysis and the coccyx. The second plane was defined by the lower border of the pubic symphysis and the two sciatic spines.

To qualify the direction of the traction during the movement, the mean and standard deviation of the angle formed by the intersection of the direction of the trajectory of the blades with the plane of the support during the three traction phases were defined. Then a principal component analysis followed by an ascending hierarchical classification consolidated using the K-means method was applied to these results in order to detect the existence of clusters. In each cluster the percentage of subjects adopting each one of the four postures was then computed.

## 3. Results and discussion



**Figure 1.** Illustration of the 3 distinct modes of traction found among the subjects.

The hierarchical clustering revealed three distinct modes of traction during the simulation of the forceps delivery as illustrated on Figure 1: 65% of the participants (Mode Reco) adopted a downward traction in the first phase, almost horizontal in the second, then upward in the last phase, which corresponds to the recommendations (Schaal, 2012); 26% pulled constantly upward (Mode Up), and 9% constantly downward (Mode Down).

**Table 1.** Distribution of the three identified traction modes among the four postures.

		Mode Reco N=37 (65%)	Mode Up N=15 (26%)	Mode Down N=5 (9%)
<b>Standing without trunk flexion</b>	N=8	3 (38%)	5 (63%)	0 (0%)
<b>Standing with trunk flexion</b>	N=12	6 (50%)	3 (25%)	3 (25%)
<b>Chevalier servant</b>	N=24	17 (71%)	6 (25%)	1 (4%)
<b>Squatting</b>	N=13	11 (85%)	1 (8%)	1 (8%)

The more flexed was the posture adopted by participant the more the traction force was oriented following the recommendations. Specifically, 85% of participants who squatted during forceps delivery pulled in the correct orientation, compared to only 38% of those who were standing (refer to Table 1). This finding supports the notion that the standing posture may not facilitate optimal traction orientation.

This observation aligns with the study conducted by Leslie et al. (2005), where participants were instructed to perform simulated forceps deliveries in both standing and sitting postures, revealing that posture does indeed impact traction force generation.

The first perspective of this work is now to assess how posture influences the intensity of traction force produced, as excessive pulling forces have been linked to obstetric injuries of the anal sphincter and neonatal complications.

## 4. Conclusions

The technique of forceps delivery can vary, with the position of the obstetrician potentially influencing the direction of forceps traction during the procedure. By contributing to the identification of the optimal posture to perform forceps delivery, the results of the present study have the potential to contribute to the training of obstetricians in forceps delivery. By doing so, it has the potential to address the decreasing frequency of forceps deliveries in modern practice, ultimately enhancing the safety of both mothers and newborns

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