

AN IN VITRO MAMMAL MODEL TO QUANTIFY THE FRICTION REDUCTION BY OBSTETRIC GELS IN HUMAN CHILDBIRTH

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Introduction

In contrast to veterinary medicine, lubricants are no Golden Standard procedure to facilitate vaginal birth although the Romans already used olive oil in this context [Tempkin, 1956]. Recently, obstetric gels were brought onto the market showing shorter durations of second stage of labor in humans [Schaub, 2008]. However, the related reduction of friction force has not been quantified so far. Thus, the present work aims at the determination of friction properties of obstetric gels when applying it to a porcine model that is moving under mechanical conditions similar to those of human childbirth.

Method

A friction testing device was developed allowing quantification of friction force up to 30 N with a maximum error of 0.2 N (Fig. 1).

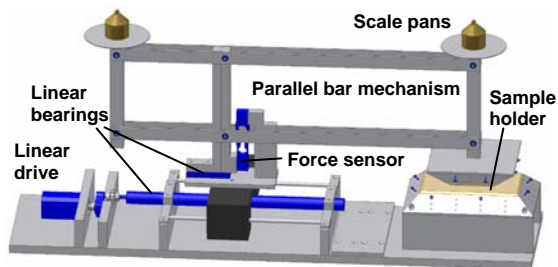


Figure 1: The friction measurement device.

The horizontal movement speed generated by a linear drive is adjustable between 1-160 cm/h, the contact pressures between 0.002 N/cm² and 125 N/cm² depending on the normal force (up to 500 N) and contact area (4-100 cm²). Porcine vaginal tissue as representative of human tissue was fixed on the sample holder whereas clean-shaven dermal porcine tissue was attached to the stamp. Pilot studies showed the expected relations between friction and contact pressure ($F_r \sim p$), increasing friction force on movement velocity ($F_r \sim v$), and a best fitting stamp size of 25 cm². Therefore, the present study was based on this stamp size; on a constant contact pressure of 3.0 N/cm² simulating common pressure between human fetal head and cervix (Rempen, 1991); and on three different movement speeds (10 cm/h, 50 cm/h, 100 cm/h).

Samples were firstly lubricated with water, 3 times tested, cleaned, and then lubricated and again 3 times tested with one of two obstetric gels differing in viscosity and water content (gel 1: Dianatal Stage I; gel 2: Dianatal Stage II). In total, 30 samples were investigated, five per movement speed and gel; repeated tests were averaged and lubrication with water compared to those with gels.

Results

Overall, the friction force ranged between 0.5 and 7 N. Due to the use of Dianatal Stage I, the force of friction was significantly reduced compared to water ($p < 0.1$, paired t-test) whereas Dianatal Stage II reduced the friction only for movement speeds of 50 and 100 cm/h. Percental reductions of friction are shown in Table 1.

Gel	v [cm/h]	$\Delta F_R = (H_2O-Gel)/H_2O$ [%]	
		mean	CI 95% _{lower}
Dianatal I	10	38	11
Dianatal II	10	-6	-19
Dianatal I	50	46	18
Dianatal II	50	31	28
Dianatal I	100	39	12
Dianatal II	100	45	28

Table 1: Percental reduction (mean and lower 95% confidence interval limit) of friction force due to lubrication by gel instead of water.

Discussion

A newly developed friction testing device enabled for the first time the quantification of friction properties of obstetric gels. It has been shown that obstetric gels are very likely to reduce the friction force by at least 10% up to 70% compared to water as control. These results support the benefit of obstetric gels during childbirth in labor facilitation.

References

- Rempen *et al*, J Perinat Med, 19:115-120, 1991.
Schaub *et al*, J Perinatal Med, 2008, in press.
Tempkin, *Soranus' Gynecology*, John Hopkins Press, Baltimore, 1956.