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Article

# Electromyographic activity in cervices with very low Bishop score during labor

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**Abstract**

*Objectives:* To investigate the activity of the smooth muscles in the cervix at the onset of induced labor and to further elucidate this activity in relation to uterine contractions and to the duration of the latent phase of labor, taking cervical ripeness into account. *Methods:* Cervical electromyographic (EMG) activity was studied at the onset of labor induced with amniotomy and oxytocin. Bipolar measurement of cervical electrical activity was performed. The root mean square of the cervical EMG activity and the intensity of intrauterine pressure in two groups of parturients with different cervical ripeness were compared. *Results:* The EMG activity was higher in the group with lower Bishop scores. We found a significant positive correlation between EMG activity and duration of the latent phase of labor. *Conclusion:* Smooth muscles in the human cervix are active during labor and act to some extent independently of the uterine corpus.

*Keywords:* Electromyography; Cervix; Cervical ripeness

## 1. Introduction

During pregnancy the role of the cervix is to remain closed and retain the products of conception, while during labor it should dilate and retract. Therefore the smooth muscles in the cervix have a dual role: during pregnancy they contribute to the closing of the cervical canal (with contractions); and in the course of labor they dilate passively, or, with a different kind of contraction, actively participate in the dilatation and retraction of the cervix.

To achieve this role in pregnancy, the cervical smooth muscle fibers, lying more or less in a circular pattern, should contract satisfactorily and act independently of the uterine corpus [1]. The smooth muscles of the cervix in ewes contract vigorously, even late in gestation and with the approach of parturition. The cervical and uterine smooth muscles appear to act independently in this mammal, possibly reflecting their independent functioning [2].

During recent decades uterine electromyograms have been extensively investigated, providing reliable and useful information on uterine muscle

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behavior [3,4]. The aims of the present study were to investigate the activity of the smooth muscles in the cervix at the onset of induced labor and to further elucidate the activity of the smooth muscles in relation to uterine contractions and to the duration of the latent phase of labor, taking cervical ripeness into account.

## 2. Materials and methods

The study involved 26 randomly selected primiparous women scheduled for induced labor. After admission to the delivery room, cervical ripeness was estimated using Bishop scores [5]. This was followed by an amniotomy. An open-ended catheter for measuring intrauterine pressure (IUP) was inserted and connected to a transducer (MOD 1286; Hewlett Packard, Santa Clara, CA, USA). For bipolar registration of the cervical electrical activity, adapted spiral fetal scalp electrodes (Hewlett Packard) were used. The electrodes were inserted directly into the cervical tissue from the vaginal side, 2–3 mm deep in the upper part of the portio, transversal to the cervical canal [6].

A miniature differential preamplifier was designed to amplify low-amplitude EMG signals with a fixed gain of 1000 and a bandwidth of up to 5 kHz (3 dB). The signal was further amplified by a galvanically isolated amplifier with adjustable gain and a built-in low-pass filter (5 Hz) to exclude signals originating from the striated muscles. The signals were recorded simultaneously with IUP, and sampled and stored in a computer for further processing.

We used the root mean square (RMS) to determine EMG activity. RMS is a measure of average intensity of muscular activity over a given time [7]. We calculated the RMS from the recorded EMG signal for each 5-s interval. These values were used for subsequent 10- and 30-min interval averaging.

The registration of EMG and IUP began 10 min after amniotomy and continued for 90 min. Within 30 min of amniotomy, oxytocin solution (Syntocinon) was administered by the drip method at a dose of 6.75 mEquiv/min.

The latent phase of labor (in minutes) was defined as lasting from amniotomy to an estimated dilatation of the cervical canal of 4 cm. The active phase of labor lasted from the estimated dilatation of the cervical canal from 4 to 10 cm.

The patients were divided into two groups: group A had a cervical ripeness of 4 and lower Bishop scores, whereas group B had a cervical ripeness of 5 and higher Bishop scores.

The differences of means between group A and B and within each group were evaluated using the *t*-test. Linear correlation (Pearson) was used to determine the extent to which the values of the length of the latent phase and RMS were proportional to each other.

## 3. Results

There was one cesarean section in group A, due to cephalo-pelvic disproportion. The RMS of this case was not interpreted.

### *3.1. Description of the groups*

There were 11 parturients in group A and 15 in group B. The mean Bishop score was 2.55 (S.D. 0.82) in group A and 6.60 (S.D. 0.45) in group B. The mean age of the parturients was 23.64 years (S.D. 4.41) in group A and 23.60 years (S.D. 2.85) in group B. The mean duration of the latent phase was 333 min (S.D. 98) in group A and 123 min (S.D. 96) in group B. This difference was statistically significant ($P < 0.001$). The mean duration of the active phase of labor was 201 min (S.D. 77) in group A and 212 min (S.D. 129) in group B.

### *3.2. Root mean square*

The EMG activity, represented by RMS, was higher in group A than in group B throughout the observation period. This difference was significant before and especially after application of oxytocin (Fig. 1). In group A, EMG activity in the first 30 min after oxytocin application was significantly ($P < 0.02$) lower than 30 min later (mean 51.4 [S.D. 31.7] vs. 74.3 $\mu$V [S.D. 46.4]). In group B the activity remained approximately on the same level.

### *3.3. The intensity of IUP*

In group A the activity of the uterine corpus, represented by the intensity of IUP, was lower than that in group B throughout the observation

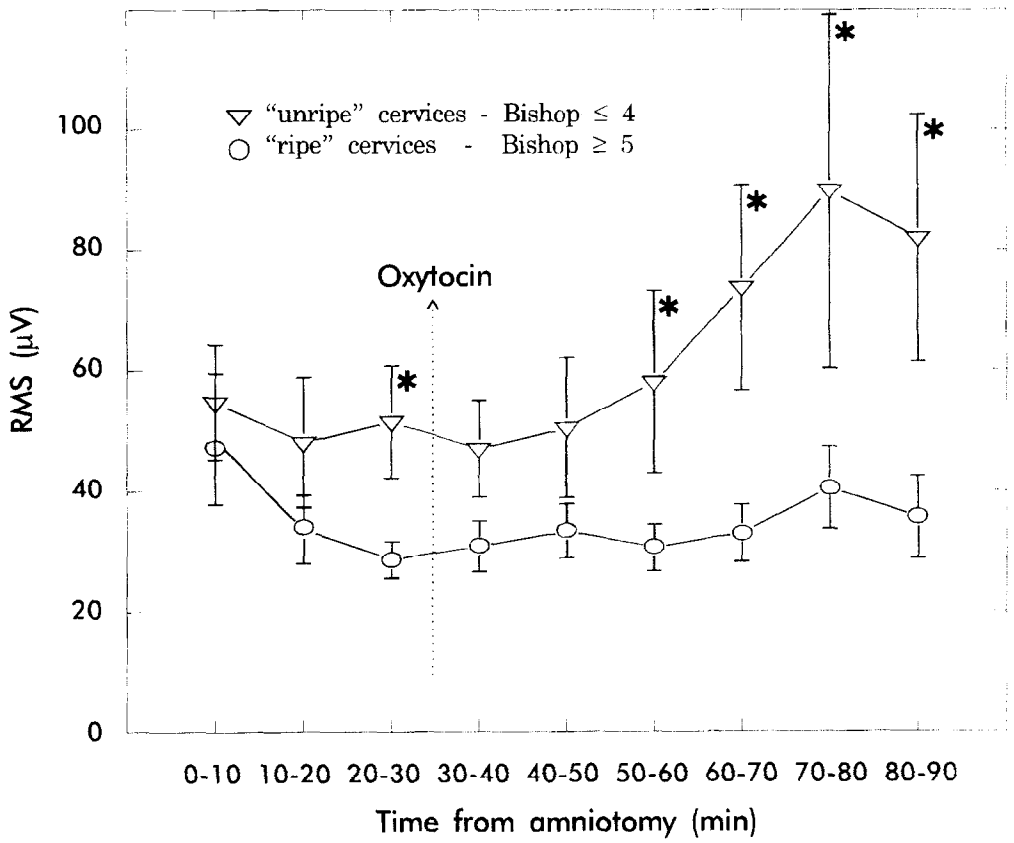


Fig. 1. Mean RMS of EMG and standard error in women with lower (group A) and higher (group B) Bishop scores. Each data point represents the 10-min average of the RMS. Time 0 represents the time of amniotomy. The mean RMS values of group B different from that of group A ($P < 0.05$) at coincident times are indicated by an asterisk.

period. This difference was statistically significant for almost the entire time (Fig. 2). The intensity of IUP increased significantly ($P < 0.0002$) in group B from a mean of 26.5 mmHg (S.D. 4.7) 30 min before oxytocin application to a mean of 32.1 mmHg (S.D. 7.1) 60 min afterwards.

### *3.4. Correlation between the duration of the latent phase of labor and RMS, and intensity of IUP*

In the total study population we found a significant ($P < 0.05$) positive correlation between the lengths of the latent phase of labor and the average RMS before oxytocin application ($r = 0.444$), as well as afterwards ($r = 0.554$). A significant ($P < 0.05$) negative correlation was found between the lengths of the latent phase of labor and the intensities of IUP before oxytocin application ($r = -0.470$) as well as afterwards ($r = -0.569$) except 10 min after amniotomy and 10 min after oxytocin application. The higher the RMS, the longer the latent phase of labor; the higher the intensity of IUP, the shorter the latent phase of labor.

## 4. Discussion

As we have no opportunity to investigate the activity of the cervical smooth muscles during the course of pregnancy, we have registered and analyzed this activity at the onset of induced labor. We presume that the activity of the smooth muscles in unripe cervices at the onset of labor still resembles that during pregnancy.

In group A, the cervices were extremely unripe,

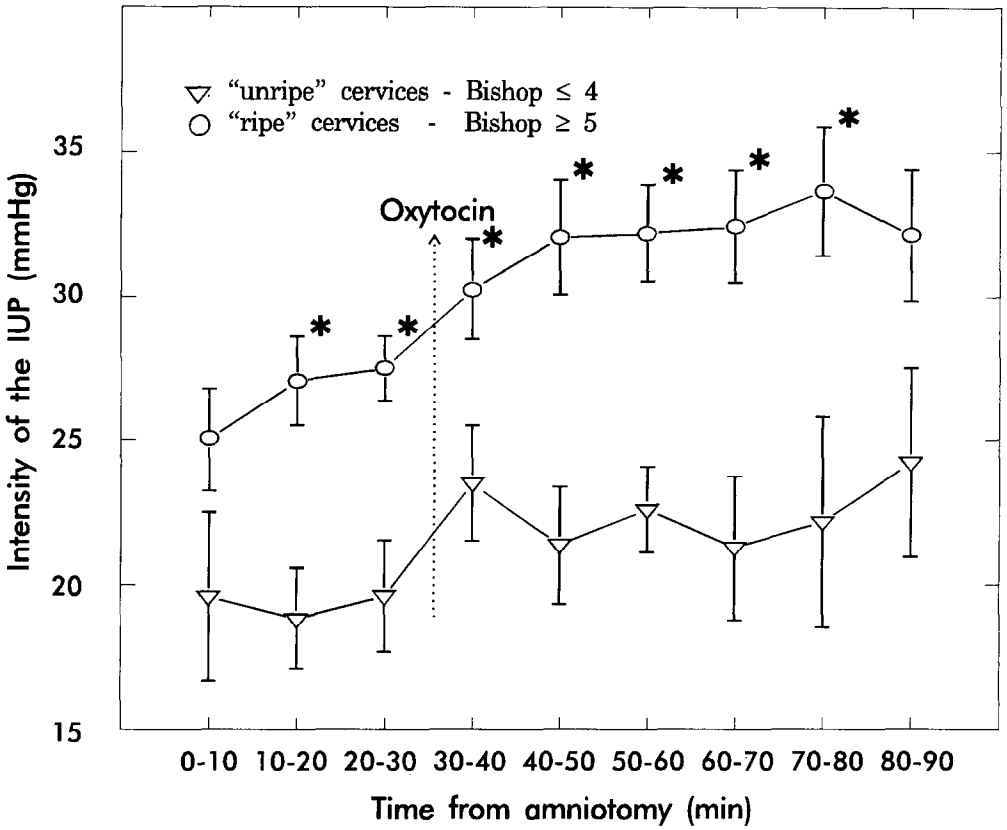


Fig. 2. Mean intensity of IUP and standard error in women with lower (group A) and higher (group B) Bishop scores. Each data point represents the 10-min average of the intensity of IUP. Time 0 represents the time of amniotomy. The mean values of the intensity of IUP in group A different from that of group B ($P < 0.05$) at coincident times are indicated by an asterisk.

and therefore needed significantly more time (longer latent phase of labor) to ripen than those in group B. The lengths of the active phase of labor were similar; in other words, cervical dilatation in both groups was similar. That is why we presume that the main difference between the groups occurred due to the factors conditioning the unripeness of the cervix. The essence of our findings is that EMG activity, represented by RMS, is significantly greater in very unripe cervices than in riper cervices at the onset of amniotomy- and oxytocin-induced labor. We have already discovered this, but by using a more primitive method for estimating EMG activity [8]. This finding has led us to presume that when the cervical canal is still closed, the cervix is firm, and when the portio is formed, the cervical muscle fibers, probably of circular [9] or spiral [10] pattern, actively contract. Our hypothesis is that such contractions also help to keep the cervical canal closed.

Increased EMG activity in riper cervices within the first 10 min after amniotomy may result from the increased local irritation of the cervix caused by manipulation with amniotomy, since it was found only in more dilated cervices.

The importance of the activity of the smooth muscles in the cervix, manifested through RMS, is also represented by the significant correlations of this activity with the lengths of the latent phase of labor. The more intense this activity after amniotomy and the application of oxytocin, the longer

the latent phase of labor. In our opinion, muscular contractions in the cervix contribute to the increased cervical resistance necessary during pregnancy, but disturb the onset of labor.

The activity of the muscles of the uterine corpus during contractions, estimated by the intensity of IUP, contrasts with the activity of the cervical muscles. The contractions of the uterine corpus are significantly less intense in cases with lower Bishop scores (group A) than in those with higher Bishop scores (group B). The intensity of uterine contractions following amniotomy increases only in the latter.

Intense contractions of the uterine corpus following amniotomy and the application of oxytocin are related to more rapidly progressing labor, primarily to the shorter latent phase of labor. This is above all possible in cases with higher Bishop scores, where the lower resistance of the cervix due to changes in the collagen of the cervix is assisted by the decreasing activity of the cervical muscle fibers lying in a circular or spiral pattern.

Further studies are needed to better understand the role of the smooth muscles in the cervix. Our investigations over many years have underlined this necessity, since we have found greatly individualized behavior of the cervix in some cases. This individuality may be explained by the reports of Danforth [11], who has found almost nonexistent smooth muscles in some cervices and up to 40% of smooth muscles in others. Nevertheless the smooth muscles of the cervix in humans are active at the end of pregnancy and during labor, and act in some way independently of the uterine corpus. We believe this to be an important factor in improving our knowledge of pregnancy and labor.

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