Determination of Normal Anal Position Index Using a Modified Technique in Turkish Neonates

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INTRODUCTION

Determination of the normal position of the anus has gained increasing clinical importance since the reports of an association between abnormal anal position and constipation had revealed.[1-3] The normal position of the anal opening is typically considered to be in the midline between the coccyx and vaginal fourchette or scrotum. The findings of the previous studies aimed at identifying the exact location of anus that have been used to define the anal position index (API).[1,2,4-8] Reisner et al.[7] presented a simple method using the API, which is the ratio of the distance between the anus and fourchette (FA) distance to coccyx-fourchette distance in females and the ratio of anus-scrotum distance to coccyx-scrotum distance in males to define the normal position of the anus in newborns. They suggested that an API of <0.46 in male and <0.34 in female neonates was indicative of anterior displacement of the anus.

The present study was aimed to develop a single quantitative technique to detect the localization of the anus during initial neonatal examination and define normal API values. For this purpose, in contrast with earlier studies, API was calculated by dividing FA (scrotum)-anus (SA) distance by anus-coccyx (AC) distance. Premature infants were also included in the present study; their API values were determined and compared with those of the term infants. In this study, a digital caliper was used for the first time for the measurement of API [Figure 1]. We recommend the use of digital calipers to determine the location of the anus as they allow precise measurements (accurate to within 0.01 cm).

MATERIALS AND METHODS

This cross-sectional study included a total of 267 neonates (age, 0–3 days) born between May and November, 2013, in Etlik Zübeyde Hanım Maternity and Women’s Health Training and Research Hospital. Infants with a congenital malformation

Aim: This study was aimed to determine the normal position of the anus using the anal position index (API) in an attempt to develop a more sensitive method for measuring API. To investigate API in a wide range of neonates, both term and preterm infants were included in the present study.

Materials and Methods: API was determined by measuring the anus-fourchette (FA) and anus-coccyx (AC) distance in female neonates and the anus-scrotum and AC distance in male neonates. API is defined as the ratio of the FA (scrotum) distance to the AC distance. A digital caliper was used for all measurements. The FA or scrotum and coccyx-fourchette or -scrotum distances were measured using digital calipers.

Results: A total of 267 neonates (females, 143; males 124) were included in this study. Of these, 36 were borderline premature infants (birth at 35–37 weeks gestation) and 231 were term infants (birth at 38–42 weeks gestation). The mean API was 1.06 ± 0.04 in female and 0.90 ± 0.08 in male neonates. When premature infants were analyzed separately, the mean API was 1.12 ± 0.08 in female and 0.99 ± 0.09 in male neonates. No significant difference in API values was observed between term and preterm neonates (P < 0.05).

Conclusions: API values that differ from the previous studies were identified in the present study. We believe our modified method allows for more accurate measurements of the API in newborns. According to our method, the anus should be considered as anteriorly located if API is <1 in female and <0.9 in male neonates. In addition, the present study is the first to measure API using digital calipers. Digital calipers were found to be convenient and are useful in determining the API with high accuracy (to within 0.01 cm).

Key Words: Anal position index, anteriorly located anus, constipation, full-term infant, premature infants

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or syndrome, such as Down syndrome, anencephaly, or congenital heart disease that could be easily recognized on physical examination, were excluded from the study. Infants with genitourinary and lower extremity anomalies, such as ambiguous genitalia, imperforate anus, or achondroplasia, were also excluded from the study. Patients with an antenatal diagnosis of SA in antenatal ultrasound or with suspected SA were excluded from the study. If physical examination showed flattening of the buttocks, loss of the gluteal cleft, widely spaced buttock dimples, determining asymmetry in the gluteal region, and a palpable sacral defect, those patients were also excluded from the study. At the same time, patients with disorders associated with the skin in lumbosacral region, significant tufts of hair or areas of pigmentation, meningocele, abnormal lumbosacral curvature, and neurological disorders of lower extremity-related changes to muscle atrophy were excluded from the study.

Infant demographic and anthropometric characteristics, such as gestational age, birth weight, height, FA or scrotum distance, and AC distance, were recorded. Gestational age was calculated according to antenatal ultrasound findings or the date of the mother’s last menstrual period (if the former data were unavailable). Digital scales were used to measure naked infant body weight. Infant height was measured using a height measurement ruler in the straight supine position. API was defined as the ratio of FA distance to AC distance for female and anus-scrotum distance to AC distance for male neonates. Newborns were placed in the genepuctural position to first measure the distance from the anus to the fourchette (scrotum), and subsequently, the distance from the lower most point of the anus to the coccyx using digital calipers. Finally, anal diameter was measured using Hegar dilators.

The ratio of scrotum- or fourchette-coccyx distance to AC distance was used to determine the API in previous studies. In contrast, the following formulae were used to determine the API in the present study:

\[ \text{API} = \frac{\text{Scrot-AN distance (cm)}}{\text{anococygeal distance (cm)}} \]  
\[ \text{API} = \frac{\text{FA distance (cm)}}{\text{anococygeal distance (cm)}} \]

Neonates born before 37 weeks of gestation were defined as preterm infants, whereas those born at 38–42 weeks of gestation were defined as term infants. This study protocol was approved by the Ethics Committee of Etlik Zübeyde Hanım Maternity and Women’s Health Training and Research Hospital.

**Statistical analysis**

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL) software package program. Demographic data, distances measured, and anal position indices were expressed as mean and standard deviation. Data were analyzed using the Chi-square test or Fisher’s exact test. Continuous variables were compared using the Student’s \( t \)-test. \( P < 0.05 \) was considered statistically significant.

**Results**

A total of 267 neonates, comprising 143 (54%) female and 124 (46%) male neonates, were included in the present study. The majority (86.5%) were term neonates, while the remaining 13.5% were premature neonates. The rate of premature birth was similar for both genders (males, \( n = 19, \) 17.4%; females, \( n = 17, \) 13.6%). No significant differences in gestational age or maternal age were observed between the genders. Demographic characteristics of included neonates according to gestational age are shown in Table 1.

The majority of neonates were term (86.5%), while the remaining 13.5% were premature. The mean gestational age at birth was 39.09 ± 1.36 weeks in male and 39.09 ± 1.32 weeks in female neonates (\( P < 0.05 \)). The mean birth weight was 3345 ± 431 g in male and 3212 ± 454 g in female neonates (\( P > 0.05 \)).

The mean API was 1.06 ± 0.04 in female and 0.90 ± 0.08 in male neonates in the present study (\( P < 0.001 \)). In the analysis of premature infants alone, the mean API was 1.12 ± 0.08 for male and 0.99 ± 0.09 for female neonates. Mean API and minimum and maximum values of measured parameters for both are presented according to the week of gestation in Table 2.

Anovestibular fistula was observed in one patient. Further investigations were performed in 11 newborns due to measured API values; however, no pathology was found. Anal diameter was measured in all neonates using Hegar dilators. No case of anal stenosis was observed in the present study.

**Discussion**

Determination of the anatomical location of anus has gained increasing clinical importance as constipation has been shown to be associated with anterior anus placement in several studies. Developments in neonatology and improved technical facilities in the past 10–15 years, and accordingly, the accumulation of knowledge and experience have increased neonatal survival. Anthropometric measures of preterm infants differ from those of term infants. Previous studies on the normal location of anus were performed in term neonates and older children. However, studies of the normal anal position and API in preterm infants are limited. Passage of meconium is delayed in preterm infants. According to the Student’s \( t \)-test, \( P < 0.05 \) was considered statistically significant.
location of the anus. Therefore, the present study included term and preterm infants to investigate API across a wide range of gestational ages.

Anteriorly located anus, anterior anus, anterior ectopic anus, anteriorly displaced anus, and short perineal body are synonyms of the same anomaly.[9] This anomaly is believed to result from malformation of the mid-portion of external sphincter and weakness of the corresponding segment of the anal canal.[9] Some researchers[6-8] have posited that anterior localization of the anus is the predominant cause of constipation. Leape and Ramenofsky[11] diagnosed anteriorly located anus on the basis of clinical inspection alone. Bar-Maor and Eitan,[2] Reisner et al.,[7] and Genç et al.[8] determined API using various methods. These studies found no difference in API values between neonates and older children. Although Genç et al.[6] found no connection between anus placement and constipation, surgical correction of the anomaly has been advocated for constipation due to anterior ectopic anus. Further, some authors have suggested that anterior sphincter is not normal in ectopic anus cases and that the anomaly should be described as perineal fistula,[12] while others consider this to be a normal anatomical variation that should be differentiated from perineal fistula.

The diagnosis of anterior ectopic anus is traditionally made on physical examination; however, this results in large variation between physicians.[8] In the present study, API values were found to be 0.90 in term males and 1.06 in term females and 0.99 in preterm males and 1.12 in preterm females. An anal dilator was used to measure the diameter of the anus in the present study, with no cases of anal stenosis observed. Anovestibular fistula was detected in one patient (0.3%).

We need to pay attention to congenital anomalies in newborns when determining API; the SA and dysgenesis in this context, especially in terms of evaluating spinal dysraphism, SA, the presence of the gluteal groove, sinus, pigmentation, and sacral hypertrichosis. SA is more often in infants of diabetic mothers.[13] But, sometimes, they can be identified as a cause of anorectal or urogenital anomalies.[14] In antenatal screening, if ultrasound examination revealed a sudden interruption of the spine and “frog-like” position of the lower limbs, caudal pathology must be considered. Ultrasonography is the diagnostic tool of choice, revealing the absence of distal vertebrae of the fetal spine.

Pang[9] summarized the associated malformations with caudal anomalies. Imperforate anus was the most common associated anomaly, being found in 14 cases (41.1%). Five patients (14.7%) had stenotic, anteriorly placed anal openings associated with hypoplastic perineal bodies. Moreover, one of the other patients (2.9%) had aganglionic megarectum (Hirschsprung’s disease). For this, it must be more careful in antenatal screening and after born. It should be kept in mind that SA maybe in neonates with anal stenosis, constipation, and urinary problems.

When preterm infants were separately analyzed, API values differed from those in term infants. Despite the absence of a significant difference, increased care should be taken when determining anus location in preterm infants. As we were only able to include late preterm infants in the present study, the exclusion of infants born before 35 weeks of gestation may be considered a limitation of the present study. A separate study of infants born before 35 weeks of gestation is required to accurately determine API in early preterm infants. As API is a simple tool for detecting ectopic anus, it will never be reasonable to decide the appropriateness of surgery based on only abnormal API values. Therefore, patients with abnormal values should be referred for further examination and follow-up. These cases should undergo detailed radiological (magnetic resonance imaging, computed tomography), urological, and neurological (electromyogram) examinations, and should be evaluated precisely before being referred for surgical treatment.

### Table 1: Demographic characteristics of the neonates according to gestational age

<table>
<thead>
<tr>
<th>Gestational age at birth</th>
<th>Total</th>
<th>Mean gestational age at birth (weeks)</th>
<th>Mean birth weight (g)</th>
<th>Mean height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth ≥38 weeks</td>
<td>231</td>
<td>39.4</td>
<td>3373</td>
<td>51.3</td>
</tr>
<tr>
<td>Birth ≤35–37 weeks</td>
<td>36</td>
<td>36.5</td>
<td>2695</td>
<td>48.8</td>
</tr>
<tr>
<td>Total</td>
<td>267</td>
<td>39</td>
<td>3272</td>
<td>51.0</td>
</tr>
</tbody>
</table>

### Table 2: Mean anal position index and minimum and maximum values of the measured parameters according to the week of gestation in girls and boys

<table>
<thead>
<tr>
<th>Birth week</th>
<th>n</th>
<th>FA/SA (cm)</th>
<th>AC (cm)</th>
<th>Mean API</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥38</td>
<td>126</td>
<td>1.5</td>
<td>3</td>
<td>1.06</td>
</tr>
<tr>
<td></td>
<td>105</td>
<td>2</td>
<td>2</td>
<td>0.90</td>
</tr>
<tr>
<td>≤35–37</td>
<td>17</td>
<td>1.5</td>
<td>5</td>
<td>1.12</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>2</td>
<td>3</td>
<td>1.06</td>
</tr>
<tr>
<td>Girls only</td>
<td></td>
<td>0.99</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>Boys only</td>
<td></td>
<td>0.90</td>
<td>0.90</td>
<td></td>
</tr>
</tbody>
</table>

FA: Fourchette anal, SA: Scroto-anal distance, API: Anal position index, AC: Anus coccyx
The findings of the present study indicate that the anal index has utility as an objective method of determining the site of the anal opening on the perineum and should be performed in all neonates.

**Conclusion**

In the present study, we determined the normal location of the anus in term and preterm females and males and observed a difference in API values between the genders ($P < 0.05$). We determined mean API values in late preterm infants, with subsequent analysis demonstrating that API values differ between preterm and term neonates ($P < 0.05$). The standardization of measurement techniques is clinically important in determining API. Therefore, we recommend the use of digital calipers as a standard measurement tool. We believe that the findings of the present study will be of interest to neonatologists and may help pediatric surgeons decide the most accurate position of the anus for cases requiring anorectoplasty. API may also have utility in preventing complications associated with incorrect anal placement, such as fecal incontinence and constipation.

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**Conflicts of interest**

There are no conflicts of interest.

**References**


