Natural resolution of rectus abdominis diastasis.
Two single case studies

Merry Hsia¹ and Sue Jones²
¹Pamela Youde Nethersole Eastern Hospital, Hong Kong ²Curtin University of Technology, Perth

Introduction

Rectus abdominis diastasis is a conventional term used to define the split between the two rectus abdominis muscles (Polden and Mantle 1990). However, as the two recti muscles are attached in the middle by the linea alba, the widening actually occurs as a result of stretching and thinning of the linea alba. Therefore, rectus abdominis diastasis should be considered as the inter-recti distance (IRD) rather than a true separation as is implied by the use of the term rectus abdominis diastasis. Though it is only one of the changes the linea alba and rectus abdominis undergo during pregnancy, it commonly occurs in childbearing women, with a reported incidence of 66% during the third trimester (Boissonnault and Blaschak 1988). It can persist in 30-60% of women during the postpartum period at different sites along the linea alba (Boissonnault and Blaschak 1988, Bursch 1987, Gilleard and Brown 1996).

An increase in IRD is postulated to be caused by hormonal influences, and biomechanical and structural changes mainly of the rectus abdominis and linea alba during pregnancy (Boissonnault and Kotarinos 1988). The altered angle of attachment, hence the angle of pull of the muscle, places the rectus abdominis in a mechanically disadvantaged position (Gilleard and Brown 1996). Traditionally, physiotherapists assess the IRD in the antenatal and postnatal period using finger widths. However, the reliability of finger measurement is poor, due to individual variations in finger widths (Bursch 1987). With carefully standardised testing and measuring procedures, Boxer and Jones (1997) demonstrated high intra-rater reliability of dial calipers in measuring IRD.

Abdominal exercises are taught in the postpartum period, and are postulated to help restore the anatomical width of the linea alba (Noble 1982, Polden 1985, Polden and Mantle 1990). Gilleard and Brown (1996) reported a decrease in IRD from 38 weeks of gestation to eight weeks postpartum. Measurements were taken at four-weekly intervals, with no measurements in the immediate postpartum period, so the rate of change in IRD is unknown. The scarcity of literature on the resolution of IRD in the postpartum period renders evaluation of the implications of IRD and the efficacy of abdominal exercise regimens difficult.

The aim of the present study was to determine the natural resolution of IRD in the postpartum period using a single case study design in two subjects. It was hypothesised that there would be a decrease in RAD after delivery and up to 12 weeks postpartum.
This information will enable physiotherapists to appreciate the implications of IRD in the first few months of the postpartum period, when a woman is still exposed to physiological (including hormonal) and physical influences. This is especially relevant to postpartum women, as there is a significant increase in physical demands during this vulnerable period, especially in view of the possibility of developing postpartum low back or pelvic pain. The information in this study will be important to physiotherapists, as it provides a baseline for the justification of abdominal exercises and subsequently a comparison for the efficacy of different exercise regimens to reduce IRD in the postpartum period.

Method

Two nulliparous women were recruited from a sample of convenience. One woman (Subject A), a 33-year-old physiotherapist, was recruited at 36 weeks of gestation. The second woman (Subject B), a 28-year-old salesperson, was recruited from an antenatal exercise class at 38 weeks of gestation. Subjects were excluded from the study if they were involved in regular exercise (three times a week) before being pregnant, had previous history of abdominal and back surgery, acute back or neck pain or caesarean section, or were unable to understand written or spoken

Case Study

Figure 1. Resting measurements of inter-recti distance (in millimetres) at 4.5cm above and 4.5cm below the umbilicus for Subjects A and B.
A - time of entry into the study
B - expected day of delivery
C - day of delivery
Nylon dial calipers of 0-150mm (manufactured by Baty International) were used to measure IRD. A pilot study was performed on nine antenatal and postnatal subjects by the principal investigator to determine intra-rater reliability. A standardised measuring procedure using dial calipers was followed. The investigator palpated the medial edge of the recti muscle borders and placed the dial calipers perpendicular to the recti borders. Measurements were taken with the dial facing away from the investigator. Readings were taken and recorded by subjects on a data collection form. The calipers were then closed and handed back to the investigator. The investigator was thus blinded to the measurements during each testing session. Prior to measurement, subjects were given a thorough explanation and practice in reading the calipers. Two types of measurements were taken for each subject: resting (rectus abdominis at rest) and active (rectus abdominis contracted during a curl-up).

Subjects were positioned in crook lying on a portable floor mat with a pillow under their head and their knees flexed to 90 degrees. The measurements were taken at three levels in the following order: at the superior border of the umbilicus; 45mm above the umbilicus; and 45mm below the umbilicus. A 9cm long tape measure was used with the central point placed at the superior border of the umbilicus. Skin markings were made with a pen at the two ends of the tape. For the resting measurement, subjects were
instructed to lift their head up gently while the investigator palpated the medial recti borders with the fingers. With the fingers in situ, the subject was asked to lower the head and relax, and the measurement was taken using dial calipers. For the active measurement, the subject was instructed to keep the chin to chest and perform a partial curl-up until the inferior angle of the scapulae were just off the mat as palpated by the investigator. Subjects maintained the curl-up for three seconds while the measurement was taken. Completion of a resting and active measurement was considered as one trial. Three trials were taken at the umbilical level initially, then repeated at 45mm above and 45mm below the umbilicus. A rest period of one minute was allowed between each trial, to avoid muscle fatigue.

All measurements were taken by the principal investigator, who was a physiotherapist with six years of clinical experience. After establishing the intra-rater reliability, the standardised measurement method was followed in the main study. Measurements were made every Monday, Wednesday and Friday over a maximum period of 16 weeks. All measurements were taken at approximately the same time of day, at the subject’s house.

The first postpartum measurement was taken within 24 hours for Subject A, in hospital, and at 48 hours for Subject B, at her house.

**Data analysis** Data from the main study were entered into Microsoft Excel software and transferred to SPSS software on a Macintosh computer for graph output. Visual analysis of the data was performed and the results reported descriptively (Riddoch and Lennon 1991).

Analysis of data from the pilot study was completed using the SuperANOVA software on a Macintosh computer. Intraclass correlation coefficient (Model 3,1) and standard error of mean were calculated to establish the intra-rater reliability of the investigator (Portney and Watkins 1993).

---

**Table 2.** Summary of inter-recti distance (in millimetres) for Subject A. The change in percentage is calculated with reference to the start of the study.

<table>
<thead>
<tr>
<th></th>
<th>Start</th>
<th>Due</th>
<th>PP</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Resting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At</td>
<td>9.7</td>
<td>55.4</td>
<td>58.2</td>
<td>44.2 (↑360%)</td>
</tr>
<tr>
<td>Above</td>
<td>8.4</td>
<td>28.8</td>
<td>59.3</td>
<td>42.4 (↑400%)</td>
</tr>
<tr>
<td>Below</td>
<td>9</td>
<td>31.2</td>
<td>35.6</td>
<td>37 (↑310%)</td>
</tr>
<tr>
<td><strong>Active</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At</td>
<td>8</td>
<td>49.6</td>
<td>39.5</td>
<td>28.5 (↑260%)</td>
</tr>
<tr>
<td>Above</td>
<td>7.6</td>
<td>26.6</td>
<td>40.9</td>
<td>24.1 (↑220%)</td>
</tr>
<tr>
<td>Below</td>
<td>8</td>
<td>25.4</td>
<td>28.7</td>
<td>25.4 (↑220%)</td>
</tr>
</tbody>
</table>

Start - start of the study
Due - due date
PP - immediately postpartum
End - end of study
Results

Both subjects delivered vaginally without instrumentation or other immediate postpartum complications. Subject profile and details of the delivery outcome are presented in Table 1.

The mean resting measurements for Subjects A and B at the three levels on each occasion are shown in Figure 1. Likewise, the active measurements for Subjects A and B are also shown in Figure 1. The exact measurements at different stages during the study and the changes in percentage at the end of the study for Subjects A and B are summarised in Tables 2 and 3 respectively.

Intraclass correlation coefficients (Model 3.1) were 0.99 and 0.99 for the resting and active measurements at the umbilicus, 0.99 and 0.99 above the umbilicus and 0.99 and 0.99 below the umbilicus. The corresponding standard error of mean were 0.78 and 0.78 for the resting and active measurements at the umbilicus, 0.68 and 0.63 above the umbilicus and 1.4 and 0.54 below the umbilicus. The results revealed high intra-rater reliability for all types and sites of measurements.

Discussion

Antenatal period This study demonstrated that both subjects had an increased IRD at some stage in the antenatal period. Relaxin has been suggested to induce ligamentous laxity of the body joints during pregnancy. Landon et al (1990) demonstrated that the recti fascia in pregnant humans is weak, with decreased tensile strength, such that tissue creep and stress relaxation of the recti fascia, especially during the rapid foetal growth period, is necessary. This may also explain the second sudden increase in IRD demonstrated both at and below the umbilicus in Subject B as she went into the second post-term week. In all measurements in the antenatal period, the distance was largest at the level of the umbilicus where it may be a potential weak point, which is supported by Boissonault and Blaschak (1988).

Immediate postpartum period Results from these two case studies show variability between subjects.

<table>
<thead>
<tr>
<th>Table 3. Summary of inter-recti distance (in millimetres) for Subject B. The change in percentage is calculated with reference to the start of the study.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td><strong>Resting</strong></td>
</tr>
<tr>
<td>At</td>
</tr>
<tr>
<td>Above</td>
</tr>
<tr>
<td>Below</td>
</tr>
<tr>
<td><strong>Active</strong></td>
</tr>
<tr>
<td>At</td>
</tr>
<tr>
<td>Above</td>
</tr>
<tr>
<td>Below</td>
</tr>
</tbody>
</table>

Start - start of the study
Due - due date
PP - immediately postpartum
End - end of study
Despite having similar short second stages of labour, only Subject A had an increased IRD immediately postpartum. Subject A stated she pushed very hard during bearing down in the lithotomy position in the second stage of labour, while Subject B had not. The upper rectus abdominis would be expected to work considerably in this situation. With the already stretched linea alba, the force and pressure generated from bearing down may have further stressed the anterior abdominal wall, causing further stretching and thinning out of the linea alba. Otherwise, IRD is expected to decrease immediately postpartum, due to the removal of stretch on the anterior abdominal wall, as was demonstrated in Subject B.

**Postpartum period** The resolution of IRD in the postpartum period progressed at different rates and in different patterns between these two subjects. Gilleard and Brown (1996) reported that the IRD at eight weeks postpartum decreased to a level similar to 22 weeks gestation. This study demonstrated that IRD at 12 weeks postpartum had not even resolved to the level at 36 weeks gestation.

As it would be expected that IRD would resolve gradually with time in the postpartum period, the fact that resting IRD in Subject B and active IRD in Subject A exhibited an upward trend again later in the postpartum period is of concern. External factors may complicate the natural resolution of IRD. In addition to baby care, Subject B was packing to move abroad during the last few weeks of the study period. When the tissue was still under the effect of relaxin (Schauberger et al 1996), increased physical demands may have stressed the linea alba further. The increase in active IRD in Subject A from the second to the fifth week coincided with the development of a breast abscess. It is uncertain whether this had any influence on muscle tone or not, nor why the resting IRD was not affected simultaneously. As the level below the umbilicus was always measured last during each session, muscle fatigue may have set in and account for some variability.

Other factors may also account for some variability of the results. Foetal position may have affected the IRD. Individual differences in tissue architecture (especially collagen) may play an important role in determining how much stress and strain the tissue can sustain, how it would react to the stress and hormones and recover afterwards. Furthermore, Subject B attended antenatal fitness classes from 30 weeks of gestation to one week before delivery, while Subject A attended none.

In accordance with the findings of Boxer and Jones (1997) who tested a postpartum population of 1.5 to 22 weeks, the resting IRD was consistently larger than the active IRD. As the postnatal guideline for returning to near normal activities is usually six weeks, the persistence of IRD up to 12 weeks postpartum may have implications for the type and level of activities postpartum women should perform. The anterior abdominal wall may not be protected sufficiently to withstand the additional stress from increased activities. Therefore, women should be encouraged to refrain from vigorous physical activities and to maintain correct posture in activities like lifting and carrying their baby, baby bathing and pushing the pram, for at least 12 weeks after delivery. The differences in the resolution of IRD also indicates the importance of measuring both resting and active IRD in the postpartum period, which has not been emphasised previously.

Frequent and regular measurements in this study provided detailed information on the IRD at different stages in both the antenatal and postpartum periods. Though visual analysis of the data may not be considered scientifically robust, it provides important clinical information, especially in addressing issues like spontaneous recovery of IRD (Riddoch and Lennon 1991). The main limitation of this study is the lack of external validity, due to the small sample size and inability to generalise the results to multiparas and women who have had a caesarean section. There is also insufficient information on the progression of IRD before 36 weeks of gestation and beyond 12 weeks postpartum. Further research is required to include a larger sample size and varying pregnant populations to enhance generalisation. When more baseline data are available, research into the effect and efficacy of different exercise regimens to reduce postpartum IRD is also recommended. Further studies are also necessary to investigate the relationship between IRD and peripartum low back pain.

**Conclusion**

This study demonstrates the occurrence of resting and active IRD up to 58mm and 55mm respectively at the level of the umbilicus in the antenatal period. An...
increase of IRD of between 200% and 400% is demonstrated at 12 weeks postpartum relative to the 36th weeks of gestation. The persistence of IRD at 12 weeks postpartum also alerts physiotherapists that these women still lack adequate protection at this stage. Furthermore, subjects clearly demonstrated individual variations in the resolution of IRD in the postpartum period. The provision of an individualised assessment and management regimen is therefore warranted.

Authors Sue Jones, School of Physiotherapy, Curtin University of Technology, Selby Street, Shenton Park, Western Australia 6008. E-mail: sue.jones@curtin.edu.au (for correspondence). Merry Hsia, Southorn Centre Physiotherapy Dept. (RH/TSKH), 3F, Southorn Centre, 130 Hennessy Road, Wan Chai, Hong Kong.

Acknowledgments The authors thank Dr J Sommers for his statistical advice and also the subjects who participated in this study.

References


