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# Effects of Manual Therapy in Management of Diastasis Recti: A Case Study

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**ABSTRACT:**

**Background**: The patient was a 32 years old postpartum female with complaint of back pain which was radiating to abdominal area, she was functional limitations and abdominal muscle weakness.

**Methods and Measures**: patient was treated 8 sessions over a period of 4 weeks.

**Study**: Case study

**Intervention**: Intervention included KT for rectus abdominis muscle and PF strengthening exercises to stabilize and strengthen the weakened muscles and to reduce IRD.

**Results**: Following treatment, the patient demonstrated in an increase in functional ability and resolution of functional limitations. Statistical analysis of the data showed significant differences from pre to post intervention from session 1 to session 8. There was clinical and statistical significance found in PFS and IRD.

**Conclusion**: Findings suggest that KT and PF strengthening exercises are more effective in reducing IRD and improving function in patient with Diastasis Recti

**Keywords**: Inter-Recti Distance(IRD), Rectus Abdominis (RA), Rectus Diastasis (RD), Diastasis Recti Abdominis(DRA), Ultrasound (Usd), Kinesio taping (KT), Physical Function Scale (PFS),Pelvic Floor (PF), Rate of Perceived Exertion (RPE), Linea Alba (LA).

## INTRODUCTION:

In a woman's life, pregnancy is a time of tremendous change on many different levels. It is remarkable how in the span of nine months a human life is gestated. There are many adjustments that occur in a women's body to accommodate the growing fetus including hormonal and musculoskeletal adaptations. One of the most common adaptations is for the (IRD) between the left and right rectus abdominis (RA) to increase in size to accommodate the growing fetus and uterus[22].

After delivery, the abdominal walls of some women seem to rebound back to their original state, while many do not. A quick internet or Pinterest search will reveal many online programs aimed at treating DRA, with most promising to close the gap and to get rid of "mommy tummy"[22].

Women are often referred to physiotherapy during pregnancy or in the postpartum period for DRA or the increased IRD. Unfortunately, there is currently no consensus on what exercise strategies should be employed in the rehabilitation of DRA. Little is known about the effect and safety of abdominal rehabilitation. The PF can be adversely affected by abdominal rehabilitation and is at risk of developing or worsening support-related pelvic floor dysfunction (SPFD) if the abdominal rehabilitation involves pressures that the PF cannot withstand and support against [22]. The aim of this article is to critically

review the literature on DRA and to propose a treatment framework for rehabilitation and support of the abdominal wall when DRA is present with consideration of the impact on the PF. A review on DRA was written by Mota et al., but since publication, there have been some salient developments[22].

Rectus Diastasis (RD) is a commonly occurring problem during pregnancy and immediate puerperium, affecting up to 70 %, 60 % of women respectively, and may extend up to eight weeks postpartum in approximately 30 % of women and may be evident in about 10 % of women 1 year post partum due to obesity, multiparity, fetal macrosomia, flaccid abdominal muscles, poly hydramnios and multiple pregnancies[24].

**ANATOMY OF THE ABDOMINAL WALL:**

The abdominal wall consists of a layered configuration that includes muscular layers and their corresponding fascia/aponeurosis. The transversus abdominis (TrA), internal oblique (IO), and external oblique (EO) comprise the lateral abdominal musculature that has attachments on the thoracic cage, pelvis and vertebral spine via the thoracolumbar fascia. The RA runs in a vertical orientation in the midline of the abdominal wall and is encased in the flat sheet-like aponeurosis of the TrA, IO and EO that form the rectus sheath. The rectus sheath is made of an anterior and posterior layer. The layers meet at the lateral edge of the rectus along a curved line, the linea semilunaris, that spans from the 9th costal cartilage to the pubic tubercle and meet medially at the LA. The arcuate line (or linea semicircularis) is a horizontal line approximately halfway between the umbilicus and the symphysis pubis that is the boundary of the lower limit of the posterior layer of the rectus sheath. It is not a sharp line, but rather a transitional zone where the posterior rectus sheath changes to the anterior rectus sheath. The function of the rectus sheath is to allow sliding of the muscles through neighbouring structures and protect the muscle fibers of the RA. The EO muscle fibers are approximately horizontal in the uppermost portion (becoming oblique in the lower portions) and its aponeurosis contributes to the anterior portion of the RA sheath. Above the arcuate line, the aponeurosis of the IO splits, allowing one layer to pass anteriorly and the other posteriorly to the RA muscle, contributing to the anterior and posterior rectus sheaths, respectively. Below the arcuate line, the aponeurosis of the IO passes anteriorly contributing to the anterior rectus sheath. Above the arcuate line the TrA aponeurosis lies behind the RA muscle and blends with the posterior rectus sheath. Below the arcuate line the TrA aponeurosis passes in front of the RA muscle and blends with the anterior rectus sheath. Below the arcuate line the transversalis fascia/transverse fascia is the only structure that separates the rectus abdominus from the parietal peritoneum. The LA is comprised of highly organized collagen fibres that continue from the rectus sheaths. The collagen structure of LA is formed by a 3-D meshwork of fibers that are in the same orientation as the muscle fibers of the ventrolateral abdominal wall (TrA, IO, EO). The LA spans from the xiphoid process to the pubic bone. The LA and rectus sheaths can be divided into craniocaudal regions: supraumbilical; umbilical; transition zone (transitional area where aponeurosis of EO, IO and TrA pass anteriorly to the rectus to become the arcuate line); and infra-arcuate. The infra-umbilical (from umbilicus to symphysis pubis) region has a greater amount of transverse fibers, which provides greater ability to resist tensile stresses imposed on the LA. The function of the LA is to maintain the abdominal muscles at a certain proximity to each other and to provide lumbopelvic function and abdominal visceral support through multiple mechanisms, including the transfer of force through fascial tension. The LA in conjunction with the rectus sheaths are regarded as the most important structures for the stability of the

anterior abdominal wall from a mechanical point of view . The abdominal wall has functions in posture, lumbopelvic stability, respiration, trunk movement and support of the abdominal viscera[22].

**Normal IRD**:

Rath et al. studied the IRD in 40 fresh cadavers and 40 abdominopelvic computed tomography (CT) scans at rest at supine. This study determined the normal IRD in males and females under 45 years of age to be 10 mm at the supraumbilical reference point (halfway between the umbilical ring and xyphoid), and 9 mm at the infraumbilical reference point (halfway between the umbilical ring and pubic symphysis). The authors found that above age 45 there was an increase in IRD at the supraumbilical and infraumbilical locations by only 5 mm. The umbilical level IRD was not affected by age. Limitations of the study include a nonhomogeneous population in the cadaver study with a mix of men and women with a range of lean to obese body builds and a high average age of 83 years (range: 62-99 years old), a mixture of men and women with a broad age range from children to seniors in the CT population, and the information regarding the number of pregnancies in the women are missing. To evaluate the normal width of the LA in nulliparous women, Beer et al. examined 150 nulliparous women between 20 and 45 years of age with a body mass index < 30 kg m-2 by ultrasound at three reference points: the origin at the xiphoid, 3 cm above and 2 cm below the umbilicus. The width was of LA was evaluated in a supine position, with the neck slightly flexed and the legs fully extended with relaxed rectus muscles and normal breathing. The examination revealed a broad range of widths at the three reference points. The LA was widest at 3 cm above the umbilicus, followed by the reference point 2 cm below the umbilicus and then the origin at the xiphoid. For the definition of the normal width of the linea, the 10th and 90th percentiles were taken. The LA can be considered "normal" from 2 to 15 mm at the xiphoid, 6 to 22 mm at the reference point 3 cm above the umbilicus and from 2 to 16 mm at the reference point 2 cm below the umbilicus in nulliparous women. As part of their study, Liaw et al. conducted ultrasound measurements on 20 nulliparous controls. Measurements were taken via ultrasound with the subject resting in supine with two pillows under the knees. Still images were obtained in resting at the end of a normal expiration, to control for the influence of respiration. Measurements were taken at 4 locations: upper and lower margins of the umbilical ring, 2.5 cm above the upper margin of the umbilical ring, and 2.5 cm below the lower margin of the umbilical ring. The mean of the measurements at the four locations from cranial to caudal for the nulliparous woman were 8.5, 9.9, 6.5, and 4.3 mm, respectively. The largest IRD for bothnulliparous and parous women were measured at the upper margin of the umbilical ring, and the smallest IRD values were found 2.5 cm below the lower margin of the umbilical ring. The authors noted that the subjects' demographic and anthropometric data such as age, body height, weight, and ethnic background may contribute to differences between studies, and therefore recommended that future studies include a nulliparous control group in postpartum studies for reference purposes .

**Definition and Etiology of DRA:**

DRA is when the IRD exceeds "normal" values. Criteria and the IRD cut-off value for the diagnosis of DRA vary in the literature and to date, there is no international agreement on the measurement location. It has also been defined as a visible midline bulge on exertion. The viscoelastic properties inherent to the collagen makes the LA prone to increase length when the mechanical stress is prolonged in time as in the case of lasting increased intra-abdominal pressure (IAP). Long lasting increased IAP from a growing fetus and expanding uterus combined with hormonal changes on connective tissue create a physiological (normal) widening of the IRD creating a DRA in pregnancy. The anterolateral abdominal wall undergoes

dramatic changes as the pregnancy progresses. For example, the weight of the uterus increases from 40 g at a non-pregnant state to 1000 g at term and the capacity increases from 4 ml in the non-pregnant state to 4000 ml at term. The maternal inferior thoracic diameter is increased. The two muscle bellies of the RA elongate and curve round as the abdominal wall expands similar to suspenders on obese man. At 38 weeks gestation, the length of the abdominal muscles increase a mean of 115% compared to the beginning of pregnancy. As previously stated, the infra-umbilical (from umbilicus to symphysis pubis) region of the LA has a greater amount of transverse fibers, which provides greater ability to resist tensile stresses imposed on it . Liaw et al. noted that during pregnancy the infraumbilical region might sustain a longer duration of stretch during pregnancy (as the growing uterus rises out of the pelvis at 12 weeks and makes contact with the abdominal wall). Their data indicated that IRD values were larger for the 2 locations above the umbilicus compared to those below the umbilicus, and suggested that the infraumbilical region of the LA has a greater ability to resist stresses imposed over a longer period of time. DRA can also occur in males with repeated increases in IAP from prolonged strenuous exercises such as weightlifting or full-excursion sit-ups, or with conditions that increase IAP such as chronic obstructive pulmonary disease. DRA can also be congenital. DRA is characterized by a thinning and widening of the LA and potential for the midline to 'bow out' with increased IAP. A DRA contributes to a bulging or protrusion of the anterolateral abdominal wall due to increased laxity in the myofascial system that supports abdominal viscera. In cases of marked DRA, only the peritoneum, attenuated fascia/LA, subcutaneous fat, and skin comprise the middle portion of the anterior abdominal wall [22].

**Risk Factors**:

Candido et al. found that women with and without DRA did not differ significantly with respect to age, ethnicity, height, history of abdominal surgery or back or neck injury, weight gain during pregnancy, pre-pregnancy weight, gestational age at delivery, method of delivery, multiple pregnancy (e.g., twins, triplets, etc.), or diabetes (preexisting or gestational). Rett et al. found no correlation between the development of DRA and mother's age, body mass index, gestational age or duration of labour. Two recent studies concluded that Caesarian delivery does not increase the risk of DRA[22].

**HOW TO MEASURE IRD/DRA**:

In research and in practice when measuring IRD, the position of the subject and the activity performed at the time of the measurement varies. Some studies measure IRD while the abdominal muscles are at rest in a supine crook-lying position, or intra-operatively in supine . Some studies measure IRD during a partial curl-up where the subject lifts the head and shoulders off the bench just until the scapula clears the surface of the bench or with neck flexion in hook-lying. Some studies do not specify if they measured at rest or with a curl-up or some other active abdominal engagement[22].

Recent studies have shown that a curl-up, which activates RA, or an isometric contraction of RA reduces the IRD in women with DRA. Lee et al. rationalize the approximation of RA muscles (and therefore reduction of IRD) with the straightening of the RA on contraction (Fig. 1). The way that IRD is measured is extremely important because the way that it is measured can yield different results. For example, an individual might have an IRD measurement with a partial curl-up that is less than the cut-off for diagnosis of DRA, when at rest the IRD measurement is above the cut-off for DRA diagnosis, therefore providing a false negative result. For example, the IRD measured at rest was more than twice the width of that measured during an active muscle contraction in women who were 11-weeks postpartum.

In a recent study, palpation was reported to have sufficient reliability to be used in clinical practice, with palpation showing good intra-rater reliability and moderate inter-rater reliability. Van de Water and Benjamin (2016) argue that palpation may be a sufficient method for detecting the presence of DRA [22].
Ultrasound imaging has been named the gold standard for non-invasive IRD assessment. IRD measurements via ultrasound are valid compared to intra-operative surgical compass measurements when imaging is performed at or above the level of the umbilicus. Ultrasound has produced consistent IRD measurements between sessions when performed by the same operator. Ultrasound imaging is also more responsive to changes in IRD than palpation as it provides a measure of IRD on a continuous scale (i.e., millimetres) , thus ultrasound is a more accurate and valid method and is recommended in future research of IRD . When using ultrasound, inter-rater reliability is acceptable when IRD is measured above or below the umbilicus, but poor when measured at the level of the umbilicus[22].
An IRD greater than 4 or more fingerbreadths or 5 cm during a curl-up has been classified as a severe DRA. In women with a severe DRA, the width of the LA may be as large or larger than the width of the ultrasound transducer making it impossible to measure with conventional ultrasound imaging[22].

**PURPOSE:**
The purpose of the study was to show the effect of rehabilitation in reducing IRD,
The purpose of the present study was to determine the natural resolution of IRD in postpartum period using single case study designed in one subject.
It was hypothesized that there would be decrease in RAD after delivery and up to 8 weeks postpartum.
**Case Description:**
**Background:**
The post-partum patient was 32 years old female with gravid one had primary complaint of back pain radiating to the abdomen, she was examined and evaluated by her gynecologist and refereed to the physical therapist

**Assessment:**
**History:**
Patient was 32 years old female who was presented to the Physical therapist with chief complaint of low back pain radiating towards anteriorly to the abdomen, which was constant post delivery which was 10weeks ago, difficulty in her activities of daily living specially during activities like holding and carrying her child, walking for little longer duration, lifting, carrying, bending, cleaning the house hold activities. Her pain included achiness in the back that was intermittent and increased with lifting, carrying, bending and front carrying of baby. She had occasional sharp abdominal pain in lower abdomen.

**EXAMINATION:**
On examination, special test was done, which included for DRA using finger-width measurement with the patient in supine position.
The measurements were one and half finger width above and three finger width at the umbilicus and two and half finger width below umbilicus.
Assessment of the patient was significant DRA was potentially causing her pain, she was unable to efficiently recruit her abdominal musculature to protect and support her back. The DRA may also have

prevented her from supporting her abdominal organs and thus this may have created a tension along her back.
MMT was 2+ for abdominal muscles.
Radiological findings (ultrasonography) has found that there was increased inter recti distance which was 2.5cm(4.5cm above the umbilicus),center of Umbilicus was 4.6cm and 4.4cm(2.5cm below the umbilicus) and due to which she had difficulty in her ADL's,
Ultrasonography has been found to be a reliable method across a range of measurement situations,
An IRD greater than 4 or more finger breadths or 5cm during curl up has been classified as severe DRA.

**INTERVENTION:**
**COURSE OF TREATMENT:**
Patient received 8 sessions in the span of 4 weeks, twice in a week. Each session of 45 minutes was provided.
The patient was informed that her designated intervention has been shown to improve her condition. The patient received the following structured exercise program encompassing kinesiological taping and conventional exercises.
All these exercises were supervised during each session and exercise parameters were adjusted as requested but without any modifications in the type of exercises. Exercises were performed in the following:
The patient received KT in the form of combined I-technique and X technique.
KT in the form of (I-technique/origin –insertion technique) included the use of 4 KT strips.
2 strips of KT was applied over the rectus abdominis bellies. As the base was affixed to the origin of 2 recti a symphysis pubis in the resting with very light to light tension(15%-25%) of available tension over the right and left rectus abdominis bellies up to the insertion at xiphoid process.
When the tail of the tape was approximately one to two inches from the end, stopped tension and laid the end down with no tension. Then the applied tape was rubbed to initiate glue adhesion with the muscle in its current stretched position.
After affixing the first pair of tape strips, second pair of KT was applied at a 90 degrees angle to the first over the reference points for DRAM (2.5cm) above and below the umbilicus centered on the side of rectus diastasis and directed towards the midpoint between the lowest rib and the iliac crest with maximum tension on the middle and no tension in both ends.
The patient received KT in the form of( X-technique/ criss-cross technique) that included the use of 8 strips of KT extending from the lower border of thoracic cage downwards and laterally towards other side in a cross manner above and below the umbilicus, towards the symphysis pubis with light to moderate tension (25%-50%) of available tension.
Exercise program included the lumbar stabilization exercises such as pelvic clock, toe tap, bridge, single leg bridge, alternate arm and leg lift in quadruped position, single leg lift, double leg lift, side push up and side bend to strengthen abdominal oblique muscle.
Intensity of exercises was measured with 10-12 on RPE. Exercise intensity was controlled using Borg's rating of perceived exertion.
**Session 1**: KT was applied and PF strengthening was done with beginning of Bridge, pelvic clock, toe tap, alternate arm and leg lift in quadruped position, each exercise consist of 1 set of 10 reps,

**Session 2**: KT was applied and PF strengthening was done as similar to the previous session. Each exercise consists of set of 10 reps

**Session 3**: KT was applied and PF strengthening was done as similar to the first session, along with the exercises of first session, single leg lift, single leg bridge was added, each exercise consists of 1 set of 10 reps

**Session 4**: KT was applied and PF strengthening was done similar to previous session.

**Session 5**: KT was applied and PF strengthening was done as similar to 3 session, along with exercises of third session double leg lift was added, each exercise consists of 1 set of 10 reps

**Session 6**: KT was applied and PF strengthening was done similar to the previous session, side pushups and side bend to strengthen abdominal oblique muscle were added, each exercise consist of 1 set of 10 reps

**Session7**: KT was applied and PF strengthening was done similar to previous session with 2sets of each exercise, each set consists of 10 reps.

**Session 8**: KT was applied and PF strengthening was done similar to previous session.

After the last session, patient was requested to go for ultrasonography and PFS

**STATISTICS:**

The above statistical values show the statistical values of the Pre and post session PFS AND USD.

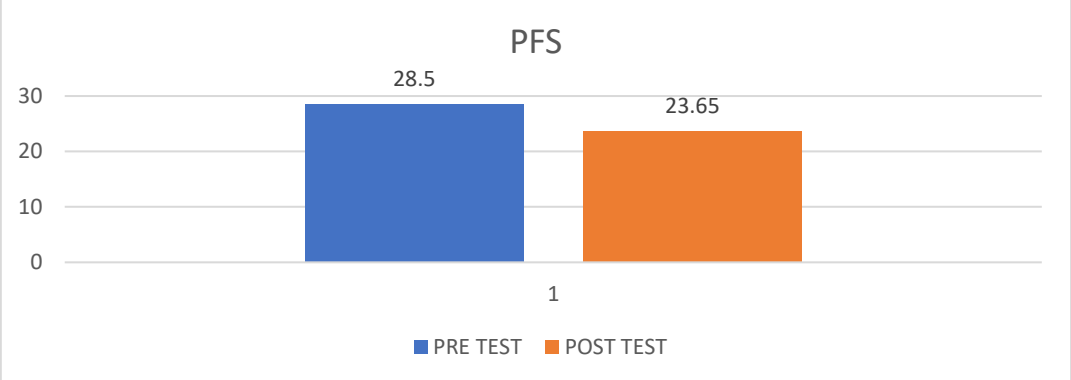
Inner Edges of Rectus Abdominis before and after the rehabilitation:

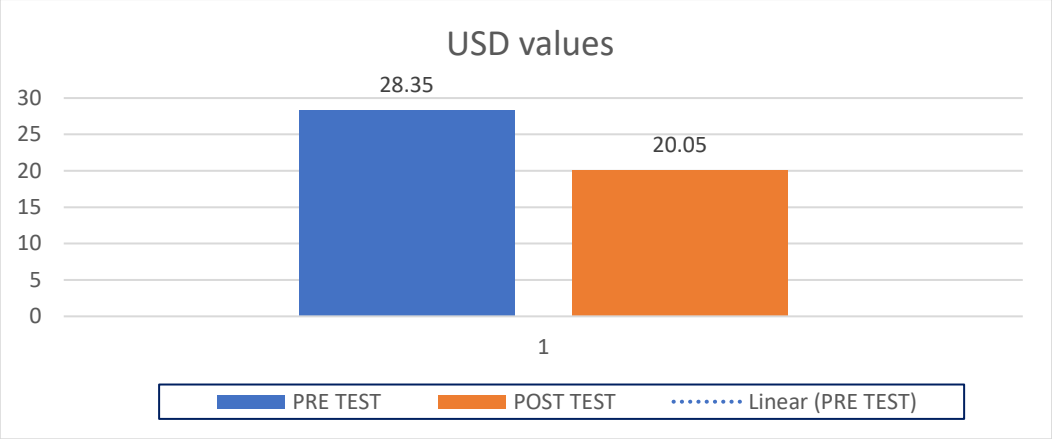
| Items | Above the Umbilicus (2.5cm) | | Center of Umbilicus | | Below the umbilicus (2.5cm) | |
|---|---|---|---|---|---|---|
| USD | Pre-Test(cm) | Post-Test(cm) | Pre-Test(cm) | Post-Test(cm) | Pre-Test(cm) | Post-Test(cm) |
| | 4.5cm | 0.7cm | 4.6cm | 1.07cm | 4.4cm | 0.9cm |
| P-Value | 0.3 | <0.0001 | 0.46 | <0.0001 | 0.59 | <0.0001 |

The below provided table shows the statistical values of pre and post session USD and PFS:

| | Pre-Test (Mean/SD) | Post -Test (Mean/SD) | MD | P-value |
|---|---|---|---|---|
| USD | 28.35/1.04 | 20.05/0.69 | 8.3 | 0.0001 |
| PFS | 28.50/0.95 | 23.65/1.14 | 4.85 | 0.0001 |

Graphical representation of the values:






All the statistical analysis in this was done using SPSS ver.16.0. The general characteristics of the participant were expected in terms of mean and standard deviation by using descriptive analysis. To compare the Pre and Post session results, paired t-test was performed. The statistical significance level was set at equal to or less than (p value-0.05) for both outcome measures.

**Results:**

There was significant difference between the pre and post session of PFS and Ultrasonography. There was clinical and statistical significance difference exists between pre and post PFS and IRD

The p value of each outcome measure was less than 0.05.

**Conclusion:**

This study concluded that, when analyzed before and after the treatment, KT and PF strengthening exercises have shown statistical significant effects on IRD, improvement in functional ability in patient with Diastasis Recti.

KT and PF strengthening exercises found to be clinically and statistically more effective with greater percent of improvement, further on comparison we found that there is statistical significant difference and better improvement of all the outcome measures from session 1 to session 8.

In conclusion, the present study provides evidence to support the use of physical therapy regimen in the form of adding KT and PF strengthening exercises for the better improvement in functional ability and IRD in the patient with Diastasis Recti.

**Discussion:**

DRA is one of the common complications of postpartum women. The treatment of diastasis rectus abdominis (DRA) can be complex. In the past due to lack of understanding of this disease, many patients could not get timely and effective diagnosis and treatment, which led to the continuous aggravation of DRA symptoms in the parturients and affected the quality of life.

Early diagnosis and detection of DRA can avoid the occurrence and progressive aggravation of complications and the necessity of the surgical treatment. Medical clinical centers are often the first- line facilities for diagnosing and treating DRA in postpartum women.

Herein, we followed standardized rehabilitation that can effectively alleviate the DRA of postpartum women. Based on the establishment of the standardized rehabilitation, normally a physical therapist did the Intervention and treatment for the patient, another effective way to treat DRA.

Simultaneously, regular abdominal exercises, pelvic floor muscle exercises, posture and back care, corsets, acupuncture treatment and other methods have all been recommended as effective non-surgical interventions for DRA treatment.

One study has proven that Abdominal muscle exercises is effective in reducing DRA in the early postpartum period, which means exercise can significantly improve DRA symptoms and is an effective non-surgical methods recommended to treat DRA.

Although exercise of pelvic floor muscles, Rectus Abdominis and other exercise programs are mainly subjective recovery methods, which require patients full perseverance to complete the exercise.

**Clinical implications:**

The non-surgical treatment used for DRA is somewhat different from the standardized Rehabilitation treatment we designed.

The current research plan adopts a combination of various exercises which is more convenient to master, apply and promote. Our research provides simple and effective standardized method to effectively treat patients with DRA.

There was statistical and clinical difference found before and after the physiotherapy sessions.

In fact, the analysis of this study showed that the DRA separation and the quality of life postpartum women was obviously improved after early treatment of standardized rehabilitation. The physical functioning scale (PFS-10) is useful self reported health measurement tool developed.

Early treatment and normalization of DRA separation is the key to improving the symptoms of patients. This is also essential for improving the quality of life of postpartum women as presented in the study.

Concurrently, our study may also help other medical staff and rehabilitation physical therapists engaged in postpartum rehabilitation in other clinical hospitals alleviate DRA symptoms and improve the quality of life of patients.

Previously, surgery has been considered on effective treatment for DRA while depending on the understanding of DRA, non-surgical treatment and/or early active intervention methods are another effective way to treat DRA.

We hope to promote this standardized rehabilitation treatment to obtain further Improvements and enhancements.

**Author contribution:**

All the authors have read and approved the final manuscript, have made important contributions to the work of the report, whether in terms of method creation, research design, implementation data aggregation, statistical analysis and interpretation etc, and participated in drafting revising and reviewing the manuscript, finally reached to an agreement on the final request for all the aspects of the work.

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