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Diastasis recti abdominis – Guide for the maternity clinic clients of Perusturvakeskus Pori

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Title of publication Diastasis recti abdominis – Guide for the maternity clinic clients of Perusturvakeskus Pori		
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<p>Diastasis recti abdominis (DRA), the condition affecting mainly women in their late pregnancy and postpartum period, but also other factors such as obesity may result in separation of the rectus abdominis muscle bellies along linea alba. Presumably almost every pregnant woman undergoes some stage of separation along the midline of the abdomen during the third trimester of pregnancy or immediately after giving birth. Multiple studies with varying results have been made while trying to determine the most efficient treatment methods, and still to this day, there are no official guidelines for treating DRA.</p> <p>The aim of this thesis was to provide the latest evidence about diastasis recti abdominis and its treatment with illustrated exercises in a form of a printable guide leaflet in Finnish and English for the client of this thesis, maternity clinic of Perusturvakeskus Pori. Exercises chosen for the guide are focusing on postpartum DRA rehabilitation by strengthening the weakened abdominal wall and pelvic floor muscles. The client of this thesis may use the guide in their work and distribute it to patients in need.</p> <p>The thesis process included the gathering of the evidence from recent years concerning DRA and its treatment methods. After the relevant evidence was selected, the thesis process continued with writing the theory part. A printable guide leaflet was created in based on the theoretical knowledge presented in this thesis.</p> <p>At the end, little is known about this common condition and future research is still required to standardize the most effective intervention methods for diastasis recti abdominis. Many women in their pregnancy and postpartum are affected by DRA without even knowing about it. Screening for DRA could be beneficial if it could be merged into a doctor's or public health nurse's checkup at the late pregnancy or in the first weeks after giving birth.</p>		
<p><u>Key words</u> diastasis recti abdominis, linea alba, pregnancy, postpartum, therapeutic exercise</p>		

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1 INTRODUCTION

Diastasis recti abdominis (DRA) is a condition in which the rectus abdominis muscle bellies separate vertically along the midline called linea alba. DRA can occur to anyone despite the age or gender, but it is mainly seen in pregnant and postpartum women. (Michalska, et al. 2018, 98) For a large number of women in their postpartum period, DRA does not settle by itself and it can remain as it is for years (Thabet & Alshehri 2019, 63). During pregnancy, the growing uterus increases the intra-abdominal pressure on the abdominal muscles which may result in their separation. The most common conservative treatment method for DRA is physiotherapy, which concentrates mostly in abdominal muscle strengthening and postural guidance. (Michalska, et al. 2018, 98-99) DRA remains controversial in discussions about its treatment methods, and official guidelines are still lacking. A comprehensive approach for the treatment of DRA is required in order to provide individually beneficial care. (Tuokko 2016, 163)

The abdominal muscle weakness can have a huge impact on the body that may result in postural changes, lumbopelvic pain and external faults. Muscles of the abdominal wall cooperate together with the pelvic floor muscles. Due to the correlation between these two muscle groups, any disturbance in the functioning of the abdominal muscles linked with DRA may alter the pelvic floor muscle performance. (Dave & Mahishale 2019, 11)

This thesis was requested by the maternity clinic of Perusturvakeskus Pori. A guide leaflet about DRA was created with illustrated exercises for DRA. Maternity clinic staff may utilize the created guide in their work and share it for the patients in need.

2 AIM AND OBJECTIVE OF THE THESIS

The aim of this thesis is to provide information about diastasis recti abdominis (DRA) to the maternity clinic staff and clients of Perusturvakeskus Pori. The objective is to create a printable guide leaflet for the maternity clinic clients which contains evidence-based information about DRA, testing for DRA, what to avoid and take into consideration when affected by DRA as well as illustrated home exercises for DRA. Guide leaflet is created in Finnish and English.

3 ABDOMINAL WALL AND PELVIC FLOOR

The purpose of all the abdominal muscles is to support the trunk, spine, abdominal cavity and internal organs. They work together with diaphragm, pelvic floor muscles and deep muscles of the back along with the bony structures and connective tissues. The abdominal muscles are also involved in all the movements of the trunk and assist with breathing movements. (Tuokko 2016, 32)

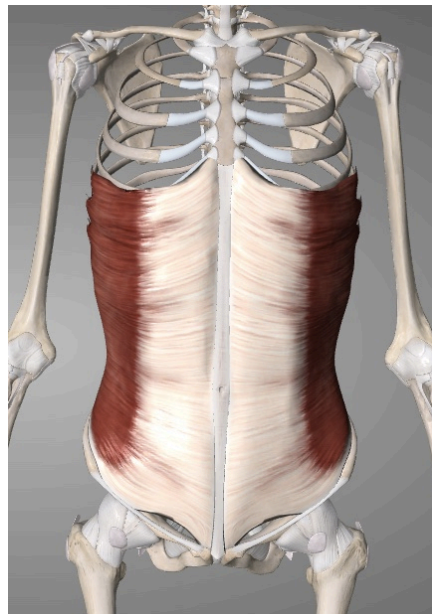
The human trunk can be seen as a barrel. The pelvic floor and gluteus muscles work as the bottom of the barrel. Muscles of the abdomen and back form the walls of the barrel and the diaphragm forms the barrel top. The diaphragm has enough space to function when the pelvic floor muscles work correctly together with the core. Pelvic floor muscles can be seen as a trampoline; bent trampoline frame or uneven tension in the springs makes jumping difficult on it. In other words, muscle tightness in the abdomen, sides or back may have an impact on the pelvic floor activity and vice versa. (Philman & Luomala 2016, 122)

The abdominal muscles form the anterolateral walls of the abdominal cavity, which are divided into three layers. The most superficial layer consists of external obliques and the middle layer consists of internal obliques and rectus abdominis. The deepest layer of abdominal muscles is the transversus abdominis. (Philman & Luomala 2016, 125) These muscles can be split into flat and vertical muscles as well. Flexion and

rotation of the trunk is executed with the flat muscles which are the external and internal obliques, and transversus abdominis. The rectus abdominis muscle is positioned vertically in relation to the flat muscles. (Varacallo & Al-Dhahir 2019)

3.1 External oblique (m. obliquus externus abdominis)

The external oblique is the largest and the most superficial of the anterolateral abdominal wall muscles (Varacallo & Al-Dhahir 2019). The external oblique muscle (Picture 1) originates from the outer surface of the 5th to the 12th ribs and inserts along linea alba on to the pubic tubercle and anterior half of iliac crest (Agur & Dalley 2013, 108). Main actions of the external obliques are flexion and rotation of the trunk. It also supports abdominal viscera, regulates intra-abdominal pressure and activates during expiration. Bilateral activation of the external oblique muscles bends the trunk forward and assist the pelvis to straighten. (Tuokko 2016, 33)

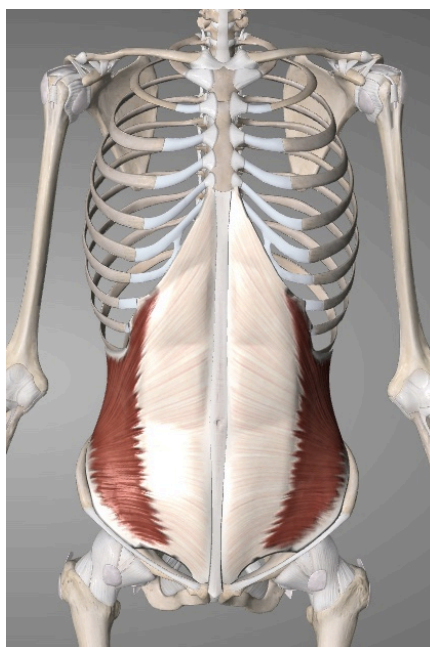


Picture 1. M. obliquus externus abdominis (Screen capture from Essential Anatomy 2014)

3.2 Internal oblique (m. obliquus internus abdominis)

In the middle layer of the abdominal wall between the external oblique and the transversus abdominis is the internal oblique muscle (Picture 2). It originates from the

thoracolumbar fascia, anterior two thirds of iliac crest and lateral half of the inguinal ligament. Insertion points are on the inferior borders of the 10th to 12th ribs and linea alba, sharing a common insertion with the transversus abdominis into pubic crest via conjoint tendon. (Agur & Dalley 2013, 108; Mota, Pascoal & Bø 2015, 61) The internal oblique muscle functions similarly as the external oblique muscle; main focus in trunk movement. Unilateral activation of the internal oblique flexes and rotates the trunk ipsilaterally. When bilateral muscle activation happens, the internal oblique muscle takes active part when the pelvis straightens, and the trunk bends forward. When the internal obliques compress the abdominal viscera, it results in forced expiration. (Tuokko 2016, 33)

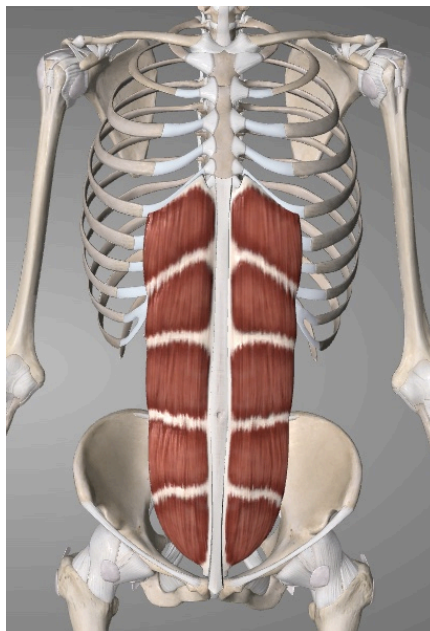


Picture 2. M. obliquus internus abdominis (Screen capture from Essential Anatomy 2014)

3.3 Rectus abdominis (m. rectus abdominis)

The rectus abdominis muscle (Picture 3) positions vertically on the abdominal wall, divided into two muscle bellies by the linea alba. It originates from pubic symphysis and pubic crest, to insert on the xiphoid process of the sternum and the costal cartilages of the 5th to 7th ribs. The rectus abdominis muscle is responsible of the lumbar spine flexion and stabilization. It compresses the abdominal viscera, activates during heavy breathing and also, controls and stabilizes the pelvis. (Agur & Dalley 2013, 108;

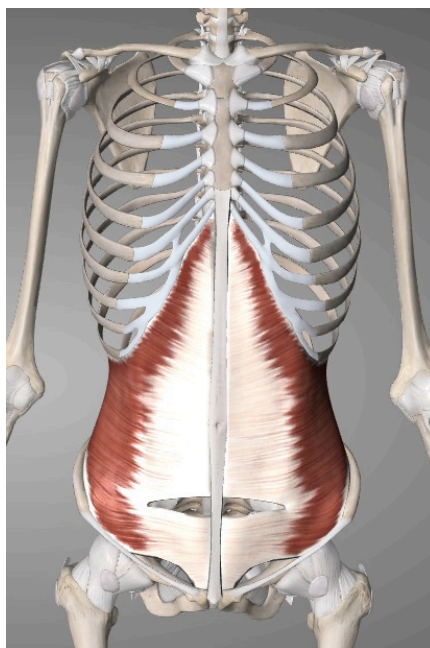
Tuokko 2016, 33) The rectus abdominis muscle is segmented by tendinous intersections where the muscle attaches on to the anterior layer of rectus sheath. (Mota, Pascoal & Bø 2015, 61)



Picture 3. M. rectus abdominis (Screen capture from Essential Anatomy 2014)

3.4 Transversus abdominis (m. transversus abdominis)

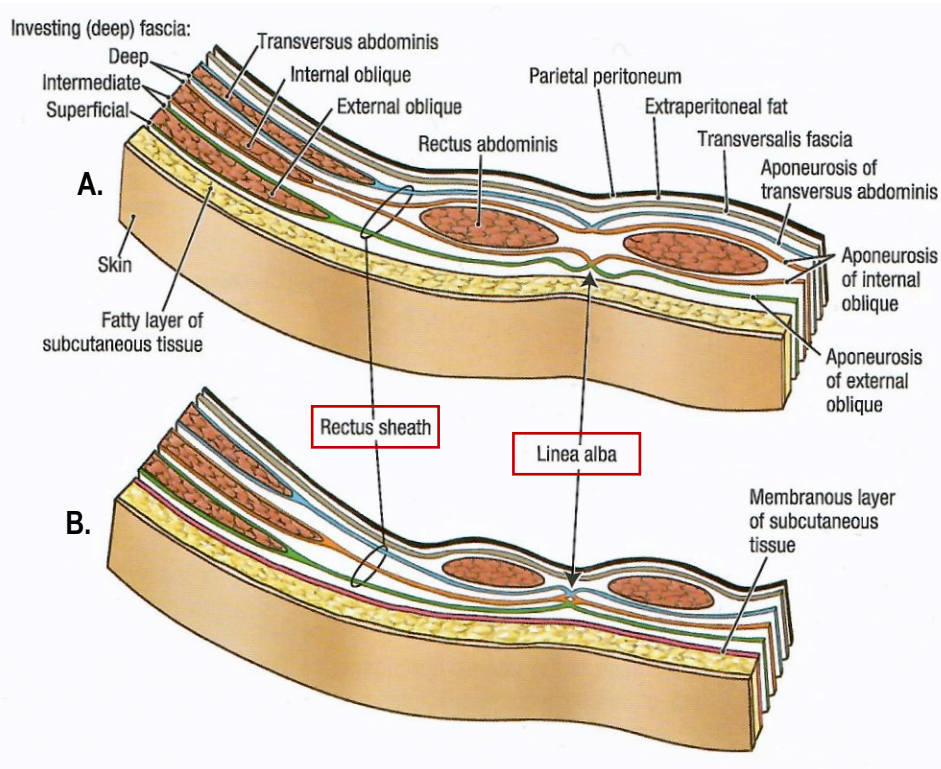
The transversus abdominis (Picture 4) is the deepest muscle on the abdominal wall. It originates from the inner surface of the 7th to 12th cartilages of the ribs, the deep layer of the thoracolumbar fascia, majority of the iliac crest anteriorly and third of the inguinal ligament laterally. (Agur & Dalley 2013, 108; Mota, Pascoal & Bø 2015, 61) Transversalis fascia is located underneath the transversus abdominis (Varacallo & Al-Dhahir 2019). The transversus abdominis muscle acts as a brace for the abdominal cavity together with the diaphragm and pelvic floor (Tuokko 2016, 33).



Picture 4. M. transversus abdominis (Screen capture from Essential Anatomy 2014)

3.5 Rectus sheath and linea alba

The rectus sheath is a multilayered aponeurosis on the abdominal wall. This strong connective tissue surrounds the rectus abdominis muscle and allows the muscles to slide within the structures. The anterior rectus sheath wall is composed of the aponeuroses of the external and internal oblique muscles. The aponeurosis of the internal oblique splits also to the posterior side, together with the aponeurosis of the transversus abdominis. Anterior and posterior walls of the rectus sheath cover almost the entire rectus abdominis muscle, until it reaches the midway between pubis symphysis and umbilicus. The posterior sheath wall disappears gradually in this junction (arcuate line) and the lower quarter of the rectus abdominis muscle is covered with the rectus sheath only anteriorly (Picture 5). The transversalis fascia connects to the rectus abdominis below the arcuate line. (Mota, Pascoal & Bø 2015, 61-62; Varacallo & Al-Dhahir 2019)



Picture 5. Abdominal wall layers, rectus sheath and linea alba. Transverse sections pictured above (A.) and below (B.) arcuate line. (Modified from Agur & Dalley 2013, 109)

The linea alba is a fibrous seam that runs down the midline of the abdomen from the xiphoid process to the pubic symphysis and is composed of the fused aponeuroses of the abdominal muscles. The collagenous meshwork structure of the linea alba performs an important role as an abdominal wall stabilizer. Tension on the linea alba, especially below the navel, is regulated by a small pyramidalis muscle above the pubic crest. (Mota, Pascoal & Bø 2015, 61)

3.6 Pelvic floor

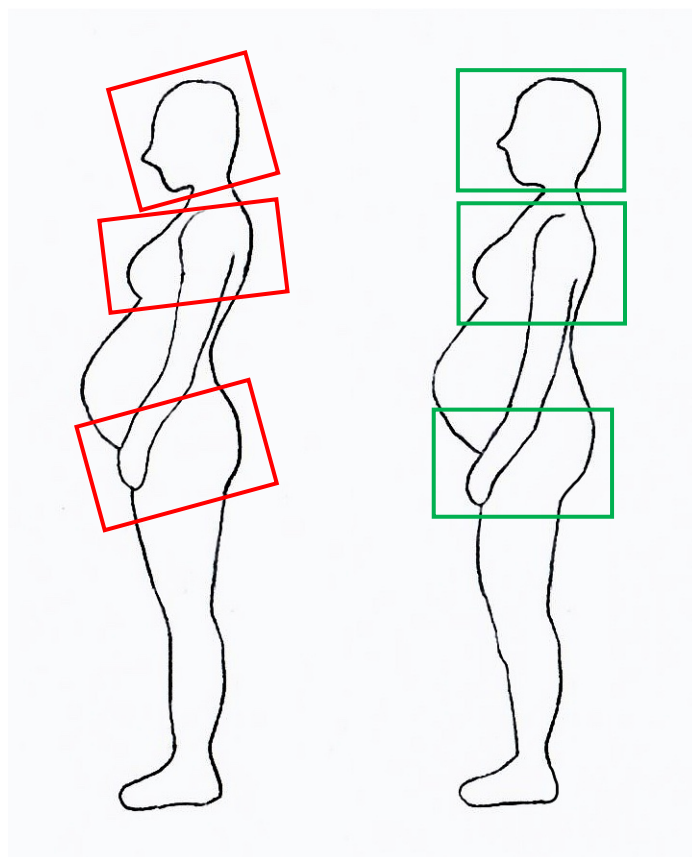
The pelvic floor consists of muscles, ligaments and fascia layers while playing an important role in the body. Its main function is to support the pelvic organs and react to alternating intra-abdominal pressure (e.g. during coughing). It also works as a urethral, vaginal and anal sphincter. The pelvic floor muscles – the levator ani muscle composed of three muscles (pubococcygeus, puborectalis and iliococcygeus) and the ischiococcygeus muscle – lie underneath the pelvic girdle where they work together with the deep muscles of the abdomen and back. The pelvic floor muscles together

with their fascia coverings are known as the pelvic diaphragm which can be imagined as a hammock that is attached anteriorly to the pubis, posteriorly to the coccyx and to the lateral walls of the pelvis. The pelvic floor structures should activate during an unexpected incident such as sneezing by resisting increased intra-abdominal pressure to prevent unwanted leakage of urine or bowels. (Ferla, et al. ... 2016, 400; Tortora & Derrickson 2014, 356) Strong pelvic floor muscles also activate and support the abdominal and back muscles (Tuokko 2016, 31). In order to take part in core movements and activation, the pelvic floor muscles' ability to relax and contract is needed (Website of the Pelvic Floor First 2020).

4 MUSCULOSKELETAL CHANGES IN PREGNANCY

Female body experiences major anatomical and hormonal changes during pregnancy that also widely influence the musculoskeletal system (Dave & Mahishale 2019, 8). Abdomen expands to accommodate the growing fetus which is one of the visible changes caused by pregnancy. Other significant change happens in the center of gravity due to weight gain. Standing posture becomes wider, lumbar spine curves into lumbar lordosis and knee joints are prone to hyperextend. The thoracic spine, also known as the upper back, is loaded by growing breasts, protracted shoulders and forward head posture, causing a kyphotic posture. (Tuokko 2016, 30-31) Effective support and stabilization from the thoracolumbar fascia of the posterior abdominal wall decreases due to its lengthening (Kisner & Colby 2012, 933).

Human body observed in a standing posture can be divided into segments which are aligned and maintained in certain positions (Picture 6). Line of gravity observed in the sagittal plane passes the following parts: middle of the mastoid process, frontal part of the shoulder joint, hip joint, frontal part of the knee joint and the frontal part of the ankle joint. (Donatelli & Wooden 2010, 95)



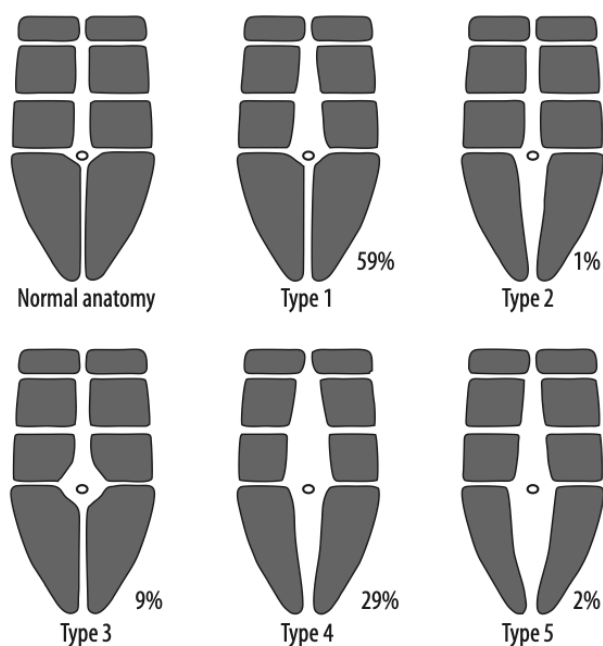
Picture 6. In a good posture (right side), the upper body is not slouched forward and the body weight is distributed evenly on both feet. Pelvis stays in a neutral position without tilting forward. (Modified from Tuokko 2016, 30)

5 DIASTASIS RECTI ABDOMINIS

Multiple physiological changes happen in the body during pregnancy resulting in musculoskeletal problems. Separation of the abdominal muscles (Picture 7) – diastasis recti abdominis (DRA) – is one of the common occurrences during pregnancy and after childbirth. Growing uterus increases the abdominal pressure which may lead to the rectus abdominis muscles separation along linea alba. (Thabah & Ravindran 2015, 582) Hormones like relaxin, progesterone and estrogen together with the displaced organs in the abdominal cavity promote the changes of the connective tissue, which may lead to DRA. It also has a connection to pelvic floor muscle weakness, low back and pelvic region pain. (Thabet & Alshehri 2019, 63) DRA may also cause the following sensations in the abdominal muscles: difficulty to contract, cramping while contracting, or the feel of losing connection to the muscles. When the DRA is present,

the abdominal area might stay in a bulging shape for months, or even years after the delivery. In some cases, a mild separation of the rectus muscles may not cause any visible signs or noticeable symptoms. (Tuokko 2016, 32)

Corvino, et al. (2019, 542-548) studied 82 female patients diagnosed with DRA, where the inter-rectus distance and its anatomical pattern type were examined with ultrasound imaging. These five anatomical pattern types of DRA (Picture 7) found in this study were the following: only above navel with prevalence of 59% (Type 1), only below navel with prevalence of 1% (Type 2), at navel level with prevalence of 9% (Type 3), complete but wider above navel with prevalence of 29% (Type 4) and complete but wider below navel with prevalence of 2% (Type 5). The fibers of the linea alba arrange more transversally below the navel than above, which may explain the prevalence of the mentioned anatomical patterns. (Corvino, et al. 2019, 542-548)



Picture 7. Simplified presentation of diastasis recti abdominis and its different anatomical pattern types with prevalence. (Corvino, et al. ... 2019, 545)

5.1 Prevalence and risk factors

There is a lot of variation between studies when looking at the prevalence values of DRA. Thabet and Alshehri (2019, 62-63) stated DRA affecting most of the women

during pregnancy. Usually it starting to occur during the second trimester of the pregnancy, where third trimester occurrence can be within 66% to 100%. Childbirth is a drastic event, and because of that more than half of the women experience DRA right after it. (Thabet & Alshehri 2019, 62-63)

Many factors can cause the incidence of DRA, pregnancy being the most common cause. Pregnancy related reasons can be number of pregnancies, large size of the fetus for gestational age, excessive amount of amniotic fluid or being pregnant with multiples. DRA may also occur due to obesity, increased intra-abdominal pressure caused by constipation or deficient breathing technique. (Thabet & Alshehri 2019, 63; Dave & Mahishale 2019, 8) Other pregnancy related factors causing DRA can be the caesarean section, tissue type, age higher than 34 or hormonal factors (Tuokko 2016, 36). DRA can also affect men, when it is usually connected to aging, alternation of weight, hereditary abdominal muscle weakness, continuous or periodic abdominal distention, weightlifting, doing full sit-ups, and actions causing high intra-abdominal pressure. (Mota, Pascoal, Carita & Bø 2015, 781)

5.2 Inter-rectus distance

Inter-rectus distance (IRD) is measured to define the width of the separation between rectus abdominis muscles at linea alba. Depending on the anatomical measurement spot, the usual IRD values vary between 1.0 cm and 2.2 cm at rest. Palpable and visible IRD is the identifying mark of DRA. Interesting findings of IRD measures suggest its connection with lumbopelvic dysfunction and urogynecological problems. (Keshwani, Hills & McLean 2016, 223-224) IRD is considered harmful when the width of linea alba exceeds 2.5 cm and it may disturb the stabilization and movements originating from the abdominal wall; also affecting on posture, defecation and giving birth (Rett, Braga, Bernardes & Andrade 2009, 278-279).

IRD measurements are usually taken while the abdominal muscles are relaxed as well as during an activation of the abdominal muscles (e.g. lifting head while supine lying). By measuring the IRD in two different states, it eases the process of evaluating and detecting the changes in the IRD over the time. There has also been notion towards the

behavior of linea alba during activation. It presumably pictures the functional ability of force transmission produced from the lateral abdominal wall, while being suggested to be used as tool to determine suitability of specific interventions. (Keshwani, Hills & McLean 2016, 223-224)

Rett, Braga, Bernardes and Andrade (2009, 277-278) examined the IRDs between primiparous and multiparous women where the IRD was measured 4.5 cm above and below the umbilicus. DRA above the umbilicus showed higher prevalence with all the postpartum women taking part in this study. When the comparison was done between the mean values of DRA below the umbilicus, the prevalence was higher in multiparous women. During pregnancy, the abdominal wall and its connective tissue are under a cumulative mechanical stress, which may explain multiparous women being affected by DRA more compared to primiparous women. (Rett, et al. 2009, 277-278)

In the assessment of the IRD, the palpation technique (Picture 8) – also known as the ‘finger width’ method – is largely used to detect DRA. Despite it being a common assessment technique, palpation is thought to be inaccurate and unreliable method when measuring the width of the separation. (Van de Water & Benjamin 2015, 52)

The procedure of the palpation technique goes as follows: Patient is supine lying, knees flexed and feet flat on the ground. Patient starts to lift up the head and shoulders slowly, hands reaching the knees, until the spine processes of the scapula are off the ground. Examiner places fingers on the linea alba at the navel. If the DRA is present, the fingers will drop in the middle of the two rectus muscle bellies or a noticeable lump rises up. The number of fingers fitting in between the rectus muscles determines the ‘finger width’ of the separation. Testing should be done along the linea alba at the navel level as well as above and below it. (Kisner & Colby 2012, 939)



Picture 8. Testing of DRA with palpation technique. (Kisner & Colby 2012, 939)

Ultrasound imaging (USI) has been broadly studied and is considered as an accurate method to locate and determine the size of the IRD. On the other hand, USI machinery is pricey and requires sufficient proficiency from the person doing the examination. (Chiarello & McAuley 2013, 496) Other methods used for measuring the IRD are calipers, tape measure, computed tomography (CT) and magnetic resonance imaging (MRI). Still to this day, there are no precise guidelines for the measurement method, the measurement spot or the position of the body while measuring. (Michalska, et al. 2018, 98)

6 TREATMENT OF DIASTASIS RECTI ABDOMINIS

Evidence concerning DRA treatment methods is still insufficient despite it being a common condition. Conservative treatment such as physiotherapy is mostly used in the treatment of DRA. In more severe cases, surgical options are being considered. (Jessen, Öberg & Rosenberg 2019, 4-5) The effects of DRA are individual, so a comprehensive examination of patient's movements and posture play a key role in the assessment (Tuokko 2016, 164).

6.1 Conservative treatment

The treatment of DRA starts with physiotherapy in most of the cases. Physiotherapy for DRA is suggested to start 6-8 weeks postpartum – most commonly with therapeutic- and/or aerobic exercise, patient education concerning posture and back as well as wearing an abdominal brace. (Jessen, Öberg & Rosenberg 2019, 1-2) In addition to previously mentioned methods, Michalska et al. (2018, 99) listed also guiding proper technique for lifting and the Noble technique (guiding rectus abdominis muscles manually closer together during a partial sit-up). According to Kamel and Yousif (2017, 471), the biggest natural recovery from DRA happens in the first 8 weeks postpartum. During that time, exercises aimed for the abdominal wall should be selected carefully, because of the weakened stabilizing performance of the abdominal wall due to pregnancy. (Kamel & Yousif 2017, 471) Benjamin, Water and Peiris (2014, 5) discussed about the effects of exercise during pregnancy. Exercise has a great impact on the overall strength, muscle tone and control which may explain its influence on preventing and reducing DRA. (Benjamin, Water & Peiris 2014, 5)

6.1.1 Exercises for DRA

Multiple researches have studied the effects of various exercises on DRA, but still to this day, there are no specific guidelines about the exercises aimed for treating the discussed condition. Exercise methods targeting on transversus abdominis and rectus abdominis are most commonly used. So far, no confirmation has been made, which one of these two methods works more effectively in decreasing IRD. (Michalska, et al. 2018, 99-100) Sancho, et al. (2015, 289) explained the reasons behind abdominal muscle strengthening with biomechanical factors. The assumption is, that the horizontal force produced by simultaneous contraction of the abdominal muscles is bringing rectus muscle bellies together. (Sancho, et al. 2015, 289)

Tuokko (2016, 107) recommended pelvic floor exercises and activation of the transversus abdominis muscle to begin right after giving birth – first with light and short contractions. Simple method to activate transversus abdominis is to do a diaphragmatic breathing exercise: Keep a your back straight while sitting on a chair or

go into supine- or side-lying position. Place your hands over the abdominal area and imagine a balloon inside your abdomen. While breathing in, the balloon fills with air and while breathing out, the balloon collapses lightly. Try not to put extra effort while inhaling or exhaling. After few times of inhalation and exhalation, try to do a light pelvic floor contraction together with breathing. Imagine lifting your pelvic floor muscles towards the belly button while breathing out and relax the muscles while breathing in. Pelvic floor muscle contraction emphasizes the activation of transversus abdominis. (Tuokko 2016, 107)

Kisner and Colby (2012, 946-947) discussed about the therapeutic exercise for DRA. Head lift exercise with and without pelvic tilt is recommended until the IRD has decreased to width of two fingers. Proper breathing technique needs to be taken into consideration during these exercises to avoid excessive increase on intra-abdominal pressure. (Kisner & Colby 2012, 946-947)

Transversus abdominis contraction forms stability at the linea alba, thoracolumbar fascia and ribs (Thabet & Alshehri 2019, 66). Voluntary contraction of transversus abdominis, known as the “drawing-in” exercise, activates the muscle in the most independent way. This maneuver is performed in a supine lying position, while knees are about 70° to 90° and feet touch the ground. Patient can also settle into prone lying or semi-reclining position. The person guiding the exercise may show the movement, guide it verbally or by touch. Patient is instructed to breath normally in and out, then lightly bring the belly button towards the floor, keeping the spine in a neutral position. When the movement is done in the right manner, the pelvis stays stable, no extra movement of the lower ribs or the rib cage is seen, abdominal wall stays hollowed and no pushing through the feet happens. (Kisner & Colby 2012, 420, 511)

Lee and Hodges (2016, 580-589) studied how a curl-up exercise affected to the linea alba behavior. Tension of the linea alba was pictured with “distortion index”; less distortion indicated more tension at the linea alba and vice versa. Distortion was measured at rest as well as during a curl-up with and without activating transversus abdominis. Curl-up exercise alone had the immediate narrowing effect on IRD but with increased distortion from rest. When performed with the pre-activation of transversus abdominis, the IRD was widening while the distortion of the linea alba

decreased. Linea alba tension is crucial in a better abdominal control and when the forces are transferred across the abdomen. This study showed, that maybe combining both of the exercises, it could work as one treatment method with DRA. Despite the result, each woman with DRA should be assessed individually, because variation in the distortion outcomes was present. (Lee & Hodges 2016, 580-589)

Mota, et al. (2015, 782, 784-787) studied the instant reaction of IRD during the abdominal crunch and the drawing-in exercise in pregnant women in their third trimester and during postpartum period until 26 weeks after delivery. Measurements during the abdominal crunch at each time showed that the IRD was significantly narrowing, even though, the abdominal crunch has not been a recommended exercise while being affected by DRA. Contrasting findings were made with the drawing-in exercise activating transversus abdominis. The IRD was narrowing when measured during pregnancy, but the results during postpartum period were showing the widening of it. However, this study highlighted the importance of future studies, since it only examined the instant effects of the exercises and could not come to the conclusion about treatment recommendations. (Mota, et al. 2015, 782, 784-787)

Bobowik and Dąbek (2018, 16) were screening different physiotherapeutic treatment methods used for women with DRA. One method was to perform exercise with elevated head while tightening the pelvic floor and abdominal muscles. This method resulted in 15% reduction of the IRD in the group who exercised with elevated head and it showed the importance of muscle strength in transversus abdominis and pelvic floor muscles. (Bobowik & Dąbek 2018, 16)

The effectiveness of an exercise program focusing on deep core stability was studied in a randomized controlled trial by Thabet and Alshehri (2019, 62, 66-67). Forty women with DRA, 3 to 6 months postpartum, were randomly split into a study group and a control group. The study group took part in deep core stability-strengthening program (pelvic floor and isometric abdominal contractions, diaphragmatic breathing and plank) and a regular abdominal exercise program (pelvic tilts, reverse sit-ups, static contractions of the abdominals and trunk rotations). In addition, participants of the study group were wrapping the abdominal area with a towel or sheet for support during the exercises. The control group took part only in a regular abdominal exercise

program. During the whole intervention period of 8 weeks, exercises were done three times per week, with 3 sets of 20 repetitions for each exercise. After the intervention, the mean values of IRD before and after the treatment, was compared between the groups. As a result, both groups had statistically significant decrease on IRD (P-value < 0.0001), although there was more improvement in the results of the study group. This study had positive impact on narrowing the separation, especially with bracing, as well as on participants' quality of life. (Thabet & Alshehri 2019, 62, 66-67)

Wrapping the abdominal area with a brace, it simultaneously gives support for the elongated muscles and ligaments, and the lower back (Walton, et al. ... 2016, 2). Abdominal bracing during core exercises showed statistically significant reduction on DRA also in a cross-sectional study made by Acharry and Kutty (2015, 1003). Bracing has been discussed to be a very sufficient method in treating DRA, especially in the early postpartum period (Acharry & Kutty 2015, 1003; Thabet & Alshehri 2019, 66). The purpose of an abdominal brace is to guide the intra-abdominal pressure upwards and it should not be tied too tightly. It also helps with backpain and promotes better posture. (Tuokko 2016, 110) Kamel and Yousif (2017, 472) discussed the effects of an external support around the core, that it may imitate the fascial tension of the transversus abdominis and give biofeedback of its activation.

Any type of exercise causing an abdominal lump, lifting feet off the ground while supine lying, crunches and sit-ups, exercise for abdominal obliques, powerful coughing without bracing and picking up excessive loads should be avoided. (Michalska, et al. 2018, 99) According to Tuokko (2016, 36-37), all the exercises causing a ridge down the midline of the belly should be avoided. Also, movements where the intra-abdominal pressure is directed towards the anterolateral abdominal wall muscles and the linea alba, should be avoided. Examples of those exercises are jackknife sit-ups, plank, push-ups, crunches, crunches with rotation, scissor abs and other exercises requiring great effort and static hold. All the mentioned exercises should be avoided during pregnancy and in the early postpartum period because of the weakened linea alba tension. It is important to pay attention to proper breathing technique while exercising, since holding your breath increases the intra-abdominal pressure. (Tuokko 2016, 36-37)

6.1.2 Physical activity recommendations

It is important to keep the physical activity recommendations in mind at all times. To achieve the health benefits of physical activity, adults (ages 18 through 64 years) are recommended to do weekly aerobic exercise for a total of 150 minutes (2 hours and 30 minutes) with moderate intensity or 75 minutes (1 hour and 15 minutes) with vigorous intensity. During aerobic exercise with moderate intensity (e.g. Nordic walking, swimming or dancing), increased breathing and heart rate stays at a level where talking is still possible. More intense effect on breathing and heart rate is reached with vigorous intensity aerobic exercise (e.g. running, cycling or ball games) where talking becomes more difficult. In addition to aerobic exercise, it is recommended to perform exercises improving muscle strength twice a week, such as stair walking or gym training. Physical activity recommendations for adults apply also for pregnancy and postpartum period. (Webiste of the UKK-instituutti 2019)

The suitable amount of physical activity is individual for each pregnant woman and is highly related to physical activity level before the pregnancy. Best monitor with physical activity is to follow your own physical state. Activities such as horse riding, combat sports, wrestling, parachute jumping, scuba diving and skating are considered risky during pregnancy. It is evident, that falling down or abdominal trauma can be dangerous for the fetus. (Tuokko 2016, 16, 18) Recovery time from the delivery is also individual, and gradual return to physical activity is recommended (Website of the UKK-instituutti 2019).

Choosing the amount of repetitions for the exercises in the postpartum recovery depends on each individual. While performing the exercises, it is good to count how many repetitions is done with a proper form. As an example: starting with five repetitions per exercise and then increasing the repetitions when the muscle strength develops. If the patient feels insecure about the exercise technique and/or repetitions, guidance from a physiotherapist or a personal trainer is recommended. Physiotherapist's assessment and guidance is also recommended if the DRA is still present more than one year after the delivery. Returning back to regular exercise habits may start after the normal core stability is restored. (Tuokko 2016, 203)

6.2 Surgical treatment

Surgery may be an option if the severity of DRA is high or the physiotherapy treatment is unsuccessful (Jessen, Öberg & Rosenberg 2019, 2). Severe DRA may also result in abdominal hernia at the linea alba and surgery is needed (Kisner & Colby 2012, 939). Surgical treatment is suggested to not perform earlier than 6-12 months postpartum since the separation of the rectus abdominis muscle bellies may ease naturally within the period. Surgical techniques used are open-, laparoscopic-, and robot assisted surgery. In all the surgical techniques, the rectus fascia is plicated (folded). Anterior rectus fascia is operated during an open surgery, while in the laparoscopic- and robot assisted surgery the posterior rectus fascia is operated. Complication rates and recurrence have been low in both methods. (Jessen, Öberg & Rosenberg 2019, 2, 5) The downside with the surgical approach is the weakened abdominal muscle strength which may cause alteration in the shape of the abdomen as well as loosening of the skin. (Dave & Mahishale 2019, 11).

7 PERUSTURVAKESKUS PORI

Perusturvakeskus Pori is responsible of various daily municipal services available for the residents of Pori. These services include basic health care, dental care, hospital services, substance abuse and mental health services, rehabilitation services, elderly and disability services, maternity and child health clinic services, social care and child protection. The operations model of Perusturvakeskus Pori is based on the service needs of the population as well as prevention and multi-professional work. The services are offered at smaller service points together with social and health care centers with broader service options. (Website of the Porin kaupunki 2020)

Maternity clinic services in Perusturvakeskus Pori are aimed for the families expecting a child and they are free of charge. During the visits at the maternity clinic, the progress of the pregnancy is monitored, and health and well-being of the family together with parenting are discussed. (Website of the Porin kaupunki 2020) Periodic maternity

health check-ups consist of approximately 8 to 15 appointments with a public health nurse and 1 or 2 appointments with a physician. Referral from the physician or public health nurse is required if any additional examination or follow-up is needed. (Website of the Terveyskirjasto 2019)

8 GUIDE LEAFLET

The official report template of Porin kaupunki was used for the guide about diastasis rectus abdominis, which was sent to the author by email as Word-document. The guide starts with the definition of DRA, followed by the causes and symptoms of DRA and what to avoid with DRA. After the previously mentioned topics, illustrated step-by-step self-testing of DRA is instructed. Last part of the guide has illustrated exercises with instructions, which may be used to start the postpartum recovery process with DRA. Pictures of the guide's exercises were taken by the author. The guide is in a pdf-form, which is easy to print out or share electronically (e.g. e-mail) to the maternity clinic clients. The guide can be offered to a patient whenever there is a need, or if the patient wants to know more about the condition.

Criteria of the exercises chosen for the guide was safety, easiness to implement at home and no requirement for specific equipment to carry out the exercises. Since the exercises are aimed for the postpartum period, the first exercise concentrates on diaphragmatic breathing activating the transversus abdominis, accompanied with pelvic floor contraction. The first exercise is safe to start promptly after giving birth. Exercises after the first one, may start 8 weeks after the delivery. These exercises are head lift with arms/towel wrapped around the abdominal area, drawing-in and pelvic tilt. Each exercise used in the guide is based on evidence and aims to strengthen the abdominal wall and pelvic floor as well as to assist in reducing the separation between the rectus abdominis muscle bellies.

9 THESIS PROCESS AND METHOD

The author of this thesis contacted the maternity clinic public health nurse of Perusturvakeskus Pori in January 2019. Discussion about the possible thesis product started and different topic options were considered. The author expressed personal interest towards diastasis recti abdominis and came into agreement with the client, Perusturvakeskus Pori, about the thesis topic and product. In February 2019, the thesis topic and product type were chosen to be a guide about the diastasis recti abdominis for the maternity clinic clients. More detailed discussion concerning the entire thesis process (Figure 1) was discussed in a meeting with the client's representative in March 2019. The client requested the following: the guide should not be too long; the guide should exist in an online form and be easily printable. Other request was, that the author would instruct the exercises put into the guide for the maternity clinic staff. The author also agreed with the client, that the guide will be created in Finnish and English, since the maternity clinic has lots of foreign patients as well. The thesis plan was presented in a thesis seminar at the end of May 2019 and the thesis agreement was officially done with the client during summer 2019.

Author started working on the theory part of this thesis properly during the fall semester 2019. During that time, the author completed one clinical practice and attended mandatory courses at Satakunta University of Applied Sciences (SUAS). The original plan to finish the thesis process was to be done by the end of May 2020. However, the supervisor of the thesis informed the author in the beginning of fall semester, that the thesis process needed to speed up due to the timing of the thesis seminar planned for March 2020. Speeding up the process felt realistic at that point, even though finding the time and energy to work on the thesis became quite challenging, combined with the on-going studies and personal life.

When the spring semester 2020 started, there was still a lot of work left towards the theory part of this thesis. At the same time, the author started a new clinical practice that would last through the rest of the thesis process. While the thesis seminar planned for March was getting closer, the author started to realize that finishing the thesis on time was not possible. Luckily after some arrangements, an additional thesis seminar

was planned for May 2020, and the author was back in the original thesis schedule. In the middle of March 2020, author's clinical practice was discontinued due to the pandemic caused by the coronavirus disease (COVID-19). After this, the author got the chance to concentrate fully on the remaining thesis process.

Once the guide leaflet was finished, the plan was to go instruct the chosen exercises to the maternity clinic staff of Perusturvakeskus Pori. However, the plan changed due to the situation with the COVID-19 pandemic and the author agreed to record an instruction video of the exercises. The thesis process was completed in May 2020.

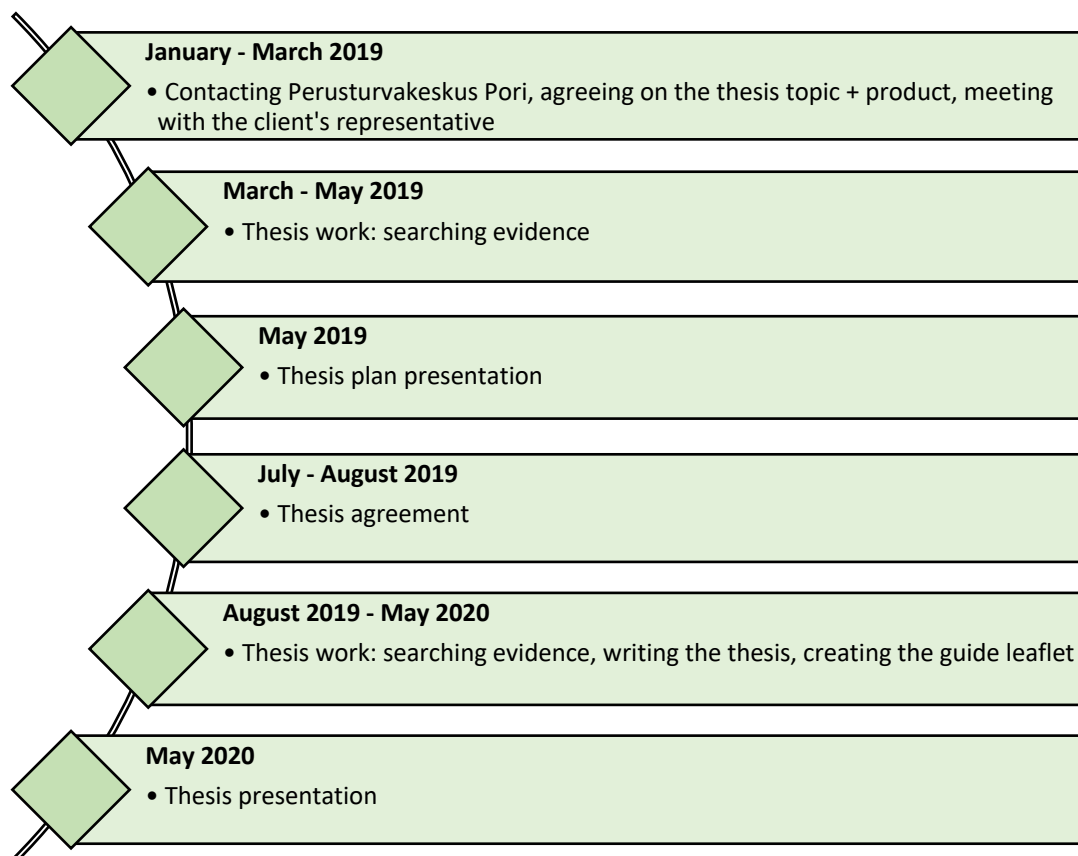


Figure 1. Thesis process

This thesis is considered as a practice-based thesis. In a practice-based thesis, the author creates a product such as a guide, a brochure, an orientation booklet or a process description (Salonen 2013, 5-6). This type of thesis consists of two parts: theory and practice. The theory part presents the evidential knowledge and the practical part presents the outcome. (HAMK 2018, 8) In this case, the outcome is the guide leaflet that is created based on theory. Evidence based information was searched through

PubMed, Physiotherapy Evidence Database (PEDro), ResearchGate, ScienceDirect and Google. Search words such as diastasis recti abdominis, vatsalihasten erkauma, inter-rectus distance and treatment of diastasis recti abdominis, were used in the searching process. Research articles were chosen first by the titles that were related to the topic of this thesis. Studies that were not relevant, were eliminated after reading. Author's goal was to gather the most recent studies as possible.

10 DISCUSSION

Choosing a topic for this thesis worked out perfectly with author's personal interest towards pregnancy related conditions. The author found out about diastasis recti abdominis by browsing the internet while being pregnant in 2017. After searching more information about the condition, it was surprising how many women are affected by it during and after the pregnancy. The unfortunate part is, that many women deal with DRA for a long time before finding out what has happened. It also sparked the thought in the author's head, that pregnant women need to be informed more about the condition. During author's own maternity clinic visits, this condition was never mentioned which confirmed her thoughts. This has just been author's personal experience without generalizing the situation being the same in all the maternity clinics in Finland.

When the thesis topic and product was confirmed with Perusturvakeskus Pori, the author felt motivated to start the thesis process. Especially for a new mom, all the information and discussions during the visits at the maternity clinic may feel overwhelming at some point. So, it was pleasing to start creating something that will help the maternity clinic staff to spread the awareness about DRA. Although this thesis process has been meaningful, it has not been the easiest. Once starting to get deeper into the topic, article after article, reading the sentence "future research is required", the author realized that dealing with diastasis recti abdominis was not so clear after all. There is so much uncertainty when it comes to the "right" and "wrong" treatment methods as well as the specific exercises.

Other challenge with the topic was, that the author has not seen any patient with the discussed condition in person, which would have given a better understanding of its characteristics. It would have been very interesting and worthwhile for the author to be part of a visit where the patient has DRA. This way the author would have been able to receive some immediate feedback from the patient about the exercises and also try out the palpation testing method. The author also thinks that testing for DRA should be part of the regular visits at the maternity clinic and maybe some developing cases could be prevented or at least slowed down. At the same time, it would require some training for the public health nurses. Other option could be, that the screening for DRA would be done at the doctor's maternity health checkup or in the first weeks after giving birth.

Little bit of hesitation was present while the author was choosing the exercises for the guide. Biggest reason behind it was the uncertainty of the results in the studies. The author would have also wanted to be in contact with a maternity physiotherapist, to be able to discuss more about the methods and exercises used for treating DRA as well as ask about the results of the DRA treatment. Unfortunately, this thought occurred to the author at the very end of the thesis process.

Future developmental ideas concerning the guide is that it would have more exercises with progression options when improvement occurs with the condition. Also, the guide offered for the patients could be an online guide with video instructions and explanations of the exercises. That way it would give a clearer picture of the exercises and be more informative. As mentioned before, future research is highly necessary. It would be very interesting to see more studies about the controversial abdominal curl-up exercise and its effects in the treatment of DRA.

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