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ORIGINAL RESEARCH

Efficacy of Standardized Rehabilitation in the Treatment of Diastasis Rectus Abdominis in Postpartum Women

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Purpose: The incidence of diastasis rectus abdominis (DRA) in parturients is continuously increasing, which may cause uncomfortable and affect the quality of life. The present study aims to retrospectively summarize the experience and efficacy in the treatment of DRA via standardized rehabilitation procedures in Eastern China.

Methods: This retrospective study included the parturients with DRA admitted to the Xishan People's Hospital of Wuxi between January 2017 and May 2021. Patients were separated into standardized rehabilitation group (SR) and non-standardized rehabilitation group (non-SR). The outcomes were the change in rectus abdominis separation and Physical Functioning Scale (PFS). Measurement data were compared between the two groups, and multivariate linear regression was used to analyze the factors associated with the standardized rehabilitation process. P values < 0.05 were considered statistically significant.

Results: Among a total of 294 patients with DRA who were included in the study, 171 patients were treated with SR (SR), and the other 123 patients were treated without SR process (non-SR). Compared with non-SR, the separation of the rectus abdominis was significantly reduced in SR after standardized rehabilitation treatment (p value < 0.0001). The multiple linear regression model analysis results suggested that standardized rehabilitation was an independent factor influencing the prognosis of DRA in parturients ($p < 0.0001$). In addition, the quality of life of the study group was significantly improved ($p < 0.0001$).

Conclusion: Standardized rehabilitation method revealed high efficiency in treating DRA in postpartum women and could improve the quality of life of parturients.

Keywords: diastasis rectus abdominis, postpartum women, rehabilitation, Physical Functioning Scale

Introduction

Diastasis rectus abdominis (DRA) is characterized by an increased distance between the rectus abdominis on both sides of the linea alba in pregnant and postpartum women.[1,2] The incidence of DRA, which is about 46.5% to 100% in the middle and late stages of pregnancy and approximately 30% to 70% after delivery,[3–5] is continuously increasing in China.[6] The diagnostic criteria for DRA are that one or more points of the linea alba are more than 2 cm separation, including the level of the umbilicus or 4.5 cm above and below, or the midline bulge is visible with force.[7,8] Parturients often have different degrees of DRA during the third trimester.[6] If ineffectively treated or left without treatment, they

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can end up with long-term severe DRA.[9] Not only does the abdomen swell and affect the appearance, but it may also cause the instability of the spine, resulting in lower back pain and affecting the quality of life. What's more serious is that some severe patients will eventually need surgical treatment to relieve clinical symptoms.[10,11] However, when DRA is timely treated, the symptoms can be immediately relieved and postpartum women's quality of life be improved as well.[2,12] Therefore, effective treatment is very important to improve the separation of rectus abdominis after delivery.

Currently, there are many methods for the treatment of patients with postpartum DRA, such as restraint band assistance,[3] exercises for enhancing the pelvic floor muscles[13] and/or abdominal binding,[14] electrical stimulation therapy,[15] acupuncture treatment in traditional Chinese medicine,[16] and surgical treatment.[10] Surgery is an effective method for treating DRA. However, it is not considered as an optimal choice, because it is a traumatic treatment method that may cause complications such as postoperative scars (even if minimally invasive surgery is used), wound infection, patch rejection, postoperative adhesions, and other complications.[11,17] Moreover, if postpartum women need another abdominal surgery in the long term, it may be affected by the abdominal surgical repair. Furthermore, available methods for treatment of postpartum DRA are still controversial, and there is a lack of effective standardized non-surgical treatment programs. Previous study has reported that Chinese medicine—acupuncture can effectively ameliorate DRA.[16] Nonetheless, this method is difficult to master, it requires a long learning cycle, and its promotion is very slow. Therefore, we have created this new systematic and standardized non-surgical method for the treatment of DRA, which is based on the traditional Chinese medicine massage technique combined with the practical application of muscle and movement systems.

Traditional Chinese medicine acupuncture has a good effect on pain and body discomfort,[18] while electrophysiology has a good physical therapy effect on muscles.[15,19] Taking advantage of these two characteristics, Standardized Rehabilitation process is a complete systematic treatment mode, including 40 minutes of manual massage (Part 1) and 30 minutes of treatment with electrophysiological equipment (Part 2) (Figure 1). The standardized rehabilitation process was completed once every other day, and the entire standardized rehabilitation was performed 10 times before completion. Although, some methods have been applied in clinical practice over the five years, with good effects and social benefits for postpartum women with DRA.[12,20] However, our proposed approach is easier to learn and use (Figure S1–S19). During the past three years, the quality of life of postpartum women with DRA was significantly improved after being treated by standardized treatment methods. We have obtained good social feedback as well. Therefore, the formulation of standardized rehabilitation treatment methods could benefit DRA patients, and we hope to benefit more patients.

The purpose of this study was to retrospectively summarize the treatment experience and efficacy of DRA in postpartum women who received standardized rehabilitation treatment in a clinical hospital in Eastern China between January 2017 and May 2021. Simultaneously, this study may help medical staff and rehabilitation physiotherapists who are engaged in postpartum rehabilitation in other clinical hospitals, assist in alleviating the symptoms of DRA patients, and improving the quality of life.

Materials and Methods

Study Design and Subjects

This retrospective study included all the patients with diastasis rectus abdominis admitted at Xishan People's Hospital of Wuxi City between January 2017 and May 2021. This study was approved by the Ethics Committee of Xishan People's Hospital of Wuxi City. The requirement for informed consent was waived. This study strictly kept the patients' information confidential. The study complied with the Declaration of Helsinki.

Inclusion criteria were: 1) 22–36 years; 2) parturients, including caesarean section; 3) body mass index (BMI) $\leq$29kg/m^2; 4) diagnosed with DRA between 3–6 months after delivery.[2,21]

Exclusion criteria were: 1) patients with incomplete data or missing follow-up data; 2) patients with any heart or respiratory disease, including excessive coughing and sneezing; 3) patients with any kind of pelvic or abdominal surgery.

Data Collection

The study group has completed the standardized rehabilitation treatment. Data collection and follow-up were carried out for both study and the control group during the same period. Collected data included age (year), weight (kg), numbers of pregnancies, BMI (kg/m2), natural delivery, cesarean section, diabetes, hypertension, chronic constipation, abdominal pain,

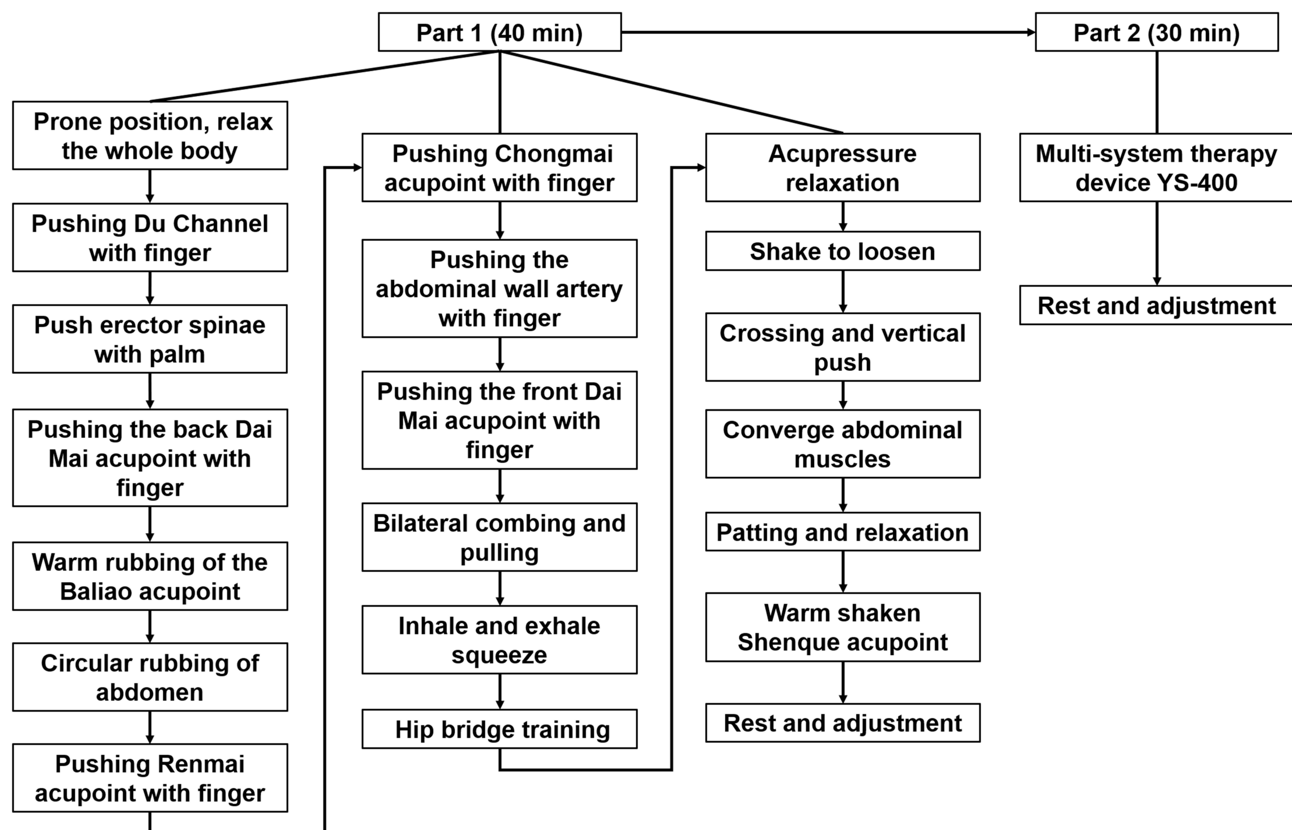

Figure 1 Standardized Rehabilitation. A representative process, which is promoted by a fixed step-by-step manual massage combined with the treatment of electrophysiological equipment.

pelvic pain, and low back pain, the inner edge of DRA and PFS from both groups. Both the study and the control groups were followed up for more than 3 months.

Outcome Measures

Each value was measured and calculated by doctors and nurses in the same group. The distance between the inner edges of the rectus abdominis was detected at the level of the umbilicus and 4.5cm above/below the umbilicus by using a B-ultrasound probe, which is very accurate. Each measurement point of postpartum women was marked using soluble markers to ensure the standardization of repeated measurements.

Physical Functioning Scale (PFS-10)

The Physical Functioning Scale (PFS-10) is a self-reported health measurement tool developed in the United States using data from medical outcome research and applying it to patients with acute and chronic diseases.[22] PFS-10 includes 10 items and is used to assess the degree of health-related limitations in physical functions. These items are scored on a 3-point Likert scale (1=very limited, 2=slightly limited, 3= not limited at all), which has been proven to be reliable and valid in previous studies.[23,24] Based on this measurement, we compiled the data before and after the treatment of standardized rehabilitation for performing the statistical analysis.

Statistical Analysis

The data were analyzed using SPSS 22.0 (IBM, Armonk, NY, USA). The continuous data were expressed as means ± standard deviations and analyzed using Student's *t*-test. Categorical data were presented as frequencies and scores and were analyzed using Fisher's exact test. Multivariate linear regression (enter method) was used to analyze the factors associated with the standardized rehabilitation process. P-value < 0.05 was considered statistically significant.

Results

Baseline Characteristics

According to exclusion and inclusion criteria, among 453 parturients with DRA admitted at Xishan People's Hospital of Wuxi City between January 2017 and May 2021, a total of 294 patients were included in the study (Figure 2). Among them, 171 patients were treated with standardized rehabilitation (SR), and the other 123 patients were without SR treatment (non-SR). There was no statistically significant difference in age, weight, and BMI between these two groups ($p>0.05$, Table 1). There was also no statistically significant difference in natural delivery, cesarean section, diabetes, hypertension, chronic constipation, abdominal pain, pelvic pain as well as low back pain between these two groups (($p>0.05$, Table 1).

Before the treatment of standardized rehabilitation, there was no statistically significant difference between SR and non-SR in the measurement of the inner edges of the rectus abdominis, including the level of the center umbilicus and 4.5cm above/below the umbilicus ($p>0.05$, Table 2). However, compared with non-SR, the change in the inner edges of the rectus abdominis, including the level of the center umbilicus and 4.5cm above/below the umbilicus, were obviously improved after the treatment with standardized rehabilitation in SR; the observed difference was statistically significant ($p<0.0001$) (Tables 2 and 3).

Health-Related Quality of Life

The Physical Functioning Scale (PFS-10) was used to evaluate the degree of mean values of health-related quality of life in physical functions; the list includes 10 items, as shown in Table 4. There was no statistically significant difference in the mean values of health-related quality of life before SR treatment between these two groups ($p>0.05$, Table 4).

After the treatment with standardized rehabilitation, and 20 days later, the Physical Functioning Scale (PFS-10), which includes 10 items shown in Table 5, was used to evaluate the degree of mean values of health-related quality of life in physical functions. Compared with non-SR, mean values of health-related quality of life were obviously increased after the treatment of standardized rehabilitation in SR; there was no statistically significant difference ($p<0.0001$, Table 5).

All 294 postpartum women included in this study were followed up for 3 months at our hospital. For the parturient in SR, the symptoms of DRA did not recur or worsen. There were very few patients in non-SR whose DRA improved, even though not completely.

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 the lack of understanding of this disease, many patients could not get timely and effective diagnosis and treatment, which led to

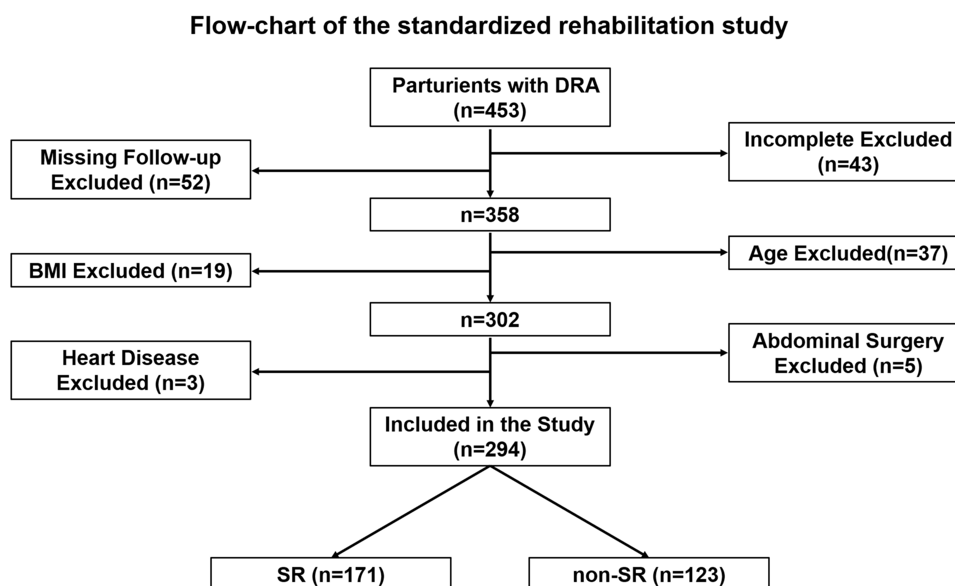

Figure 2 Flow-chart of the standardized rehabilitation study. The participants included in this study were selected based on the inclusion and exclusion criteria.

Table 1 Characteristic and Clinical Features of Patients

Items	SR (n=171)	Non-SR (n=123)	P value
Age (year)	28.00±3.12	27.35±3.33	0.076
Weight (kg)	60.05±6.08	60.11±6.26	0.936
Numbers of pregnancies	1.46±0.55	1.44±0.56	0.795
BMI (kg/m^2)	23.4±2.52	23.47±2.43	0.762
Natural delivery	112	97	0.308
Cesarean section	59	26	0.062
Diabetes	5	3	0.906
Hypertension	3	2	0.708
Chronic constipation	31	18	0.502
Abdominal pain	3	3	0.987
Pelvic pain	4	2	1.000
Low back pain	87	66	0.792

Abbreviation: BMI, body mass index.

Table 2 The Inner Edges of the Rectus Abdominis Before and After Standardized Rehabilitation

Items	Above the Umbilicus (4.5cm)		Center of Umbilicus		Below the Umbilicus (4.5cm)	
	Before SR (cm)	After SR (cm)	Before SR (cm)	After SR (cm)	Before SR (cm)	After SR (cm)
SR (n=171)	4.58±0.66	0.80±0.28	4.62±0.81	1.07±0.54	4.41±0.70	0.96±0.37
Non-SR (n=123)	4.48±1.02	3.84±0.92	4.68±0.49	3.94±0.96	4.36±0.92	3.59±0.90
P value	0.309	< 0.0001	0.466	< 0.0001	0.597	< 0.0001

Table 3 Multiple Linear Regression Model (Before and After Standardized Rehabilitation)

Items	Above the Umbilicus (4.5cm)			Center of Umbilicus			Below the Umbilicus (4.5cm)		
	β	t	P value	β	t	P value	β	t	P value
(constant)	18.649	1.4	0.163	1.874	0.12	0.904	9.955	0.68	0.497
Age (year)	0.025	1.919	0.056	0.03	2.026	0.044	0.02	1.419	0.157
Weight (Kg)	0.146	1.331	0.184	0.02	0.155	0.877	0.081	0.67	0.503
Height (m)	−11.482	−1.386	0.167	−1.329	−0.137	0.891	−6	−0.659	0.51
BMI (kg/m^2)	−0.389	−1.37	0.172	−0.044	−0.133	0.894	−0.216	−0.69	0.491
Numbers of pregnancies	0.029	0.415	0.678	−0.004	−0.055	0.956	0.052	0.691	0.49
Natural delivery vs Cesarean section	0.126	1.459	0.146	0.082	0.812	0.417	0.105	1.108	0.269
SR vs non-SR	2.493	32.55	<0.0001	2.678	29.917	<0.0001	1.934	22.978	<0.0001

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Table 4 Mean Values of Health-Related Quality of Life in Both Groups Before Standardized Rehabilitation

Items	SR (n=171)			Non-SR (n=123)		
	Limited a Lot (n)	**Limited a Little (n)**	**Not Limited at All (n)**	**Limited a Lot (n)**	**Limited a Little (n)**	**Not Limited at All (n)**
Vigorous activities	107	62	2	78	44	1
Walking 100m	13	56	102	10	41	72
Walking several 100m	55	99	17	40	71	12
Walking more than 1km	107	63	1	77	46	0
Bending/kneeling/stooping	91	80	0	66	57	0
Lifting/carrying groceries	95	76	0	67	56	0
Bathing/dressing	13	64	94	10	46	67
Moderate activities	75	96	0	53	70	0
Climbing 1 flight of stairs	17	76	78	12	55	56
Climbing several flights of stairs	94	76	1	66	56	1
Mean ± SD	17.82±4.94			17.80±4.95		
MD		4.61		4.64		
P value	0.973					

Abbreviations: Mean±SD, means ± standard deviations; MD, mean difference.

Table 5 Mean Values of Health-Related Quality of Life in Both Groups After Standardized Rehabilitation

Items	SR (n=171)			Non-SR (n=123)		
	Limited a Lot (n)	**Limited a Little (n)**	**Not Limited at All (n)**	**Limited a Lot (n)**	**Limited a Little (n)**	**Not Limited at All (n)**
Vigorous activities	50	44	77	73	48	2
Walking 100m	0	30	141	9	40	74
Walking several 100m	27	70	74	37	65	21
Walking more than 1km	55	53	63	71	46	6
Bending/kneeling/stooping	56	40	75	64	53	6
Lifting/carrying groceries	36	51	84	72	51	0
Bathing/dressing	0	23	148	10	45	68
Moderate activities	33	42	96	55	68	0
Climbing 1 flight of stairs	0	48	123	11	53	59
Climbing several flights of stairs	41	67	63	63	59	1
Mean ± SD	23.78±6.25			18.28±5.21		
MD	5.35			4.86		
P value	< 0.0001					

Abbreviations: Mean±SD, means ± standard deviations; MD, mean difference.

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 surgical treatment. Medical clinical centers are often the first-line facilities for diagnosing and treating DRA in postpartum women in China.

Herein, we designed standardized rehabilitation that can effectively alleviate the DRA of postpartum women (Tables 2–5). Based on the establishment of standardized rehabilitation (Figure S1–S19), normally an obstetrician-gynecologist and a nurse-physical therapist together do the intervention and treatment for the patient in our center. During the latest period, from January 2017 to May 2021, a total of 294 patients were included in the study, there was no statistically significant difference between these two groups before the treatment of standardized rehabilitation (Table 1). In fact, the analysis of this study showed that the DRA separation (Tables 2 and 3) and the quality of life of postpartum women (Tables 4 and 5) was obviously improved after the early treatment of standardized rehabilitation. The Physical Functioning Scale (PFS-10) is a useful self-reported health measurement tool developed in the United States applying it to patients with acute and chronic diseases.[22] This study showed that the Mean values of health-related quality of life of DRA patients have been evidently improved after receiving standardized rehabilitation treatment (Tables 4 and 5). Importantly, those parturient treated by standardized rehabilitation, the symptoms of DRA did not recur or worsen with more than 3 months' follow-up.

In the past, little attention was paid to maternal postpartum DRA because of its mild early symptoms. However, with more and more researches and studies, a deeper understanding of DRA has been gained.[12,25] DRA is one of the common complications during pregnancy and postpartum periods. It can appear around 14 weeks of pregnancy and gradually worsen until delivery.[26] Although the condition itself has become clearer, diagnosis and treatment of DRA are still controversial.[13,27] Previous studies have clearly reported that long-term postpartum DRA may lead to health complications, such as persistent low back pain, abdominal and pelvic pain, and similar. According to statistics, approximately 40% of women report persistent lower back and pelvic pain in the first half-year after childbirth.[26,28] As a matter of fact, DRA is not a health problem for many postpartum women that can be solved by itself and may even progress for many years.[29] Therefore, whether to intervene or provide treatment is related to the symptoms of DRA and whether they can be directly or indirectly relieved. The results of this study suggested that the DRA separation was significantly repaired and improved, including above the umbilicus 4.5cm, the Center of the umbilicus and below the umbilicus 4.5cm, not partial recovery (Tables 2 and 3). Early treatment and normalization of DRA separation is the key to improving the symptoms of patients.[20] This is also essential for improving the quality of life of postpartum women, as presented in this study (Tables 4 and 5). Concurrently, our study may also help other medical staff and rehabilitation physiotherapists engaged in postpartum rehabilitation in other clinical hospitals alleviate DRA symptoms and improve the patients' quality of life.

Previously, surgery has been considered an effective treatment for DRA.[25] While depending on the understanding of DRA, non-surgical treatment and/or early active intervention methods are another effective way to treat DRA.[13] Simultaneously, parturients regular abdominal exercises and aerobic exports, pelvic floor muscle exercise, posture and back care, corsets, acupuncture treatment, and other methods have all been recommended as efficient non-surgical interventions for DRA treatment.[2,13,16] The previous study has proven that abdominal muscle exercise is very effective in reducing DRA in the early postpartum period, which means exercise can significantly improve DRA symptoms and is an effective non-surgical solution.[2] To date, there is little scientific knowledge on non-surgical methods recommended to treat DRA. Although there are many non-surgical methods, there is also a lack of regulation and standardization.[30] Herein, we set the standardized rehabilitation procedure (Figure S1–S19) and treated the patients since 2017, achieving effective results as presented above. All the parturients who received standardized rehabilitation treatment experienced significant improvement in their condition, and their quality of life was significantly improved.

In China, traditional acupuncture physiotherapy is efficient and has its own characteristics;[16] however, it is very difficult to master. Using this method to treat DRA may also be time-consuming and laborious. Exercise pelvic floor muscles, rectus abdominis, and other exercise programs are mainly subjective recovery treatment methods, which require patients full perseverance to complete the exercise.[14] Other studies have reported that

electrophysiological and magnetic therapy equipment can effectively relieve DRA in postpartum women.[17] Based on the understanding of the previous research, combined with the characteristics of the electrophysiological treatment, we designed the current standardized rehabilitation treatment program for DRA (Figure S1–S19), which has been promoted through clinical trials over recent years, with good effects. This suggested that standardized rehabilitation treatment is safe and efficient for parturients with DRA. The standardized rehabilitation treatment model we set mainly includes the standardized operation of medical staff or rehabilitation physiotherapists and the proficient use of electrophysiological treatment equipment. The whole course of treatment has a short cycle (20 days, Figure S1–S19) and remarkable curative effect whilst providing patients with a comfortable treatment environment (Tables 4 and 5). Patients could better cooperate with the medical staff and/or rehabilitation physiotherapists within the standardized rehabilitation treatment. Furthermore, compared with other non-surgical treatments for DRA, standardized rehabilitation treatment significantly improved the separation of the rectus abdominis above the umbilical cord, below the umbilical cord, and the central part of the umbilicus of the parturients' DRA, evading partial recovery.

Clinical Implication

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 Chinese and Western medicine, which is more convenient to master, apply and promote. Our research provides a simple and effective standardized method to effectively treat patients with DRA. We hope to promote this standardized rehabilitation treatment, as well as to obtain further improvements and enhancements.

Conclusion

The purpose of our design and establishment of standardized rehabilitation treatment is to help parturients with DRA. This retrospective study revealed that our standardized rehabilitation treatment method is simplicity and efficiency. This approach can improve the quality of life of parturients, thus could be further promoted and applied.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author, Chaobo Chen, on reasonable request. For any queries, kindly contact bobo19820106@gmail.com.

Ethics Approval and Consent to Participate

The study was approved by the Ethics Committee of Xishan People's Hospital of Wuxi City, No. xs2020ky013. The need for individual consent was waived by the committee. This article was a retrospective study, patient parental consent to review their medical records was not required by the ethics Committee of Xishan People's Hospital of Wuxi City. This study strictly kept the patients' information confidential. The study complied with the Declaration of Helsinki.

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Author Contributions

All authors have read and approved the final manuscript; have made important contributions to the work of the report, whether in terms of methods creation, research design, implementation, data aggregation, statistical analysis, and interpretation, etc., and participated in drafting, revising, and reviewing the manuscript; finally reaching an agreement on the journal to which the article was submitted; and finally agreed to be responsible for all aspects of the work.

Jiang Hu and Juanfen Gu have contributed equally as co-first authors. Chaobo Chen and Lina You should be considered joint corresponding authors.

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Disclosure

The authors declare no conflicts of interest for this work.

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