

# EFFECT OF BIOFEEDBACK TRAINING ON FECAL INCONTINENCE IN CHILDREN WITH MYELOMENINGOCELE

**Reda SM Sarhan** PTD \*, **Enas Elsayed** PTD \*\*

\* *Physical therapy department , Al-Hussein university hospital, Al-Azhar university . \*\*Physical therapy department for neuromuscular disorders and its surgery, faculty of physical therapy, Cairo university.*

## **Abstract:**

**Purpose :** *This study aimed at evaluating the effects of biofeedback training on children with fecal incontinence.*

**Subjects:** *Twenty children (12 males and 8 females), diagnosed as spina-pifida (myelomeningocele), were recruited from pediatrics outpatient clinic, Al-Hussien university hospital, Cairo, Egypt, Their age ranged from ten to fifteen years .*

**Methods:** *Anorectal manometric functions were assessed for all children before and after treatment .The children were randomly divided into two groups of equal number (control and study). Both groups received physical therapy program (daily rectal evacuation program, diet control and pelvic floor muscle exercises) . In addition, the study group received biofeedback training program. Treatment for all patients continued for three months ( one hour/session , three times/week ) .*

**Results :** *The results revealed statistically significant improvement in the outcome measures in the study group. Biofeedback training improved anal squeeze as well as rectal sensation.*

**Conclusion :** *Biofeedback training in conjunction with conventional therapy program was effective in improving fecal incontinence in children with myelomeningocele*

**Key Words:** Myelomeningocele-Neurogenic fecal incontinence– Urodynamic biofeedback .

## **Introduction**

Neural tube defects are complex congenital malformations involving the spine (spina bifida) or the cranium (anencephaly, encephaloceles)<sup>1,2</sup>. These defects occur before the end of the 4th week of gestation and are characterized by a midline vertebral defect (spina bifida), most often in the dorsal portion of the lumbosacral vertebrae. When only a meningeal sac protrudes through the defect, it is called a meningocele; if the spinal cord also protrudes, it is called a myelomeningocele (MMC)<sup>3</sup>. Myelomeningocele accounts for about 75% of all cases of spina bifida and may affect as many as one out of every 800 infants. The cause is unknown; however, folic acid deficiency is thought to play a part in neural tube defects. Preconception folic acid supplementation may prevent spina bifida. The disorder appears to be more common in families. Research also indicates possible environmental factors such as radiation. Protrusion of the spinal cord and meninges damages

the spinal cord and nerve roots, causing a decrease or lack of function of body areas controlled at or below the defect. Symptoms are related to the anatomic level of the defect<sup>4,5,6</sup>. Recent spinal hemorrhages may be superimposed upon pre-existing defects. If early therapeutic strategies can prevent these superimposed secondary spinal hemorrhages, motor outcome may improve<sup>7</sup>.

Rectal sensation, peristalsis and adequate ano-rectal function are of major importance for normal continence and defecation. Neurological defects in patients with spinal lesions may affect one or more of these components and are manifested as inadequate sensation of rectal fullness, poor peristalsis, inappropriate tone or activity of the anorectal sphincter mechanism or a combination of these, resulting in fecal incontinence or chronic constipation or both<sup>8</sup>.

Fecal incontinence is the inability to control bowel movements, causing stool to leak from rectum. It ranges from an occasional leakage of stool

while passing gas to a complete loss of bowel control<sup>9</sup>. In childhood and adolescence, fecal soiling represents a psychologically devastating problem. The medical management of those patients is usually combined with behavioral techniques (toilet training) and cognitive exercises (psychotherapy and family therapy) . In patients who cannot achieve the main elements for bowel continence (anorectal sensation, functioning sphincters, and rectal motility), these methods of treatment often fail to achieve satisfactory results<sup>10,11</sup>. Biofeedback is a conditioning treatment in which information about a physiologic

process is converted into a simple visual or auditory signal to enable the patient to learn to control a disordered function<sup>12</sup>. Anal sphincter exercises and biofeedback therapy have been used to treat the symptoms of people with fecal incontinence. However, standards of treatment are still lacking and the magnitude of alleged benefits has yet to be established<sup>13</sup>.

### **Aim of the study:**

The aim of the present study was to evaluate quantitatively the effectiveness of biofeedback training as a primary tool designed to control fecal incontinence in children with myelomeningocele .

## ***SUBJECTS, MATERIALS AND***

### ***METHODS***

#### **SUBJECTS:**

The present study included twenty children of both sexes (12 males and 8 females) diagnosed as MMC . They were recruited from pediatrics out - patient clinic, Al-Hussien university hospital, Cairo, Egypt .

#### ***Inclusion criteria:***

Patient's age ranged from ten to fifteen years (mean =  $11.6 \pm 2.8$ ) . They were the same as regard the socioeconomic status and the educational level , they were ambulant and their IQ varied from 73 to 96 ( mean = 88.40 ) estimated by psychiatrist. The patients' level of incontinence ranged from

grade zero to grade one according to Kelly's score for continence<sup>14</sup>.

**Exclusion criteria** : Ano-rectal surgical interference e.g. sphincteric repair or muscle transplantation.

Children were randomly assigned into two equal groups : Study and control groups .

## **MATERIALS**

### **Evaluation Instruments :**

#### **Electromyograph**

Danetee Key point M , made in Denmark.

**Sandhill's anorectal manometry kit** : It includes syringes, pressure transducers, stopcocks, extension lines and recorder.

### **Treatment Instruments :**

**Aanorectal manometry** : It includes: *Schuster probe*, model PIN, A86-5050, Sandhill's Scientific, Inc., Littleton, Colorado USA, which is a flexible, silicone, rubber tubes , pediatric size .

*Manometry kit (Sandhill's)*

*Computer accessories:* Colored monitor, loudspeaker, keyboard, mouth and multi-channel recorder.

*Computer programs* with two different soft wares, one for anorectal manometry and the other for biofeedback training called biofeedback meter which has audible tones and visual bar graph for reinforcing the level of effort.

## **METHODS**

### **Evaluation Methods:**

All children were evaluated clinically through detailed history taking and general and local examination .

**Anorectal manometry:** It was performed by using the Sandhill anorectal kits. The following measurements were recorded:

#### **Maximal resting anal pressure (MRAP):**

It is the highest pressure in the anal canal with the patient at rest, located at 1.5 cm from the anal verge for both males and females. The normal MRAP ranges from 70-120 cm water for males and 60-100 cm. water for females<sup>15</sup> .

#### **Maximal voluntary contraction pressure (MSAP):**

It is the maximal increase above the resting pressure<sup>16</sup> .

#### **Voluntary contraction time** :

It is the time from the beginning of contraction until half decrease of the rectal pressure amplitude .

**Threshold of rectal sensation :** The upper balloon was gradually inflated by water until the patient felt desire to defecate . The smallest volume to which the patient responds was recorded as the minimum sensory threshold .

**Maximal tolerable rectal volume:** A balloon catheter with a 50cc capacity was inserted in the rectum and gradually inflated with air. The volume at which the patient perceives additional inflation would be intolerable or at which the balloon involuntarily expelled is considered the maximal tolerable volume. This volume constitutes a rough measure of rectal capacity.

### **Treatment Methods :**

#### **Control group**

#### ***Patients belonging to control group***

received conventional therapy program in the form of :

#### **Daily rectal evacuation program:**

After complete initial rectal evacuation , the rectum was maintained empty through giving daily anal laxative suppository given

twice daily for the first 2 days, then once daily for 10 days to three weeks . The child was asked to go to the toilet every 6 hours during the daytime. This fixed dose might stimulate a conditional reflex for daily rectal evacuation. When complete control was reached, the suppository program was stopped and the child was encouraged to go to the toilet for regular rectal evacuation.

**Diet control:** The diet was given in the form of bulk forming diet, fruits, vegetables, cereals and bran. The usual daily dose for children was two table spoonful twice/day .

#### **Pelvic floor muscle exercises (Kegel's exercises)<sup>17</sup>:**

The patient was instructed to lie side lying position with knees bent towards the chest . He or she was instructed to pull his/her pelvic muscles upward and inward and hold the contraction for 6 seconds, as if to hold back a defecation movement , followed by relaxation for 6 seconds . The exercise was repeated 25 times. Gradually increase the time until

reaching 10 seconds of contraction and relaxation for each with repetition up to 30 times.

To avoid substitution of hip adductor muscles for pelvic-floor muscle contractions, the patient's knees were manually supported.

During the performance of pelvic muscle contractions, the patient was instructed to perform pursed-lip breathing to avoid valsalva response.

### **Study group:**

#### ***Patients belonging to the study group***

were subjected to the same conventional therapy program in addition to biofeedback training

#### ***Technique for biofeedback training:***

The patient was instructed to lie on the left side lying position with flexed knees towards chest and facing the monitor in order to see the changes that occur during the procedure on the screen .

### **A schuster balloon tri-luminal catheter**

**pediatric size (Sandhill)** was used as follow<sup>18</sup> :

1. The lower (distal) balloon was adjusted to lie opposite to the anal verge .
2. The middle balloon was adjusted opposite to the internal anal sphincter located at 1.5 cm from the anal verge for both males and females.
3. The upper (proximal) balloon was adjusted 4-12 cm above the anal verge
4. The part of the probe that remains extra - anal was fixed to the perineum by adhesive tapes to prevent its sliding out.

### ***Steps for biofeedback training:***

5. The middle balloon was inflated by air first to stimulate the internal anal sphincter thus avoiding slipping of the catheter, followed by inflation of the lower balloon to stimulate the external anal sphincter (anal resting pressure)
6. The rectum was stimulated by inflation of the upper balloon gradually by air until the patient feels desire to defecate (threshold of rectal sensation).
7. Immediately after onset of feeling rectal distension , the patient was asked to pull

his/her pelvic muscles upward and inward the contractions up to 30 times (strain) , as much as he can for of 6 seconds, /session.

as if to defecate and then asked to relax the muscles for 6 seconds with repetition for 25 times, to increase and decrease the pressure of the anal canal at the same time . In order to reinforce controlling the anal sphincter by will, the patient was shown that the diagram on the monitor of the computer screen increases during contraction and decreases during relaxation.

8. The rectal distention was stopped when the rectal pressure amplitudes reached to its half value due to sphincteric fatigue.

9. Patients were encouraged verbally to practice pelvic floor contraction between biofeedback sessions and to take bulk-forming agents.

10. After each session, the patient was requested to practice the same procedure at home, twice daily.

11. The procedure was repeated each session and the patient was encouraged to increase the time of contraction gradually until reaching 10 seconds contraction followed by 10 seconds relaxation and to repeat

12. When the patient linked psychologically the sensation of rectal distension with voluntary contraction of the pelvic floor muscle and external anal sphincter, the patient was asked to repeat these procedures and relax the anal sphincter without visualizing the monitor.

13. When the patient had acquired the capability of contracting and relaxing the sphincter without looking at the monitor on every single attempt, the patient has been encouraged to practice regularly these exercises at home.

14. The study continued for three months , three times per week and each session lasted for 60 min.

## **Results**

### ***Maximal resting anal pressure:***

Before treatment, there was no significant difference in the mean value of the anal resting pressure between the study and control groups ( $p=0.831$ ). After treatment, a very highly significant

improvement was found in the study group compared to that of the control group ( $p = 0.0001$ ). Also the results revealed a highly significant increase in the anal resting pressure mean value

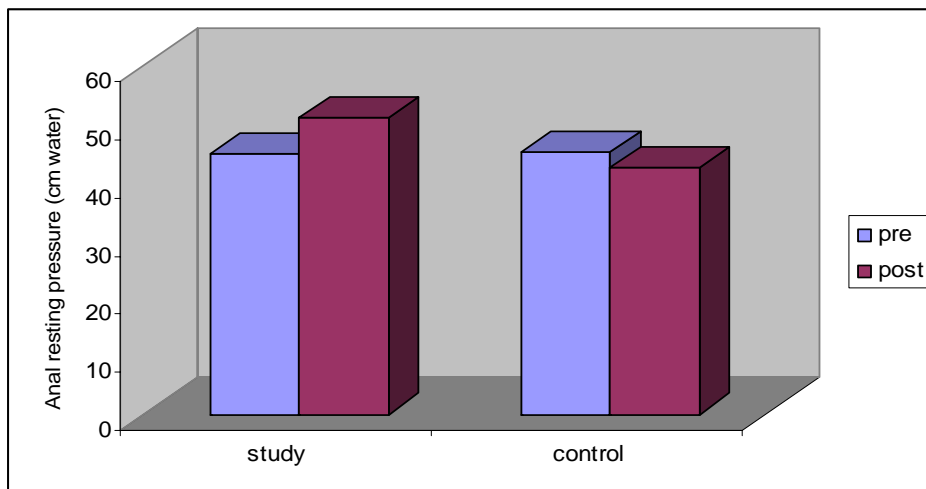
within the study group after treatment compared to that before treatment ( $p=0.003$ ) (table (1)and fig.(1) ).

**Table(1): Comparison between study and control groups as regard maximal anal resting pressure before and after treatment.**

Maximal anal resting pressure (cm water)	Study group Mean $\pm$ SD	Control group Mean $\pm$ SD	<i>t</i>	<i>p</i>
<b>pre</b>	44.75 $\pm$ 3.37	45.13 $\pm$ 3.52	- 0.218	0.831
<b>post</b>	51.00 $\pm$ 2.56	42.38 $\pm$ 1.77	7.834	0.0001***
<i>t</i>	4.429	-1.536		
<i>p</i>	0.003**	0.168		

\*\* Highly significant

\*\*\* Very highly significant



**Fig. (1): Mean values of maximal anal resting pressure before and after treatment in the study and control groups.**



***Maximal voluntary contraction pressure:***

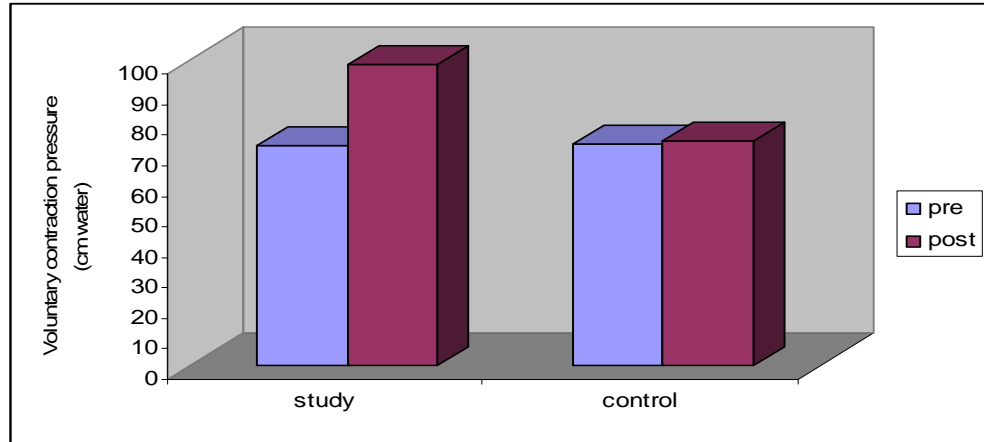
Before treatment, there was no significant difference in the mean value of the voluntary contraction pressure between the study and control groups ( $p=0.871$ ). After treatment, a very highly significant improvement was found in the study group compared to that of the

control group ( $p = 0.0001$ ). Also the results revealed a very highly significant increase in the voluntary contraction pressure mean value within the study group after treatment compared to that before treatment ( $p=0.0001$ ) (table (2) and fig.(2) ).

***Table(2): Comparison between study and control groups as regard maximal voluntary contraction pressure before and after treatment.***

<b>Maximal voluntary contraction pressure (cm water)</b>	<b>Study group Mean <math>\pm</math> SD</b>	<b>Control group Mean <math>\pm</math> SD</b>	<b><i>t</i></b>	<b><i>p</i></b>
<b>pre</b>	71.88 $\pm$ 7.04	72.50 $\pm$ 8.02	- 0.166	0.871
<b>post</b>	98.88 $\pm$ 3.23	73.63 $\pm$ 8.67	7.722	0.0001***
<b><i>t</i></b>	- 13.75	- 0.709		
<b><i>p</i></b>	0.0001***	0.501		

\*\*\* Very highly significant



**Fig. (2): Mean values of maximal voluntary contraction pressure before and after treatment in the study and control groups.**

***Voluntary contraction time:***

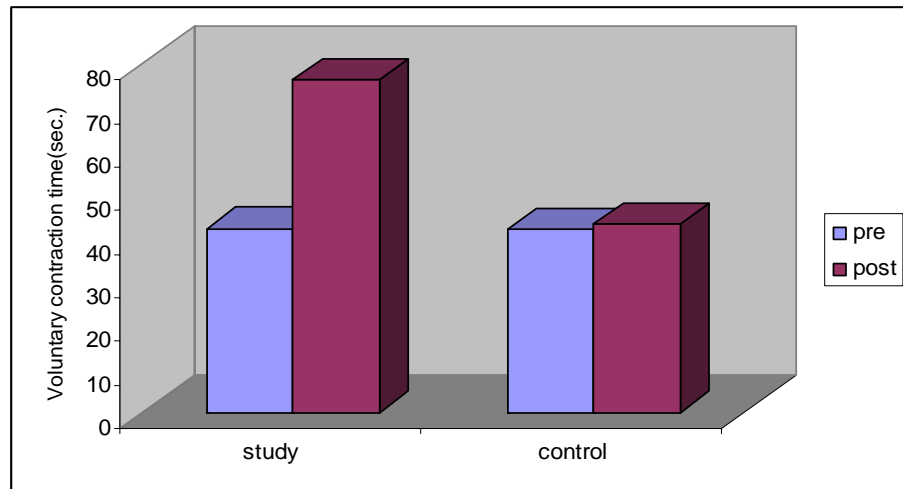
Before intervention, there was no significant difference in the mean value of the voluntary contraction time between the study and control groups ( $p=0.940$ ). After treatment, a very highly significant improvement was found in the

study group compared to that of the control group ( $p = 0.0001$ ). Also the results revealed a very highly significant increase in the voluntary contraction time mean value within the study group after treatment compared to that before treatment ( $p=0.0001$ ) (table (3) and fig.(3))

**Table(3): Comparison between study and control groups as regard voluntary contraction pressure before and after treatment.**

Voluntary contraction time (sec.)	Study group Mean $\pm$ SD	Control group Mean $\pm$ SD	<i>t</i>	<i>p</i>
<b>pre</b>	42.13 $\pm$ 6.56	41.88 $\pm$ 6.51	0.077	0.940
<b>post</b>	76.25 $\pm$ 12.75	43.13 $\pm$ 10.66	5.639	0.0001***
<b><i>t</i></b>	- 10.688	- 0.518		
<b><i>p</i></b>	0.0001***	0.620		

\*\*\* Very highly significant



**Fig. (3): Mean values of voluntary contraction time before and after treatment in the study and control groups.**

***Threshold of rectal sensation***

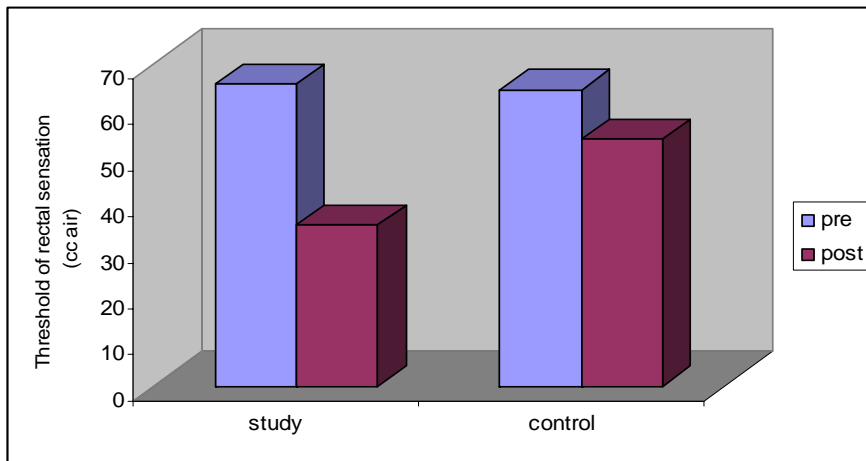
Before intervention, there was no significant difference in the mean value of the rectal sensation threshold between the study and control groups ( $p=0.601$ ). After treatment, a highly significant decrease was found in the study group compared to that of the control group ( $p = 0.002$ ). Also the results revealed a very highly

significant decrease in the rectal sensation threshold mean value within the study group and a significant decrease within the control group after treatment compared to that before treatment ( $p=0.0001$  and  $0.019$  respectively ) (table (4) and fig.(4) ).

**Table (4): Comparison between study and control groups as regard threshold of rectal sensation before and after treatment.**

<i>p</i>	<i>t</i>	Control group Mean ± SD	Study group Mean ± SD	Threshold of rectal sensation (cc air)
0.601	0.535	64.38±4.90	65.63±6.56	<b>pre</b>
0.002**	- 3.910	53.75±10.61	35.00±12.75	<b>post</b>
		3.032	12.114	<i>t</i>
		0.019*	0.0001***	<i>p</i>

\*Significant \*\* Highly significant \*\*\* Very highly significant



**Fig. (4): Mean values of threshold of rectal sensation before and after treatment in the study and control groups.**

***Maximal tolerable rectal volume***

Before intervention, there was no significant difference in the mean value of the maximal tolerable rectal volume between the study and control groups ( $p=0.898$ ). After

treatment, a very highly significant decrease was shown in the study group compared to that of the control group ( $p = 0.0001$ ). Moreover , a highly significant decrease was obtained in the maximal tolerable rectal volume mean value within the

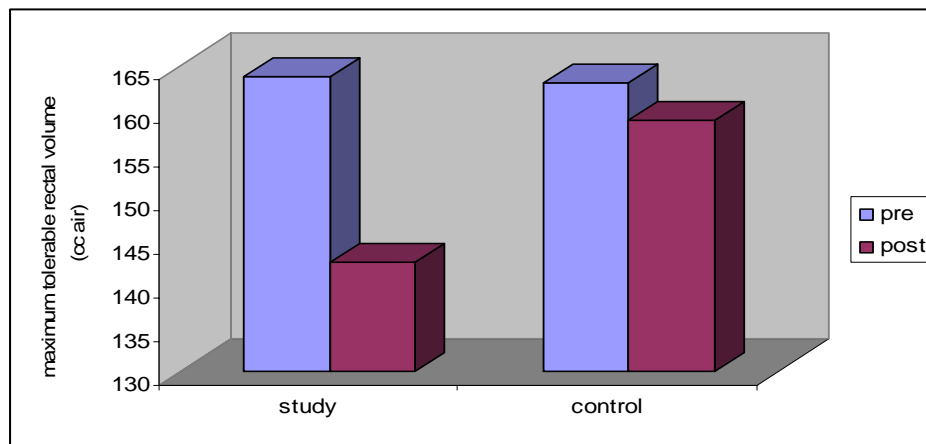
study group after treatment compared (table (5) and fig.(5) ).  
to that before treatment ( $p=0.001$ )

**Table (5): Comparison between study and control groups as regard maximum tolerable rectal volume before and after treatment.**

<i>p</i>	<i>t</i>	Control group Mean ± SD	Study group Mean ± SD	Maximal tolerable rectal volume (cc air)
0.898	0.131	163.13±9.61	163.75±9.54	<b>pre</b>
0.0001***	- 5.017	158.75±6.41	142.50±6.55	<b>post</b>
		1.986	5.667	<i>t</i>
		0.087	0.001**	<i>p</i>

\*\* Highly significant

\*\*\* Very highly significant



**Fig. (5): Mean values of maximal tolerable rectal volume before and after treatment in the study and control groups.**

## Discussion

The management of the fecal incontinence in children is difficult, and its social consequences are usually devastating . The general objectives of any bowel program are to produce social continence, predictability, and independence. Achievement of those goals depends in part on the underlying cause . In children, fecal incontinence can occur from a variety of causes . The most common is overflow incontinence from functional fecal retention, but it can also occur in otherwise healthy children with functional non-retentive fecal soiling or in children with organic causes such as congenital malformations in children with myelomeningocele or any other condition affecting the anorectum, anal sphincters or the spinal cord .

The results of the present study showed clearly the beneficial effects of using biofeedback training on increasing the anal resting pressure, increasing the voluntary contraction pressure,

decreasing the rectal sensation threshold and improving anal squeeze.

The findings of the current study are supported by Dobben et al<sup>9</sup> who indicated that physiotherapy is a common treatment option in patients with fecal incontinence. Although physiotherapy may result in relief of symptoms, changes in the anorectal function is still unclear. Physiotherapy improves squeeze pressure and urges sensation , however, improved anorectal function does not always result in a decrease in fecal incontinence complaints.

.Moreover , our results are supported by those of Jensen<sup>19</sup> who attributed the effect of biofeedback training to the increased sensory feedback mechanism resulting in enhancement of voluntary motor control . He concluded that a multidisciplinary approach to treatment has the potential to improve the outcome for patients with fecal incontinence.

The improvement of the outcomes in patients with fecal incontinence also came in agreement with the findings of Terra et al<sup>20</sup> who found that pelvic

floor rehabilitation with biofeedback leads to a modest improvement in severity of fecal incontinence, squeeze pressure, and maximal tolerated volume . They reported that the improvement might be due to an improved pattern of recognition areas of both sensory and cerebellar cortexes. This leads to development of pattern anagrams in the sensory-motor cortex that is related to the anorectal function .

Also , The findings of the current work coincide with that of Whitehead et al<sup>21</sup> who observed that approximately six hours of biofeedback training given to eight fecally incontinent children with MMC were enough to learn children to evacuate normally or to reduce soiling . The patients were shown a polygraph tracing of the external anal sphincter while they were being encouraged voluntarily to contract the sphincter when the rectum was distended with progressively larger volumes of air in a balloon . The results Norton and Kamm<sup>22</sup> are also consistent with that of the current research .They reported

that application of biofeedback training in addition to traditional physical therapy program , played an important role for those patients with congenital/neuropathic incontinence .

Combination of those maneuvers can be used to change stool consistency, anorectal function and rectal evacuation . Sphincter pressure can be altered and bowel movement can be induced. The results of the present study are also confirmed by those of Norton et al<sup>13</sup> who postulated that anorectal biofeedback is a treatment program that utilizes neuromuscular conditioning techniques to treat patients with fecal incontinence or chronic constipation that is associated with dysynergic defecation . Dysynergic defecation, also known as anismus or pelvic floor dysynergia, is characterized by failure of the abdominal, rectal, pelvic floor and anal sphincter muscles to coordinate and complete the act of defecation. It is characterized by impaired propulsion of stool from the rectum, paradoxical anal contraction, or inadequate anal relaxation or a combination of these

mechanisms. Moreover , the results of the present piece of work coincide with the findings of Solomon et al<sup>23</sup> who performed a prospective , randomized , controlled trial to assess whether pelvic floor exercises with biofeedback using anal manometry or transanal ultrasound are superior to pelvic floor exercises with feedback from digital examination alone in terms of continence, quality of life, physiologic sphincter strength and compliance. They concluded that patients who completed pelvic floor exercises with feedback from digital examination achieved benefit from biofeedback and measurement with transanal ultrasound or manometry . Their study has confirmed that pelvic floor retraining programs are effective treatment for improving physiologic, clinical and quality of life parameters in those patients .In contrast , Van Tets et al<sup>24</sup> concluded that external sphincter contraction exercises under direct electromyographic vision were not effective in neurogenic fecal incontinence. The degree of continence did not improve and the external

sphincter function did not increase significantly. Their results can be attributed to the age range they included which was very wide being 29 – 61 years . Also , they studied the effect of biofeedback on neurogenic fecal incontinence in general whatever the cause which may include aging causes .

The results of the present study were not also in agreement with those of Brazelli and Griffiths<sup>25</sup> who reported that , in a randomized controlled study, bio-feedback plus behavioral management was compared to behavioral management alone in children with fecal incontinence due to MMC . Both study and control groups displayed significant improvement, suggesting that bio-feedback has the same effects as behavioral management for most children with MMC . However, it must be stressed that patients with spinal cord defects show commonly worst responses to bio-feedback than patients with incontinence due to other causes .



### ***CONCLUSIONS***

This study demonstrated that biofeedback training program is an effective tool in improving bowel continence parameters in children with MMC. It is recommended that

biofeedback therapy in combination with conventional physical therapy are essential treatment for patients with fecal incontinence.

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