

**Introduction**

One of the treatment methods for patients with the intestinal transit disorders, caused by postoperative concretion induced occlusions, may be physiotherapy with the application of Dynamic Taping (DT) techniques.

**Aim of the Study**

In this study, we have aimed to evaluate the effects of the DT method applied for regulating of intestinal transit, based on the test of hydrogen molecules in the air exhaled by a patient. In the study we have also assessed the number of bowel movements and the stool consistency.

**Materials and Methods**

In our study participated patients (15 women and 5 men, mean age 48.85 years) with the intestinal transit disorder syndrome, caused by concretions after surgical procedures. The patients knowingly and voluntarily took part in the research. Our project has received a positive opinion from the Commission of Bioethics of the Opolska Medical Chamber in Opole. The participating patients were divided randomly, with the use of a computer randomizing program, between the test group TE (12 women and 4 men, mean age 47.67 years) and the control group CO (3 women, 1 man, mean age 54.25). In the TE group, to improve the intestinal transit the dynamic taping has been used. In the CO group, the placebo effect has been applied (procedures with no therapeutic importance). In order to assess the effects of the DT technique in the patients, we have used the hydrogen breath test (evaluation of the hydrogen molecules in the exhaled air). We have also assessed the number of bowel movements per day and the stool consistency according to the Bristol Stool Scale (Table 1). The number of bowel movements, and the stool consistency, have been assessed prior to the DT technique application, and in 1, 5, 10, 15, 20 and 24 days after the application. The hydrogen breath test (hydrogen molecules in the exhaled air) has been performed before, and in 5 and 15 days after the procedure.

**Table 1. Bristol Stool Scale**

Type 1		Separate hard lumps, like nuts (hard to pass)	Type 5		Soft blobs with clear cut edges (passed easily)
Type 2		Sausage-shaped, but lumpy	Type 6		Fluffy pieces with ragged edges, a mushy stool
Type 3		Like a sausage but with cracks on its surface	Type 7		Watery, no solid pieces, entirely liquid
Type 4		Like a sausage or snake, smooth and soft			

In order to assess the effects of DT physiotherapy method, we have applied hydrogen breath test using the H2-Check device, manufactured by MD Diagnostics Ltd. The factor used for the test was lactulose, in the dose of 10g. Each hydrogen breath test had been performed at least 12 hours before the tested patient had a meal. Before, and during the test, the patients had not been taking any medicines, which could have had an impact on the test results, according to the methodology provided by the measuring device manufacturer. After measuring of the initial value of hydrogen in the exhaled air “on an empty stomach” (bioassay before dosing the factor), the concentration of hydrogen in the breath was measured every 30 minutes, over a period of 3 hours, and additionally in 15 minutes after the administration of the factor. We have assumed, that the reduction of concentration of hydrogen in the breath means improvement of the intestinal transit.

The additional measures of the transit improvement have also been: the higher number of the stool type in Bristol scale, and the regularity of bowel movements.

### Methods of Dynamic Taping

In the TE group of patients, the following DT methods have been applied:

1. muscular – detonization of the external oblique muscles on the left side;
2. muscular – detonization of the internal oblique muscles on the right side;
3. facial in the area of liver (Fig. 1).

In the patients included in the CO group, the procedures applied have had no impact on the physiotherapy process. We have applied, on both sides, the muscular technique of type 1 on the iliopsoas muscle (with a light tension of the tape 15-25%), the base has been taped 3 cm below the navel and the end at the height of the lesser trochanter of the femur (Fig. 2). In all the patients the tapes were being replaced every 3 days.

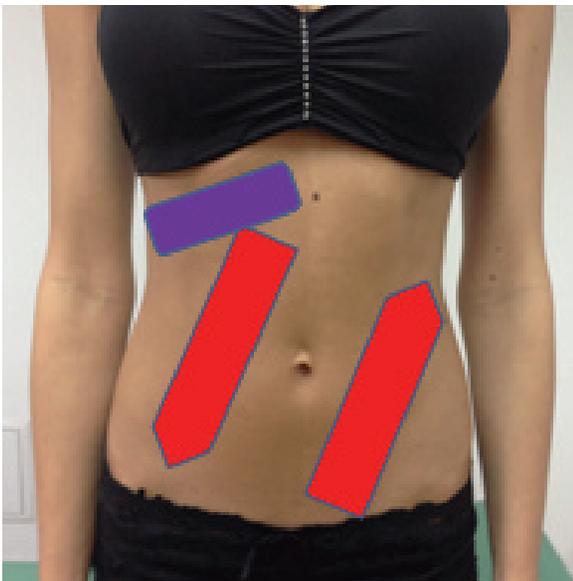


Fig. 1. Applications used in the TE group



Fig. 2. Applications used in the CO group

### Statistical Methods

To evaluate the results, we have employed the Friedman Test method, which verifies the variance between examination tasks and the appropriate post hoc analysis, testing the significance of differences between the examination tasks. For each of the examinations, there has been applied a separate comparative analysis, to compare both groups (Mann-Whitney U Test).

Due to the so called “alpha error cumulation” for multiple comparisons, the test result has been adjusted with the Bonferroni correction, and on this basis the significance of difference for the predetermined level has been established ( $p=0.05$ ).

The resulting significance, after the above correction, has been presented as the Bonferroni correction for the multiple comparisons.

### Results

The type of variable shown in our research, together with the low absolute values of skewness and kurtosis, have suggested the use of the analysis of variance (ANOVA) with the double classification of the repeated measurements. The differentiating factor has been the group (TE/CO), and the repetition factor – the test before the therapy application (0), and 5, and 15 days after the application of the DT method.

### H<sub>2</sub> Content in the Exhaled Air

**Table 2. Descriptive statistics of the H<sub>2</sub> molecules in the exhaled air (TE group)**

TE group (16 persons)				
Test	$\bar{x}$	Min.	Max.	SD
H <sub>2_0</sub>	47.12	20.00	82	17.77
H <sub>2_5</sub>	21.87	8.00	40	9.00
H <sub>2_15</sub>	11.06	0.00	32	7.57

**Table 3. Descriptive statistics of the H<sub>2</sub> molecules in the exhaled air (CO group)**

CO group (4 persons)				
Test	$\bar{x}$	Min.	Max.	SD
H <sub>2_0</sub>	37.75	25.00	60	16.64
H <sub>2_5</sub>	37.50	18.00	55	16.05
H <sub>2_15</sub>	47.75	20.00	84	27.93

**Table 4. Variance analysis with double classification for the repeated measurements (ANOVA) – median values**

Immediate Effect: F(2, 36)=13.166, p=.00005						
	Group	Test	$\bar{x}$	SD	PU -95.00%	PU 95.00%
1	TE	H <sub>2_0</sub>	47.12	4.40	37.89	56.36
2	TE	H <sub>2_5</sub>	21.87	2.63	16.35	27.40
3	TE	H <sub>2_15</sub>	11.06	3.33	4.06	18.06
4	CO	H <sub>2_0</sub>	37.75	8.79	19.27	56.23
5	CO	H <sub>2_5</sub>	37.50	5.26	26.46	48.54
6	CO	H <sub>2_15</sub>	47.75	6.67	33.75	61.75

**Variance Analysis for Repeated Measurements**

**Table 5. Variance analysis with double classification for repeated measurements**

	SS	Stopnie swobody Degrees of freedom	MS	F	p
Polynomial	43983.34	1	43983.34	129.69	1.166E-09
Group	1966.54	1	1966.54	5.80	0.02698
Error	6104.31	18	339.13		
TEST	1418.47	2	709.24	5.49	0.00831
TEST*Group	3403.07	2	1701.54	13.16	0.00005
Error	4652.62	36	129.24		

**Table 6. Multivariate tests for repeated measurements**

Sigma restricted parametrization Effective hypothesis decomposition						
	Test	Value	F	Effect df	Error df	p
TEST	Wilks	0.7074021	3.5157963	2	17.00000	0.05274
TEST*Group	Wilks	0.4661537	9.7343297	2	17.00000	0.00152

Our research analysis has found a statistically significant difference between the groups of TE and CO ( $p=0.027$ ) and a statistically significant difference between the individual tests ( $p=0.008$ ). It has also shown a significant effect of the interaction of those factors ( $p < 0.001$ ).

Due to the failure to fulfill, in the tests, the sphericity condition (Mauchly Test,  $p = 0.036$ ), we have additionally applied the multivariate analysis of variance MANOVA, which has confirmed the significant effect of the interactions, which have occurred.

Post hoc analysis (Bonferroni Test) has shown, that the hydrogen molecules concentration in the exhaled air, found in the patients from the TE group, has been significantly reduced between their tests prior to the therapy application and after 5 days after the therapy with the DT method ( $p < 0.001$ ), and between their tests prior to the therapy and after 15 days after the DT therapy has been applied ( $p < 0.001$ ). There has also been established a significant difference in the hydrogen molecules concentration between the TEST and the CONTROL group, upon 15 days after the DT method has been applied ( $p=0.00047$ ) (Table 7, Fig. 3).

Table 7. Bonferroni Test

Probabilities for the Post-hoc Tests							
Error: MS Between Groups, Measurements Rep., together= 199.20, df							
Group	Test	{1}	{2}	{3}	{4}	{5}	{6}
		47.125	21.875	11.062	37.75	37.5	47.75
1	TE	H2_0	0.00000	0.00000	1.00000	1.00000	1.00000
2	TE	H2_5	0.00000	0.16139	0.75689	0.81053	0.03085
3	TE	H2_15	0.00000	0.16139	0.02300	0.02518	0.00047
4	CO	H2_0	1.00000	0.75689	0.02300	1.00000	1.00000
5	CO	H2_5	1.00000	0.81053	0.02518	1.00000	1.00000
6	CO	H2_15	1.00000	0.03085	0.00047	1.00000	1.00000

Legend:

- The significance of the differences between the tests within the same group
- The significance of differences between the groups during the same test

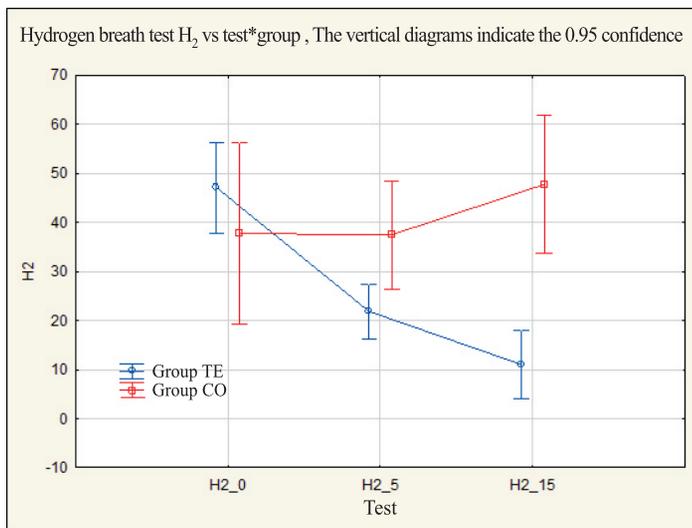


Fig. 3. The comparison of the H<sub>2</sub> concentration in the exhaled air in the two groups (TE/CO)

### Assessment of the Number of Bowel Movements

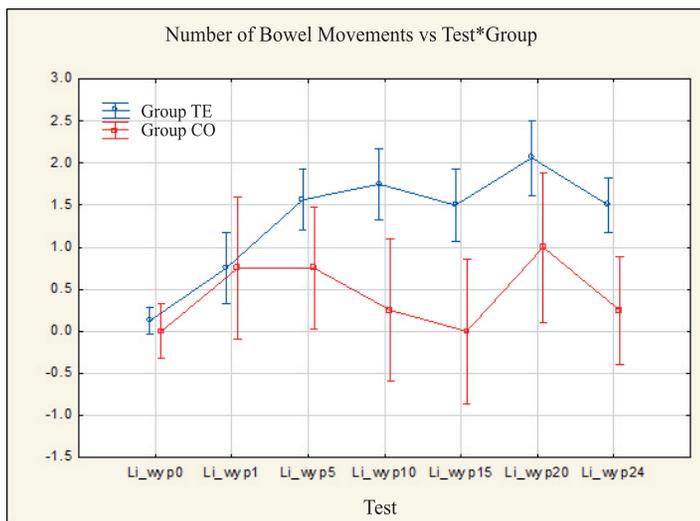
Comparative analysis has shown significantly more bowel movements on the 15th and 24th day after the treatment in the TE group, if compared with the results in the CO group (Tables 8,9), which confirms the effectiveness of the applied physiotherapy with the use of taping (Fig. 4).

Table 8. Descriptive statistics of the assessment of the number of bowel movements (in TE group)

TE group (16 persons)				
	$\bar{x}$	Min.	Max.	SD
No_bow_mov0	0.12	0	1	0.34
No_bow_mov1	0.75	0	2	0.77
No_bow_mov5	1.56	1	3	0.72
No_bow_mov10	1.75	0	3	0.85
No_bow_mov15	1.50	0	3	0.8
No_bow_mov20	2.06	0	3	0.85
No_bow_mov24	1.50	1	3	0.63

Table 9. Descriptive statistics of the assessment of the number of bowel movements (in CO group)

CO group (4 persons)				
	$\bar{x}$	Min.	Max.	SD
No_bow_mov0	0.00	0	0	0.00
No_bow_mov1	0.75	0	2	0.95
No_bow_mov5	0.75	0	1	0.50
No_bow_mov10	0.25	0	1	0.50
No_bow_mov15	0.00	0	0	0.00
No_bow_mov20	1.00	0	2	0.81
No_bow_mov24	0.25	0	1	0.50



**Fig. 4.** Number of bowel movements on the particular days during the tests (in the groups TE and CO)

### Stool Consistency

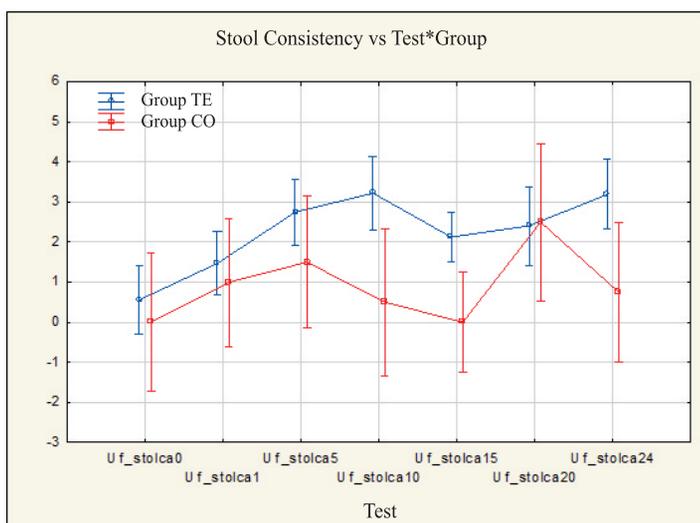
Comparative analysis has shown significantly greater indicator of the stool consistency on the Bristol scale, on the 15th day of the tests in the TE group, if compared with the results in the CO group (Table 10, Table 11, Fig. 5).

**Table 10.** Descriptive statistics of the assessment of the stool consistency (in the TE group)

Grupa BA (16 osób)/TE group (16 persons)				
	$\bar{x}$	Min.	Max.	SD
Uf_stolca0/St_cons0	0.56	0	7	1.78
Uf_stolca1/St_cons1	1.46	0	5.5	1.58
Uf_stolca5/St_cons5	2.75	1	7	1.61
Uf_stolca10/St_cons10	3.21	0	7	1.85
Uf_stolca15/St_cons15	2.12	0	5	1.31
Uf_stolca20/St_cons20	2.40	0	5	1.49
Uf_stolca24/St_cons24	3.18	1	7	1.68

**Table 11.** Descriptive statistics of the assessment of the stool consistency (in the CO group)

TE group (4 persons)				
	$\bar{x}$	Min.	Max.	SD
Uf_stolca0/St_cons0	1.78	0	0	0.00
Uf_stolca1/St_cons1	1.58	0	2	1.15
Uf_stolca5/St_cons5	1.61	0	3	1.29
Uf_stolca10/St_cons10	1.85	0	2	1.00
Uf_stolca15/St_cons15	1.31	0	0	0.00
Uf_stolca20/St_cons20	1.49	0	7	3.10
Uf_stolca24/St_cons24	1.68	0	3	1.50



**Fig. 5.** Stool consistency according to Bristol scale (in TE and CO groups)

### Discussion

It is assumed, that concretions in the peritoneal cavity are caused by surgical procedures. The estimation is, that over 90% of concretions in the peritoneum area is being formed in effect of the intraoperative endothelial injury [2, 3].

So far, there is no effective pharmacotherapy treatment for the patients with the intestinal transit disorders, which was caused by the postoperative concretion induced occlusions. Over the past 30 years, the Dynamic Taping (DT) method has gained a significant popularity and has become one of the methods applied in the physiotherapy after abdominal surgeries [1]. The reflectory mechanism of this method is being explained on the basis of the skin-organ and organ-skin reflexes, associated with the so-called Haed fields [3, 4, 5, 6, 7, 8].

In our study, we have proven effectiveness of the dynamic taping therapy after surgical procedures. In our patients we have established statistically significant effects of the applied dynamic taping treatments. In those patients, after the rehabilitation procedures, there have been noted an increase in the number of bowel movements per day, normalization of stool consistency and reduction of hydrogen molecules in the exhaled air.

### Conclusions

1. The analysis of the tests, before and after application of the therapy, has shown in the TE group of patients a significant decline of hydrogen molecules in the exhaled air, which confirms the improved intestinal transit in this group of patients.
2. Established in our study, the significantly higher number of bowel movements and the significantly greater indicator of stool consistency in the TE group, in comparison with the results in the CO group, confirms the effectiveness of the applied physiotherapy, based on the dynamic taping.
3. Our test results indicate the efficacy of applying the dynamic taping in physiotherapy for the patients with intestinal disorders.

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