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The estimation of the value and mobility of Parks' angle in case-series of patients with defecatory disorders - prospective clinical examination supplemented with the defecographic examination

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Background. *Defecography is used by a majority of colorectal surgeons for it is the only method for anatomic and dynamic studies of the act of defecation. The method provides information on different aspects of anorectal and pelvic floor function and offers the possibility of visualizing the development of anatomic abnormalities.*
Methods. *We analyzed the defecography findings carried out at 56 patients (50 female and 6 male) from 24 to 83 years of age (the average age 58.3 years) with proctologic ailments such as: faecal incontinence, sensation of obstruction in the rectum, constipations, rectal prolapse, solitary ulceration of rectum. The values of Parks' angle (ARA - the anorectal angle) were measured at rest, at strain and during defecation. Other parameters measured included: duration of sphincter relaxation, overall duration of defecation, mobility of the pelvic diaphragm.*
Results. *Abnormal values of Parks' angle at rest and at strain were found in patients with the following problems: faecal incontinence, sensation of obstruction in rectum and constipation. However, they did not turn out to be characteristic for patients with rectal prolapse. Defecography has helped to detect concomitant rectocele in patients suffering from constipation and sensation of obstruction in the rectum. Defecography has also proved to be effective in the evaluation of patients who suffered from solitary ulceration of rectum. During the examination of these patients it has been observed that Parks' angle in various phases of defecation has flattened. The duration of sphincter relaxation in the studied group was changeable and did not depend on the kind of pathology.*
Conclusions. *Defecography is one of the examinations which can be helpful in the evaluation of patient's motor functions both before and after the operation.*

Key words: constipation; foecal incontinence; defecography

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Introduction

The complex mechanism of defecation is controlled by both the central nervous system and the medullar centres. One of the steps of defecation reflex is the relaxation of sphincter muscles (puborectal and external anal sphincter) and the widening of the anorectal angle (ARA) of Parks', caused by the activated sensation of tenesmus of the central nervous system.

There are several factors which affect the defecation activity: volume and consistency of faeces, capacity of the rectal ampulla and susceptibility of the rectum wall, continence of sphincter muscles, sensory mechanism, mechanical factors such as: pelvis floor muscles, and value of the ARA of Parks'. Recognized as the necessary condition for normal human continence, Parks' angle is formed between the longitudinal axis of the rectum and the axis of the anal canal and created by applying traction on the rectum by stretched puborectal muscle.[1]

Today, defecography is used by a majority of colorectal surgeons for it is the only method for anatomic and dynamic studies of the act of defecation.[2] The method provides information on different aspects of anorectal and pelvic floor function and offers the possibility of visualizing the development of anatomic abnormalities.[2]

Although the number of investigations has questioned the significance of the ARA in the maintenance of faecal incontinence, the configurational changes of the ARA with voluntary contraction or relaxation of the pelvic floor may be important.[3] Furthermore, many clinicians continue to place credence in the ARA, and routine measurements are often taken.[3] In this paper we present the application of defecography in the measurement of the ARA and the findings in defecography in patients with disturbed defecation.

Methods

A group of 56 consecutive patients (50 females and 6 males) from 24 to 83 years of age (the average age 58.3 years old) who suffered from defecation activity disorders in the form of:

- constipation,
- sensation of obstruction or incomplete defecation,
- faecal incontinence,
- rectal prolapse,
- solitary ulcer of rectum

were examined.

Each patient was qualified for defecography by the surgeon. Prior to the examination the medical history of these patients was taken including information about past diseases, injuries and child-birth, in the case of the female patients. The patients' continence for gas and faeces was evaluated with the Wexner scale. They also underwent the usual proctologic investigation and rectoscopy. Finally, the defecographic examination was performed be an experienced radiologist. Whole diagnostics were performed by one team of doctors.

Informed consent was obtained after the nature of the procedures had been fully explained to the patients, and the study was approved by the Medical Academy authorities.

The technique of defecographic examination

The patients were prepared in a similar way as for the enema examination. The day before the investigation they took X-Prep or Fortrans. The contrast medium used for the examination was barium sulphate suspension concentrated with starch (solution of boiled potato flour) in order to obtain the thick consistency similar to the consistency of stool. The contrast medium was administered per rectum through Foley's catheter in the amount enough to fill the splenic flexure of the colon. The examination was carried out in

two stages. During the first stage, after the application of the contrast medium in the recumbent position, the patient was seated on a plastic bucket and then the catheter was withdrawn. The patient was asked to bear down as if to defecate.

The examination was recorded on a magnetic tape and the durations of the sphincter relaxation and the overall defecation were measured. The duration of sphincter relaxation is the time measured between the beginning and the end of widening of the anal canal. The overall duration of defecation is the time needed for passing stools.[4] The recording was made in video technique with PANASONIC UCR/TV camera and XD PRO SUPER UMS 180 tape. During the second stage three x-ray films were taken: at rest, during the defecation and in the phase of maximum contraction. The x-ray films taken in 35 x 35 mm format were later used for measuring precisely the anorectal angle and evaluating the pelvis floor mobility. The films also allowed for the evaluation of the size of rectocele.

During defecography the following parameters were estimated: ARA and its dynamics,[3,5] duration of sphincter relaxation and overall duration of defecation. ARA was formed at intersection of the line running along the axis of the anal canal and the tangent line to the posterior wall of the rectum. The proper value of this triangle at rest is 95 - 105°. During the defecation the angle should increase (up to about 150°) and during the contraction it should decrease up to about 80°. The mobility of pelvic diaphragm was estimated on the basis of lowering of the anorectal junction in relation to the ischiadic tubers. The accepted standard was the lowering of anorectal junction not exceeding 3.5 cm during tenesmus.[6] In addition, the distance of the rectal posterior wall from the sacral bone was measured. The recording of the defecographic examination on the video tape allowed estimating individual stages of the defecation.

Results

Tables 1-6 show the results for six separate groups of patients depending on the ailment and the course of the disease.

Thirteen patients with symptoms of gas and faecal incontinence were examined

Table 1. Patients with faecal incontinence

No.	Age	Sex	No of births	Parks' angle at rest	Parks' angle at contraction	Parks' angle at defecation	Rectocele	Wexner scale	Pelvic floor mobility (cm)	Total defecation time/s/
1	77	M	-	110	90	115	-	3	<1	10
2	66	F	2	110	110	145	-	12	>1	10
3	51	F	2	150	100	120	Big	14	<5	8
4	73	F	2	115	110	120	-	14	<5	20
5	49	M	-	100	95	125	-	3	<5	17
6	69	F	4	85	80	90	-	4	<3	7
7	55	F	1	115	105	125	-	17	<7	10
8	35	F	1	120	110	118	-	14	<1	35
9	56	F	1	110	110	120	-	8	<1	10
10	73	F	-	117	108	123	Big	4	<5	30
11	57	F	-	118	112	125	Small	10	1	32
12	72	F	2	120	120	135	-	17	4	5
13	51	F	1	115	98	132	Big	12	4	17

Table 2. The patients who felt sensation of obstruction or incomplete defecation

No.	Age	Sex	No of births	Parks' angle at rest	Parks' angle at contraction	Parks' angle at defecation	Rectocele	Wexner scale	Pelvic floor mobility (cm)	Total defecation time/s/
1	55	F	2	110	80	120	little	0	≤1cm	20
2	59	F	3	115	95	125	-	0	≤2cm	110
3	55	F	1	95	95	105	little	0	≤10cm	10
4	46	F	-	120	110	112	-	1	≤1,5cm	125
5	45	F	2	115	110	135	big	0	≤2cm	12
6	30	M		95	85	115	-	3	≤4cm	150
7	59	F	4	105	95	125	little	2	≤5cm	240
8	63	F	-	105	95	110	-	1	≤5cm	45
9	73	F	2	95	86	115	big	2	≤4cm	25
10	69	F	1	133	120	130	little	0	≤3cm	32
11	65	F	2	90	80	180		14	≤1cm	3
12	35	M		115	105	122		0	≤3,5cm	41
13	60	F	1	95	90	115	little	8	≤4cm	6

(Table 1). In 1 case a small rectocele was detected which had not been discovered initially by means of the proctologic examination. In 3 other cases a big rectocele was detected. Other 11 patients were characterized by too obtuse Park's angle at rest and did not decrease during contractions. Two patients had the right angle. In 9 out of 13 cases Parks' angle did not decrease during the contraction. The lowering of pelvis floor mobility was detected in 7 cases. The overall duration of defecation did not turn out to be characteristic. The value of ARA in these cases was mostly incorrect.

Thirteen patients, who felt sensation of obstruction or incomplete defecation, were examined (Table 2). In 8 cases ARA at rest was abnormally obtuse but in 9 cases it was properly acute during contractions. Rectocele, not diagnosed initially during palpation, was detected at 6 patients; in 2 of them it was big. The overall duration of defecation lengthened; in 1 case it amounted to 2.5 minutes. Most of the patients in this group had abnormally obtuse Parks' angle at rest and the overall duration of defecation was lengthened.

Another group consisted of 2 female patients with solitary ulcer of rectum (Table 3). These patients were characterized by "flattening" of the value of Parks' angle during various stages of defecation. In both cases ARA did not decrease during the contraction and the overall duration of defecation lengthened. The pelvis floor mobility was in both cases normal. Defecography turned out to be useful at examining patients with this rare disease. Values of Parks' angle in various stages of the defecographic examination got flattened (the lack of dynamics of ARA during defecation) and the overall duration of defecation lengthened.

There were 10 patients with rectal pro-

Table 3. Patients with solitary rectal ulcer

No.	Age	Sex	No of births	Parks' angle at rest	Parks' angle at contraction	Parks' angle at defecation	Rectocele	Wexner scale	Pelvic floor mobility (cm)	Total defecation time/s/
1	37	F	-	108	110	118	-	0	1,5cm	40
2	66	F	1	155	125	155	-	0	1,5cm	14

Table 4. Patients with rectal prolapse

No.	Age	Sex	No of births	Parks' angle at rest	Parks' angle at contraction	Parks' angle at defecation	Rectocele	Wexner scale	Pelvic floor mobility (cm)	Total defecation time/s/
1	81	F	4	*	*	*	-	13	*	*
2	80	F	-	*	*	*	-	14	*	*
3	47	F	4	*	*	*	-	16	*	*
4	24	M	-	95	80	115	-	0	4	7
5	72	F	3	95	120	140	Big 7-8 cm	2	7	10
6	50	M	-	110	80	180	-	0	1	20
7	70	F	2	128	127	140	4cm	0	4	25
8	61	F	1	??	??	?	-	8	4	15
9	74	F	1	120	107	140	-	16	*	*
10	65	F	1	85	87	140	-	16	*	47

*Due to technical difficulties not all the parameters hale been measured.

lapse (Table 4). Three of them could not undergo the examination due to technical reasons, i.e. the complete incontinence of contrast medium. In 2 cases the examination helped to detect rectocele (1 was big). The overall duration of defecation was lengthened in 4 cases. The pelvis floor was abnormally lowered in 2 cases. In 3 cases abnormally obtuse ARA was detected. Values of ARA did not turn out to be characteristic for the group of patients with rectal prolapse.

The group, who is characterized by symptoms of constipation, consisted of 12 patients (Table 5). The overall duration of defecation was lengthened in 4 cases and in the remaining 8 cases it was within the normal range. Rectocele was found in 9 patients: a small one in 2 cases, a medium one in 6 cases, and a big one in 1 case. In 5 cases ARA during contraction did not decrease which was abnormal. In six cases abnormally obtuse ARA was detected at rest.

The last group consists of 2 female patients who could not be assigned to any other group of proctologic ailments (Table 6). One of them had undergone rectopexy and the

Table 5. The patients with obstruction

No.	Age	Sex	No of births	Parks' angle at rest	Parks' angle at contraction	Parks' angle at defecation	Rectocele	Wexner scale	Pelvic floor mobility (cm)	Total defecation time/s/
1	79	F	2	135	95	135	-	0	≤4	10
2	69	F	3	120	90	135	-	0	≤2	15
3	77	F	-	143	135	155	-	0	≤12	8
4	55	F	-	103	95	118	little	6	≤2	22
5	66	F	1	123	129	148	middle	0	≤6,8	19
6	53	F	1	105	80	100	middle	0	≤3	10
7	47	F	-	70	80	100	middle	0	≤2,4	20
8	31	F	-	97	84	132	big	0	≤2	10
9	44	F	2	115	115	120	middle	2	≤4	10
10	26	F	-	127	120	143	middle	0	≤2	18
11	57	F	-	72	66	70	middle	0	≤5	15
12	72	F	-	105	105	150	llittle	0	≤3	15

Table 6. Others disorders

No.	Age	Sex	No of births	Kind of disorder	Parks' angle at rest	Parks' angle at contraction	Parks' angle at defecation	Rectocele	Wexner scale	Pelvic floor mobility (cm)	Total defecation time
1	48	F	1	Following rectopexy	100	100	135		5	4	10
2	48	F	2	Following burgery on recto-vaginal fistula	95	92	100		0	5	30

other post partum plastic operation of rectovaginal fistula protected with transversostomy. The former was characterized by low dynamics of ARA during defecation and the lack of decreasing the angle during contractions. Unfortunately no examination was carried out due to the complete incontinence of contrast medium caused by the full wall rectal prolapse. The examination could not be comparative in relation to the pre-operative condition of the patient.

In the case of the patient with post partum plastic operation of rectovaginal fistula protected with transversostomy the fistula was not detected. ARA during defecation got flattened; there were very small differences between the various stages of defecation. The overall duration of defecation lengthened more than twice. These disorders might have been caused with the temporary exclusion of the last segment of alimentary tract.

Additionally to the above presented groups of patients, four underwent the examination simultaneously in two groups. There were two patients with symptoms of rectal prolapse and faecal incontinence and another two patients with constipation and sensation of the obstruction. In each group the duration of sphincter relaxation was individually variable and did not depend on the pathology.

Discussion

Defecation activity disorders may occur on a different level and their causes are not always easy to diagnose. In order to evaluate the causes affecting the defecation a number of methods is used, such as: anorectal manometry, transrectal ultrasound, electromyography, magnetic resonance and others. The significance of defecography and especially its value in measurements of the ARA is, however, questioned by many authors. The main drawback of the method is inability to differentiate the effect of pelvic floor laxity from the incontinence on the basis of ARA result.[3]

Many clinicians continue, however, to place credence in the ARA, and routine measurements are often taken.[3] This examination, apart from estimating ARA, allows physicians to evaluate the efficiency of rectal sphincters, pelvis floor muscles and susceptibility of the rectal ampulla. It is at this time probably the only objective means of measurement of anorectal anatomy and function because the sitting position for examination is not easily attainable with other methods.[7]

Defecography was first described in 1952 by Walden.[8] In 1953 Ekengren and Snellman[9] published an article in which they presented the application of defecography in diagnostics of constipation. In 1968 Broden and Snellman[10] characterized and named the defecographic technique as well as indications for its application. In 1980s Mahieu *el al.*[11,12] described the application of defecography as a new diagnostic procedure. Their work consisted of two parts and included an evaluation of anorectal functions using defecography. The investigation was carried out on healthy patients and patients suffering from proctologic diseases.

We present results of defecography per-

formed in several groups of patients with following disorders:

- constipation,
- sensation of obstruction or incomplete defecation,
- suspicion of rectocele,
- faecal incontinence,
- rectal prolapse.

Defecography turned out to be a useful examination and allowed for a very precise diagnosis. In a group of patients with the sensation of incomplete defecation and sensation of obstruction, for example, six out of thirteen were diagnosed with rectocele. It was also possible to measure ARA fairly precisely and in this way to evaluate the function of the pelvic diaphragm what is impossible using other diagnostic methods. Abnormal values of ARA were detected in the group of patients characterized by constipations, faecal incontinence and the sensation of obstruction in the rectum. It could be related to defective function of pelvic diaphragm and in some cases with the low contractility of puborectal muscle. Signs of nonrelaxing puborectalis muscle Agachan *et al.*[13] found in 28.8% of the patients with defecatory disorders. He used manometry, electromyography, and defecography. The latter in his opinion was probably the best for this purpose. This opinion is supported by Karasics *et al.*,[14] who claims that the value of the ARA is directly dependent on the puborectal muscle activity. Not effective contraction of the puborectalis causes abnormal values of the ARA in each phases of defecation. He adds that many patients have not evident functional diseases of the rectum which may be diagnosed by means of defecography. Also Jorge *et al.*,[3] who compared defecography with proctography, found defecography reliable and superior, mostly because it is the only diagnostic test which provides anatomic details.

In the majority of our patients suffering from incontinency value of the ARA was abnormal. Almost half of them had the excessive lowering of the pelvis floor, which might have led to incontinency. The latter factor is underlined by many authors.[3]

ARA did not turn out to be characteristic for patients with rectal prolapse. Although the defecographic examination was difficult to carry out in this group of patients, it showed the mechanism of rectal prolapse and was useful in choosing the right surgery technique. Defecography is particularly useful in the diagnostics of early stages of the rectal prolapse when the upper part of the rectum becomes intussuscepted. In one case we observed acute ARA during the maximal sphincters contraction following the rectocele surgery because of the rectal prolapse, which was typical for the functional results of surgery of that type.

Defecography has also proved to be effective in the evaluation of patients who suffered from solitary ulcer of rectum. During the examination of these patients it has been observed that ARA in various phases of defecation has flattened. The duration of sphincter relaxation in the studied group was changeable and did not depend on the kind of pathology.

Despite improvements in imaging technique and better understanding of anorectal disorders, the exact role of defecography in defining anorectal disorders and its impact on therapy remains controversial.[7,14] In spite of its undoubted diagnostic value we conclude that this examination should be an additional one to the clinical examination. The defecography is enable to visualise the peritoneal outline and its pouches, and may be of limited value in case of enterocele or rectal intussesception[16] (although in the latter, defecography is necessary to sort out cases of intussesception that might be clinical relevant whereas the clinical diagnosis of intussusception is related only to long intussusception).[17] The problem may also result from e.g. multifactoral aetiology of obstructed defecation which makes it difficult to determine whether de-

fecographic findings are the cause or result of excessive straining in patients with the obstructed defecation.[7] Additionally, there are scientific works which describe healthy volunteers who underwent this examination. Although they had not suffered from any proctological ailments, the defecographic examination detected some disorders.

Besides, not all the parameters which were used in our study appeared reliable for other researchers. Klauser[18] tested reproducibility and agreement among three clinicians (a radiologist, a gastroenterologist, and a colorectal surgeon), all experienced in defecography, in evaluating defecographies, and did not include in his study the measurement of the ARA. In his opinion, it has no clinical relevance. Dvorkin *et al*.[19] compared magnetic resonance defecography and evacuation proctography. They confirmed the primary role of proctography for the diagnosis of intussusception, and the complementary role of magnetic resonance defecography by giving information on movements of the whole pelvic floor. Whereas Beer-Gabel *et al*.[20] found no differences between dynamic transperineal ultrasound and defecating proctography for the measurement of the ARA, anorectal junction position at rest and during straining.

Although defecography cannot be the only grounds for treating the patient,[7] contemporary surgery of large intestine should be supplemented with a detailed evaluation of rectum functional functions. Our results in several case-series presented did not allow for any definitive data because of the heterogeneity of the included group. They are preliminary, and some cases, e.g. solitaire rectal ulcer and rectal prolapse, were presented due to their rareness. The whole work will continue but at this stage we are convinced that defecography is one of the examinations which can be helpful in the evaluation of patient's motor functions both before and after the operation.

Conclusions

1. Abnormal values of Parks' angle at rest and during constipation were detected at patients who suffered from: faecal incontinence, sensation of obstruction in rectum and with constipation.

2. Values of Parks' angle did not turn out to be characteristic for the examined group of patients with rectal prolapse.

3. Duration of sphincter relaxation was individually variable and did not depend on the pathology.

4. Defecography enabled to detect concomitant rectocele at patients with constipations and the sensation of obstruction in rectum

5. Defecography was helpful at the evaluation of patients with solitary ulcer of rectum. In these cases ARA at various stages of defecation becomes "more flat".

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