Medifactia®
Transit-Pellets

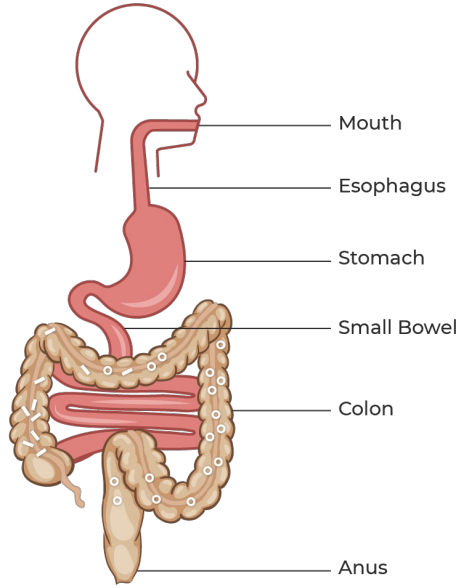
Measurement of Colonic Transit with Transit-Pellets method

Contents

Measurement of Colonic Transit Time (CTT)

Measurement of colonic transit time is an important investigation in clinical gastroenterology. The measurement is indicated particularly in patients with chronic constipation that does not respond to conventional treatment. The result can help the physician to understand the patient's problem and support in further decisions on treatment. The method is a simple and cost-effective way to measure slow, normal and rapid colonic transit.

Both total transit and segmental transit dysfunction in colon can be evaluated.



Scematic Figure
Female patient with 27 markers in the colon,
10 tube-formed markers and 17 ring-formed markers.
Transit time is 2.7 days, i.e., normal.

Origin of the Transit-Pellets method

The setup of a simple but accurate method to investigate CTT at the Sahlgrenska Hospital Gastro Unit was prompted by the high number of referrals for constipation in the early 1980's, the relatively high number of colectomies for constipation on weak grounds, and a need to study effects of drugs on CTT.

In 1985, Prof. Abrahamsson developed the Transit-Pellets method (formerly known as the Abrahamsson method) with the capacity to measure both total and segmental transit times. The principle was found simple and proved to be sufficient to reach equilibrium (saturation state) in all healthy subjects and was selected for enlarged studies.

1990's. The increasing interest at the Sahlgrenska Gastroenterology Section in the pathophysiology of functional and other diarrheal disorders prompted a modification of the transit test; by dividing the marker doses taken 24 and 12 hours before X-ray on day seven, rapid transit could be measured with enhanced precision.

Hasse Abrahamsson
MD; Emeritus Professor of Gastroenterology.
Founder of the method in 1985.

For more information, please see *Origin of the Transit-Pellets method for the measurement of Colonic Transit Time (CTT).*

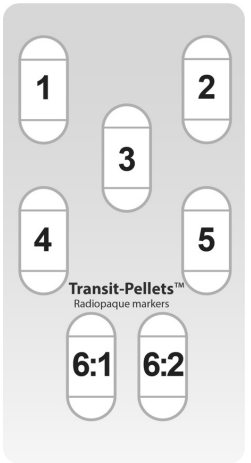
Key studies with the Transit-Pellets method

The method previously referred to as the Abrahamsson method, now known as the Transit-Pellets method, was developed at Sahlgrenska University Hospital in Sweden and has been the subject of around twenty scientific reports, a few of which are exemplified below. Currently, reference values are based on measurement in 199 adults (114 women and 85 men).

Author and Year	Conclusion and Authors' Comments
Abrahamsson H, Antov S, Bosaues I. Gastrointestinal and colonic segmental transit time evaluated by a single abdominal x-ray in healthy subjects and constipated patients. Scand J Gastroenterol. Suppl 1988; 152:72- 80.	This original study showed the usefulness of the Transit-Pellets method with intake of 10 markers daily for six days followed by an abdominal X-ray on day seven. Based on the principle that an equilibrium between ingested and excreted markers has been attained
Abrahamsson H, Antov S. Accuracy in assessment of colonic transit time with particles: how many markers should be used? Neurogastroenterol Motil. 2010; 22:1164-69.	Showed that measurement of colonic transit time with ten markers daily yields an accuracy very similar to 15-20 markers daily but a significantly higher accuracy than five markers daily.
Sadik R, Abrahamsson H, Stotzer PO. Gender differences in gut transit shown with a newly developed radiological procedure. Scand J Gastroenterol. 2003; 38:36-42.	This study showed that modification of the Transit-Pellets method by dividing the marker dose on day six into one morning dose and one evening dose is a simple and safe principle to measure rapid, normal and slow colonic transit.
Törnblom H, Van Oudenhove L, Sadik R, et al. Colonic transit time and IBS symptoms: what's the link? Am J Gastroenterol. 2012; 107:754-60.	Study on a large number of patients (n=359) showing that the modified Transit-Pellets method is very useful to characterise e.g. IBS patients with respect to normal, slow or rapid colonic transit.
Sadik R, Abrahamsson H, Ung KA, et al. Accelerated regional bowel transit and overweight shown in idiopathic bile acid malabsorption. Am J Gastroenterol. 2004; 99:711-8.	The Transit-Pellets method can be used to elucidate pathophysiology and diagnosis in patients with rapid colonic transit. Accelerated bowel transit and obesity are both implicated in idiopathic bile malabsorption.

Transit-Pellets radiopaque markers

Product name	Transit-Pellets radiopaque markers
Product classification EU	Medical device class IIa
Product classification US	Medical device class II
EC Certificate, Cert no.	SC0557-15
FDA 510(k) no.	222000
Primary packaging	The numbers 6:1 and 6:2, printed on the back of the blister pack, correspond to the morning dose and the evening dose on day six.
Secondary packaging	Contained within the carton box is a package insert (IFU), which has been translated into over 15 languages.



- To be dispensed only by physician to patients for oral intake
- For Intended Use/Indications for Use, please refer to the Clinical Instruction for Use
- The IFU provides important instructions on the proper use of Transit-Pellets and should be thoroughly reviewed to ensure safe and effective use of the device.

Constipation – A common symptom often difficult to evaluate

About 20% of the population suffer from constipation. For the common types of functional constipation idiopathic and IBS- related constipation, the proportion of women is about 80-90%. It is important to structure the management of this large patient group.
The duration of symptoms is of relevance. In general, a long history allows for more restricted investigations, and the management can be focused on the patient's symptoms. It may be very difficult to assess from the patient's description whether the colonic transit time is normal or delayed. If the initial management with diet modification, bulking agents and common laxatives is not successful, further investigations, including evaluation of colonic transit time with radiopaque markers, should be considered.

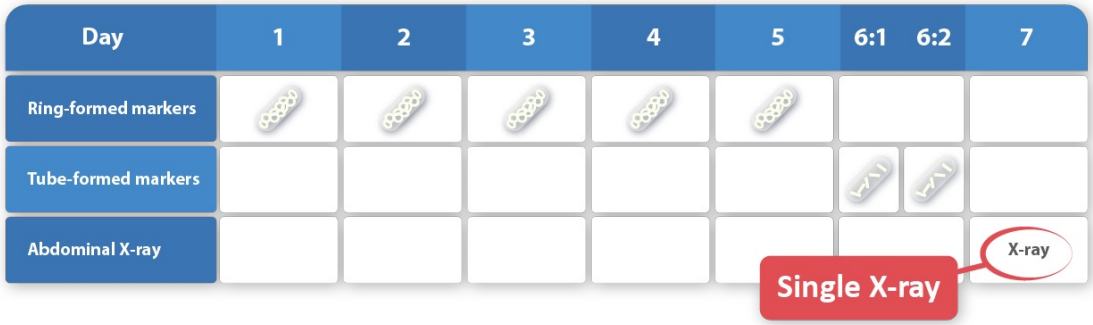
Transport in colon

The transit investigation reflects the physiological transport of intestinal content and what happens when transit is disturbed. Colonic transit time measurement yield information about the propulsive activity and elucidate physiology as well as pathophysiology in the colon.

When assessing colonic transit time, a method using Transit-Pellets radiopaque markers is usually applied. The markers represent the passage of solid and semi-solid contents. The most common reason to do this investigation is suspicion of so-called slow-transit constipation. However, with the modification of marker intake on the sixth day, it is also possible to easily measure rapid passage, which could be of interest in the investigation of patients with chronic diarrhea.

The patient swallows' Transit-Pellets radiopaque markers for six consecutive days. On day seven, an abdominal radiograph is taken. Based on the number of retained markers and their position in the colon, the colonic transit time is calculated and compared to reference values. Because only one radiograph is needed, the radiation dose is limited, and the cost for the test kept at a minimum.

Schedule for marker intake with the Transit-Pellets method

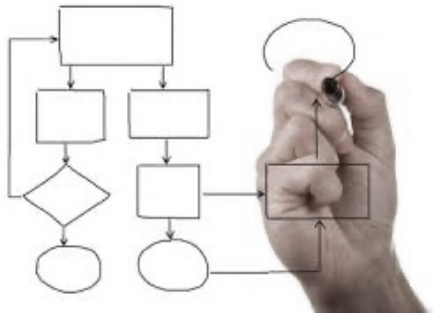


From diet, laxatives & lifestyle modifications to colonic transit studies

The most common application of the colonic transit test is in investigations of severe constipation and to make decisions about treatment when there is a suspicion of slow-transit constipation or, alternatively, suspicion of so-called outlet obstruction. The test can verify whether there is a slow transit or some other type of transit disturbance.

In clinical practice, the most common reason for the test is when a patient with constipation does not respond to treatment. A low defecation frequency, <3 per week combined with abdominal complaints may be a sign of disturbed motility with colonic transit. Constipation-related dysfunctions, i.e., transit disturbances, are specifically looked for with the test. The method is also suitable for repeated measurements, e.g., for documentation of effects of treatment.

In cases with diarrhea, a rapid colonic transit can often be seen. In contrast, if a patient has so-called constipation-induced diarrhea with liquid content passing faecal impaction, the test will show a slow transit despite the patient's report of loose stools.



Instructions for transit measurement

The patient swallows in total ten (10) Transit-Pellets radiopaque markers per day contained in seven (7) HPMC capsules for six consecutive days. One (1) capsule is swallowed day one thru day five. On day six one (1) capsule is swallowed in the morning, 24 hours prior to X-ray, and one (1) capsule is swallowed in the evening, 12 hours prior to X-ray. The capsules dissolve in the gut and will release the markers and the markers will pass out with feces. The numbers 6:1 and 6:2, printed on the back of the blister, correspond to the morning dose on day six and the evening dose on day six.

It is important that the markers are ingested every day exactly as prescribed. The interval between first marker intake and the X-ray must be six days (approx. 144 hours). On day seven an abdominal radiograph or fluoroscopy is performed, and the number of retained markers are counted. Based on the number of retained markers and their position in colon a colonic transit time is calculated and compared to reference values.

From the abdominal radiograph on day seven, the total number of retained markers is counted, as well as their distribution in the various segments of the colon.

The markers on day six have a different shape. If correctly taken, these markers should be located mainly proximal to the ring markers in the colon. If transit is slow, these markers are located in cecum-ascending colon and help to delineate this segment. The tube-formed markers can also provide important information in case of rapid transit.

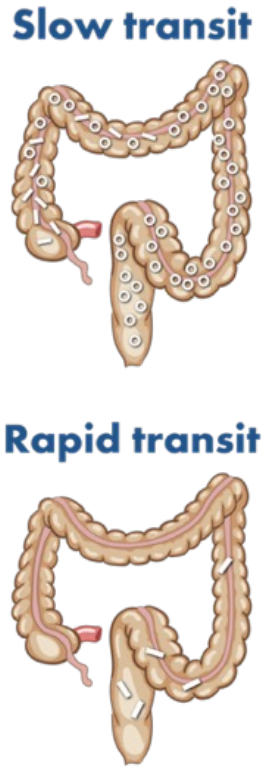


Illustration (Source: Medifactia) of the movement of the Transit-Pellets radiopaque markers through the colon.

Laxatives

Note that if the patient takes laxatives leading to defecation, the test will give an erroneous value and it may be impossible to verify a slow transit. If the patient absolutely cannot avoid laxatives for seven days, one possibility can be to take markers for a shorter period (as long as possible) but minimally for two days, with the X-ray 24 hours after the last marker intake.

If more than fifteen (15) ring-formed markers are located in cecum-ascending colon, the transit is slow in at least this segment. If the marker count shows that at least five (5) markers have been excreted, i.e., an equilibrium has been reached, the calculation of transit time and interpretation can be done. Thus, if a patient contacts the laboratory saying that laxatives cannot be avoided, it can be of value to have an X-ray and marker count earlier than day seven, provided practitioners are informed exactly how the markers have been taken.

Calculation

Colonic transit time is calculated as the mean Oro-Anal Transit Time (OATT, mouth-to-anus) for the daily marker doses swallowed. Because the colonic transit constitutes the main part of the mouth-to-anus transit time, OATT is used as a measure of colonic transit. The transit time is equivalent to the number of daily marker doses retained. All markers, regardless of the form, contribute to the final value.

With a daily dose of 10 markers, the transit time is:

$$\text{Oro-Anal Transit Time in days (OATT)} = \frac{M}{10}$$

i.e., the number of markers counted from the X-ray film (M) divided by the daily dose.

If, for example, 35 markers are retained, the OATT is 3.5 days according to the formula M/10. A numerical transit time value can be given if the number of retained markers is in the range 3–55 markers. Thus, at least half a daily dose should be excreted and at least half of the evening dose on day six must be retained. If the number of retained markers is only 0–2, the transit time is less than 0.3 days. If 56–60 markers are retained, the transit time is more than 5.5 days (an equilibrium has not been reached).

With 10 markers per day each marker is equivalent to 0.1 days or 2.4 hours (i.e., 2.4 hours per marker). The formula Mx2.4 can be used on both total- and segmental transit time for clinics that prefer a result in hours.

It should be noted that the term Oro-Anal Transit Time (OATT) is also utilized interchangeably with CTT to convey the same meaning but provides a more precise description.

Interpretation

The total number of markers in the colon determines if the colonic transit is delayed or not. The upper reference value ('normal value' = percentile 95) is gender dependent and is 4.0 days (40 markers) for women. A guideline for the referring physician can be for women: 4.1 to 5.0 days is a slight to moderate delay and >5.0 days is a definite delay in transit.

Healthy men have a more rapid mean transit time than healthy women. The upper reference value for men is 2.2 days (22 markers). If a patient has abnormally rapid colonic transit, the OATT is lower than the lower reference value (percentile 5). This means <0.6 days (<6 markers) for women and <0.5 days (<5 markers) for men.

The distribution of markers in the various colonic segments can provide information about the type of delay. Note that healthy men and women may have a transit value in a few segments close to the upper reference value but not in all segments at the same time, as indicated by the reference value for the total transit time.

Total Transit Time (OATT, mouth-to-anus)

Indicates if colonic transit time is delayed, normal or rapid

Women			Men		
No. of markers	Days	Type of transit	No. of markers	Days	Type of transit
0-5 markers	<0.6 days	Rapid transit	0-4 markers	<0.5 days	Rapid transit
6-40 markers	0.6-4.0 days	Normal transit	5-22 markers	0.5-2.2 days	Normal transit
41-50 markers	4.1-5.0 days	Moderately delayed transit	23-40 markers	2.3-4.0 days	Moderately delayed transit
51-60 markers	>5.0 days	Clearly delayed transit	41-60 markers	>4.0 days	Clearly delayed transit

Normal transit time corresponds to the range from percentile 5 to percentile 95 in the control material. Reference values based on 199 subjects: 1) Abrahamsson et al., Sand J Gastroenterol 1988 Suppl 152:72-80; 2) Sadik et al., Scand J Gastroenterol 2003, 38:36-42; 3) Törnblom et al., data on file, Gastrointest Lab, Sahlgrenska University Hospital.

Segmental Transit Time

Provides information on the type of delay, e.g., distal or left sided

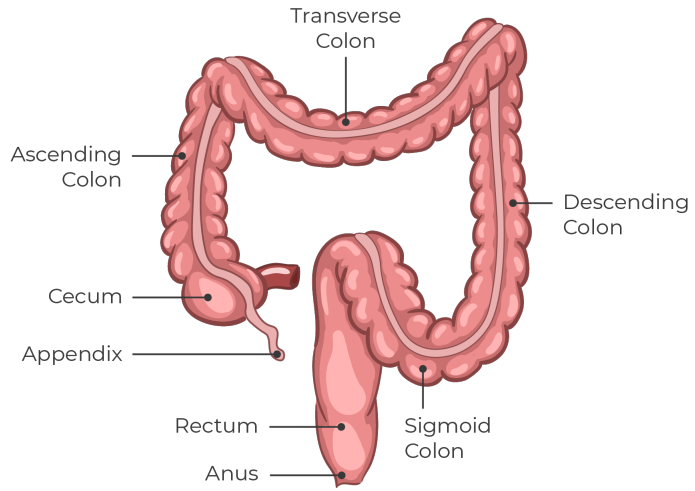
	Cecum-Ascending colon	Transverse colon	Descending colon	Sigmoid colon-rectum	Total
Women	1.3	0.7	2.3	1.3	4.0
Men	1.0	0.5	1.2	1.3	2.2

Segmental transit time: Abrahamsson et al., Scand J Gastroenterol 1988 Suppl 152:72-80. Percentile 95 calculated *per segment* in healthy subjects

Interpretation

Patients with a severe form of slow-transit constipation – so-called colonic inertia – have slow transit in the whole colon and have a high retention of markers in the cecum-ascendent part (>15 markers). Many patients with slow transit constipation have a delay only in the left colon. If the test shows a very high number of markers in the recto-sigmoid area but normal retention in the middle and proximal parts of the colon, this is a finding compatible with outlet obstruction.

When analyzing the abdominal radiograph, it is usually easy to calculate exactly the total number of retained markers. A few patients may have the cecum located more medially so that some overlap with the sigmoid must be considered. If the patient has a slow colonic transit, the tube-formed markers located in the cecum can help to solve the location problem. In rare patients, it may be a problem to differentiate between the sigmoid and the transverse colon. If so, the problem can be solved by inflation via a rectal tube to delineate the sigmoid.



Application

After the CTT measurement, at follow up, discuss the results with the patient and show the transit profile obtained. Discuss the transit profile in relation to the patient's symptoms.

- If the colonic transit is delayed, intensified constipation therapy should be considered with alteration of laxative treatment, motility stimulating drugs, etc.
- If the patient has severe complaints of constipation but the transit time is completely normal, there is a high possibility of altered sensitivity like IBS, and the therapy should be directed accordingly
- If transit through the cecum-ascending colon is delayed, this may be an indication of colonic inertia
- If transit through sigmoid colon-rectum is delayed, the possibility of outlet obstruction, including pelvic floor dysfunction should be considered

How to refer for a transit measurement

Referral for transit measurements may be sent to the radiology department. Most radiology departments have experience in determining whether colonic transit is slow, rapid or normal. The referral can be written by e.g., general practitioners or another doctor who has experience in gastroenterology patients. In difficult cases, consult a gastroenterologist or an interested gastro surgeon about the suitable way to process a potential referral.

Typically, the radiology department is in charge of instructions to and the markers for the patients. As indicated above, the instructions/information are a very important part of the process.

The result and evaluation of the examination is sent to the referring physician, noting the total number of markers in the colon, and thus, if the transit is slow, normal or rapid. Even the distribution of the markers in the different segments of the colon should be mentioned and – based on these values – segmental transit time can be calculated. Previous slides displays comparative values.

Publications: Studies using the Transit-Pellets method

*Studies with the original version, also known as the Abrahamsson method; last marker dose 24 hours before X-ray on day seven.
**Studies with the present version; last marker dose 12 hours before X-ray on day seven.

*Abrahamsson H, Antov S, Bosaeus I. Gastrointestinal and colonic segmental transit time evaluated by a single abdominal X-ray in healthy subjects and constipated patients. *Scand J Gastroenterol* 1988, 23(suppl 152), 72-80.
*Abrahamsson H, Antov S. Accuracy in assessment of colonic transit time with particles: how many markers should be used? *Neurogastroenterol Motil.* 2010;22:1164-69.
*Bohlin J, Dahlin E, Dreja J, Roth B, Ekberg O, Ohlsson B. Longer colonic transit time is associated with laxative and drug use, lifestyle factors, and symptoms of constipation. *Acta Radiologica Open*. 2018;7(10):1-9.
*Tsimogiannis KE, Karlbom U, Lundin E, Graf W. Long-term outcome after segmental colonic resection for slow transit constipation. Int J Colorectal Dis 2019, 34(6):1013-1019.
**Sadik R, Abrahamsson H, Stotzer PO. Gender differences in gut transit shown with a newly developed radiological procedure. *Scand J Gastroenterol* 2003;38:36-42.
**Sadik R, Abrahamsson H, Björnsson E, Gunnarsdottir A, Stotzer PO. Etiology of portal hypertension may influence gastrointestinal transit.. *Scand J Gastroenterol*. 2003 Oct;38(10):1039-44.
**Sadik R, Abrahamsson H, Kilander A, Stotzer PO. Gut transit in celiac disease: delay of small bowel transit and acceleration after dietary treatment.. *Am J Gastroenterol*. 2004 Dec;99(12):2429-36.
**Sadik R, Abrahamsson H, Ung KA, et al. Accelerated regional bowel transit and overweight shown in idiopathic bile acid malabsorption. *Am J Gastroenterol* 2004;99:711-718.
**Sadik R, Stotzer PO, Simrén M, Abrahamsson H. Gastrointestinal transit abnormalities are frequently detected in patients with unexplained GI symptoms at a tertiary centre. *Neurogastroenterol Motil.* 2008;20:197-205.
**Abrahamsson H, Östlund-Lindqvist AM, Nilsson R, Simrén M, Gillberg PG. Altered bile acid metabolism patients with constipation-predominant irritable bowel syndrome and functional constipation. Scand J Gastroenterol. 2008;43(12):1483-8.
**Sadik R, Björnsson E, Simrén M. The relationship between symptoms, body mass index, gastrointestinal transit and stool frequency in patients with irritable bowel syndrome. Eur J *Gastroenterol Hepatol*. 2010 Jan;22(1):102-8.
**Simren M, Bajor A, Gillberg PG, Rudling M, Abrahamsson H. Randomised clinical trial: The ileal bile acid transporter inhibitor A3309 vs. placebo in patients with chronic idiopathic constipation--a double-blind study. *Aliment Pharmacol Ther*. 2011;34(1):41-50.
**Strid H, Simrén M, Störsrud S, Stotzer PO, Sadik R. Effect of heavy exercise on gastrointestinal transit in endurance athletes. *Scand J Gastroenterol*. 2011 Jun;46(6):673-7.
**Törnblom H, Van Oudenhove L, Sadik R, Abrahamsson H, Tack J, Simrén M. Colonic transit time and IBS symptoms: what's the link? *Am J Gastroenterol*. 2012 May;107(5):754-60.

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*Studies with the original version, also known as the Abrahamsson method; last marker dose 24 hours before X-ray on day seven.
**Studies with the present version; last marker dose 12 hours before X-ray on day seven.

**Lindfors P, Törnblom H, Sadik R, Björnsson ES, Abrahamsson H, Simrén M. Effects on gastrointestinal transit and antroduodenojejunal manometry after gut-directed hypnotherapy in irritable bowel syndrome (IBS) *Scand J Gastroenterol*. 2012 Dec;47(12):1480-7.
**Stotzer, P.O., Abrahamsson, H., Bajor, A., et al. Effect of Cholestyramine on Gastrointestinal Transit in Patients with Idiopathic Bile Acid Diarrhea: A Prospective, Open-Label Study. Ashdin Publishing: Neuroenterology Vol. 2, 2013.
**Tucker, R M, Ryan, S, Hussain Hayee, B. et al. Distinctive Pathophysiology Underlying Constipation in Parkinson's Disease: Implications for Cognitive Inefficiency. *J. Clin. Med.* 2020, 9: 1-4.
**Simrén M, Törnblom H, Palsson OS, et al. Cumulative Effects of Psychologic Distress, Visceral Hypersensitivity, and Abnormal Transit on Patient-reported Outcomes in Irritable Bowel Syndrome. Gastroenterology. 2019;157:391-402.
**Algera JP, Colomier E, Melchior C, et al. Associations between postprandial symptoms, hydrogen and methane production, and transit time in irritable bowel syndrome. Neurogastroenterology & Motility. 2023;35:e14482.