Annals of Obesity & Disorders

Open Access

Austin Publishing Group

Special Article - Bariatric Surgery

How Accurate can we Estimate the Length of the Limbs in Gastric Bypass Surgery? An *Ex Vivo* Experiment

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Received: September 23, 2016; **Accepted:** November 10, 2016; **Published:** November 14, 2016

Abstract

Background: The role of limb length in Roux-en-Y gastric bypass is the subject of several studies. The results of multicenter and multiple surgeon studies could be influenced by the technique used to determine limb length. We conducted an *ex vivo* experiment to compare results between surgeons estimating the limb length without a measuring device.

Objectives: We measured intra- and inter-observer differences in determining limb length in order to ensure comparability.

Setting: European teaching hospital staff conducted the experiment in an *ex-vivo* lab.

Methods: In a laparoscopic box trainer three participants estimated lengths of 80, 120 or 200 centimeters on a segment of devascularized pork gut with thirty repetitions. The results were analyzed for intra- and inter-observer differences with a power of 91% to detect non-inferiority.

Results: One participant estimated within a 10 per cent margin on all three tasks. The other participants underestimated the length of their segments overall, with a larger difference on the longer tasks. This resulted in significant inter-observer differences.

Conclusion: The participants were able to estimate limb lengths within a ten per cent margin on the 80-cm task, but we found intra-observer variance and significant inter-observer differences especially in the long limb tasks. The presented box model can be used to specify this variation.

Keywords: Gastric bypass; Technique; Limb lengths; Box model

Introduction

Obesity is one of the largest global health problems, with over 600.000 million obese adults worldwide [1]. In the Netherlands ten percent of all adults are obese. Obesity and obesity related illness account for 2.2% of all healthcare costs in the Netherlands, which in 2012 corresponded to 1.6 billion Euros [2]. For morbidly obese patients with a Body-Mass-Index (BMI) > 40kg/m^2, or above 35kg/m^2 with associated comorbidities, bariatric surgery is the most efficacious treatment. The Roux-en-Y gastric bypass is an established safe and effective procedure in the treatment of morbid obesity [3]. The length of the alimentary limb, biliopancreatic limb and common channel, and their influence on weight reduction and weight regain are widely discussed. In variants of the classic Roux-en-Y gastric bypass longer limb length may lead to extra weight loss, but has malnutrition as a potential threat. In these procedures accurate limb length measurement is especially important.

In laparoscopic Roux-en-Y gastric bypass surgery multiple techniques to determine the length of a limb are used. Different operating techniques may explain some of the discrepancies in the results of studies on limb length [4]. Some bariatric surgeons try to measure the length exactly, using a rope or tape measure [5]. Others estimate the length on sound judgment or compare their steps with an object with fixed length, like a grasper or other laparoscopic instrument. This study aims to determine whether this estimation technique results in reproducible lengths of the gastric bypass limbs.

Methods

Study design

Since 2012, a tailored Roux-en-Y gastric bypass is performed in our bariatric center. The surgeons construct the biliopancreatic limb with a variable length of 80, 120 or 200 centimeters, based on the patient's Body-Mass-Index (BMI) (< 40, 40-50, and > 50 kg/m^2 respectively). Using graspers as reference points, the length of the bypassed bowel is estimated. The alimentary limb has a standard length of 150 centimeters. Anatomic variations like mesenteric fat deposition may influence the exact place of the anastomosis.

This study aims to determine if different bariatric surgeons in a single center can estimate the length laparoscopically with interchangeable results and without variation in their own series. As no comparable studies are found in literature, a variation of 10% (e.g. a biliopancreatic limb of 108 to 132 centimeter for morbidly obese patients with a BMI between 40-50 kg/m^2) is assumed to cause no significant differences in weight loss, awaiting more research on the ideal limb lengths. With this 10% margin a sample size of 26 measurements for each surgeon would achieve a power of 91% to detect non-inferiority (both under and over-estimation) in the inter-

Citation: Kaijser MA, Emous M, Dijkstra FA, Apers JA and Totte ER. How Accurate can we Estimate the Length of the Limbs in Gastric Bypass Surgery? An *Ex Vivo* Experiment. Ann Obes Disord. 2016; 1(3): 1016.

Table 1: Means, % deviation and number of attempts between 10% margins for all participants on all three tasks.

		Participant *A*	Participant *B*	Participant *C*	Total
Task 80cm [72-88]	**Mean**	**78.73**	**80.36**	**72.61**	**77.05**
	Mean % deviation	-1.59%	0.44%	-9.24% *	-3.69%
	Between margins	8 of 10	7 of 7	4 of 9	19 of 26
Task 120cm [108-132]	**Mean (cm)**	**125.3**	**113**	**106**	**114.1**
	Mean % deviation	4.40%	-8.85%	-11.65% *	-4.93%
	Between margins	8 of 9	7 of 11	5 of 11	20 of 31
Task 200cm [180-220]	**Mean**	**205**	**180**	**180.7**	**188.5**
	Mean % deviation	2.51%	-10.04% *	-9.66% *	-5.74
	Between margins	9 of 11	6 of 12	5 of 10	20 of 33

observer variation [6]. Moreover, the intra-observer differences can be determined.

In an *ex vivo* experiment, the estimation of the biliopancreatic limb was simulated in a laparoscopic box trainer. A four-meter segment of cleansed and devascularized pork gut was attached at one end to a Styrofoam board, simulating the fixated ligament of Treitz. Three participants were selected, two bariatric surgeons (5 and 2.5 years of experience in bariatric surgery each, operating on 250 and 200 gastric bypass cases each year) and a chief resident from the same center (portfolio includes over 250 solo or supervised laparoscopic cases including 50 gastric bypass surgeries). Each participant completed three rounds of 10 measurements, estimating lengths of 80, 120 and 200 centimeters in random order. These lengths correspond to the standard limb lengths for the tailored bypass. A 30 degree Karl Storz® camera fixed in position and two Karl Storz® fenestrated fixation forceps were used. The obtained length was measured twice outside the box by a single observer using a tape measure. The participants did not receive any feedback on their results until after the experiment, eliminating any influence of learning.

Statistical analysis

The values were analyzed with SAS/STAT® software. The individual scores of the participants are expressed as mean and standard deviation. The separate variances (i.e. proportional differences between obtained and intended length) were analyzed by means of a mixed model, using a 95% confidence interval, testing for non-inferiority in all three samples and comparing the inter-observer differences.

Results

Individual results

In the 80-centimeter task all participants scored a mean of their repetitive measurements within the expected 10% deviation. The standard deviations were 7.88 cm, 4.90 cm and 5.48cm.Participant a estimated between the upper and lower limit 8 out of 10 times, participant *B* 7 out of 10 times and the third participant 4 out of 10 times (Table 1).

Participant *A* managed to estimate with a mean deviation between -1.59% and 4.40% on all tasks, while participant *C* scored a mean deviation around -10% on every task, thus underestimating the limb length. Participant *B* however, progressed from an almost zero percent deviation on the shortest limb to over 10% on the 200-centimeter limb task.

Table 2: Inter-observer differences, expressed in estimated difference (cm) and significance level.

	Difference	P-value
Participant *A* vs *B*		
80cm	-2.0329	0.6078
120cm	10.2455	0.0136*
200cm	12.5508	0.0001*
Participant *A* vs C		
80cm	7.6544	0.0649
120cm	16.0455	<0.0001*
200cm	12.1691	0.007*
Participant *B* vs *C*		
80cm	9.6873	0.0102*
120cm	5.8	0.1159
200cm	-0.3817	0.9183

Differences between participants

To determine the inter-observer differences between the surgeons, the means and mean deviation percentage between three pairs of participants (*A-B, A-C* and *B-C*) were analyzed (Table 2). In the 80-centimeter task we found no significant difference between *A* and *B*, with an average difference in the 80-centimeter task of -2.03%. Between *A* and *C* there was a 7.65% difference, both not significant. However, between *B* and *C* there was a significant (P<0.05) difference. On the second task of estimating 120 centimeters, the differences between participant *A*'s scores and the other participants' scores were over 10% and both significant. The same observation was made in the 200-centimeter task. In this last task however, the differences between participant *B* and *C* were almost zero and therefore not significant.

Discussion

The ideal limb length in gastric bypass surgery is a matter of debate in current research in bariatric surgery. This discussion raised the question whether these lengths can accurately be estimated. This experiment shows that it is possible to obtain consistent en reproducible results when estimating the length of a limb in gastric bypass surgery. However, the differences between the participants suggest care should be taken when comparing results in multicenter or multiple surgeon studies.

As innovators and early adapters performed the first trials on bariatric surgery, most of the studies describe operations performed by just one surgeon. With the upcoming role of bariatric surgery in the treatment of morbid obesity there will be more multicenter studies and studies with operations performed by more surgeons in one center. Stefanidis et al. reviewed four randomized trials focusing on alimentary limb length [4]. The differences between those studies illustrate the discussed issues. Both Brolin et al. and Choban et al. used an open technique, allowing the use of a simple measuring device and controlling the stretch of the bowel [7,8]. However in Brolin's study only one surgeon performed all the procedures? Inabnet et al. performed a laparoscopic Roux-en-Y gastric bypass [5]. The relative positions between the camera and the laparoscopic instruments used to manipulate the bowel may influence the observed length of a grasped bowel segment. Inabnet used an umbilical tape with a handover technique to exclude this. However, due to fulcrum effects the stretch of a bowel segment is still difficult to control while performing laparoscopic procedures. Pinheiro et al. also used the laparoscopic technique. The exact method to determine length of limbs was not described in their study [9].

Despite the upcoming use of virtual reality trainers, most surgical techniques are still taught through master-apprentice models. In this particular situation the surgeon – the master – will decide whether the fellow surgeon or resident – the apprentice – adequately and reproducibly estimates or measures the length of the limbs. A simulation, either with a box or virtual reality trainer, may be of use in training and evaluating performance. The results of participant *C* show a consistent pattern of underestimating the length of the limb (overestimating the length of the step). The use of a box model can give the surgeon feedback on their performance.

The results of participant *B* showed a remarkable difference between an almost perfect performance on the 80-centimeter task and an only 50% accurate performance on the 200-centimeter task. This may suggest some sort of fatigue or loss of concentration when determining the length of a longer limb. Again, feedback from box simulation or virtual reality training may be beneficial. Further research should determine whether estimating limb length produces comparable results to measuring limb length with a device.

Limitations of the Study

The present study does have its limitations mostly due to the use of an *ex vivo* model with devascularized gut, which excludes factors relevant to estimating limb length like peristaltic bowel movements and the limited stretch of the mesentery. Those factors cannot easily be simulated *ex vivo*. The use of an in vivo wet lab model would facilitate a more realistic environment, though it would be difficult to compare the estimated length to a golden standard like a tape measure. Virtual reality trainers could calculate the estimation easily, but haptic feedback would decrease.

Although only a small number of participants were used, this may be an adequate reflection of daily practice, with a lot of bariatric centers employing three surgeons or even less. The use of a statistical test for non-inferiority takes this small sample size into account. Results of a larger group of participants may cause reduction of the mean intra-observer variation and therefore underestimate the differences between two or three surgeons.

Conclusion

In conclusion, this *ex vivo* box model shows surgeons are able to estimate an instructed bowel length within a 10 per cent margin in the 80-centimeter task, but on longer limbs participants underestimate the limb lengths, causing possible significant variation of the weight loss results between surgeons. The exact influence of this margin of error on the results of gastric bypass surgery is unclear, however in future research on limb length the technique used to determine limb length should be taken into account. The use of different sorts of measuring devices or marked instruments could be beneficial to accurate limb length determination.

Learning effects and other factors may contribute to significant differences between surgeons and variation in the results of a single surgeon. The presented model can be used to compare the performance of different surgeons to ensure an acceptable inter-observer variance in multi-surgeon studies. Surgeons could also use the feedback from a box simulator to improve the accuracy of their limb length estimation. Laparoscopic box training could be included in training programs as an addition to master-apprentice learning.

Acknowledgment

We kindly thank Dr. Nic Veeger for his advice and statistical analysis of the data.

References

1. World Health Organization. Geneva: World Health Organization; c2015. Media Center Factsheet N311, Obesity and Overweight.
2. Schut FT, Varkevisser M. Royal Association for Economics. [Preliminary Advices 2012. A financially healthy health care system]. Dutch. 2012.
3. Colquitt JL, Pickett K, Loveman E, Frampton GK. Surgery for weight loss in adults. Cochrane Database of Systematic Reviews. 2014; 8.
4. Stefanidis D, Kuwada TS, Gersin KS. The importance of the length of the limbs for gastric bypass patients-an evidence-based review. Obes Surg. 2011; 21: 119-124.
5. Inabnet WB, Quinn T, Gagner M, Urban M, Pomp A. Laparoscopic Roux-en-Y gastric bypass in patients with BMI <50: a prospective randomized trial comparing short and long limb lengths. Obes Surg. 2005; 15: 51-57.
6. Chow SC, Shao J, Wang H. Sample Size Calculation in Clinical Research. New York, Marcel Dekker. 2003.
7. Brolin RE, Kenler HA, Gorman JH, Cody RP. Long-limb gastric bypass in the super obese. A prospective randomized study. Ann Surg. 1992; 215: 387-395.
8. Choban PS, Flancbaum L. The effect of Roux limb lengths on outcome after Roux-en-Y gastric bypass: a prospective, randomized clinical trial. Obes Surg. 2002; 12: 540-545.
9. Pinheiro JS, Schiavon CA, Pereira PB, Correa JL, Noujiam P, Cohen R. Long-limb Roux-en-Y gastric bypass is more efficacious in treatment of type 2 diabetes and lipid disorders in super-obese patients. Surg Obes Relat Dis. 2008; 4: 521-525.

Ann Obes Disord - Volume 1 Issue 3 - 2016
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Citation: Kaijser MA, Emous M, Dijkstra FA, Apers JA and Totte ER. How Accurate can we Estimate the Length of the Limbs in Gastric Bypass Surgery? An *Ex Vivo* Experiment. Ann Obes Disord. 2016; 1(3): 1016.