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ONCOLOGICAL AND FUNCTIONAL RESULTS AFTER SURGERY FOR LOW RECTAL CANCER

Thesis

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By

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TO OBTAIN THE MEDICAL DOCTORATE

KEYWORDS :

Low rectal cancer - Conservative surgery - Non-Conservative surgery
Oncological results - Functional results - Quality of life

JURY

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LIST OF ABBREVIATIONS

APPEAR : anterior perineal plane for ultra-low anterior resection

APR : abdominoperineal resection

AR : anterior resection

CAA : coloanal anastomosis

CEA : carcinoembryonic antigen

CRC : colorectal cancer

CRM : circumferential margin

CRT : chemoradiotherapy

CT : computed tomography

DRE : digital rectal examination

DRM : distal resection margin

EUS : endorectal ultrasound

Gy : Gray (unit of absorbed ionizing radiation in a particular mass)

ISR : intersphincteric resection

LAR : Low anterior resection

LARS : low anterior resection syndrome

LR : local recurrence

MRI : magnetic resonance imaging

OS : overall survival

PET : positron emission tomography

QoI : quality of life

R0 : complete removal of all tumor

RT : radiotherapy

Rx : X-ray

TAE : transanal excision

TAMIS : transanal minimally invasive surgery

TEM : transanal endoscopic microsurgery

TME : total mesorectal excision

TNM : classification of malignant tumours (tumor, lymph nodes, metastasis)

PLAN

INTRODUCTION

Colorectal cancer is the third leading cause of cancer death in men and women in the United States. It is the second most common cancer after breast cancer in Europe. Approximately 30% of colorectal cancers are located in the rectum, with a yearly incidence of 1 million new diagnosis; rectal cancer is a significant health problem worldwide with both social and economical consequences.

Surgery has always been the most important aspect in the treatment of rectal cancer. It is the best way to achieve healing of the patient and to obtain local control of the disease. The traditional surgical approach to tumors located in the distal one-third of the rectum is the abdominoperineal resection (APR) technique, first reported by Miles in the early 20th century, it was the standard surgical procedure for low rectal malignancy with a complete tumor removal but patients with tumor located at the lower rectum are often confronted with the possibility of requiring permanent stoma, causing drastic changes in life style and physical perceptions (1).

The development of better surgical techniques such as the low and ultra-low anterior resection (LAR), the total meso-rectal excision (TME), combined with the development of better anastomotic techniques and the possibility to construct a neo-rectum after excision of the rectum led to a greater focus on sphincter-preserving surgery. The better understanding of loco-regional tumor spreading and the evolution to preoperative chemo-radiotherapy were other important factors in this evolution.

Since the advances in multimodality therapy, 1 cm resection margin has been suggested to be adequate for patients receiving preoperative chemo and radiation therapy. So in 1994, Schiessel et al first described the intersphincteric resection technique (ISR), and this procedure has been used to increase sphincter preservation by achieving greater distal resection margins for patients with low rectal cancers. However, the intersphincteric resection has potential disadvantages in increasing the

possibility of surgical morbidities and local recurrence.

ISR is a surgical technique that extends the rectal resection into the space between the internal and external sphincter, known as the intersphincteric space. It is performed by a synchronous abdominoperineal approach with TME and excision of the entire or part of the internal sphincter, followed by a hand sewn colo-anal anastomosis (24). This procedure makes it possible to treat rectal tumors within 2 cm of the sphincter complex without the need of a permanent colostomy, which is an unavoidable consequence of the APR procedure.

However, this procedure is not without risk. Since the internal anal sphincter is responsible for resting anal continence, excision of the internal anal sphincter can compromise the sphincter function and result in anal incontinence (3). In addition, other common rectal cancer surgery complications such as anastomotic leakage or stricture, pelvic sepsis, wound infection and even death can occur. Another potential disadvantage of the ISR procedure is the possibility of incomplete removal of the tumor (R0 resection) when the tumor is located too close to the sphincter complex, resulting in an increased local recurrence rate. The intersphincteric resection has potential disadvantages in increasing the possibility of surgical morbidities and local recurrence, so the oncological results of the intersphincteric resection remain an important issue to be concerned.

The aim of this thesis is to evaluate the oncological and the functional results after surgery of low rectal cancer among patients included in the COLOREC study at the University Hospital Hassan II of Fes.

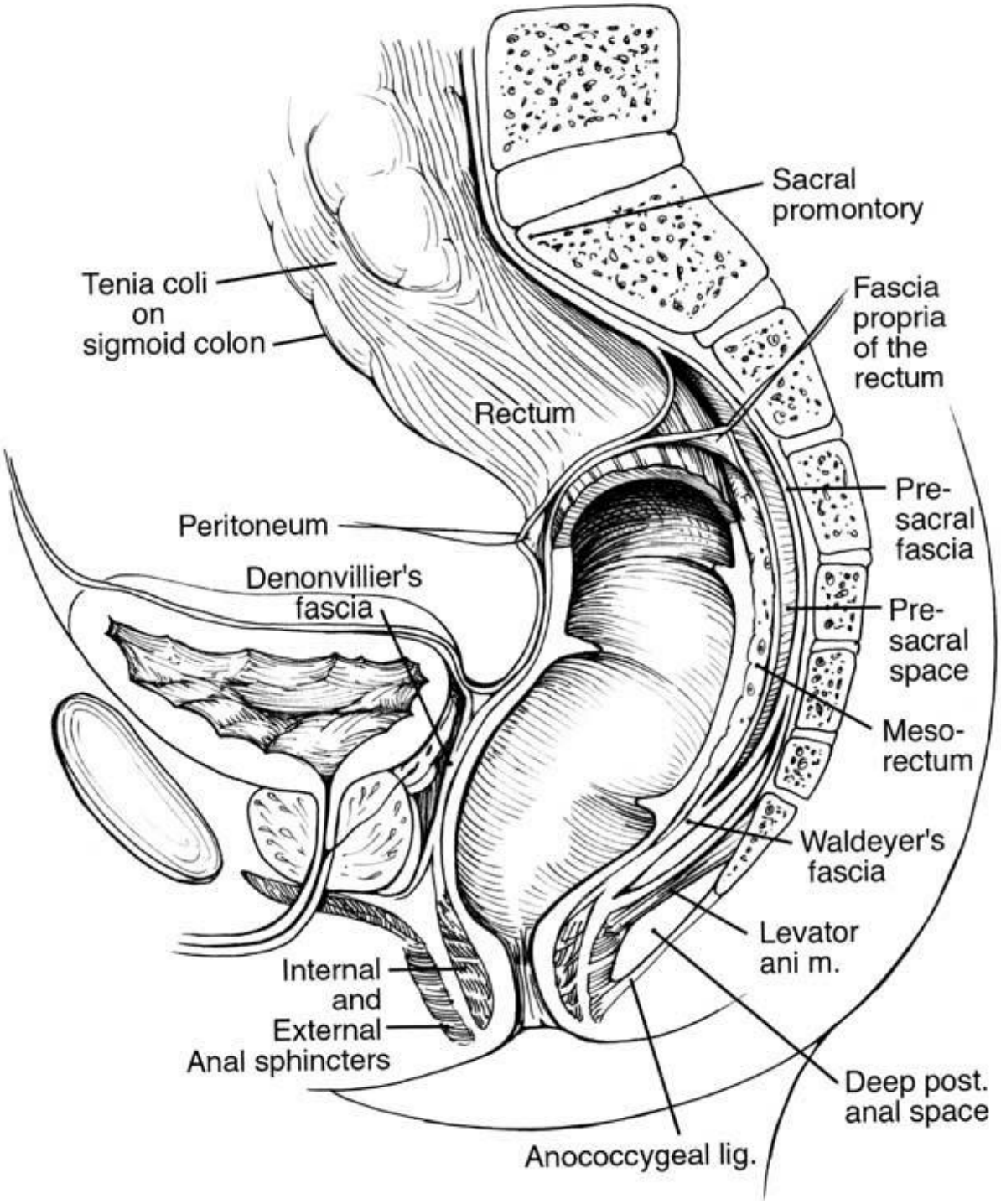
BACKGROUND

I-Anatomy and physiology of the rectum:

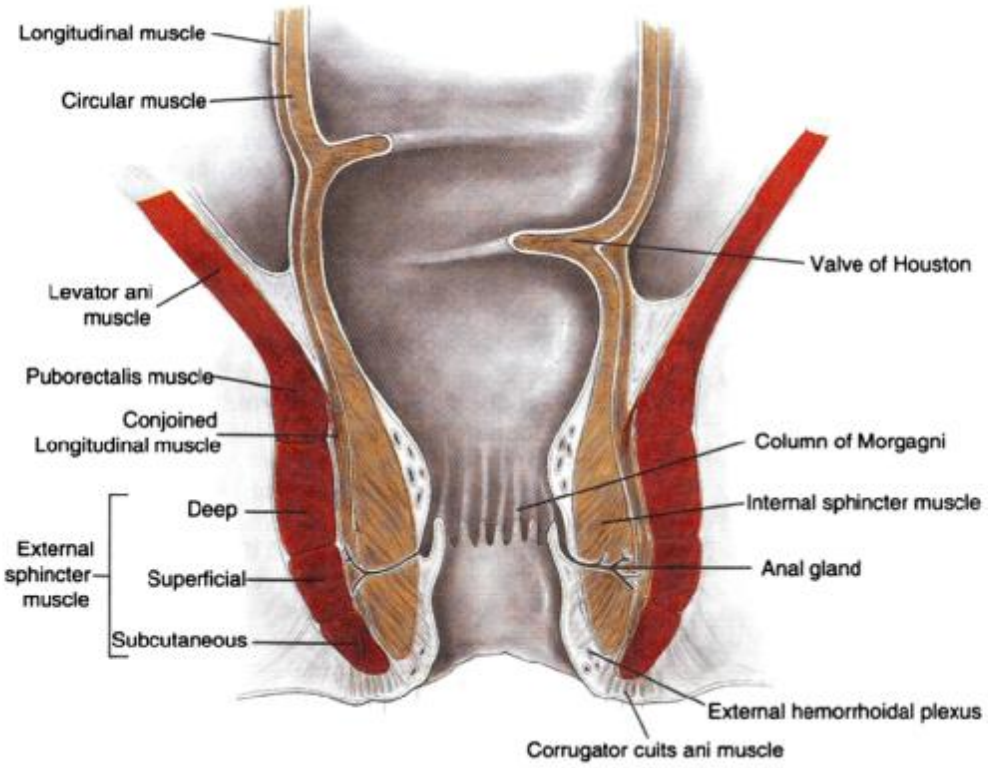
A- Anatomy:

1-Rectum:

The rectum is the terminal segment of the gastrointestinal tract and is located in the pelvis. It is preceded by the sigmoid colon (= pelvic colon) and it ends with the anal canal at the anus. Noting where the adventitial taeniae bands have coalesced to form outer longitudinal muscle can mark the transition between sigmoid colon and rectum. The rectum follows the concavity of the sacrum after which it bows dorsal to the anus. The total length of the rectum is approximately 12 to 18 cm. The bladder and prostate are located anterior to the rectum. The anterior upper two-thirds and the lateral upper one-third are covered by the peritoneum. The reflection of the peritoneum is variable but occurs approximately 6 to 8 cm above the anal verge. The lower one-third of the rectum is without peritoneal covering. The endopelvic fascia, also known as the Denonvilliers fascia, coats the ventral lower one-third of the rectum. The rectum is attached to the ventral surface of the sacral bone by the Waldeyer's fascia. Within its lumen the rectum has 2 or 3 plicae transversales, also known as valves of Houston. (4)



Sagittal view of the anal canal and rectum



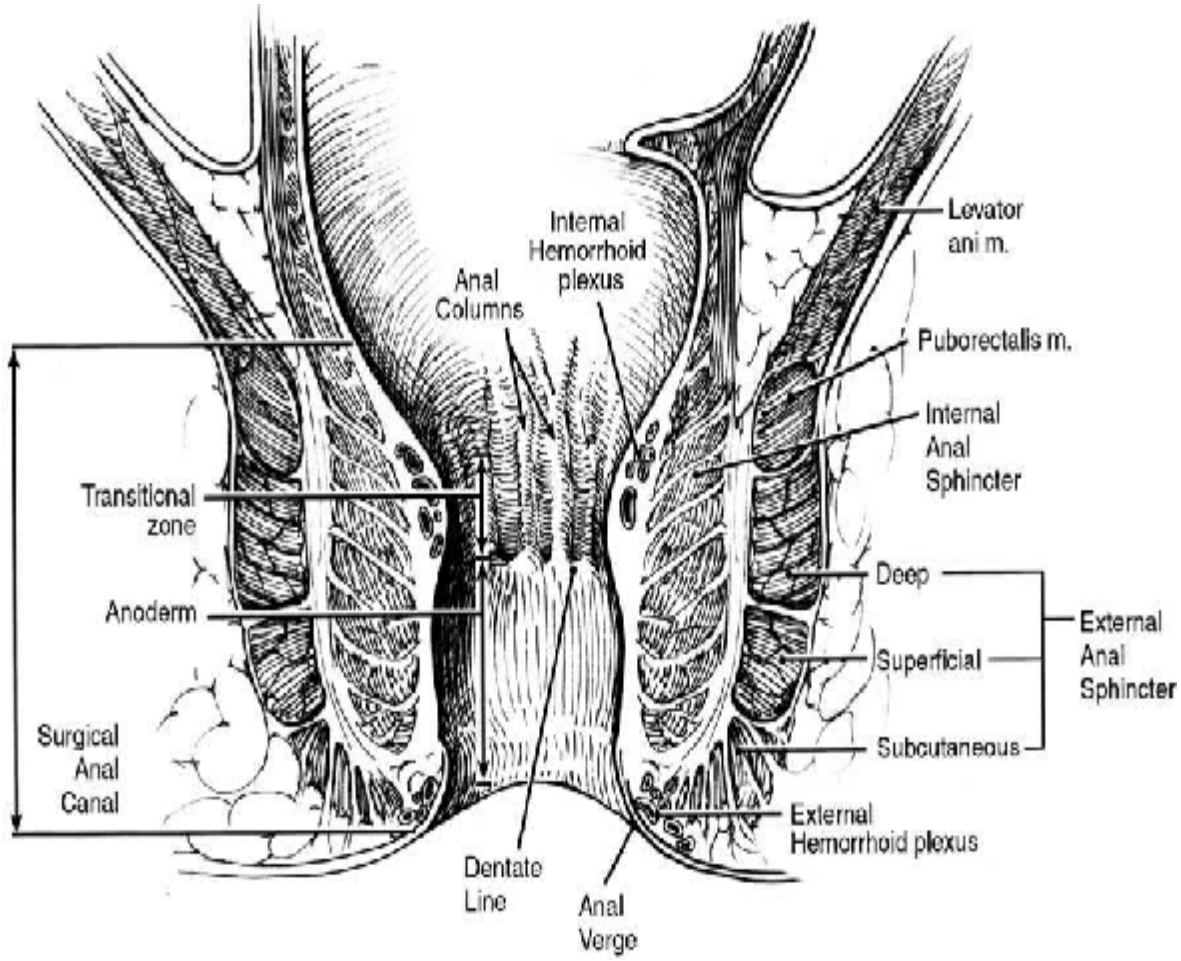
Internal and external anal sphincter

2-Anal canal:

The anal canal, the last part of the rectum, begin at the level of the levator ani muscle and open to the anal verge and it's approximately 2.5 to 5 cm in length. The internal and external anal sphincter muscle surrounds the anal canal. The internal sphincter muscle is an extension of the inner circular smooth muscle layer of the rectum. The striated external anal sphincter encircles the internal sphincter. The external anal sphincter is a part of the puborectalis muscle, in turn part of the levator ani muscle.

Histologically, the anal canal can be divided into 3 parts: the zona columnaris (columnar epithelium), the zona intermedia (columnar, transitional, or stratified squamous epithelium) and the zona cutanea (stratified squamous epithelium). The border between the zona intermedia and the zona cutanea is called the dentate

(pectinate) line; it is located 2 cm above the anal verge. Above the dentate line, parallel to the length of the anal canal, there are folds in the mucosa: the columns of Morgagni. The anal crypts that drain the anal glands are located between these columns. (4)



Anatomy of the anal canal and the sphincter complex

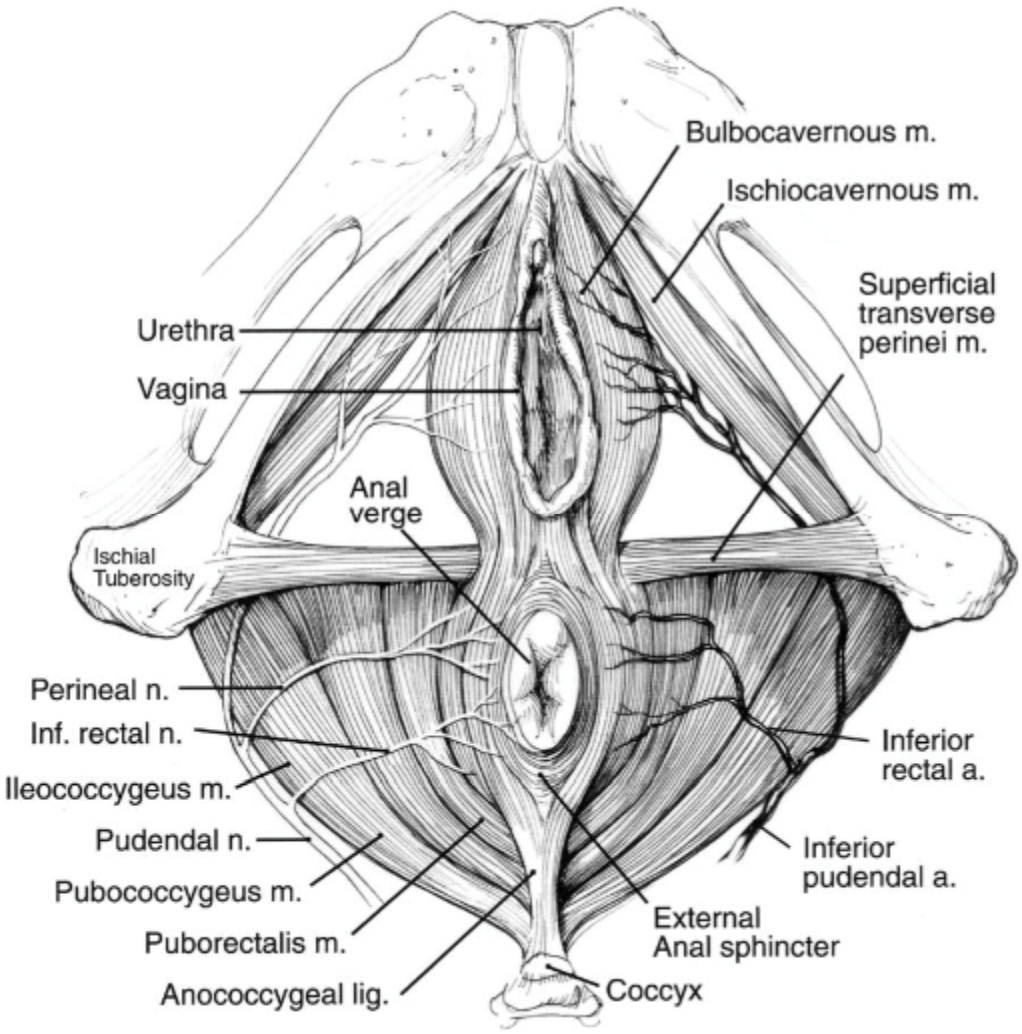
3-Muscles and spaces:

The levator ani muscle consists of 3 muscles: the ilio-coccygeal muscle, the pubo-coccygeal muscle and the puborectalis muscle. The main function of the levator ani muscle is supporting the viscera of the abdomen and assisting defecation. The puborectalis muscle creates the angulation between the rectum and the anal canal: the anorectal angle.

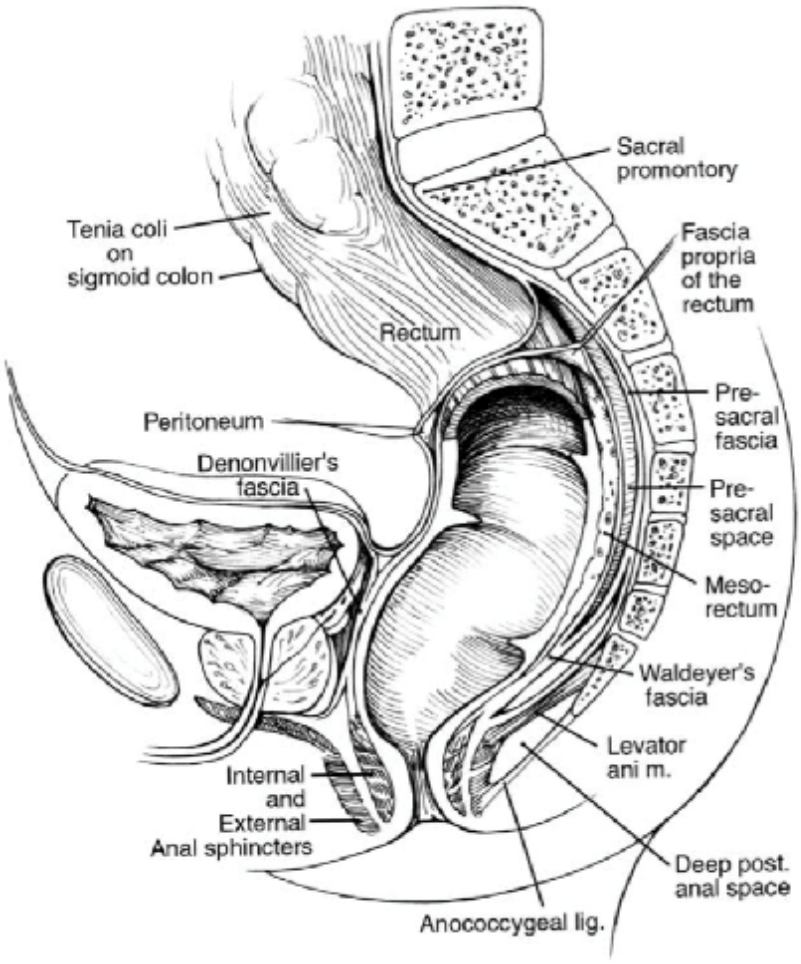
Perianal and perirectal spaces are spaces filled with loose areolar tissue or fat

between the rectum and the surrounding muscles or between two muscles mutually. One of these spaces is located between the internal and external anal sphincter: the intersphincteric space. This space is used in intersphincteric surgery to separate the internal from the external anal sphincter.

A fascia coats the portion located under the peritoneum and it's composed of two layers: the visceral layer and the parietal layer, the 2 layers join together to form the Denonvilliers fascia in men and the recto-vaginal septum in women. Approximately 3 or 4 cm above the recto-anal junction, they form the sacro-rectal ligament, which is sectioned to have access to the levator ani. (4)



Pelvic diaphragm



A sagittal view of the anal canal and rectum is depicted

4-The Mesorectum:

The mesorectum is not a rectal mesentery and that is why the term must be accepted as a linguistic convention. The term mesorectum defines the adipose tissue that surrounds the rectum, surrounded by it's own fascia and is the first field of rectal cancer spreading.

The fascia that circumscribes the rectum offers a relative avascular dissection plane (a very thin layer of lax tissue located between the parietal and the visceral layer if the pelvic fascia) respecting this dissection plane reconciles the oncological imperative of the operation with the gyneco-urinary function preservation.

The perirectal adipose wrap (the mesorectum) reaches the rectal adventitia,

this is not identifiable structures but it substitutes the visceral peritoneum in the extra-peritoneal part of the rectum. Posterior the mesorectum along with perirectal fascia reach the presacral fascia. Lateral the presacral fascia is performed by several apertures through which the rectal branches of the inferior hypogastric plexus and the medium rectal vessels pass. Anterior, the mesorectum stretches up to the Denonvilliers fascia. Actually the perirectal fascia is sometimes mistaken for the so-called “posterior layer” of the Denonvilliers fascia. Inferior the mesorectum stretches up to the insertion of the levator ani.

After dividing the mesorectum into 4 quadrants (Posterior, right lateral, left lateral, anterior) and into 3 parts (corresponding to the superior, Medium and inferior thirds of the rectum), most lymph nodes (92%) are located in the posterior quadrant and in the superior 2/3 of the mesorectum, the superior third of the rectum has no mesorectum in the anterior quadrant, most of the lymph nodes are small (0,5-3mm), considering the small size of the lymph nodes it is possible (In the absence of fat solvent) to see some of the rectal cancers as being in a lower stage.

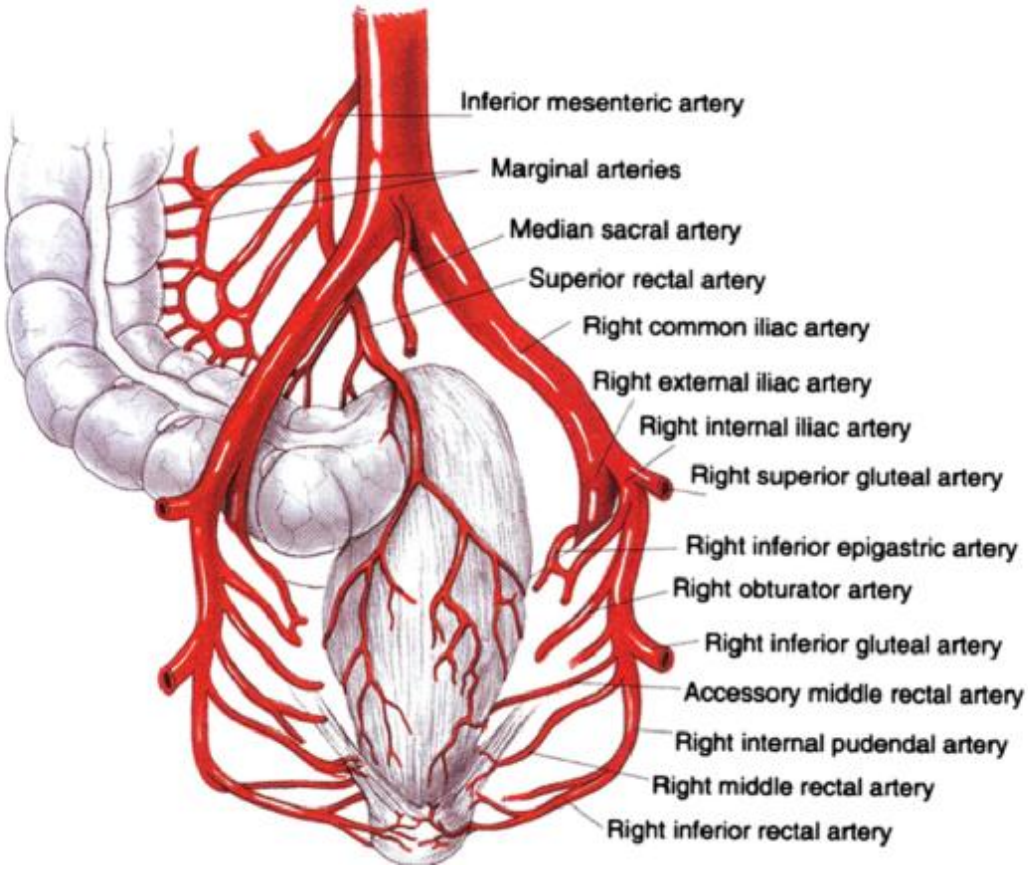
Intrarectal ultrasound is used to determine the tumoral invasion of the rectal wall (the mucosa - Tl, the own musculature - T2, the adventitia and the mesorectal fat - T3, the invasion of adjoining organs - T4) as well as the presence and size of peritumoral adenopathies – Nl. (4)

5-Arterial, venous system:

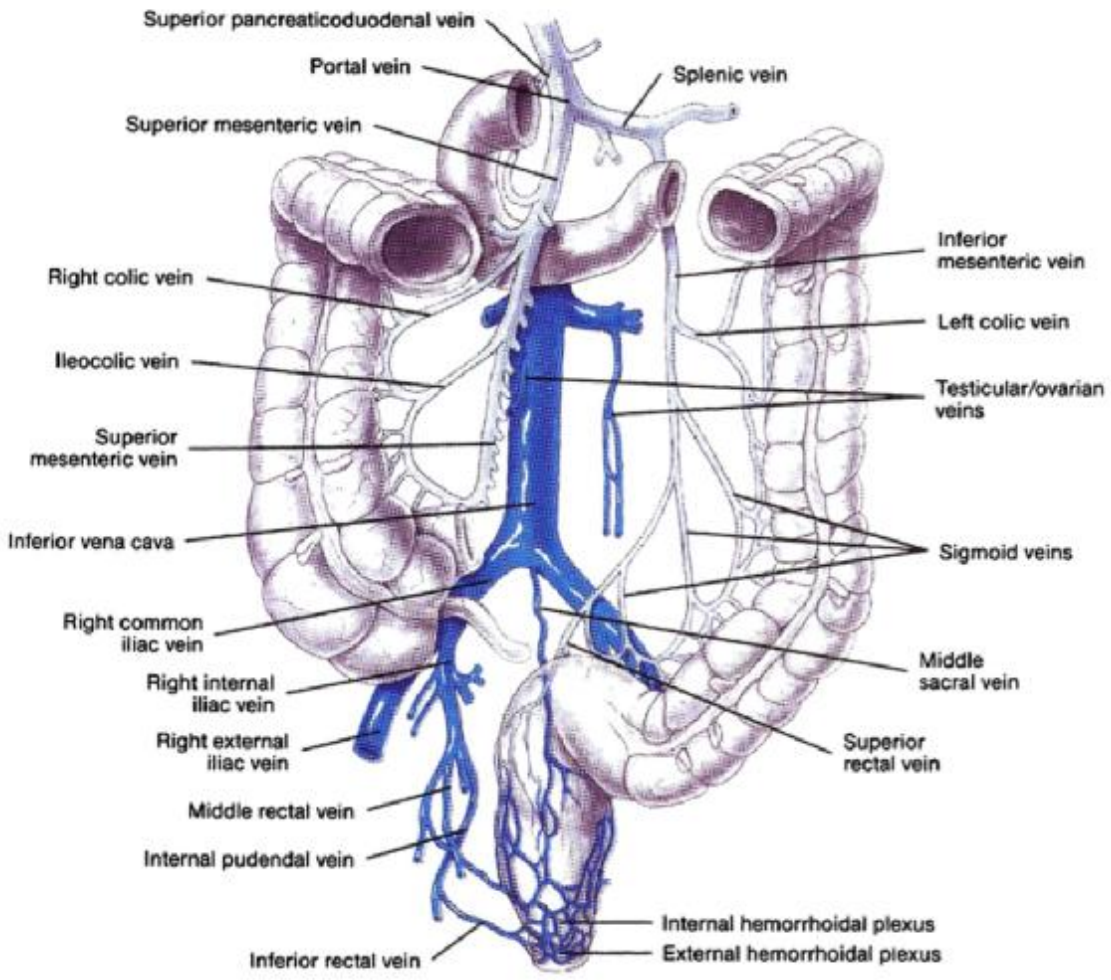
3 arteries irrigate the rectum and anal canal: the superior rectal artery, the middle rectal artery and the inferior rectal artery. The superior rectal artery arises from the inferior mesenteric artery (this is the last branch of the aorta before its bifurcation) and provides the rectum and the upper third of the anal canal. The middle rectal arteries supply the distal rectum and proximal anal canal. These middle rectal arteries originate from the internal iliac arteries. The inferior rectal

arteries provide the sphincter muscles. These arteries arise from the internal pudendal artery, which is a branch of the internal iliac artery.

The venous drainage of the rectum follows the arterial system. Most of the blood from the rectum drains into the portal circulation using the superior hemorrhoidal (rectal) veins. The other portion drains into the internal iliac veins directly through the middle rectal veins and the inferior rectal veins. (4)



Anorectal arterial blood supply



6-lymphatic system:

Much of the lymphatic drainage of the anal canal and rectum follows the arterial supply. The rectum drains via the superior rectal lymphatics to the inferior mesenteric lymph nodes in the retroperitoneum and laterally to the internal iliac nodes along the middle and inferior rectal vessels through the ischio-anal fossa. Lymph drainage from below the dentate line drains to the inguinal nodes. The study of lymphatic drainage in normal anatomy of the rectum revealed the rectal drainage via the superior rectal and inferior mesenteric vessels to the lumbo-aortic nodes that have no communication with to the internal iliac nodes. However, if distal obstruction occurs, drainage can occur from the anal canal to the superior rectal nodes or laterally to the ischio-anal fossa.(4)

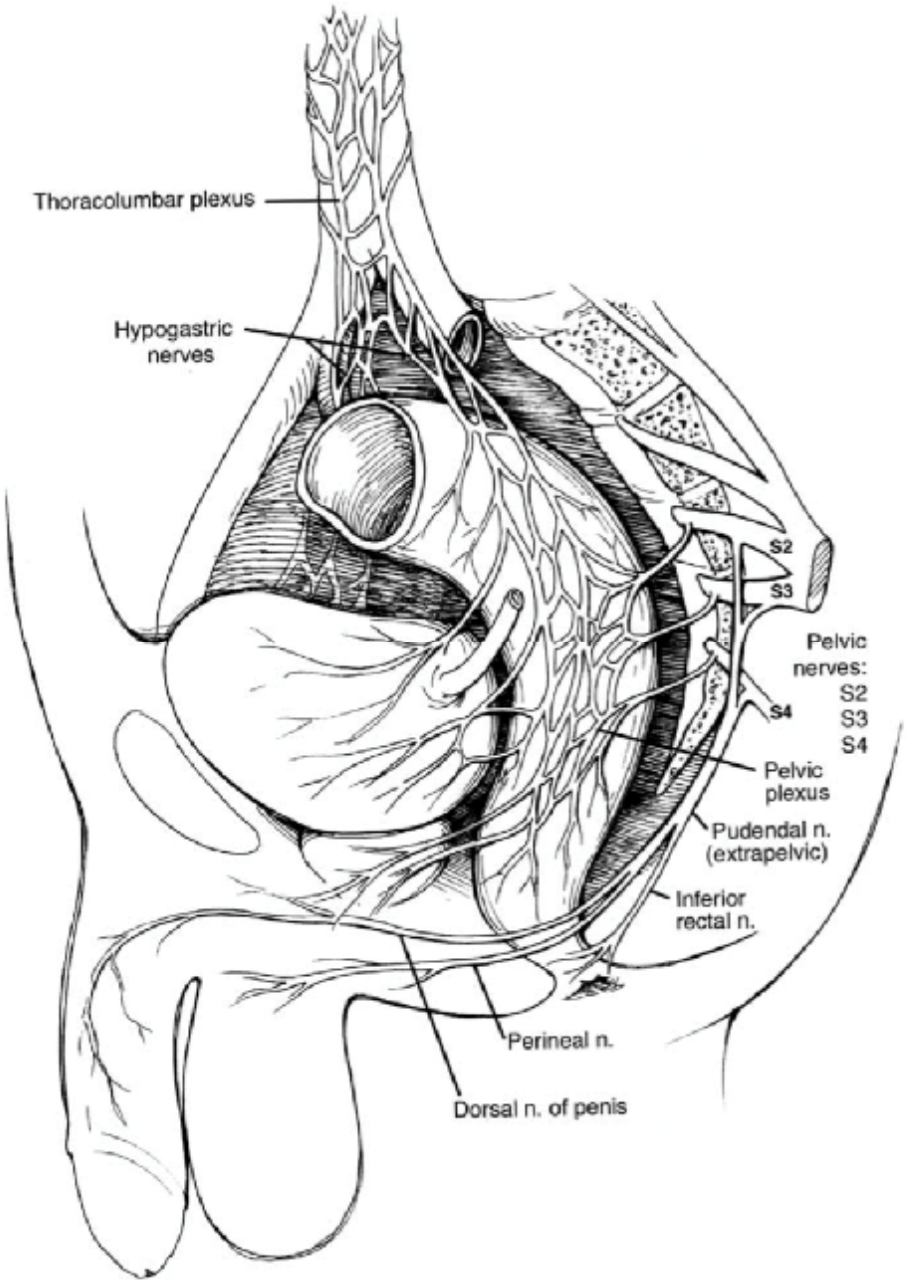
7-innervation:

Sympathic nerves, parasympathic nerves and the pudendal nerve innervate the rectum. The Sympathic nerves arise from the first 3 lumbar segments. They join the pre-aortic plexus anterior to the abdominal aorta and extend toward the mesenteric plexus. At the level of the aorta bifurcation the inferior mesenteric nerve bifurcates into two hypogastric nerves. These two hypogastric nerves join the pelvic plexus at the lateral sides of the rectum.

The parasympathic innervation originates from the 3 caudal sacral nerve roots (S2, S3 and S4). After exiting the sacral foramina, they form the pelvic nerves, also known as the Nervi errigentes. The hypogastric nerves, forming the pelvic plexus, join these nerves. Damage to these nerves during surgery can result in incomplete erection, lack of ejaculation, retrograde ejaculation or complete impotence.

The pudendal nerve arises from S2-S4. This nerve is important for the motor innervation of the pelvic floor muscles and the external anal sphincter. The internal anal sphincter shares the same sympathetic and parasympathetic innervation as the rectum.

The area between the dentate line and 0.3 cm to 1.5 cm above that line is sensitive to touch, pinprick, and heat and cold. The rectum proximal to this region is only sensitive to distension. The inferior rectal branch of the pudendal nerve transmits these sensory stimuli. (4)



Pelvirectal autonomic neuroanatomy

B-Embryology:

The gastrointestinal tract develops from the 3 parts of the embryological intestinal tube: the mouth, esophagus, stomach, duodenum and bile tract originate in the anterior intestine. The small intestine and the colon (up to the distal half of the transverse colon) originate in the medium intestine. The descendant colon the sigma and the rectum develop from the posterior intestine. It's distal segment ends in a pouch (cloaca); the allantois opens in the anterior part of this pouch. The pouch is of endodermic origin and an ectodermic membrane seals it (the cloacal membrane –proctodeum).

During the sixth week of development, a mesodermal septum divides the cloaca into an anterior cavity (the urogenital sinus) and a posterior cavity (the anal canal). This septum merges in the seventh week with the cloacal membrane forming the perineal body. Thus, the cloacal membrane is divided into a urogenital membrane (the larger anterior part) and an anal membrane (the smaller posterior part). The anal membrane ends in a depression covered by the ectoderm (anal depression - the origin of the anatomical anal canal). During the eighth week the anal membrane disappears. The location where the anal membrane was inserted is called the pectinate line, although there are no consistent arguments in favor or against its existence.

Following this development, the rectum and the superior anal canal are of endodermic origin and the inferior mesenteric artery provides their vascularization; the inferior anal canal (anatomical) is of ectodermic origin and branches of the intern iliac artery provide its vascularization. The tubercles develop on each side of the anal membrane from the somatic mesoderm; these tubercles merge (in "horseshoe" shape) posterior to the rectum and then unite with the perineal body. The external anal sphincter is made of this structure.

The primitive (embryological) intestinal tract is suspended posterior by a primitive mesentery, in which blood and lymphatic vessels and lymph nodes develop. At the level of the anterior intestine, this primitive mesentery forms the bursa omentalis. At the level of the medium intestine, the mesentery of the proximal colon is formed. At the level of the posterior embryological intestine, the mesentery of the distal colon and the mesorectum are formed.

C-Physiology:

The normal function of the anorectum represents a complex interaction between neurologic, myogenic, sensory, anatomic, and hormonal components. Failure or weakness of any one part or combination of parts of this array may lead to symptoms recognized as many common and some not so common diseases and conditions.

Anal continence is very complex, and investigation continues to further elucidate its mechanism. Several types of studies can be used to evaluate anorectal function, including anorectal manometry, electromyography, defecography, nerve stimulation testing, and radiographic studies, including endorectal ultrasound and magnetic resonance imaging (MRI).

Anal continence relies upon the ability of the ano-rectum to discriminate between the states of fecal matter, solid, liquid, or gas. Its presence also depends on both voluntary and involuntary control and a multitude of other factors, adding to its complexity.

Patients' symptoms of incontinence may vary depending on the state of fecal matter. It is thought that this is the most common factor affecting continence. If patients are continent of solid stool but not liquid or gas, maneuvers to change the consistency may be enough to ameliorate symptoms and regain fecal control. The

rectum acts as a reservoir where stool accumulates (reservoir continence). Other possible contributing factors to reservoir function include the adaptive compliance of the rectum, differences in pressure patterns, and angulations between the rectum and anal canal, which is due to continuous tonic activity of the puborectalis muscle.

The internal anal sphincter is the major contributor to the high-pressure zone. When the external sphincter is paralyzed, resting anal pressure changes minimally, suggesting that the internal sphincter is primarily responsible for resting anal continence. Control of the internal anal sphincter is thought to be a complex interaction between the intrinsic and extrinsic neuronal systems and myogenic neurons. The external anal sphincter also has continuous tonic activity at rest and even during sleep. Thus, the external sphincter is unique because other striated muscles are electrically silent at rest. Postural changes and other increases in intra-abdominal pressure such as sneezing, coughing, and the Valsalva maneuver increase the resting tone of the external sphincter by an anal reflex. The second sacral spinal segment modulates the external sphincter, which can be contracted voluntarily for 40- to 60-second periods.

It was traditionally thought that nerve endings responsible for the determination of the fecal state exist in the levator ani muscle outside the anal wall; however, Ruhl and colleagues demonstrated that sacral dorsal roots contain some afferents from low-threshold mechanoreceptors located in the rectal wall and that these afferents monitor the filling state and the contraction level of the rectum. Sensation within the anal canal is carried out by several types of sensory receptors, including free intra- epithelial nerve endings (pain), Meissner corpuscles (touch), bulbs of Krause (cold), Pacini corpuscles and Golgi-Mazzoni corpuscles (pressure and tension), and genital corpuscles (friction). Despite an extensive network of nerves within the anal mucosa, anal continence does not rely heavily on input from

these nerve endings. They are thought to play only a minor role in discrimination between the states of fecal matter. Thus, when this area is anesthetized, discrimination between solid and gas is impaired; however, continence is maintained.

At rest, the aforementioned factors keep stool within the rectum. Once this reservoir is distended, the stimulus for initiating defecation is sent. The resultant process of the left colon initiating peristaltic waves that result in propulsion of the fecal mass downward into the rectum occurs once or several times a day. Once the rectum is distended, the internal sphincter relaxes (rectoanal inhibitory reflex) and the external sphincter contracts maintaining continence. Squatting straightens the angle between the rectum and the anal canal. Adding the pressure of a Valsalva maneuver overcomes the resistance of the external sphincter and the pelvic floor descends. If the external anal sphincter receives inhibiting signals causing relaxation, the fecal bolus passes. Timing results from the balance of environmental factors acting through cortical inhibition and basic reflexes of the ano-rectum. (3-4)

II-Colorectal incidence

A-Prevalence of colorectal cancer around the world:

Colorectal cancer is a major cause of morbidity and mortality throughout the world. It accounts for over 9% of all cancer incidences. It is the third most common cancer worldwide and the fourth most common cause of death, CRC is in fact responsible for 12,2% of all the cancer deaths; and is only preceded by lung cancer.

Countries with the highest incidence rates include Australia, New Zealand, Canada, the United States, and parts of Europe. The countries with the lowest risk include China, India, and parts of Africa and South America.

In the United States, colorectal cancer is the third most common cancer diagnosis among men and women. There are similar incidence rates for cancer of the colon in both sexes, and a slight male predominance for rectal cancer. In 2005, ~108,100 and 40,800 individuals were diagnosed with cancer of the colon and rectum, respectively. As of January 1, 2012, there were almost 1.2 million Americans alive with a history of colorectal cancer. The American Cancer Society's estimates for the number of colorectal cancer cases in the United States for 2016 are 95,270 new cases of colon cancer and 39,220 new cases of rectal cancer, It is expected to cause about 49, 190 deaths during 2016 at a death rate of 100 000 people per year.

In France, the prevalence of CRC is around 15 000 new cases per year, the number of colorectal cancer cases increased from 24 000 to 36 000 between 1980 and 2000. Colorectal cancer is the third most common cancer in France right behind breast cancer and prostate cancer.

In Europe, colorectal cancer (CRC) is the second most common cancer after breast cancer with a yearly incidence of 447,000 new diagnoses. Colorectal cancers

make up for 13.0% of all cancer cases. Approximately 30% of the colorectal cancers are located in the rectum. (5)

B-Prevalence of colorectal cancer in Morocco:

In Morocco, the lack of cancer registers makes the evaluation of colorectal cancer incidence imprecise, but in estimation, colorectal cancer is less frequent in Morocco compared to other foreign countries.

A number of regional initiatives were made to solve this issue; in 2005 The Cancer Register of Rabat was created followed by the register of Casablanca that covers from 2005 to 2007.

More recently a retrospective study was established in the anatomopathology department of the teaching hospital Hassan II of Fes, collecting anatomo-pathological and epidemiological data from 2004 until 2010.

1-Rabat Area

Rectal cancer is the second most common gastro-intestinal cancer in Rabat right after gastric cancer, The prevalence of rectal cancer in Rabat like any other country in North Africa is low compared to other countries such as china and japan. (6)

	Total المجموع	Hommes ذكور	Femmes إناث	
Nombre de cas	22	12	10	عدد الحالات
Incidence brute (pour 100 000)	3,5	3,9	3,1	معدل الإصابة الخام (في 100,000)
Incidence standardisée sur la population mondiale (IC à 95%)	3,3 (1,9 -4,8)	3,9 (1,6-6,2)	2,8 (1,1-4,6)	معدل الإصابة حسب القياس العمري العالمي
Incidence standardisée sur la population marocaine (IC à 95%)	2,8 (1,6-4,0)	3,0 (1,3-4,7)	2,7 (1,0-4,3)	معدل الإصابة حسب القياس العمري المغربي
Risque cumulé 0-74 ans (%)	0,4	0,5	0,3	الإخطار التراكمي 0-74 سنة (%)

Rectal cancer incidence in the Rabat Area, 2005.

	Hommes	Femmes
Japon, Nagazaki (1998-2002)	19,5	10,0
France, Bas-Rhin (1998-2002)	19,2	8,9
USA, SEER (9): Blancs (1998-2002)	12,4	7,4
Suède (1998-2002)	12,1	7,3
Suisse, Genève (1998-2002)	11,6	6,7
Chine, Shanghai (1998-2002)	11,2	8,3
Italie, Modena (1998-2002)	10,6	5,6
Libye, Benghazi (2004)	5,5	4,1
Maroc, Rabat (2005)	3,9	2,8
Tunisie, Nord (1995-1998)	3,7	3,3
Algérie, Sétif (1998-2002)	3,6	3,8
Zimbabwe, Harare (1998-2002)	3,4	3,0
Maroc, Casablanca (2004)	2,8	3,1

Rectal cancer: a comparison between the standardized incidence and other registers.

2-Casablanca Area

Colorectal cancer is the 3ed cause of cancer in Casablanca for men and the 4th in women, with a higher prevalence among men. (7)

Les cinq premières localisations des cancers chez l'homme. RCRC. 2005 - 2007

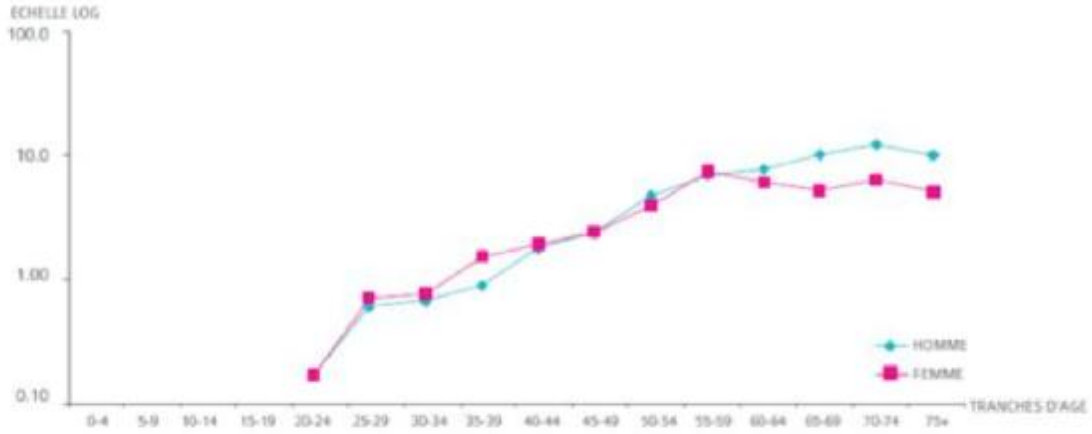
Position	Cancer	Fréquence *	Incidence brute	Incidence** standardisée	Moyenne d'age
1	Poumon	22,1	20,8	25,9	59,5
2	Prostate	10,5	10	13,5	70,4
3	Colorectal	7,2	6,9	8,1	57,7
4	Vessie	7	6,7	8,7	64,7
5	LNH	6,6	6,4	7,2	-

* Fréquence peau exclue sauf mélanome
** Population mondiale de référence

Position	Cancer	Fréquence *	Incidence brute	Incidence** standardisée	Moyenne d'âge
1	Sein	34,3	37,5	36,4	49,5
2	Col utérin	13,3	14,4	15	52,9
3	Thyroïde	6,5	7,1	6,7	44,8
4	Colorectal	5	5,4	5,8	55,6
5	Ovaire	4,7	5,1	5,3	52,4

* Fréquence peau exclue sauf mélanome
** Population mondiale de référence

Five top fist cancer locations in men (first chart) and women (second chart)



Fes-Boulmane area

There is no cancer register in this region to define the colorectal cancer prevalence; Colorec study examined the epidemiological and anatomopathological profile of 5532 cancer cases in the teaching hospital Hassan II of Fes

Rectal cancer distribution by Sex and Age, 2005-2007

	Incidence standardisée	
	Homme	Femme
Canada 2003 - 2004 [15]	34	6,7
USA 2004 - 2008 [9]	22,9	16,9
Japon (Hiroshima) 1998 - 2002 [14]	22,3	10,6
France (Francim) 2005 [10]	20,2	8,7
Algérie (Oran) 1996 - 2004 [13]	4	3,2
Tunisie (Nord Tunisie) 1999 - 2003 [7]	4,9	4
Maroc RCRC 2005 - 2007	**3,4**	**2,6**

A comparison between rectal cancer incidence in Morocco and other countries.

The incidence in the Maghreb countries is low compared to other countries such as Canada and USA.

3-Fez-Boulmane Area

There is actually no data available about neither rectal cancer incidence nor characteristics in this region. This study examines the epidemiological and

anatomopathological profile of 5532 cancer cases selected in the anatomopathological service in the teaching hospital Hassan II Fez between 2004 and 2010.

It shows that there is a predominance of digestive tract cancers (1120 cases which is 20.25% of all cancer cases), the incidence is 87 new cases for every 100 000 cases admitted in the hospital during the period of the study. The frequency of colorectal cancer is high with 464 cases which is 41.43% the incidence is 36 new cases for every 100 000 cases. (8)

Localisation	Nbre de cas	%	% de l'ensemble
Cancers digestifs	*1120*	*20,25*	
Côlon-rectum (appendice et anus inclus)	464		41,43
Estomac	332		29,64
Foie	91		8,12
Intestin grêle	88		7,86
Œsophage	67		5,98
Vésicule biliaire	58		5,18
Pancréas	20		1,79

Distribution of all digestive tract cases by location and frequency

A second study was conducted in the gastroenterology service of the Hospital Hassan II Fez called COLOREC Fez. It examined 385 patients with colorectal cancer between January 2010 and December 2013, providing the first base of colorectal cancer data investigation. The authors mention a lower incidence compared to western countries, which lays between 2.5 and 3.3 cases per 100 000 habitant.

III-Predisposing Conditions and Risk Factors

Risk factors to develop colorectal cancer are: age (>50 years), diet (too much red and processed meat, saturated fatty acids, proteins and alcohol, low dietary fiber, sugar), lack of exercise, obesity and smoking. In addition, the use of non-steroidal anti-inflammatory drugs (NSAIDs), hormone replacement therapy (HRT), statins and oral contraceptives have been associated with an increased risk of CRC. Inflammatory bowel diseases (colitis ulcerosa and Crohn's disease), diabetes or colorectal polyps are pre-existing conditions, resulting in a higher risk of developing colorectal cancer. A family history of CRC and increasing age are the two most common risk factors for CRC. Fish, calcium and milk, fiber and vegetables play a protective role in the development of CRC. (26-27-28).

IV-Symptoms

A big challenge in diagnosing colorectal cancer is that patients in an early stage are often asymptomatic. In the occasion they do have symptoms, these vary depending on the size and location within the large bowel. When located on the right side the complaints tend to be non- specific, including malaise, weight loss, vague abdominal pain or even a self-detected mass in the abdomen. Left-sided colonic and rectal lesions are more likely to cause obstructive symptoms. In which case the patient presents with change in bowel habit with constipation and more frequent diarrhea with or without abdominal pain. Rectal bleeding, usually upon defecation is more typical for rectal and sigmoid cancers. When distally located tumors invade the anal canal, a more pronounced pain is often perceived. Tenesmus and symptoms of iron deficiency anemia from occult bleeding of the tumor (fatigue, headaches, faintness, breathlessness, angina, intermittent claudication and

palpitations) are other clinical signs of colorectal cancer. Moreover, locally spread CRC can cause fecal incontinence (infiltration of the anal sphincters), back pain (infiltration of the sacral plexus), urinary infection, a rectovesical fistula or renal failure (infiltration of the renal tract). (33).

V-TNM staging:

The TNM staging system is by far the most used staging tool for rectal cancer. The depth of local invasion of the primary tumor (T), the extension of regional lymph node involvement (N) and the presence of distant metastasis (M) are the key parameters of this system. With this system, it is possible to divide patients into groups with similar prognosis and similar therapeutic interventions. These days, there is a preference for the 5th version (1997) of the TNM staging system. To distribute the patients into this stages (I, II, III and IV) different imaging modalities are used such as endorectal ultrasound (EUS), X-ray (Rx), (endorectal) magnetic resonance imaging (MRI), computed tomography (CT) and positron emission tomography - computed tomography (PET-CT). (35)

1-Evaluation of local invasion of the primary tumor (T):

Endorectal ultrasound (EUS) is considered the most ideal imaging tool for staging superficial rectal tumors. EUS can accurately evaluate the depth of tumor penetration into the rectal wall to differentiate T1 from T2 rectal tumors. The sensitivity and specificity from EUS for muscularis invasion and perirectal tissue invasion are respectively 94 % and 86% and 94% and 69%. Because ultrasound is observer dependent, the values of sensitivity and specificity can differ strong between different centers. It is better not to use EUS for the staging of large, locally

invasive or desmoplastic tumors because it is difficult to distinguish true tumor infiltration from tissue reaction, resulting in overstaging. (36-37)

TNM	Stage	Extension to		Prognosis (5-year overall survival)
T*is* N0 M0	0	Carcinoma *in situ*: intraepithelial or invasion of lamina propria		>90%
T1 N0 M0	I	Submucosa		
T2 N0 M0	I	Muscularis propria		
T3 N0 M0	IIa Substaging	Subserose/perirectal tissue T3a T3b T3c T3d	 Less than 1 mm 1-5 mm 5-15 mm 15+ mm	60%-85%
T4 N0 M0	IIb	Perforation into visceral peritoneum; or invasion to other organs		
T1-2 N1 M0	IIIa	1-3 regional nodes involved		55%-60%
T3-4 N1 M0	IIIb	1-3 regional nodes involved		35%-42%
T1-4 N2 M0	IIIc	4 or more regional nodes involved		25%-27%
T1-4 N1-2 M1	IV	Distant metastases		5%-7%

TNM classification (version 5, 1997) with subclassifications and stage-specific survival

The accuracy of EUS after preoperative radiotherapy is decreased due to an increased echogenicity of the rectal wall. EUS cannot be used in patients with high or

stenotic circumferential rectal tumors. All things considered, the accuracy of EUS for T staging is about 80% to 95%.

Endorectal MRI has the same accuracy as EUS in T1 and T2 tumors but has the advantage that it also can be used in high located or stenosing cancers and it is less observer-dependent. However, endorectal MRI is not the first choice because of its high costs. It is also a technically more demanding imaging tool and it is a less comfortable procedure to undergo for the patients.

In T3 tumors, EUS can be considered equally accurate to endorectal MRI. Both MRI and EUS have difficulties in the differentiation between T2 and borderline T3 lesions, which can result in overstaging and suboptimal therapy choice. MRI can assess the depth of extramural spread of T3 rectal tumors as accurately as histology. For tumors located in the lower third of the rectum MRI is superior to EUS when high-resolution sequences with scans perpendicular to the anal canal and coronal scans of the sphincter complex are used. In the evaluation of local invasion of lower rectal tumors, CT remains inferior to EUS and MRI because it cannot differentiate between the layers of the rectal wall and the inherent soft tissue planes. For the evaluation of high rectal tumors CT is useful to show the relationship of the tumor to pelvic structures.

For advanced rectal cancer (T3 and T4 tumors), only phased array MRI has a high accuracy in the evaluation of local infiltration.

To evaluate the circumferential resection margin (CRM), which is important for the substaging of T3 tumors, phased array MRI is the imaging modality of choice. Endoscopic ultrasound, endorectal MRI and conventional CT have no place in the evaluation of the CRM.

Digital examination (DRE) is a good way to evaluate the height of the tumor in the rectum. This examination is highly accurate for mid-rectal and lower rectal

tumors. In contrast to rigid proctoscopy, flexible endoscopy is not always reliable to locate the tumor. The distance between the anorectal junction and the distal part of the tumor as well as the length of the tumor are usually measured with a phased array MRI. CT can also be used to determine the distance of the tumor to the anal sphincter complex.

Tumor infiltration of the internal or external sphincter can be accurately evaluated by digital rectal examination, EUS, phased array or endorectal MRI. (35-36)

2-Evaluation of regional lymph node involvement (N):

Currently, characterizing lymph nodes into malignant or benign enlarged lymph nodes remain an important radiological challenge. Nodes larger than 8 mm are considered as malignant on CT, MRI and EUS. EUS is considered better than MRI and CT for nodal staging except for nodes located in the mesorectum. However, the size is not a good predictor for malignancy. The best way to indicate malignant lymph nodes is based on morphological features such as the presence of mixed signal intensity within the lymph node and/or irregularity of the borders of the lymph node. The best way to describe these morphological alterations is by using high-resolution MRI scans techniques. The use of FDG PET is not recommended in the search for malignant lymph nodes. (36)

3-Evaluation of distant metastasis (M):

About 50-60% of all rectal cancer patients will develop distant metastasis after treatment. These metastases are usually found in the liver (20-25%), the lungs (10-20%), bone (6-10%) and less common in the brain (3%). The finding of distant metastasis has important implications on the choice of treatment.

In search for distant disease, the investigations generally used are chest X-ray, thoracic and abdominal CT or MRI. FDG-PET and MRI are superior to helical CT in the detection of hepatic metastases. FDG-PET had a significantly higher sensitivity on a per- patient basis, but not on a per-lesion basis. The sensitivity per lesion basis for MRI using liver- specific contrast agents was significantly superior to that for helical CT. When clinical symptoms - such as bone pain or neurological dysfunction - occur, a bone and brain scan can be performed in search of distant metastasis. (37-38)

VI-Low rectal cancer treatment

The only way to cure cancer is to remove or destroy every malignant cell in the entire body. Radical removal of the primary tumor and prevention of local recurrence form the main principles in general cancer treatment. As with most types of cancer, surgery is the most effective way to accomplish this. When surgery cannot insure a complete removal of the tumor, preoperative therapy can be performed to improve surgical conditions. Preoperative therapy consists of radiotherapy (RT) and/or chemotherapy.

Based on a study from Smith and Brown (40), Blomqvist and Glimelius divided rectal cancers into three groups with a different preoperative management: “the good, the bad and the ugly”. The distribution into these groups is based on the position of the tumor into the TNM classification, the location of the tumor in the rectum and the status of the circumferential resection margin before surgery (negative or positive for malignant cells). Other factors that play a role in the decision-making concerning preoperative therapy, such as size of the mesorectum, anterior or posterior location of the tumor and extramural vascular invasion were not included in this algorithm.

The “good” group of rectal tumors shows no bad prognosis factors on MRI or a risk of local or systemic failure. Therefore, surgery for “good” tumors does not need to be preceded by preoperative treatment. Rectal cancer with an increased risk for distant metastases is classified in the “bad” group; those cancers are usually treated with short-course RT followed by immediate surgery. The “ugly” group consists of tumors with features suggesting high risks for local recurrence and distant metastases. It is recommended to treat these patients with chemo radiotherapy before delayed surgery.

A-Preoperative treatment

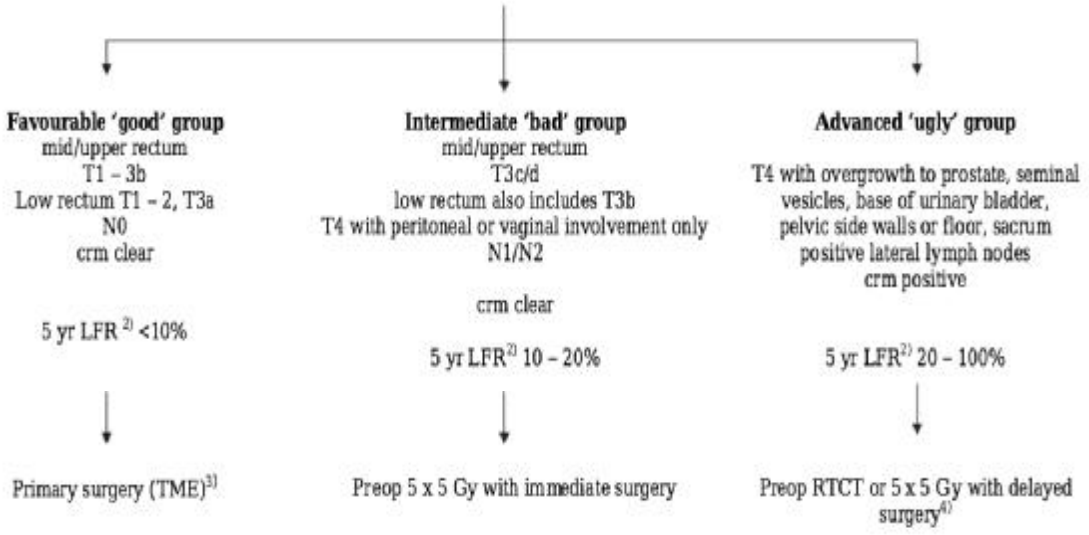
1-Radiotherapy

The use of radiotherapy is of great importance in the treatment of rectal cancer. The main purposes of radiotherapy are reducing local recurrence and obtaining a better survival rate. A variety of treatment modalities, distinguishable by preoperative, intraoperative, postoperative application, with or without chemotherapy and duration are used around the world. Several randomized trials explored the effect of radiotherapy (RT) on local recurrence to define the optimal biologically effective dose (BED), fractionation and time-point (pre- or post-operative) for RT in rectal cancer. Many of these studies were conducted in Sweden.

1.1. Preoperative Vs. Post- operative radiotherapy

Before the 1990s, researchers from the United States investigated postoperative RT while European researchers did the same with preoperative RT. Several studies showed the superiority of preoperative RT versus postoperative RT. The main advantage of preoperative RT compared to postoperative RT is its down staging effect on the tumor, which results in better surgical options. There are more sphincter-saving procedures performed after preoperative RT and this technique is

less toxic than its postoperative variant. However, when a second biopsy is performed to evaluate the histopathological response after radiotherapy, pathological details such as margins, depth of bowel wall penetration and histological features can be hard to investigate due to tissue destruction. (40-41-42)



1) The algorithm does not primarily address the risk of systemic disease, although this risk also increases with the presence of many of 'the risk factors', however, not necessarily parallel to the local failure rate (LFR).
2) Calculated in the group of patients planned for surgery, i.e. irrespective of the surgical outcome. The figures are valid if the surgeon is an experienced rectal cancer surgeon and no pre-treatment is given.
3) A local procedure is possible in a few (chiefly pT1, sm1 + 2, N0).
4) RTCT means radiochemotherapy to 50.4 Gy in 1.8 Gy fractions with 5-fluorouracil. 5 x 5 Gy with delayed surgery is used in patients not fit for RTCT. The relative antitumour efficacy of conventionally fractionated RT or the short-course schedule is not known with any greater certainty [30,31]

MRI-directed pre-operative evaluation practised presently in Uppsala and Stockholm, Sweden

Of course, this does not apply for postoperative RT. Postoperative radiochemotherapy can be an alternative treatment option when the patient with comorbidity refuses radical surgery while adverse prognosis factors such as involved margins, poorly differentiated tumors and lymphovascular invasion are absent.

1.2. Indications:

In preoperative RT, short-course irradiation, most commonly used in the “bad” group, consists of a dose of 25 Gy over 1 week (5 x5 Gy) with surgery within 10 days after the first radiation fraction. Long-course RT in the other hand consist in a dose of 50.4 Gy in 1.8 Gy/ fractions and followed by surgery after a 6–8 week gap is mostly used in the “ugly” group of rectal cancers.

Preoperative radiotherapy should be planned using a four-field plan, with shielding of normal tissue to reduce toxicity. The primary tumor with the mesorectum and lymph nodes (those most at risk) outside the mesorectum should get the highest irradiation dose.

As shown in the table, radiotherapy is indicated especially in the intermediate “bad” and advanced “ugly” group of rectal tumors. In most cases early-localized cancers (favorable “good” group) require no further therapy besides surgery. After the introduction of the total mesorectal excision (TME) technique, the local recurrence rates were reduced dramatically even without preoperative RT. Because TME already achieves a low recurrence rate, preoperative radiotherapy is not recommended in the “good” group of rectal cancers. Exceptionally, when the medical condition of the patient does not allow a surgical procedure or if the patient refuses radical surgery, radiotherapy alone can be performed.

In the intermediate “bad” and the advanced “ugly” group of rectal cancers preoperative radiotherapy is performed standard even in combination with the TME technique. The Dutch CKVO 95-04 trail examined the outcome of preoperative RT with the TME technique versus TME surgery alone in 1805 patients who had a resectable rectal cancer. Preoperative radiotherapy with TME had an overall 5-year local recurrence rate of 6% while TME alone had a rate of 12%. An alternative option is initial surgery followed by postoperative CRT if the tumor is T3 and/or N1-2. (40)

1.3. Delay between the radiotherapy and surgery

The interval between preoperative CRT and surgery is longer (6-8 weeks = long-course RT) in the locally advanced rectal cancers than in the group of the “bad” rectal cancers (< 10 days after the first radiation fraction = short-course RT). The longer period between preoperative irradiation and surgery provides an increased down staging of the tumor without noxious effect on toxicity. However, this delay after CRT did not result in a significant difference in long-term local control or survival. It is important to know that short-course RT does not downstage the tumor. For this reason, short-course RT is only indicated when the circumferential resection margin (CRM) is free of cancer based on preoperative MRI. When the CRM is threatened by the tumor, down staging, long-course CRT is indicated. (40)

1.4. Post radiotherapy evaluation

Currently, the focus is on organ preservation, some institutions restage the tumor after preoperative CRT; when no viable tumor cells are found, no further therapy is delivered and the patient is monitored for at least 5 years. This approach can only be performed in some early cases of rectal cancer.

MRI and FDG-PET can be used in the evaluation of response after preoperative CRT, but it is not recommended to modify the extent of surgery based on the findings of these examinations. It is uncertain that the results of these images are reliable predictors of tumor down staging after RT. (40-43)

2- Radio-Chemotherapy combination

Currently, chemotherapy is typically used in combination with radiotherapy. In contrast to colon cancer, the evidence of the use of chemotherapy in rectal cancer is not well investigated. Therefore, the evidence about the use of chemotherapy in colon cancer is generally used in the treatment of rectal cancer. (45)

2.1. Indications:

Neoadjuvant or induction chemoradiotherapy is an increasingly used strategy for patients with rectal adenocarcinomas. The only definitive indication for neoadjuvant chemoradiotherapy, supported by the results of randomized trials, is the presence of a T3 or T4 tumor. However, relative indications for neoadjuvant chemoradiotherapy include the presence of clinically node-positive disease in a patient with a magnetic resonance imaging (MRI) or transrectal endoscopic ultrasound (EUS)-staged T1/2 rectal cancer, a distal rectal tumor for which an abdominoperineal resection (APR) is thought to be necessary, and a tumor that appears to invade the mesorectal fascia on preoperative imaging because of the decreased likelihood of achieving a tumor-free circumferential resection margin with upfront surgery.

2.2. Chemotherapy indication for T4 stage or bulky tumors

For patients with T4 or bulky tumors or those with extensive nodal disease, studies suggest induction chemotherapy followed by chemoradiotherapy (or chemoradiotherapy followed by induction chemotherapy) as an appropriate alternative to induction chemoradiotherapy alone. In these circumstances, they recommend that physicians proceed cautiously with scans after two months of therapy and move directly to chemoradiotherapy if no response is seen. If this approach is chosen, they suggest use of an oxaliplatin-based chemotherapy regimen rather than a fluoropyrimidine alone.

2.3. Radiotherapy regiment

The best regimen for neoadjuvant therapy has not been established. For most patients, studies suggest that the conventional fractionation radiotherapy (RT) with concurrent fluoropyrimidine chemotherapy (ie, long-course chemoradiotherapy) is better than the short-course Swedish approach to RT alone.

Short-course RT has been adopted in many institutions as the standard preoperative approach for operable rectal cancer. Some institutions in the United States are now using short-course RT in selected patients, such as those who are thought unlikely to tolerate full-course chemoradiotherapy, or prior to rectal surgery in the setting of metastatic disease to minimize delays in initiation of systemic therapy. However, at many institutions, long-course chemoradiotherapy is still considered the preferred approach for most patients.

2.4. Chemotherapy regiment

The chemotherapy regiment consists of a continuous infusion fluorouracil (FU; 225 mg/m2/24 hours) during the entire course of RT, as has been used in the postoperative setting for rectal cancer, although oral capecitabine (825 mg/m2 twice daily, five days per week) is an appropriate alternative.

The benefit of oxaliplatin as a component of neoadjuvant concomitant chemoradiotherapy in early rectal cancer remains unclear. Nevertheless, given that toxicity is clearly worse compared with chemoradiotherapy with a fluoropyrimidine alone and that efficacy is not yet proven, we suggest not adding oxaliplatin to fluoropyrimidine-based chemoradiotherapy outside of the context of a clinical trial.

B-Surgical treatment

1-History of rectal cancer surgery

The ancient Egyptians collected knowledge of anorectal diseases. Several rectal procedures and medications are documented on the Ebers and the Chester Beatty Medical Papyrus. Herodotus, a fifth century Greek historian, concluded after his studies at the Library of Alexandria that rectal cancer was a disease without cure. It took more than a millennium until Giovanni Morgagni proposed to resect the rectum for treatment of rectal cancer during the 18th century.

In 1739, Jean Faget (France) was the first one who performed a rectal resection. The result of this attempt was an uncontrollable sacral anus, which was difficult to manage. The patient did not survive. Henri Pillore also executed the first colostomy in France in 1776; this patient also did not survive the procedure. Jacques Lisfranc performed The first successful excision of the rectum in 1826. Via a perineal approach he could remove a few centimeters of the distal rectum. The functional result of such an operation could be compared with a perineal colostomy. Because of the lack of anesthesia and hemostasis at that time, patients did not survive the procedure due to excessive hemorrhage. So only five of the nine resections he performed were successful.

In 1874, Theodor Kocher introduced the posterior approach. After closure of the anus, in order to minimize the risk of spillage and infection, he removed the entire coccyx and a part of the sacrum to enhance the accessibility to the rectum. When the rectum was removed he performed an anastomosis between the colon and the anus. Simultaneously, Paul Kraske developed a technique similar to that of Kocher (resection of the coccyx and a piece of the left wing of the sacrum). The main disadvantage of the perineal and sacral approach was the limited vision of the surgical field compromising chances for complete tumor removal.

In the same century, Carl Gussenbauer performed the first abdominal resection with intraperitoneal closure of the distal rectum while J. Hochenegg developed a “pull through” technique by averting the anus and rectum, then excising the tumor and finishing with a recto- anal anastomosis. In 1884, Vincent Czerny was the first surgeon performing a combined abdominal and perineal resection when it was impossible to remove the tumor via the sacral approach.

A review of 1500 rectal resection cases carried out before 1900 showed an operative mortality of 20.9% and a recurrence rate of 80%. Due to these high recurrence rates, Ernest Miles started postmortem examinations on patients who died from cancer recurrence after rectal surgery. He found recurrences in the pelvic peritoneum, the mesocolon, and the lymph nodes situated at the bifurcation of the left common iliac artery. In 1908, he concluded that lymphatic spread occurred in all directions (upward, lateral and downward) and that these involved lymph nodes were responsible for the development of locally recurrent disease. Miles suggested removing the tumor, the rectosigmoid (and its blood supply), the mesorectum and associated lymph nodes en bloc through a combined abdominal and perineal approach. He also performed a wide perineal resection with removal of the levator ani muscle and created an abdominal colostomy afterwards. The abdominoperineal resection (APR) was born. In 1923, Miles reported a mortality and recurrence rate of 31% and 29.5% respectively. Mortality was mainly caused by blood loss and infection.

However, Miles procedure did not become the golden standard because others claimed the procedure was too risky for patients over the age of sixty with comorbidities. Furthermore, Miles procedure was considered too radical and was accompanied with a high morbidity: genitourinary dysfunction, permanent colostomy and psychosocial implications. Consequently, most surgeons continued

to perform perineal resections. With the advent of blood transfusion and improved anesthetics the outcome improved with a decrease of mortality from 36% to 9%. Since then, Miles's radical APR became the standard procedure for all rectal tumors.

To eliminate the need of a colostomy and to spare the sphincter Donald Balfour was the first surgeon who described the anterior resection procedure. He dissected the tumor through an abdominal approach and constructed a primary end-to-end anastomosis. Later in 1948, Claude Dixon demonstrated the safety of sphincter-saving surgery and reported a mortality rate of 2.6% and a 5-year survival rate of 64%. Because of its sphincter-saving nature, the anterior resection procedure became the golden standard for tumors in the middle- and upper third of the rectum. However, it did not become the golden standard for tumors of the distal third of the rectum because of the standard minimal distal resection margin of 5cm in that period. Until the 1970s, the abdominoperineal resection technique remained the surgical treatment modality of choice for low rectal tumors.

With the development of the low anterior resection (LAR) technique by Alan Parks (1972), where the anastomosis of the colon and the anus is done peranal via a pull-through technique, it was possible to resect also low-lying tumors without the need of a permanent colostomy. From then on, LAR was chosen over APR because of its sphincter-saving characteristics. (46-47)

2-Surgical treatment principles:

2.1.Total mesorectal excision (TME)

The principles of surgical oncology, defined by an en bloc resection of the affected bowel segment with the surrounding lymphatic tissue as described for example by W. E. Miles, were not applied consistently. The blunt dissection in the pelvis, accompanied by a characteristic sucking noise, frequently left "blocks of fatty lymphovascular tissue" along the pelvic sidewall. Serious intraoperative bleeding and

cumbersome local recurrence were common to occur.

In the 1980s studies disclosed that more than a quarter of the resected rectum specimens had lateral wall margins that were positive for tumor cells. Local pelvic recurrence occurred in 85% of these cases. .

In response to this data, in 1982, Professor Bill Heald from the Basingstoke District Hospital, UK, developed the total mesorectal excision (TME) technique, the state-of-the-art technique for surgical treatment of rectal cancer today. In order to minimize the chance of positive lateral margins he excised the tumor and mesorectum en bloc to the level of the levator muscles through sharp dissection of the avascular plane between the mesorectum and the surrounding tissues under direct vision. To preserve a good urinary and sexual function after surgery, it is important to protect the surrounding structures (ureter, deferent duct, bladder) and the autonomous nerves while excising the mesorectum. His technique led to decreased positive lateral margins and decreased local recurrence rates (a decrease of ±7%) in combination with good functional postoperative results. TME has become a standard surgical procedure for middle and lower rectal tumors. For tumors of the upper one-third of the rectum TME is still controversial. (46-47-48)

2.2. Distal resection margin (DRM):

One of the oncological principles of rectal cancer surgery is to attain an adequate bowel resection margin for preventing the risk of microscopic tumor expansion. According to the practice guidelines for managing rectal cancer, the distal resection margins should be 2 cm or greater. Advances in multimodality therapy have improved local control by increasing clearance of distal intramural microscopic spread. Consequently, a 1 cm distal resection margin has been suggested to be adequate for patients receiving preoperative chemo- radiation therapy (49-50-51)

The ideal length of the distal resection margin is still a controversial issue in rectal cancer surgery. Traditionally, a length of 5 cm was taken between the DRM and the edge of the tumor. Better understanding of the distal spread of rectal cancer and preoperative CRT led to shortening of this distance. Currently a distal margin of 2 cm is considered as the standard for all rectal cancers. To permit a sphincter-saving procedure, a distal margin of 1 cm is accepted for low rectal cancers because distal intramural spread occurs over 1 cm in only 4-10% of the cases.

Two recent systematic reviews showed a slightly higher local recurrence rate (+-1%) in the group with a DRM of ≤1cm compared with the >1cm group. However, this data was not statistically significant (P = 0.175 and 0.600) and therefore they both concluded that a DRM of ≤ 1cm was not associated with an increased risk for local recurrence. Both studies could not even approve significant higher recurrence rates in the group with a DRM of ≤ 5mm. This data calls the current '2-or 1-cm rule' into question. (52-53-54)

3-Low rectal cancer surgical techniques:

Despite all progress in the development of oncologic therapy (radiation and chemotherapy), radical surgical removal of the tumor is the only chance for permanent cure of rectal cancer. Beside this main objective, the preservation of fecal continence and having an acceptable quality of life are the second most important goal to reach.

Although approximately all tumors localized in the upper third of the rectum near the rectosigmoidal junction make surgical resection easily feasible, patients with a cancer localized in the middle or lower third are still confronted with the possibility of a permanent colostomy.

Nowadays, the main surgical procedures in low rectal cancer surgery to choose from are the conservative ones such as: low anterior resection (LAR) and the

intersphincteric resection (ISR) or the more radical abdominoperineal resection (APR) with permanent left colostomy technique. Sphincter-saving techniques are soon to be the most used one. New more local procedures are still in development, further research is necessary to learn their full potentials.

3.1. Conservative surgical techniques:

- Low Anterior resection for low rectal cancer (LAR)

Low anterior resection is the surgical procedure of choice for low rectal cancers that do not invade the sphincter complex and where the rectal dissection proceeds below the pelvic floor. Sphincter-sparing procedures for resection of mid and some distal rectal cancers have become increasingly prevalent, as their safety and efficacy have been established. The advent of circular stapling devices is largely responsible for their increasing popularity and utilization. This procedure consists of a total or near-total excision of the rectum, with TME, in combination with a coloanal anastomosis after a complete mobilization of the splenic flexure of the colon.

Ø Surgical technique:

LAR can be performed via an open (abdominal) or laparoscopic approach.

Patient is placed in a supine, 30 revered Trendelenburg position and both legs are kept straight and slightly open, in order to allow passage of the circular EEA stapler.

The dissection starts by medial to lateral dissection using the scissors, grasper and knife after pedicle ligation.

The rectosigmoid and descending colon are mobilized by and the left colic branch of the inferior mesenteric artery with an electrosurgical cutter while preserving most of the mesentery to supply the anastomosis.

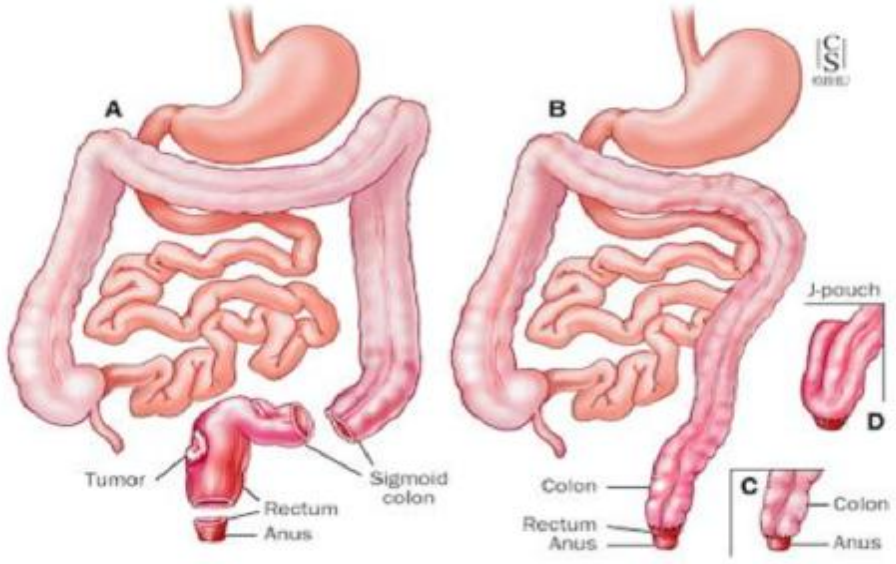
The rectum is transected, with a GIA stapler, distal to the lesion at the planned

site for the anastomosis, the tumor –bearing segment is exteriorized.

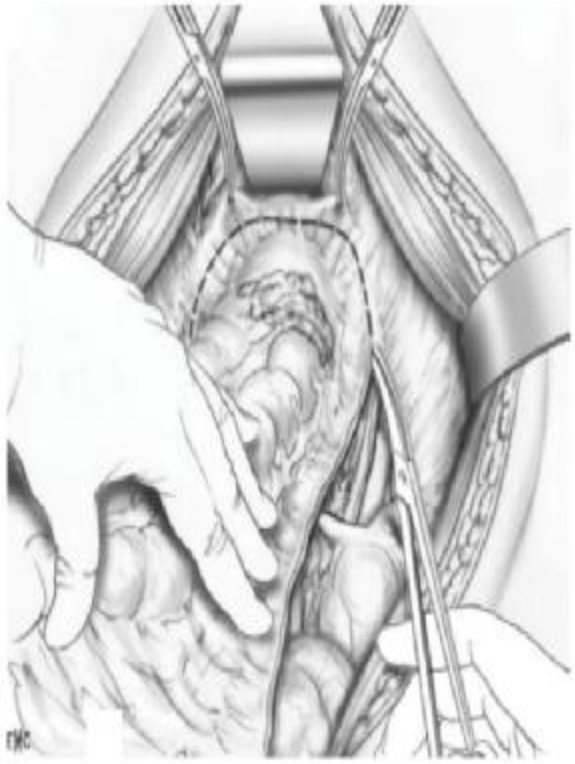
The diseased segment (colon and rectum) is resected extracorporeally with a GIA stapler. LAR involves dissection and anastomosis below the peritoneal reflection with ligation of the superior and middle hemorrhoidal arteries. An extended LAR indicates complete mobilization of the rectum down to the pelvic floor with division of the lateral ligaments and posterior mobilization through Waldeyer's fascia to the tip of the coccyx. Additionally, there is dissection of the plane between the anterior rectal wall and the vagina in a female patient and dissection of the plane between the rectum and the prostate in a male patient to a level distal to the inferior margin of the prostate gland.

The distal rectal end is returned into the abdomen, the bowel end-to-end continuity is restored using an EEA stapling device through adequately irrigated rectal stump.

All left-sided rectal anastomosis are carried out intracorporeally, all left-sided anastomosis should be tested for proper integrity. A drain is placed selectively if indicated and wounds are then closed in layers.



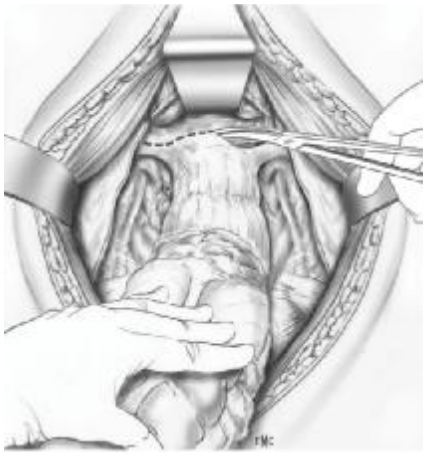
Sometimes, to improve the healing of the coloanal anastomosis, a temporary diverting colo- or ileostomy is constructed and then removed 2 or 3 months after surgery. (55-56)



Pelvic peritoneal incision, the peritoneum is opened laterally, back to front, 1 cm from urethra. The anterior incision of the peritoneum is done on the border of the seminal vesicle in men, 1 to 2cm above the Douglas pouch. The incision is continued to meet the lateral one.

Posterior rectal detachment, the rectum is moved and pulled toward the pubic bone by the surgical help to expose the aortic bifurcation and the superior hypogastric plexus, at this level the dissection plan is between the visceral and parietal peritoneum

Anterior rectal detachment in male pelvis, the dissection plan goes between the Denonvillier's fascia and the prostate and seminal vesicles.



The detachment is stopped at the base of the prostate and the Denonvillier's fascia is sectioned transversally, the dissection continues then until the pelvic muscle.

Rectal lateral ligaments dissection is done progressively, posterior toward anterior.

- Intersphincteric resection for low rectal cancer (ISR)

Intersphincteric resection of low rectal tumors is a surgical technique extending rectal resection into the intersphincteric space. This procedure is performed by a synchronous abdominoperineal approach with mesorectal excision and excision of the entire or part of the internal sphincter. Traditionally, rectal tumors located close to the sphincter complex were treated with the APR procedure, even when malignant cells did not infiltrate the internal or external sphincters. With the knowledge of the cephalic lymphatic spread into the mesorectum and the limited distal spread of rectal cancer, Rudolf Schiessel, an Austrian colorectal surgeon, developed the intersphincteric resection (ISR) technique in 1994 as an alternative for the APR procedure in the treatment of distally located rectal cancer. However, since intersphincteric resection of the rectum already existed in the treatment of inflammatory bowel disease (since 1977), the ISR technique developed by Schiessel and colleagues can be considered more as a modification of an existing technique than a real invention.

This technique, based on the existence of the with fat-filled intersphincteric space between the internal and external anal sphincter, consists of an excision of the rectum in combination with TME and a total or partial resection of the internal sphincter followed by a hand-sewn coloanal anastomosis.

Ø Surgical technique:

The operation is carried out in two stages: an abdominal and a perineal part. The operation is performed in Lloyd-Davies position after standardized bowel preparation and antibiotic prophylaxis. After complete dissection of the rectum and mesorectum down to the pelvic floor, the anal part of the operation is started. The application of a self-holding retractor positioned into the anal canal guarantees a

comfortable access to this region (Fig. 1). After injection of 0.4 mg of terlipressin diluted in 10 ml of saline solution below the dentate line, which reduces bleeding in this area and improves the dissection (Fig. 1), a circular incision of the anoderm (Fig. 2) facilitates the exposure of the internal sphincter. The internal sphincter is identified as a white band-like structure. The next step is the incision of the internal sphincter and separation from the external sphincter and puborectalis. The abdominal team supports this part of the dissection (Figs. 3 and 4). Separating the rectum from the prostate and the seminal vesicles or vagina can be easily performed by the synchronous abdominoperineal approach. After circular dissection of the tumor-bearing rectum, the specimen is delivered per anally. After macroscopic inspection on a separate table, the specimen is sent to pathology. The pelvis is then rinsed with saline from the abdomen and from the perineal wound as well. After pull through of the descending colon (Fig. 5), the coloanal anastomosis is performed (Fig. 6).

The sutures are placed between the colon, the external sphincter, and the anoderm. Special care is taken to reconstruct the anal canal by fixation of the anoderm to the original level inside the anus. A protective stoma (transverse colostomy or ileostomy) is optional and is closed after an uneventful x-ray enema with water-soluble contrast media six weeks later.

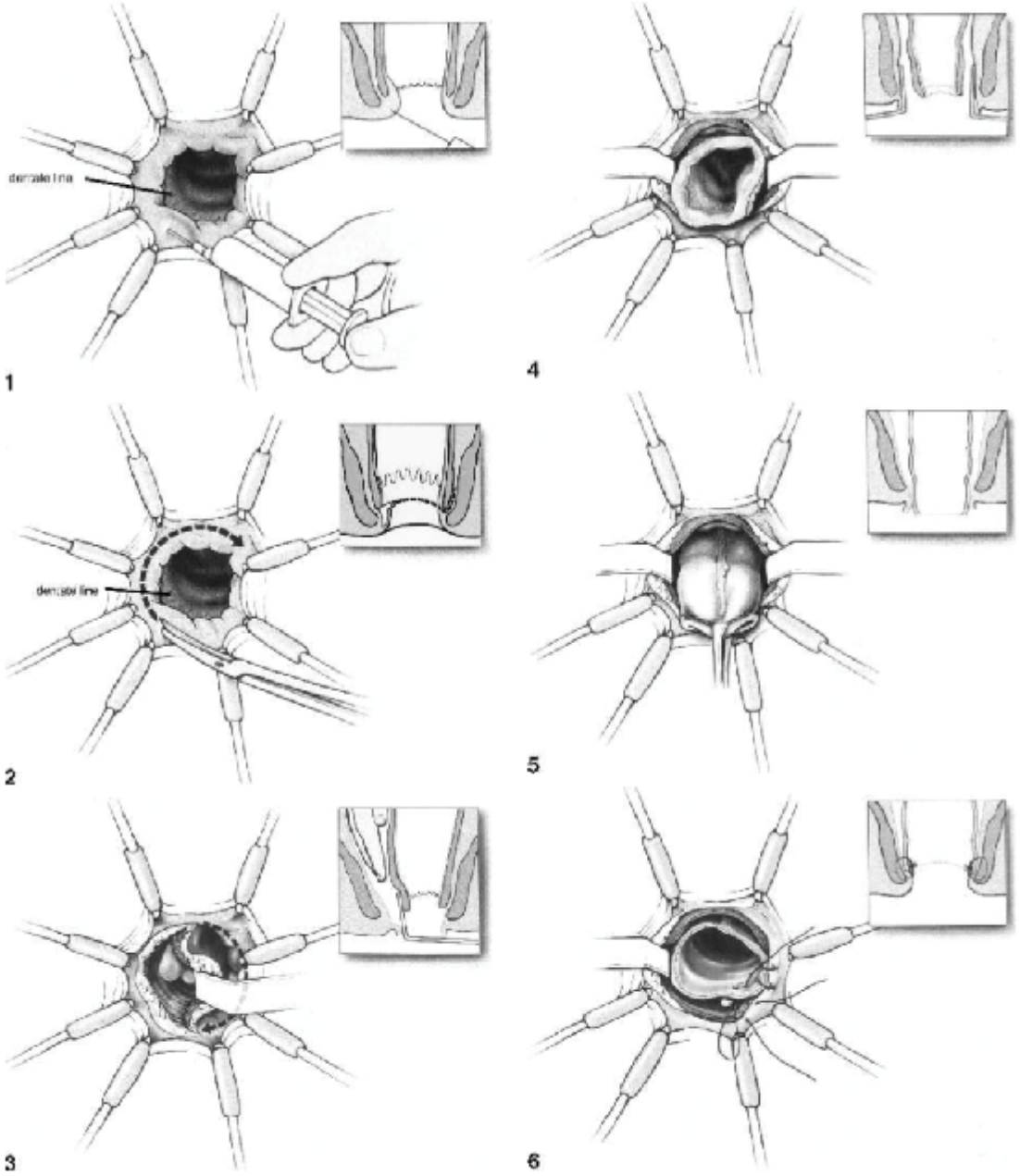


Figure 1. Injection of diluted ornipressin solution between the external and internal anal sphincter.

Figure 2. Circumferential incision of the anal mucosa with special attention to preserve a sufficient length of anoderm.

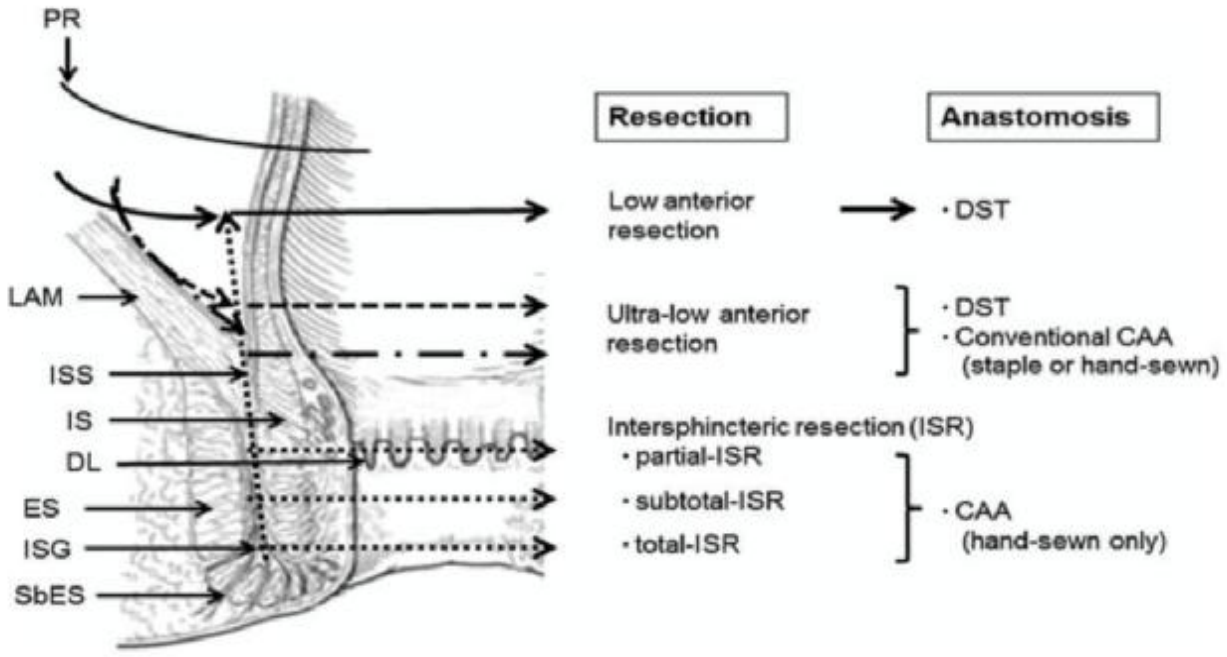
Figure 3. Preparation of the “intersphincteric space” is facilitated by contact with the “abdominal surgeon.”

Figure 4. After circumferential preparation the rectum is mobile and the external sphincter has been completely pre- served.

Figure 5. After resection of the specimen the colon is pulled through the anal canal.

Figure 6. A coloanal anastomosis is performed with single sutures taking the anus

and parts of the external anal sphincter.



Differentiation between the LAR and ISR technique based on height and method of anastomosis. The arrows show the distal resection line for each technique. Abbreviations: PR peritoneal reflection, LAM levator ani muscle, ISS intersphincteric space, IS internal sphincter, DL dentate line, ES external sphincter, ISG intersphincteric groove, SbES subcutaneous part of the external sphincter, DST double stapling technique, CAA coloanal anastomosis.

In contrast to APR with its permanent colostomy, ISR is a sphincter-saving procedure that preserves the gastrointestinal continuity. Based on the distal resection line, which depends on the distance from the tumor to the anal verge, ISR can be divided into three subtypes: total-, subtotal- or partial-ISR. When the entire internal sphincter is excised we speak of a total-ISR, the resection line is then located at the intersphincteric groove. For subtotal- and partial-ISR the resection line is lying respectively at or above the dentate line and between the dentate line and the intersphincteric groove. The upper one-third of the internal sphincter is removed when performing a partial- ISR and the upper two-third when performing a

subtotal-ISR. The choice between these three options depends primarily on the location of the tumor and the size and depth of invasion and the decision should ideally be made prior to surgery.

Currently, many variations are made on the original ISR procedure as described by Schiessel, such as ISR with mechanical stapler anastomosis, full abdominal ISR procedures or ISR with partial resection of the external sphincter (PESR) when the intersphincteric space or external anal sphincter is suspected for tumor invasion.

Low anterior resection (LAR) with hand-sewn coloanal anastomosis, as described by Parks, is often thought to be a variation of the partial-ISR technique. However, since the internal sphincter is almost completely preserved performing LAR, it cannot be classified as a subtype of ISR. (15-58-59-60)

- Local excision

Local excision of rectal tumors is still a controversial topic in rectal surgery. Local excision can be an option in selected early stage rectal cancers, more advanced tumors in combination with CRT and for tumors in patients who are unable to undergo transabdominal surgery. Small (<3cm), mobile, node-negative pT1 tumors with favorable histology would be ideal candidates for local excision. However, none of these factors can be preoperatively determined with certainty by means of EUS or MRI.

Buess et al, firstly developed transanal endoscopic microsurgery (TEM), in the 1980s, for the removal of endoscopically unresectable sessile rectal polyps. The author developed specific surgical rectoscope and instruments to address this problem. This facilitated a new way of operating in the rectum that was very precise and accurate due to its binocular vision and 3D visualization.

Ø Surgical technique:

The equipment consists of a rigid rectoscope fixed to operating table and a unit for carbon dioxide insufflation, suction, irrigation and rectal pressure monitoring. The rectoscope is 4 cm in diameter, available in two main sizes, short (12 cm) and long (20 cm). Which one will be used, depends on the pre-operative location of the lesion in the rectum. The removable faceplate of the rectoscope has ports to facilitate the insertion of the long instruments, the suction required and to accommodate the stereoscope through which the surgeon can see the lesion magnified by six-fold. In recent times this can be connected to a laparoscopic video stack, which some surgeons prefer.

For anterior lesions, the patient should be placed prone and for posterior lesions in the lithotomy position.

The pneumorectum is maintained at a constant pressure of 10-12 mmHg, which is enough for rectal wall distension, and exposure of the tumor. The dissection begins by making a dotted line with the monopolar electric scalpel 10-15 mm from the macroscopic tumor margin.

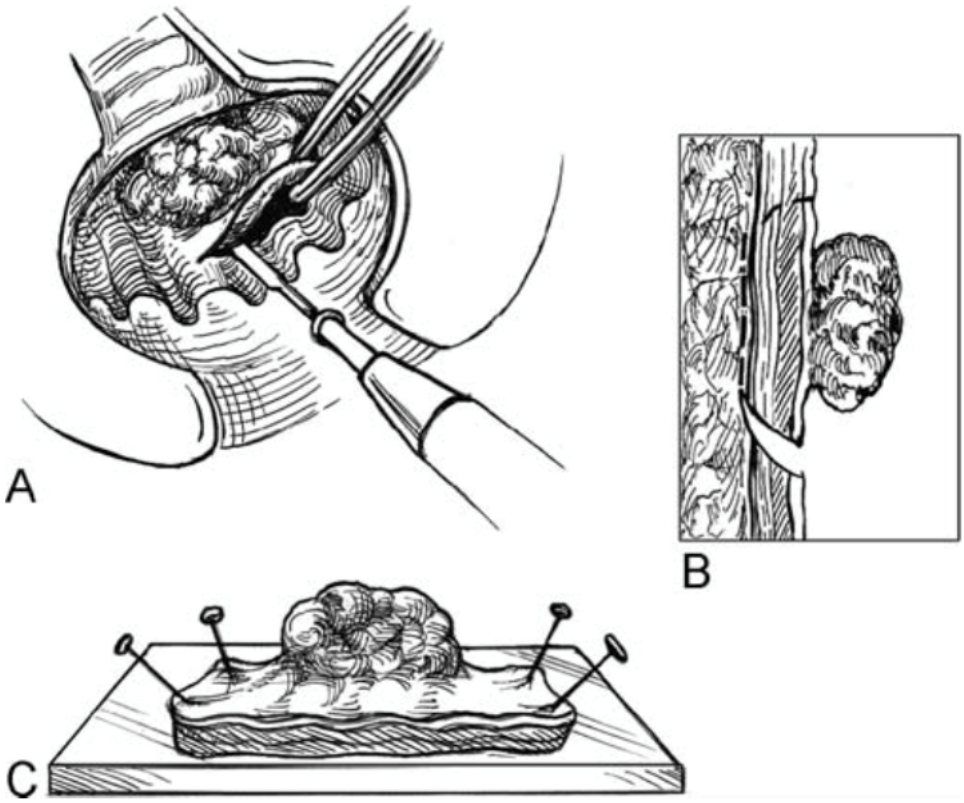
For adenomas located within the intraperitoneal portion of the rectum, a careful mucosectomy, avoiding entry into the peritoneum, is indicated. For extraperitoneally located adenomas and for all invasive carcinomas, full thickness resection should be offered as a standard treatment option. Circumferential adenomas in the lower and middle rectum can be resected as complete full thickness segments, followed by an end-to-end anastomosis

Invasive carcinomas in the posterior or lateral wall may be resected with some perirectal fat, often including 1 or 2 adjacent lymph nodes, which can be examined for metastatic spread.

With TEM, it is possible to perform local excisions with low risk of perforation

at a distance up to 18-20 cm when the tumor is located in the posterior quadrant and up to 15 cm when it is located anteriorly or laterally. The limit for low located lesions is the anal verge itself.

The resection bed is usually closed using a running 3-0 polydioxanone (PDS) suture on a small-half needle. If peritoneum is entered, the defect should be always closed, while the resection bed below the peritoneal reflection, may be left open. Finally, the surgical specimen is pinned out and oriented for pathological analysis of the margins.



Transanal excision. A transanal excision is per- formed by marking out a 1 cm or greater margin around the tumor. B A full-thickness excision is then performed to obtain adequate radial as well as lateral margins. C The specimen is then oriented accurately for the pathologist.

TEM has not become universally adopted by colorectal surgeons due to the considerable cost of the apparatus and the steep learning curve required for the mastering of the technique. These disadvantages prompted surgeons to examine alternative methods for performing trans-anal surgery. (61)

Transanal endoscopic microsurgery (TAMIS) was developed in 2009, and it is defined as the use of any multichannel single-port which can be placed trans-anally, combined with the use of ordinary laparoscopic instruments, such as a laparoscopic camera (preferably a 5-mm, 30° or 45° lens) and a standard laparoscopic carbon dioxide insufflator for performing endoluminal and more recently, extraluminal surgery. A systematic review of the published studies revealed that eight different types of TAMIS platforms have been used for local excision of rectal neoplasia. Regardless of which platform is used, the principles of TAMIS remain the same and the key advantages to its use are upheld.

Although there are still only a few studies available, the local excision techniques seem to be relatively safe, with less anorectal and genitourinary dysfunction and better quality of life compared with radical surgery, on condition of careful patient selection .The local excision procedures seem to become an attractive option for well selected early rectal cancer cases. (61)

- The new conservative surgical techniques

  Ø <u>Transanal Total Mesorectal Excision (TaTME)</u>

Transanal Total Mesorectal Excision (TaTME) was developed to overcome technical difficulties associated with laparoscopic TME. Most of the surgeons believe that patients with narrow pelvis, visceral obesity or large tumor diameter, are favored by this technique.

The procedure is feasible for mid and low rectal cancers.

Trananal TME is a new technique that allows the transanal mobilization of the

rectum from distal to proximal using a variety of flexible or rigid transanal platforms. The devotees of the technique support that TaTME facilitates radical dissection of the difficult distal part of the TME dissection in a narrow and/or rigid pelvis, allowing clear and safe definition of the tumor-free distal resection margin.

TaTME can be performed in conjunction to transabdominal assistance through multiport laparoscopy, mini-laparoscopy or a single-port access. Some authors report that abdominal phase of the operation should be performed first, with the transanal phase to follow, other teams perform the two phases synchronously, pure TaTME has also been reported, while different type of platforms or even robotic TaTME has also been performed.

The standardized technique has two phases, abdominal and transanal. Most authors complete the abdominal phase with high ligation of inferior mesenteric vessels and mobilization of the left colon and the splenic flexure. The fecal stream is diverted with a loop ileostomy, unless a permanent stoma is being fashioned.

The transanal phase starts after the placement of a self-retaining retractor and the exploration of the rectum. For tumors located up to 3 cm from the anal verge, there is a necessity to be performed an intersphinteric dissection, after sectioning the dentate line with electrocautery. Once the full-thickness rectal wall is completely sectioned, a purse-string suture is placed through the rectum to tightly occlude it. Thereafter, it is necessary for the transanal dissection of the first 4 to 4.5 cm of the anal canal to insert a Transanal Access Platform. CO2 is insufflated to a pressure of 10 to 12 mmHg, and it is adapted during the progression of the dissection. Once introduced into the presacral plane, the mesorectum is mobilized and the posterior dissection proceeded cephalic in the avascular presacral plane in accordance to TME principles. This plane of dissection is extended medially, laterally, and interiorly to achieve circumferential rectal mobilization. The dissection

is performed circumferentially and progressively to avoid retraction of the rectum that could make the division of one side difficult. Finally, the peritoneal reflection is visualized and divided to achieve sigmoid colon mobilization, with both teams collaborating to complete it. The device is removed and the specimen is carefully extracted transanally. The section of sigmoid colon is performed proximal to the vascular pedicle with scalpel. The division of the remaining mesentery and the marginal artery are completed with the specimen exteriorized. A handsewn coloanal anastomosis is then performed between the proximal sigmoid colon and the distal anorectal cuff.

For middle and low rectal tumors, after positioning of a self-retaining retractor, the Transanal Access Platform, is positioned in the anal canal. A purse-string suture is placed through the rectal mucosa to tightly occlude it distally to the lesion. Endoscopic transection of the full-thickness rectal wall is performed and, thereafter, another purse-string suture was placed in the distal rectal mucosa. The mesorectum mobilization is made as previously described. The specimen is exteriorized transanally, the colon is sectioned, a purse-string suture is placed and the anvil is inserted. The rectal anastomosis is performed with a EEA 33 mm circular stapler.

In the only systematic review enrolling 150 cases, no mortality was reported. The complications rate was 22.7%, mainly related to infectious complications such as pelvic abscess (n = 6) and anastomotic fistulas (n = 2). In a latter study, the postoperative complications rate was 26% and the anastomotic leak rate was 5.3%.

Although more studies are required to be confirmed the above findings, the comparative results published by Velthuis et al, indicated that TaTME may be associated to a significantly higher rate of completeness of mesorectal excision, compared to laparoscopic TME.

Functional outcomes are reported only in one study. After the reversal of the ileostomy in 52 out of the 56 enrolled patients, 3 (5.7%) required a colostomy because of severe fecal incontinence, while for the remaining 49 patients without stoma (94.3%), the median Wexner score was 4 (range: 3-12) and among them, 14 (28.5%) had a score greater than 7 and 13 (28%) reported stool fragmentation and difficult evacuation.

TaTME is feasible and safe. The general consensus is that curative TaTME should be performed only when a board-approved protocol is available and only by colorectal surgeons with extensive experience in minimally invasive and transanal endoscopic surgery. More studies are needed to evaluate the oncological and functional outcomes of the technique. (62)

Ø Anterior perineal plane for ultra-low anterior resection (APPEAR)

Very recently Williams et al described the Anterior Perineal PlanE for ultra-low Anterior Resection (APPEAR) technique.

This procedure was developed to allow sphincter-preserving rectal resection for both benign and malignant pathology, which would traditionally required APR or completion proctectomy, if treated by conventional means. In recent case reports, APPEAR is indicated for patients with low rectal cancer, 2-5 cm from the anal verge.

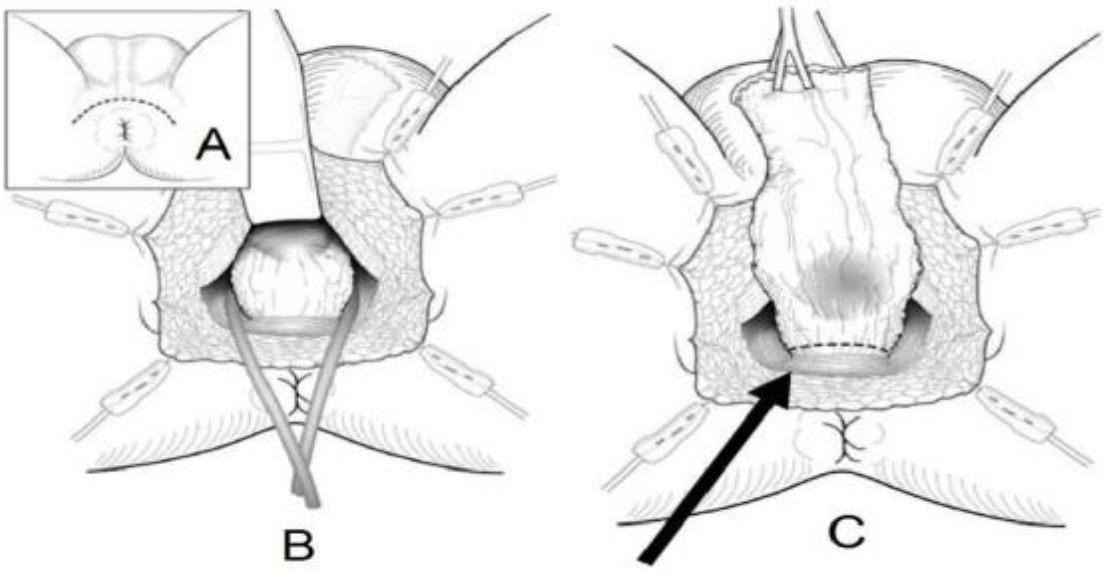
The APPEAR technique, was firstly described in 2008, The technique consists of abdominal and perineal approach, allowing access to low and difficult to be reached rectum between the levator ani muscle and the superior margin of EAS.

The abdominal phase of the operation is the same as the abdominal phase of ISR and is described above. The abdominal phase can be performed either by laparoscopic or open surgery.

For the perineal phase, the patient is placed in a high lithotomy position and the recto-vaginal/prostatic plane is infiltrated with 1 in 300000 adrenaline saline

solution. A convex crescentric skin incision is made in the perineum midway between the vagina or the base of the scrotum and the anal verge. The skin and subcutaneous tissue are dissected from the underlying external anal sphincter and transverse perinei muscles, and reflect forwards. In the female, the plane between the posterior vaginal wall and the anterior rectal wall is entered anteriorly to the perineal body. In the male, the recto-urethral/prostatic plane is entered similarly, firstly isolating and then dividing bilaterally the recto-urethralis muscle, close to the rectum. After dividing the recto-urethralis muscle, the anterior rectal wall is mobilized from the prostate, using both blunt and sharp dissection. At the inferolateral aspect of the prostate, the dissection is performed close to the rectum, avoiding damage to the neurovascular bundles. The perineal dissection is continued cephalad until the plane created from above by the abdominal operator is reached. The rectum is then freed laterally and the specimen is delivered through the perineum. The continuity of GI tract was established with either straight coloanal anastomosis or a short colonic pouch, with protecting ileostomy.

Currently there are still few studies discussing oncologic and functional outcomes of the APPEAR procedure. The initial results from Williams et al., however, seem promising. Of the 14 (from which 7 had rectal cancer) patients who had undergone this procedure no one died and no one developed LR. All patients were continent to solid and liquid stool. Quality of life pre- and postoperative seemed to be comparable. The only disadvantage was the high rate (50%) of perineal sepsis and subsequent colonic/ileoanal pouch perineal fistulation. Further research is necessary to evaluate this technique. (62-63)



APPEAR-procedure. A) Incision line between anus and scrotum. B) Initial dissection to expose the distal rectum. C) Fully mobilized rectum before transecting the bowel above the external anal sphincter.

- Coloanal anastomosis in conservative surgery

Ø <u>Mechanical trans-sutural colorectal anastomoses:</u>

Restoration of bowel continuity through coloanal anastomosis is possible in most of the lower rectal cancers. The coloanal anastomosis can be accomplished in 2 ways: handsewn or stapled. Distal CAA is most commonly done through a double cross stapled technique using a circular intraluminal-stapling instrument that is introduced transanally.

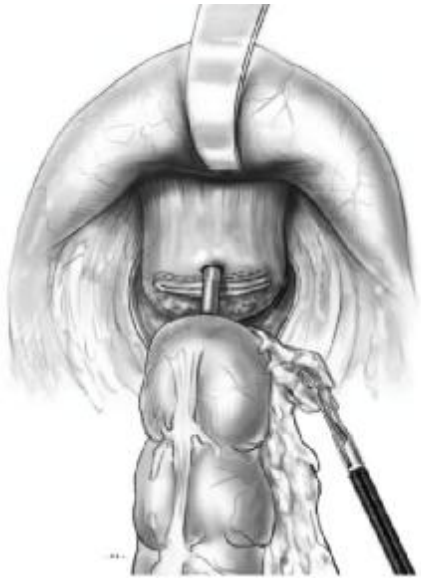
It is crucial to transect the splenocolic ligament to have enough length for a tension free low anastomosis, the transection of the inferior mesenteric artery with an electrosurgical cutter while preserving most of the mesentery to supply the anastomosis allows descending the anastomosis 2 cm below the pubic bone, to obtain a tension free viable anastomosis.

The steps of the Knight and Griffen technique of mechanical trans-sutural colorectal anastomosis are described bellow.

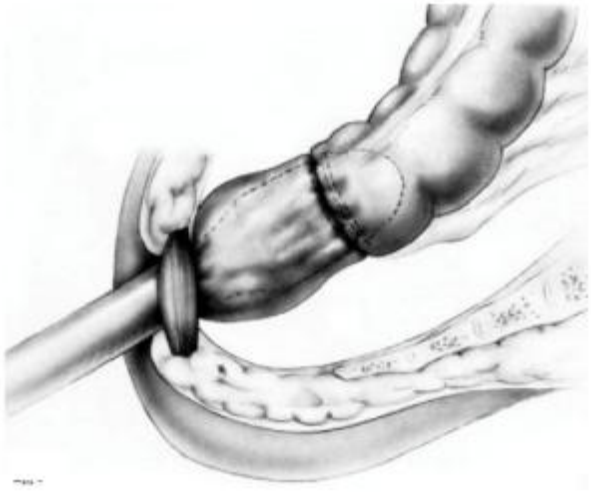
Because the reservoir function of the rectum is lost when performing a straight end-to-end anastomosis, this technique is associated with higher rates of defecation frequency, fecal urgency and incontinence. This combination of defecation related symptoms are called the ‘low anterior resection syndrome. (64)

Mechanical coloanal anastomosis (Knight and Griffen technique), the top of the mechanical circular suture forceps is introduced in the colon ending and a purse is knotted around the neck of the device.

The circular suture forceps is introduced anally; avoiding the sutures the forceps pierces the top of the rectal stump. Then the two parts of the device are assembled



Fatty tissues around the anastomosis are cleared and the surgeon checks if the vaginal wall is caught between the two ends of the device.



When the surgeon obtains the right alignment the device is activated to perform a circular suture

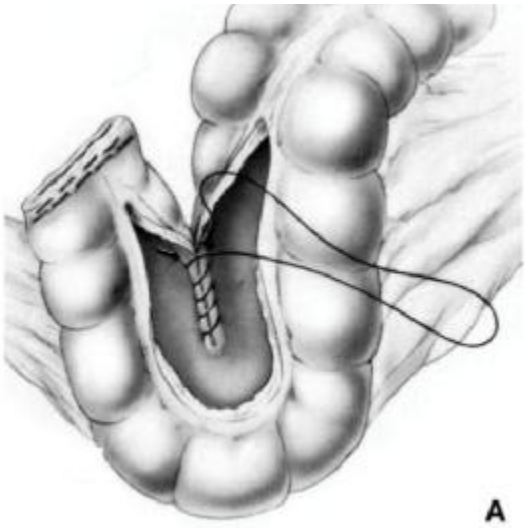
Ø Colonic J-Pouch:

To improve bowel function and quality of life after rectal resection, neorectum reconstruction techniques, such as the colonic J-pouch were developed.

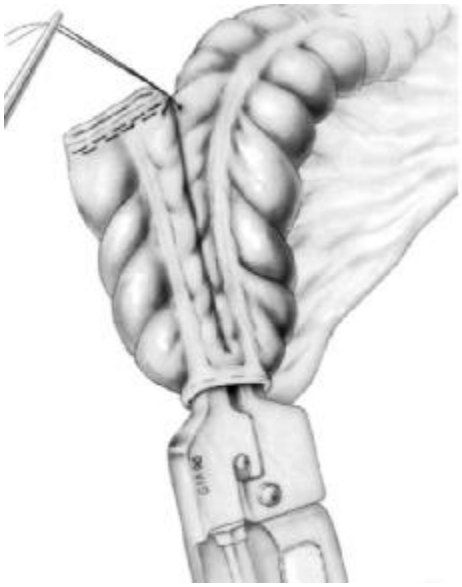
Because of the larger capacity of the J pouch construction, anorectal function is thought to be improved, especially early after the surgery. The J pouch is created by folding the distal end of the colon back on itself, approximately 5–8 cm, and then creating a common channel. The actual anastomosis to the anus is then done from the apex of the J in side to end manner.

The colonic J-pouch consists of a J-shaped reservoir of 6-7 cm. Larger reservoirs are associated with more evacuation problems. Heriot et al. found in their meta-analysis that the colonic J-pouch had better functional results compared to the straight end-to-end anastomosis. The J-pouch showed lower rates of stool frequency and there were less complaints of urgency up to one year after surgery. (65)

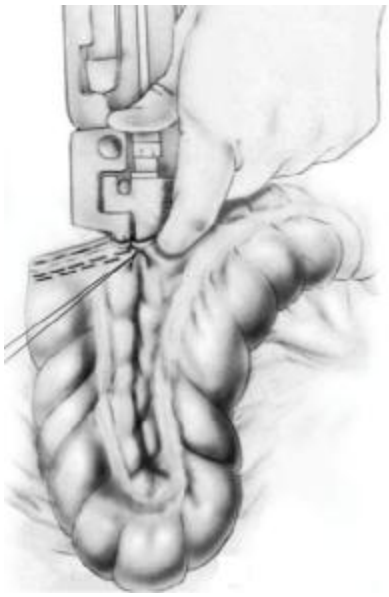
The figure below describes the J-pouch technique.



The first image shows a manual colonic J-pouch.



The second image shows a mechanical colonic J-pouch using a linear suture forceps. The colon is folded on itself and an entrance is created at the top of the cross, then the two shafts are introduced in botch colon channels.



After being sutured with the linear suture forceps. The septum inside the J-pouch is sectioned to create a large reservoir.

The J pouch is then anastomosed to the anus using a circular stapler or in a hand-sewn manner.

Ø Transverse coloplasty anastomosis:

This technique and the colonic J-pouch are neorectum reconstruction techniques.

After an adequate distal margin is achieved, the rectum is transected at the level of the pelvic floor musculature. The remaining anal mucosa between the dentate line and the level of transection of the pelvic floor can then be “stripped” and an anastomosis between the colon and the anus is performed to restore continuity.

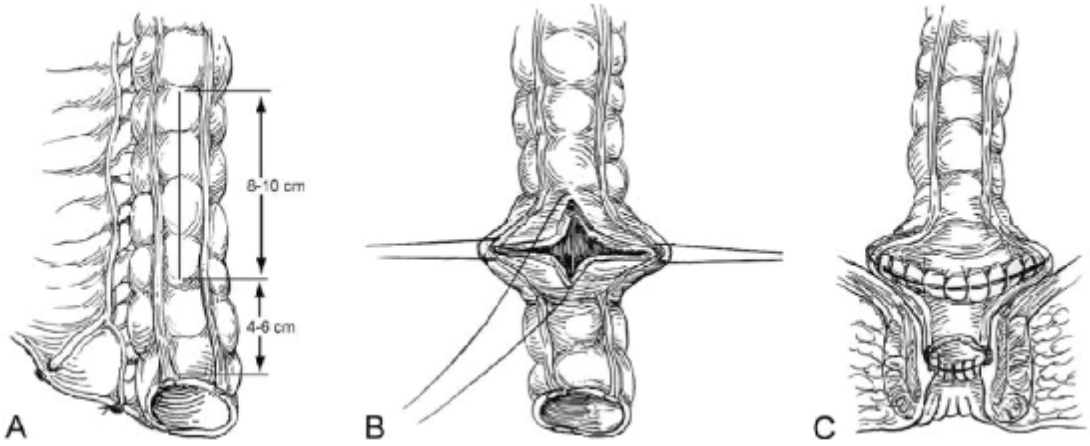
Alternatively, the procedure can be started at the dentate line with a tubular mobilization of the distal rectum in the intersphincteric groove. This perineal resection can proceed up to the superior margin of the puborectalis muscle before dissecting into the pelvis and connecting with the pelvic and abdominal dissection.

The procedure usually requires full mobilization of the splenic flexure, such that the vascular supply of the left colon now based on the middle colic vessels can reach the distal pelvis.

This technique is similar in concept to a stricturoplasty. The distal colon is divided in a longitudinal direction for 8–10 cm starting 4–6 cm from the distal edge of the pedicle. The longitudinal incision is then approximated transversely making a larger reservoir capacity. The technique can decrease frequency in the early postoperative period but it has been associated with an increased number of anastomotic leaks. A proximal diverting stoma is advisable because of the potential for an anastomotic leak or vascular compromise of the left colon.

The Contraindications to the procedure include baseline fecal incontinence from deteriorated anal sphincter muscles; tumor invasion of the anal sphincter musculature or recto-vaginal septum; Tenesmus; and technical factors such as body habitus, tumor location, and tumor size.

The transverse coloplasty can be an alternative in patients where construction of a colonic J- pouch is not possible due to technical (narrow pelvis, bulky anal sphincters, diverticulosis, insufficient colon length or pregnancy) or non-technical (complex surgery or distant metastasis) issues. Coloplasty has a smaller volume compared to the colonic J-pouch but has comparable functional results. (66)



This figure shows a transverse coloplasty anastomosis technique. The bowel is divided in a longitudinal manner as shown and resutured transversely to create a larger reservoir capacity.

2-Radical surgical techniques:

- Abdominoperineal excision technique (APR):

The APR was the first radical resection described by Miles in 1908 (reprinted in 1971). Since the invention of the abdominoperineal resection technique, it has long been the standard treatment for most of the tumors of the middle and lower rectum. Miles set out several principles to be achieved with any radical resection. These principles included: Removal of the whole pelvic mesocolon, Removal of the "zone of upward spread" in the rectal mesentery, Wide perineal dissection, An abdominal anus Removal of the lymph nodes along the iliacs.

Four of five of these principles are the anchor of our technique even today (the dissection along the iliacs is not done routinely). Candidates for an APR are patients with tumors either into the anal sphincter or are so close to the anal sphincter that a safe distal margin cannot be obtained. Also, there is a small subset of patients with mid rectal tumors but with poor continence that benefit from an APR even though they are technically sphincter-preservation candidates. There have been recent reports that obturator/pelvic sidewall lymph nodes are more often involved in patients with very low rectal cancers. It has been suggested that these patients should undergo an extrafascial TME dissection. (67)

Ø Surgical technique:

Usually a patient is placed in the lithotomy position. We often elevate the mid and upper sacrum off the bed with a blanket or a towel so that the coccyx is away from the bed and therefore able to be more easily prepped into the field.

The abdomen is usually entered through a midline incision. In thin patients, the incision can often be kept below the umbilicus. Low transverse incisions can also be performed as long as the ostomy site is not compromised. The APR is also a good application of laparoscopic-assisted surgery. The abdominal portion of the

procedure can be performed using laparoscopic techniques with extraction of the specimen through the perineum. It has yet to be shown, however, whether there is any value added with the laparoscopic-assisted approach.

The exploration of the abdomen and pelvis should be the first step after accessing the abdomen. The liver, aortic lymph nodes, superior hemorrhoidal lymph nodes, iliac lymph nodes, and the pelvis should all be examined. A large tumor burden, particularly multiple peritoneal implants, should lead to a reassessment of the need for resection and perhaps only a colostomy should be performed.

To excise the whole pelvic mesocolon and “zone of upward spread,” the sigmoid colon and left colon need to be mobilized. The mobilization begins along the left pelvic brim. The gonadal vessels, ureter, and iliacs are reflected toward the retroperitoneum and the colon and mesocolon are pulled toward the midline. The left colon is mobilized but the splenic flexure rarely needs to be taken down. The dissection then is started on the right pelvic brim. Often, one can identify the sympathetic nerve trunks behind the superior hemorrhoidal artery (SHA) as one mobilizes the rectal mesocolon away from the sacral promontory.

After mobilization of the mesentery, the bowel is divided near the sigmoid colon/left colon junction at right angles to the blood supply. Because a high ligation of the SHA or of the IMA is planned, the blood supply to most of the sigmoid colon will be compromised. For most cases, a ligation of the SHA flush with the left colic artery should be performed. A higher ligation of the IMA should be performed if there is any question of lymph node involvement outside the pelvis (e.g., palpable nodes along the SHA up to or above the left colic artery). The IMA should be ligated flush with the aorta and the inferior mesenteric vein should be ligated near the ligament of Treitz. A high ligation may also be required for additional colonic mobilization.

After dividing the bowel, sequential clamps of the sigmoid vessels are placed and the mesentery is ligated and divided. A high ligation is performed of the SHA with care being taken to not injure the ureters, and also to make sure that the sympathetic nerve trunks are preserved.

A successful TME starts with the proper ligation of the SHA or IMA. As one dissects down toward the sacral promontory, the sympathetic nerve trunks are identified. The dissection plane is just anterior or medial to these nerves. Using the cautery or scissors, nerves are reflected toward the pelvic sidewall while the mesorectal fascia surrounding the mesorectal fat is kept as an intact unit. The dissection starts posteriorly and then at each level proceeds laterally and then anteriorly. In the mid rectal area along the lateral sidewalls, one can sometimes see the parasympathetic nerves tracing anteriorly toward the hypogastric plexus. The plexus is usually on the anterolateral sidewall of the pelvis, just lateral to the seminal vesicles in the man and the cardinal ligaments in the woman. There is often a tough “ligament” that traverses the mesorectum at this point. It theoretically contains the middle rectal artery. However, in a study by Jones et al, this artery is only present to any significance about 20% of the time. (68)

The anterior dissection is perhaps the most difficult. In men, one should try to include the two layers of Denonvillier’s fascia. This fascia is composed of peritoneum that has been entrapped between the seminal vesicles and prostate anterior and the rectum posterior. In woman, the peritoneum at the base of the pouch of Douglas is incised and the recto-vaginal septum is then separated.

If done properly, the mesorectum begins to appear as a bulky bilobed structure. As one progresses distally beyond the mid rectum, the mesorectal fat begins to attenuate. At the pelvic floor there is often only a thin layer of mesorectal fat around the bowel.

As the abdominal procedure proceeds distally, the perineal dissection can commence. Before the preparation and draping of the patient, the position of the perineum is ensured so as to allow a wide elliptical incision around the anus. The rectum is usually cleared of any stool or residual preparation and the anus is sewn closed. The incision for the perineal dissection starts anteriorly at the perineal body, goes laterally to the ischiorectal spines, and then finishes posteriorly at the tip of the coccyx (Figure 3). After incising the skin and subcutaneous ischiorectal membrane and fat, the levators are then encountered. The perineal surgeon then coordinates their dissection with the abdominal team in the posterior pre-coccygeal plane. A pair of long scissors is used to divide the ligaments in the posterior midline behind the rectum (Figure2). Once a connection has been opened, the perineal surgeon places their finger above the levators and “hooks” them down toward the perineal field. The levators are then divided with the cautery. The dissection starts posteriorly and then proceeds laterally and anteriorly. Often it is best to complete the anterior dissection after the proximal portion of the specimen has been averted out to the perineal surgeon (Figure1). The remaining attachments in the anterior plane are then divided with the cautery. Once the specimen is removed, hemostasis is ensured with the cautery or absorbable figure-of-8 sutures. Typically there are vessels that need to be ligated in the crease between the lateral prostate and the pelvic floor (Figure 4).

After irrigating the pelvis, one approximates the residual levators with absorbable sutures and then the subcutaneous fat, ischiorectal fat, and skin are closed in several layers. Drains in the pelvis can be brought out through the pelvis or via the abdomen (Figure 5).

With the specimen removed, attention is turned to creating an ostomy. The end of the colon is carefully cleaned of any fat. The skin is divided in a circular

shape at the ostomy site (Figure 6). A core of fat is removed from the subcutaneous tissues (Figure 7). The fascia is divided in a cruciate manner. The muscle is split but not divided, and then the peritoneum is incised. The hole is made wide enough to accommodate the bowel and the accompanying mesentery. The bowel should then be brought up through the opening so that it is 1–3 cm higher than the skin (Figures 8-9-10).

After creating the ostomy, pelvic drains are placed. These keep fluid from leaking through the perineal closure and allow for better healing and a reduced risk of a perineal hernia. The midline fascial opening is then closed and the skin approximated. After skin closure and placement of the dressing, the ostomy is then matured. (67-68)

Figure 1

Figure 2

Figure 3

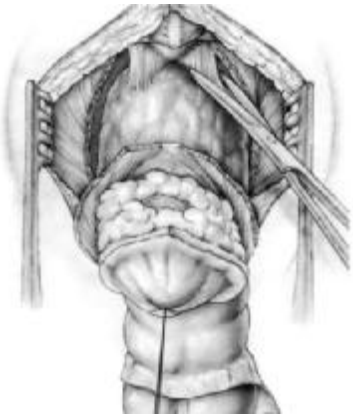


Figure 4

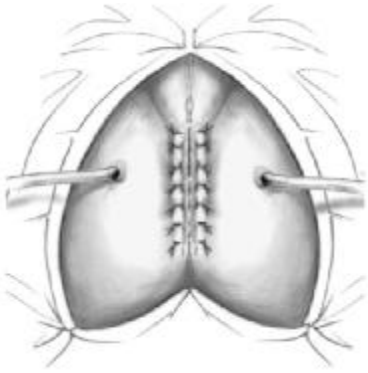


Figure 5

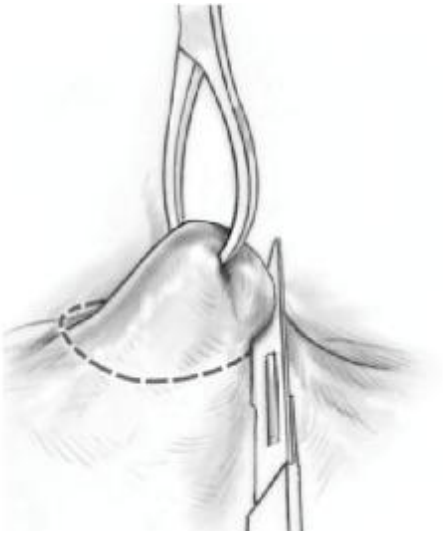


Figure 6

Figure 7

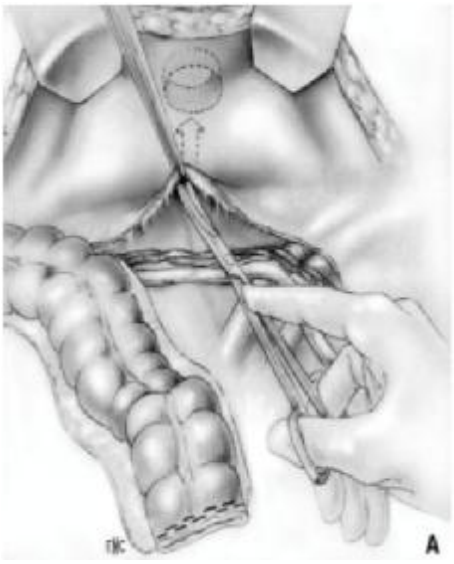


Figure 8

Figure 9

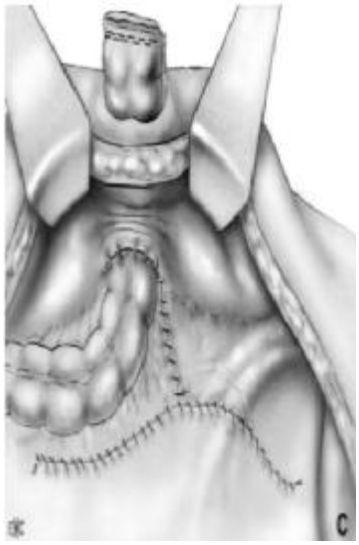


Figure 10

- Other variations of the APR technique

Ø Hartmann procedure:

The Hartmann procedure involves resection of the rectosigmoid colon with creation of a colostomy. Henri Albert Hartmann at the 30th Congress of the French Surgical Association first described it in 1921.

After the colorectal resection a direct path colostomy is created with the proximal end, then the rectal stump is stapled, marked with a non-absorbable suture material and then left in the abdominal cavity. (69)

Ø Rectum Reconstruction technique after APR:

Perineal pseudocontinent colostomy (PCPC) is a reconstruction technique performed after APR, in which the permanent colostomy is placed in the perineum instead of left low quadrant of the abdomen. In this procedure, a graft of smooth colonic muscle tightly surrounds the lowered colon. This technique was first described by Schmidt, for abdominal colostomies, and then applied by Gamagami to the perineum.

It was encouraged by the fact that it offers two major advantages: preservation of the body image by invisible perineal placement, improving the quality of life of these patients, and a reasonable continence with acceptable functional results. Since previous studies reported that abdominal colostomy is associated with a negative impact on the quality of life this technique could fix this issue.

The first step of this procedure starts with a usual APR technique as described before. Then the second step is done by a perineal approach ensuring an extended excision of the entire internal and external sphincter complex, allowing the excision of the specimen. Eight to ten cm of the end of the colon is resected and harvested as a free graft. This colonic fragment is stripped of its meso and epiploics, then inverted and freed from its mucosa and placed in an antibiotic solution

(Metrornidazol 500 mg) for 10 to 15 min. This graft is folded upon itself longitudinally keeping the serosal surface inside and wrapped snugly around the end of the colon 2–3 cm from its distal end for 1 and a half round. Absorbable 3.0 Sutures are taken to hold it in place. The end of the colon is brought out as a stoma in the perineum. The omentum is placed in the pelvis behind the colon. A drainage tube is placed in the perineum. (69)

4-Low rectal cancer management:

- In case of a complete response to the neoadjuvant treatment

Habr Gama et al conducted a study including 34 patients with low rectal cancer; these patients were treated with neoadjuvant chemoradiotherapy, 10 patients with a complete response were followed for 24 months, the sterilization rate was 65%.

Authors recommend then a chemoradiotherapy (54Gy + Capecitabine) followed by 6 months of consolidation chemotherapy.

- Management of non-metastatic low rectal cancer

Ø According to TNM stage:

-Stage T1 and T2 tumors: It is recommended that these patients go directly thought conservative surgery without neoadjuvant treatment. The types of surgeries recommended in this case are Low anterior resection (LAR) and Local resection.

Local resection is a good alternative to the low anterior resection but should be reserved for patients with a T1 stage tumor, <3 cm, localized in the lateral or posterior rectal walls, this technique is also recommended for elderly patients that refuse the APR, in this case a postoperative radiotherapy is recommended afterward.

For stage T1 T2 patients the indications for the abdominoperineal technique should be exceptional, in case of facing an anal incontinence or a pelvic narrowness.

-Resectable stage T3 and T4 tumors: A preoperative chemoradiotherapy is indicated in this group. Choosing a conservative or a more aggressive approach depends on the tumor's distance from the anal margin and the perineal muscle it also depends on gender and patient's response to the neoadjuvant treatment.

-Fixed T4 tumors with a high risk of R2 unhealthy resection margin: It's recommended in this case to start with chemoradiotherapy followed by an "en bloc" resection. A large more mutilating surgery is discussed in case of potential R0 healthy margin resection in a young patient with local extension without metastatic distant nodes.

Ø According to Anal margin distance:

- Distance >1cm from the external sphincter: Low anterior resection is the preferred technique in this case; the abdominoperineal resection should be reserved in case of anal incontinence.

- Distance <1cm from the external sphincter: Abdominoperineal resection is the most used technique is this case but if the external sphincter is intact an intersphincteric resection can be chosen. A recent systematic review addressed that the intersphincteric resection should be ideally applied in T1-3 tumors located within 30-35 mm from the anal verge, with or without internal anal sphincter (IAS) invasion.

Absolute contraindications for the method are T4 tumors, invasion of external anal sphincter (EAS), fixed tumors in digital examination (indication that the tumor has broken through the intersphincteric plane), poorly differentiated tumor, poor preoperative sphincter function, distant metastases and presence of mental disease.

Although many authors asset the possibility of a non-surgical, adaptable to the patient, treatment called a "a la carte" treatment in case of a complete response to the neoadjuvant treatment. Further studies are needed to validate this treatment

in the future. (26-35)

- Management of metastatic low rectal cancer

Ø Resectable synchronous metastases

There is no standard approach to adopt in these cases; it's recommended to discuss them in a multidisciplinary reunion. In general the treatment choice, in case of resectable tumors, depend on TN staging and the localization of the metastases.

Ø Non-resectable synchronous metastases

Certain non-resectable metastases have a limited extension and can be reduced by chemotherapy alone, and become resectable afterward.

Overall there is no consensus on how to manage patients with non-resectable metastases and the cases should be discussed in multidisciplinary reunions. But these patients are treated with palliative chemotherapy.

The short-term goals should be to maintain a good quality of life, to avoid mutilating extended surgery and manage pelvic pain.

These patients benefit from a close follow-up and the surgical treatment is proposed only if the metastases become resectable

5-Palliative tumor destruction techniques

Ø Transanal electrocoagulation therapy (TEC)

TEC was initially employed as a palliative measure in patients with disseminated disease or in patients with complicated medical problems that precluded APR. The surprising success of the technique in achieving local control of a tumor in this setting precipitated its use as primary treatment for potentially curable carcinoma of the rectum.

A complete bowel preparation is not necessary. But patients receive traditionally a phosphate enema the evening prior to the surgery.

The patient is placed in the lithotomy position. A perianal block with local

anesthetic is performed (infiltration with 10–15 ml xylocaine 2% in 1:1 dialysis with normal saline), which allows anal sphincter relaxation. Anal dilatation is frequently required to provide adequate exposure of the tumor. Patients can develop potential problems with incontinence after the anal dilatation. A specially designed proctoscope with a built-in smoke ejection port is inserted into the rectum. An electrocautery device is used to cauterise the lesion along with a 1-cm halo of normal mucosa. The fixed wire loop attachment for the electrocautery unit is employed to debulk the exophytic portion of the tumor. The base of the tumor is electrocoagulated using the ballpoint or needlepoint attachment to produce an eschar that extended 1–2 cm beyond the margin of the tumor.

This technique is still rarely used probably due to a necessity of a prior training.

Ø Laser Photocoagulation

A diverting colostomy to palliate symptoms of obstruction and bleeding is often the only other option when resection fails. This is often associated with a fairly high level of morbidity and mortality, and the quality of life may not be improved.

Other alternative methods such as radiotherapy, cryotherapy and electrocoagulation can achieve satisfactory palliation of obstructing and bleeding rectal tumors. However, these techniques have their limitations.

Since its introduction in Nath et al. 12 in 1973, the efficacy of the neodymium-yttrium aluminum garnet (Nd:YAG) laser in treating bleeding or obstructive lesions of the gastrointestinal tract has been well documented.

Patients are sedated with intravenous diazepam and pethidine. In obstructive tumors an enema is used for bowel preparation. The tumor is ablated in a distal-to-proximal direction until the lumen is widened sufficiently to admit a flexible endoscope.

In bleeding tumors a bowel preparation is needed. The procedure is carried out in a proximal-to-distal direction to reduce the risk of perforation and is done until adequate hemostasis is achieved.

C-Post-operative adjuvant chemotherapy

Following resection, the National Comprehensive Cancer Network (NCCN) suggests that all patients who undergo neoadjuvant chemoradiotherapy receive four months of a fluoropyrimidine-based chemotherapy regimen, regardless of the pathologic findings at the time of resection. However, practice is variable because of the limited data supporting the benefit of postoperative adjuvant chemotherapy in patients treated with neoadjuvant chemoradiotherapy. At some institutions, patients who have a pathologic complete response to neoadjuvant chemoradiotherapy are not routinely offered postoperative chemotherapy. If four months of neoadjuvant chemotherapy has been administered prior to surgery, postoperative chemotherapy would be omitted.

There is uncertainty as to the benefit of postoperative chemotherapy in patients undergoing preoperative chemoradiotherapy, although at least in the United States, most oncologists recommend it, and the majority of patients receive it. The evidence used to support this approach is mainly an extrapolation of the proven benefit of postoperative adjuvant therapy with radiotherapy (RT) and chemotherapy that was the standard of care in the era before preoperative combined modality therapy. As an example, a Cochrane review of adjuvant chemotherapy in resectable rectal cancer concluded that fluorouracil (FU)-based chemotherapy significantly reduced the risk of death and disease recurrence. However, in only one of the included 20 randomized trials was preoperative chemoradiotherapy administered to all patients. (76-77)

1-The benefit of postoperative chemotherapy following preoperative chemoradiotherapy for rectal cancer:

In the previously described EORTC trial 22921, patients who had received preoperative RT with or without chemotherapy underwent a second randomization to four cycles of postoperative FU and leucovorin (LV) or no further therapy. The addition of chemotherapy, either before or after surgery, significantly improved local control. However, in the latest update, there was no evidence that adjuvant chemotherapy improved 10-year overall or disease-free survival.

An unplanned subgroup analysis limited to the 785 patients who underwent complete (R0) resection and who had no evidence of metastatic disease at surgery (ie, node-negative) revealed that the addition of postoperative chemotherapy significantly improved overall survival in those whose tumors were downstaged to ypT0-2 but not stage ypT3-4 disease.

These data raise the possibility that a response to preoperative chemoradiotherapy might serve as a marker for response to postoperative chemotherapy, a finding also noted in at least one retrospective series. However, the interaction between the tumor downstaging effect of preoperative therapy and benefit of adjuvant chemotherapy disappeared at later follow-up of this study, and other studies failed to show a better outcome from postoperative chemotherapy in patients with greater degrees of downstaging from neoadjuvant chemoradiotherapy. It is possible that posttreatment pathologic stage represents a prognostic, rather than predictive, factor, but there are no prospectively collected data with sufficient statistical power to address this question.

2-Guidelines recommendations:

Guidelines from the NCCN recommend that operated patients receive chemotherapy, even if they have a pathologic complete response to neoadjuvant therapy.

European Society of Medical Oncology (ESMO) recommendations state that, operated patients with T3-T4 stage and N1-2 stage patients should receive adjuvant chemotherapy.

In contrast, experts convened by a European Rectal Cancer Conference concluded that there is insufficient evidence on the benefit of adjuvant chemotherapy after preoperative chemoradiotherapy to recommend its use.

Until additional data become available, we agree with the approach recommended by the ESMO.

3-Choice of postoperative regiment

Reasonable options for postoperative chemotherapy include LV-modulated FU, fluoropyrimidine monotherapy, short-term infusional FU plus LV and oxaliplatin (FOLFOX or XELOX). Some clinicians routinely utilize an oxaliplatin-based regimen for all patients who have received neoadjuvant chemoradiotherapy, regardless of yp status. However, use of a risk-adapted treatment strategy (ie, selecting an oxaliplatin-containing regimen preferentially for those patients with lesser degrees of tumor downstaging after preoperative chemoradiotherapy [ie, ypT3-4 or node-positive disease]) is also reasonable and has been adopted at many institutions. Other factors that should also be taken into account when deciding to pursue an oxaliplatin- versus non-oxaliplatin-based adjuvant regimen are performance status and comorbidity.

There are few randomized phase III trials comparing different postoperative regimens after neoadjuvant chemoradiotherapy, and no consensus as to the best

approach. Common approaches include four months of LV-modulated FU, either weekly bolus FU and high-dose LV (both 500 mg/m2 per week for six of each eight weeks according the RPMI regimen) or short-term infusional FU plus LV (the de Gramont regimen), or capecitabine alone, extrapolating from experience in adjuvant treatment of colon cancer. As with colon cancer, regimens containing irinotecan cannot be recommended.

Consensus-based NCCN guidelines suggest that LV-modulated FU, FOLFOX, or XELOX are all appropriate alternatives for adjuvant therapy after neoadjuvant chemoradiotherapy but that an oxaliplatin-containing regimen is preferred.

In our view, the decision to use or not use an oxaliplatin-based chemotherapy regimen after surgery should be based mainly on performance status and comorbidity.

D-Palliative chemotherapy:

Approximately 30% of patients with rectal cancer are presented with a metastatic disease. Many of these patients have symptoms of bleeding or obstruction. Approximately half of patients with rectal cancer may be candidates for palliative therapy at some point during their disease process, either because of locally advanced or metastatic disease at the time of presentation, or the late development of metastases

Several treatment options are available to deal with the various complications that may afflict these patients. Endorectal stenting, laser ablation, and operative resection are a few of the options available to the patient with a malignant large bowel obstruction. A thorough understanding of treatment options will ensure the patient is offered the most effective therapy with the least amount of associated morbidity.

Palliative treatment strategies for advanced stage rectal cancer should be individualized to patients according to their symptoms. Chemotherapy for metastatic disease is the current recommendation for asymptomatic patients. Symptomatic patients can present particularly difficult challenges and can be treated with chemotherapy or combined chemoradiation therapy in conjunction with a procedure, if necessary, to relieve their symptoms.

Although the most appropriate treatment option is not always evident, a careful multidisciplinary approach with the surgeon playing the central role of determining when aggressive operative intervention is warranted can ensure the most appropriate treatment strategy is devised.

The presence of synchronous metastases clearly decreases survival. However, those patients who are surgical candidates and can have all sites of disease removed have a better overall prognosis. On the other hand, individuals who do not fall into the category of resectable advanced stage disease should have systemic treatment initiated expeditiously after diagnosis.

Currently, according to the National Comprehensive Cancer Network guidelines, patients with unresectable, asymptomatic metastatic disease should undergo initial therapy consisting of one of the following: choice of FOLFOX, CapeOX or FOLFIRI, with or without bevacizumab; or FOLFOX or FOLFIRI with or without cetuximab/panitumumab. Alternatively, FOLFOX or FOLFIRI alone can be utilized in an attempt to render patients possible candidates for resection. (78)

VII-Prognostic factors

1-Localization

Four multivariate studies compared survival between different patients with different colorectal cancer locations and demonstrated that the low rectal localization was associated with the worst survival rate. (80)

2-TNM staging

TNM staging is the principle factor that influences the prognosis, indeed survival decreases in advanced stages of rectal cancer. (80)

3-Age

Age is known to be a prognostic factor, 6 studies concluded that advanced age was associated with poor prognosis. (80)

4-Gender

Gender is related to survival, women have previously been shown to have better overall and cancer-specific survival for colorectal cancer. In addition men have a higher incidence if rectal cancer. (80)

5-Factors related to surgery

The prognostic is worse in patients discovered at the complication stage; in fact the survival rate is 4 to 7 times worse in patients operated urgently.

In more that 5 multivariate studies, bowel obstruction is considered to be a bad prognosis risk factor.

The tumor perforation causes the dissemination of cancer cells according to

Steinberg; perforation is a risk factor of local recurrence without having any effect on the survival. (80)

6-Cell differentiation

Since 1928 the degree of differentiation is considered a prognostic factor, a numerous multivariate studies suggest that differentiation was independent from the evolution stage. The differentiated tumors are known to be less aggressive and have a better prognosis compared to the indifferent type. (80)

7-The carcinoembryonic antigen (CEA)

Multiple studies asset that a high preoperative CEA level was associated with a bad prognosis. (80)

VIII-Postoperative surveillance

The main goal of an appropriate postoperative follow up is to search for local recurrences and metachronous metastases at an early stage.

1-Physical examination

The surgeon, in patient's follow up, often performs a routine physical examination; the physician should search for the appearance of a hepatomegaly, a sub-clavicle node and local recurrences. A full physical exam including a pelvic examination must be performed every 3 months during 3 years, then every 6 months during 2 years. (81)

2-Colonoscopy

5% of cases of rectal cancer have a colonic second localization, for this reason a coloscopy should be performed at 1 year, 3 years and then every 5 years. (81)

3-The carcinoembryonic antigen (CEA)

CEA level regains it normal rate 3 months after the surgical treatment, a second elevation is associated in 95% to a recurrence. It is recommended to a CEA dosage every 3 months. (81)

4-Liver ultrasound

A liver ultrasound should be performed every 3 to 6 months during 3 years then every year for 2 years. It is imperative to do a regular hepatic ultrasound in order to search for the appearance of metachronous liver metastases. (81)

5-Chest X-ray

A chest x-ray is performed every year during 5 years, and is used to detect metachronous pulmonary metastases. (81)

PATIENTS AND METHODS

Objectives

Primary goal

The Primary aim of our study is to investigate survival and recurrence rates following surgery for low rectal cancer.

Secondary Goal

The secondary aim of this study is to evaluate functional results and the quality of life (QoL) after low rectal cancer surgery.

Patients and Methods

Study design

This study is a retrospective, descriptive and comparative review of low rectal cancer patient's data.

Study Framework

University Hospital Hassan II of Fez is a 1050 bed teaching general hospital in Morocco servicing the northeastern part of the country. Operative and clinical notes of all patients who underwent low rectal cancer surgery at "the department of abdominal surgery A" and "the department of abdominal surgery B", from January 2009 to December 2015 were reviewed retrospectively and the relevant data collected.

Data extraction

-A non-computerized search using as supports:

The consultation register, the hospitalization register: All patients admitted for rectal cancer, rectal hemorrhage and bowel obstruction were selected.

We also used medical charts, operative reports register, pathology registers and Colorec Study data.

- A computer search of all the patients with low rectal cancer who undergone surgery, using the data collection computer system of University Hospital Hassan II Fez “HOSIX”, using Patient’s Identification (IP) and nominal search.

Population Studied

Inclusion criteria

All the patients diagnosed with low rectal cancer (<5cm from the anal margin), at the university hospital Hassan II of FEZ through appointments or the emergency, were included.

Exclusion criteria

All patients with a rectal cancer situated beyond 5 cm from the anal margin.

Patients with a non-malignant rectal lesion such as:

-Endoscopically resectable polyps.

-Patients with rectal melanomas.

Statistical analysis

The patient data were coded and entered on an Excel file. After validation, statistical analysis was performed using the analysis software IBM SPSS Statistics23 following 3 steps:

Step 1: We performed a descriptive analysis of data collected. The results were presented as a percentage and mean ± standard deviation.

Step 2: Univariate analysis for comparing averages and percentages using statistical tests Student and khi 2 and fisher.

Step 3: Multivariate analysis by logistic stepping down regression.

The results are reported in graphs and tables commented.

A $p<0.05$ was considered significant.

Limits of the Study

On the 160 cases of low rectal cancer diagnosed, in both departments of abdominal surgery A and B, 7 files were unfortunately lost in the archives department. Those files were from 2009 and 2010 before the establishment of the data collection program “HOSIX”. 19 files were judged very incomplete and therefore were not included in this study

The functional results were studied only on 42 patients.

21 patients answered the quality of life survey, the other patients could not be reached for the survey.

STATISTICAL

RESULTS

I-Epidemiological data

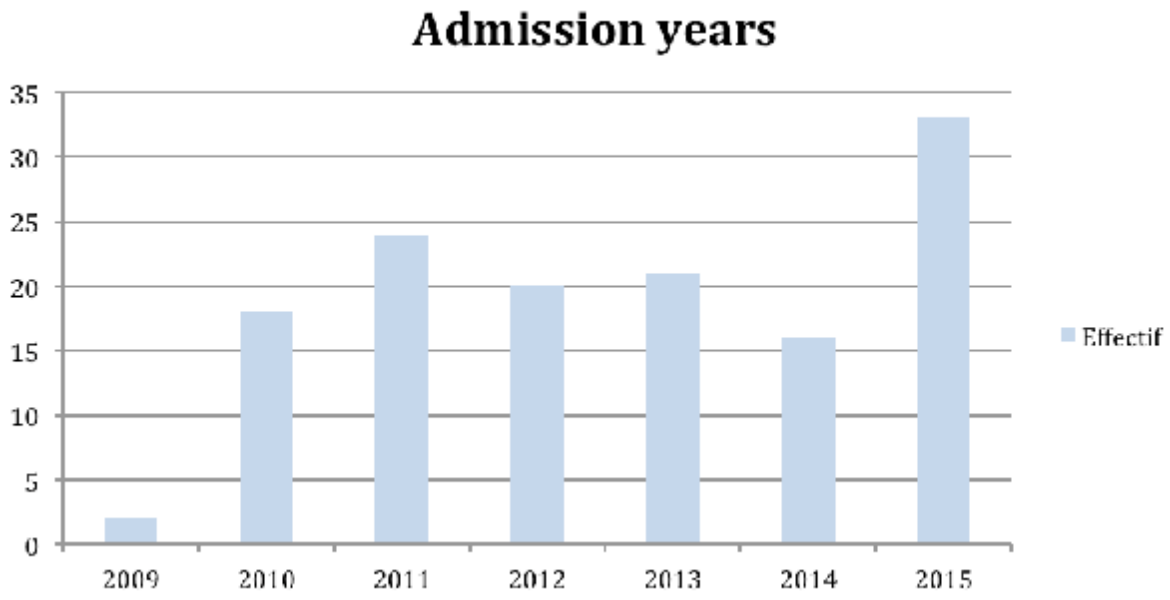
1-Annual patient recruitment

- From January 2009 to December 2015, 160 patients were diagnosed with a primary cancer in the distal rectum (up to 5 cm).
- 19 files were not complete and therefore were not included in our study. 7 files were lost before the establishment of the new data collection system (HOSIX).
- 134 patients were collected in this study, with an average of 19 patients per year (1 to 2 patients per month) with a minimum of 2 to a maximum of 33 patients per year (1 to 3 patients per month).

A hundred and thirty four patients constituted the overall simple of our study.

Table1: distribution of patients per year of admission

Year	Patients (n=134)	Percentage
2009	2	1,50%
2010	18	13,40%
2011	24	17,90%
2012	20	14,90%
2013	21	15,70%
2014	16	11,90%
2015	33	24,60%
Total	134	100%

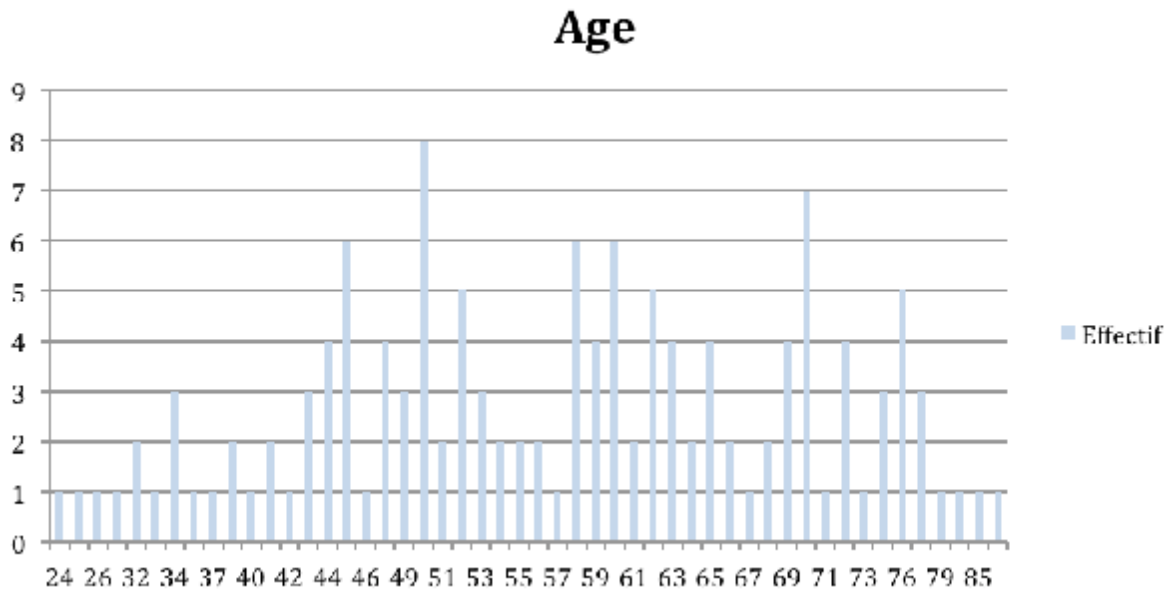


2-Distribution by Age

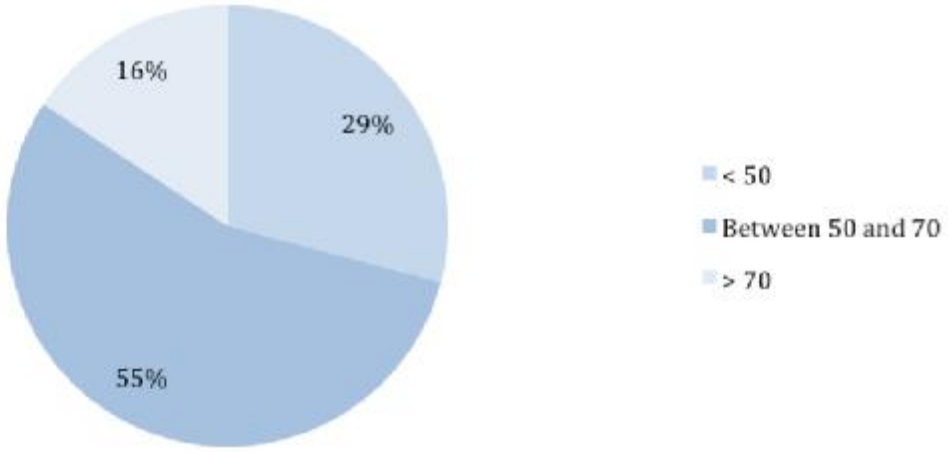
The average age of our patients is 56 +/- 13 years mainly raging from 24 to 90 years.

Table2: distribution of patients per age

	Number	Minimum	Maximum	Median	Standard deviation
Age	134	24	90	56,72	13,61



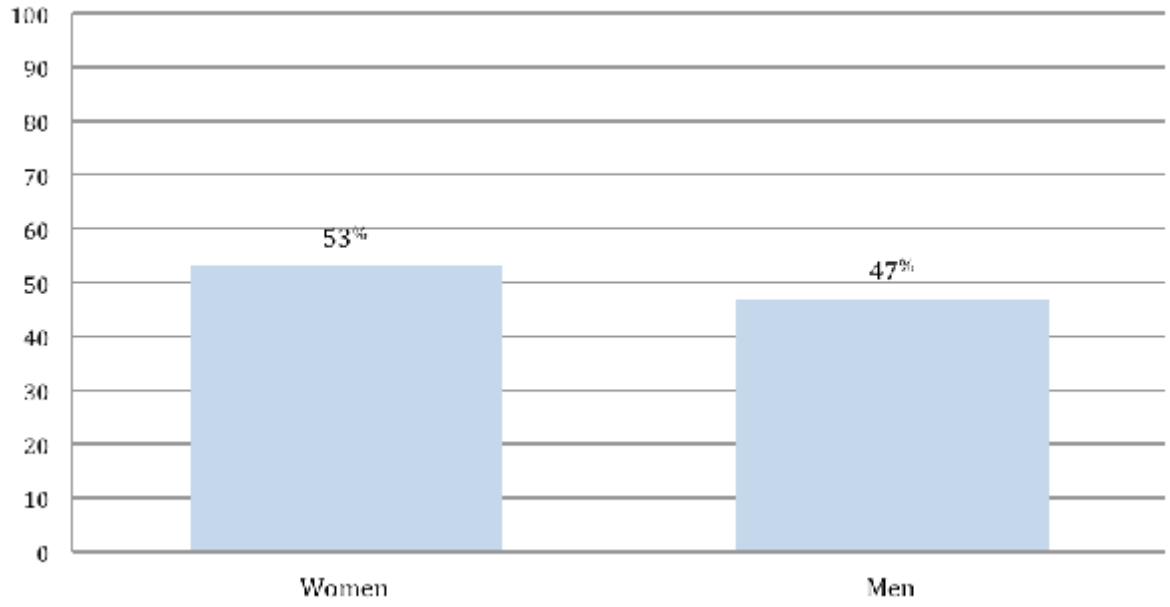
Age (years)	Number	Percentage
< 50	39	29,1%
Between 50 and 70	74	55,2%
> 70	21	15,7%



3-Distribution by gender

In our study we notice a slight women predominance, 71 female for 63 male patients with a gender ratio of F/H = 1.

	Patients	Percentage
Women	71	53%
Men	63	47%
Total:	134	100%



II-Clinical Study

1-Consultation period

The average consultation period was 4 months with a range from 9 months to 26 months.

2-Antecedent

102 patients didn't have any history of diseases, which represent 76% of the overall studied sample.

Ø Medical history

- Comorbidity

14 patients had a concomitant disease, which represents 10% of the studied population. The following table demonstrates the distribution of patients according the past medical history.

Medical History	Patients	Percentage
Hypertension	6	43%
Asthma	1	7%
Cardiopathy	2	14,2%
Diabetes	5	35,7%
Total	14	100%

- Risk factors

2 patients had a history of familial adenomatous polyposis (FAP) with a percentage of 1,5%.

We didn't find any case of chronic inflammatory disease or lynch syndrome.

Ø Surgical history

Overall 18 patients presented a surgical background (14%), dominated by transurethral resection of a benign prostate hypertrophy found in 10 patients. The following table shows the distribution of patients according their surgical history.

Surgical antecedents	Patients	Percentage
Transurethral resection of a benign prostate hypertrophy	10	55,5%
Cholecystectomy	4	22,2%
Cervix cancer	1	5,5%
Anal fistula	3	16,6%
Total	18	100%

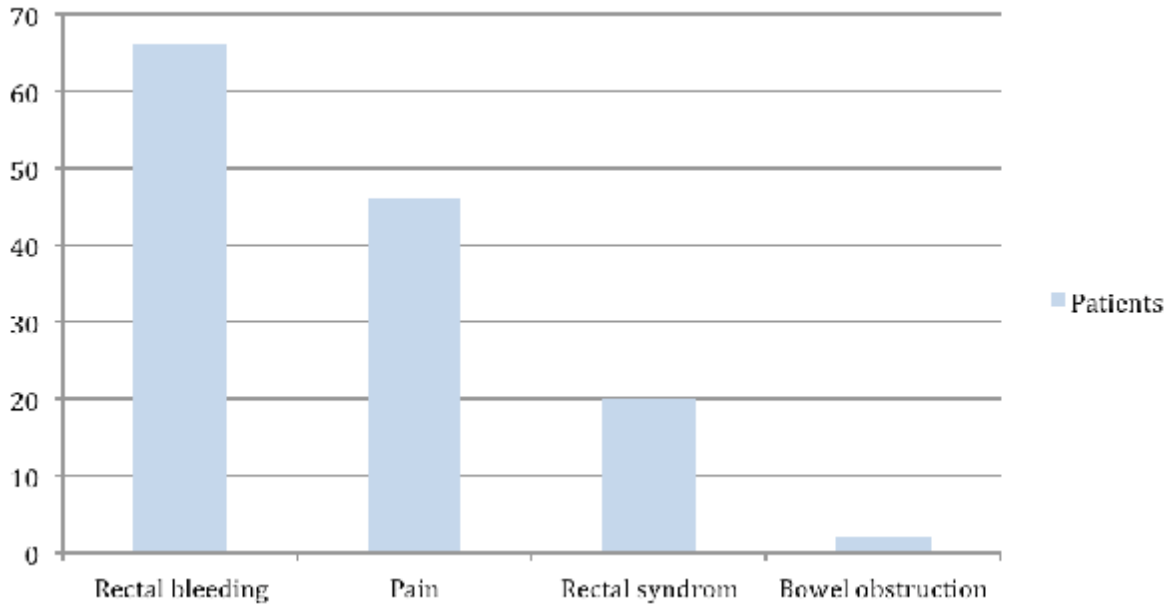
Ø Familial history

- 2 patients have a history of familial adenomatous polyposis (FAP).

3-Clinical signs

Rectal bleeding is the main symptom and was found in 66 patients, which represents 49% of all the patients studied.

Symptoms	Patients	Percentage
Rectal bleeding	66	49,3%
Pain	46	34,3%
Rectal syndrome	20	14,9%
Bowel obstruction	2	1,5%
Total:	134	100%



III-Diagnosis

1-Rectal exam

In our study, all patients received a rectal exam at the admission and the tumor was accessible in all cases.

2-Tumor characteristics

Rectal exam helps the physician define the lower part of the tumor and also give an estimation of its distance from the anal margin.

Ø Distance of the tumor from anal margin

Distance from anal margin varies depending on the physician's perception in the rectal exam; it is not an accurate measurement exam.

	Patients	Percentage
0	11	8,2%
1	14	10,4%
2	29	21,6%
3	30	22,4%
4	28	20,9%
5	22	16,5%
Total	134	100%

Ø Tumor position

In 50% of patients we found a circumferential tumor.

Only 7.5% of the patients had a lateral tumor position.

	Patients	Percentage
Circumferential	67	50%
Anterior circumferential	26	19,4%
Posterior circumferential	19	14,2%
Lateral right circumferential	4	3%
Lateral left circumferential	6	4,5%
Unspecified	12	9%
Total:	134	100%

Ø Fixity of the tumor

55 patients had a fixed tumor at the rectal exam (41%), 33 patients had a mobile tumor (24,6%).

	Patients	Percentage
Not fixed tumor	33	24,6%
Fixed tumor	55	41%
Unspecified	46	34,3%
Total	134	100%

Ø Sphincter tonus

9% of patients had an impaired sphincter tonus.

	Patients	Percentage
Unspecified	15	11,2%
Good	72	53,7%
Average	35	26,1%
Bad	12	9%
Total	134	100%

Ø Recto-vaginal septum and sphincter invasion

A sphincter invasion was found in 16 cases, it represents 12% of the patients in our study

8 women in our study had an invaded recto-vaginal septum.

	Patients	Percentage
Unspecified	47	66,3%
Invaded septum	8	11,2%
Non invaded septum	16	22,5%
Total	71	100%

IV-Para-clinical parameters

1-Colonoscopy

- The Colonoscopy was performed in all patients
- Simultaneous tumors were found in 3 patients, they were located in the right colon, left colic angle and the sigmoid.
- Polyps were found in 10 patients.
- Colonoscopy was hard to perform in 37 patients due to rectal tumor stenosis.

Ø Distance from the anal margin

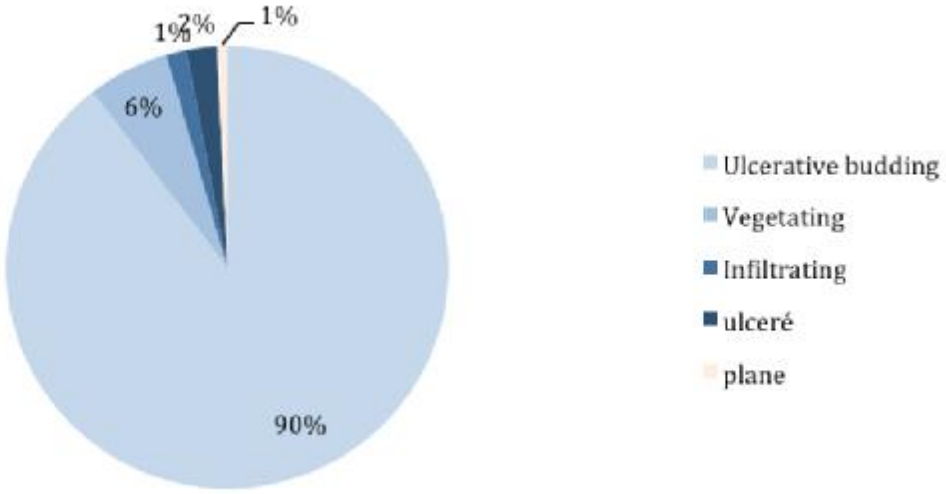
The median distance from the anal margin is 2,77 cm.

	Patients	Percentage
0	12	9%
1	17	12,7%
2	33	24,6%
3	26	19,4%
4	20	14,9%
5	26	19,4%
Total:	134	100%

Ø Macroscopic aspect

The most frequent macroscopic aspect is the ulcerative budding, it was found in 120 patients with a percentage of 89%. Others forms are represented in the table below.

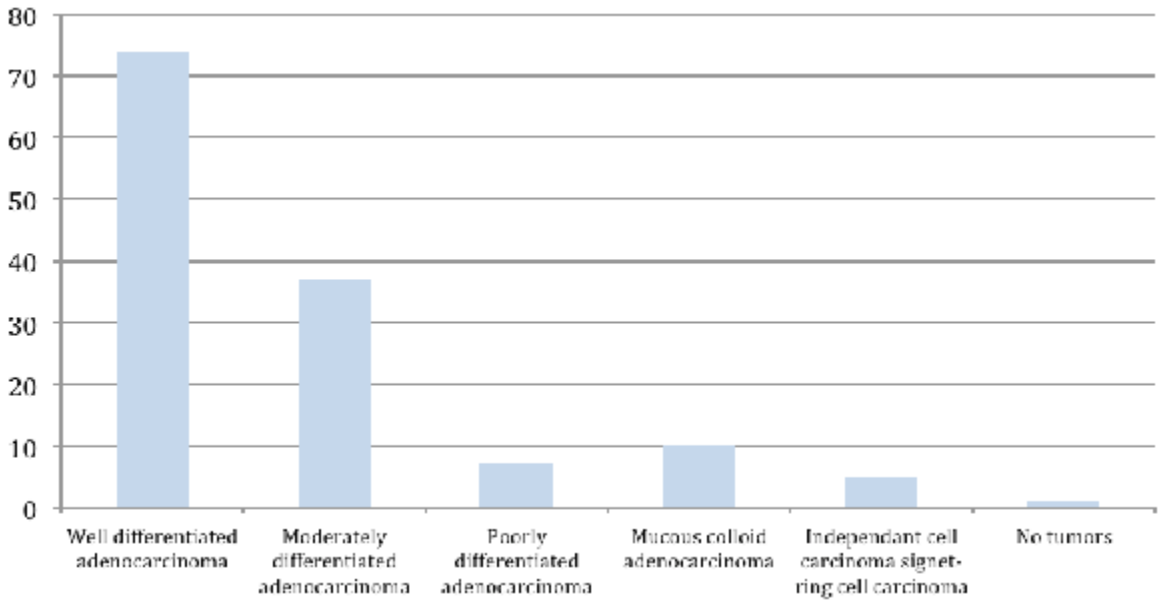
	Patients	Percentage
Ulcerative budding	120	89,60%
Vegetating	8	6%
Infiltrating	2	1,50%
Ulcerated	3	2,20%
Plane	1	0,70%
Total	134	100%



2-Histopathological report of the tumor biopsy

- The anatomopathological study of the biopsies harvested in the endoscopy exam confirmed the diagnosis in all the patients in our study, they were no lymphomas nor sarcomas found.
- Adenocarcinoma was the most frequent histological type found in the study (95% of patients), presented mainly by the wall-differentiated form.
- One patient had no evidence of tumors in the biopsy.

Histological Type	Patients	Percentage
Well differentiated adenocarcinoma	74	55,22%
Moderately differentiated adenocarcinoma	37	27,6%
Poorly differentiated adenocarcinoma	7	5,2%
Mucous colloid adenocarcinoma	10	7,4%
Independent cell carcinoma signet-ring cell carcinoma	5	3,73%
No tumors	1	0,74%
Total:	134	100%



3-CT-scan chest, abdomen and pelvis (C.C.A.P)

A CT-scan was performed in all our patients.

Ø Tumor size

The average tumor size on the CT scan was 6,50cm ranging from a minimum of 02cm to 130cm.

Ø Adjacent organs invasion

30 patients had an adjacent organ invasion on the CT-scan, which represents 22,4% of the general population studied.

- 6 cases of vaginal invasion.
- 4 cases of uterus invasion.
- 6 cases of a prostate invasion.
- 2 patients had invaded seminal vesicles.
- The bladder was invaded in one case
- 5 patients had a pelvic floor invasion.
- 3 patients had a pelvic shielding.

- In one case the abdominal wall was invaded.
- In one patient the CT-scan showed a small bowel invasion.
- In one case the bladder, the prostate and the seminal vesicles were all invaded.

In 104 patients the CT-scan didn't report any adjacent organs invasion (77,6%).

Ø Lymphadenopathy

Mesorectal lymphadenopathies were found in 72 patients, which represent 54% of patients.

Distant lymphadenopathies were found in the CT-scan of 27 patients, which represents 20% of patients.

Ø Synchronous metastasis

-15% of patients had synchronous metastases on the CT-scan.

- 14 patients had non-resectable metastases.

- 6 patients had resectable metastases.

4-Pelvic MRI

- An MRI was performed on 20% of patients when there was a doubt of sphincter invasion in the rectal exam.
- There were 9 cases of sphincter invasion diagnosed.

V-Preoperative work-up

1-Biological check up

Ø Cancer tumor markers

- Carcinoembryonic antigen

A carcinoembryonic antigen (CEA) dosage was done on 113 patients, 60 patients had a positive test.

- Carbohydrate antigen 19-9

Carbohydrate antigen 19-9 (CA19-9) dosage was done on 111 patients, and it was positive in 47 patients.

Ø Hemoglobin dosage

An anemia was detected in 75 patients, which represents 56% of our patients.

Ø Albumin dosage

13 patients presented a hypoalbuminia (< 30g/L), which represents 9,7% of our patients.

Ø Protein test

17 patients presented a hypoproteinemia (<65g/L), which represents 12,6% of our patients.

2-Pulmonary profile

- A pulmonary exam was performed in our patients at the admission; it was normal.
- A chest X-ray was performed in the preoperative workup of the patients. It showed pulmonary opacities in 2 patients.
- A functional respiratory investigation was performed in one patient and showed an obstructive lung disease associated with asthma.

3-Cardiac profile

- A cardiovascular examination was performed in our patients and showed no abnormalities.
- The EKG showed a bundle branch blocks in 2 patients.
- We performed a transthoracic echocardiography in 67 patients (50%). It showed a cardiomyopathy in one patients and a cardiac failure in another patient.

VI-Treatment

1-Neoadjuvant treatment

Ø Preoperative combined chemoradiotherapy (CMT) and radiotherapy alone (RT)

-125 patients were given a preoperative a neoadjuvant treatment with a percentage of 93% percent:

- 8 patients were directly transferred to receive a palliative chemotherapy: 2 patients were not eligible for surgery and 6 patients with an advanced cancer stage.
- One patient had intensive radiotherapy for a cervix cancer; therefore no more neoadjuvant treatment was given to her and went directly through surgery.

-The average time between confirming the diagnosis and radiotherapy start was 35 days with a minimum of 9 days and a maximum of 300 days.

Ø Post neoadjuvant treatment reevaluation:

-15 patients were not eligible to go through surgery:

In the light of the clinical and biological evaluation, 2 patients were not operable:

- The first patient was not operable because of an advanced local invasion associated with a cardiac disorder and a left lower limb ischemia.
- And the second patient suffered from a pulmonary embolism and a thrombophlebitis.

6 patients had an advanced cancer stage and were judged non-operable.

7 patients were lost to follow up.

-On those 15 patients 8 received palliative chemotherapy.

2-Surgery

119 patients of our study were admitted to the operating room.

- 11 patients had non-resectable tumors and they had palliative colostomies.
- 108 patients underwent a surgical low rectal cancer removal.

Ø Surgical approach

On 108 patients that underwent a tumor resection, the laparoscopic approach was performed in 47 patients (43%).

	Patients	Percentage
Laparotomy	44	40,7%
Laparoscopy	47	43,5%
Conversion to laparotomy	17	15,7%
Total	108	100%

There was a 16% (17 cases) of conversion rate.

- In 2 cases the tumor invaded the pelvic floor.
- 4 patients presented an adjacent organ invasion.
- 5 patients presented a hemorrhage.
- In 6 cases because of technical problems.

Ø Surgical technique

- Type of procedures

Ø The abdominoperineal resection was the most frequent form of surgery.

Type of treatment	Patients	Percentage
Low anterior resection (LAR)	37	34,3%
Intersphincteric resection (ISR)	21	19,4%
Abdominoperineal resection (APR)	50	46,3%

Total	108	100%

Ø 15 patients underwent an abdominoperineal resection with a pseudocontinent colostomy.

	Abdominoperineal resection	Percentage
Permanent left colostomy	35	70%
Pseudocontinent colostomy	15	30%
Total	50	100%

Ø Adjacent organ resection was performed in 10 cases:

- In 4 patients we performed a hysterectomy with a bilateral ovarectomy and a partial vaginal resection.
- 4 patients had a partial vaginal resection.
- A patient had a prostate and seminal vesicles resection.
- And one patient had an enormous tumor that invaded the pelvic floor.

Ø 6 patients underwent a metastasectomy:

- 5 patients had liver metastasectomy.
- 1 patient had a lung segmentectomy.

- Procedure duration

The average procedure duration is 5,7 hours in the laparoscopy group and 4,3 hours in the laparotomy group.

- Hospital duration

The average hospital stay in our study was 14 days.

- Histopathological data

Ø The histological types of the tumors resected were summarized in the following table.

	Patients	Percentage
Well differentiated adenocarcinoma	59	54,6%
Moderately differentiated adenocarcinoma	27	25%
Mucous colloid adenocarcinoma	5	4,6%
No tumors	15	13,9%
Independent cell carcinoma signet-ring cell carcinoma	2	1,9%
Total	108	100%

- Ø The average number of lymphadenopathies harvested during the procedure is 11 +/_5 lymphadenopathies.
- Ø We harvested positive lymphadenopathies in 34 patients, which represent 31% of our patients.

TNM classification

TNM		Number	Percentage
pT	T0	14	13%
	T1	4	3,7%
	T2	36	33,3%
	T3	47	43,5%
	T4	7	6,5%
pN	N0	74	68,5%
	N1	20	18,5%
	N2	14	13%

- Resection margin

  Ø The resection margins were healthy in 105 patients and invaded in 3 patients (3%). 3 patients had an R1 resection margin invasion.

  Ø 2 patients had an intersphincteric resection converted later to an abdominoperineal resection with a pseudocontinent colostomy.

  Ø The third patient had a low anterior resection converted to an abdominoperineal resection with a permanent left colostomy.

3-Adjuvant chemotherapy

Ø 54 patients received a post-operative adjuvant chemotherapy, which represents 50% of our patients.

ONCOLOGICAL RESULTS

1-Mortality rate

- On the 108 operated patients, 4 died in the short post-op period, which represents 3,7%:
- 2 patients died from a sepsis due to an anastomotic leakage and peritonitis.
  - One patient died from a hemorrhagic choc during surgery.
  - One patient died from hemorrhagic choc shortly after surgery.

2-Morbidity rate

- 40 patients had a post op complication, which represents a morbidity rate of 37%.
- 12 patients had non-specific postop complications (11%):

  Ø 8 patients suffered from a urinary infection.

  Ø One case of thrombophlebitis.

  Ø 2 patients developed a post op abdominal infection.

  Ø One case developed both a thrombophlebitis and a urinary infection.

	Patients	Percentage
Nothing to report	96	89%
Urinary infection	8	7%
Thrombophlebitis	1	1%
Abdominal wall infection	2	2%
Urinary infection + Thrombophlebitis	1	1%
Total	108	100%

- 37 patients developed a specific postop complication: they are summered in this chart.

	Patients	Percentage
Nothing to report	71	66%
Recto-vaginal fistula	7	7%
Bowel obstruction	1	1%
Small bowel perforation	1	1%
Neurogenic bladder	11	10%
Colic anastomosis necrosis	6	5%
Bleeding	1	1%
Anastomosis leakage	10	9%
Total	108	100%

3-Continuity restoration

The average period of time between the procedure and the continuity restoration was 135 days, with a range of 60 to 365 days.

Average	135 days
Median	90 days
Minimum	60 days
Maximum	365 days

4-Local Recurrence

- In our study we spotted a local recurrence in 5 patients with a percentage of 4,6%.
- The average amount of time to recurrence to appear is 7 months; it varies from 6 to 21 months.

5-Metachronous metastases

20 patients developed a metachronous colorectal metastasizes it represents 18,5% of our patients.

	Number of patients
Local recurrence alone	2
Metachronous metastasizes alone	17
Both local recurrence and Metachronous metastasizes	3
Total	22 patients

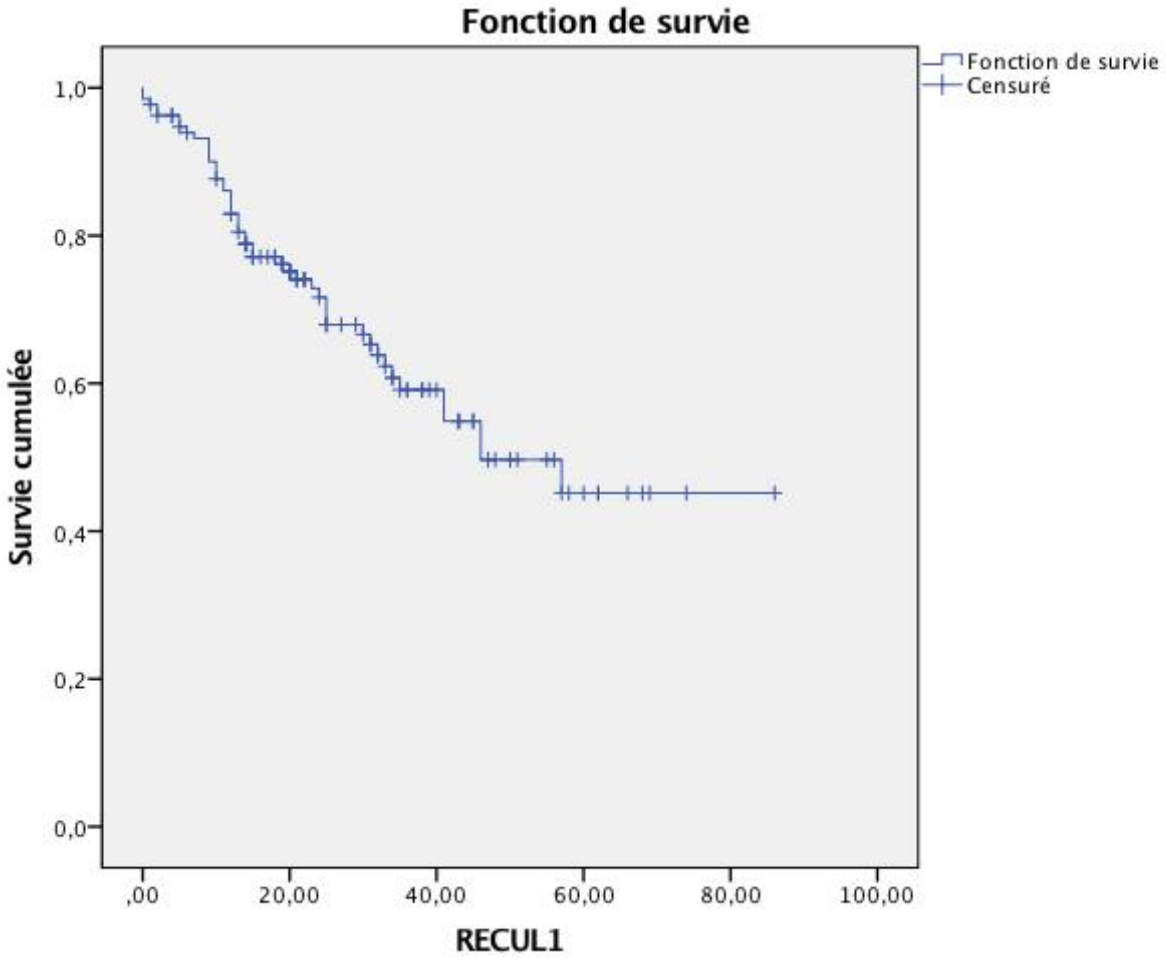
6-Palliative treatment

- Ø The decision was to give post-operative palliative chemotherapy to 22 patients with metachronous metastasizes and/or local recurrences.
- Ø 19 patients received the chemotherapy.
- Ø 3 patients were lost to follow up.

7-Survival

The survival was calculated after 6 months, 2 years, 3 years and 5 years.

- At 6 months the survival rate was 96,3%
- At 2 years the survival rate was 87,7%
- At 3 years the survival rate was 80,5%
- At 5 years the survival rate was 75,2%



COMPARATIVE STUDY

This part of the study is a comparison between patients that had different types of surgeries, in terms of characteristics such as gender, age, surgical approach, TNM staging but also the oncological follow up (local recurrence and metachronous metastasizes).

Group 1

The first Table shows a comparison between patients that underwent an intersphincteric resection and patients that received an abdominoperineal resection with a pseudocontinent colostomy.

	ISR (n=21)	PCC (n=15)	P-value
Gender (%)			0,500
- Female	52,4%(n=11)	46,7% (n=7)	
- Male	47,6%(n=10)	53,3% (n=8)	
Average Age (years)(standard deviation)	55+/-13	52+/-12	0,393
Average tumor distance from anal marge (cm) (standard deviation)	3+/-1	2+/-1	0,031
Staging T (%)			0,404
T0	9,5%(n=2)	20%(n=3)	
T1	9,5% (n=2)	0% (n=0)	
T2	38,1% (n=8)	33,3%(n=5)	
T3	42,9%(=9)	46,7%(n=7)	
Staging N (%)			0,418
N0	85,7%(n=18)	73,3%(n=11)	
N+	14,3%(n=3)	26,75%(n=4)	
Laparoscopy (%)			0,500
Yes	47,6%(n=10)	53,3% (n=8)	
No	52,4% (n=11)	46,7% (n=7)	
Metachronous Metastasis (%)			0,560
M0	90,5% (n=19)	86,7% (n=13)	
M+	9,5% (n=2)	13,3% (n=2)	
Adjuvant chemotherapy (%)			0,821
Yes	42,9%(n=9)	46,7%(n=7)	
No	57,1%(n=12)	53,3%(n=8)	
Local recurrence (%)			1
Yes	0%(n=0)	0%(n=0)	
No	100%(n=21)	100%(n=15)	
Survival (%)			
	68%	60%	

Comparing the two groups there was no significant difference between the ISR and the PCC in age or gender (p value equals respectively 0,393 and 0,500), the majority of TNM stages lay in T2-T3 in both groups. Approximately 53% of the patients had a laparoscopic approach in both groups without a significant difference (p=0,404). Two patients that underwent the intersphincteric resection had unhealthy resection margin R1.

Metachronous metastases appeared in 13% in the PCC group compared to 9% in the ISR group without a significant difference (p=0,560). The survival after ISR was 68% compared to 60% after the PCC and there was no local recurrence in both groups.

Group 2 The following table shows characteristics of patients that underwent an abdominoperineal resection compared to the patients that underwent a low anterior resection.

	APR (n=50)	LAR (n=37)	P-value
Gender (%)			0,577
- Female	48%(n=24)	54% (n=20)	
- Male	52%(n=26)	46% (n=17)	
Average Age (years)(standard deviation)	55+/-13	56+/-13	0,793
Average tumor distance from anal marge (cm) (standard deviation)	2+/-1	4+/-1	0,001
Staging T (%)			0,471
T0	14%(n=7)	13,5%(n=5)	
T1	0% (n=0)	5,4% (n=2)	
T2	34% (n=17)	29,7%(n=11)	
T3	44%(n=22)	43,2%(n=16)	
T4	8%(n=4)	8,1%(n=3)	
Staging N (%)			0,934
N0	64%(n=32)	65%(n=24)	
N+	363%(n=18)	35%(n=13)	
Laparoscopy (%)			0,579
Yes	40%(n=20)	54% (n=17)	
No	60% (n=30)	46% (n=20)	
Metachronous Metastasis (%)			0,376
M0	76% (n=38)	83,8% (n=31)	
M+	24% (n=12)	16,2% (n=6)	
Adjuvant chemotherapy (%)			0,094
Yes	44%(n=22)	62,2%(n=23)	
No	56%(n=28)	37,8%(n=14)	
Local recurrence (%)			0,389
Yes	8%(n=4)	2,7%(n=1)	
No	92%(n=46)	97,3%(n=36)	
Survival (%)			
	43%	58%	

There was no significant difference in age, gender and TNM stage between the abdominoperineal resection group and the low anterior resection group (the p value equals respectively 0,793, 0,577 and 0,471). There was a significant difference in the average distance from the anal margin between the two groups (p=0,001). The laparoscopic approach was used in 40% of the APR group and 54% of the LAR group without a significant difference. Unhealthy resection margins were found in on patient in the LAR group.

24%of APR patients and 16% of LAR patients developed metachronous

Group 3

metastases, local recurrence was found in 8% of the APR patients against 2% in the LAR group. The survival was better after LAR, 58% compared to 43% after APR.

The following table shows characteristics of patients that underwent an intersphincteric resection compared to the patients that underwent a abdominoperineal resection

	ISR (n=21)	APR (n=50)	P-value
Gender (%)			0,736
- Female	52,4%(n=11)	48%(n=24)	
- Male	47,6%(n=10)	52%(n=26)	
Average Age (years)(standard deviation)	55+/-13	55+/-13	0,983
Average tumor distance from anal marge (cm) (standard deviation)	3+/-1	2+/-1	0,014
Staging T (%)			0,092
T0	9,5%(n=2)	14%(n=7)	
T1	9,5% (n=2)	0% (n=0)	
T2	38,1% (n=8)	34% (n=17)	
T3	42,9%(=9)	44%(=22)	
T4	0%(=0)	8%(=4)	
Staging N (%)			0,067
N0	85,7%(n=18)	64%(n=32)	
N+	14,3%(n=3)	363%(n=18)	
Laparoscopy (%)			0,553
Yes	47,6%(n=10)	40%(n=20)	
No	52,4% (n=11)	60% (n=30)	
Metachronous Metastasis (%)			0,205
M0	90,5% (n=19)	76% (n=38)	
M+	9,5% (n=2)	24% (n=12)	
Adjuvant chemotherapy (%)			0,929
Yes	42,9%(n=9)	44%(n=22)	
No	57,1%(n=12)	56%(n=28)	
Local recurrence (%)			0,312
Yes	0%(n=0)	8%(n=4)	
No	100%(n=21)	92%(n=46)	
Survival (%)			
	68%	43%	

There was no significant difference between the two groups in age, gender and average tumor distance from the anal margin (the p value was respectively 0,983-0,736-0,014). The APR group holds more advanced stages compared to the ISR group. A laparoscopic approach was used on both groups at a same rate without any significant difference (p=0,553). There was no unhealthy resection margin in the APR group compared to 2 patients after undergoing an ISR.

Metachronous metastases appeared in 24% of patients that underwent an APR compared to 9,5% in the ISR group, Local recurrences didn't appear in the ISR group

Group 4

Compared to 4 patients in the APR group and survival after ISR was better (68%) compared to 43% after APR

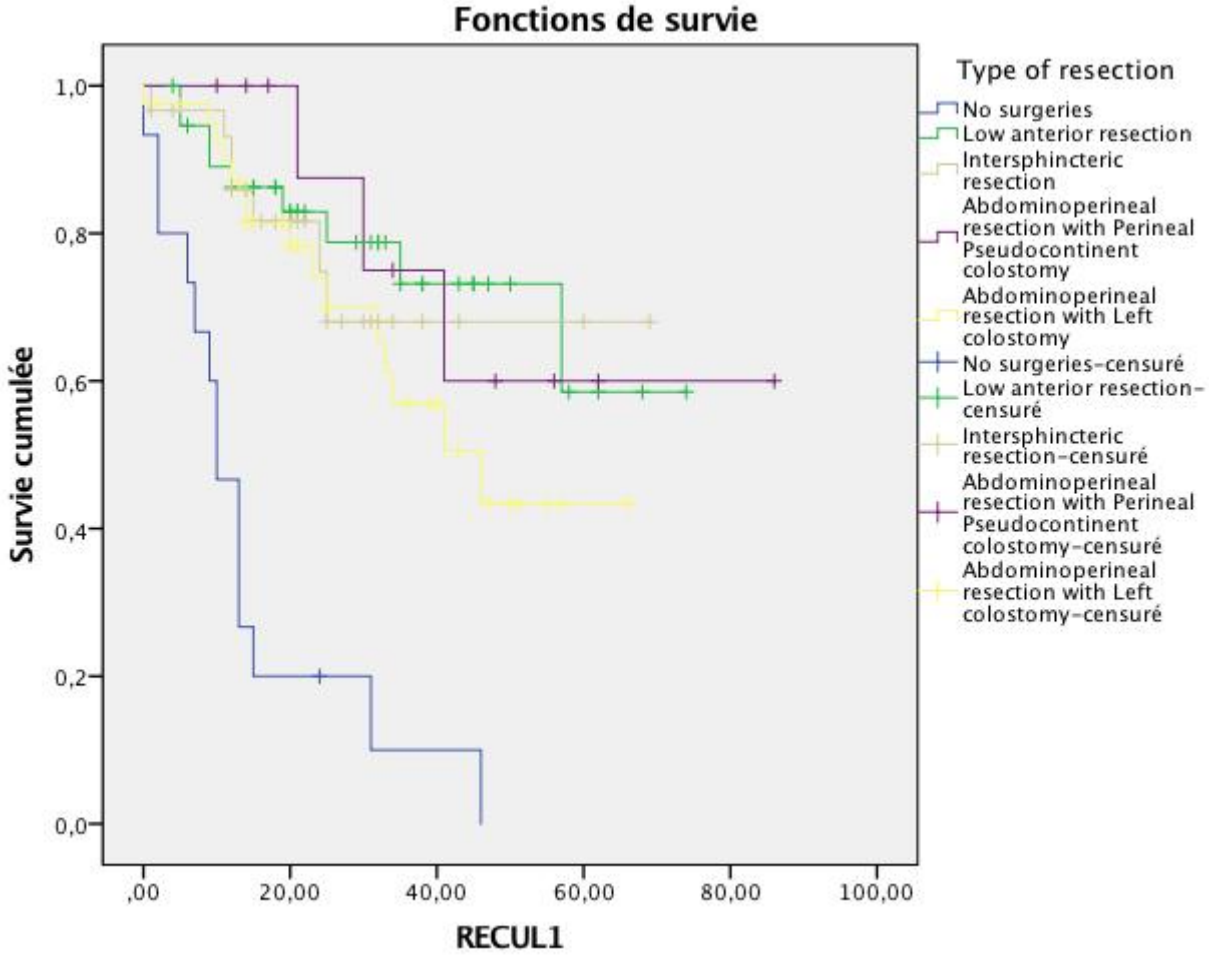
The following table shows characteristics of patients that underwent a low anterior resection compared to the patients that underwent an intersphincteric resection.

	LAR (n=37)	ISR (n=21)	P-value
Gender (%)			0,577
- Female	54% (n=20)	52,4%(n=11)	
- Male	46% (n=17)	47,6%(n=10)	
Average Age (years)(standard deviation)	56+/-13	55+/-13	0,852
Average tumor distance from anal marge (cm) (standard deviation)	4+/-1	3+/-1	0,004
Staging T (%)			0,481
T0	13,5%(n=5)	9,5%(n=2)	
T1	5,4% (n=2)	9,5% (n=2)	
T2	29,7%(n=11)	38,1% (n=8)	
T3	43,2%(n=16)	42,9%(=9)	
T4	8,1%(=3)	0%(=0)	
Staging N (%)			0,088
N0	65%(n=24)	85,7%(n=18)	
N+	35%(n=13)	14,3%(n=3)	
Laparoscopy (%)			0,902
Yes	54% (n=17)	47,6%(n=10)	
No	46% (n=20)	52,4% (n=11)	
Metachronous Metastasis (%)			0,698
M0	83,8% (n=31)	90,5% (n=19)	
M+	16,2% (n=6)	9,5% (n=2)	
Adjuvant chemotherapy (%)			0,155
Yes	62,2%(n=23)	42,9%(n=9)	
No	37,8%(n=14)	57,1%(n=12)	
Local recurrence (%)			0,638
Yes	2,7%(n=1)	0%(n=0)	Yes
No	97,3%(n=36)	100%(n=21)	No
Survival (%)			Survival (%)
	58%	68%	

There was no significant difference between the intersphincteric resection and low anterior resection in terms of age, gender and TNM stage (the p value was respectively 0,852-0,577-0,481); there was a significant difference between in two groups in average tumor distance from the anal margin since the ISR is reserved to low situated tumors. There were 2 cases of unhealthy resection margin in the ISR group compared to one case after LAR.

Metachronous metastases appeared in 16% of the LAR group compared to 9,5% in the ISR group. Local recurrence appeared in one patient that underwent LAR and survival was better after ISR (68%) compared to 58% after LAR.

The survival curve according surgery:



POST-OPERATIVE FUNCTIONAL RESULTS:

- We asked 21 patients that underwent a low rectal cancer surgery, to answer a survey about bowel continence, urinary function and sexual function.
- 21 other patients had their post-operative functional data on the Hosix system.

Bowel Function

The bowel functional results are gathered in the following table:

	Patients	Percentage
Flatus incontinence	26	62%
Bowel incontinence	25	59,5%
Nocturnal leakage	17	40,5%
Bowel urgency	20	47,6%
Difficult evacuation	20	47,6%
Antidiarrheal use	10	23,8%
Rectal enema	6	14,3%

Urinary Function

The urinary function data is in the following table:

	Patients	Percentage
Urinary incontinence	3	7,1%
Bladder empting difficulties	2	4,8%
Abnormal flow	3	7,1%
Presence of residual urine	2	4,8%
Nocturnal leakage	4	9,5%
Urgency	4	9,5%

Sexual Function

The sexual function results is in the following table:

	Patients	Percentage
Absence of sexual activities	14	33,4%
Retrograde ejaculation	10	23,8%
Erection dysfunction	12	28,6%
Vaginal dryness	1	2,4%
Absence of sexual satisfaction	10	23,8%

Comparative study

We compared the functional results according to types of conservative surgery.

Group 1

The functional results concern 42 patients (LAR=18, ISR=13, APR with PCC=3, APR with left colostomy=8).

This table is a comparison between low anterior resection and intersphincteric resection in term of functional results.

	LAR (n=18)	ISR (n=13)	P-value
Flatus incontinence	66,7% (n=12)	84,6% (n=11)	0,242
Bowel incontinence	83,3% (n=15)	69,2% (n=9)	0,309
Nocturnal leakage	33,3% (n=6)	61,5% (n=8)	0,119
Bowel urgency	50% (n=9)	69,2% (n=9)	0,284
Difficult evacuation	55,6% (n=10)	61,5% (n=8)	0,732
Antidiarrheal use	22,2% (n=4)	38,5% (n=5)	0,279
Urinary Incontinence	0% (n=0)	7,7% (n=1)	0,778
Bladder empting difficulties	0% (n=0)	7,7% (n=1)	0,778
Abnormal flow	0% (n=0)	0% (n=0)	
Presence of residual urine	0% (n=0)	0% (n=0)	
Nocturnal leakage	0% (n=0)	0% (n=0)	
Urgency	0% (n=0)	0% (n=0)	
Absence of sexual activities	22,2% (n=4)	38,4% (n=5)	0,681
Retrograde ejaculation	22,2% (n=4)	38,4% (n=5)	0,681
Erection dysfunction	22,2% (n=4)	46,1% (n=6)	0,182
Vaginal dryness	0% (n=0)	0% (n=0)	
Absence of sexual satisfaction	5,5% (n=1)	30,7% (n=4)	0,833

There was no significant difference between the intersphincteric resection and low anterior resection in terms of bowel, urinary and sexual function.

Group 2

This table is a comparison between conservative surgery (LAR, ISR, APR with PCC) and non-conservative surgery (APR with left colostomy) in terms of functional outcomes.

	Conservative surgery (n=34)	Non-Conservative surgery (n=8)	P-value
Urinary Incontinence	2,9% (n=1)	25% (n=2)	0,245
Bladder empting difficulties	2,9% (n=1)	12,5% (n=1)	0,569
Abnormal flow	0% (n=0)	37,5% (n=3)	0,025
Presence of residual urine	2,9% (n=1)	12,5% (n=1)	0,569
Nocturnal leakage	2,9% (n=1)	37,5% (n=3)	0,083
Urgency	2,9% (n=1)	37,5% (n=3)	0,083
Absence of sexual activities	29,4% (n=10)	50% (n=4)	0,362
Retrograde ejaculation	29,4% (n=10)	0% (n=0)	0,013
Erection dysfunction	35,2% (n=12)	0% (n=0)	0,010
Vaginal dryness	2,9% (n=1)	0% (n=0)	0,086
Absence of sexual satisfaction	20,5% (n=7)	37,5% (n=3)	0,727

There was no significant difference between the conservative and non-conservative surgery in terms of urinary and sexual function.

QUALITY OF LIFE

We asked 21 patients to answer a quality of life survey.

(1) To the question “how do you rate your quality of life?”

Evaluation	Patients
Very poor	2
Poor	5
Neither poor or good	3
Good	11
Total	21

(2) To the question “how satisfied are you with your health?”

Evaluation	Patients
Very dissatisfied	1
Poor	4
Neither satisfied nor dissatisfied	3
Satisfied	13
Total	21

(3) To the question “To what extend do you feel that physical pain prevents you for doing what you need to do?”

Evaluation	Patients
Not at all	9
A little	5
A moderate amount	5
An extreme amount	2
Total	21

(4) To the question “how much do you enjoy life?”

Evaluation	Patients
Not at all	2
A little	2
A moderate amount	9
Very much	8
Total	21

(5) To the question “how do your pain affect your life?”

Evaluation	Patients
Not at all	11
A little	3
A moderate amount	6
An extreme amount	1
Total	21

(6) To the question “how do your bowel dysfunction affect your life?”

Evaluation	Patients
Not at all	1
A little	5
A moderate amount	5
An extreme amount	10
Total	21

(7) To the question “how healthy is your physical environment?”

Evaluation	Patients
A little	3
A moderate amount	10
An extreme amount	8
Total	21

(8) To the question “do you have enough energy for daily life activities?”

Evaluation	Patients
Not at all	1
A little	2
A moderate amount	5
Mostly to completely	13
Total	21

(9) To the question “are you able to accept your bodily appearance?”

Evaluation	Patients
Not at all	2
A little	5
A moderate amount	3
Mostly to completely	11
Total	21

(10) To the question “how you able to get around?”

Evaluation	Patients
Very poor	1
Poor	3
Neither poor or good	3
Good	14
Total	21

(11) To the question “how satisfied are you with your sleep?”

Evaluation	Patients
Very dissatisfied	3
Poor	2
Neither satisfied nor dissatisfied	1
Satisfied	15
Total	21

(12) To the question “how satisfied are you with your ability to perform your daily life activities?”

Evaluation	Patients
Very dissatisfied	1
Poor	4
Neither satisfied nor dissatisfied	4
Satisfied	12
Total	21

(13) To the question “how satisfied are you with your capacity of work?”

Evaluation	Patients
Very dissatisfied	1
Poor	8
Neither satisfied nor dissatisfied	2
Satisfied	10
Total	21

(14) To the question “how satisfied are you with yourself?”

Evaluation	Patients
Very dissatisfied	2
Poor	2
Neither satisfied nor dissatisfied	8
Satisfied	9
Total	21

(15) To the question “how satisfied are you with your personal relationships?”

Evaluation	Patients
Very dissatisfied	2
Poor	4
Neither satisfied nor dissatisfied	6
Satisfied	9
Total	21

(16) To the question “how satisfied are you with your sex life?”

Evaluation	Patients
Very dissatisfied	7
Poor	6
Neither satisfied nor dissatisfied	3
Satisfied	5
Total	21

(17) To the question “how do you negative feelings?”

Evaluation	Patients
Never	5
Seldom	9
Often	2
Constantly	5
Total	21

DISCUSSION

I-Demographic

A-Incidence

A study was conducted in the teaching hospital Mohammed VI of Marrakesh from 2003 to 2006. The study concluded that 61 colorectal cancer cases were diagnosed during that period, 52,4% of them had a rectal localization. 143 colorectal cases were treated in the oncological department 50,3% of them were rectal cancers. (9)

According to a retrospective study conducted in the Cancer Center of Oujda from 2009 to 2011. A 100 cases of colorectal cancer were admitted, 65 cases were localized in the rectum. (10)

134 cases of low rectal cancer were collected in our study, with an average of 19 patients per year.

B-Age

The table below compares the mean age in different studies done on low rectal cancer.

References	Year	Mean Age (years)
1-Koyama et al. (11)	2014	65
2-Cong et al. (12)	2014	60,3
3-Konanz et al. (13)	2013	63,1
4-Dumont et al. (14)	2013	61
5-Akagi et al. (15)	2013	65
6-Laurent et al. (16)	2012	64
7-Lim et al. (17)	2011	64
8-Kuo et al. (18)	2011	60,1
9-Yamada et al. (19)	2009	51,1
10-Weiser et al. (20)	2009	59,4
11-Han et al. (21)	2012	63
12-Akasu et al. (22)	2008	57
13-Chamlou et al. (23)	2007	58,9
14-Schiessel et al. (24)	2005	63,6
15-Köhler et al. (25)	2000	60

16-Our study	2016	56

In our study the median age is 56,7 years (range: 24-90), 55% of the general population studied had an age range between 50 and 70 years. 21 patients were older than 70 years.

The mean age in our study is lower, but still in line with the range age of the other studies.

C-Gender

Gender is related to survival. Women have previously been shown to have a better overall and cancer-specific survival for colorectal cancer. However, men have a higher incidence of rectal cancer.

Around the world colorectal cancer affects men and women almost equally, with just over 1 million new cases recorded in 2002, the most recent year for which international estimates are available. Actually, in men, CRC is the third most common cancer (13,2%) after prostate cancer (22,8%) and lung cancer (15,9%). In women, CRC is the second most common cancer (12,7%) after breast cancer (28,8%); lung cancer follows CRC with 7,7%. In both men and women CRC is the second leading cause of cancer related death (11,6% and 13,0%) after respectively lung (26,1%) and breast cancer (16,8%).

According to cancer register of Rabat area, colorectal cancer touches slightly more men than women (18,4 every 100000 men), and (14,6 every 100000 women).

The following table compares the sex ratio in different studies.

References	Year	Sex ratio (M/W)
1-Koyama et al. (11)	2014	56/21
2-Cong et al. (12)	2014	21/17
3-Konanz et al. (13)	2013	26/7
4-Dumont et al. (14)	2013	9/5
5-Akagi et al. (15)	2013	77/47
6-Laurent et al. (16)	2012	45/20
7-Lim et al. (17)	2011	86/25
8-Kuo et al. (18)	2011	16/10
9-Yamada et al. (19)	2009	76/31
10-Weiser et al. (20)	2009	25/19
11-Han et al. (21)	2012	20/15
12-Akasu et al. (22)	2008	92/28
13-Chamlou et al. (23)	2007	59/31
14-Schiessel et al. (24)	2005	83/38
15-Köhler et al. (25)	2000	17/14
16-Our study	2016	63/71

In our study we noticed a slight predominance of women 71 females for 63 males with a

Sex Ratio M/W of 0,88.

II-Predisposing Conditions and Risk Factors

Most of the colorectal cancers are adenocarcinomas that usually occur sporadic (75-85%). However a hereditary susceptibility to CRCs is not rare (5-10%). Familial adenomatous polyposis (FAP) and hereditary non-polyposis colorectal cancer (HNPCC or Lynch syndrome) are the most frequently seen hereditary CRCs. Both inherit in an autosomal dominant way. A third group of patients with colorectal cancer consists of patients with a first-degree family relative affected by colorectal cancer. (26-27-28)

In our study, two patients have a history of familial adenomatous polyposis (FAP).

III-Diagnosis

A-Consultation period

The majority of Moroccan studies state that the consultation period is 6 months. (29-30-31-32)

In our study the average consultation period is 4 months.

This consultation delay is why patients are diagnosed at advanced stages, it is explained by patient's negligence to their symptoms, putting them on the account of a more common diagnosis, hemorrhoids.

B-Diagnostic procedures

Along with the typical symptoms of rectal cancer and physical examination of the patient, the diagnosis of rectal cancer is usually based on digital rectal examination (DRE) or colonoscopy/rectoscopy.

1-Digital rectal examination:

The DRE is essential to the diagnosis of low rectal cancer, it is realized on an empty rectum and bladder. The probability of sphincter-preservation, fixation and involvement of the sphincter complex, the distance from the anorectal ring and the size of the tumor can be examined by DRE.

Considering the overall accuracy of DRE is only 65%, other imaging modalities are necessary for the staging of rectal cancer (34-35).

In our study a rectal examination was performed on all our patients.

2-Colonoscopy:

When a colonoscopy is performed, it is possible to take a biopsy of the tumor immediately. Histopathological examination of the biopsy can confirm the diagnosis of rectal cancer, but it has only a slight impact on the treatment decision. (34)

A colonoscopy was performed on all our patients. The ulcerative budding macroscopic aspect was the most common and was found in 89% of our patients.

3-Biopsy:

A histological proof is essential before any treatment initiation. It can give a clear answer on the origin of the tumor and therefore eliminate any other diagnostic such as lymphomas, local extension of any other intra-perineal organ or a metastatic localization of stomach or breast cancer. (35)

It should be performed with a biopsy forceps, repeatedly if the results are negative or the biopsy site is too superficial and therefore can't appreciate the infiltrating character of the tumor.

A biopsy was performed on all the patients, a well-differentiated adenocarcinoma was the most common pathological aspect found in our study with a percentage of 55%.

4-CT-Scan:

Multiple studies showed the superiority of the CT-scan in the TNM staging compared to the endorectal ultrasound. The CT-scan is efficient at finding peritoneal carcinosis, lung and liver metastases. Therefore it is recommended that this exam replace the chest X-ray and the liver ultrasound. (36-37)

A CT-scan was performed on all the patients in our study.

5- Magnetic Resonance Imaging (MRI):

MRI has been a major advance in visualizing rectal tumors and can predict the T stage with good accuracy. MRI is also accurate both at demonstrating tumor response to CRT and in measuring the distance between the CRM and the tumor post CRT.

However, it has been suggested that the accuracy in correctly predicting the CRM status diminishes the nearer the tumor is to the anal verge. This may reflect difficulties in interpreting the anatomy of this region, in addition to technical deficiencies in imaging the fine detail of the margins at this level. (37)

The MRI was performed on 27 patients in our study.

6- Cancer Tumor Markers

6.1-Carcinoembryonic antigen (CEA):

Carcinoembryonic antigen (CEA) is one of the most widely used tumor markers worldwide. Its main application is mostly in gastrointestinal cancers, especially in colorectal malignancy.

The lack of sensitivity and specificity limit the application of CEA in diagnosing colorectal cancer, especially early disease.

Currently, the most useful application of CEA is in the detection of liver metastasis from colorectal cancers. Because of the relative success of surgery in resecting hepatic metastases, serial determinations of the marker are recommended

for detecting cancer spread to the liver.

Multiple studies have shown that patients with high preoperative concentrations of CEA have a worse out- come than those with low concentrations of the marker, therefore the CEA dosage can be useful in evaluating patient's prognosis.

CEA dosage is the most helpful in the surgical response evaluation, a regular CEA dosage is recommended in the follow up. An elevated dosage 6 weeks after surgery is an indicator of tumor persistence. (39)

60 patients had a positive CEA dosage.

6.2-CA19-9:

In low rectal cancer, the CA19-9 dosage is only useful if complementary to the CEA dosage when this one is negative.

This dosage was positive in 47 patients.

IV-Preoperative chemoradiotherapy versus radiotherapy:

Several randomized trials and a meta-analysis have directly addressed the question of whether the concurrent administration of chemotherapy with conventional fractionation RT is critical to the success of this approach.

The largest trial, EORTC 22921, examined both the benefit of concurrent chemoradiotherapy (using a five-day bolus FU and LV regimen during weeks 1 and 5 of RT) versus preoperative RT alone (45 Gy over five weeks) and the contribution of postoperative (adjuvant) chemotherapy (four cycles of bolus FU and LV), using a 2 x 2 factorial design. Compared with RT alone, patients undergoing preoperative chemoradiotherapy had a significantly higher rate of pathologic complete response (14 versus 5 percent); significantly less advanced pT and pN stage; and fewer cases with venous, perineural, or lymphatic invasion.

Local failure rates were significantly lower in all three groups receiving chemotherapy, regardless of whether it was given prior to or following surgery. In the latest update, the cumulative incidence of local relapse at 10 years was 22.4 percent with RT alone, compared with 11 to 15 percent in the three groups receiving chemotherapy. Ten-year DFS was similar in patients receiving preoperative chemoradiotherapy versus RT alone (46 versus 44 percent), as was overall survival (51 versus 49 percent). Furthermore, the addition of adjuvant chemotherapy did not significantly improve outcomes.

In a subsequent meta-analysis of this trial and five others (two of which compared short-course RT with long-course chemoradiotherapy) [47,49,52-54], the addition of concomitant chemotherapy to neoadjuvant RT improved local control. However, there was also a higher rate of acute grade 3 or 4 treatment-related toxicity with chemoradiotherapy and no significant impact on rates of sphincter preservation or overall survival. Comparative p pathological complete response rates

were not reported.

Given the relationship between pathologic stage after neoadjuvant chemoradiotherapy and overall survival that has been shown in many trials and a meta-analysis, the reason why higher rates of pathological complete response have not translated into better survival outcomes is not clear. Nevertheless, the addition of chemotherapy to conventional fractionation RT has become a standard approach to neoadjuvant combined modality therapy. (45)

In our study 125 patients were given a preoperative chemoradiotherapy treatment with a percentage of 93% percent.

V-Feasibility of the laparoscopic approach:

Since its initial use more than a decade ago, curative colorectal resection may now be achieved with laparoscopic assistance, bringing advantages to patients such as more rapid recovery, fewer complications, and shorter duration of hospital stay than for those with standard treatment. (70-71) Adding to these benefits, we consider that laparoscopic surgery provides definite advantages for surgeons in visualizing the surgical dissection planes by using high-definition images even in a narrow pelvic space.

While laparoscopic surgery is clearly advantageous in terms of patient outcomes, the procedure is more difficult from the surgeon's perspective when compared to traditional, open surgery, the surgeon has limited range of motion at the surgical site resulting in a loss of dexterity and poor depth perception.

The curability of colorectal cancer using laparoscopic colorectal surgery remains controversial because of uncertainties about overall recurrence rates, loco-regional recurrence rates and rates of distant metastases, especially the possibility of cancer dissemination at the port or wound site.

Hang et al, (72) demonstrated, in meta-analysis including 1033 patients, that there was no significant difference in global survival at 3 years follow up between the laparoscopic surgery (LS) group and the open surgery (OS) group in rectal cancer surgery. There was no significant difference between the two groups in local recurrence (RR=0.55; 95%CI:0.22-1.40, P=0.21). The 3-year overall survival [Hazard ratio (HR)=0.76; 95%CI:0.54-1.07, P=0.11] and 3-year disease-free survival (HR=1.16; 95%CI:0.61-2.20, P=0.64) were not significantly different between the two groups.

Ohtaniet et al. (73) confirmed the results of the precedent study by conducting a meta-analysis including 2095 patients and concluded the absence of significant difference between LS and OS in terms of 3 years disease-free survival (OR=0,90; IC 95%: 0,66-1,24; p=0,35) and 5 years recurrence-free survival (OR=1,17; IC 95%: 0,85-1,61; p=0,35).

Two others meta-analysis concluded that the laparoscopy reduces significantly postoperative complications (HR=0,71; IC 95%: 0,58-0,84; p=0,001) (HR=0,83; IC 95%: 0,76-0,91; p<0,001) (74-75).

These results are probably based on the fact that all procedures considered in these studies were undertaken or directly supervised by surgeons skilled in both laparoscopic and open colorectal surgery. This observation is extremely important, in that if surgeons still on their learning curve performed these operations, the results would be different.

Rectal procedures are known to be challenging, especially in men with a narrower and smaller pelvis, in addition to the common causes of conversion (visibility, hemorrhage control and difficult dissection sites), the technical difficulty of the laparoscopic approach raises some concerns on the safety of the laparoscopic approached compared to the open surgery.

A laparoscopic approach was performed on 43% of the operated patients in our study. Laparoscopy was converted to laparotomy in 16% of the cases.

There was no significant difference in surgical approach between the surgical groups compared in our study.

VI-Oncological Outcomes:

A-General outcomes:

1-The Morbi-mortality in low rectal cancer:

1.1. Morbidity:

The most frequent postoperative surgical complications after colorectal resections are surgical site infection, anastomotic leakage, intra-abdominal abscess, ileus and bleeding. These complications have different influences on outcome and have to be diagnosed accurately. In order to meet certain quality standards it is essential to assess postoperative complications. (82)

- Risk factors predicting complications:

Ø Risk factors related to patients

A multivariate study done by Alves et al concluded that smoking and an ASA score >2 were statically significant morbidity predicting factors. They also stated that a large number of patients received an urgent care, and that was the cause of a high morbidity rate of 43% in their study.

According to Saint Antoine multivariate study, male patients have a higher risk of complications in surgery. Male gender is associated with increased anastomotic leakage rates after low rectal anastomoses. They also stated the circumferential character of the tumor is a general risk factor of morbidity, surgical complications and anastomotic leakage. According to the same study diabetes was a risk factor of

anastomotic leakage.

Stelzmueller et al studied 99 patients with locally advanced low rectal cancer and concluded that, on the contrary, female patients, ASA score>2, preoperative anemia and prolonged hospital stay were risk factors of complications like the anastomotic fistulas. The advanced stage was also associated with severe complications.

Richards et al, concluded smoking and the presence of synchronous metastases were both risk factors of anastomotic dehiscence.

Ø Risk factors related to the patient's management

Preoperative chemoradiotherapy

Back in 2013 Schiffmann et al, proved that the preoperative chemoradiotherapy was a risk factor predicting medical complications, urinary complications, cardio and respiratory complications, abdominal wall infection, perineal infection, anastomotic fistula and a high revision surgery rate.

Beaujon confirmed these previous results in 2014 he conducted a study and concluded that preoperative chemoradiotherapy was a risk factor of infectious complications and anastomotic fistulas. It was also associated with a longer operation time and a longer hospital stay.

Bowel preparation

Over the last decades the presence of bowel content during surgery has been linked to anastomotic leakage and wound infection. This dogma was based more on observational data than on solid evidence. Several well-designed prospective randomized trials have shown that preoperative bowel cleaning does not prevent anastomotic leakage or wound infection in patients undergoing open or laparoscopic colorectal surgery.

Moreover, one study revealed even an increased risk of anastomotic leaks and

wound infection after mechanical bowel preparation. In addition, inadequate mechanical bowel preparation leads to liquid bowel contents and increases the rate of intraoperative spillage. Spillage of bowel contents may increase the rate of postoperative infectious complications.

On the other hand, bowel preparation might decrease operating time by improving bowel handling during anastomosis and might be helpful when intestinal palpation is necessary for identification of a lesion. Furthermore a recent French randomized prospective study that preoperative colon preparation reduces the morbidity rate from 44% to 27%.

Type of surgery

According to Rullier, the type of intervention (ISR, LAR, APR) doesn't influence the morbidity rate.

Other studies concluded that the mechanical anastomotic suture didn't increase the anastomotic leakage and dehiscence rate.

Preoperative contamination

A multivariate study done by Alves et al, concluded that the preoperative contamination of the surgical site with stools is a predictive factor of postoperative surgical complications.

Stoma use

According to a prospective randomized Swedish study, using a protective stoma reduces the rate of anastomotic dehiscence from 28% to 10%.

Pelvic drainage

According to a German retrospective study the absence of pelvic drainage and protective stoma are risk factors of anastomotic dehiscence.

In a retrospective study of 363 cases of laparoscopic low rectal resections with mechanical anastomosis technique, the absence of pelvic drainage is a risk factor of

anastomotic fistula.

Operation time length

Alves et al multivariate analysis concluded that operations longer than 6 hours are a factor predicting surgical complications.

Blood transfusions and anticoagulants

According to the Saint Antoine team blood transfusion is a predictive risk factor of global morbidity, medical complications, surgical complications and anastomotic dehiscence.

Studies have shown that the anticoagulant use is considerate a general risk factor of surgical complications.

Ø Morbidity results:

The following chart shows the morbidity rate in different rectal cancer studies.

Reference	Morbidity (%)	Anastomotic leakage (%)	Anastomotic stricture (%)	Hemorrhage (%)	Fistula (%)	Pelvic sepsis (%)	Bowel obstruction (%)	Wound complications (%)	Urinary tract infection (%)	Neorectal mucosal prolapse (%)
Lonanz et al. (13)	48	-	-	-	-	-	15	9	-	-
Akagi et al. (15)	12	5,6	-	-	-	-	-	-	-	-
Laurent et al. (16)	53,8	-	-	-	-	20	-	-	-	-
Kim et al. (17)	21,6	1,8	6,3	-	0,9	2,7	4,5	-	-	1,8
Yamada et al. (19)	14,9	4,7	8,4	0	0	-	3,7	3,7	0,9	3,7
Weiser et al. (20)	39	4,5	16	-	4,5	-	-	6,8	-	-
Han et al. (21)	7,5	2,5 APR	0	-	0	0	0	5APR	5,7PPC 9,4APR	-
Akasu et al. (22)	33	15	-	-	-	-	-	-	-	-
Chamlou et al. (23)	18,8	8,8	-	2,2	1,1	5,5	2,2	1,1	-	-
Schiessel et al. (24)	17,1	-	9,4	0,8	5,1	-	0,8	-	-	-
Löhler et al. (25)	64,5	48,3	9,7	3,2	19,3	0	3,2	6,4	-	-
Our study	37	9	5	1	7	1	-	2	8	-

The morbidity rate in our study was 37%, which is in line with the rates fond in the literature.

2.1-Mortality

Rectal surgery was associated with a high rate of mortality, but since the introduction of neoadjuvant treatments and news surgical technics the mortality rate has decreased drastically.

In a French prospective multicentric study (82), on the 238 cases of subperitoneal rectal tumors, the mortality rate was 2,5%, 67% of death causes were medical (heart or respiratory failure). The Saint Antoine team published in 2012 a study of 483 cases of low rectal cancer operated on a period of 9 years. The surgical technique used was a coloanal anastomosis (89%) or a hand sewn coloanal anastomosis (69%). The overall mortality rate was only 0,4%.

From 1944 to 2009, 404 low rectal cancer were collected for a study published in 2013(84), those patients received either a conventional coloanal anastomosis, a partial intersphincteric resection, a total intersphincteric resection or an abdominoperineal resection at percentage of 33%, 32%, 14%, 21% respectively. The short-term postoperative mortality rate was 1,2%.

In an Iranian multicentric study published in 2013 (85), concerning 88 patients with a low rectal tumor who underwent a low anterior resection (LAR) with a coloanal anastomosis. The mortality rate was 1,1%.

The postoperative mortality rate after an abdominoperineal was 1,6% according to a Swedish study published in 2014 (86), this study was conducted on 4977 patients.

In a Japanese systemic review (15) including 15 studies with a total number of 1217 patients with low rectal cancer underwent a colo anal resection and a coloanal intersphincteric anastomosis, the mortality varies from 0 to 1,7%.

Excellent results were found in recent prospective study (87), on the 28 patients with low rectal cancer who underwent a laparoscopic abdominoperineal

resection, the mortality rate was 0%.

In our study we have a mortality rate of 3,7%. As seen in the following table the mortality rate in our study is comparable to the other studies of low rectal cancer. (82)

Studies	Mortality Rate (%)
Heald et al (1978-97)	3%
Longo et al (1991)	3%
Porter et al (1983-90)	2%
Bockey et al (1971-91)	3%
Dehni et al (1987-95)	1%
Marijnen et al (1996)	4%
Holm et al (1980-93)	4%
Pollard et al (1984)	1%
Benoist et al (1990)	2%
Marusch et al (1999)	5%
Smedh et al (1993)	4%
Morino et al (1994- 2001)	2%
Anthuber et al (1996-2002)	1%
Zhou et al (2001-2003)	0%
Leroy et al (1991-2000)	2%
Leung et al (1993-2002)	2,4%
Our study (2016)	3,7%

2-Overall recurrence rate:

2.1-Incidence

The studies have shown that local recurrence occurs in 2 to 10% of cases treated with curative low cancer surgery. The third of deaths after low cancer surgery are due to local recurrence. In our study the local recurrence rate was comparable to the other studies

Metachronous metastases appeared in 18% of patients, with is in the range of other studies.

Reference	Local recurrence (%)	Metachronous metastasis (%)
Akagi et al. (15)	4,8	10,5
Laurent et al. (16)	5	24
Lim et al. (17)	5,4	20,7
Kuo et al. (18)	7,7	15,3
Yamada et al. (19)	2,5	8,4
Akasu et al. (22)	6,7	13
Chamlou et al. (23)	6,6	8,8
Schiessel et al. (24)	5,3	-
Köhler et al. (25)	9,7	9,7
Our study	4,6	18,5

The median delay for LR diagnosis, according to previous series, varies between 20 and 39 months, with a long delay of LR occurrence, in some cases up to 5 years.

The average delay of LR occurrence is 7 months ranging from 6 to 21 months.

2.2-Risk factors

Ø TNM stage

It was demonstrated that advanced stages (such as stage II- stage III) low rectal cancer were correlated to a high risk of local recurrence.

Ø Total mesorectal excision

An inadequate TME was proven to be a major risk factor of local recurrence

Ø Preoperative radiotherapy

Radiotherapy was on the contrary proven to be a protective factor by a randomized study. Local recurrence rate decreased from 8,2% to 2,4% after 2 years, regardless of the TN stage, in patients who received preoperative RT and an R0 resection.

2.3- Local recurrence treatment

The only way to treat local recurrence and obtain a satisfying local control is achieving an R0 resection by operating again. Reoperation can increase the 5 years survival by up to 50%.

If a resection was decided after the diagnosis of LR, it is recommended that the patient receive preoperative radiotherapy sometimes associated to chemotherapy in order to obtain more local control and increase survival. In the other hand, a dose superior to 15 Gy involves a high morbidity rate.

3-Overall survival

We compared the overall survival rate in different studies in the following table.

Reference	3-year survival (overall) (%)	5- year survival (overall) (%)
Akagi et al. (15)	-	81,7
Laurent et al. (16)	-	82
Lim et al. (17)	92,8	-
Kuo et al. (18)	83	83
Yamada et al. (19)	-	91,7
Akasu et al. (22)	95	91
Chamlou et al. (23)	-	82,0
Schiessel et al. (24)	-	87
Köhler et al. (25)	-	79
Our study	80	75

Our 3 years and 5 years survival rate were slightly lower but still line compared to the other studies.

B- Comparative outcomes

1-Intersphincteric resection Vs. APR with pseudocontinent colostomy:

Intersphincteric resection and abdominoperineal resection with a pseudocontinent colostomy are the only two procedures that avoid a permanent abdominal stoma after resection of ultra-low rectal cancer. With an ISR, the circumferential and distal margin is decreased thus exposing the patient to a higher risk of recurrence.

For ultra-low rectal cancer located at or below the dentate line, the Shirozou study (88) showed that tumor involvement of the intersphincteric sphincter plane was 49%. Although a recent literature review of 612 ISR (58) reported a satisfactory 5 years survival rate of 81.5%, the local recurrence rate was high at 9.5%.

From 1993 to 2007, a large study of 380 APRs for low rectal adenocarcinomas was conducted in the Department of Surgical Oncology in both the National Institute of Oncology and the Al Azhar Oncological Center in Rabat, Morocco. Local and distant recurrences occurred in respectively 6,8% and 20% of the patients with an overall and disease free and five year survival rate of respectively 74,6% and 60,3%.

The distal and lateral margins are larger in cylindrical APR than in a sphincter-sparing rectal resection. The cylindrical APR removes 8–20 mm of lateral additional tissue from the internal sphincter and a supplementary distal margin of approximately 20 mm . Circumferential margin (CRM) involvement and the perforation rate during APR have decreased significantly with a cylindrical APR compared to a standard APR. With a standard APR, after following the mesorectal fascia down to the sphincter and pelvic floor, the widest area of resection is around the tumor itself and this leads to a high rate of intraoperative perforation and CRM

involvement. Although in a study done by Dumont et al (14), they reported that In the PCC group, 38% patients had experienced a post-operative perineal complication including a pelviperineal infection in 18.1% and perineal desunion without infection in 18,1%. 14.2% had experienced pelvic sepsis including one anastomotic fistula.

Knowing that the ISR resection may have a better survival rate, a better local control is achieved with the APR, furthermore the quality of life is improved with the pseudocontinent colostomy, which makes the PCC an oncologically safer procedure for the ultra-low rectal carcinoma. Further comparative studies between an ISR and a pseudocontinent colostomy after APR in a homogeneous group of patients with similar tumors are needed to evaluate whether the choice of ISR would be acceptable ontologically.

In our study, 21 Intersphincteric resections and 15 pseudocontinent colostomies were performed, when we compared the two groups there was no significant difference between them in age or gender (respectively p=0,393, p=0,500), the majority of TNM stages lay in T2-T3 in both groups. Approximately 53% of the patients had a laparoscopic approach in both groups (p=0,404).

2 patients that underwent an intersphincteric resection had unhealthy resection margin, they were treated with extensive surgery and both underwent an APR with PCC, they both had resection clearance afterward.

Metachronous metastases appeared in 13% and 9% in respectively the PCC group and ISR group with no significant difference (p=0,560). Local recurrence didn't appear in any patient in both groups and the survival was 60% after PCC and 68% after ISR. In concordance with the literature review ISR and PCC both show good survival rate in our study, in addition to very good local control.

2-The Abdominoperineal excision Vs. the low anterior resection:

For centuries the abdominoperineal resection has been the gold standard for all the cancers of the lower third and bulky tumors of the middle third of the rectum. However, there were significant numbers of patients who do not agree to the treatment with permanent iliac colostomy. Facing the challenge of the physical, psychological consequences of a permanent iliac colostomy from those patients, majority of surgeons tried to develop procedures to save the lower end.

The concept of total mesorectal excision (TME) and the increasing use of stapling devices for rectal and anal anastomoses have had a significant impact on the treatment of distal cancer. With the use of TME and a close distal resection margin, the need for sphincter ablation can be reduced.

Although APR has been described as standard treatment for tumors less than 8 cm from the anal verge, more patients with distal rectal cancer are now being treated with sphincter-saving surgery. Low anterior resection (LAR) with straight coloanal anastomosis gained wide acceptance in the treatment of the cancer of lower third of the rectum. With the advent of stapling instruments and the techniques such as transanal coloanal anastomosis, the incidence of APR is reduced by 50 %.

For those patients with lower rectal cancer eligible for surgical treatment, whether APR or LAR is the better choice remains controversial.

In a study of 608 rectal cancer patients done by Marr et al (79), APR was associated with greater local recurrence and a lower 5-year survival rate compared with LAR. Two studies reported that the incidence of CRM involvement in APR was more than threefold greater than in LAR. To avoid CRM involvement, Holm et al. recommend an extended APR, which includes en bloc excision of the levator muscles with the anus and the lower rectum.

However, another research showed that the oncologic outcomes of patients treated by APR are not worse than those treated by LAR. Kim and colleagues (55) indicated that APR could be used safely without impairing oncological outcome when performed with appropriate skill to achieve R0 resection.

These conflicting results were likely due to small sample size of the study.

A meta-analysis done by Xiao-Tong Wang (89) was the first study to systematically estimate the technical feasibility, effectiveness, and safety of APR and LAR in the treatment of lower rectal cancer, through a systematic review of published comparative studies. The results of this meta-analysis indicated that APR led to worse cancer specific outcome than LAR. In other words, APR group could not increase 5-year survival rate and reduce operative complications compared with LAR, in keeping with other published results. And concluded that LAR has a higher 5-year survival rate, low CRM rate, local recurrence and complications rate than APR. In selected low rectal cancer patients, LAR is a better option than APR. One analysis showed that CRM is of prognostic value for both local recurrence and overall survival in patients treated with an APR and concluded that the poor prognosis of APR was attributable to frequent CRM involvement.

Chuwa et al (90), had pointed out that only 37 % of the patients whose tumors were located 5 cm or less from the anal verge had complete mesorectal excision, because of the greater difficulty of performing a perfect TME low down in the pelvis. And TME cannot always be performed down to the levators in APR because of the presence of a large tumor around this level. The frequency of CRM involvement for APR has not diminished with TME. CRM involvement in the APR specimens is related the removal of less tissue at the level of the tumor in an APR. The poor prognosis of the patients with an APR is ascribed to the resection plane of the operation leading to a high frequency of margin involvement by tumor and perforation with this

current surgical technique.

Despite important progress made in the past decade regarding techniques and perioperative management, patients with rectal cancer still inevitably experience surgical complications. The commonest complication of APR is perineal wound failure, and anastomotic leak is the commonest complication after LAR. With the lowering level of colo-anal anastomosis and increasing demands for anal-sphincter preservation, risks such as anastomotic leakage and hemorrhage are considered to be the major complications of LAR. Jorge et al reported a leakage rate of 11-12 % following rectal cancer surgery.

Local recurrence is an important indicator of the success of rectal surgery. The high rates of local recurrence of APRs could be explained by a number of factors either singly or in combination. Although there is convincing evidence that TME reduces local recurrence rates by 1–6 %.

We conclude from this review that sphincter-preserving surgery must be considered the primary procedure of choice; LAR can be safely used in patients with proper technique without impairing oncological outcome, although an APR is necessary in many patients with low or advanced tumors and cannot be substituted with an LAR.

Future prospective, multicenter, and randomized trials including small number of cases, preoperative radiotherapy, chemotherapy, and/or neoadjuvant chemoradiation administered to the patients will be useful to confirm this conclusion.

In our study 50 patients underwent an APR and 37 patients underwent a LAR, there was no significant difference in age, gender and TNM stage (respectively p=0,793, p=0,577 and p=0,471), there was although a significant difference in the average distance from the anal margin, most patients that underwent an APR in our

study had a tumor laying around 4 cm from the anal margin against 2 cm for the LAR group (P=0,001).

We used a laparoscopic approach in 40% of APR patients and 54% of the LAR without any significant difference (p=0,579). Unhealthy resections margins were found in one patient in the LAR group, this patient was treated with extensive surgery and underwent an APR with permanent left colostomy afterward. We conclude that unlike the literature review APR showed excellent margin resection control in our study compared to sphincter saving surgery.

24% of APR patients and 16% of LAR patients developed Metachronous metastasis and Local recurrence were found in 8% of the APR patients against 2% in the LAR group (respectively p=0,094, p=0,389). The survival after LAR was 58% and 43% after APR.

The following table shows the oncological outcome of other LAR and APR studies. (84)

	LAR			APR		
	N	LR	Survival	N	LR	Survival
Gamagami et al (1991)	164	8%	78%	31	13%	74%
Lavary et al (1997)	162	8%	70%	99	11%	62%
Topal et al (1998)	41	21%	62%	41	26%	58%
Luna- Parez et al (2000)	NA	NA	NA	137	9%	75%
Enker et al (1997)	NA	NA	NA	148	5%	60%
Nissan et al (2001)	NA	NA	NA	292	6%	58%
Denhi et al (2003)	NA	NA	NA	165	10%	76%
Koyama et al (2014)	NA	11,7%	88,2%	NA	12,1%	51,2%
Weiser et al (2009)	NA	1%	85%	NA	6%	47%
Our study (2016)	37	2,7%	58%	50	8%	43%

LAR has better recurrence control and survival compared to the APR; our results are in line with the literature review.

3-Intersphincteric resection Vs. Abdominoperineal resection:

Because of advancements in stapled anastomosis and improved transanal anastomosis techniques, anal sphincter-preserving surgery has been widely indicated in cases of lower rectal cancer. However, for super-low rectal cancer adjacent to the anal canal, abdominoperineal resection (APR) of the rectum involving permanent colostomy has been a standard surgical technique.

Intersphincteric resection (ISR) is becoming more widely accepted; for example, the use of ISR instead of APR for super-low rectal cancer has been indicated for preventing a permanent colostomy. To establish this operative method as a standard surgical technique, it is necessary to study its indications for cancer curability.

Although Saito et al (91) disclosed that the 5-year overall survival was worse after APR compared the ISR (61.5% vs. 80%), most of the studies comparing APR and ISR (92-93-94), concluded that there is no statistically significant difference regarding their oncological outcome.

A recent study conducted by Koyama et al (11) compared APR and ISR, they noticed that the APR group holds more advanced TNM stages compared to the ISR group, the overall recurrence rate (both local and distant) was 7.8% after ISR compared to the 12.1% after APR (P = 0.67). The local recurrence rate was 2.6% for the ISR group compared to the 6.1% in the APR group (P = 0.57). The 5-year local recurrence-free survival was 93.5% for the ISR group and 87.9% for the APR group; although these differences were not statistically significant. The 5-year overall survival rate after ISR was 76.4%, better than the APR (51.2%), probably reflecting the higher frequency of advanced cancers in APR group of patients.

Since Schiessel et al reported their initial experience with ISR in 1994; the indication for ISR has been progressively evaluated and rigorously applied. From an

oncological viewpoint, local control is the most important surgical goal for lower rectal cancer. There is no difference in local recurrence rates between patients who undergo LAR as a sphincter-preserving procedure and those who undergo APR.

In a recent literature review (95) comparing ISR and APR, the local recurrence rate varies from 2% to 30% and from 6% to 11% respectively. The overall 5 years survival varies from 62% to 79% and 53% to 80% respectively. They concluded that there was no oncological difference between the two groups.

According to the long-term results from a median follow- up of 56.2 months by Chamlou et al. (23), an 8.8 % local recurrence rate was reported in 90 patients who underwent ISR, including 41 % of patients who had preoperative CRT. Portier et al. (92) reported that the 5-year pelvic recurrence rate, regardless of the tumor stage, was 10.6 % in 173 patents who underwent ISR, with a mean follow-up of 66.8 months.

A recent study done by Takayuki Akasu et al (22) evaluated the oncological safety of the intersphincteric resection; they concluded that ISR, in general, does not increase local or distant recurrences. With T1 and T2 tumors, if meticulous dissection and irrigation after closure of the distal stump are performed, local control is assured and radiotherapy is not necessary. For T3 tumors, if resection margins are estimated to be insufficient, preoperative therapy should be considered to reduce the risk of local failure.

Choosing between the ISR and the APR is still a subject of controversy, when some studies concluded that there is no difference in oncological outcomes between them other studies clamed having worse oncological results with the APR technique. These contrasted results need good quality randomized trials without selection bias since the ISR was only indicated in small T1-T2 not fixed tumors in the majority of the series.

In our study the abdominoperineal resection was performed in 50 patients and the intersphincteric resection on 21. There was no significant difference between the two groups in Age, Gender and average tumor distance from the anal margin (respectively (p=0,983) (p=0,736) (p=0,014)). There were no significant difference in TNM stage either but we noticed that the APR group holds more advanced stages. A laparoscopic approach was used on both groups at a same rate without any significant difference (p=0,553).

There was no unhealthy resection margin in the APR group, compared to 2 in the ISR group. The metachronous metastases rate was higher in the APR group (24%) compared to 9,5% in the ISR, there was no local recurrence in the ISR compared to 4 patients in the APR group, and the survival was 68% after ISR compared to 43% after APR.

The following table compares the oncological outcomes of the ISR and APR in other low rectal cancer surgery series.

	ISR			APR		
	N	LR	Survival	N	LR	Survival
Braun et al (1992)	65	11%	62%	77	17%	53%
Kasper et al (1998)	85	8,7%	71%	81	17%	55%
Saito et al (2009)	132	10,6%	80%	70	15,7%	61%
Weiser et al (2009)	44	0%	96%	63	9%	59%
Kuo et al (1997)	26	0%	83%	23	3,8%	46%
Our study (2016)	21	0%	68%	50	8%	43%

Our results show that the ISR is an oncologically safe procedure for low rectal cancer, which is comparable to the results found in the other studies.

4-Low anterior resection Vs. the intersphincteric resection:

The standard surgical procedure for low rectal malignancy is low anterior resection (LAR). Patients with the tumor localized at the lower rectum still confront the possibility of requiring permanent stoma, causing drastic changes in life-style and physical perceptions. With the advances in multimodality therapy, a 1 cm resection margin has been suggested to be adequate for patients receiving preoperative chemoradiation therapy.

The intersphincteric resection technique has been used to increase sphincter preservation by achieving greater distal resection margins for patients with low rectal cancers. However, the intersphincteric resection has potential disadvantages in increasing the possibility of surgical morbidities and local recurrence. So far, the oncological results of the intersphincteric resection remain an important issue to be concerned.

In 2011 Kuo et al (18) published a study where he reviewed 162 charts of patients with extraperitoneal rectal cancer. One hundred one patients (62.3%) underwent low anterior resection (LAR), 26 patients (16%) received radical proctectomy and intersphincteric resection (ISR), and 23 (14.2%) had abdominoperineal resection (APR).

One patient had a R1 microscopic resection in the intersphincteric group, but there was no statistical difference in local recurrence between intersphincteric resection and LAR.

In the ISR group the overall survival rates at 3 and 5 y were 83% and 83%, and the disease-free survival rates at 3 and 5 y were 82% and 76%, respectively. In the LAR group, The 3 y and 5 y overall survival rates were 89% and 81%, the disease-free survival rates at 3 and 5 years were 71% and 64%.

In another study done by Koyama et al (11) ISR resection had better results.

Between 2000 and 2007, a total of 77 consecutive patients with low rectal cancer underwent curative surgery; the curability outcomes for ISR and LAR were compared. The 5-year survival rate after ISR was 76,4 % compared to 80,7 % after LAR. Local recurrence after ISR occurred in 7,8 % of patients and LAR 11,7 %.

In our study, there was no significant difference between the ISR and the LAR in terms of age, gender and TNM stage (respectively p=0,852 - p=0,577 – p=0,481); there was although a significant difference in average tumor distance from the anal margin between the two groups (p=0,004), LAR is reserved for tumors located high in the low rectum.

There were two cases of unhealthy resection margin in the ISR group compared to only one case in the LAR group.

Metachronous metastasis appeared in 16% of the LAR group compared to 9,5% in the ISR group, this is probably due to advanced staged patients operated using the LAR. A local recurrence appeared in only one patient after LAR and the survival after ISR was 68% compared to 58% after LAR.

Studies comparing the ISR and the LAR are unfortunately rare, the following chart are literature reviews for the oncological outcomes of LAR and ISR in other studies.

Table: Oncological outcomes after the intersphincteric resection in low rectal cancer treatment

	LAR			ISR		
	N	LR	Survival	N	LR	Survival
Gamagami et al (1991)	164	8%	78%	NA	NA	NA
Lavary et al (1997)	162	8%	70%	NA	NA	NA
Topal et al (1998)	41	21%	62%	NA	NA	NA
Marks et al (1993)	NA	NA	NA	52	14%	85%
Mohiuddine et al (1998)	NA	NA	NA	48	15%	82%
Rullier et al (2005)	43	11,7%	88,2%	92	2%	81%
Braun et al (1992)	NA	NA	NA	63	11%	62%
Köhler et al (2000)	NA	NA	NA	31	10%	79%
Bannon et al (1995)	NA	NA	NA	109	11%	87%
Yoo et al (2005)	NA	NA	NA	29	31%	86,2%
Shiessel et al (2005)	NA	NA	NA	121	5,3%	88%
Saito et al (2006)	NA	NA	NA	228	3,6%	9,2%
Chamlou et al (2007)	NA	NA	NA	90	7%	82%
Han et al (2009)	NA	NA	NA	40	5%	97%
Yamada et al (2009)	NA	NA	NA	107	2,7%	92%
Weiser et al (2009)	NA	NA	NA	44	0%	96%
Saito et al (2009)	NA	NA	NA	132	10%	80%
Han et al (2010)	NA	NA	NA	310	11,6%	66%
Kuo et al (2011)	NA	NA	NA	162	7,7%	83%
Reshef et al (2012)	NA	NA	NA	986	3%	71
Our Study (2016)	37	2,7%	58%	21	0%	68%

As shown in both tables, conservative techniques (such as the conventional one for supra-anal tumors or the one associated with internal sphincter sacrifice in the case for intra-anal tumors) don't compromise the local recurrence or the survival. Our results are in line with the literature review.

VII-functional results

The increase in survival has led to an increased attention to the importance of functional outcome and QoL. Knowledge of not only oncological, but also long-term functional outcome is essential for all colorectal surgeons in order to manage low rectal cancer patients, both in terms of choosing the optimal treatment option and in terms of managing the functional deficits after recovery.

1-Definitive colostomy

The proctectomy for low rectal cancer involves risks of functional after-effects, which can be the cause of the altered quality of life noticed in these patients. The definitive colostomy, often feared by patients, is associated in most cases to urinary and sexual dysfunctions.

The APR is the most used technique in low rectal cancer surgery and the definitive left colostomy is the last step of this procedure. Patients often apprehend this intervention because it alters the social life, family life and sexual life; this intervention also affects the bodily image, which causes severe postoperative depressions.

In order to minimize the consequences, the colostomy must be placed far from skin folds to avoid the colostomy sac detachments.

The most frequent complications of the colostomy are the stoma prolapse and the peristomial evisceration; they are treated with corrective surgery, which can sometime be challenging.

The perineal scar can often be the field of chronic suppurations, which can cause the residual rectal cavity to be infected and causes the perineal sinus. The constant discharge experienced by patients can be very disabling. A randomized trial asset that closing the perineal wound fast with the help of an epiploplasty prevents these unwanted complications.

2-Bowel dysfunctions after conservative surgery

Ø Low anterior resection syndrome (LARS)

Bowel dysfunction following LAR is often referred to as low anterior resection syndrome (LARS). Although recognized for years, a clear definition has not been established. Recently, Bryant et al. proposed a very pragmatic definition: “disordered bowel function after rectal resection, leading to a detriment in quality of life”. LARS is characterized by urgency; frequent bowel movements, emptying difficulties and incontinence for flatus and/ or feces. It is most pronounced during the first months after surgery, improves during the first year and reaches a steady state 1-2 years after surgery.

Symptoms and probable causes

Symptoms of LARS include a mix of high bowel frequency/day with liquid stools, sometimes multiple evacuations with multiple movements within a limited time period, urgency, and fecal incontinence. These symptoms may occur in 10–20 % of patients after sphincter-saving operations. Indeed low anorectal mobilization and rectal excision may impair bowel function, which is sometimes already worsened by adjuvant or neo-adjuvant chemo-radiotherapy, resulting in some patients suffering from a defecation disorder, A number of publications have reported that radiotherapy leads to a worsening of the continence function in the sense of increased episodes of incontinence, shortening of the urge sensation, evacuation disorders and increased frequency of bowel movements. Ito et al (96) reported that preoperative CRT is the risk factor with the greatest negative impact on anal function after ISR. Moreover a number of publications have reported that radiotherapy leads to a worsening of the continence function in the sense of increased episodes of incontinence, shortening of the urge sensation, evacuation disorders and increased frequency of bowel movements.

The proportion of patients who suffer from this syndrome seems to increase as the level of anastomosis approaches the anal sphincter. Indeed ultralow anterior resection with straight coloanal anastomosis may be associated with the highest incidence of impaired continence (30 %)

Impaired bowel function in patients having sphincter- saving operations is usually provoked either by colonic dysmotility, neorectal reservoir dysfunction and anal sphincter damage or by a combination of these factors. Surgical technique defects may be added to these possible causes: anastomotic ischemia, short length of the descending colon and stretching of neorectal mesentery may play a role.

Bowel functional results

It is not surprising that, especially with this surgical technique which involves not only a low anastomosis within the anal canal, but also partial resection of the internal sphincter, post-operative continence will be considerably compromised, it has even been pointed out that impaired continence is an inevitable consequence of intersphincteric rectal resection. Surgical removal of the rectum leads to many changes in anorectal function, the most obvious being a marked reduction in reservoir capacity and a significant decrease in anal sphincter pressure. A significant proportion of patients suffer bowel frequency and urgency with minor faecal leakage after sphincter-preserving surgery. Although it is believed that these clinical problems disappear with the passage of time. Therefore postoperative anal function is a particularly important clinical outcome measure after sphincter-preserving surgery for lower rectal cancer.

In our study we found no statistical significant difference when we compared the bowel functional results between the ISR group and LAR group.

Koyama et al (11) conducted a study in 2007; they evaluated the long-term defecation functions following ISR for an average observational period of 6.3 years.

And compared the postoperative functions in the LAR cases to determine whether this operative method is an acceptable function-preserving surgery. They found that the postoperative defecation functions in the ISR cases, such as the frequency of defecation, urgency and the ability to distinguish gas emission, were equal to those in LAR cases.

On The contrary in a study conducted by Allal et al (97) found that 24 patients (45%) were able to undergo restorative surgical procedures, in 20 cases using LAR with coloanal anastomosis. They were able to assess anal sphincter function in 11 patients having undergone restorative resections and alive without recurrence at a minimum follow-up of 1 year. The bowel function was good to excellent in 9/11 patients (82%), whilst two patients had fair function.

The gastro enteric disorders and incontinence are more frequent after an intersphincteric resection compared to other sphincter saving surgeries this is probably due to the partial or total resection of internal sphincter (18). Saito et al (98) conducted a study of 181 patients who underwent an ISR after APR; the period of the follow up was 3 to 24 months. 110 patients were evaluated using the Wexner scale and the continence was evaluated using Kirwan classification. The average score was 7,8 after a follow up of 24 months. The Kirwan classification demonstrated a perfect incontinence in 36 patients, flatus incontinence in 32 patients, minor occasional anal leakage in 25 patients, frequent bowel leakage in 7 patients no patient needed a colostomy for bowel incontinence.

In the long-term one in two patients will suffer from bowel dysfunction, including frequent bowel movements, stool fragmentation, urgency and in certain cases bowel incontinence, the last symptom is considered the most disabling (99). A significant fecal incontinence (at least once a week) was noted in 20% of patients after a total mesorectal excision, it is more frequent after internal sphincter excision

(100), also after preoperative radiotherapy (101).

The functional complications seem to occur in the 5 first years after surgery, they are at their peak in the first 6 months and gradually decrease in one year. For certain patients those symptoms may last for years and therefor alter their quality of life (102).

Multiple studies evaluated the functional results after ISR and low rectal anastomosis and they are resumed in the following chart

Reference	Functional tool	Urgency (%)	Bowel incontinence (%)	Incontinence to flatus (%)	Difficult evacuation (%)	Constipation (%)	Nocturnal leakage (%)	Need to wear a pad (%)	Antidiarrheal medication (%)	Wexner-score (mean(+-SD))
Koyama et al. (11)	Wexner	57 ISR 47 LAR	-	-	-	-	-	84 ISR 33 LAR	11 ISR 8 LAR	8,1 (± 4,8)
Our study (2016)		69 ISR 50 LAR	69 ISR 83 LAR	84 ISR 66 LAR	61 ISR 55 LAR	-	61 ISR 33 LAR	-	38 ISR 22 LAR	-
Cong et al. (12)	Saito function questionnaire; Wexner	39,5	-	-	57,9	47,4	-	65,8	47,4	7,3 (± 3,8)
Konanz et al. (13)	Wexner	-	-	-	-	-	-	-	-	12,9
Dumont et al. (14)	Wexner	-	-	-	-	-	-	-	-	11 ISR 10 PPC
Laurent et al. (16)	Wexner	40,9	-	-	77,3	40,9	-	-	-	12
Lim et al. (17)	Wexner	-	-	-	-	-	-	-	-	7,5 (± 2,7)
Kuo et al. (18)	Wexner	19	-	-	38,1	-	-	19	28,6	2,8
Yamada et al. (19)	Wexner, Kirwan	-	57,7	29,8	-	15,4	27,9	-	-	-
Han et al. (21)	Kirwan score	31,4	57,2	28,5	42,8	31,4	28,5	-	40	-
Chamlou et al. (23)	Wexner	19	59	-	41	-	-	46	26,5	-
Schiessel et al. (24)	Williams and Johnston classification	-	13,7	-	-	-	13,7	-	-	-
Köhler et al. (25)	-	-	70,4	11,1	-	0	26	26	-	-
Our study	-	47,6	59,5	62	47,6	-	40,5	-	23,8%	-

In our study 62% of the patients followed experienced flatus incontinence, 60% experienced bowel incontinence, nearly 50% of our patients experienced urgency, difficult evacuations and nocturnal leakage. 10 patients used antidiarrheal medication on a daily basis and 6 patients often used rectal enemas. Our results seem comparable to other studies, although future studies with a higher number of followed up patients is needed.

3-Urinary and sexual dysfunctions after low rectal cancer surgery

Urinary and sexual dysfunctions are recognized complications of rectal resection for carcinoma. The main cause of dysfunctional seems to be injury to the autonomic nerves in the pelvis and along the distal aorta. The incidence of genitourinary dysfunctions depends on the type of operation performed (the plane of dissection, the degree of preservation of the autonomic nerves and the extend of pelvic dissection). Dysfunction seems to be more common after abdominoperineal resection than after LAR and ISR.

The wide range of reported sexual dysfunction rates in the literature (18–54 %) might be attributed to differences in the preservation status of the autonomic nerves during TME. Identification and preservation of the autonomic nerves are not always easy during TME. Junginger et al. (103) reported that the ability to identify the autonomic nerves during open TME is associated with the degree of urinary dysfunction. It was also stated the usefulness of electrical stimulation of the autonomic nervous system in order to identify these nerves and preserve it during surgery; this seems to be somewhat complicated for everyday practice. In a study (104) 75% of males and 90% of females maintained a sexual activity after undergoing a conservative surgery, in the other hand 63% and 72% respectively after APR. This is perhaps due to the rare risk of surgical lesions of pelvic autonomic system's distal branches; those terminal nerves are exposed during perineal amputation, it is also

due to the preservation of the cavernous plexus during the dissection time in ISR. The maintenance of the sexual function is important mostly in young patients.

On the contrary, in our study more patients in the conservative group suffer from physical sexual dysfunctions such as impotence, retrograde erection and vaginal dryness, the absence of sexual satisfaction also was more frequent in this group.

In our study there was more patients with urogenital dysfunctions in the APR group without having a statically significant difference between conservative and non-conservative groups. We although noticed that in the APR group, 4 patients didn't have any sexual activity without having any physical sexual problem (such as erectile dysfunction or erectile dysfunction) this is probably due the presence of a stoma, it has an impact on sexual function, but it is more likely to be perceived as a problem by the patient rather than the spouse, which can inhibits the sexual activity.

Postoperative urogenital dysfunction may be caused by several non-neurogenic reasons as well: inflammatory changes in the perivesical tissues, altered perineal anatomy, immobilization, decreased perineal relaxation because of pain, failure to open the bladder neck due to stress-induced sympathetic over-activity, bladder distension and reduced contractility as a result of high intravenous fluid loads, or bladder sedation due to residual effects of anesthetic agents are not rare. These factors may explain the transient nature of symptoms encountered in many patients.

In addition several studies have demonstrated a detrimental effect of radiotherapy on a patient's sexual function. Marijnen et al (105) demonstrates that for patients without recurrence, sexual activity declines postoperatively for both male and female patients RT had a negative effect on sexual functioning in males (P .004) and females (P .001). Irradiated males had more ejaculation disorders (P .002),

and erectile functioning deteriorated over time (P .001). RT had similar effects in patients who underwent a low anterior resection (LAR) versus an abdominoperineal resection (APR with PCC). In addition, the differences in VAS score, activity level, and physical problems between irradiated and non-irradiated patients were consistently larger at 3 months compared with 6 months, suggesting that patients that undergo radiotherapy have more difficulties recovering after surgery than patients that don't have RT.

Sexual dysfunction is not reported equally between genders, a majority of the studies are about men and few studies are specifically designed for women. In a study comparing patients who underwent rectal surgery with a control group. The authors reported that more than 50% of the patients refused to participate. The women that underwent rectal surgery felt sensitively less attractive and complained about having a too short vagina with less elasticity. They also reported feeling pain during intercourse besides finding fecal contaminations. In the other hand there was no difference in sexual desire and libido between the two groups studied.

VIII-Quality of life

The bowel dysfunction has a direct impact in the both the social and professional activities in 20 to 50% (101). A recent revue of the Cochrane database concluded the absence of difference in quality of life between APR and sphincter preserving surgeries (106). The APR had advantages in term of bowel function such as diarrhea or constipation, while conservative surgery preservers sexual function and body image (107). In fact the acceptance of postoperative disabilities depends on socio-demographic and cultural characteristics. Having an abdominal stoma as a negative impact on South European countries and Muslim countries, while it was more tolerated in north European countries (108-109).

The surgical and urinary problems after low rectal cancer surgery are, as shown earlier, very frequent. Age, preoperative radiotherapy and APR procedure are predictive factors of urinary and sexual complications (110).

Digennaro et al (111), the quality of life in 60 patients operated for a low rectal cancer, 26 patients had an APR 36 patients had a LAR. The sexual function was more maintained in the LAR group, they also concluded that the fecal and urinary incontinence both have a strong impact on the quality of life.

In a prospective study published in 2013 (13) that included 131 patients, after a median survival of 59 month, the authors concluded that the overall quality of life was comparable in between the APR, CAA and ISR after LAR groups, the physical activity was better in the sphincter saving surgery group ($p<0,05$).

In a study conducted by Dumont et al (14) aimed to assess whether the additional oncologic risk run with ISR offers a better Qol and continence compared with an APR plus PCC. No difference was found between ISR and PCC in terms of continence. They conclude that the pseudocontinence of PCC by colonic irrigation and a muscular graft has the same impact on continence as the voluntary continence of ISR and that continence function should not be a determinant for preferring ISR over the PCC procedure. There were no significant differences in any of the measured Qol outcomes in the patients who had undergone ISR and PCC confirming that the perineal stoma provides the same Qol as sphincter sparing. In PCC, clustering is avoided by the colonic irrigation, which facilitates bowel emptying. However, these irrigations constitute another drawback, namely prolonged irrigation lasting 30–45min and the constant availability of colonic irrigation devices. The colonic irrigations could become difficult for older patients although no patients required a permanent iliac stoma for difficulties of irrigations. Finally, the difficulties of each procedure do not lead to a difference in Qol.

Recent studies indicated that the potential benefits of avoidance of colostomy were equalized by a worse functional outcome (112). Jan Scheele et al (113) conducted a study published in 2015 evaluating quality of life (QoL) of cancer patients after sphincter-preserving anterior resection (LAR) Diarrhea and defecation problems considerably affect long-term functional outcome and QoL after LAR for rectal cancer. Because physical function improves after survival of cancer surgery the overall global health status was not affected. Neoadjuvant RT can impair subscales of QoL like defecation problems.

CONCLUSION

Colorectal cancer is the fifth most frequently diagnosed cancer and the leading cause of cancer death in developing countries. In the west, approximately one-third of cases occur in the rectum. Rectal cancer management has evolved into a complex multimodality approach with survival, local recurrence, and quality of life parameters being the relevant endpoints.

The emphasis of surgery for low rectal cancers has undergone a distinct change from the oncologic importance of complete excision, adding a focus on a good functional result and the importance of maintaining quality of life (QOL). The “5-cm rule” of the distal margin of resection has been generally abandoned and many now accept any distal margin as long as the margin is tumor-free. Thus, the specific indications for low rectal cancer resections have changed, and there has been a focus on sphincter-saving surgeries and reconstructive modalities that may improve functional outcome after these procedures.

Currently, neoadjuvant chemoradiation followed by total mesorectal excision is considered as standard of care for low rectal cancer. In addition, the use of neoadjuvant chemoradiation and adjuvant chemotherapy increase overall survival rate.

Surgical treatment for low rectal cancer has changed dramatically over the past 100 years. Since surgery is the standard approach of curative treatment in rectal cancer. Low rectal cancer is traditionally treated by abdominoperineal resection. In recent years, several new techniques for the treatment of very low rectal cancer patients aiming to preserve the gastrointestinal continuity and to improve both the oncological as well as the functional outcomes have been emerged. Small cancers with superficial invasiveness may be successfully treated with limited surgery, such as local excision. However, the majority of rectal cancers present at more advanced stages that need more extensive surgery, such as low

anterior resection (LAR), abdominoperineal resection (APR) or Intersphincteric resection (ISR).

Although in our study, an abdominoperineal resection with permanent colostomy was associated with a good local control, the functional results are still very disabling and alter the quality of life. The conservative technique with the pseudo continent colostomy has the advantage of the oncological outcome of the APR with promising functional outcomes.

Though the treatment of tumors of the distal rectum continues to be a matter of great controversy among oncologic surgeons. There are increasingly promising indications that functionally conservative surgery may be a valid therapeutic alternative to conventional therapy in patients with tumors of the lower rectum. Patients with the tumor localized at the lower rectum still confront the possibility of requiring permanent stoma, causing drastic changes in life-style and physical perceptions.

In our study, conservative techniques such as LAR and ISR showed promising local control and survival rates, overall the oncological outcomes of our study was comparable to other studies. The functional results were also promising but need further studies with a wilder sample to determine whether it is worth to run the oncological risk.

Thesis summary

Rectal cancer management has evolved into a complex multimodality approach with survival, local recurrence, and quality of life parameters being the relevant endpoints. Surgical treatment for low rectal cancer has changed dramatically over the past 20 years.

Abdominoperineal resection, once the standard of care for all rectal cancers, has become much less frequently utilized as surgeons devise and test new techniques for preserving the sphincters, maintaining continuity, and performing oncologically sound ultra-low anterior or local resections. Improved understanding of the anatomy and pathophysiology of the disease, innovative surgical technique, improved technology, multimodality approaches, and increased appreciation of the patient's quality of life have driven progress in rectal cancer surgery.

With improving survival of rectal cancer, functional outcome has become increasingly important. Following sphincter-preserving resection many patients suffer from severe bowel dysfunction with an impact on quality of life (QoL) - referred to as low anterior resection syndrome (LARS).

Since 2009 in University Hospital Hassan II of Fes has been provided a prospective study about colorectal cancer (COLOREC).

Aim: The aim of our thesis work is to focus on oncological and functional results after surgery of low rectal cancer from January 2009 to December 2015.

Material and methods: This is a retrospective, descriptive and comparative study concerning patients that underwent low rectal cancer surgery in both surgical services "A" and "B" during a period between January 2009 and December 2015, in University Hospital Hassan II of Fes.

Results: 134 patients were included in this study. The average age was 56 years with a sex ratio F/H=1. 10% of the patients had a known field of comorbidity. Management entails tumoral resection associated in most cases with preoperative chemoradiotherapy. 119 patients in our study underwent surgery, 11 of them had non-resectable tumors. 46% of the patients operated underwent an abdominoperineal resection, 34% a low anterior resection and 20% an intersphincteric resection. 15 patients received a pseudocontinent colostomy. The short-term mortality rate was 3,7% and the morbidity rate is 37%. The percentage of local recurrence was 4,6%. The overall 5 years survival was estimated at 75%.

We followed 42 patients in our study, 60% of them developed bowel incontinence, 62% flatus incontinence, bowel urgency and difficult evacuation were both found in 47% of our patients. Urinary incontinence was shown in 3 patients, 2 patients developed a bladder emptying difficulties. 14 patients didn't have a sexual activity, 10 patients developed retrograde ejaculation and 12 patients developed impotence. 7 patients had a poor quality of life, 5 patients were unsatisfied with their health, 4 patients weren't enjoying life and 5 patients had constant negative feelings such as anxiety or depression.

Conclusion:

ISR is an oncologically safe procedure that can be proposed as an alternative to the classical abdominoperineal resection (APR) for low rectal cancer. The APR stays the most used technique in low rectal cancer treatment, with good oncological results local control, but the permanent stoma is a major after-effect that can disable patients. The pseudocontinent colostomy is a rectum reconstruction and a good alternative with acceptable oncological and functional results.

RÉSUMÉ

La prise en charge du cancer colorectal s'est muée en une approche multidisciplinaire complexe reposant sur des paramètres déterminants tels que la survie, la récurrence locale et la qualité de vie post chirurgicales. La chirurgie du cancer du bas rectum aura changé radicalement durant les 20 dernières années.

La résection abdomino-périnéale, considérée autrefois comme la chirurgie princeps de tous les cancers rectaux, est de moins en moins utilisée devant l'essor de nouvelles techniques chirurgicales visant à préserver l'intégrité des sphincters, maintenir la continuité, et réussir des résections antérieures ou locales oncologiquement performantes.

Une connaissance approfondie de l'anatomie et de la physiopathologie du cancer colorectal, l'innovation en matière de techniques chirurgicales, l'avancement de nouvelles technologies, les réunions pluridisciplinaires, et le souci accru de la qualité de vie du patient font de la prise en charge du cancer du bas rectum un continuel progrès.

Avec l'amélioration de la survie du cancer du rectum, les résultats fonctionnels des chirurgies ont désormais leur importance. En suivant l'exemple des résections inter-sphinctériennes dites conservatrices, de nombreux patients présentent des troubles intestinaux sévères, avec un impact sur leur qualité de vie (QoL) , notamment avec l'apparition d'un syndrome de résection antérieure .

Depuis 2009, le CHU Hassan II de Fès mène une étude prospective a propos des cas de cancers colorectaux (COLOREC) observés.

But de l'étude : Notre travail a pour but de mettre en évidence les résultats oncologiques et fonctionnels post-chirurgicaux du cancer du bas rectum.

Matériel et méthodes : Il s'agit d'une étude rétrospective, descriptive et comparative concernant des patients ayant bénéficié d'une cure chirurgicale pour un cancer du bas rectum, au niveau des deux services de chirurgie viscérale A et B, sur une durée allant de Janvier de 2009 à Décembre 2015, au sein du CHU Hassan II de Fès.

Résultats: 134 patients sont inclus pour cette étude. La moyenne d'âge est de 56 ans avec un sexe ratio de 1. 10% des patients présentent des tares associées. La prise en charge comprend une résection tumorale associée dans la plupart des cas une chimio radiothérapie préopératoire. 119 patients ont bénéficié d'une chirurgie mais la résécabilité tumorale était possible pour 108 d'entre eux seulement. 46% des patients opérés ont subi une résection abdominopérinéale (RAP), 34% une résection antérieure et 20% une résection intersphinctérienne (RIS). 15 patients ont bénéficié d'une colostomie pseudo continente (CPC). Le taux de mortalité à court terme est de 3,7% et le taux de morbidité est de 37%. Le pourcentage de récurrence locale est de 4,6%. La survie à 5 ans est estimée à 75%.

On a pu faire le suivi de 42 patients dont 60% ont développés une incontinence anale aux selles, 62% ont développés une incontinence aux gaz, une urgence d'aller a la selle et un fractionnement des selles ont été notés chez 47% de nos patients. Une incontinence urinaire a été perçue chez 3 patients, 2 patients ont développés des problèmes de vidange de vessie. 14 patients n'ont pas d'activité sexuelle, 10 patients on développés une éjaculation rétrograde et 12 patients on développés une impotence en postopératoire. 7 patients ont une mauvaise qualifié leurs vie, 5 patients étaient insatisfaits de leurs état de santé, 4 patients ont perdu le gout de la vie, 5 patients ont développés des sentiments négatifs comme l'anxiété et la dépression.

Conclusion:

La technique de résection inter sphinctérienne est une procédure fiable de point de vue autant chirurgical qu'oncologique, qui peut être proposée comme alternative sure à la résection abdominopérinéale pour la cure du cancer bas rectum. La résection abdominopérinéale est la technique la plus utilisée dans le traitement du cancer du bas rectum mais la colostomie permanente reste un handicap qui inquiète les patients. La colostomie périnéale pseudocontinente a donc été crée pour palier a ce problème en évitant au patients le stigmate d'une colostomie.

ملخص

أصبح حاليا علاج سرطان المستقيم يعتمد على منهج تعدد الاختصاصات, وأهدافه الرئيسية هي البقاء, التحكم المحلي و

جودة الحياة. وبذلك تكون جراحة سرطان المستقيم المنخفض قد تغيرت تماما خلال العشرين سنة المنصرمة.

يعتبر Øyxl ý البطني العجاني لسرطان المستقيم المنخفض تقنية جراحية فريدة من نوعها, لتتبعها بعد تطور تقنيات جراحية

جديدة, تدعو للحفاظ على العضلة العاصرة للحفاظ على الاستمرارية, أو للتأثر تماما ولو لم يلاءم.

وبذلك تكون معرفة كيفية تنظيم و لوجيا الموضعية للمستقيم, إدراك التقنيات الجراحية, وكذلك لوجيا الممنهجة, تعدد

المناهج والتقنيات الجديدة في التحديات الحالية في الاتجاه أجزاء الاتجاه الحرج في علاج سرطان المستقيم المنخفض.

مع تحسين البقاء على قيد الحياة من سرطان المستقيم, أصبحت النتائج الوظيفية ذات أهمية متزايدة. وبعد Øyxl ý

بالمحافظة على المعصرة الشرجية، تبين أن العديد من المرضى يعانون من ضعف الأمعاء, مما يؤثر على جودة حياتهم, و

يؤدي لظهور متلازمة LARS .

منذ سنة 2009, يعمل المركز الاستشفائي الجامعي الحسن الثاني بفاس على القيام بدور استشرافي تقبلية بشأن

جراحة سرطان المستقيم .

الغاية من الأطروحة :

هو تقييم النتائج الوظيفية والأورام لجراحة سرطان المستقيم.

الأدوات والطرق :

إنها دراسة استعادية وصفية, تقارن بين مرضى خضعوا لجراحة سرطان المستقيم المنخفض في قسم الجراحة

العامة –أ- و –ب- خلال الفترة بين يناير

2009 ويونيو 2015 بالمركز الاستشفائي الجامعي الحسن الثاني بفاس.

النتائج :

أدرجت 134 حالة في هذه الدراسة. متوسط العمر كان 57 سنة مع نسبة جنس

تناهز 1,3. 14 ٪ من المرضى لديهم سوابق صحية. يستلزم العلاج تضاؤل الورم في معظم الحالات مع

chemoradiotherapy قبل الجراحة. وخضع 125 مريضا في المستشفى لعملية جراحية, إلا أنه تم تضاؤل الورم ل

119 حالة منهم فقط. وخضع 42 ٪ من المرضى لاستئصال بطني عجاني, 32% استئصال أمامي منخفض و 25% عملية

جراحية ترميم (ISR) تلقى 11 مريضا فغرة لون .

وكان معدل الوفيات على المدى القصير 2،5 ٪ ومعدل الإصابة هو 33،6 ٪. كانت نسبة التكرار المحلية 4، 2 ٪ .

و يقدر البقاء ب 95%

وازداد هذا الخلل بالنسبة للمرضى الذين خضعوا لـ ISR, لم يحدث أي خلل بعد الاستئصال البطني العجاني مع PCC، و 6 مرضى بعد استئصال الأمامي المنخفض وقد لوحظ غياب النشاط الجنسي في 4 حالات الذين خضعوا لـ ISR و في حالة واحدة خضعت لـ LAR وحالة واحدة التي حصلت على PCC

وأفاد 10 مريضا في دراستنا وجود نوعية جيدة للحياة بعد جراحة سرطان المستقيم المنخفض, و 13 مريضا بأنهم راضين عن صحتهم. أفاد 10 مريضا أن اختلال الأمعاء أثر على حياتهم بشكل كبير.

خاتمة

في دراستنا أثبتنا أن ISR هو إجراء آمن لاستئصال الأورام التي يمكن توقع حدوثها بدلا من الجراحة الكلاسيكية بطني عجاني أو استئصال الأمامي لسرطان المستقيم المنخفض. (ISR) يسمح بالمحافظة على العضلة العاصرة. إلا أنه يرتبط باضطرابات بولية وجنسية مقارنة مع الجراحات الأخرى.

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