

Clinical applications of radiofrequency in proctology: a review

V. FILINGERI, G. GRAVANTE, D. CASSISA

Department of Surgery, University of Rome Tor Vergata – Rome (Italy)

Abstract. – The radiofrequency scalpel is an innovative instrument which allows to cut and coagulate tissues in an atraumatic manner, conversely to the electric scalpel. The authors describe the use of radiofrequencies in proctology by making a literature review for every major proctologic disease (hemorrhoids, anal fistulas, anal fissure, sinus pilonidalis, hypertrophied anal papillae). Many techniques have been developed with radiofrequencies in hemorrhoids treatment: coagulation, ablation with plication, Milligan Morgan and Parks hemorrhoidectomy. In the treatment of anal fissures, radiofrequency subcutaneous lateral internal sphincterotomy has been described. For anal fistulas, both radiofrequency fistulotomy and fistulectomy. Finally, radiofrequency sinotomy for sinus pilonidalis and coagulation for hypertrophied anal papillae are present in literature.

The analysis of the results obtained with radiofrequency surgery compared with those of the “classic” surgery for proctologic disease shows that in most of them radiosurgery facilitates, accelerates and improves the surgical procedure.

Key Words:

Radiofrequencies, Radiosurgery, Radiofrequency bistoury, Proctology.

Introduction

After the initial clinical applications in anticancer treatment (hyperthermia) and in invasive cardiology (catheter ablation of the arrhythmogenic myocardium), radiofrequencies have recently been introduced into surgery. Actually ear, nose, and throat surgery, dermatology, plastic surgery, vascular surgery, orthopaedics, neurosurgery and minimally invasive surgery use this new tool in their practice. Among them, proctology ar-

rived last to discover the potential benefits of this technique because proctologist surgeons were satisfied, and sometimes still are, with the current techniques.

The radiofrequency scalpel is an innovative instrument which allows to cut and coagulate tissues in an atraumatic manner, contrarily to the electric scalpel. The temperatures generated by the radiofrequency passage disintegrate and fuse cells located on their trajectory. They are lower than the ones used with diathermy, giving the possibility to cut the tissues with virtually no burns. Furthermore, the small spreading of the heating to the surrounding tissues limit the damage virtually to the section line. An histological analysis of hemorrhoidal specimens removed with radiofrequency found that heat damage spawned for 0.75 mm while that with diathermy was 1.78 mm (Figures 1, 2). For this reasons, healing times are shorter compared to traditional techniques and the risk of cheloid formation or scars is virtually zero with evident functional advantages¹.

The radiofrequency scalpel allows to stop the diffuse bleeding during the cut that is often present in proctologic surgery because all vessels up to 2 mm on the section line are automatically coagulated. In this way, the highly vascularised nature of the tissues is changed into a dense connective and allows the surgeon to incise as if he were cutting with a sharp blade with scarce bleeding and few coagulations. Furthermore, the atraumatic nature of radiofrequency and contemporarily cutting-coagulating ability help to eliminate unfavourable postoperative sequelae mainly represented by pain, excessive blood loss and oedema because coagulation, when required, is shorter. For all this reasons, radiosurgery facilitates, accelerates and improves surgical procedure¹.

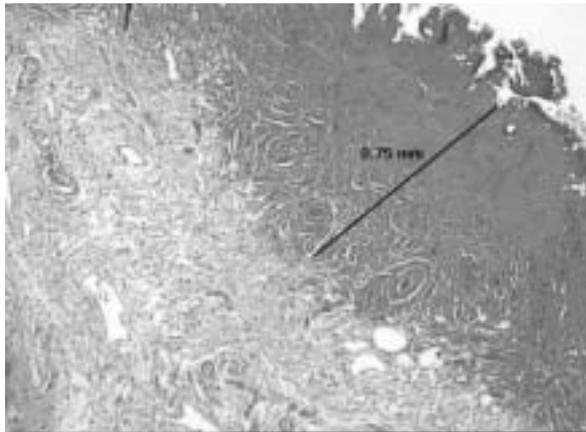


Figure 1. Heat effect caused by radiofrequency in an hemorrhoidal specimen: the damage spans for less than 0.75 mm

Specific Treatments

Hemorrhoids

Hemorrhoids are the proctologic disease that most frequently require surgery for cure. The surgical techniques used are many and have been developed to eliminate the most troublesome adverse effect of surgery, postoperative pain. New techniques have recently been introduced as modifications of the standard open and closed hemorrhoidectomy.

The use of radiofrequency in hemorrhoids treatment has been very useful and many techniques have been developed with. These are the radiofrequency coagulation²⁻⁶, radiofrequency ablation with plication⁷⁻⁹, radiofrequency Milligan Morgan hemorrhoidectomy¹⁰ and radiofrequency Parks hemorrhoidectomy^{1,11-14}.

The radiofrequency ablation and coagulation use a small ball electrode to coagulate the whole pile mass by gently rotating the electrode of the radiofrequency probe over the hemorrhoid. The power of the radiosurgical unit is adjusted so as to produce shrinkage and a gradual change of hemorrhoids to a dusky white colour (blanching) indicating a satisfactory coagulation necrosis²⁻⁹. Milligan Morgan or Parks radiofrequency hemorrhoidectomy are performed using the radiofrequency scalpel in front of classic diathermic scalpel with few modifications to the original techniques (Figures 3, 4)¹⁰⁻¹⁶.

Radiofrequencies in hemorrhoids surgery ease the procedure for both ablation-coagulation, Milligan Morgan and Parks hemorrhoidectomy. They use lower temperatures than classic diathermy with less burns and postoperative pain. They give an almost bloodless operating field and shorten the coagulating time. Surgery becomes shorter and easier and postoperative stay is limited to day surgery or the first postoperative day. For all these reasons radiofrequencies have become a revolutionary method in the treatment of hemorrhoids.

There are no literature data that compare the radiofrequencies with other techniques for hemorrhoids surgery as Stapler hemorrhoidopexy, cryotherapy or laser therapy.

Stapler hemorrhoidopexy, since its introduction in 1998¹⁷, received and still receives favourable attention and great emphasis. Randomized trials compare this procedure vs. open or Milligan-Morgan hemorrhoidectomy¹⁸⁻²⁰, closed hemorrhoidectomy²¹, sealing vessel generator hemorrhoidectomy²² and every study reports less postoperative pain,

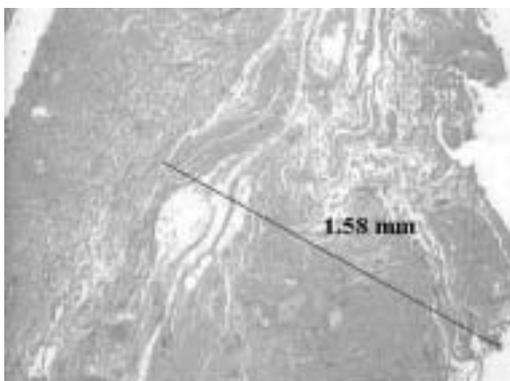


Figure 2. Heat effect caused by classic diathermy in an hemorrhoidal specimen: the damage spans for 1.58 mm.

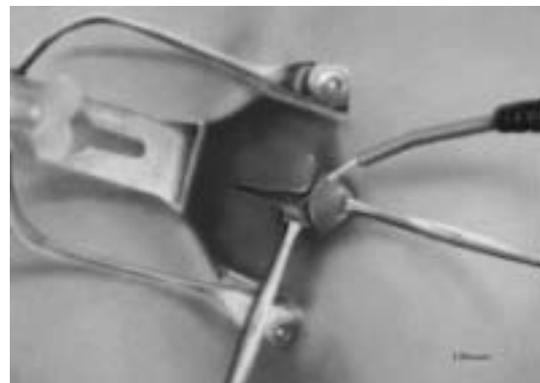


Figure 3. Submucosal hemorrhoidectomy: lifting the mucosa from the hemorrhoidal vessels.

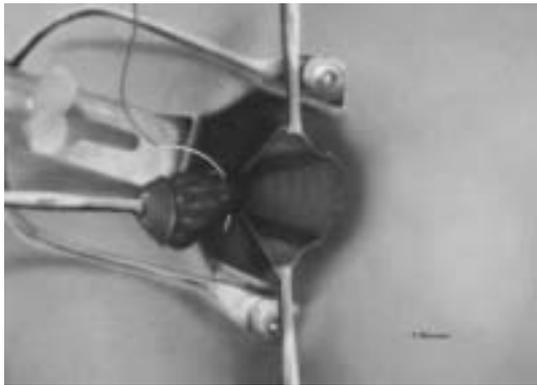


Figure 4. Submucosal hemorrhoidectomy: transfixion of the pedicle.

shorter recoveries, faster return to normal activities and more satisfaction rates for the stapler hemorrhoidopexy. In the long term, this technique seems to give no stenosis or incontinence. Nonetheless, rare but potentially fatal complications have been described such as retroperitoneal hematomas, Fournier gangrene, retroperitoneal perforations up to the subcutaneous emphysema and sepsis, rectovaginal fistulas²³⁻³³. These complications derive from the depth of the stitches of the purse-string before firing; the more the depth, the more tissue is excised during the firing with weaker resistance of the rectal wall to the fecal pressure. Furthermore, stapler hemorrhoidopexy induces the appearance of tenesmus in 40% of treated patients³⁴⁻³⁶ and needs a reintervention in 11% of cases due to the persistency of severe anal pain or severe postoperative bleeding, the formation of anal fissure the persistency of the prolapsing piles^{37,38}. For all these reasons, we think that stapler hemorrhoidopexy is not as simple and safe as certain surgeons describe. Other authors believe that can be a dangerous procedure in the hands of the uninitiated surgeons³⁹. Anyway, no randomized trial compared stapler hemorrhoidopexy with radiofrequencies.

Cryotherapy has been forbidden for the treatment of external hemorrhoids by the American Colon Rectal Surgeons Society for the associated high risk of anal stenosis (it's still recommended for the treatment of first and second degree hemorrhoids)⁴⁰. Few controlled studies have compared laser with conventional hemorrhoidectomy. In some studies there was no difference between laser and conventional hemorrhoidectomy with regard

to the quality and timing of wound healing^{41,42}. Another study, which was prospective and randomized, comparing laser vs. cold scalpel conventional hemorrhoidectomy stated that the only significant difference between the two groups was a greater degree of wound inflammation in the laser group in the early postoperative period and the average cost per case in the laser group was substantially higher⁴³.

Anal Fissure

Idiopathic anal fissure is a frequent proctologic disease that is sometimes associated with other proctologic diseases. Its pathogenesis and location derive from the inner anal canal anatomy and from the elevated tone of the internal sphincter muscle. Symptoms are varied but pain is the most frequent followed by the rectal bleeding, tenesmus, constipation and pruritus⁴⁴.

The treatments are varied. They can be classified as conservative treatments, as high fiber diet to avoid constipation combined with emollients and laxatives, the application of local anesthetic oils, anal dilation, and non conservative treatments mostly surgical to lower the internal sphincter tone (medial posterior sphincterotomy, lateral internal sphincterotomy, subcutaneous lateral internal sphincterotomy)⁴⁴.

Radiofrequencies have been rarely used in the treatment of anal fissures. Radiofrequency subcutaneous lateral internal sphincterotomy has been described⁴⁴. Associated pathologies (sentinel piles and tags) have been treated with simple coagulation or excised if greater⁴⁵⁻⁵⁰.

The use of radiofrequencies in the surgery of anal fissures has few advantages if compared with classic diathermy. Postoperative pain and fissure healing time are the same for both traditional and radiosurgery. Operative times and surgical wound healing times appear to be shorter but the data don't reach statistical significance⁴⁴.

Anal Fistulas

Anal fistula represents one of the most frequent anorectal disease combined with hemorrhoids and anal fissure. A correct diagnosis and treatment influence positively and reduce the risk of recurrences as well as complications⁵¹.

The classic technique of fistulotomy is believed to be a correct therapy from most of the surgeons and, actually, the gold standard of treatment. Problems related to fistulotomy are numerous and, among them, we recall postoperative pain, bleeding, delayed or impaired wound healing⁵². Fistulectomy lowers the incidence of recurrences⁵³ but it's less feasible than fistulotomy, requires a longer operating time and a longer healing process because the residual wound is wider than with fistulotomy⁵¹. For this reason this technique is less used. Other techniques are fistulotomy with marsupialization, curettage of fistula and placement of mucosal or skin flaps, placement of medicated setons, insertion of antibiotic beads and injection of fibrin glu⁵⁴⁻⁵⁵.

In literature both radiofrequency fistulotomy and fistulectomy are described. Radiofrequency fistulotomy is performed according to the lay open technique⁵⁶ slitting the complete tract from the internal to the external opening and excising a small tract of tissues around the external and internal openings along with a small margin of tissue lining the tract⁵⁷⁻⁶⁵. Radiofrequency fistulotomy reduces to half the time for the procedure, reduces the bleeding and the need for sutures. The recurrence rate was of 1.5%.

The application of radiofrequencies to fistulectomy has many advantages. Technically, it renders more feasible and eases the operation for the ability of cutting-coagulating at the same time. The electrode is small and fine in shape and allows a more precise dissection of the granulation tissue from the healthy one. The data show that radiofrequency fistulectomy is a bit longer than traditional fistulotomy the difference relates with the time spent in the more precise dissection; on the contrary, it's faster than traditional fistulectomy for the ability of cutting-coagulating at the same time that the traditional operation has not. Postoperative pain is smaller than traditional fistulotomy because of the lower temperatures used, that do not burn tissues, and for the shorter time spent in coagulating. The surgical wound bed is smaller than traditional fistulectomy and, for this reason, there is a faster wound healing shorter even when compared to that of the traditional fistulotomy⁶⁶.

Sinus Pilonidalis

The sinus pilonidalis is a benign disease that affects the sacrococcygeal region of

young adults. His etiology is still unknown. His treatment are various and without clear different indications: wide excision with closure of the defect by Z-plasty, rhomboid or myocutaneous advancement flap, wide excision with healing by granulation, incision and laying open (sinotomy), marsupialization of the skin edges after excision, injection of phenol (phenolization), cryosurgery, electrocauterization, ND-YAG or Ruby laser, minimal excision, conservative treatments (cleaning of the intergluteal sulcus and brushing of the openings). Most of the sinuses are treated by incision and laying open (sinotomy) for the simplicity of the procedure and the quick return to normal activity⁶⁷⁻⁶⁹.

Radiofrequency sinotomy has been described in literature. All the tracts of the fistulas are open on the guide of the sinus probe and the infected and indurated tissues are removed leaving a raw area. Any hairs or foreign material, if found, are removed. The wound doesn't reach the sacrococcygeal fascia and is left open for subsequent medications⁶⁷⁻⁶⁹.

The results obtained with radiofrequency sinotomy are not enough to reach definite conclusions over current technique and further studies are ongoing to validate the author hypothesis.

Hypertrophied anal Papillae and Fibrous anal Polyps

Radiofrequency has been described even in the treatment of the hypertrophied anal papillae and the fibrous anal polyps. The papillae are directly coagulated with the radiofrequency unit set on coagulation mode. In the fibrous anal polyps, their base was coagulated circumferentially with the ball electrode and then shaved off using the loop electrode⁷⁰⁻⁷². Even in this case, radiofrequency has to prove its utility and long term efficacy.

In conclusion, radiofrequency bistoury is a valuable new surgical tool that recently has been introduced even in proctology. The most important characteristic that makes it different from other devices is its cutting-coagulating ability developed through the use of radiowaves. These waves generate a tissue temperature that doesn't exceed 65°C and for this reason it's considered a "cold" bistoury. This advantage is important when operating on a delicate tissue such as the anal canal mu-

cosa because the atraumatic nature of the cut allows a dramatic reduction of tissue oedema with subsequent improvement of the postoperative pain (the chief complaint of every proctologic operation). Moreover, healing processes are optimal and faster than normal with fewer long term complications (anal stenosis). Last but not least, radiobistoury eases and fastens the execution of every proctologic techniques. For these reasons radiofrequency bistoury has found a wide application in every proctologic operation during the last years and we believe that in the future will have a greater diffusion.

References

- 1) FILINGERI V, GRAVANTE G, BALDESSARI E, et al. A randomised trial comparing submucosal haemorrhoidectomy with radiofrequency bistoury vs. diathermic haemorrhoidectomy. *Eur Rev Med Pharmacol Sci* 2004; 8: 79-85.
- 2) GUPTA PJ. Radiofrequency coagulation: a treatment alternative in early hemorrhoids. *Indian J Gastroenterol* 2002; 21: 167.
- 3) GUPTA PJ. Novel technique: radiofrequency coagulation—a treatment alternative for early-stage hemorrhoids. *Med Gen Med* 2002; 4: 1.
- 4) GUPTA PJ. Radiofrequency coagulation: an alternative treatment in early grade bleeding hemorrhoids. *Tech Coloproctol* 2002; 6: 203-204.
- 5) GUPTA PJ. Radiofrequency coagulation versus rubber band ligation in early hemorrhoids: pain versus gain. *Medicina (Kaunas)* 2004; 40: 232-237.
- 6) GUPTA PJ. Ambulatory hemorrhoid therapy with radiofrequency coagulation. *Clinical practice paper. Rom J Gastroenterol* 2005; 14: 37-41.
- 7) GUPTA PJ. Radiofrequency ablation and plication of hemorrhoids. *Tech Coloproctol* 2003; 7: 45-50.
- 8) GUPTA PJ. Radio-ablation of advanced grades of hemorrhoids with radiofrequency. *Curr Surg* 2003; 60: 452-458.
- 9) GUPTA PJ. Randomized trial comparing in-situ radiofrequency ablation and Milligan-Morgan hemorrhoidectomy in prolapsing hemorrhoids. *J Nippon Med Sch* 2003; 70: 393-400.
- 10) FILINGERI V, ROSATI R, GRAVANTE G, et al. Milligan-Morgan hemorrhoidectomy with a radiofrequency scalpel. *Minerva Chir* 2003; 58: 355-359.
- 11) FILINGERI V, ROSATI R, CORTESE F, BELARDI A, CASCIANI CU. Submucosal modified hemorrhoidectomy by the Parks' technique. *Minerva Chir* 1993; 48: 1407-1410.
- 12) FILINGERI V, CASCIANI CU. Submucosal hemorrhoidectomy with a radiofrequency scalpel. *Minerva Chir* 1997; 52: 1255-1259.
- 13) FILINGERI V, GIUDICEANDREA F, ROSATI R, FIORITO R, CASCIANI CU. Surgical treatment of hemorrhoid disease. A comparison between techniques. *Minerva Chir* 2001; 56: 41-46.
- 14) FILINGERI V, GRAVANTE G, BALDESSARI E, GRIMALDI M, CASCIANI CU. Prospective randomized trial of submucosal hemorrhoidectomy with radiofrequency scalpel vs. conventional Parks' operation. *Tech Coloproctol* 2004; 8: 31-36.
- 15) MILLIGAN ETC, MORGAN C, NAUGHTON-JONES LF, OFFICE RR. Surgical anatomy of the anal canal and the operative treatment of haemorrhoids. *Lancet* 1937; ii: 1119-1124.
- 16) PARKS AG. The surgical treatment of haemorrhoids. In: C Rob, R Smith (eds.): *Operative Surgery-Chap. 5: Abdomen and Rectum and Anus. Ed. 2, Philadelphia, J.B. Lippincott, 1969, pp 706-717.*
- 17) LONGO A. Treatment of haemorrhoidal disease by reduction of mucosal and hemorrhoidal prolapse with a circular stapling device: a new procedure. In: *Proceedings of the 6th World Congress of Endoscopic Surgery. Monduzzi, Rome, 1998, pp 777-784.*
- 18) BIKHCHANDANI J, AGARWAL PN, KANT R, MALIK VK. Randomized controlled trial to compare the early and mid-term results of stapled versus open hemorrhoidectomy. *Am J Surg* 2005; 189: 56-60.
- 19) RACALBUTO A, ALIOTTA I, CORSARO G et al. Hemorrhoidal stapler prolapsectomy vs. Milligan-Morgan hemorrhoidectomy: a long-term randomized trial. *Int J Colorectal Dis* 2004; 19: 239-244.
- 20) SHALABY R, DESOKY A. Randomized clinical trial of stapled versus Milligan-Morgan haemorrhoidectomy. *Br J Surg* 2001; 88: 1049-1053.
- 21) KHALIL KH, O'BICHERE A, SELLU D. Randomized clinical trial of sutured versus stapled closed haemorrhoidectomy. *Br J Surg* 2000; 87: 1352-1355.
- 22) BASDANIS G, PAPADOPOULOS VN, MICHALOPOULOS A, APOSTOLIDIS S, HARLAFTIS N. Randomized clinical trial of stapled hemorrhoidectomy vs open with Ligasure for prolapsed piles. *Surg Endosc* 2005; 19: 235-239.
- 23) MEYER P, STIEGER R. Retroperitoneal hematoma due to seam insufficiency after stapled hemorrhoidectomy. *Chirurg* 2004; 75: 1125-1127.
- 24) BONNER C, PROHM P, STORKEL S. Fournier gangrene as a rare complication after stapler hemorrhoidectomy. *Case report and review of the literature. Chirurg* 2001; 72: 1464-1466.
- 25) PESSAUX P, TUECH JJ, LAURENT B, et al. Morbidity after stapled haemorrhoidectomy: long-term results about 140 patients and review of the literature. *Ann Chir* 2004; 129: 571-577.
- 26) RIPETTI V, CARICATO M, ARULLANI A. Rectal perforation, retroperitoneum, and pneumomedi-

- astinum after stapling procedure for prolapsed hemorrhoids: report of a case and subsequent considerations. *Dis Colon Rectum* 2002; 45: 268-270.
- 27) PESCATORI M, QUONDAMCARLO C. Prevention of intra-operative complications during stapled excision of rectal mucosal prolapse. *Tech Coloproctol* 1999; 3: 103-104.
 - 28) MOLLOY RG, KINGSMORE D. Life threatening pelvic sepsis after stapled haemorrhoidectomy. *Lancet* 2000; 355(9206): 810.
 - 29) FILINGERI V, GRAVANTE G. Pneumoretroperitoneum, pneumomediastinum and subcutaneous emphysema of the neck after stapled hemorrhoidopexy. *Tech Coloproctol* 2005; 9: 86.
 - 30) KANELLOS I, BLOUHOS K, DEMETRIADES H, PRAMATEFTAKIS MG, BETSIS D. Pneumomediastinum after dilatation of anal stricture following stapled hemorrhoidopexy. *Tech Coloproctol* 2004; 8: 185-187.
 - 31) NISAR PJ, ACHESON AG, NEAL KR, SCHOLEFIELD JH. Stapled hemorrhoidopexy compared with conventional hemorrhoidectomy: systematic review of randomized, controlled trials. *Dis Colon Rectum* 2004; 47: 1837-1845.
 - 32) McDONALD PJ, BONA R, COHEN CR. Rectovaginal fistula after stapled haemorrhoidopexy. *Colorectal Dis* 2004; 6: 64-65.
 - 33) OUGHRIS M, YVER R, FAUCHERON JL. Complications of stapled hemorrhoidectomy: a French multicentric study. *Gastroenterol Clin Biol* 2005; 29: 429-433.
 - 34) ORTIZ H, MARZO J, ARMENDARIZ P, DE MIGUEL M. Stapled hemorrhoidopexy vs. diathermy excision for fourth-degree hemorrhoids: a randomized, clinical trial and review of the literature. *Dis Colon Rectum* 2005; 48: 809-815.
 - 35) WEXNER SD. Persistent pain and faecal urgency after stapled haemorrhoidectomy. *Tech Coloproctol* 2001; 5: 56-57.
 - 36) CHEETHAM MJ, MORTENSEN NJ, NYSTROM PO, KAMM MA, PHILLIPS RK. Persistent pain and faecal urgency after stapled haemorrhoidectomy. *Lancet* 2000; 356 (9231): 730-733.
 - 37) BRUSCIANO L, AYABACA SM, PESCATORI M et al. Reinterventions after complicated or failed stapled hemorrhoidopexy. *Dis Colon Rectum* 2004; 47: 1846-1851.
 - 38) ORTIZ H, MARZO J, ARMENDARIZ P. Randomized clinical trial of stapled haemorrhoidopexy versus conventional diathermy haemorrhoidectomy. *Br J Surg* 2002; 89: 1376-1381.
 - 39) O'CONNOR JJ. Staplers and hemorrhoids. *Dis Colon Rectum* 2000; 43: 118-119.
 - 40) THE STANDARDS PRACTICE TASK FORCE, THE AMERICAN SOCIETY OF COLON AND RECTAL SURGEONS, USA. Practice parameters for the management of hemorrhoids (revised). *Dis Colon Rectum* 2005; 48: 189-194.
 - 41) ENRIQUEZ-NAVASCUES JM, DEVESA MUGICA JM, BUCHELI PROANO P. Hemorrhoidectomy: conventional or by Nd:Yag contact laser? A prospective and randomized study. *Rev Esp Enferm Dig* 1993; 84: 235-239.
 - 42) LEFF EI. Hemorrhoidectomy—laser vs. nonlaser: outpatient surgical experience. *Dis Colon Rectum* 1992; 35: 743-746.
 - 43) SENAGORE A, MAZIER WP, LUCHTEFELD MA, MACKEIGAN JM, WENGERT T. Treatment of advanced hemorrhoidal disease: a prospective, randomized comparison of cold scalpel vs. contact Nd:YAG laser. *Dis Colon Rectum* 1993; 36: 1042-1049.
 - 44) FILINGERI V, GRAVANTE G. A prospective randomized trial between subcutaneous lateral internal sphincterotomy with radiofrequency bistoury and conventional Parks' operation in the treatment of anal fissures. *Eur Rev Med Pharmacol Sci* 2005; 9: 175-178.
 - 45) GUPTA PJ. Current trends of management for fissure in ano. *Rom J Gastroenterol* 2002; 11: 25-27.
 - 46) GUPTA PJ. Sphincterotomy with radio frequency surgery: a new treatment technique of fissure in ano and associated pathologies. *Rom J Gastroenterol* 2003; 12: 37-40.
 - 47) GUPTA PJ. Treatment of fissure in ano- revisited. *Afr Health Sci* 2004; 4: 58-62.
 - 48) GUPTA PJ. Treatment trends in anal fissures. *Bratisl Lek Listy* 2004; 105: 30-34.
 - 49) GUPTA PJ. Radiosurgery in proctology practice. *Internet Journal of Gastroenterology* 2002; 1(2).
 - 50) GUPTA PJ. Radiofrequency surgery: offering a novel approach to ano-rectal diseases. *Middle East J Fam Med* 2005; 3(1).
 - 51) THE STANDARDS PRACTICE TASK FORCE. The American Society of Colon and Rectal Surgeons. Practice parameters for treatment of fistula-in-ano—supporting documentation. *Dis Colon Rectum* 1996; 39: 1361-1372.
 - 52) COX SW, SENAGORE AJ, LUCHTEFELD MA, MAZIER WP. Outcome after incision and drainage with fistulotomy for ischioanal abscess. *Am Surg* 1997; 63: 686-689.
 - 53) SCHOUTEN WR, VAN VROONHOVEN TJ. Treatment of anorectal abscess with or without primary fistulectomy. Results of a prospective randomized trial. *Dis Colon Rectum* 1991; 34: 60-63.
 - 54) EU KW. Fistulotomy and marsupialisation for simple fistula-in-ano. *Singapore Med J* 1992; 33: 532.
 - 55) ABEL ME, CHIU YS, RUSSELL TR, VOLPE PA. Autologous fibrin glue in the treatment of rectovaginal and complex fistulas. *Dis Colon Rectum* 1993; 36: 447-449.
 - 56) KRONBORG O. To lay open or excise a fistula-in-ano: a randomized trial. *Br J Surg* 1985; 72: 970.
 - 57) GUPTA PJ. Radio frequency "sutureless" fistulotomy—a new way of treating fistula in anus. *World J Gastroenterol* 2003; 9: 1082-1085.

- 58) GUPTA PJ. Radiofrequency fistulotomy in anal fistula. An alternative to conventional surgical fistulotomy. *Medicina (Kaunas)* 2003; 39: 996-998.
- 59) GUPTA PJ. Radiofrequency fistulotomy in anal fistula. An alternative to conventional surgical fistulotomy. *Bratisl Lek Listy* 2003; 104: 165-166.
- 60) GUPTA PJ. Anal fistulotomy with radiofrequency: a better option to a conventional procedure. *Rom J Gastroenterol* 2003; 12: 287-291.
- 61) GUPTA PJ. Anal fistulotomy with radiofrequency. *Dig Surg* 2004; 21: 72-73.
- 62) GUPTA PJ. Radiosurgical fistulotomy; an alternative to conventional procedure in fistula in ano. *Curr Surg* 2003; 60: 524-528.
- 63) GUPTA PJ. Radio frequency fistulotomy—novel modification of the conventional technique in low anal fistula. *J Coll Physicians Surg Pak* 2004; 14: 307-308.
- 64) GUPTA PJ. Radio frequency fistulotomy—a novel modification of the conventional technique in low anal fistula. *J Okla State Med Assoc* 2004; 97: 235-236.
- 65) GUPTA PJ. Radiofrequency fistulotomy: a better alternative for treating low anal fistula. *Sao Paulo Med J* 2004; 122: 172-174.
- 66) FILINGERI V, GRAVANTE G, BALDESSARI E, CASCIANI CU. Radiofrequency fistulectomy vs. diathermic fistulotomy for submucosal fistulas: a randomized trial. *Eur Rev Med Pharmacol Sci* 2004; 8: 111-116.
- 67) GUPTA PJ. Pilonidal sinotomy with radiofrequency. *J Coll Physicians Surg Pak* 2003; 13: 540-541.
- 68) GUPTA PJ. Radiofrequency incision and lay open technique of pilonidal sinus (clinical practice paper on modified technique). *Kobe J Med Sci* 2003; 49: 75-82.
- 69) GUPTA PJ. A randomized study between excision and marsupialization and radiofrequency sinus excision in sacro-coccygeal pilonidal disease. *Curr Surg* 2004; 61: 307-312.
- 70) GUPTA PJ, KALASKAR S. Removal of hypertrophied anal papillae and fibrous anal polyps increases patient satisfaction after anal fissure surgery. *Tech Coloproctol* 2003; 7: 155-158.
- 71) GUPTA PJ. A study of hypertrophied anal papillae and fibrous polyps associated with chronic anal fissures. *Rom J Gastroenterol* 2004; 13: 103-107.
- 72) GUPTA PJ. Hypertrophied anal papillae and fibrous anal polyps, should they be removed during anal fissure surgery? *World J Gastroenterol* 2004; 10: 2412-2414.