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Surgery in Motion

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Please visit www.europeanurology.com and www.urosource.com to view the accompanying video.

Abstract

Background: Over the years, several techniques for performing robot-assisted prostatectomy have been implemented in an effort to achieve optimal oncological and functional outcomes.

Objective: To provide an evidence-based description and video-based illustration of currently available dissection techniques for robotic prostatectomy.

Design, setting, and participants: A literature search was performed to retrieve articles describing different surgical approaches and techniques for robot-assisted radical prostatectomy (RARP) and to analyze data supporting their use. Video material was provided by experts in the field to illustrate these approaches and techniques.

Surgical procedure: Multiple surgical approaches are available: extraperitoneal, transvesical, transperitoneal posterior, transperitoneal anterior, Retzius sparing, and transperineal. Surgical techniques for prostatic dissection sensu strictu are the following: omission of the endopelvic fascia dissection, bladder neck preservation, incremental nerve sparing by means of an antegrade or retrograde approach, and preservation of the puboprostatic ligaments and dorsal venous complex. Recently, techniques for partial prostatectomy, as either anterior or Menon precision prostatectomy, have been described.

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1. Introduction

Anatomical studies performed during the 1970s and early 1980s have set the foundations to the current knowledge of the periprostatic anatomy [1,2]. Since then, several major and minor modifications have been proposed in an effort to respect the periprostatic anatomy as much as possible during the dissection phase of radical prostatectomy (RP) [3–19].

Almost 3 decades after the studies that changed the RP field, the introduction of robots led us to achieve a further level of precision during surgery. In fact, thanks to the magnification and the millimetric robotic instruments, more detailed understanding of the periprostatic anatomy has been achieved [20,21]. This ultimately translated into a more anatomical approach and a higher level of tissue preservation during prostatectomy.

Although multiple techniques for robot-assisted RP (RARP) have been described over the years, the extraperitoneal and the transperitoneal approach remained the two main approaches. During the dissection phase of prostatectomy, the main implementations have been omission of the endopelvic fascia dissection, incremental nerve sparing (by means of an antegrade or a retrograde approach), and preservation of the puboprostatic ligaments [3–17]. Additionally, thanks to the implementation of multiparametric magnetic resonance imaging (mpMRI) in the diagnostic and staging prostate cancer pathways, techniques for partial prostatectomy have also been described [18–20].

Vis et al. [22] have recently summarized the available evidence and techniques on posterior, anterior, and perirethral reconstruction after prostatectomy in an effort to provide with a better understanding of the pelvic floor anatomy, also allowing for better training of future generation of urologists. The aim of the present study is to focus on the dissection phase of prostatectomy, describing the surgical techniques and summarizing the current evidence supporting their implementation.

2. Patients and methods

2.1. Selection of surgical approaches

By means of a review of the literature, relevant articles on currently used surgical techniques have been identified. Articles published in English peer-reviewed literature were selected (2000 through May 2020), based on the presence of a detailed anatomical description of the technique. Each author provided his/her opinion regarding the summary of the current evidence. Video clips included in this study were provided by experts in the field.

2.2. Surgical approaches for RARP

2.2.1. Extraperitoneal

In the extraperitoneal approach, the space between the rectus abdominis and the posterior sheet of the muscle is developed by means of a dilating balloon. The ports are placed in the extraperitoneal space, and the space of Retzius is developed further. The subsequent steps follow those of the transperitoneal anterior approach [3].

2.2.2. Transvesical

The transvesical approach can be performed in an extraperitoneal fashion if the ports are placed directly inside the urinary bladder, and the procedure is initiated under pneumovescum, or in a transperitoneal fashion, where the bladder is incised and the procedure performed transvesically [19]. After bladder neck (BN) excision (Fig. 1), the procedure is carried out similarly to the transperitoneal anterior technique [4,23].

2.2.3. Transperitoneal posterior

In the transperitoneal prostatectomy, the ports are placed in the peritoneal cavity.

The original approach for laparoscopic prostatectomy entailed a posterior retrovesical approach to the vasa...
defereenta and seminal vesicles, continuing the dissection anteriorly [5]. This approach has been the cornerstone for robotic prostatectomy and still represents a widely used technique.

After the perineotomy at the lower peritoneal fold, the vasa deferentia are identified and transected, the seminal vesicles are carefully dissected free, and the prostatic base is identified. At this point, the Denovilliers fascia is incised and the prostatic base is dissected posteriorly until the apex of the prostate is seen. After having completed these steps, the dissection moves anteriorly.

Following incision of the parietal peritoneum, the bladder is released. The space of Retzius is developed, and the fatty tissue surrounding the prostate is cleared. The BN can be either preserved or sacrificed (Fig. 2A and 2B, respectively). In the latter, the anterior wall of the bladder is incised and the BN sacrificed.

At this point, since the Denovilliers fascia has already been incised, the prostate is dissected on its posterolateral aspects and the dissection then moves to the apex and, after having controlled the prostatic pedicles and the dorsal venous complex (DVC), the urethra is transected.

2.2.4. Transperitoneal anterior

This approach begins with the incision of the parietal peritoneum lateral to the lateral umbilical ligaments. The bladder is released and the space of Retzius developed. The BN is either preserved or sacrificed, and the dissection moves posteriorly. The retrotrigonal space is developed until the seminal vesicles and the vasa deferentia are identified. The vasa deferentia are transected and their distal part used for lifting the prostate (Fig. 3). This facilitates the isolation and dissection of the seminal vesicles. The Denovilliers fascia is then incised. After this step, the procedure follows the same steps as those of the transperitoneal posterior prostatectomy [6,7].

2.2.5. Transperitoneal lateral

In the lateral approach, the peritoneum is incised solely lateral to the right umbilical ligament. The space is developed caudally until the pubic bone is reached. At this point, the right prostate vesical angle is identified. The dissection of the prostate begins at the right base, the right neurovascular bundle (NVB) is pushed laterally, and the right hemigland is disected free without resecting the DVC and the detrusor apron. The prostatic dissection continues on the base through left side after careful dissection of the seminal vesicles. The dissection of the left hemigland is performed without developing the space of Retzius on the left side, allowing for the preservation of the detrusor apron, DVC, and puboprosthetic ligaments (please see section 2.3.4).

2.2.6. Transperitoneal Retzius-sparing RARP

The preservation of the space of Retzius (or Boccardi approach) during RARP was first described in 2010. The anatomic rationale of this technique stems from the preservation of the anterior structures involved in continence and potency preservation, such as pubovesical ligaments, puboprostatic fascia, NVBs, accessory pudendal artery, and the DVC. This approach encompasses incising the parietal peritoneum at the anterior surface of the vesicorectal pouch, at the level of the seminal vesicles (Fig. 4). After having dissected the vasa deferentia and the seminal vesicles, and retracted them by means of two sutures placed transabdominally, dissection of the prostate is carried out in an antegrade fashion. The Denonvilliers fascia is separated by the posterolateral surface of the
prostate, and the prostatic apex is reached. Intrafascial antegrade nerve sparing is performed when oncologically safe. Conversely, in case of more advanced disease, an interfascial or extrafascial antegrade dissection is performed. Thereafter, the surgeon goes back to identify the vesicoprostatic plane and dissect the BN. To easily identify the BN orifices during the first steps of the anastomosis, two short stitches can be placed at 6 and 12 o’clock positions. The anterior surface of the prostate is then dissected in an antegrade fashion, without incising the Santorini plexus. The section of the urethra completes the prostatic dissection [8].

2.2.7. Transperineal

The transperineal approach was the first approach to be described for RP in 1905 by Young [9]. Over the past few years, this technique has gained attention again, especially thanks to the introduction of the Da Vinci SP robot. Access to the prostatic fossa by means of the transperineal approach is slightly more difficult than by the transabdominal approach. After having performed a transversal incision in the perineum on a semicircumferential line connecting the ischial tuberosity, the rectourethralis muscle is divided, the external urethral sphincter is retracted, and the pubococcygeus branches of the levator ani are divided. The robot is then docked, and the prostate is identified. The Denovilliers fascia is dissected, and the prostate is freed toward the vasa deferentia and seminal vesicles (Fig. 5A). The dissection then moves laterally and the NVBs are dissected. The apical dissection is then performed, and the anterior prostate dissection in a caudocranial fashion finally completes the operation (Fig. 5B) [10,24].

2.3. Prostatic dissection sensu stricto

2.3.1. Endopelvic fascia

After having released the bladder, the endopelvic fascia is generally incised and the prostate is then released anterolaterally [6]. The resulting increased prostatic mobility might help in the dissection of the NVBs, given the possibility of applying more countertraction on the prostate. The endopelvic fascia can be preserved, but this might result in lower prostatic mobility and might render the prostatic dissection more difficult in case of larger prostates [7].

2.3.2. Bladder neck

After having identified the prostate-vesical junction and having developed this plane, the BN can be identified in the midline and its muscle fibers can be preserved, after a gentle dissection. In case a non-BN–sparing surgery is carried out, the bladder is incised by means of cautery and the BN is circumferentially excised.

2.3.3. Neurovascular bundles

Two techniques are available for the dissection and NVB preservation: antegrade or retrograde [11,12].
After the seminal vesicle release and vasa deferentia transection, the prostate is lifted, and the Denovilliers fascia is identified and incised using sharp dissection. The prostate is dissected posteriorly from the Denovilliers fascia. The dissection then moves posterolaterally until the NVB becomes evident. After having completed this step, the subsequent one entails releasing the NVB from the posterolateral prostatic surface. During an antegrade dissection, the triangle between the pedicle and the prostatic pseudocapsule at the base is identified after gentle traction on the bundle and prostate counter traction. Once the desired plane for NS is identified, the dissection is carried out proceeding anteromedially toward the prostatic apex (Fig. 6A) [11].

The retrograde approach encompasses peeling of the lateral prostatic fascia (LPF) from the prostatic pseudocapsule. A gentle dissection of the LPF at the level of the mid-prostate is carried out in order to avoid a pseudocapsule breach. If present, one of the landmarks in this step can be the prostatic artery that can help in delineating the NVB course in a retrograde manner until the prostatic pedicle is encountered [14]. Once the desired plane is identified, the dissection proceeds caudally so that the space created during the posterior dissection is identified, and the bundle at this point is free. Dissection of the bundle proceeds toward the pedicle in a retrograde fashion (Fig. 6B). The pedicle is identified at its entry on the posterolateral angle of the base of the prostate, clipped, and dissected [13].

Regarding the degree of preservation of the NVB, this can be preserved in toto (intrafascial dissection) or partly (interfascial dissection), or dissected completely (extrafascial dissection) [25]. Tewari et al [26] have described a graded approach for NVB preservation, where grade 1 corresponds to a complete interfascial dissection and grade 4 to an extrafascial dissection. Grades 2 correspond to an interfascial dissection that is carried out by sectioning the venous plane of the bundle in the former case and along the adipose tissue of the bundle in the latter case.

Schatloff et al [12] have also described a graded approach for NVB preservation, which consists of a five inverse-graded scale, with grade 1 corresponding to the extrafascial
dissection. They used the "landmark artery" that runs on the lateral border of the prostate as a reference point for dissection. Grade 5 corresponds to a complete infrapiriform dissection, grades 4 and 3 to a dissection immediately medial and that immediately lateral to the landmark artery, respectively. Grade 2 represents a dissection lateral to the artery in the adipose tissue with embedded vessels.

2.3.4. DVC and puboprostatic ligaments

When dissecting the anterior side of the prostate, a plane can be developed between the anterior fibromuscular stroma and the detrusor apron [14]. This dissection technique allows for complete preservation of the structures lying anteriorly to the prostate, also known as the pubovesical complex [15].

2.3.5. Apical dissection

The dissection of the prostatic apex can be carried out with a sharp and direct division of the membranous urethra at the level of the urethroprostatic junction. Alternatively, it can be performed by progressively dissecting the three different muscular layers at the level of the urethral sphincter complex (rhabdosphincter, circular smooth muscle, longitudinal smooth muscle, and mucosa), as described in the "collar" technique. During this phase, rotation of the prostate helps with the dissection and delineation of the apex laterally and posteriorly [27].

2.4. Novel techniques for robot-assisted partial and total prostatectomy

2.4.1. Anterior prostatectomy

Villers et al. [16,17] have described the anterior partial prostatectomy for patients with organ-confined disease, grade group ≤ 3, and a tumor in the anterior prostate. The technique entails the dissection of the BN, transition zone and anterior fibromuscular stroma along with the preservation of the posterolateral aspect of the submucosal urethra, peripheral zone, and periprostatic tissues. At the end of the dissection, the anterior part of the bladder that had initially been sectioned is sutured to the anterior urethra.

2.4.2. Menon precision prostatectomy

The Menon precision prostatectomy (MPP) technique consists in the dissection of the prostate leaving 1–2 mm of glandular tissue posterolaterally, along the course of the NVB for patients with unilateral organ-confined disease with grade group ≤ 3 and prostate-specific antigen (PSA) ≤ 15 ng/ml at the time of diagnosis [18]. All the other steps mirror those of anterior prostatectomy.

2.4.3. Robotic total prostatectomy

Robotic total prostatectomy (RTP) has recently been described for patients who meet the eligibility criteria for active surveillance and have severely enlarged glands resulting in lower urinary tract symptoms refractory to medical therapy. The RTP entails a dissection between the posterior surface of the prostate and the pseudocapsule. This allows removal of all the three prostatic zones (central, transitional, and peripheral). By avoiding dissection below the pseudocapsule, the seminal vesicles, ampulla of vasa deferentia, and NVBs are preserved completely [28].

3. Results

3.1. Surgical approach

Few randomized controlled trials (RCTs) have been produced over the years, and the vast majority of the published studies regarding surgical techniques are represented by retrospective evidence.

Two RCTs have evaluated the extraperitoneal versus the transperitoneal approach [29,30]. Both trials, even if limited by their small sample size, demonstrated similar outcomes of the two approaches, with one showing reduced time to solid diet when the extraperitoneal approach was chosen [30]. The transperitoneal approach has the advantage of not violating the peritoneal cavity. Disadvantages include slightly longer time for post placement than the transperitoneal approach and a narrower operative space that might represent a limitation for performing extended pelvic lymph node dissection.

The only level I evidence currently available concerning the superiority of a technique over another is an RCT by Dalela et al. [31] demonstrating an earlier return to continence with the Retzius-sparing RARP (RS-RARP) technique than with the anterior approach. Overall, this difference in terms of continence recovery (zero to one security pad per day) was annihilated at the 12-mo follow-up. Yet, if the definition of continence was restricted to zero pads per day, a statistically significant difference in favor of RS-RARP was still observed at the 12-mo follow-up. Noteworthy, this pivotal study had the intrinsic bias that the operating surgeon had greater experience with the anterior approach and, despite that, the RS technique emerged as the technique associated with an earlier return to continence recovery [31,32]. Another advantage of the Retzius-sparing technique is observed when performing RP in patients after kidney transplant [33].

Concerning the other techniques, no level I evidence is available demonstrating the superiority of one over another, and each technique is generally used in accordance with the surgeon’s preferences.

Few studies have reported experience with a transvesical approach. Recently, Zhou et al. [19] reported encouraging data in a series of 35 patients. One potential advantage of this technique is that urologists are generally well acquainted with this approach, which mirrors partial prostatectomy [4]. In addition, this has the advantage of sparing the Retzius space, and it makes it easier to deal with larger prostate with respect to the Bocciardi approach. A potential drawback of this technique could be theoretically represented by a higher chance of acute urinary retention for intravesical clot formation. Further data on this approach are needed to better evaluate its role in preservation.
The transperineal approach for RARP has recently gained attention again due to the advent of the SP Da Vinci robotic platform, and the first experience has recently been reported [10].

3.2. Techniques for prostatic dissection

No RCTs aimed at evaluating differences in the prostatic dissection itself during RARP have been produced. In a subgroup analysis of an RCT evaluating the preservation of the BN versus no preservation including patients treated with open and RARP, the preservation of the BN provided earlier return to continence [34]. Retrospective evidence seems to suggest that preservation of the endopelvic fascia, as well as the DVC and puboprostotic ligaments, might aid in earlier return to continence [15,35]. Concerning the degree of NVB preservation, there is presently no consensus on the system that should be used [20]. Concerning apical dissection, adoption of the “collar” technique seems to help in reducing apical positive surgical margins [27].

3.3. Partial prostatectomy

Both the MPP and the anterior partial prostatectomy seem to be promising procedures. Currently, none represents the standard of care, given the absence of RCTs evaluating the oncological outcomes of these procedures with respect to RP. The major drawback of the MPP is that PSA invariably persists after the procedure and a definition of “response” will have to be defined. However, an RCT is currently ongoing evaluating MPP versus RP.

3.4. Summary of evidence

Table 1 summarizes the current evidence regarding the techniques for robotic prostatectomy. Concerning RP, there is level I evidence showing earlier return to continence with the Retzius-sparing approach. This approach also offers an advantage for performing RARP in patients who have received kidney transplantation. Regarding the dissection phase of the prostatectomy, there is a lack of prospective studies evaluating the role of the techniques for dissection during prostatectomy.

Given the lack of prospective comparative evidence, partial prostatectomies should not be offered outside clinical trials.

4. Discussion

In this review, we summarized the current evidence concerning the approaches and techniques for robotic prostatectomy and briefly described the surgical techniques. Presently, there is still a lack of level I evidence in many subfields of robotic prostatectomy. In accordance with the available evidence and retrospective studies, a summary of evidence as well as authors’ recommendations is provided.

Several approaches and techniques are available for performing RARP. Evidence seems to suggest that RS-RARP allows for faster continence recovery without increasing the risk of complications [31,32]. Presently, the major concern of the RS approach is the rate of positive surgical margins relative to the standard approach, especially in case of tumors that are located or have invaded the anterior fibromuscular stroma [36,37]. This difference might be related to the learning curve of RS-RARP. Indeed, all included studies relied on surgeons with extensive expertise with standard RARP and only limited experience for RS-RARP [36]. However, the largest comparative retrospective study suggested that the rate of positive surgical margins of RS-RARP versus standard RARP is comparable [38]. Despite that, the question whether RS-RARP is associated with a higher rate of positive surgical margins is still open. Future RCTs relying on surgeons with the same baseline expertise for both approaches are needed to solve this dilemma.

Concerning the various techniques for the dissection of the prostate, no RCT is available, and retrospective evidence seems to suggest that the more the preservation of anatomical structures, the better the outcomes. However, studies aimed at evaluating the role of each technique in the long term are currently lacking. Additionally, there is a lack of uniformity when interpreting studies, since not all consider patients with complete dryness as continent and some of them still include patients using one pad among continent individuals.

The transvesical approach might seem to be a reasonable option to “anteriorly” spare the Retzius space, and

| Table 1 – Summary of the available evidence regarding surgical approaches and techniques |
|------------------------------------------|----------------------------------|------------------------------------------|
| Surgical approach for RARP | The Retzius-sparing approach results in earlier return to continence with respect to the anterior approach | Level I |
| Prostatic dissection | The Retzius-sparing approach should be performed in patients after kidney transplantation | Authors’ opinion |
| | Retrospective evidence suggests that the more the preservation of periprostatic structures, the better the functional outcomes | Level IV |
| | In case of anterior tumor, the pubovesical complex should not be preserved | Authors’ opinion |
| Partial prostatectomy | Partial prostatectomies should not be offered outside clinical trials | Authors’ opinion |
| Total prostatectomy | Total prostatectomies should not be offered outside clinical trials | Authors’ opinion |

RARP = robot-assisted radical prostatectomy.
urologists are generally familiar with this technique since many steps are similar to those of the simple prostatectomy. Yet, further studies are needed to assess its effectiveness, learning curve, and outcomes in the long term.

Encouraging results have also been reported recently for the transperineal approach. This technique has the potential to further decrease hospital stay and the need for postoperative pain therapy [39]. However, transitioning from an abdominal approach to the transperineal would likely require some learning curve, and studies are needed to demonstrate the oncological safety of this approach in case of advanced disease, when a wider dissection is required.

Thanks to the advances in the mpMRI field, a partial resection of the prostate can be planned in selected candidates [16,18]. Regarding the partial prostatectomy techniques, functional outcomes are expected to be good in selected patients. Potentially, in addition to RCTs, a novel definition of PSA response after the procedure would likely be required in an effort to assess the oncological success of the procedure.

Indeed, we want to emphasize that the best technique is the one that is tailored to patient’s anatomy and takes into consideration the tumor stage and grade. In a holistic approach, the best outcomes are achieved by integrating an optimal preoperative plan into an excellent dissection and reconstruction strategy or into a postoperative strategy. Interestingly, despite that different approaches and techniques might result in an earlier return to continence, differences in the functional outcomes seem to be annihilated over a long-term period. This is in keeping with Vis et al [22] who report similar continence rates at the 12-mo assessment despite different reconstruction techniques.

5. Conclusions

Herein, we provide a video-based description of contemporary approaches and dissection techniques for RARP. While evidence supporting the use of one over the others remains limited, the RS-RARP approach seems to be superior in terms of early return to continence. Partial prostatectomy should still be considered investigational. Ultimately, surgeon’s preference and expertise remain the key for the adoption of one technique over the others.

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Appendix A. Supplementary data

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