Igloo-technique for robotic radical prostatectomy—maximum nerve sparing for very early recovery of continence and sexual function

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Article

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Abstract

**Background:** We describe a surgical technique to facilitate very early return of continence and erectile function after robotic-assisted radical prostatectomy (RARP) for prostate cancer.

**Objective:** To describe the “igloo technique” for RARP.

**Design, setting, and participants:** Prospective study of the first 13 patients to be treated with the igloo technique at a major urban hospital. Only patients without suspected invasion of the neurovascular bundle were included.

**Surgical procedure:** RARP was performed using “igloo technique” to preserve all periprostatic structures, including the puboprostatic ligament complex, neurovascular bundles, Santorini complex, endopelvic and periprostatic fascia, and accessory pudendal arteries.

**Outcome measurements and statistical analysis:** Descriptive analysis of the perioperative, pathological, and short-term oncological outcomes.

**Results and limitations:** The median operative time was 200 minutes [inter-quartile range (IQR): 188–210]. The transurethral catheter was removed after a median of 3 days post-RARP. In the first 24 hours after catheter removal, the median urine loss was 4g/24h[IQR: 2–10g/24h]. Ten days after surgery, 3 patients had urine loss of 10g/24h, and 10 patients had urine loss of 0g/24h. At 6 weeks after surgery, only 1 patient had urine loss of 10g/24h, and the remaining 12 patients all reported urine loss of 0g/24h. The median IIEF-15 decrease after surgery was 19[IQR: 5–36]. Positive surgical margins were reported for 4 participants(31%), and biochemical recurrence was observed in 1 subject who did not have a positive surgical margin.

**Conclusions:** The igloo technique is a technically demanding technique for RARP that spares most periprostatic structures with very early return of continence and erectile function after surgery. Despite case selection, a considerable proportion of participants showed a positive surgical margin.

**Patient summary:** Through improved preservation of the anatomical structures around the prostate, we achieved very early return of urinary continence and erectile function after surgical removal of the prostate.

Introduction

Robotic-assisted radical prostatectomy (RARP) is a treatment option for men with localised prostate cancer. The challenge of RARP consists of competing oncological and functional goals. The most common side effects following RARP are urinary incontinence and erectile dysfunction, which occurred in 74% and 79%, respectively, of participants in the PROTECT study, a prospective randomized trial in the United Kingdom [1]. These results contrast with single-institution cohort studies of high-volume centres, which have reported urinary incontinence and erectile dysfunction in as few as 11% and 34%, respectively,
of participants three years after RARP [2]. These differences may be caused by patient selection, differences in outcome definitions, and/or differences in surgical technique.

The hypothesis that the surgical technique influences the outcome has led to several modifications of RARP that aim to preserve and/or reconstruct the delicate periprostatic structures to improve functional outcomes. Previous surgical techniques have attempted to preserve or reconstruct several periprostatic structures, including the puboprostatic ligament complex, Denonvilliers’ fascia, neurovascular bundles, bladder neck and urethra, endopelvic fascia, accessory pudendal arteries, and Santorini complex.

Inspired by Dr. Richard Gaston’s laparoscopic technique, we illustrate a robotic technique that preserves all periprostatic structures to facilitate early return of continence and erectile function, after which the preserved periprostatic anatomical structure has the appearance of an igloo. Our primary aim in this study is to describe the surgical steps of the novel standardized “igloo technique”. The secondary aim is to present early functional and oncological outcomes of this technique.

**Methods**

**Indication and preoperative staging**

Patients eligible for this surgical technique are men with histologically proven low-to-intermediate-risk prostate cancer with a life expectancy of at least 10 years and intact continence and erectile function who are eligible for bilateral intrafascial nerve sparing.

**Informed consent**

Prior to surgery, patients are counselled about their diagnosis, prognosis, and different options for treatment, including active surveillance, external beam radiotherapy (EBRT), brachytherapy and RARP. The expected benefits, risks, and likelihood of success for each option are given. Surgical complications are discussed, including urinary incontinence, erectile or sexual dysfunction, nerve injury resulting in altered skin sensation or pain, infection, injury to vessels leading to bleeding or thrombosis, cancer recurrence, inguinal hernia, infertility, seroma, lymphedema, venous thromboembolic and arterial events, and general complications of anaesthetic. Patients are informed that any complication or disease recurrence may require further treatment. Written informed consent and video publication consent were obtained from all patients.

**Surgical procedure**

**Patient positioning and docking**

A four-arm da Vinci Si Surgical System (Intuitive Surgical-ISRG, Sunnyvale, CA, USA) was used for all cases. All procedures were performed by a single experienced surgeon (A.M.) at least 6 weeks after prostate biopsy. During the procedure, the patient is placed supine, and a rectal catheter is introduced after general anaesthesia. After placement of a supraumbilical 12mm optic trocar (Covidien, Dublin,
Ireland), the abdominal cavity is inspected with a zero-degree 10mm robotic laparoscope to exclude adhesions, and three 8mm robotic trocars (da Vinci System, Intuitive Surgical-ISRG, Sunnyvale, CA, USA) are placed under vision, followed by another 12mm and a 5mm assistant port (Covidien, Dublin, Ireland). The 5mm and 12mm ports are positioned cranially two fingers’ breadth from the right robotic port to allow triangulation. Next, the patient is positioned in steep Trendelenburg position at about 45° incline, and the robotic system is docked as previously described [3-5].

**Prostatectomy in 10 steps**

The igloo prostatectomy technique consists of the following 10 steps (Figure 1a-1i).

1) The peritoneum lateral of the right plica umbilicalis medialis is incised using the monopolar scissor. The paravesical space is exposed until the vas deferens is visualised. The urinary catheter is moved to visualise the bladder neck.

2) The endopelvic fascia and periprostatic fascia are incised using scissors close to the puboprostatic ligament.

3) The right neurovascular bundle is mobilized using sharp or blunt dissection, and vessels are clipped with 5mm titan clips (B. Braun, Melsenburg, HE, Germany). The dissection is continued until the base of the seminal vesicles.

4) The seminal vesicles are first anatomized on the right side and then on the left side. Denonvilliers’ fascia is incised below the prostate base. Next, the plane between the prostate and bladder is incised using monopolar coagulation.

5) The bladder neck is dissected after complete mobilisation to ensure a narrow bladder neck.

6) The neurovascular bundle is dissected on the contralateral side.

7) The dorsal venous complex is spared, and the apex is completely dissected.

8) The meticulous apex dissection includes sparing the rhabdosphincter and achieving maximal urethral length.

9) The urethrovesical anastomosis is performed using the Van Velthoven technique, which consists of two tied 4-0 monofilament sutures [6].

10) The endopelvic fascia on the right side is closed using a running barbed suture (V-Loc™, Medtronic, Dublin, Ireland).

**Closure and Dressings**

No drains are used [7]. The supraumbilical incision is widened to remove the prostate, and the fascia is closed with a 1-0 polyglactin suture. All other incisions are closed with 3-0 polyglactin subcutaneous
sutures. The skin is closed with staples (Appose™ ULC single-use skin stapler, Covidien, Dublin, Ireland) and covered with adhesive film dressings (Smith & Nephew, London, UK). The rectal catheter is removed.

**Postoperative care**

The patient can mobilise, eat, and drink immediately after surgery. A urinary culture is sent on day 3, followed by empiric antibiotic prophylaxis with trimethoprim/sulfamethoxazole 800/160mg twice a day for 3 days, starting the day before catheter removal on day 4. Bodyweight-adapted thromboprophylaxis with dalteparin sodium is prescribed once daily until discharge. Tadalafil 20mg twice weekly is offered to all patients for penile rehabilitation during the first 12 weeks after surgery.

**Clinical follow-up**

The patient is seen by the operating surgeon 10 days and 12 weeks after surgery to remove staples, check wound conditions, and assess the functional result. Additional follow-up consultation is performed by the referring general practitioner or urologist. Prostate-specific antigen (PSA) measurements are recommended every 3 months for 2 years after surgery and every 6 months for an additional 3 years after surgery, after which yearly measurements are recommended.

**Cohort study and video**

All patients consented to the use of photographic and videographic material for educational purposes, in accordance with local institutional guidelines. Ethical approval was provided by the Ethics Committees of northwest- and central Switzerland EKNZ, the data have been acquired under the BASEC-number 2021-00181. Data were collected prospectively by a urologist.

**Statistical analysis**

Descriptive statistics were used to report patient and tumour characteristics, as well as perioperative and oncological outcomes. Operation time was defined from surgical sign-in to sign-out. The Clavien-Dindo score was used to grade complications [8]. Early continence was evaluated using pad tests [9], and erectile function was evaluated using the International Index of Erectile Function (IIEF-15) questionnaire [10]. Statistical analyses were performed using R version 3.1.3 (R Foundation for Statistical Computing, Vienna, Austria).

**Results**

Between February 2020 and January 2021, 13 men underwent an igloo technique RARP (Table 1). The mean patient age was 58 years [inter-quartile range (IQR): 54–61], and the median preoperative PSA for patients was 6.8 (IQR: 6.0–8.8). Preoperative biopsy-proven histology included Gleason Score 6 in 8 patients (62%), Gleason score 7a in 3 patients (23%), and Gleason score 7b in 2 patients (15%). The prostatectomy specimens confirmed pT2 in 11 patients (85%), T3a in 1 patient (7.5%), and T3b in 1
patient, as well as Gleason 6 in 6 patients (46%), Gleason 7a in 6 patients (46%), and Gleason 7b in 1 patient (8%).

The median operative time was 200 minutes [IQR: 188–210]. The transurethral catheter was removed after a median of 3 days after RARP [range: 3–11]. One patient (8%) required the catheter for 11 days because of a leakage observed during cystography. One patient (8%) experienced a Clavien-Dindo grade III complication, specifically bleeding from a small prostatic artery, which was treated with superselective embolization. No transfusions were required, and no further complications were observed.

In the first 24 hours after catheter removal, the median urine loss was 4g/24h [IQR: 2–10g/24h]. Ten days after surgery, 3 patients had a urine leak of 10g/24h, and the remaining 10 patients had 0g/24h. After 6 weeks, only 1 patient had a median loss of 10g/24h, and the remaining 12 patients had 0g/24h.

All but 2 patients used twice-weekly tadalafil 20mg for penile rehabilitation during the first 12 weeks after surgery. The median IIEF-15 scores decreased from a median preoperative score of 65 [IQR: 61–65] to a median score of 48 [IQR: 27–59] 12 weeks later (Figure 2).

In 4 of 13 participants (31%), a positive surgical margin was reported, including Gleason pattern 3 in all men. Follow-up data were available for 12 of the 13 patients, and the mean follow-up time was 9 months [IQR: 6–13]. One patient without a positive surgical margin experienced a biochemical recurrence, although there were no visual signs of recurrence in the subsequent PSMA-PET scan.

**Discussion**

Refinements to radical prostatectomy surgical techniques may explain the divergent results in the literature regarding postoperative complications, including urinary incontinence and erectile dysfunction. The igloo technique for RARP described in this report represents a modification to the anterior approach that is similar to previously published techniques. Preservation of the periprostatic structures has been proposed in open radical prostatectomy [11]; with the introduction of RARP, improved visualisation has led to numerous new techniques. Our igloo technique extends the hood [12] or De Carvalho technique [13] in that we completely preserve and do not transect the dorsal venous plexus, which lies anterior to the prostate. However, preservation of the dorsal venous plexus is challenging and impairs visualisation of the contralateral neurovascular bundle. This challenge could explain the long median operating time, as well as the considerably high proportion of positive surgical margins. Nevertheless, further studies are warranted to evaluate preservation of the dorsal venous complex and its influence on urinary continence and erectile function.

This study has limitations. First, this study represents a single-institution series of an experienced robotic surgeon within the learning curve of this new approach; therefore, our results may not be reproducible at other institutions. Second, this is a prospective study with no comparative arm, and the results of the study should ideally be verified in a randomized clinical trial. Third, the study’s exclusion criteria may
have confounded our results because we excluded cases with suspected neurovascular bundle infiltration.

**Conclusion**

Our igloo technique represents a modification of the anterior RARP technique with promising very early continence results and moderate erectile function results; however, a considerable proportion of participants had positive surgical margins. Careful patient selection (i.e., exclusion of patients with a risk of neurovascular bundle infiltration) is mandatory, and larger series are required before this technically demanding technique can be recommended.

**Declarations**

**Conflict of interest:** The authors have no relevant financial or non-financial interests to disclose.

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**Author contributions**

Christian Fankhauser had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Study concept and design:** Fankhauser, Malkmus, Mattei

**Acquisition of data:** Malkmus, Aschwanden, Baumeister

**Analysis and interpretation of data:** Fankhauser, Malkmus, Mattei

**Drafting of the manuscript:** Fankhauser

**Critical revision of the manuscript for important intellectual content:** Aschwanden, Baumeister

**Statistical analysis:** Malkmus

**Obtaining funding:** None

**Administrative, technical, or material support:** None.

**Supervision:** Mattei
Data availability statement:

The dataset generated and analysed during the current study are not publicly available as the conditions of the ethics approval do not permit public archiving of the data but are available from the corresponding author on reasonable request.

References


Tables

**Table 1** Baseline characteristics of the included patients treated with the igloo prostatectomy technique
<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median age in years</td>
<td>58 (IQR 54-61)</td>
</tr>
<tr>
<td>Median prostate size in mL</td>
<td>29 (IQR 21-43)</td>
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<tr>
<td>Preoperative Gleason Score</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>8 (62%)</td>
</tr>
<tr>
<td>7a</td>
<td>3 (23%)</td>
</tr>
<tr>
<td>7b</td>
<td>2 (15%)</td>
</tr>
<tr>
<td>Median preoperative PSA level (ng/mL)</td>
<td>6.8 (IQR 6-8.8)</td>
</tr>
<tr>
<td>Prostatectomy T-stage</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>11 (85%)</td>
</tr>
<tr>
<td>T3a</td>
<td>1 (7.5%)</td>
</tr>
<tr>
<td>T3b</td>
<td>1 (7.5%)</td>
</tr>
<tr>
<td>Prostatectomy Gleason Score</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>6 (46%)</td>
</tr>
<tr>
<td>7a</td>
<td>6 (46%)</td>
</tr>
<tr>
<td>7b</td>
<td>1 (8%)</td>
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<tr>
<td>Surgical margin status</td>
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<tr>
<td>R0</td>
<td>9 (69%)</td>
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<tr>
<td>R1</td>
<td>4 (31%)</td>
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<tr>
<td>Gleason pattern, length and location of positive surgical margins</td>
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<tr>
<td>Gleason pattern 3, 0.5mm, apex</td>
<td></td>
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<tr>
<td>Gleason pattern 3, 0.5mm, seminal vesicles</td>
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</tr>
<tr>
<td>Gleason pattern 3, 2mm, apex</td>
<td></td>
</tr>
<tr>
<td>Gleason pattern 3, 10mm, base of bladder</td>
<td></td>
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<tr>
<td>All men with R1 had no biochemical recurrence during available follow-up</td>
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</tr>
</tbody>
</table>

Abbreviations: IQR: inter quartile range

**Figures**
Figure 1

Surgical steps of the igloo prostatectomy technique. Incision of the peritoneum lateral of the right plica umbilicalis medialis (a). Incision of the endopelvic fascia (b) and periprostatic fascia (c). The right neurovascular bundle is mobilized (d). The dissection is continued until the base of the seminal vesicles, and both seminal vesicles are dissected (e). Denonvilliers’ fascia is incised below the prostate base (f). Next, the bladder neck is visualized and dissected (g). The dorsal venous complex is spared (h), and the apex is transected (i).
Figure 2

Spaghetti plot showing pre- and postoperative IIEF-15 scores of individual patients (dots with lines) and median scores (triangles).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Igloo Technique FINAL.mp4