

# The History of Gender-Affirming Vaginoplasty Technique

Andrew J. Zilavy, Richard A. Santucci, and Maxx A. Gallegos

## SOCIOPOLITICAL BACKGROUND

Evidence of gender variance is present throughout all societies of human history, dating back to the earliest cultures of which we have anthropologic record.<sup>1</sup> The phenomenon first came to the attention of modern medicine around the turn of the twentieth century, where it was described as a psychiatric illness by Richard von Krafft-Ebing and other early sexologists.<sup>1,2</sup> With the primordial classification of the condition as a form of delusional disorder, all means of psychotherapy were attempted to convince patients to abandon the belief they were trapped in the wrong sex body and to accept their assigned gender.<sup>3</sup> Such attempts were widely and consistently ineffective to convert the adult transgender/non-binary (TGNB) patient or to relieve their suffering, which was regularly severe enough to drive patients to genital amputation or suicide.<sup>3,4</sup> Therapeutic benefit was first achieved using the affirmative treatment pathway, originally pioneered in Magnus Hirschfeld's Institute of Sexual Research in 1919 in Berlin, until it was sacked and its library burned by the Nazi party in 1933.<sup>2</sup>

The endocrinologist Harry Benjamin successfully championed comprehensive transgender healthcare beginning in the early 1950s in San Francisco.<sup>1,2</sup> His affirmative treatment pathway supported patients' case-by-case need for social transition, need for the newly available cross-sex hormones, and even the need to refer patients for gender-affirmation surgery where appropriate.<sup>1,2</sup> During this time there were scarce surgeons offering gender-affirming vaginoplasty (GAV): for example the American trained Plastic surgeon Fernando Ortiz Monasterio of Mexico,<sup>5,6</sup> the British Urologist Peter Philip,<sup>7</sup> the American Urologist Elmer Belt,<sup>2,8</sup> and most notably the French Gynecologist Dr. Georges Burou.<sup>8</sup> So few were willing to risk performing the operation due to fear of patient regret and retribution, professional shame and legal consequence.<sup>1,2</sup> It was well understood that any

surgeon who performed GAV might be charged with criminal mayhem, the purposeful maiming of a patient.<sup>1,2</sup>

The Danish-American trans woman Christine Jorgensen, who had become famous for undergoing a gender-affirming surgery in 1952, used her growing influence to create "as much good publicity as possible for the sake of all those to whom I am a representation of themselves."<sup>2,9</sup> She fit into the role of the classic American female.<sup>2</sup> She presented herself with poise and because of her the stereotype of the transgender person as a mentally ill, sexual-deviant began to fade.<sup>2</sup> She became Benjamin's patient as he used her spotlight to further his mission to facilitate greater access to transgender medical and surgical care.<sup>1,2</sup>

By the early 1960s, in part due to referrals by Christian Hamburger and Christine Jorgensen, Benjamin had become the mecca for TGNB patients seeking hormonal and surgical care.<sup>1,2</sup> He referred patients to Burou and the few other known surgeons.<sup>1</sup> As he toured the country giving lectures on transgender medicine, his network of potential surgeons grew.<sup>1</sup> Despite this, his ability to connect his patients to surgeons was still lacking.<sup>1</sup> By 1964, only 31 of his patients had received GAV.<sup>1</sup>

Transgender medicine was a taboo fringe science and little progress occurred in the field until 1963, when Benjamin met his most significant patient since Christine Jorgensen.<sup>1,2</sup> Reed Erikson was an American transman and millionaire philanthropist.<sup>1,2</sup> He founded and personally financed the Erickson Educational Foundation (EEF) in 1964; the first international transgender healthcare network.<sup>1,2</sup> The EEF supported Benjamin's mission to link transgender patients to capable providers, and it directly funded almost every aspect of research and applied science related to transgender care in the 1960s and 1970s.<sup>1,2</sup>

The 1970's were a time of expansion for genital gender-affirmation surgery.<sup>1,2</sup> The opening of the Johns Hopkins Gender Identity Clinic (GIC) in 1966 was closely followed by the establishment of GICs in the United States at The University of Minnesota, The University of Washington Seattle, Stanford, University of California Los Angeles, University of Texas Galveston and Northwestern.<sup>1-3,10</sup> GICs were also founded in the Netherlands and Charing Cross Hospital in London.<sup>7,11</sup> The unquestionable reputation of these combined institutions removed the previous dread of retribution from the minds

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From the University of New Mexico Department of Surgery, Division of Urology, 1 University of New Mexico, Albuquerque, NM

Address correspondence to: Andrew Zilavy, M.D., Division of Urology, 1 University of New Mexico, MSC10 5610, Albuquerque, NM 87131-001. E-mail: [azilavy@salud.unm.edu](mailto:azilavy@salud.unm.edu)

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of potential GAV surgeons.<sup>1</sup> With new patient selection protocols, the risk of post-operative regret was decreasing.<sup>1</sup> Surgeons no longer had cause to fear criminal mayhem charges as the operation was now part of legitimate medical science.<sup>1</sup> The positive public image of trans woman Christine Jorgensen, Harry Benjamin's growing provider network, coupled with the arrival of the first high-volume provider since Burou, together marked the beginning of the renaissance in transgender surgical care.<sup>1</sup> Stanley Biber, a rural community general surgeon, first performed GAV in 1969 on a Benjamin patient utilizing operative reports he'd requested from Hopkins.<sup>12</sup> In the small town of Trinidad, Colorado, from 1969 to 2003, Biber would perform an estimated 4000 GAV operations, including complex revision work.<sup>1,12,13</sup>

In 1977 the American psychologist-sexologist Paul A. Walker reorganized the foundation and the EEF became known as the Janus Information Facility (JIF).<sup>14</sup> In 1979, Walker and an elected committee of 6 others renamed and expanded the JIF into the Harry Benjamin International Gender Dysphoria Association (HBIGDA).<sup>14</sup> This committee published the first Standards of Care (SOC) for transgender health.<sup>14</sup> The SOC set forth by the HBIGDA provided a practical set of guidelines to help determine who was a candidate for GAV.<sup>2,14</sup> In 2007, the HBIGDA was renamed the World Professional Association for Transgender Health (WPATH) and their published guidelines are still considered the standard of care in transgender medicine.<sup>2</sup>

Opponents of the affirmative treatment pathway for TGNB patients argued that these irreversible, morbid treatments did not truly help patients.<sup>15</sup> They held the archaic position that TGNB patients suffered from a form of delusional disorder and that all aspects of the affirmative treatment pathway, most notably surgery, were inappropriate in the treatment of a purely psychiatric illness.<sup>15</sup> The poster child of this influential opposition movement was Paul R. McHugh.<sup>15</sup> In 1979, wielding his position as the chair of Psychiatry at Johns Hopkins Hospital, he successfully closed the Hopkins GIC.<sup>15</sup> This resulted in a confused, hostile atmosphere for transgender healthcare in the United States and accordingly the growth of the

field plateaued and was effectively stifled for at least 3 decades.<sup>15,16</sup>

Expert transgender healthcare providers, who saw patients benefit from gender-affirmative social transition, hormones and surgery debated the opposition camp, asking the critical question: "what meaningful alternative help have you been able to offer the transsexual patient?"<sup>17</sup> Eventually, the answer from the opposition to this question became apparent, they had no meaningful alternative to the affirmative treatment pathway.<sup>15</sup> Gradually, the influence of the opposition waned and the hostile environment lifted.<sup>15</sup> In 2017, Hopkins moved beyond the anti-transgender views of McHugh and reopened the GIC.<sup>15</sup> This occurred within the context of a larger phenomenon, a long overdue expansion of gender-affirming healthcare providers and surgeons.<sup>15,16</sup>

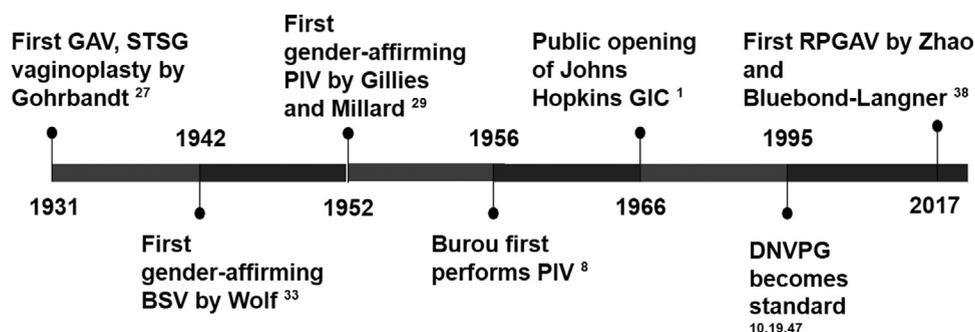
Recent United States and Dutch data show that TGNB persons compose an estimated 0.4%-1.1% of the population.<sup>18</sup> 12% of American trans women have undergone GAV and an additional 54% desire GAV.<sup>4</sup> Of those seeking insurance coverage for GAV, 55% are denied and 21% were covered, but had no GAV surgeons available in their network.<sup>4</sup> As the demand for GAV continues to rise, so will the need for qualified GAV providers.<sup>16</sup>

In this new era of gender-affirming surgery, where a growing number of urologic, plastic, gynecologic and general surgeons are becoming specialty trained in gender-affirmation surgery, the fascinating history of GAV is more important than ever.<sup>16</sup> The traditional history that persists to this day has left behind several significant events and persons.<sup>19,20</sup> We present an updated, overview of the history of GAV technique based on rigorous re-review of the primary literature, historical research and historical discovery.<sup>49-54</sup>

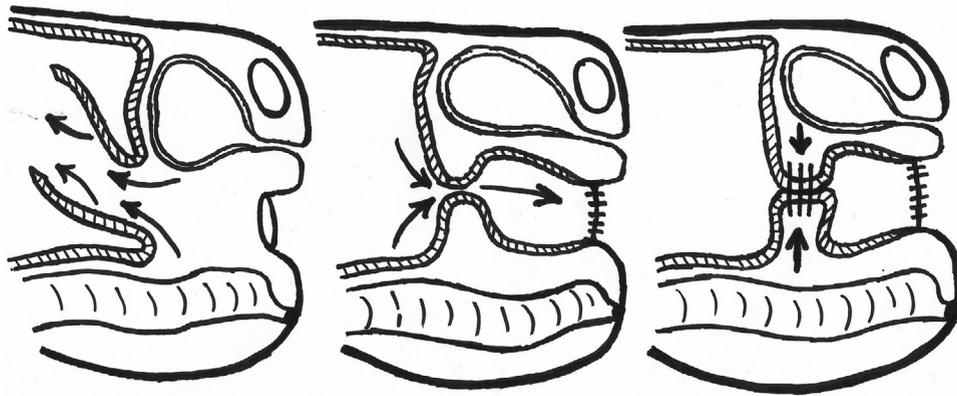
## VAGINOPLASTY TECHNIQUE

### Random Skin Flaps and Pedicled Fasciocutaneous Flaps

Descriptions of surgical interventions to restore form and function for vaginal obstruction or non-functioning



**Figure 1.** Timeline of select major events in GAV history. Gender-affirming vaginoplasty (GAV), split thickness skin graft (STSG), bowel substitution vaginoplasty (BSV), penile inversion vaginoplasty (PIV), gender identity clinic (GIC), dorsal neurovascular pedicled glansplasty (DNVPG), robotic-assisted peritoneal flap gender-affirming vaginoplasty (RPGAV) (Color version available online).



**Figure 2.** <sup>49</sup> Peritoneal flaps are mobilized, pulled down to be anastomosed to the skin of the distal canal, and the peritoneal apices are coapted (Color version available online).

vagina, be it from imperforate hymen, vaginal septum, vaginal hypoplasia or vaginal agenesis, date back to Greek antiquity.<sup>20</sup> Incision of the obstruction or sharp dissection for creation of a canal in the pre-aseptic era generally resulted in injury to the urethra, bladder or rectum with fistula or entry into the peritoneal cavity and death from infection.<sup>20</sup> Even with improved safety in canal dissection due to increased surgical prowess and adoption of aseptic technique, simple perineal rectovesical canal dissection for creation of a neovagina proved insufficient.<sup>20</sup> It was observed that without maintenance the cavity uniformly stenosed or obliterated.<sup>20</sup> Therefore, indwelling neovaginal molds with progressive dilation and epithelialization over a period of months following dissection were attempted in cis-women, but these too with dissatisfying results; stenosis, incomplete epithelialization and excessive granulation tissue.<sup>20</sup>

In 1872, C.L. Heppner was the first to line the newly dissected neovaginal cavity of a cisgender woman with random skin flaps.<sup>21</sup> The distal canal was lined with advancement flaps from the rectovesical septum and the proximal canal was lined with thigh flaps.<sup>21</sup> Random skin flaps from labia, perineum and buttock donor sites have also been described.<sup>20,21</sup>

The early days of random skin flap surgery were guided by primitive knowledge.<sup>22</sup> It was understood that a random connection between the flap and the body must be maintained for blood supply.<sup>22</sup> Surgeons realized that random skin flaps of large size or irregular shape tended to suffer ischemic loss, so rigid flap length-to-width ratios were followed.<sup>22</sup> Knowledge began to accumulate regarding methods for increased skin flap survival, for example the observation that the intact skin of musculocutaneous flaps had excellent survival.<sup>23</sup> Through insights derived from such observations, modern skin flap surgery developed.<sup>22</sup>

Ponten popularized the pedicled fasciocutaneous flap (PFCF) in 1981, a culmination of decades of combined experience in the plastic surgery community that described principles for creation of well vascularized skin flaps.<sup>22,23</sup> These principles included dissection of appropriately thick flaps composed of cutis, subcutaneous tissue and fascia.<sup>23</sup> Greater understanding of skin vascular

pedicle anatomy and preservation of the subcutaneous and fascial vascular network increased PFCF survival.<sup>22,23</sup>

Cairns and De Villiers first demonstrated random skin flaps for revision of stenotic neovagina in the transgender population as early as 1977 using random medial thigh flaps.<sup>5</sup> Ted Huang described use of inguinopudendal PFCFs based on superficial branches of the internal pudendal artery.<sup>10</sup> He demonstrated successful outcomes in 109 primary GAV cases from 1978 to 1992.<sup>10</sup> Mukai et al reported 15 cases of GAV utilizing inguinopudendal flap from 2010 to 2016, noting the continued feasibility of the technique.<sup>24</sup>

Though effective, donor site scarring and morbidity of PFCF is significant.<sup>19</sup> These flaps lack self-lubrication and can be bulky, resulting in dry neovaginal vaults of lesser dimensions.<sup>19</sup> Because of this, non-genital skin flaps are generally currently reserved for atypical cases of salvage GAV where other salvage methods are not possible.<sup>19</sup>

### Grafts

Robert Abbe described the first case of split thickness skin graft (STSG) vaginoplasty in 1898 for a cisgender woman with vaginal agenesis.<sup>25</sup> STSG harvested from the thighs was left over a mold in the neovaginal canal.<sup>25</sup> Archibald Hector McIndoe became the namesake of the modern Abbe-McIndoe STSG vaginoplasty which McIndoe popularized in 1938 in cisgender women.<sup>11</sup>

Unlike the more technically demanding PFCF, STSG vaginoplasty was accessible to more surgeons.<sup>19</sup> Lifelong dilation is still necessary to prevent stenosis and there is still appreciable morbidity associated with donor sites.<sup>19</sup> Various other grafts have been used effectively: meshed and full thickness skin grafts, peritoneum, minced and grafted buccal mucosa graft, and even in vitro tissue-engineered vaginal mucosa.<sup>26</sup>

The first operation for creation of a neovagina in a TGNB patient occurred in Magnus Hirschfeld's Institute of Sexual Research in Berlin.<sup>2</sup> In 1931, Erwin Gohrbandt performed STSG GAV on Dora Richter.<sup>2,27</sup> For the following 3 decades, GAV would occur rarely, generally in secrecy, and by the hands of virtuoso surgeons who tended to dabble in a few cases before deserting the practice.<sup>8</sup>

The Danish Surgeon Eling Dahl-Iverson performed a penectomy and cosmetic vulvoplasty in 1952 on 24 year old Danish-American Christine Jorgensen following an orchietomy in Denmark the year prior.<sup>9</sup> She had received preoperative hormonal therapy from Danish endocrinologist Christian Hamburger.<sup>9</sup> On December 1, 1952 Jorgensen made the United States and even world headlines as a model of a sensational case of gender-affirmation surgery.<sup>2,9</sup> In light of the publicity, the Danish government refused to perform castration or other gender-affirming surgery on foreign nationals.<sup>9</sup> Despite this, Hamburger, an advocate for transgender care, received 645 letters from patients all over the world desperate for care he could not legally provide.<sup>2,9</sup> In 1956 the Danish surgeon Poul Fogh-Andersen reported a case of one foreigner who had come to Denmark seeking gender-affirmation surgery and when denied, he attempted to castrate himself; forcing the surgeons to complete the orchietomy.<sup>9</sup> At the insistence of the patient, Fogh-Andersen agreed to perform penectomy and vaginoplasty using full thickness penile skin graft.<sup>9</sup> Fogh-Andersen's innovative use of the penile skin to line the neovaginal canal had the great benefit of no graft donor site morbidity.<sup>8</sup>

### Penile Inversion

The first described penile fasciocutaneous flap inversion vaginoplasty was performed by J. Riddle Goffe for an intersex woman with vaginal hypoplasia in 1903.<sup>28</sup> He utilized the skin covering the enlarged clitoris as a pedicled flap to line the neovagina.<sup>28</sup> Goffe demonstrated not only that genital skin could be utilized, thereby preventing donor site morbidity, but that the neurovascular pedicle could be preserved in the process.<sup>28</sup>

Sir Harold Delf Gillies and David Ralph Millard devised and performed the first anteriorly pedicled fasciocutaneous tabularized penile inversion flap to line a neovagina in 1952 on trans woman Roberta Cowell.<sup>29,30</sup>

In 1956, Georges Burou independently developed anteriorly pedicled penile inversion vaginoplasty (PIV) in transgender women, and first performed the operation in Casablanca, Morocco.<sup>8</sup> In purposeful secrecy, Burou performed at least 800 PIV operations.<sup>8</sup> Trans women who learned of his clinic would travel from all over the world to pursue his care.<sup>8</sup> For several decades, he was the only provider consistently offering GAV.<sup>8</sup> He stripped the penile skin free of the glans, corpus spongiosum and corpora cavernosa, which were transected at the level of the pubis.<sup>8</sup> The penile skin tube was closed distally, inverted, and used to line the neovaginal cavity.<sup>8</sup>

The Johns Hopkins Gender Identity Clinic publicly opened in 1966 with funding from the EEF.<sup>1</sup> Hopkins Gynecologist, Howard W. Jones Jr., independently discovered PIV for the third time in history in 1968.<sup>1,31</sup> Jones utilized a combination of anterior penile and posterior scrotal PFCFs.<sup>1</sup> The anterior penile flap was opened along the ventrum, converting the native tubular architecture to a rectangle.<sup>1</sup> A posterior scrotal flap was developed.<sup>1</sup> The apices of the anterior and posterior flaps were

anastomosed.<sup>1</sup> This combined anterior and posterior flap complex was then inverted into the neovaginal canal.<sup>1</sup> Milton T. Edgerton described the modified Hopkins method in 1970 in which posteriorly based pedicled tabularized PIV was performed with preservation of the scrotum which was utilized in a delayed, second stage operation for labiovulvoplasty.<sup>31</sup> Gillies and Burou's effective single stage method of anteriorly pedicled PIV with scrotal flaps used for labiovulvoplasty ultimately became the basis of the modern PIV.<sup>32</sup>

The renaissance in transgender medicine, which began in the late *sixties* and early *seventies*, was fully realized with the advent of prolific providers.<sup>1</sup> Preecha Tiewtranon first performed PIV in 1975 and his work led to Thailand's emergence as a major GAV destination.<sup>32</sup> The global modernization of PIV is reflected in the evolving operative technique of his group over the course of 3000 cases from 1975 to 2013.<sup>32</sup> Use of full thickness scrotal skin graft anastomosed to the open end of pedicled inverted penile fasciocutaneous flap to augment the proximal canal and apex became commonplace to create neovaginas of adequate dimension, generally defined as 12.5 cm in depth, 3.5 cm diameter.<sup>32</sup>

Clear advantages of forming at least the introitus and distal canal with a neurovascularly PFCF made total skin graft vaginoplasty obsolete for primary colpoptosis in GAV.<sup>31</sup> PIV features decreases stenosis as compared to skin grafting, though lifelong dilation is still required to prevent stenosis and loss of depth.<sup>19</sup> With over 60 years of experience, multiple large case series demonstrating the safety and efficacy of the modern PIV, it continues to be known in numerous circles as the 'Gold Standard' in GAV.<sup>19</sup>

### Intestinal Substitution

W.F. Sneguireff performed the first primitive bowel substitution vaginoplasty (BSV) in 1892 in cis women using pedicled terminal rectum and anus, pulling down the proximal rectum to perform anorectoplasty.<sup>11,21</sup> James Fairchild Baldwin first described a pedicled ileal neovagina in 1904 and performed the operation in 1907 in cis women.<sup>11,21</sup> By 1911, both Schubert and Albrecht described successful methods for rectosigmoid vaginoplasty in cases of vaginal hypoplasia/aplasia.<sup>11,21</sup>

Building on these effective operations in the cisgender population, bowel substitution was then able to be translated into the transgender population.<sup>33</sup> Charles Wolf of Switzerland successfully performed rectosigmoid vaginoplasty on Arlette-Irene Leber in 1942, modelled on Schubert's method, the first case of bowel substitution GAV.<sup>33</sup> In 1978, Colin Markland of the University of Minnesota published his success utilizing colon BSV in 9 trans women with neovaginal stenosis following PIV.<sup>34</sup> In the combined abdominoperineal procedure, an isolated ileal or colonic flap is obtained, primary bowel anastomosis is performed, and the pedicled bowel flap is pulled through for enterocutaneous anastomosis.<sup>35</sup> Rectosigmoid colon,

right colon, ileum and several pouch modifications utilizing ileum have all been demonstrated.<sup>35,36</sup>

In search of a GAV method with utility in cases of limited genital skin or in cases of revision vaginoplasty, the Stanford Plastic Surgeon Dr. Donald R. Laub expanded and modernized the bowel substitution GAV.<sup>13,37</sup> He published his long term follow up data in 2015 of 83 patients who had received open sigmoid vaginoplasty in his hands from 1978 to 2000; 13 as secondary operations and 70 as primary operations.<sup>37</sup> He demonstrated safety and efficacy of the method which had previously been dismissed as unacceptably risky.<sup>37</sup>

His findings were corroborated by a 2014 Dutch Retrospective review of 686 patients who underwent rectosigmoid vaginoplasty and 169 patients who underwent ileal vaginoplasty from 1996 to 2013 for any indication; including cis-female patients with primary vaginal agenesis from any cause, cis-females with acquired conditions like trauma or gynecologic malignancy, and vaginoplasty for gender-affirmation.<sup>35</sup> With 1.3-12 year follow up, no cases of anastomotic leak, diversion colitis or colonic neoplasm were reported.<sup>35</sup>

Advantages of ileum include minimal tendency for malodor and prolapse.<sup>35</sup> Diversion colitis and potential for colonic neoplasm development are not concerns with ileum.<sup>35</sup> Advantages of BSV include adequate neovaginal dimensions, preserved sensation, self-lubrication, hairless tissue, and minimal tendency for neovaginal stenosis with only temporary dilation requirement.<sup>13,35,37</sup> Disadvantages of BSV include intestinal surgery with potential accompanying donor site morbidity such as ileus, increased length of postoperative hospitalization, introital stenosis, and bothersome neovaginal secretions.<sup>13,35,37</sup>

Though BSV has been demonstrated as a primary GAV method and there are some that advocate for its use as a primary method which should be offered to all patients, the strongest justification for BSV is refractory neovaginal stenosis.<sup>13,19,35,37</sup> However, a new GAV technique has emerged with similar utility in primary cases where genital skin is limited and in revision cases for refractory stenosis.<sup>38,39</sup> Due to the decreased donor site morbidity of this new method, the limited indications for BSV may become even fewer.

### Peritoneal Flaps

In 1912, Walter Stoeckel described his use of peritoneal flaps for Colpopoiesis in a cis woman.<sup>40</sup> Friedrich Schauta credited the Russian Gynecologist Dmitry Oskarovich Ott with discovery of the technique though S.N. Davydov became the namesake of the modern procedure after his case series in 1969 in cis women.<sup>21,38,41</sup>

Lee C. Zhao and Rachel Bluebond-Langner first performed their novel robotic modification of the Davydov peritoneal flap vaginoplasty for GAV in 2017.<sup>38</sup> They have since described 145 primary and 24 salvage cases of Robotic-assisted peritoneal flap gender-affirming vaginoplasty (RPGAV).<sup>38,39</sup> The transabdominal portion of the case consists of creating a horizontal incision in the

peritoneum of the rectovesical pouch.<sup>38</sup> Denonvilliers' fascia is incised and the prostatorectal space is developed until the retrograde perineal dissection is encountered.<sup>38</sup> Well vascularized peritoneal flaps are mobilized from the posterior bladder and anterior rectum.<sup>38</sup> A standard PIV is performed and the inverted penile skin forms the distal and mid canal.<sup>38</sup> The anterior and posterior peritoneal flaps are anastomosed to the penile skin to form the distal canal.<sup>38</sup> The peritoneal flaps are then coapted to form the vaginal apex and exclude the neovagina from the abdominal cavity.<sup>38</sup> A full thickness scrotal skin graft was always utilized in early cases to form the mid canal where penile skin was insufficient.<sup>38</sup> With technical advancement, larger peritoneal flaps could be harvested, in some cases obviating the need for supplemental scrotal skin graft augmentation.<sup>38</sup>

Although creation of a deep and wide neovaginal canal is easily performed by expert surgeons using standard penile inversion techniques, the authors suggest that an additional improvement of the peritoneal vaginoplasty technique is the ability to dissect the space robotically.<sup>39</sup> The robotic dissection is nearly identical to that of a robotic radical prostatectomy.<sup>39</sup> Familiarity and previous experience with robotic prostate surgery may allow more confident canal dissection in vaginoplasty, perhaps further minimizing the risk of bladder, urethra and rectal injury.<sup>39</sup> Because the peritoneum of the rectovesical pouch is used to form the vaginal apex, this technique may result in increased depth compared to standard PIV in which the dissection stops at the peritoneal reflection.<sup>38,39</sup> Donor site morbidity in Zhao and Bluebond-Langner's cohort was rare with no instances of peritonitis and only one case of small bowel herniation through a separation in the peritoneal flap which was treated with subsequent laparoscopic surgery.<sup>38,39</sup> Further research is required and the performance characteristics of this approach after widespread adoption is unknown.<sup>38,39</sup>

RPGAV allows creation of hairless neovaginas with adequate dimension and may have decreased tendency for stenosis, though extended dilation is still required.<sup>38</sup> Due to demonstrated safety and efficacy as both a primary and secondary GAV option, the RPGAV has already begun to disseminate to other centers.<sup>38,39</sup>

### VULVOPLASTY AND CLITOROPLASTY TECHNIQUE

It had long been accepted that the primary outcomes for GAV were canal dimensions and minimization of complications.<sup>42</sup> Once these goals were regularly achieved in the hands of expert surgeons, attention gradually turned to the finer points of the operation.<sup>42</sup> The prolific Amsterdam group is often cited as influential in their formal announcement in the academic literature that aesthetic and function, patient focused outcomes, should be considered of principal focus as well.<sup>19,32,42</sup> By the mid-1990s, following 2 decades of collaborative experience in the

GAV surgical community, there were well described principles for creation of a more aesthetic and functional clitoris, urethral meatus, vaginal introitus, anterior and posterior commissure, and labia majora.<sup>19,32,42</sup>

Biber was the first major GAV provider to preserve the glans penis in any fashion.<sup>13</sup> During penectomy, the glans penis was transected free from the more proximal corpus spongiosum and left attached to the penile skin tube there at the apex and, once inverted, it formed a sensate neocervix.<sup>13</sup> Prior to Edgerton's description of this method in 1970 and Biber's adoption of the neocervixplasty, the glans penis was uniformly discarded during penectomy in all methods of GAV.<sup>31,43</sup> Similarly, clitoridectomy was the standard of care during feminizing genitoplasty for clitoromegaly in intersex patients.<sup>44</sup> In 1968, Barinka et al first described a successful method for functional preservation of the clitoris in intersex patients, which would prove important in the creation of a properly sized, sensate, orthotopically located clitoris during vaginoplasty.<sup>44</sup> They preserved the dorsolateral neurovascular pedicles of the enlarged clitoris, resected excessive corporal erectile tissue, and affixed the pedicled clitoral flap in a native female position.<sup>44</sup> John Brown published 65 cases of gender-affirming PIV utilizing dorsal neurovascular pedicled glansplasty (DNVPG) in 1976.<sup>43</sup> It should be noted that due to many documented instances of profoundly dangerous and negligent care, John Brown ultimately had his medical license revoked and was imprisoned for second-degree murder of a patient.<sup>45</sup> Alternative methods of functional or cosmetic clitoroplasty were attempted but all with inferior outcomes compared to DNVPG; these included free composite graft of glans, pedicled corpus spongiosum or urethral substitution flap, corporoplasty, ventrally based glans flap with intact corpus spongiosum pedicle, and even a purely aesthetic subcutaneously placed chin implant.<sup>46</sup> Refined descriptions by Sava Perovic, Jan Eldh, and others led to DNVPG becoming standard for neoclitoroplasty in GAV around 1995.<sup>10,19,47,48</sup> Perovic also pioneered the augment pedicled urethral flap inlay for PIV.<sup>47</sup>

Extended excision or corporocleisis of the residual proximal corporal bodies, and spongiocleisis of the residual bulbar corpus spongiosum was adopted to prevent unsightly, painful, potentially obstructive engorgement of this erectile tissue.<sup>32,42</sup> Spatulation urethroplasty to prevent meatal stenosis and create an appropriately oriented meatus for seated urination became standard.<sup>32,42</sup> An innovative posterior triangular flap was described by the Amsterdam group to break the circular introitus and create a more natural and functional posterior commissure without dorsal introital webbing.<sup>42</sup> They also demonstrated secondary Z-plasties to narrow an unnaturally wide anterior commissure seen in cases where lateral dislocation had occurred during healing of the labia majora.<sup>42</sup> A secondary operation to create labia minora from the medial aspect of the labia majora was yet another innovation from the group.<sup>42</sup> Such modifications in primary construction

and secondary revisions of the anterior and posterior commissures led to more aesthetic vulva.<sup>19</sup>

## DISCUSSION

A growing number of urologic, plastic, gynecologic and general surgeons are becoming specialty trained in gender-affirmation surgery.<sup>16</sup> As we enter this new era of GAV, the fascinating history of its development is more important than ever.<sup>16</sup> Utilizing rigorous re-review of the primary literature, historical research and historical discovery we present an update to the traditional historical narrative which had left behind several significant events and persons.<sup>19,20</sup>

## SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at <https://doi.org/10.1016/j.urology.2022.03.032>.

## References

- Green R, Money J. *Transsexualism and Sex Reassignment*. 2nd ed. Baltimore, Maryland: The Johns Hopkins University Press; 1969.
- Stryker S. *Transgender History*. New York, New York: Seal Press; 2017.
- Pauly IB. The current status of the change of sex operation. *J Nerv Ment Dis*. 1968;147(5):460–471.
- James SE, Herman JL, Rankin S, Keisling M, Mottet L, Anafi M. *The Report of the 2015 U.S. Transgender Survey*. Washington, DC: National Center for Transgender Equality; 2016:95–102. Published online.
- Cairns T, de Villiers W. Vaginoplasty. *S Afr Med J*. 1980;57:50–55.
- Gallegos E. Fernando Ortiz Monasterio, cirujano plastico: el uico limite es la imaginacion. *La Jomada (Mexico City)*. Published online 1997:12.
- King D, Ekins R. Pioneers of transgenering: John Randell, 1918–1982. *GENDYS 2002: The Seventh International Gender Dysphoria Conference*. 2002. Published online.
- Hage JJ, Karim RB, Laub DR. On the origin of pedicled skin inversion vaginoplasty: life and work of Dr Georges Burou of Casablanca. *Ann Plast Surg*. 2007;59:723–729.
- Fogh-Andersen P. Transvestism and trans-sexualism; surgical treatment in a case of auto-castration. *Acta Med Leg Soc (Liege)*. 1956;9:33–40.
- Huang TT. Twenty years of experience in managing gender dysphoric patients: I. Surgical management of male transsexuals. *Plast Reconstr Surg*. 1995;96:921–930.
- Freundt I. *Colocolpoptosis: The Use Of Sigmoid Colon In The Treatment Of Conditions Associated With Absence Of The Vagina*. Rotterdam, Netherlands: Erasmus University Rotterdam; 1994:31–66. Published online.
- Bradley-Springer L. Interview with marci bowers, MD. *J Assoc Nurses AIDS Care*. 2010;21:186–191.
- Laub DR, Laub Jr. DR, S Biber. Vaginoplasty for gender confirmation. *Clin Plast Surg*. 1988;15:463–470.
- Walker PA. Memo to: persons interested in the harry benjamin international gender dysphoria association. Published online 1979. <https://www.wpath.org/about/history>.
- Nutt AE. Long shadow cast by psychiatrist on transgender issues finally recedes at Johns Hopkins. *Washington Post*. 2017. [https://www.washingtonpost.com/national/health-science/long-shadow-cast-by-psychiatrist-on-transgender-issues-finally-recedes-at-johns-hopkins/2017/04/05/e851e56e-0d85-11e7-ab07-07d9f521f6b5\\_story.html](https://www.washingtonpost.com/national/health-science/long-shadow-cast-by-psychiatrist-on-transgender-issues-finally-recedes-at-johns-hopkins/2017/04/05/e851e56e-0d85-11e7-ab07-07d9f521f6b5_story.html).

16. Terris-Feldman A, Chen A, Poudrier G, Garcia M. How accessible is genital gender-affirming surgery for transgender patients with commercial and public health insurance in the United States? *Sex Med.* 2020;8:664–672.
17. Edgerton MT. The role of surgery in the treatment of transsexualism. *Ann Plast Surg.* 1984;13:473–481.
18. Meerwijk EL, Sevelius JM. Transgender population size in the United States: a meta-regression of population based probability samples. *Am J Public Health.* 2017;107:1–8.
19. Bizic M, Kojovic V, Duisin D, et al. An overview of neovaginal reconstruction options in male to female transsexuals. *Scientific World J.* 2014;14:1–8.
20. Goldwyn R. History of attempts to form a vagina. *Plast Reconstr Surg.* 1977;59:319–329.
21. Kroemer P. Die plastische Neubildung der Scheide bei partiell und totalem Defekt. *Praktische Ergebnisse der Geburtshilfe und Gynäkologie.* 1912;5-6:89–120. Jahrg.
22. Hashimoto I, Abe Y, Ishida S, et al. Development of skin flaps for reconstructive surgery: random pattern flap to perforator flap. *J Med Invest.* 2016;63:159–162.
23. Ponten B. The fasciocutaneous flap: its use in soft tissue defects of the lower leg. *Br J Plast Surg.* 1981;34:215–220.
24. Mukai Y, Watanabe T, Sugimoto M, Kimata Y, Namba Y. Vaginoplasty with a pudendal-groin flap in male-to-female transsexuals. *Acta Med Okayama.* 2017;71:399–405.
25. Abbe R. New method of creating a vagina in a case of congenital absence. *Med Record (1866-1922) Am Period.* 1898;54:836.
26. Raya-Rivera AM, Esquiliano D, Fierro-Pastrana R, et al. Tissue-engineered autologous vaginal organs in patients: a pilot cohort study. *Lancet North Am Ed.* 2014;384:329–336.
27. Abraham F. Genital reassignment on two male transvestites (genitalumwandlungen an zwei männlichen transvestiten). *Int J Transgender.* 1998;2:223–226.
28. Goffe JRA. A Pseudohermaphrodite, in Which the female characteristics pre-dominated; operation for removal of the penis and the utilization of the skin covering it for formation of a vaginal canal. *Am J Obstet Dis Women Children.* 1903;48:755–763.
29. Gillies H, Millard RD. *The Principles and Art of Plastic Surgery.* 1st ed. Little: Brown and Company; 1957. Vol 2.
30. Kennedy P. *The First Man-Made Man: The Story of Two Sex Changes, One Love Affair, and a Twentieth-Century Medical Revolution.* Bloomsbury, USA; 2007.
31. Edgerton MT, Bull J. Surgical construction of the vagina and labia in male transsexuals. *Plast Reconstr Surg.* 1970;46:529–539.
32. Wangjiraniran B, Selvaggi G, Chokrungravanont P, Jindarak S, Khobunsongserm S, Tiewtranon P. Male-to-female vaginoplasty: Preecha's surgical technique. *J Plastic Surg Hand Surg.* 2015;49:153–159.
33. de Savitsch E. *Homosexuality, Transvestism and Change of Sex.* Charles C Thomas; 1958.
34. Markland C, Hastings D. Vaginal reconstruction using bowel segments in male-to-female transsexual patients. *Arch Sex Behav.* 1978;7:305–307.
35. Bouman MB, van Zeijl MCT, Buncamper ME, Meijerink WJH, van Bodegraven AA, Mullender MG. Intestinal vaginoplasty revisited: a review of surgical techniques, complications, and sexual function. *J Sex Med.* 2014;11:1835–1847.
36. Garcia MM, Shen W, Zhu R, et al. Use of right colon vaginoplasty in gender affirming surgery: proposed advantages, review of technique, and outcomes. *Surg Endosc.* 2020;35:1–12. Published online.
37. Morrison SD, Satterwhite T, Grant DW, Kirby J, Laub DR, Van-Maasdam J. Long-term outcomes of rectosigmoid neocolporrhaphy in male-to-female gender reassignment surgery. *Plast Reconstr Surg.* 2015;136:386–394.
38. Dy GW, Jun MS, Bluebond-Langner R, Zhao LC. Outcomes of gender affirming peritoneal flap vaginoplasty using the da vinci single port vs xi robotic systems. *Eur Urol.* 2021;79:676–683. <https://www.sciencedirect.com/science/article/pii/S0302283820304693>.
39. Dy GW, Blasdel G, Shakir NA, Bluebond-Langner R, Zhao LC. Robotic peritoneal flap revision of gender affirming vaginoplasty: a novel technique for treating neovaginal stenosis. *Urology.* 2021;154:1–7.
40. Stoeckel W. Zur operativen Herstellung einer künstlichen Vagina. *Monatsschrift für Geburtshilfe und Gynäkologie.* 1919;49-50:129–140.
41. Schauta F, Gersuny R. Report from obstetric gynecological society meeting in vienna march 8th, 1904. i. gersuny: eine operation bei angeborenem defekte der scheide mit demonstration der pat. *Zentralblatt für Gynäkologie.* 1904;29:18–19.
42. Hage JJ, Goedkoop AY, Karim RB, Kanhai RCJ. Secondary corrections of the vulva in male-to-female transsexuals. *Plast Reconstr Surg.* 2000;106:350–359.
43. Brown J. Creation of a functional clitoris and aesthetically pleasing introitus in sex conversion. *Transactions of the sixth international congress of plastic and reconstructive surgery.* Paris: Masson; 1976:654–655. Published online.
44. Barinka L, Stavratjev M, Toman M. Plastic adjustment of female genitals in adrenogenital syndrome. *Acta Chir Plast.* 1968;10:99–106.
45. Ciotti P. Why did he cut off that man's leg? *LA Weekly.* 1999. <https://www.laweekly.com/why-did-he-cut-off-that-mans-leg/>. Published.
46. Hage JJ, Karim RB, Bloem JJAM, Suliman HM, Alphen M van. Sculpturing the neoclitoris in vaginoplasty for male-to-female transsexuals. *Plast Reconstr Surg.* 1994;93:358–364.
47. Perovic S. Male to female surgery: a new contribution to operative technique. *Plast Reconstr Surg.* 1993;91:703–711.
48. Eldh J. Construction of a neovagina with preservation of the glans penis as a clitoris in male transsexuals. *Plast Reconstr Surg.* 1993;91:895–900.
49. Zilavy A. Figure 2. *Peritoneal Flap Gender-Affirming Vaginoplasty.* 2021.
50. Zilavy A. *Random Medial Thigh Flaps and Inguinopudendal Pedicled Fasciocutaneous Flaps.* 2021.
51. Zilavy A. *Split Thickness Skin Graft.* 2021.
52. Zilavy A. *Penile Inversion Vaginoplasty.* 2021.
53. Zilavy A. *Bowel Substitution Vaginoplasty.* 2021.
54. Zilavy A. Figure 1. *Timeline.* 2021.