

## A Comprehensive Review of Vaginoplasty Procedures for Vaginal Agenesis Reconstruction

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### ABSTRACT

This literature review provides a comprehensive analysis of the vaginoplasty procedure for vaginal agenesis reconstruction. Vaginal agenesis is a rare disorder in which the vagina does not develop, and the womb (uterus) may only develop partially or not at all. This congenital condition can significantly impact the quality of life and psychosocial well-being of affected individuals. Vaginoplasty, a surgical method aimed at creating a neovagina, offers a promising solution for these patients. This review critically examines the existing literature, including studies, case reports, and systematic reviews, to evaluate the various surgical methods, outcomes, complications, and patient satisfaction associated with vaginoplasty for agenesis vagina reconstruction.

**KEYWORDS:** Vaginoplasty, agenesis vagina reconstruction, congenital vaginal aplasia, neovagina, surgical methods, outcomes, complications, patient satisfaction.

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### I. INTRODUCTION

Vaginal agenesis, also known as congenital vaginal aplasia or Müllerian agenesis, is a rare congenital anomaly characterized by the absence or underdevelopment of the vagina in females. This condition can have a significant impact on the physical, psychological, and sexual well-being of affected individuals. Vaginal agenesis is considered a rare congenital anomaly, with an estimated prevalence of approximately 1 in 4,000 to 5,000 female births in the global population.<sup>1</sup> The rarity of this condition can pose challenges in terms of early diagnosis and appropriate management. The comprehensive epidemiological data on the prevalence of vaginal agenesis in the Asian population has not been extensively studied. The incidence and prevalence rates of this condition within the Indonesian population are also limited. Further research and comprehensive epidemiological studies are needed to determine the exact prevalence of vaginal agenesis in Indonesia and its potential variations among different regions and ethnic groups within the country.

Understanding the clinical significance of vaginal agenesis is crucial for appreciating the importance of vaginoplasty as a reconstructive procedure. There are several impacts of vaginal agenesis on women, encompassing both the physical

and psychosocial aspects of their lives. Women with vaginal agenesis may experience menstrual difficulties,<sup>2,3</sup> such as the absence of vaginal bleeding, menstrual fluid accumulation, or the need for alternative methods to manage menstrual flow. Vaginal agenesis also affects reproductive health, as the absence of a functional vagina may lead to difficulties or impossibility in achieving vaginal intercourse, which can impede natural conception.<sup>3</sup> Furthermore, vaginal agenesis can increase the risk of urinary tract infections and urinary retention due to anatomical abnormalities and difficulty in maintaining proper hygiene.<sup>4</sup>

In term of psychological and psychosocial impact, vaginal agenesis can negatively affect body image and self-esteem due to feelings of inadequacy, stigma, and a sense of being different from peers. Women with vaginal agenesis may also experience psychological distress, including depression, anxiety, and impaired quality of life, stemming from the challenges and limitations imposed by the condition. Vaginal agenesis significantly impact sexual function and intimate relationships, leading to decreased sexual satisfaction, difficulties in engaging in penetrative sexual intercourse, and challenges in forming intimate connections. All the aforementioned later affect partner relationships, as it may require adjustments in sexual intimacy,

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communication, and emotional support. In social relationships, women with vaginal agenesis may face challenges in social settings, such as dating, disclosure of their condition, and potential stigma or misconceptions surrounding their sexual identity.<sup>5</sup>

Vaginoplasty, a surgical procedure aimed at creating a neovagina, offers a potential solution to restore normal anatomy and improve quality of life for these patients. The purpose of this literature review is to provide a comprehensive understanding of the procedure's surgical methods, outcomes, complications, patient perspectives, and future directions. By critically analyzing the existing literatures, this review aims to contribute to the body of knowledge surrounding this reconstructive option, informing clinical practice, improving patient care, and guiding further research in the field.

### II. VAGINAL AGENESIS

Vaginal agenesis, also referred to as Müllerian aplasia, is a congenital condition characterized by the absence (aplasia) or underdevelopment (hypoplasia) of the vagina, the uterus and the upper part (2/3) of the vagina. It is considered a rare congenital anomaly, with an estimated prevalence of approximately 1 in 4,000 to 5,000 female births in the global population.<sup>1</sup>

Vaginal agenesis can be found in The Mayer-Rokitansky-Kuster-Hauser (MRKH) syndrome and this syndrome come with normal secondary sex characteristics and a normal female karyotype (46,XX).<sup>1,6</sup> The first sign of MRKH syndrome is primary amenorrhea presenting with normal development of secondary sexual characteristics and normal external genitalia, with normal and functional ovaries and karyotype 46,XX.<sup>6</sup> Müllerian agenesis is caused by embryologic underdevelopment of the Müllerian duct, with resultant agenesis or atresia of the vagina, uterus, or both. The vaginal canal is markedly shortened and may appear as a dimple below the urethra. A single midline uterine remnant may be present or uterine horns (with or without an endometrial cavity) may exist. The ovaries, given their separate embryologic source, are typically normal in structure and function, though they may be found in atypical locations.<sup>7</sup>

In male embryos, anti-Müllerian hormone (AMH) inhibits the development of Müllerian structures, which led to idea of overexpression of AMH and its receptors as a cause of MRKH syndrome. Mutations in WNT4 were detected in patients with Müllerian aplasia and virilization/hyperandrogenism. WNT4 is a secreted protein that in humans is encoded by the Wnt4 gene, found on chromosome, and promotes female sex development and represses male sex development.

Furthermore, genetic variants have been reported in the WNT9B gene, involved in genitourinary development acting upstream of WNT4 protein. This anomaly is also hypothesized by chromosomal imbalances

(deletions/duplications) and several recurrent copy number variations (CNV) have been identified located at chromosomal regions 1q21.1, 16p11.2, 17q12, and 22q11.21. The most promising genetic CNVs are 17q12 and 16p11.2. The 17q12 locus encompasses LHX1 and HNF1B. Single nucleotide variants in LHX1 have been reported in MRKH syndrome and Lim1 knock-out in mice results in a Müllerian aplasia. Variants in HNF1B have been associated with various renal and uterine abnormalities.<sup>6</sup>

Evaluation of the patient with MRKH syndrome include assessing the testosterone level, FSH level, and karyotype. Initial radiologic evaluation includes trans-abdominal, trans-labial, or trans-rectal two-dimensional or three-dimensional ultrasonography to assess for the presence of a midline uterus. Rudimentary Müllerian structures are found in 90% of patients with Müllerian agenesis by magnetic resonance imaging (MRI). On ultrasonography, these rudimentary Müllerian structures are difficult to interpret and may be particularly misleading before puberty.<sup>1,2</sup> MRI images revealed that all the uterine cavities had expanded, and the atresia sites were above the inner urethral orifice. This may occur because the cervical wall's ductility is lower, and the menstrual blood accumulates in the uterine cavity and then reaches the pelvis through the fallopian tubes. When the cervical isthmus develops well, there might be less blood accumulation in the uterine cavity. The cervical canal expands largely, which could mimic distal vaginal atresia in the MRI image.<sup>7</sup>

There are 3 types of MRKH syndrome: type 1 is utero-vaginal aplasia, type 2 is hypoplasia or aplasia of utero-vaginal asymmetrically with 1 or 2 Fallopian tubes can be missing, ovaries malformation and/ renal system, and type 3 is best known as MURCS (Müllerian duct aplasia, renal dysplasia, and cervical somite anomalies).<sup>6</sup>

The surgical outcome in term of reproductive health is not always favorable after the first surgery, but with regular evaluations and controls, both primary and secondary surgery can have a successful results. Several researches have reported that patients with McIndoe surgery have a normal function of delivering menstrual blood and also have a spontaneous gestation. Similar outcome also came from the other procedures such as Vecchietti procedures and Davydov procedures.<sup>8,9</sup>

Body image concerns and self-esteem issues are common among patients with vaginal agenesis. The absence or underdevelopment of the vagina can affect one's perception of femininity and may lead to feelings of inadequacy or a negative body image. These concerns can impact self-esteem and contribute to a sense of social isolation or reduced confidence. Psychological distress, including depression and anxiety, is frequently observed in individuals with vaginal agenesis. Coping with the challenges of living with a condition that affects sexual and reproductive health can be emotionally challenging. Feelings of sadness, frustration, and anxiety about body image, relationships, and

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sexual intimacy can significantly impact a person's overall well-being.

Interpersonal relationships, including romantic and sexual partnerships, can be affected by vaginal agenesis. The condition may create communication barriers, difficulties in disclosing the condition to partners, or concerns about sexual functioning. These factors can strain relationships and lead to emotional distance or decreased satisfaction in intimate connections. Open and supportive communication, along with professional guidance, can help couples navigate these challenges and maintain healthy relationships. The impact on sexual intimacy is a significant concern for individuals with vaginal agenesis. The absence or underdevelopment of the vagina can affect sexual functioning and experiences. It may result in pain or discomfort during intercourse, reduced sexual desire, or challenges in achieving sexual satisfaction. These factors can lead to a decrease in sexual intimacy and potentially impact the overall quality of life for patients.

Many reports have revealed how the psychosocial outcome is getting better after reconstructive surgery. Patients have increased their self-esteem and have the same ability for sexual intimacy as a normal person. There are many tools to measure psychosocial impact, among them are the Female Sexuality Function Index (FSFI), Patient Health Questionnaire (PHQ), Brief Symptom Inventory (BSI), World Health Organization Quality of Life Assessment (WHOQoL-BREF); Parental Bonding Instrument (PBI), and a German questionnaire on body image.<sup>5, 10</sup>

Considering how the corrective procedure may include several body parts and the risk of complications related to it, the multidisciplinary team works together to provide comprehensive care and support to individuals with vaginal agenesis.<sup>11</sup> Plastic surgeons play a crucial role in the surgical management of this condition. One of the primary treatment options is vaginoplasty, a surgical procedure aimed at creating or reconstructing the vagina and creating a well-functional and aesthetically pleasing vaginal canal. The surgical method employed may vary based on the specific needs of the patient, such as the extent of the agenesis and individual preferences. Collaboration with gynecologists is essential for evaluating the patient's overall gynecological health and ensuring that any associated conditions, such as abnormalities of the reproductive organs or hormonal imbalances, are addressed appropriately. Gynecologists can provide preoperative assessments, hormonal therapy, and follow-up care, thereby enhancing the overall outcome of the treatment.

Psychologists also play a crucial role in the multidisciplinary approach. They provide counseling and support to individuals with vaginal agenesis, addressing the psychological and emotional aspects associated with the condition. Psychologists can help patients cope with body image concerns, sexual intimacy issues, and other psychological challenges that may arise due to living with

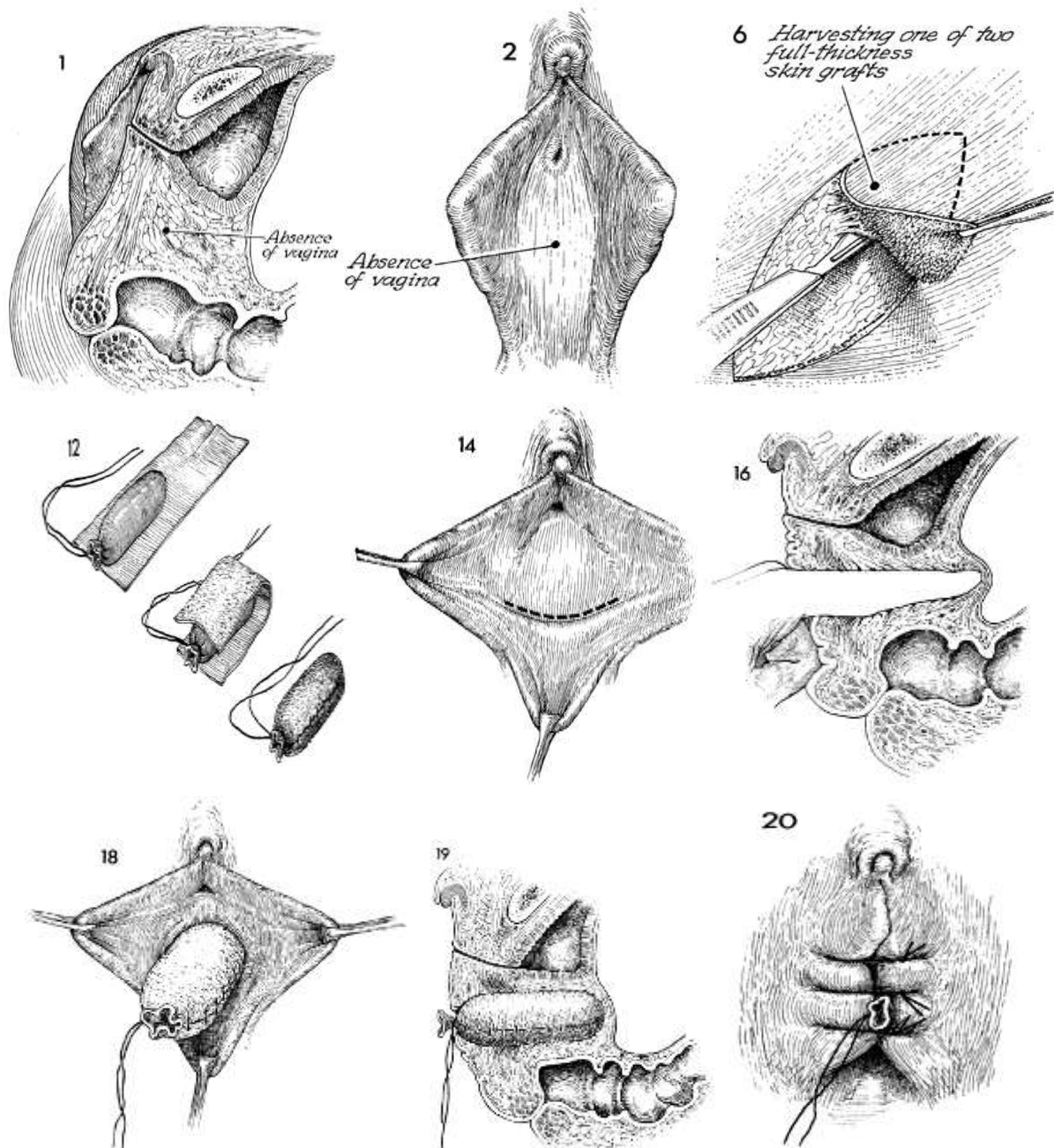
vaginal agenesis. Additionally, they can offer guidance and therapy to patients and their partners regarding sexual functioning and relationships. Other specialists, such as geneticists or endocrinologists, may be involved in cases where there is an underlying genetic or endocrine disorder contributing to vaginal agenesis. Their expertise can help identify and manage any associated conditions that may impact the patient's overall health and well-being.

### III. SURGICAL METHODS FOR VAGINOPLASTY

Primary vaginoplasty is the initial reconstruction surgical procedure for vaginal agenesis. There are several different types that may be offered, most of which are Abbé-McIndoe procedure, Vecchiotti procedure, and Davydov procedure.<sup>12</sup>

The **Abbé-McIndoe procedure** is the most common surgical procedure performed to create a neovagina in patients with congenital absence of the vagina. This method is by far the most popular and safe. It utilizes split-thickness skin grafting to line the vaginal space, and was first pioneered by Robert Abbé (1851–1928), before further popularized by Sir Archibald McIndoe (1900-1960). The original Abbé-McIndoe procedure consisted of the surgical creation of a vagina in between the bladder and the rectum and the successive lining with full-thickness skin grafting. Since the publication in 1938, numerous authors have reported good results in large series. Many modifications of the shape and the material of the mould, details of the method, and improvements in post-operative care have been suggested.<sup>13,14</sup> (see **Picture 1**)

McIndoe method places a sheet of skin graft on a vaginal mould and inserts them into the space that has been created to become the neovagina. The mould is left inside for the first several months after surgery in order to facilitate take of the skin grafting to the neovaginal inner lining and also to maintain patency of the neovaginal cavity fit for intercourse. As the skin is not a mucosal tissue, so it does not self-lubricate. Another setback is the skin graft contraction may increase the risk of narrowing (stricture) or even closing of the vaginal opening.<sup>14,15</sup>



Picture 1. McIndoe vaginoplasty<sup>17</sup>

McIndoe method has already had several modification. Tanner and colleagues modified this procedure by introducing the inner lining of neovagina with amnion graft, with the following report from Karjaleinen and associates suggested amnion graft provided a more superior result than the skin grafting. There is also a novel inflatable vaginal stent compliant with operating room procedures. This creation requires a silicone Foley catheter instead of a rigid stent. Its easy insertion and removal of the stent without disrupting the tissue graft help prevent tissue necrosis, and provide a fluid drainage port during graft adherence are some of this benefit stent.<sup>16</sup>

In 1965, an Italian gynecologist **Giuseppe Vecchiatti** (1914-1990) introduced his method for creating a neovagina in patients with vaginal agenesis, and published a scientific

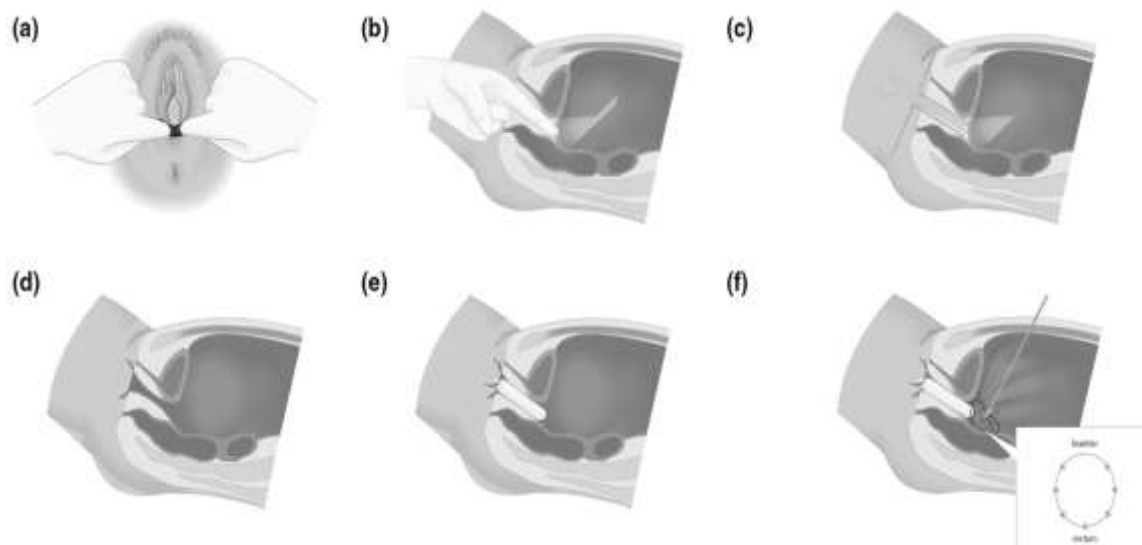
paper about it in the same year. This landmark publication described the use of a traction device to gradually create a neovagina by applying tension to a vaginal mould inserted in the patient's pelvic cavity. The Vecchiatti procedure offered a less invasive alternative to traditional surgical methods for vaginal reconstruction and has since become an important method in the field of vaginoplasty.<sup>18</sup> (see **Picture 2**)

Vecchiatti procedure is a trans-vaginal operation and laparoscopic surgery. This procedure makes use of an epidural catheter (inserted in to Veress needle) for perineal puncture through a transverse incision in the center of the navel. Using laparoscopic surveillance and guided by the index finger in the rectum, a surgeon insert the Veress needle through the vesicorectal space, then pumping the

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epidural catheter from the core into the abdominal cavity. An epidural puncture needle with wire perforated the peritoneum through McBurney's point and the opposite

McBurney's point, pulling the epidural catheter out of the abdominal cavity.<sup>19,20</sup>

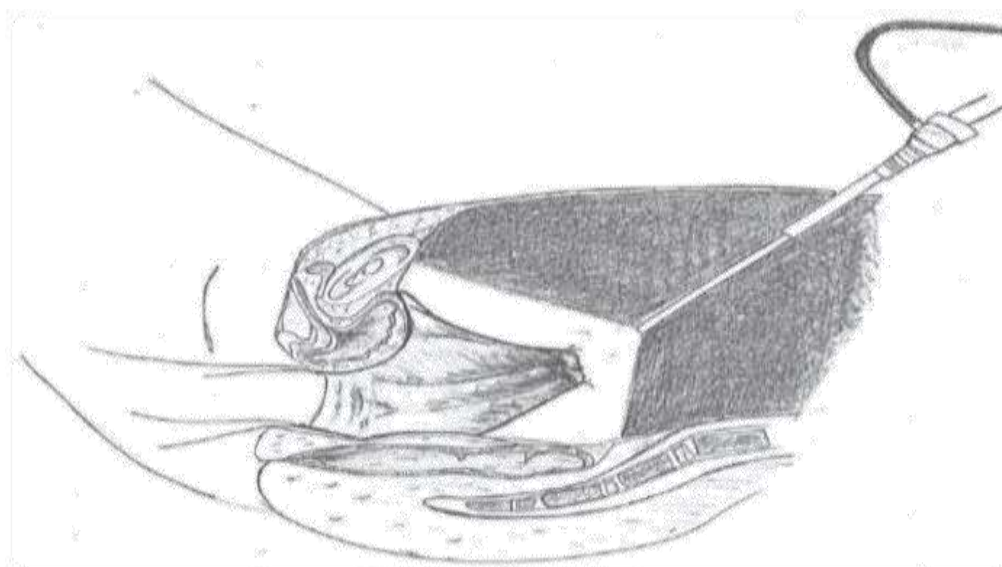


Picture 2. Vecchietti vaginoplasty<sup>20</sup>

A Russian gynecologist, **Sergei N. Davydov**, introduced the surgical method known as colpopoiesis using peritoneum for vaginoplasty in 1969. He utilized the patient's own peritoneum, the membrane that lines the abdominal cavity, to construct the neovagina and published his method in his original publication titled "*Operatsiia kol'popeza iz briushiny matochno-priamokishechnogo prostranstva*" (Colpopoiesis from the peritoneum of the uterorectal space) which later re-published in English language. By utilizing the peritoneum, Davydov aimed to provide a functional and anatomically similar neovagina with improved outcomes compared to previous methods. The use of peritoneum for vaginoplasty has since gained recognition as a viable option in certain cases, particularly for patients with limited or

unavailable local tissue for grafting. The Davydov method remains an important contribution to the field of vaginoplasty, providing an alternative method for neovagina construction with favorable results.<sup>20</sup>

The modified laparoscopic Davydov method involves a laparoscopic step and peritoneal step. During the laparoscopic step, after exploration of the pelvis and abdominal cavity, the strand that connects the 2 rudimental uterine horns is lifted, and the peritoneum immediately below is incised transversely for a section of 4 –5 cm. The perineal step allows the creation of an anastomosis between the previously incised pelvic peritoneum and the mucosa of the vaginal vestibulum.<sup>21</sup>



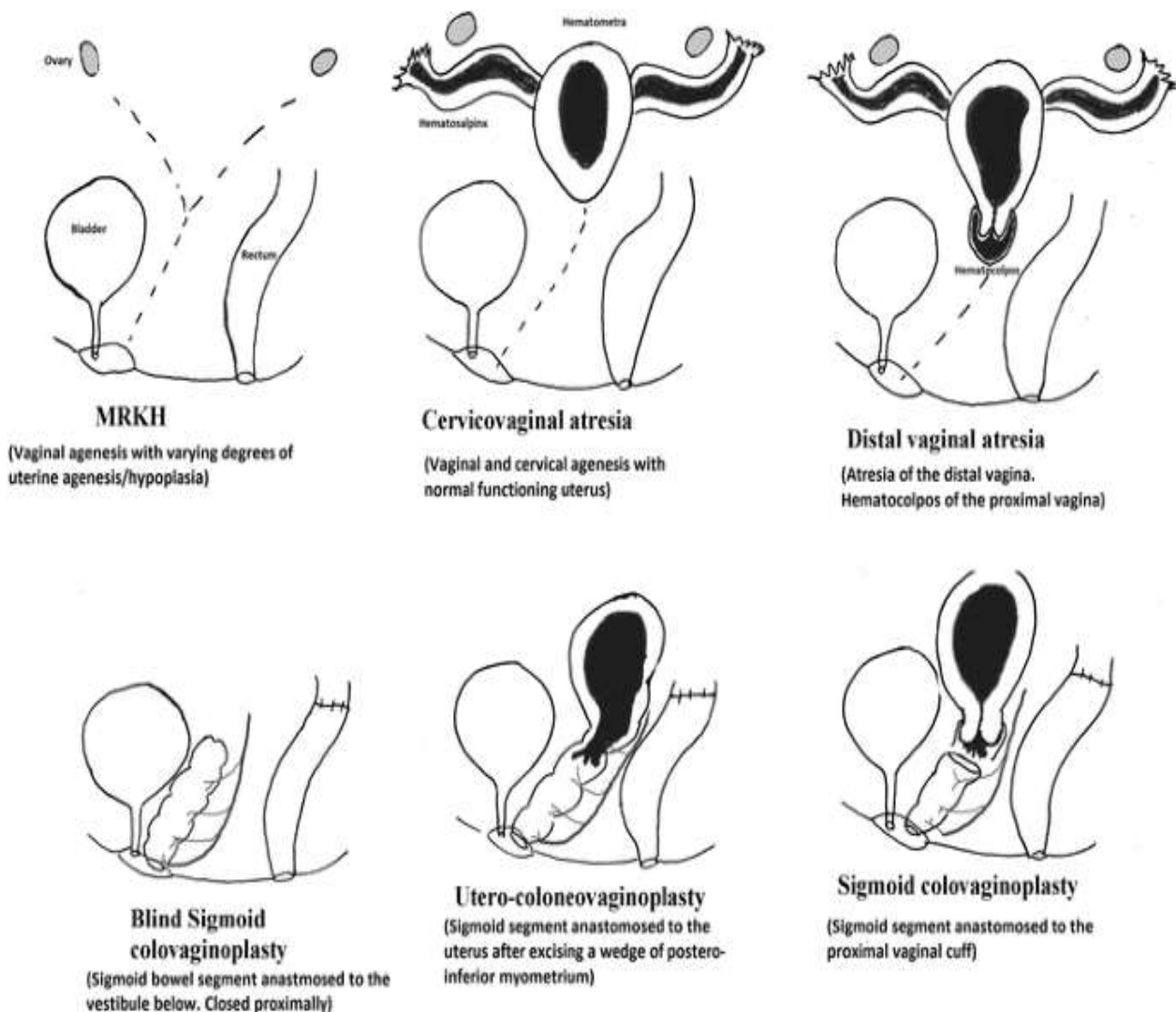
Picture 3. Davydov vaginoplasty<sup>21</sup>

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Beside vaginoplasties for primary intention, there are also secondary vaginoplasties as the procedures for stricture complication in patients with previous vaginoplasty. Several reports revealed that vaginoplasty procedure has high rates of revisions, with reports ranging from approximately 27% to 60% from cosmetic refinement to functional revision (usually secondary to neovaginal stenosis, though inadequate depth or, more seriously, fistula formation and prolapse), although such reconstruction mostly in gender affirmation surgeries due to penile inversion not in vaginal agenesis reconstruction surgery.<sup>12,13</sup>

In 1892, a Russian pioneer gynaecologist **Vladimir Fedorovich Snegirev** (1847-1917; **Sneguireff**, in western publication), introduced reconstruction of the neovagina using the rectal tissue and published it in French publication includes dissection of the sigmoid colon graft for vaginal reconstruction then create colorectal reanastomosis.<sup>23,24</sup> (see **Picture 4**)

as "*Un cas d'établissement d'un vagin artificiel au moyen d'une nouvelle méthode opératoire*" (A case of establishing an artificial vagina using a new surgical method), and in 1904 reported another two cases in German publication as "*Zwei fälle von restitutio vaginae per transplantationem*" (Two cases of vagina restitutions per transplantations). James Fairchild Baldwin IV (1850-1936) first reported the use of the small intestine in vaginoplasty in his publication "The formation of an artificial vagina by intestinal transplantation" in 1904.<sup>22</sup> Bowel or intestinal vaginoplasties have been used for secondary procedures ever since. Bowel vaginoplasty may utilize any part of the lower digestive tract including colon, caecum or ileum, however surgeons prefer to use sigmoid colon due to a lot of advantages. A sigmoid colovaginoplasty i



**Picture 4. Sigmoid colovaginoplasties for different type of vaginal agenesis<sup>23</sup>**

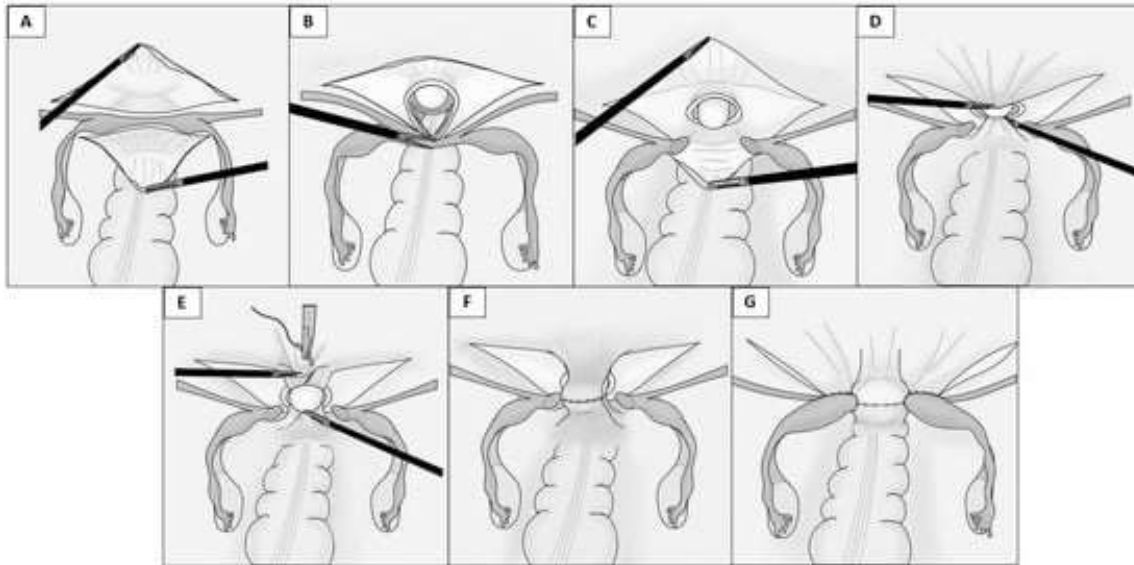
Beside using bowel tissue, there are also methods utilizing peritoneal tissue for vaginoplasty. **Davydov** used the peritoneal flap in vaginoplasty due to its several advantages such as a readily available graft material and a good blood supply. Peritoneal pull-through vaginoplasty is a newer

method based on the Davydov procedure. In peritoneal pull-through vaginoplasty, a peritoneal graft is utilized to create the neovaginal canal. The peritoneal tissue is harvested and shaped into a tube, which is then pulled through the pelvic space to form the neovagina. This method

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offers advantages such as a relatively simple procedure, minimal donor site morbidity, and the potential for a

natural-looking and functional neovagina.



**Picture 5. Kisu modification of Davydov vaginoplasty**

There is a Kisu modification of Davydov procedure, a laparoscopic creation of a neovagina using a modified peritoneal pull-down method with uterine strand incision. (A) The anterior and posterior peritoneal flaps (the peritoneum in the supravescical pouch and pouch of Douglas) are dissected extensively. (B) A transverse incision below the uterine strand serves as the opening of the neovaginal apex. (C) The uterine strand is divided via a longitudinal incision. (D) The anterior and posterior peritoneal flaps are pulled down through the neovaginal canal and sutured to the neovaginal introitus. (E) The neovaginal apex is created by suturing between the supravescical and suprarectal peritoneum at the target neovaginal length. (F) The neovaginal apex is shown before suturing the incised uterine strand to the lateral sides of the neovaginal apex. (G) The uterine strands provide additional structural support for the neovaginal vault.<sup>25</sup> (see **Picture 5**)

### IV. OUTCOMES AND COMPLICATIONS

Several literatures compared the outcomes of two treatment procedures between the conventional dilation methods and surgeries. Neovaginal depth between ones from surgeries and dilatation treatments are not much significant, however they revealed that the resulted neovaginas from dilatation treatments are a bit shorter (9.6 cm in average, range from 5.5 to 12 cm) compared to surgery group (11 cm in average, range from 6 to 15 cm). Both groups resulted in favorable results in term of neovaginal caliber, as two fingers can be inserted easily (around 3 cm).<sup>8,26</sup>

An assessment of sexual function utilizing the Female Sexual Function Index (FSFI, see **Picture 6**) between subjects receiving McIndoe and Davydov methods reported partners satisfaction scores were similar, both procedures gave no difference appearance of neovagina from the normal vagina and all patients had regular sexual activities.<sup>8</sup> There

is also a report that showed Vecchiotti procedure resulted in a good outcome in term of sexual satisfaction.<sup>27</sup> Sexual satisfaction rate was also high in intestinal vaginoplasty, scored above 26.5 on FSFI scale and were determined as having no sexual dysfunction.<sup>28</sup>

Vaginoplasty procedure also improve psychological well-being including sexual function, psychological status (depressive and somatic symptoms), quality of life, and own-body experience. The assessments of psychological being utilize tools like FSFI, psychological domain of the WHOQoL-BREF (see **Picture 7**), PHQ-15, and BSI Positive Symptom Total.<sup>10</sup>

Reported post-surgical complications include infection, hematoma, neovaginal stenosis and fistula formation. Long-term use of a mould as a foreign body is associated with development of infectious disease. It is important to maintain canal clean and not being infected. There were several reports of patients with infective complication following uterovaginal canalization that required hysterectomy for pelvic inflammatory disease, and even there was a report of death due to sepsis.<sup>9,29</sup> Hematomas usually happen in the first post-surgical week due to oozing from the urethra, which practically can be stopped by pressuring the local site, or should it not work, the surgeon can place a larger catheter (20F) with suture around it. Normally, localized hematomas spontaneously drain through the vagina or suture line. The blood characteristically appears dark, and is not accompanied by clots.<sup>30</sup> Neovaginal stenosis is the major post-surgical complication in vaginal agenesis/cervical atresia is infection and stenosis of the neocanal. Many of these cases required catheters to maintain patency of the neocanal.<sup>9,29</sup> A dreaded post-surgical complication of vaginoplasty is utero-vesical fistula, presenting as Youssef's Syndrome; a triad of menouria, amenorrhea and urinary continence.<sup>9</sup>

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### V. PATIENT SATISFACTION AND QUALITY OF LIFE

Clinicians assess post-surgical patient satisfaction using Female Sexuality Function Index (FSFI) and assess their post-surgical quality of life using World Health Organization Quality of Life Assessment (WHOQoL-BREF).<sup>10</sup> FSFI consists of 19 items subdivided into six domains: desire,

arousal, lubrication, orgasm, satisfaction, and pain.<sup>10</sup> It evaluates sexual function in women during the past 4 weeks, with full-scale scores ranging from 2.0 to 36.0, with higher scores indicating better sexual function. Scores less than 23 are considered “poor” sexual function, “good” when ranging between 24 and 29, and “very good” when  $\geq 30$ .<sup>10</sup> (see **Picture 6**)

#### FSFI SCORING APPENDIX

Question	Response Options
1. Over the past 4 weeks, how <b>often</b> did you feel sexual desire or interest?	5 = Almost always or always 4 = Most times (more than half the time) 3 = Sometimes (about half the time) 2 = A few times (less than half the time) 1 = Almost never or never
2. Over the past 4 weeks, how would you rate your <b>level</b> (degree) of sexual desire or interest?	5 = Very high 4 = High 3 = Moderate 2 = Low 1 = Very low or none at all
3. Over the past 4 weeks, how <b>often</b> did you feel sexually aroused (“turned on”) during sexual activity or intercourse?	0 = No sexual activity 5 = Almost always or always 4 = Most times (more than half the time) 3 = Sometimes (about half the time) 2 = A few times (less than half the time) 1 = Almost never or never
4. Over the past 4 weeks, how would you rate your <b>level</b> of sexual arousal (“turn on”) during sexual activity or intercourse?	0 = No sexual activity 5 = Very high 4 = High 3 = Moderate 2 = Low 1 = Very low or none at all
5. Over the past 4 weeks, how <b>confident</b> were you about becoming sexually aroused during sexual activity or intercourse?	0 = No sexual activity 5 = Very high confidence 4 = High confidence 3 = Moderate confidence 2 = Low confidence 1 = Very low or no confidence
6. Over the past 4 weeks, how <b>often</b> have you been satisfied with your arousal (excitement) during sexual activity or intercourse?	0 = No sexual activity 5 = Almost always or always 4 = Most times (more than half the time) 3 = Sometimes (about half the time) 2 = A few times (less than half the time) 1 = Almost never or never

**Picture 6. The Female Sexual Function Index (FSFI)**

The WHOQoL-BREF is a brief version of the World Health Organization Quality of Life Assessment. It consists of 26 items belonging to four domains: “Physical Well-Being”, “Psychological Well-Being”, “Social Relationships and Environment”, and “Global value”. Scores ranging from 0 to 5 points can be assigned to each item, and the final domain

scores range from 0 to 100. The higher the scores mean the better the perceived quality of life.<sup>10</sup> (see **Picture 7**)





Picture 7. The World Health Organization Quality of Life Assessment (WHOQoL-BREF)

Most studies reported that 12-24 months after vaginoplasty surgeries, whether they are primary or secondary, all patients showed favorable outcome. The same literatures also revealed that despite various methods of vaginoplasty available for vaginal agenesis, stenosis due to not using the dilatator continuously or not having intercourse was the most reported complication.<sup>9,10,29</sup>

**VI. COMPARISON OF RECONSTRUCTIVE METHODS**

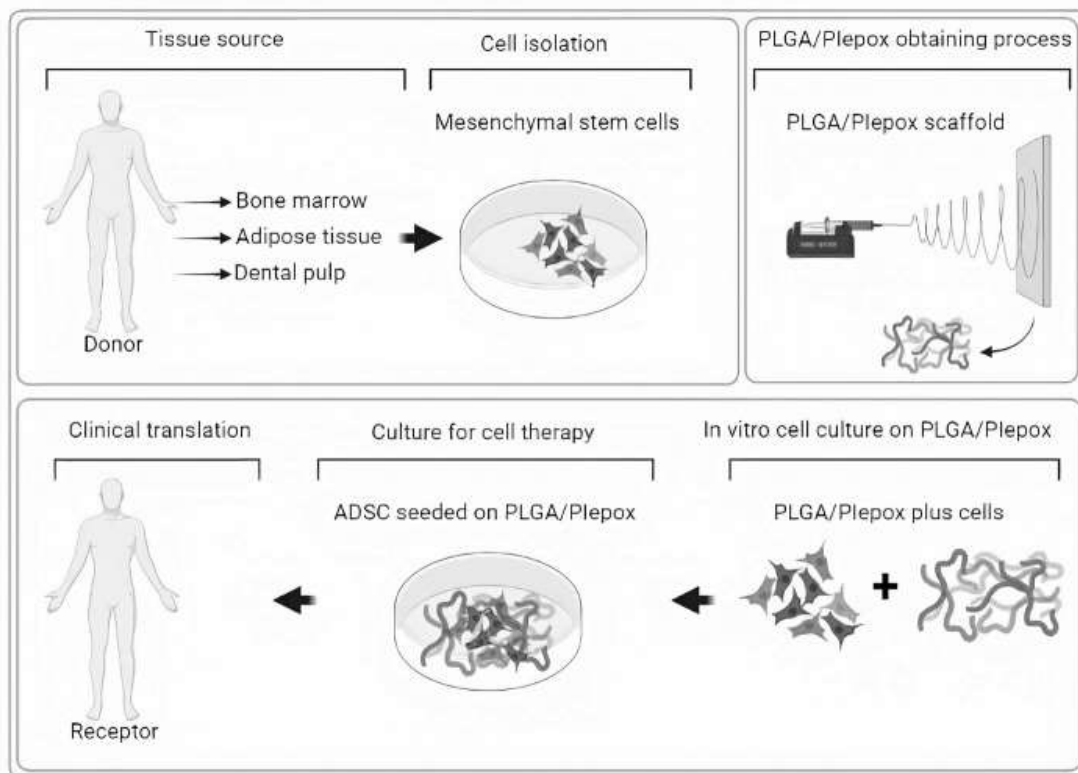
A few meta-analyses and systematic reviews compared conservative and surgical procedures for vaginal atresia. The surgical methods contained within the studies are various, such as McIndoe’s method, Vecchietti’s, Davydov’s, bowel method, and peritoneal method.<sup>9</sup> They stated that both conservative and surgical treatment has their own benefit and risk, depending on the situation that patient have, such as gender, age, patient comorbid, and cost.<sup>9</sup> The difference among the various surgical approaches lies in the tissues utilized to line the neovagina. The reconstruction with flaps is good due to its bulkiness and sturdiness, however flaps are not the procedure of choice in patients with MRKH syndrome because of its high failure rate due to tenuous vascularity of the flaps. The pudendal flaps risk even more, including flap dehiscence, infection, and drainage problems.<sup>9</sup>

The McIndoe procedure showed a good option due to its simplicity, low morbidity, and high success rates. Its disadvantages are risk of fistula formation, partial or total obliteration of the vagina, and long-term use of mould to keep neovaginal space open and escape re-obliteration.<sup>9</sup> Although McIndoe’s is still the most widely known and utilized method, a review by McQuillan and Grover mentioned that bowel vaginoplasty had recently been the most popular procedure. The use of bowel segment for vaginoplasty may be favorable for good vaginal sexual function, as (1) it is self-lubricating; (2) mucus production is less of a problem than with the use of small bowel; (3) it grows with the child when used before puberty; (4) there is minimal risk of stenosis; (5) it is close to the perineum; (6) it can easily be mobilized on its vascular pedicle; and (7) it does not require moulds.<sup>9</sup>

**VII. FUTURE DIRECTIONS AND INNOVATIONS**

One breakthrough method in vaginal reconstruction is robotic surgery. Robotic reconstruction of vagina using bowel segment is safe and feasible in certain condition. One study reported a successful robotic-assisted ileo-vaginoplasty for a patient with failed buccal mucosal graft vaginoplasty as a clinical and cystoscopic examination a year after the procedure revealed an adequate vaginal depth and dilatation.<sup>31</sup>

Newer studies introduced an innovation for vaginal reconstruction using MSC mesenchymal stem cell (MSC) transplantation, usually in combination with porous scaffolds fabricated from biocompatible and biodegradable like polymerspolylactide-co-glycolide acid. This method is used to overcome the main difficulties or side effect of conventional procedure. This potential offers hope to patients with diseases that are often ignored or treated inadequately with non-effective treatments. But it is still necessary to evolve in studies with the usage of signaling, such as synthetic factors or isolated cell factors in attempt to increase the treatment biosafety.<sup>32</sup> (see **Picture 8**)



**Picture 8. Process involving mesenchymal stem cells transplantation combined with poly(lactide-co-glycolide) acid scaffold**

Zhu and colleagues reported that patients with MRKH syndrome that undergone tissue-engineered biomaterial graft procedures showed no complications, with 100% successful anatomic formation and normal sexual function.<sup>33</sup> Such a breakthrough is quite a favorable statement, as we know that vaginoplasty has high rates of revisions, as literatures reported a range from 27% to 60% with indications from cosmetic revision to functional reconstruction (usually secondary to neovaginal stenosis, inadequate depth or, more seriously, fistula formation and prolapse).<sup>12</sup>

### VIII. CONCLUSION

Vaginal agenesis is a rare disorder in which the vagina does not develop, and the womb (uterus) may only develop partially or not at all. It can be found in The Mayer-Rokitansky-Kuster-Hauser (MRKH) syndrome and can be treated by various methods, both surgical and nonsurgical procedure. The non-surgical treatment is the first line therapy and using dilatation method. Several surgical procedures for vaginoplasties include Abbè-McIndoe procedure using skin grafting, Vecchiotti procedure using traction device, Davydov's colpoeisis using peritoneum, and Snegirev/Sneguireff procedure using the colorectal tissue. Every surgical procedure has each advantages and risks. Clinicians have to plan and perform surgeries with the most advantageous for each case. Regular evaluation and education after surgery is important to avoid complications and the needs for secondary surgeries.<sup>34</sup> Further researches and innovations such as tissue-engineered biomaterial grafting and robotic-assisted

surgical methods are essentially needed to support treatment that is less harmful and less complicating in vaginal agenesis patients.

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