Loop Electrosurgical Excision Procedure (LEEP)

In the late twentieth century, Sheldon Weinstein, a surgeon who worked in gynecology in the United States, invented the Loop Electrosurgical Excision Procedure, or LEEP, a procedure for removing abnormal, pre-cancerous cells from a woman's cervix in the US. LEEP, also known as the Large Loop Excision of the Transformation Zone, involves inserting a wire loop heated by an electrical current into a woman’s vagina to remove the entire surface layer of cells in the cervix, the passage between the vagina and the bottom of the uterus. The procedure removes cells with pre-cancerous changes before they progress into cervical cancer. Women who receive LEEP often spend less than an hour at their gynecologist's office for the procedure and may experience side effects such as cramping and light bleeding. LEEP replaced several invasive and potentially dangerous cervical cancer treatments, providing a quick and inexpensive way to remove women's pre-cancerous cervical cells before they progress to cervical cancer.

According to the National Cancer Institute, the causes of virtually all cases of cervical cancer are different strains of the same type of virus, known as the Human Papillomavirus, or HPV. In 1976, virus researcher, Harald zur Hausen first proposed that Human Papillomavirus, a virus transmitted through sexual contact and body fluids, caused cervical cancer. Since then, scientists have discovered that two main strains of HPV, strains HPV16 and HPV18, cause over seventy percent of cases of cervical cancers and created vaccines that protect men and women from contracting those strains of HPV. For non-vaccinated women, physicians can find areas with pre-cancerous cells during Pap smears, and those cell areas may need technologies like LEEP to remove cells for further testing. As of 2022, The US Centers for Disease Control and Prevention, or CDC, recommends that all women, regardless of vaccination status, continue to receive regular Pap smears to check for cellular changes in the cervical tissue.

The American College of Obstetricians and Gynecologists defines LEEP as a technology that physicians use to remove pre-cancerous cervical cells from women. Physicians often use LEEP after a woman has an abnormal cervical cancer screening result. Most cervical cancer screenings involve using a Pap smear. During a Pap smear, a physician uses an instrument called a speculum to hold the walls of the woman’s vagina apart to see the cervix and scrapes the cervix with a spatula-like device to obtain cell samples. Smearing the cells on a glass slide before stabilizing and staining them allows a technologist to examine them under a microscope to see if there are any cervical cancer or pre-cancer present. Cervical pre-cancer consists of abnormal cellular changes on the surface of the woman’s cervix that have not progressed deeper into the tissues. Pre-cancer differs from actual cancer, which is an uncontrolled division of cells, normally in the form of a tumor. When there is evidence of cervical pre-cancer or early stages of cervical cancer, the physician may use LEEP to remove the areas on the woman’s cervix with abnormal cell changes. By inserting a small wire loop into the patient’s vagina through which an electrical current flows, the wire acts as a cutting instrument to remove the areas on a woman’s cervix where there may be pre-cancer or cervical cancer tissue. LEEP primarily treats pre-cancerous cervical changes found during screening methods.

Prior to LEEP, medical professionals used many therapies in attempts to remove cervical cancer tumors and cells from women's cervixes. In the early twentieth century, some physicians surgically placed glass vials of radium into women's uteruses. That procedure led to infertility among those women and an increased risk of premature death from radium exposure. Throughout the mid-twentieth century, physicians surgically removed either the entire uterus or the visible cervical cancer tumors that were visible, either with a scalpel or with a heat source designed to remove cancer. Another commonly used procedure was cold-knife conization, also called a cone biopsy, which is when a physician uses a knife to remove the pre-cancerous cervical cells. Researchers

found that cold-knife conization results in higher risks of pre-term delivery and perinatal mortality for women who become pregnant after the procedure than those who receive LEEP. The risks of hemorrhage, or profuse bleeding, also increase with cold-knife conization procedures.

LEEP also carries risks of infection, bleeding, a chance of scarring the cervix by removing tissue, trouble getting pregnant, and low birth weight babies. Despite risks associated with the procedure, many physicians recommend LEEP for women who experience pre-cancerous cervical changes. However, many earlier stages of cervical cancer are not visible to the naked eye, and patients can die from only treating cancer in its later, more advanced stages.

According to the alumni news of the University of Pittsburgh Medical School in Pittsburgh, Pennsylvania, a 1963 MD graduate Sheldon Weinstein invented the LEEP sometime during the 1970s to treat early stages of cervical cancer and pre-cancer before it developed into advanced cervical cancer. Gynecological researchers Michelle Khan and Karen Smith-McClure state that physicians readily adopted the LEEP over traditional removal techniques due to concerns that those other therapies were not fully treating pre-cancer and invasive cervical cancers that did not exhibit any symptoms.

Weinstein designed LEEP to treat cervical dysplasia. Dysplasia, or cervical intraepithelial neoplasia, is the abnormal growth of cells on the surface of a woman's cervix. While cervical dysplasia is not cancer, it can progress to eventually become cervical cancer, making it a type of pre-cancer. The progression of a woman's cervical dysplasia is based on how many abnormal cells are present, from Grade I for the lowest number of abnormal cells to Grade III for the highest number of abnormal cells. The American Society of Obstetricians and Gynecologists recommends treatment with LEEP if cervical cells taken during a Pap smear or examined visually exhibit either cervical pre-cancers or more advanced abnormalities than cervical dysplasia.

Physicians administer LEEP after the woman has an abnormal Pap smear. Women who require a LEEP visit their gynecologist's office to receive the procedure. The purpose of LEEP is to both remove the cervical tissue with the abnormal, pre-cancerous cellular changes, and further examine the cervical tissue to ensure there is no cancer in the deeper tissue layers. The physician asks the woman to lay down and put her feet into stirrups, and then inserts a speculum into the woman's vagina to see the cervix. The physician performing LEEP procedure may inject local anesthetic such as lidocaine directly into the cervical tissue, or the doctor may use a general anesthetic so that the patient is fully unconscious during the procedure. The device for the procedure is a long metal probe with a wire loop at the end. An electrical current passes from a power source to the wire loop, allowing the loop to heat up and function as a scalpel to remove the pre-cancerous cervical tissue. Often, physicians remove the entire exposed layer of the cervix with the loop device, up to six or seven mm. The physician removes the tissue sample from the vagina, fixes it in formalin, a mixture of formaldehyde and water, and sends it to a lab for additional testing. The physician then can either apply a paste designed to stop the bleeding, or can cauterize, or burn, the remaining tissue to stop the bleeding of the entire cervical surface.

The Mayo Clinic states that the most common side effects of LEEP include mild cramping, brown discharge, and light bleeding. Doctors also state that women should avoid inserting anything into their vaginas for up to six weeks following the procedure to allow for the cervix to heal. Beyond common side effects of LEEP, some women report difficulties in getting pregnant and maintaining a full-term pregnancy. Various studies have indicated that there may be a connection between early pre-term delivery and patient history of having LEEP. Additionally, some researchers argue that the removal of the surface of the cervix via LEEP might make it easier for the cervix to dilate early on in pregnancy, which may result in a miscarriage or premature birth.

A 2013 study from a team of researchers at the University of Iowa in Iowa City, Iowa, showed a correlation between cervical surgeries, including LEEP, and difficulty becoming pregnant. The researchers analyzed 1,324 women who gave birth in the state of Iowa between May 2002 and June 2005 for how long it took for them to reach a wanted pregnancy. Of the participants, 77.1 percent of the women had not received any surgical intervention, 11.4 percent had a punch biopsy, or removal of a small sample of tissue removed for diagnosis, and 11.5 percent, had cervical surgery. Because of the small sample of cervical surgeries, the researchers grouped the surgeries, resulting

in forty-six cone biopsies, forty-five LEEPs, forty-four cryosurgeries that use intense cold to destroy tissue, and seventeen laser vaporizations that converts tissue to a gas, as a single treatment category. The researchers specifically looked for which participants took more than twelve months to become pregnant. They state that over one year of trying to become pregnant indicates reproductive difficulty. In the no surgery group, 9.4 percent of the women took longer than twelve months to become pregnant. For women in the surgery group, over sixteen percent took longer than twelve months to become pregnant. The researchers concluded that women who have undergone LEEP and other cervical procedures have a higher risk of reproductive difficulty. The researchers state that LEEP and other cervical surgeries likely remove some of the mucus-producing tissues of the cervix, which help sperm to travel into the uterus.

Another study found that women who became pregnant shortly after a LEEP had an increased risk for a miscarriage. In 2013, the same year as the Iowa study, a team of researchers at Washington University in St. Louis in St. Louis, Missouri, published a study focusing specifically on pregnancy outcomes after LEEP. The researchers used data from 596 women who had been pregnant between 1996 and 2006. For the women who became pregnant within twelve months after receiving LEEP, the researchers found that they had a 17.9 percent experienced a miscarriage. For the women who became pregnant over twelve months after receiving LEEP, 4.6 percent experienced a miscarriage. The researchers found no connection between LEEP and preterm birth.

Despite possible side effects from LEEP, most physicians support it as the safest procedure for removing pre-cancerous cervical cells as of 2022. LEEP treats cervical pre-cancers by removing them before they can progress into advanced, deadlier cervical cancers. According to the National Institutes of Health, since 1975, rates of cervical cancer cases have fallen by about fifty-five percent, and rates of death from cervical cancer have fallen by about sixty percent. In 2021, the CDC projected that 14,480 women in the US will develop new cases of cervical cancer in the following year, and 4,290 women will die from cervical cancer. As of 2022, LEEP will continue to be a method for treating cervical pre-cancer and lowering the risk of death from cervical cancer.

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