The Colposcope and Colposcopy (1925–1980) [1]

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Colposcopy is a technique used to examine the vagina [2] and cervix [3] to identify abnormalities or earlier stages of cervical cancer. During an exam, a physician uses an instrument, called a colposcope, that illuminates and magnifies the tissues. Hans Hinselmann developed the colposcope in December of 1924 in Hamburg, Germany. Hinselmann's colposcope enabled doctors to detect cervical tumors when they were relatively small. By the twenty-first century, doctors used colposcopy as a follow-up procedure to an abnormal Pap test result to confirm or disconfirm the existence of any precancerous cells in the cervix [3].

In 1901, at the University of Bonn [4] in Bonn, Germany, Otto von Franqué established that abnormalities in cervical tissues played a role in cervical cancer. Franqué employed Hinselmann as an assistant to study leukoplakia, white, patch-like abnormalities on the cervix [3] visible to the unaided eye. Because of that assignment, Hinselmann began searching for a better way of viewing the cervix [3] and for identifying the early stages of cervical cancer.

The cervix [3] is the lower, narrow portion of the uterus [5] and is cylindrical or conical in shape. Only half of the cervix [3] is visible from the vagina [2]. The remainder lies above the vagina [2] beyond view. In the early twentieth century, diagnoses of cervical cancer consisted of palpation and visual examination. Physicians palpated the vagina [2] and cervix [3] by inserting their middle and index fingers into the vagina [2] to feel the cervix [3]. The physician then noted the position, shape, consistency, regularity, and tenderness of the cervix [3]. If physicians noted irregularities in the way the cervix [3] felt, they performed further examinations or procedures to determine why.

Hinselmann designed a device that magnified a physician's view of the cervix [3], using a set of lenses and an intense light source. Hinselmann mounted a binocular (made for two eyes) Leitz dissection microscope [6] on a tripod with a built-in light. The Optical Institute of Ernst Leitz in Wetzlar, Germany, produced the Leitz microscope [6] used in the colposcope. Hinselmann then attached the optical system to a stand, which enabled him to move it in many directions, and he added a screw mechanism in case he needed to adjust the height of the instrument. Hinselmann first used the colposcope in December of 1924, but did not report his findings until 1925. Hinselmann also proposed a classification system for the cervical abnormalities detected by colposcopy, especially early signs of cancer. He numbered the stages of cancerous development using roman numerals to indicate how far the cancer had spread.

During the colposcopy procedure, a woman lay on her back with her buttocks close to the end of the examination bed with the colposcope positioned directly in front of her. Next, the physician inserted a speculum, a metal device used to keep the vagina [2] open, so the cervix [3] can be easily accessed and clearly viewed. The physician examined the vagina [2] and cervix [3] for any abnormalities that may have required a biopsy. A biopsy is a sample taken from an affected area that a physician later views under a microscope [6] to determine if the cells are abnormal.

Most abnormalities, such as cancerous cells, occurred in the lower third of the cervix [3]. A physician swabbed the cervix [3] and vagina [2] with diluted acetic acid to highlight areas where the cells were discolored. Normal top layer cervical cells let light pass through to the underlying tissue, which should have been pink. But when there were abnormal cell proteins present, the cells below appeared white. The physician also identified abnormalities by looking for a characteristic pattern made by abnormal blood vessels. The white appearance of atypical areas enhanced the appearance of underlying abnormal blood vessels, which may have looked like a mosaic or punctuation marks. Where cancer invaded deeper structures, vessels took on the appearance of curlicues or question marks.

The physician conducting the colposcopy may have decided to obtain a biopsy from the most affected area, as indicated by white discoloration. The physician may have taken several samples, depending on the size of the abnormal area, removing a conical section of the cervix [3] for inspection under a microscope [6]. After the biopsy, treatments such as high heat (diathermy), extreme cold (cryotherapy), or lasers were used to eliminate the remaining cells that might be cancerous.

Some colposcopes allowed for up to forty times magnification, but the most useful views of the cervix [3] were usually gained at five to twenty times magnification. Lower magnification enabled the physician to have a wider view of the cervix [3] for general inspection, while the higher magnification enabled precise examination of areas of interest and possible abnormalities. Higher magnification was also used to examine any abnormal blood vessel development seen on the surface of the cervix [3]. Doctors used a green filter that intensifies the color of the fine blood vessels, a technique first described by Helmut Kraatz in Berlin, Germany, in 1939.

During the early nineteenth century, the colposcope became used more widely in Germany and parts of Europe than in the US. In 1928 in Vienna, Austria, Walter Schiller developed the Schiller test for staining cells in the cervix [3]. He applied iodine to the

cervix [3] to identify non-glycogenised areas, the cells that absorbed the iodine because they had no glycogen, of the cervix [3] for subsequent biopsy. The Schiller test became a widely accepted technique among US gynecologists. Although later incorporated into the standard colposcopy procedures, for many years, the Schiller procedure delayed the use of colposcopy in the US.

Fred Emmert was one of the first to write about the colposcope in the US in 1931. While other gynecologists in the US were also interested in the colposcope, they criticized it for being too cumbersome and bulky. Physicians also had to receive specific training to use the instrument and to see the cell structure of cervix [3] to be able to view and analyze it through the colposcope.

When World War II broke out in Europe in 1939, it disrupted communication between Europe and the US, further preventing the spread of the colposcope. Additionally, George Papanicolaou's work on cervical cancer provided another way to screen women for cervical cancer. Working at Cornell University [7] Medical College in New York City, New York, Panaicolaou developed a method for identifying cervical cancer, called the Pap test. Shortly after Hinselmann published on his technology, Papanicolaou developed a procedure in which a medical professional scraped cells from the cervix [3] or vagina [2] and smeared them on a microscope [6] slide. Later, a pathologist examined those cells under a microscope [6], looking for abnormal cells that may have indicated cancer. By the 1960s, the medical community used the Pap test, named after Papanicolaou, as the primary way to test for cervical cancer.

Medical professionals in the other parts of the world medical professionals did not adopt the Pap test as the standard for cervical cancer pre-screening. Some instead adopted the colposcope for examining the cervix [3] for cervical cancer. Albert Singer in the UK, Karl Bolten in the US, and Malcolm Coppleson in Australia traveled to Germany after World War II to train on how to use the colposcope. They used the colposcope as a diagnostic tool, as opposed to screening technique, for evaluation of the abnormal cervical cells. Coppleson established the first Australian colposcopy clinic at Royal Prince Alfred Hospital in Sydney, Australia, in the 1950s. Likewise, Bolten returned to the US to establish colposcopy clinics in Louisiana, where he also trained physicians in the technique. More physicians began using colposcopy in the 1960s, and some of Bolten's students established the American Society for Colposcopy and Colpomicroscopy in 1964.

The colposcope's design has remained essentially the same since its conception [8]. However, over time, physicians began to use halogen lights because they produced a particularly clean, white light. Many modern colposcopes are also equipped with digital still or video equipment to take photographs or videos of the the procedure and its findings.

Even though Papanicolaou's screening test became the standard for cervical cancer screening in the US by the 1960s, by the 1970s, colposcopy became the standard follow-up procedure if a physician noted abnormalities in a woman's Pap. However, in Germany, Latin America, and South America, physicians incorporated colposcopy into regular women's examinations and used it as the primary screening technique for cervical cancer. Later, cryosurgery and carbon dioxide laser surgery were introduced as out-patient treatments to test for cervical cancer. Colposcopy also became an important tool in the detection, diagnosis, and treatment of human papillomavirus infections (HPV) in men and women.

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