

PRINCIPLES OF SURGICAL TECHNIQUE*

WITH PARTICULAR REFERENCE TO THE USE OF SILK

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THE principles of surgical technique here discussed are based to a great extent upon observations and work done at Peter Bent Bringham Hospital, the Harvard Medical School, and in private practice.

Dr. Elliott C. Cutler tells the following story about Dr. Harvey Cushing: When Dr. Cushing had completed his training in surgery at the Massachusetts General Hospital, he received an appointment as assistant to Dr. Halsted at Johns Hopkins. From his training at Massachusetts General, he had come to believe that speed was an important factor, and regarded with considerable pride the fact that he had assisted Dr. J. C. Warren to perform a radical amputation of the breast in some twenty-two minutes. When he went to Johns Hopkins, Dr. Halsted requested him to observe their methods for a few days before beginning to assist. The first morning Dr. Cushing observed an operation, Dr. Halsted was doing an amputation of the breast. When nearly two hours had passed and Dr. Halsted had not completed the operation, Cushing had become rather anxious about the patient's condition. Finally after nearly two and a half hours the operation was completed, and by that time Cushing's anxiety had about reached the limit. Late that afternoon when Dr. Halsted was making rounds he went in to see the patient and found Dr. Cushing there with saline, strychnine, etc., all ready. It was then that Dr. Cushing explained his anxiety concerning the patient and stated he considered her badly shocked. Dr. Halsted told him if she was shocked it could be easily determined by

taking her blood pressure. They took the blood pressure and to the amazement of Dr. Cushing it was normal. Then they took up one by one the questions of giving her strychnine and other remedies Dr. Cushing had in the room, and after their discussion, Dr. Cushing was unable to give good reasons why the patient would be benefited by any of them. To Dr. Cushing's surprise and amazement the patient made an uneventful recovery.

Dr. Cushing often tells this story on himself to emphasize that hurry is not a good surgical principle. To be able to operate quickly and at the same time to observe certain well defined principles of surgery such as gentleness and careful hemostasis is fine, but no surgeon should attempt to hurry through an operation in a patient who is a good risk. He cannot hurry and at the same time observe the primary principles of gentleness and careful hemostasis.

There has been voluminous literature during the past two decades or more on the importance of preoperative preparation and postoperative care. I do not desire in any way to detract from the importance of all that has been written; in fact, I think it would be well to reemphasize and concur in the importance of careful pre- and postoperative measures. But this point I do want to make: if there has been proper preoperative investigation and preparation, and careful technique—including gentleness and hemostasis during operation—then there will be fewer postoperative complications, and the postoperative care will not play so important a part.

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I do not expect all surgeons to agree with some of the principles I follow, particularly in the use of silk. I probably would have disagreed with these same statements one year ago, particularly in reference to speed and the use of silk. I had always attempted to place considerable importance on speed, or perhaps what would be nearer correct would be to say speed to the extent of hurrying, and while I had seen some silk used, I have never been convinced of the logic of its use.

It is not my intention to discuss the technique of different surgical procedures. Dr. Cutler says: "If you are gentle, if you do not infect your patient, if you are careful about hemostasis, and have proper anesthesia, all other things being satisfactory in a good risk patient, you can operate on the patient as long as it is reasonably necessary." After observing his technique and seeing his patients after operation, I am inclined to believe what he says. Speed must never be obtained at the sacrifice of gentleness and careful hemostasis. The surprising thing to me is that Dr. Cutler's patients do not appear to be sick after surgical intervention as my patients used to be, and as those of other physicians frequently are. It is unusual to hear his patients complain to any particular extent; they look well, usually smiling, and the record in reference to temperature, pulse, respiration, etc., seems to bear that out. They do not seem to have the complications and distention I have been used to seeing. The temperature seldom goes above 100.5 F. at any time during their postoperative stay in the hospital. The postoperative appearance of patients, who in the vast majority of cases did not appear really sick, and whose charts indicated their unusually mild postoperative courses (much better than I had been accustomed to see), was the thing that convinced me of the logic of his teachings.

What are the factors in producing such satisfactory postoperative courses?

1. Careful hemostasis.
2. Gentleness.

3. The use of silk.

Of course there are other factors such as asepsis, proper anesthesia, etc. But these are observed by many surgeons who nevertheless are not able to obtain the mild postoperative course that is seen where gentleness and careful hemostasis are stressed, and where silk is used. Gentleness and hemostasis employed in the use of catgut are far different from the same connections when silk is used. The full significance of this is not appreciated until silk is actually employed. With silk a gentleness far beyond what one is accustomed to employ is necessary, because of the delicate nature of the fine silk used. As this gentleness improves, one naturally develops greater consciousness for better hemostasis. Gentleness and careful hemostasis go hand in hand with the use of silk.

I saw a bilateral herniorrhaphy performed, silk being used on one side and catgut on the other, with silk used in the skin on both sides. After three days the dressings were removed and those in the class who were not present when the operations were performed were asked to examine the wounds to see if they could determine on which side catgut had been used. All five men were able to state definitely on which side each had been used. On the catgut side the width of the area of induration and tenderness along the incision was about twice as great as on the silk side.

Dr. Shambaugh has reported on postoperative wound complications in a controlled series of 2,360 inguinal herniorrhaphies performed from 1914 to 1934, comparing silk and catgut. When catgut was employed, No. 1 or 2 chromic was used in the fascia, and No. 00 plain for the hemostatic ties. When silk was employed No. 4 black twisted silk was usually used, although occasionally No. 9 black twisted silk was used in the fascia.

In the 2,360 operations there were 108 infections, an incidence of 4.57 per cent. There were sixty-one minor wound complications (hematomas or serum), 2.59 per

cent. There were forty-seven suppurative infections, an incidence of 1.99 per cent.

During the past fourteen years there has been a more extensive use of silk and at the

TABLE I
INCIDENCE OF FAULTY WOUND HEALING IN CLEAN
INGUINAL HERNIORRHAPHIES*

Author	Number of Cases	Wound Infections		Total Wound Complications		Method of Skin Preparation
		No.	Per Cent	No.	Per Cent	
Coley.....	500	64	12.8	Iodine
Beckman.....	308	17	5.5			Not stated
Meleney.....	502	21	4.1	50	9.9	Ether, soap, iodine
Morian.....	1407	40	2.8	73	5.2	Not stated
Eliason.....	749	13	1.7	78	10.4	Soap and mercurochrome
P.B.B.H. series.	2360	47	1.9	109	4.5	Alcohol and bichloride

TABLE II
EFFECT OF AGE UPON THE INCIDENCE OF WOUND
INFECTIONS*

Age Group	Number of Operations	Suppurative Infections	
		No.	Per Cent
Under 50 years.....	1730	31	1.79
50 years and over.....	630	15	2.38

TABLE III
EFFECT OF LOCAL ANESTHESIA UPON THE INCIDENCE
OF WOUND INFECTIONS*

Anesthesia	Silk		Catgut			
	Total Cases	Suppurative Infections		Total Cases	Suppurative Infections	
		No.	Per Cent		No.	Per Cent
Local.....	557	8	1.43	85	2	2.35
General and spinal.....	727	10	1.37	878	25	2.84

* After Shambaugh, in *Surg., Gynec. & Obst.*, 64: 765, 1937.

same time an almost continuous decrease in the number of infections, so that out of a total of 511 operations during the past five years there were only seven infections (five suppurative infections and two minor wound complications) an incidence of 1.27 per cent. Everything else being equal, it was found that wound infections occurred 30 per cent more frequently in patients 50 years and older than in patients under 50 years of age. (Table II.) The use of local anesthesia was not found to be a factor in the development of wound infection (Table III), but the incidence of wound infection in the catgut series was twice that of the silk series. In minor wound complications the superiority of silk was still greater, as these minor infections occurred eight times more

TABLE IV
EFFECT OF SUTURE MATERIAL UPON THE INCIDENCE
OF WOUND COMPLICATIONS*

Suture	Number of Operations	Suppurative Infections		Minor Wound Complications		Total Wound Complications	
		No.	Per Cent	No.	Per Cent	No.	Per Cent
Silk.....	1284	18	1.4	8	0.62	26	2.0
Catgut...	963	27	2.8	51	5.29	78	8.1
Silk and catgut.	113	2	1.77	2	1.77	4	3.0
Totals.	2360	47	1.99	61	2.59	108	4.57

TABLE V
EFFECT OF SUTURE MATERIAL UPON HEALING
OF SUPPURATIVE WOUND INFECTIONS*

	Number of Cases	Average Hospital Convalescence, Days	Average Total Convalescence, Days
Silk, slight suppuration...	5	17	25
Catgut, slight suppuration.....	12	19	24
Silk, marked suppuration.	13	22	42
Catgut, marked suppuration.....	14	26	46

frequently in the catgut series. (Tables IV and v.)

I quote Dr. Shambaugh's conclusions,

THE PRINCIPLE OF SILK TECHNIQUE

The following are some of the principles involved in the silk technique:

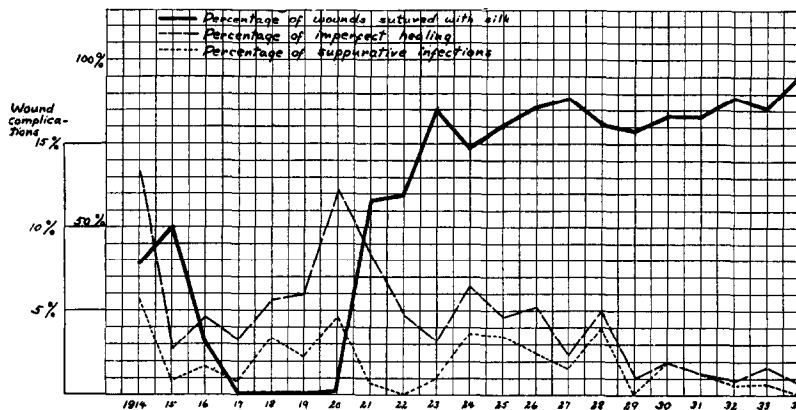


FIG. 1. Graph showing relationship between the employment of silk and the annual incidence of wound complications. (From Shambaugh, in *Surg., Gynec. & Obst.*, 64: 766, 1937.)

because they represent the impressions formed by those who have used silk in a large number of cases:

"1. The alcohol and bichloride method of skin preparation compares favorably with other methods as regards the incidence of postoperative wound infection.

"2. Suppuration in clean operative wounds is more likely to occur in elderly patients than in the younger group.

"3. Anesthesia by local injection does not increase the likelihood of wound infection.

"4. In a controlled series the incidence of suppurative wound infections where catgut was employed as a suture material was twice as great as where silk was used.

"5. Where fine silk (No. 4) is used and the principles laid down by Halsted are followed, the presence of silk in suppurating wounds does not, on the average, delay the healing of the wound.

"6. Infected wounds may heal completely and permanently without discharging the silk sutures.

"7. The presence of fine silk in infected wounds may delay healing for periods up to three or four months, but this is exceptional and should not deter one from employing the silk technique in suitable cases."

No. 4 black twisted silk is ordinarily used for most purposes, except in the fascia where a larger size up to No. 9 may be used. The silk should first be dipped in melted bone-wax. The excess wax is wiped off and the silk is autoclaved. It should not be sterilized several times, as it soon loses its strength from repeated sterilizations. A small half-circle No. 2 or 3 French needle is used, except in intestinal work where a straight needle is usually preferable. The sutures are usually cut about 18 inches long. It is best not to use the same suture more than once in a French needle as it may become frayed. A small needle holder must be used, and it is best to clamp the French needle near its middle. The hemostat used for clamping the vessels must be small. One should attempt to clamp only the bleeders; if any tissue is included in the clamp it must be the smallest amount possible. The strangulation of large amounts of tissue must be avoided, but all bleeding must be controlled immediately. The silk suture, the finest that will furnish the necessary strength, must be cut at the knot. Silk sutures are usually interrupted, except in the peritoneum, where they may be continuous. The interrupted skin suture is the only one with which I am familiar

that can be removed without the possibility of contamination of the wound, that is, without drawing some of the exposed

with gauze. Silver foil is used to cover the incision and it helps to prevent contamination of the wound.

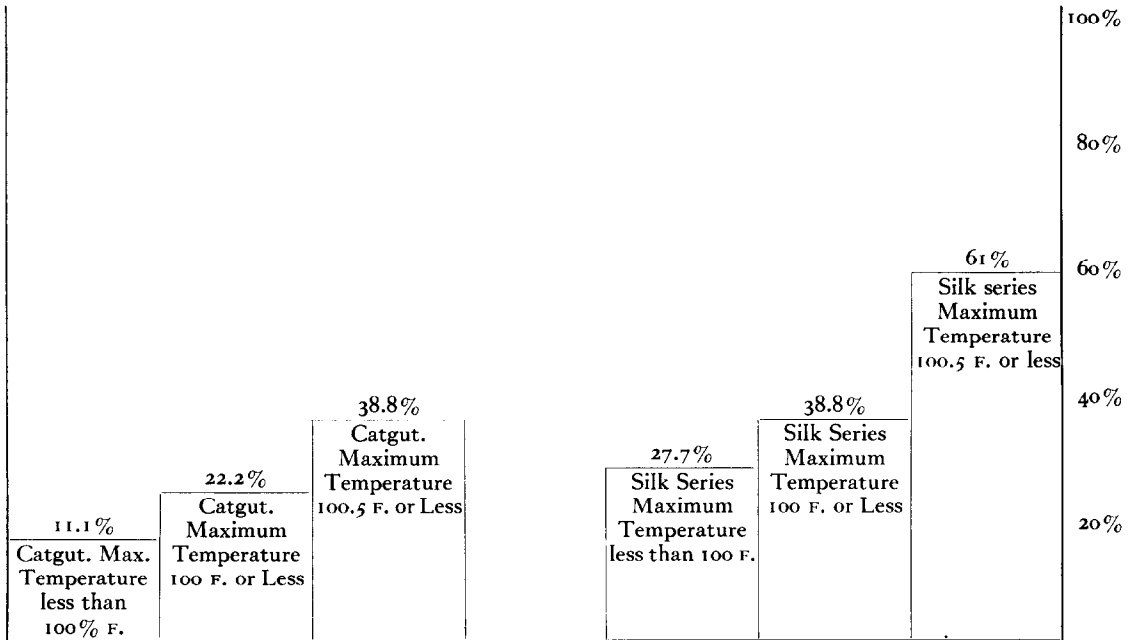


FIG. 2. Graph showing the comparison of temperatures in a series of catgut and silk cases.

part of the suture through the tissues. Skin sutures should be just tight enough to approximate the skin edges; they should not be under tension. A subcutaneous suture is used for the purpose of almost approximating the skin edges, and should be placed so the knot will be underneath. The bite should include only the deeper layer of the skin and should be taken a short distance from the edge of the wound. This subcutaneous suture is very important, because it keeps tension off the skin sutures, helps to produce a narrower scar, and closes dead space. All infections of operative wounds do not occur during the operation; a fairly large percentage occurs afterward from contamination due to carelessness in changing dressings, from carelessness in removing properly placed sutures, and from removing improper sutures. In order to avoid trauma, incisions should be of sufficient length to give adequate exposure. The edges of wound and skin during operation should be protected

PRELIMINARY REPORT

I am well aware of the fact that the small number of cases in this preliminary report cannot be used for the purpose of forming definite conclusions. This report is a series of unselected and consecutive private cases to compare the difference in temperature, etc. when cat-gut and silk were used. In this report there are thirty-six cases, eighteen in each series. In a few cases in the silk series, catgut was used in the peritoneum in order not to delay the surgeon following; catgut was also used in the pelvic part of the operations and around the sites of the drainage wounds. In all cases the peritoneal cavity was opened; there were thirty-three intra-abdominal operations and three inguinal herniorrhaphies (two herniorrhaphies in the catgut series, and one in the silk series). Drainage was necessary in six cases: one cholecystectomy, one ruptured appendix, and one tubo-ovarian abscess in each series. There were three cases of acute appendicitis

in the silk series and none in the cat-gut series. There was one case in the silk series where appendectomy was done for chronic

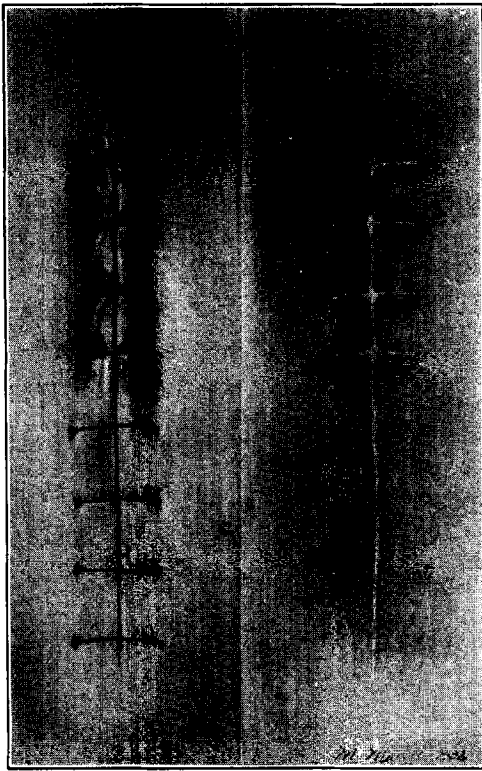


FIG. 3. Difference between the effects of tight and loose skin sutures. The cross scars are the result of anemic necrosis. (From Reid, in *South. M. J.*, 26: 110.)

appendicitis, and there were four such cases in the catgut series. The other operations included appendectomies for subacute appendicitis; supravaginal hysterectomies and various combinations of operations on the internal female organs, which were about equally divided between the two series. As the lowest temperatures are obtained in abdominal surgery in which there is simply an appendectomy for chronic appendicitis, and as there were no cases of acute appendicitis in the catgut series, it seems that if any particular difference existed in the mildness of the conditions, it was in favor of the catgut series.

As indicated by Figure 2, there were definitely lower temperatures in the silk

series, but because of the small number of cases no definite conclusions can be reached; however, if this same advantage for silk could be maintained in a large series of cases it would be a most important point in favor of the silk technique.

In the catgut series 11.1 per cent had a maximum temperature of less than 100 F. In the silk series this was true in 27.7 per cent. In the catgut series the maximum temperature was 100 F. or less in 22.2 per cent; in the silk series in 38.8 per cent. A maximum temperature of 100.5 F. was observed in 38.8 per cent of the catgut series and 61 per cent of the silk series.

If, when using the silk technique in clean cases, the postoperative temperature goes above 100.5 F., one should look for complications. They will not always be present, but with the silk technique temperatures are usually low, and a rise above 100.5 F. often indicates that something is wrong. The maximum temperature in the patient who had the least elevation of temperature in the catgut series was 99.8 F. The diagnosis was chronic appendicitis. The maximum temperature in the patient who had the least elevation of temperature in the silk series was 99.4 F. The diagnosis was chocolate cyst of the left ovary; cystic right ovary; chronic appendicitis, and partial stenosis of the cervical canal. There were three cases of acute appendicitis in the silk series and the maximum temperature did not reach 100 F. in any case.

No evidence of infection occurred in any of the clean cases in the silk series. In the drainage cases in the silk series there was no infection except around the drain, and the drainage wounds healed promptly with no evidence of infection in any other part of the incisions.

The duration of operations when using the silk technique is usually from twenty-five to fifty minutes longer than when using catgut, and because of the longer duration of the operations it is advisable to use basal anesthetics more often. In this series avertin was used as a basal anesthetic, in doses of 60 or 70 mg. per kilo of body

weight. Avertin was not used when there was a diseased condition of the biliary system or kidneys, or in hypotension.

The coöperation of the interns, anesthesiologist and operating room nurses is absolutely essential. The patient is the most important person in the operating room during the operation, and everyone connected with the operation should pay particular attention to the various steps so there will be no unnecessary delay.

CONCLUSIONS

From this preliminary report no definite conclusions can be reached in regard to the use of silk; however, it does seem that there is some justification for a favorable impression from the results obtained in the silk series. Certainly the lower the temperatures, the more comfortable the patients and the fewer the complications.

The milder postoperative courses observed when using the silk technique seem to result from a combination of circumstances, of which silk is the most important, as its use commands greater gentleness and more careful hemostasis.

While there were lower temperatures in the silk series, the things which impressed me most were the general well-being of the patients and a milder postoperative course than I have been able to obtain before. There also seemed to be less distention and fewer gas pains.

From the experience of those who have used the silk technique in a considerable number of cases and from my own limited

experience, it appears that silk has a definite superiority over catgut in regard to wound complications.

Trauma, hemorrhage, and infection are the big factors in producing postoperative discomfort and complications.

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