

A COMPARATIVE STUDY OF DEXON AND SILK
AS SKIN SUTURE MATERIAL

by

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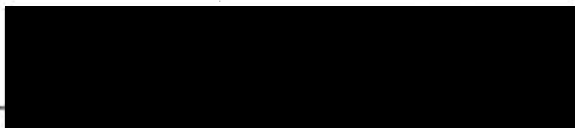
A FIELD STUDY

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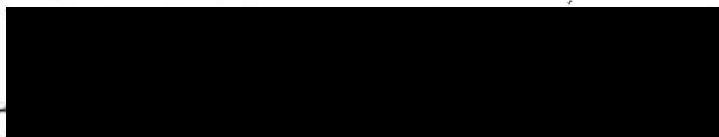
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CHAPTER I

INTRODUCTION

Introduction to the Problem

As the nursing role expands into practitioner status, the nurse must assume responsibility for material appropriate to her field. The surgical nurse clinician, as part of her professional responsibilities, ligates bleeders and closes the fascia and skin on many surgical incisions. Post operatively, the surgical lesion is evaluated and managed by this nurse. Because the effects of surgical techniques and materials are of immediate concern to the surgical nurse clinician, she is an appropriate investigator of the new materials being marketed.

This study compares Dexon to silk, two suture materials used in skin closures, to determine if Dexon is more acceptable than silk when used in the skin. Silk has been used for over fifty years and is a well accepted suture for deep and cutaneous closures. Dexon is a new product which has not been used extensively for skin closure. This study will focus on Dexon, investigating its acceptability as a skin suture when compared to silk.

As surgical techniques become more sophisticated, the requirements for suture materials become more demanding.

Today, the ideal suture is described as one that can be used throughout any operation, the only variable being its size and tensile strength. Further, it should have a positive effect on wound healing and the tensile strength of the suture must remain stable in the presence of infection. The suture should not incite excessive foreign body reaction or predispose to sinus formation and extrusion. The "ideal" suture would also combine flexibility with ease and reliability of handling and tying. Finally, stability and dependability of sterilization and storage constitute additional important characteristics (Eilert, 1971).

Polyglycolic acid (PGA) suture, developed and marketed by Davis and Geck under the name "Dexon," is a new absorbable suture material that purportedly meets a number of the requirements of the ideal suture. It is "a synthetic, non-collagenous, absorbable suture with surgical handling properties similar to those of silk. The material has been shown to be completely non-toxic upon implantation into animals and to function satisfactorily when used in a wide variety of surgical operations" (Dardek, et al., 1971). Dexon has been used successfully for general, thoracic, genito-urinary, gynecologic and plastic surgeries. Because Dexon is absorbable, it is not recommended where extended approximation of tissues is required. During manufacture, the suture is first extruded as a filament of linear polyester of glycolic (hydroacetic) acid. The filament is then

braided into a non-coated suture material. Following implantation, the suture is hydrolyzed in approximately three weeks and the breakdown products, CO_2 and H_2O are eliminated from the body in urine, feces, and expired air (Frazza, 1971; Mennie, 1972). The suture, first introduced in 1970, has since proved quite satisfactory for many surgical procedures.

Silk suture is made from fibroin, the protein extrusion of the silk worm larva. The protein fibers are twisted, or more frequently, braided to form the suture strand. Untreated silk has a capillary action, therefore, surgical silk is coated with Teflon to render it non-capillary and serum proof. It also is dyed with a vegetable dye, most commonly black, for easy visibility in tissues. Silk has been the most commonly used non-absorbable suture and is used extensively by surgeons for skin closure. For this reason, it was selected as the standard to which Dexon was compared.

Review of the Literature

Dexon and silk have been compared as regards tensile strength, toxicity, reliability in sterilization, storage and for their effect on tissues. Tissue reactivity, or the inflammatory response, was the most salient issue to this investigation. Researchers have commented on the almost near absence of inflammatory response with Dexon. The

minimal inflammatory response that is seen is attributed to the mechanical trauma of dragging a needle and suture through tissue. Silk, being an organic protein, has the potential for inciting tissue response. Mechanically, it is very easy on tissues due to its soft flaxen qualities.

Tissue studies of Dexon, silk and other suture types show histologically that Dexon generates less inflammatory response than silk. Echeverria in comparing histologic reactions at suture sites, stated, "We saw that mast cells are present at the suture site with catgut, silk, and cotton, but are seen only rarely with PGA. Plasma cells are sometimes seen with PGA, but much more often with silk, catgut, and cotton. Clinically, this means there is less inflammation with PGA." (Dunphy, 1971). Eilert, in a more definitive study comparing the tissue reactivity to Dexon and catgut, silk, Dacron and cotton, used layered abdominal closures in rats. He found that on the third and fifth post-operative days, the acute inflammatory reaction had subsided and histologic differences were noted. "The polyglycolic sutures were surrounded by a few polymorphonuclear cells and histiocytes, and rare foreign body giant cells. There was minimal fragmentation or digestion of the sutures" (Eilert, 1971). With the silk sutures, Eilert found that "There was a moderate number of leukocytes, round cells, histiocytes, and giant cells surrounding the silk, cotton, and Dacron sutures with the least reaction about the Dacron"

(Eilert, 1971). The early tissue reaction around Dexon was comparable to that of silk, cotton and Dacron. Ochsner and Anscombe agreed that the lack of tissue reaction was especially important in the use of Dexon; however, they conducted descriptive studies only (Mennie, 1972).

Research comparing Dexon and silk as skin closure is not so readily available as for other uses. Beal, in a study comparing Dexon, plain and chromic catgut, silk, cotton and Dacron in layered abdominal closures including skin on rats, found gross and histologic differences were insignificant among the sutures tested when studied three to five days after operation. Ten to seventeen days after implantation, histologic differences in tissue reactivity became apparent. Dexon was surrounded by a few polymorphonuclear leukocytes, histiocytes and rare foreign body cells (Mennie, 1972). Lord closed the incision of one mastectomy patient with alternating Dexon and silk sutures and after eight days found the same amount of skin reaction around each type (Mennie, 1972). Anscombe, in a descriptive study using only Dexon, found that very few patients developed redness around the stitches which remained in situ for two to three weeks (Mennie, 1972).

Inflammatory response can be generated by causes other than suture type. Van Winkle and Hastings (1972) reported that skin would show an inflammatory response from the trauma of inserting a needle. They also found all

sutures showed a peak reaction between two and seven days.

In summary, the literature generally agrees that in buried suture, Dexon generates less inflammatory response than does silk. Relatively little investigation has been conducted into the comparative differences between Dexon and silk as used in the skin.

Purpose of the Study

The literature shows that Dexon has often been tested and compared to silk in deep, buried sutures, but studies of the use of Dexon for skin suture are limited. The purpose of this study will be to compare Dexon suture to silk suture to determine if Dexon is a better skin suture.

Hypotheses

1. There will be fewer mechanical complications with Dexon than with silk suture when used in the skin.
2. There will be less inflammatory reaction to Dexon than to silk suture when used in the skin.

CHAPTER II

METHODOLOGY

Subjects

The sample was fifteen patients between the ages of 17-72 years who were candidates for clean, elective surgery on the torso only.

Design

The design of this study was experimental. Each of the fifteen subjects represented a perfectly matched pair. Each subject had his/her incision closed with Dexon on one end and silk on the other. On the clinically appropriate day for suture removal, data on mechanical complications and inflammatory response were collected on each suture type. These data were later compared for significant differences. Because silk has long been accepted for skin suture, it was the standard to which Dexon was compared clinically.

Procedure

Following a clean surgical procedure on the torso, the incision was closed with Dexon and silk. The sutures were placed with a bipolar segregation. All sutures were braided, swaged-onto an atraumatic cutting needle and 4-0

in size. The stitches were always simple running or simple interrupted, often times a combination of the two. The sutures were removed on the clinically appropriate day, ranging from the fifth to the tenth post-operative day, depending on the site of the incision.

On the day of suture removal, inflammatory response and mechanical complications were assessed. Inflammation was measured by degree of rubor and degree of induration. The diameter of the rubor and induration surrounding each suture's cutaneous insertion site was measured in millimeters with calipers. These diameter sizes were scaled as follows:

0 represents absence of any or all redness or induration,
1+ represents a diameter size of less than or equal to 2.5mm
2+ is greater than 2.5mm and less than or equal to 5.0mm
3+ is greater than 5.0mm and less than or equal to 7.5mm
4+ is greater than 7.5mm in size.

A simple count of how many sutures of each type had what degree of inflammation was kept for each subject. Dolor and calor were unmeasurable. Dolor was found to be uniformly absent due to the local cutaneous anesthesia in the post-operative wound. Calor could not be measured by the instruments available to this researcher.

From the data on inflammation, a Relative Reactivity Figure was arrived at for both Dexon and silk for each

subject. It was computed as follows:

degree of inflammation X fraction of sutures
affected = Relative Reactivity Figure

example: Subject #1 (for silk only)
degree of inflammation (1+) X fraction of sutures
affected (3/3) = 1+ Relative Reactivity Figure.

The Relative Reactivity Figure became the comparative index of inflammatory response and the numerical basis for all statistical analysis. (Appendix A, pg. 25)

Mechanical complications were also measured on the day of suture removal. A simple percentage of the total sutures that showed evidence of knot slippage, untying, tissue laceration, or suture breakage was calculated.

The information on inflammatory response and mechanical complications was collected on each subject and recorded on individual Patient Data Form. (Appendix D, pg. 28) This form also contained information about the patient such as age, sex, procedure, site of incision, size and number of sutures and time in place.

Analysis of the Data

The data collected on each suture type was compared to determine if the difference in inflammatory response and mechanical complications between the suture types, Dexon and silk, was significant.

Statistical analysis of the Relative Reactivity Figures for each suture type in each patient was performed

by the use of the Wilcoxon's matched-pairs signed ranks test with an alpha level of 0.01 significance. (Appendix C, pg. 27)

If the inflammatory response and mechanical complications with Dexon were significantly less than with silk, then Dexon was to be considered more acceptable than silk as a skin suture.

CHAPTER III

RESULTS

Findings

The findings of this study revealed Dexon to be more acceptable than silk as a skin suture in the fifteen subjects studied. The inflammatory response to Dexon in the skin was less than to silk. (See Graph 1, pg. 14) Mechanical complications were essentially absent in both suture types and therefore did not contribute to either side. The data had also been broken down to reflect some interesting trends in age, sex and site of incision. Composite raw data is found in Appendix B, pg. 26.

The results presented in Appendix A reflect the degree of inflammation as defined by the pre-determined sizes of induration and rubor (see Chapter II, procedures section). The gradations ranged from 0-3+ in inflammatory response to the two different skin suture types, but to silk slightly more than to Dexon. 3 subjects had a 2+ or better reaction to one or both types. No 4+ inflammatory reaction was seen nor was a wound infection seen. Folliculitis was noticed in several inguinal hernia cases where pubic hair had been shaved. Subject #2 showed no reaction to either suture. This patient expired from squamous cell carcinoma of the

bronchial tubes one week after suture removal.

Also presented in Appendix A are the Relative Reactivity Figures. This figure was computed by multiplying the degree of inflammation by the fraction of sutures exhibiting the reaction. This figure became the comparative index of reactivity for each experimental application. The Relative Reactivity Figure was then used in the Wilcoxon's matched-pairs signed-ranks test at an alpha level of 0.01 significance (Appendix C, pg. 27). The results of the statistical analysis support hypothesis #2. Dexon did show less clinical inflammation than did silk when both were used in clean torso skin incision in the fifteen subjects studied. A graphic representation of the Relative Reactivity Figures for Dexon and silk (Graph 1, pg. 14) demonstrates the differences in inflammatory responses to the two suture types.

Mechanical complications were as follows (See Appendix B, pg. 26): of 113 Dexon sutures placed in 15 different subjects, 1 untied, 1 could not be moved due to adhesion to underlying tissues, and 1 subject of 15 complained that Dexon hurt on removal; of 113 silk sutures placed in 15 subjects, 4 had drainage (all were from a 3+ inflammatory response subject with an inguinal hernia repair), and 1 subject of 15 complained of silk "pulling" on removal. There were no incidences of breakage or tissue laceration in the study. The mechanical complications were essentially absent in this study and both suture types were found to be easy to

handle and reliable when in place. It might be noted that the black silk was easier to see than the white Dexon which becomes red after blood staining.

The degree of inflammation also varied with sex, age and site of incision on the torso:

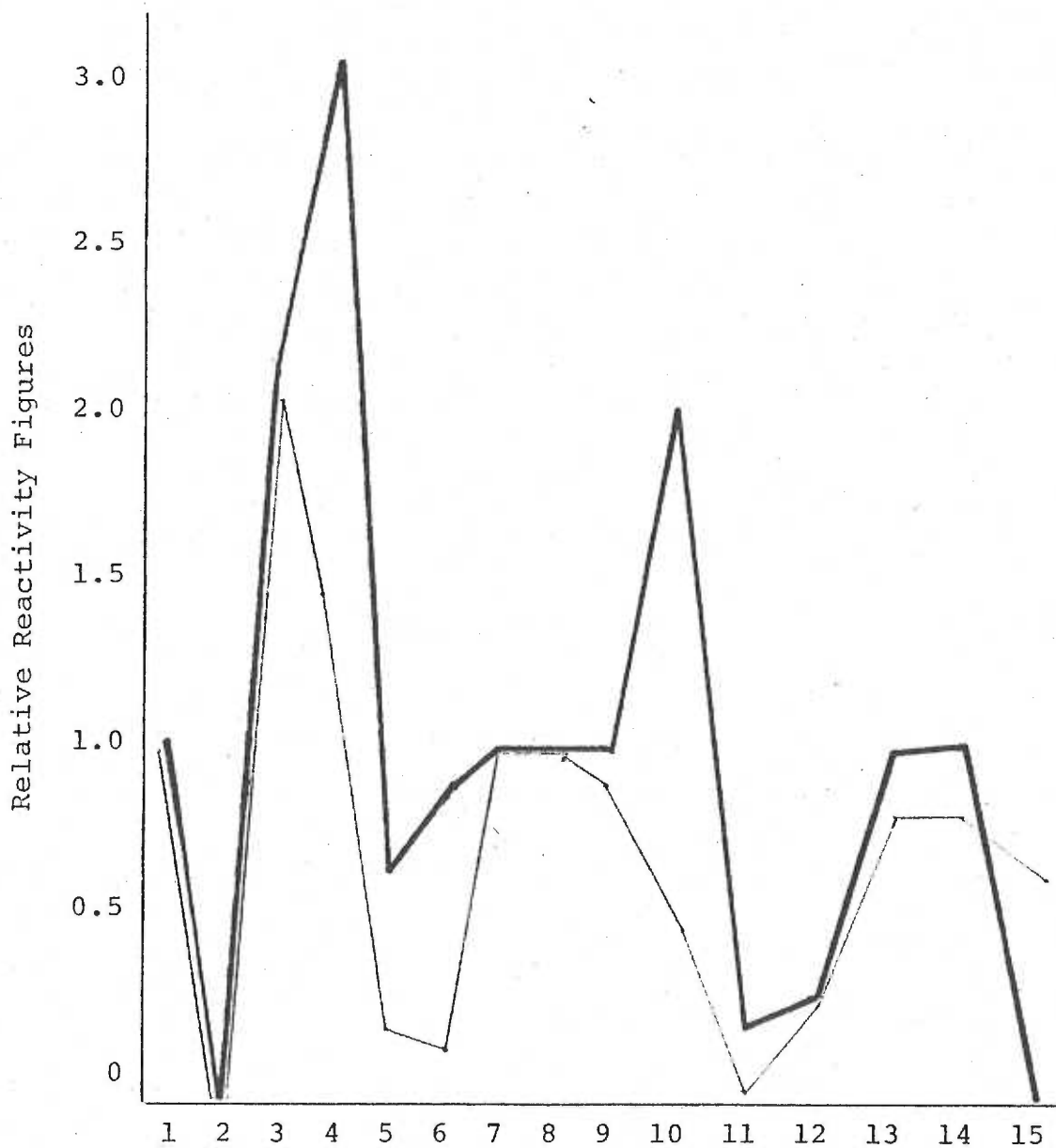
Table 1 shows that males exhibited more inflammatory response to Dexon and silk sutures than did females to either type; (pg. 15)

Table 2 reflects that the 55-70 year old group demonstrated more inflammatory response to Dexon and silk skin sutures than did the 17-40 year old group; (pg. 16)

Table 3 shows a trend toward the lower torso incisions (groin) generating more inflammatory reaction than did the other incision sites (pg. 17). This was reasonable as the area is usually easily contaminated.

It must be noted, though, that these findings all reflect the typical hernia patient, i.e. older, male with a groin incision.

Graph 1. Comparative Graph of Relative Reactivity Figures
Dexon vs. Silk



Subjects 1-15

Dexon: In fine line
Silk: In heavy line

Table 1. Average Relative Reactivities of Males and Females

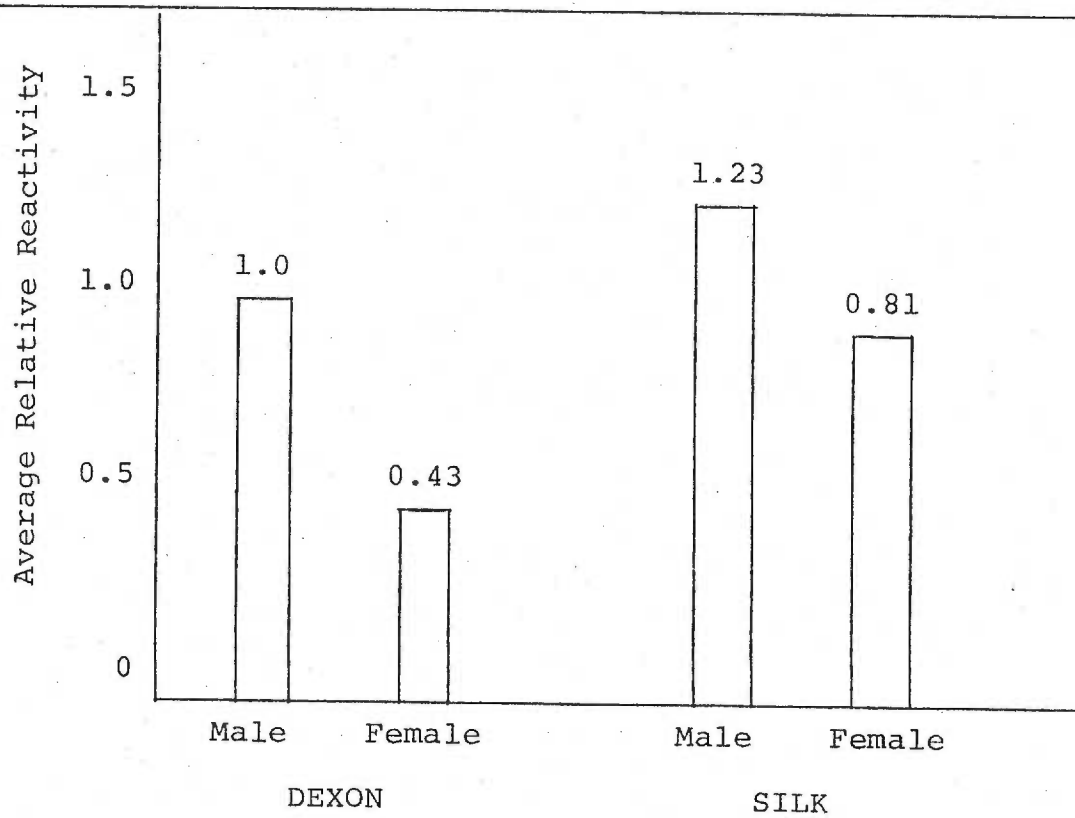


Table 2. Average Relative Reactivities of Age Groups to Dexon and Silk

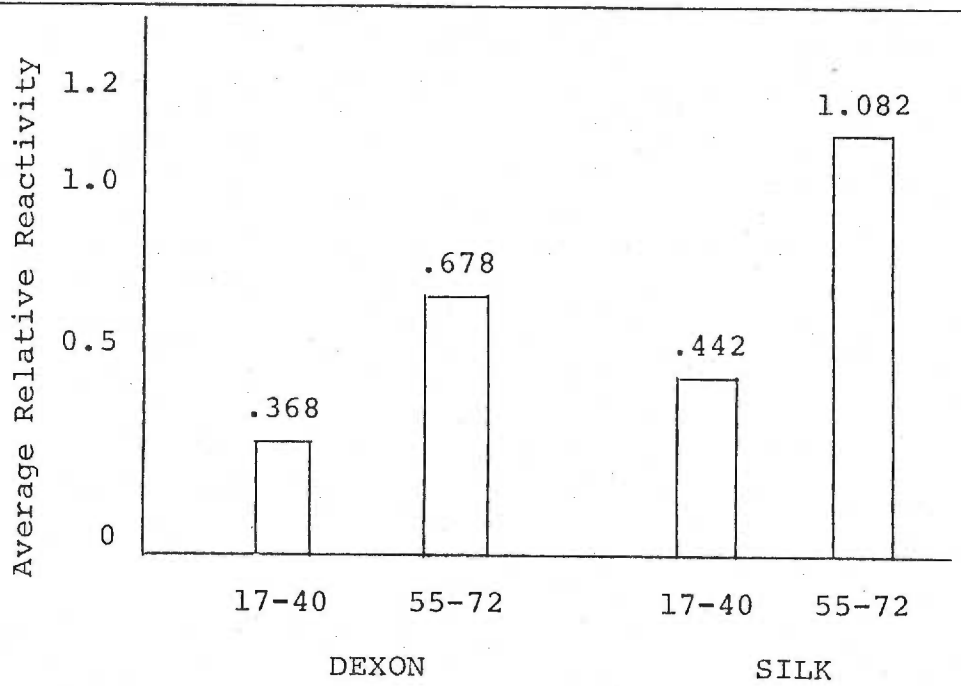
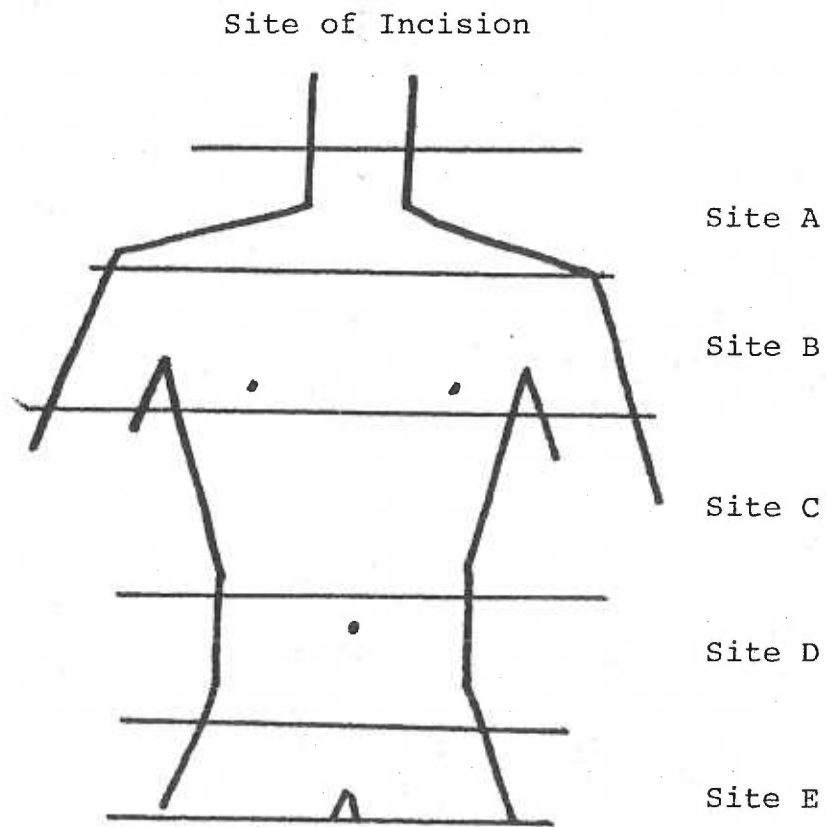
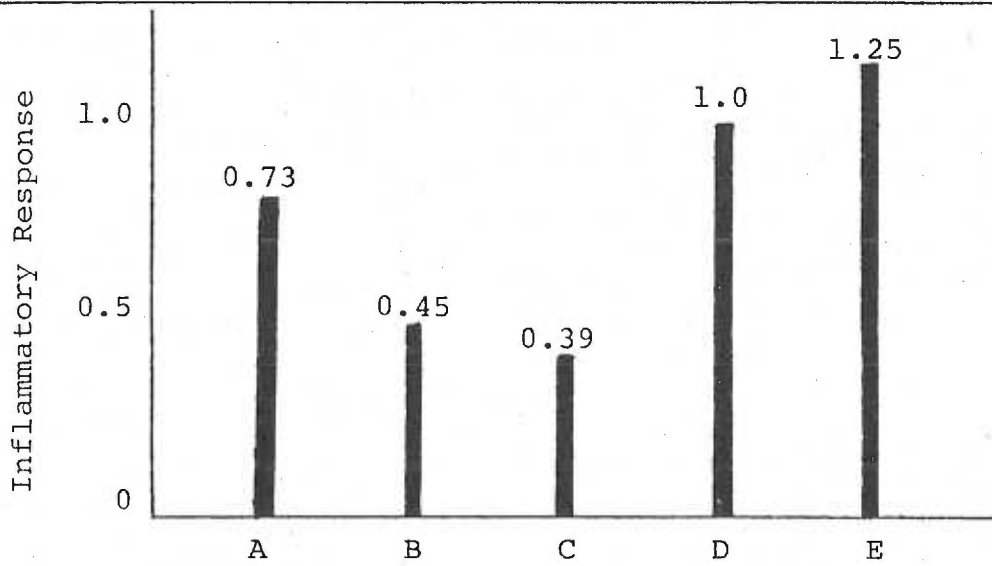


Table 3. Site of Incision vs. Inflammatory Response for all Subjects



CHAPTER IV

DISCUSSION

Significance and Speculation

It has been found that in the fifteen sample subjects there was a statistically significant difference between the inflammatory response of tissues to Dexon and silk sutures used in the skin: Dexon proved to cause less tissue response than did silk. No significant mechanical complications were noted in either suture type. The statistical difference in tissue reaction did not correlate with the patients' subjective responses to the pain for the two suture types. The patients could tell no difference in local pain or discomfort between Dexon and silk. Thus, although statistically a significant difference could be shown, clinically this difference proved to be very slight and engendered no differences in the patient's clinical course.

This researcher speculates that the source of the inflammatory response is different for Dexon than it is for silk. It is speculated that silk is reactive first as a foreign protein and secondly from the mechanical trauma of dragging the suture through the tissue. Silk is a very smooth, flaxen material and pliable. Dexon, however, is probably more reactive from mechanical trauma, as it is

coarse and has a sawing effect when being pulled through the tissues, especially after it has been moistened. Both sutures were always used on a swaged on, atraumatic cutting needle for skin closure.

The coincidental findings of this study, i.e. increased inflammatory response in the old, the male and the lower torso (groin) incisions bear some attention. Possibly these reflect higher risk groups for surgical complications such as wound infection or incisional pain. Most probably, this group showed an increased inflammatory response because of the site of the incision and not because of their age or sex.

CHAPTER V

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

In summary, there was found to be a significant statistical difference between Dexon and silk as a skin suture when inflammation was measured. There was, however, no difference noted in mechanical complications or patients' subjective responses to local discomfort. However, neither Dexon nor silk appeared as the ideal skin suture in that both generated an inflamed wound in several instances. Although neither may be recommended as the first choice for skin closure material, certainly they are both usable. If the perfect removable skin suture is being sought, this writer would suggest an inert, non-absorbable, synthetic, monofilament polyester or nylon extruded suture swaged onto a cutting needle as the most ideal. This suture type would have the lowest mechanical and chemical inflammatory producing potential.

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APPENDIX

Appendix A: Relative Reactivity Figures

for Dexon & Silk as a Skin Suture

in 15 Subjects

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DEXON total # used	3	10	10	10	6	34	6	6	9	5	5	4	5	5	3
# inflamed	3/3	0/10	10/10	7/10	1/6	3/34	6/6	6/6	8/9	2/5	0/5	1/4	4/5	2/5	2/3
degree of inflam- mation	1+	0	2+	2+	1+	1+	1+	1+	1+	1+	0	1+	1+	2+	1+
RELATIVE REACTIVITY FIGURE	1+	0	2+	1.4+	0.17+	0.09+	1+	1+	0.89+	0.4+	0	0.25+	0.8+	0.8+	0.66+
SILK total # used	3	10	10	10	8	22	6	6	10	4	5	7	4	5	3
# inflamed	3/3	0/10	10/10	10/10	5/8	18/22	6/6	6/6	10/10	4/4	1/5	2/7	4/4	3/5	0/3
degree of inflam- mation	1+	0	2+	3+	1+	1+	1+	1+	1+	2+	1+	1+	1+	2+	0
RELATIVE REACTIVITY FIGURE	1+	0	2+	3+	0.63+	0.82+	1+	1+	1+	2+	0.2+	0.29+	1+	1+	0

Relative Reactivity Figure=degree of inflammation x fraction of inflamed sutures.

Appendix B: Data Sheet

Composite of Raw Data

	PT#	AGE	SEX	SITE	DAYS IN PLACE	SIZE #	SUTURES	RELATIVE REACTIVITY FIGURE	COMPLIC.
DEXON	1	72	f	B	9	4-0	3	1+	0
	2	55	f	A	5	4-0	10	0	0
	3	60	m	E	8	4-0	10	2+	0
	4	60	m	E	8	4-0	10	1.4+	0
	5	26	m	E	5	4-0	6	0.17+	0
	6	60	f	C	7	4-0	34	0.09+	pulled
	7	61	m	A	4	4-0	6	1+	hurt
	8	17	m	E	6	4-0	6	1+	0
	9	70	f	E	6	4-0	9	0.89+	0
	10	59	f	A	6	4-0	5	0.4+	1 untied
	11	40	f	B	5	4-0	5	0	0
	12	39	f	B	5	4-0	4	0.25+	0
	13	28	m	E	7	4-0	5	0.8+	0
	14	21	f	D	8	4-0	5	0.8+	0
	15	28	m	C	6	4-0	3	0.66+	0
SILK	1	72	f	B	9	4-0	3	1+	0
	2	55	f	A	5	4-0	10	0	0
	3	60	m	E	8	4-0	10	2+	0
	4	60	m	E	8	4-0	10	3+	pus
	5	26	m	E	5	4-0	8	0.63+	0
	6	60	f	C	7	4-0	22	0.82+	0
	7	61	m	A	4	4-0	6	1+	0
	8	17	m	E	6	4-0	6	1+	pulled
	9	70	f	E	6	4-0	10	1+	0
	10	59	f	A	6	4-0	4	2+	0
	11	40	f	B	5	4-0	5	0.2+	0
	12	39	f	B	5	4-0	7	0.29+	0
	13	28	m	E	7	4-0	4	1+	0
	14	21	f	D	8	4-0	5	1.2+	0
	15	28	m	C	6	4-0	3	0	0

Appendix C

Wilcoxon's matched-pairs signed-ranks Test

SUBJECT #	SILK*	DEXON*	S-D=	R(+)	R(-)
1	1+	1+	0		
2	0	0	0		
3	2+	2+	0		
4	3+	1.4+	1.6+	9.5	
5	0.63+	0.17+	0.46+	6	
6	0.82+	0.09+	0.73+	7	
7	1+	1+	0		
8	1+	1+	0		
9	1+	0.89+	0.11+	2	
10	2+	0.4+	1.6+	9.5	
11	0.2+	0	0.8+	8	
12	0.29+	0.25+	0.04+	1	
13	1+	0.8+	0.2+	3	
14	1.2+	0.8+	0.4+	5	
15	0	0.66+	0.34-		4
				sum R(+)=51	sum R(-)=4

*figure represents the Relative Reactivity Figure

Mean sum of the ranks = $\frac{T}{4} = \frac{N(N+1)}{4}$ and N=15 (number of subjects)

$$= \frac{15(15+1)}{4}$$

$$= 60$$

Wilcoxon's T = sum of R(-) = 4

60 ≠ 4 thus there is a difference.

Wilcoxon's T of 4 for N=15 is significant at the 0.01 alpha level, hence Dexon does show less inflammation than does silk when both were used in clean torso skin incisions.

Appendix D
Patient Data Form

Case # _____

Day of surgery _____

Day of removal _____

Time in place _____

Vital Statistics

age

sex

diag

site of incision (diagram)

procedure

elective, non-elective

Closure Information

type of suture

size of suture

number of each kind

staging illustration (diagram)

Post-operative Data

Inflammation

redness

pain

induration

Complications

untying

drainage

tissue laceration

breakage

other

ABSTRACT

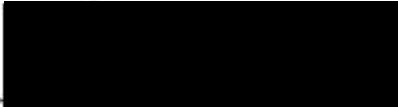
AN ABSTRACT OF THE FIELD STUDY OF

Margaret J. Black for the Masters degree in Nursing

Date receiving this degree June 1975

Title: A Comparative Study of Dexon and Silk as Skin Suture

Material

Approved 

The purpose of this study was to compare Dexon suture to silk suture to determine if Dexon was a better skin suture in terms of inflammation and mechanical complications. Fifteen patients with elective, clean, torso surgery had their incisions closed with Dexon and silk skin sutures in a bipolar segregation. On the appropriate day for suture removal, data on inflammatory response and mechanical complications were collected on each suture type. A Wilcoxon's matched-pairs signed-ranks test applied to the data on inflammatory response showed that there was significantly less inflammatory reaction with Dexon than with silk. Mechanical complications were found to be essentially non-existent and both suture types were found to be easy to handle, reliable mechanically. The hypothesis that Dexon was a more acceptable skin suture than was silk was upheld.