

Five Year Study of Tissue Reaction to Synthetic Sutures

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Sutures were implanted in the abdominal wall muscles of rabbits and specimens recovered at intervals from six months to five years. Tissue reaction around Nylon and Dacron® was minimal. The reaction to Teflon® coated Dacron was increased because of shedding of the Teflon. The polypropylene sutures showed fragmentation in 4% of the sutures examined and the perisutural formation of bone, cartilage or both in 2.6%.

A PREVIOUS STUDY² of the tissue reaction to sutures over a period of two years implantation showed occasionally fragmentation of the polypropylene material. For this reason, the study was repeated but the period of observation extended to five years.

Methods

Size 3-0 monofilament nylon, monofilament polypropylene, multifilament Dacron®, and Dacron coated with Teflon® were used. The implantation technique has been previously described.² Briefly, the abdominal wall musculature of the rabbit was exposed and the test suture inserted intramuscularly in three loops, the ends being tied loosely. Autopsy was performed at intervals from six months to five years after implantation, tissue was removed to include a cross section of the sutures, fixed and stained with hematoxylin and eosin.

Results

Table 1 shows the number of animals for each time interval and the number of sutures examined. The latter was less than anticipated but synthetic sutures cause problems in sectioning and the suture material would not be retained. Although the sites of sutures were easily identified, only those with retained suture were counted.

Detailed descriptions of tissue reaction to sutures have been published earlier^{2,3} and will only be described very briefly. Nylon causes the least tissue response and is usually surrounded by a thin rim of fibrous tissue (Fig.

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1). Dacron usually remains compact, has a slightly wider connective tissue zone and shows a few mononuclear cells near the suture. The Teflon coated Dacron differs only in that the teflon is shed from suture and stimulates its own reaction of histocytes and lymphocytes.

Polypropylene in most sections shows a reaction similar to that of nylon. Of the 351 polypropylene sutures examined, however, 14 or 4% showed some fragmentation of the suture (Fig. 2). In addition, nine sutures (in different animals) showed formation around the suture of bone, cartilage, or both (Fig. 3). Five sutures had both fragmentation and bone-cartilage deposition.

Discussion

No explanation for either the fragmentation of polypropylene or the heterotopic bone-cartilage formation is apparent.

Liebert and his associates¹ studied the chemical changes after subcutaneous implantation in hamsters of filaments of polypropylene, one with and one without antioxidants. Degradation of the polypropylene without antioxidant began within a few days by an oxidation process. They note when the hydroperoxides first formed begin to decompose, chain scission occurs, causing carbonyl groups to form. Rapid oxidation then follows, causing a sharp increase in carbonyl content and a significant loss of tensile properties. While this or another chemical change may be involved, no greater loss in breaking strength occurred in our study compared with the other materials, and the manufacturer states no antioxidants are used. In addition, fragmentation was found in only one of every 13 of the animals.

A limited survey of the literature indicates that little is known about heterotopic ossification. Rhone and Horowitz⁴ in their review, while noting the exact mechanism is unclear, list the following conditions

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TABLE 1.

Time Months	No. Animals	Dacron No. Sutures	Nylon No. Sutures	Teflon-coated		Polypropylene		No. Bone
				No. Sutures	No. Shed	No. Sutures	No. Fragment	
6-11	21	62	50	65	24	33	2	1
12-17	32	105	66	119	37	64	5	5
18-23	25	83	57	86	8	49	3	1
24-29	31	100	75	107	25	63	1	2
30-35	17	48	43	57	13	36	1	0
36-41	15	45	47	57	16	28	1	0
42-47	9	28	22	22	7	8	0	0
48-53	2	9	5	4	0	7	0	0
54-59	2	6	4	8	0	5	0	0
60	29	79	66	104	46	58	1	0
Total	183	565	435	629	176	351	14	9

which appear to be necessary: formation of a proliferating connective tissue, liberation of calcium in the vicinity of this tissue, reduced viability of cells and an adequate blood supply. They indicate that other work has sug-

gested that an alkaline pH, neutral sugars, acid polysaccharides, and necrosis may play important roles. An inducing substance has also been suggested but not demonstrated. No prior description of bone or cartilage

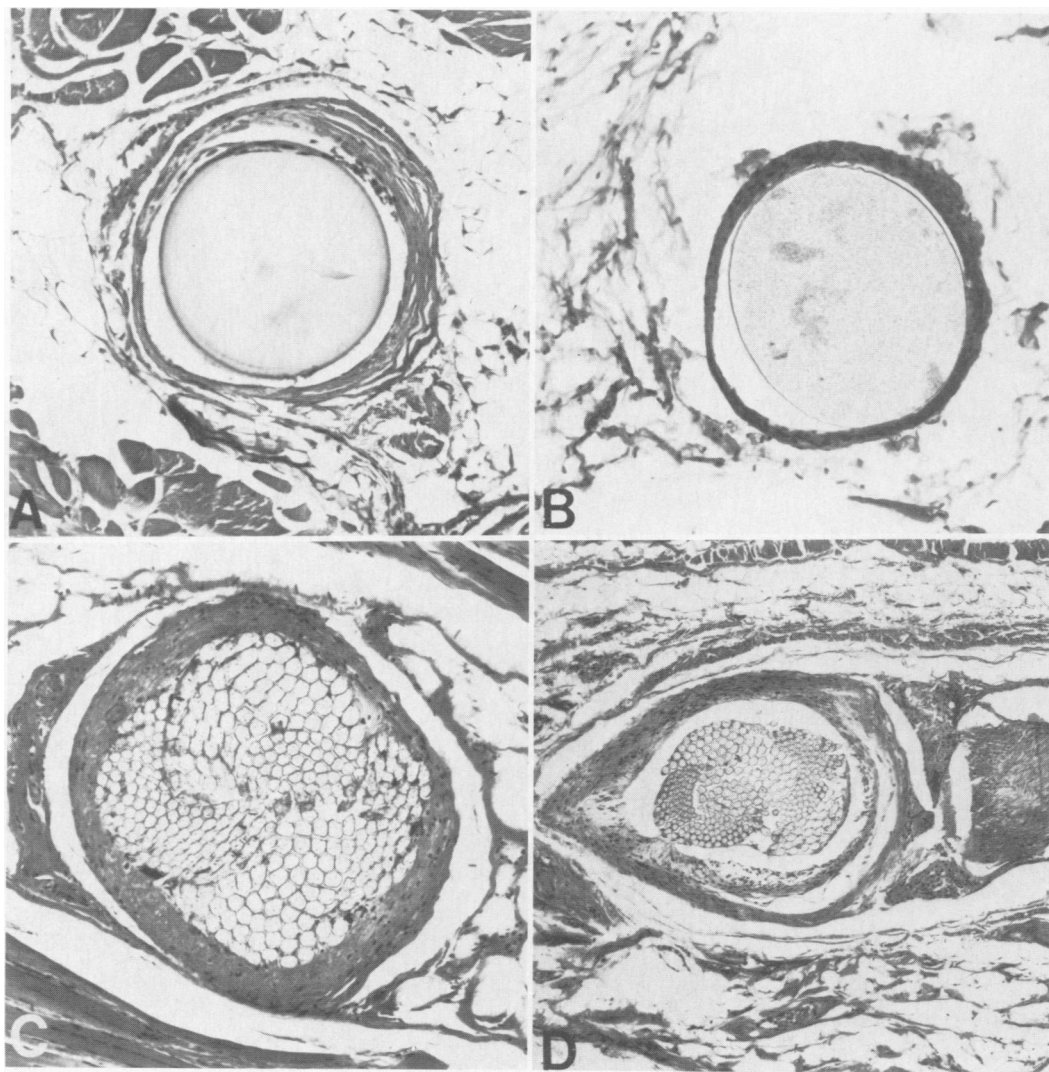


FIG. 1. Nylon in A and polypropylene in B show narrow rim of fibrous tissue. Dacron in C shows slightly more tissue reaction. Teflon has shed off the dacron, in D, and stimulated the reaction in the two triangular areas to the right of the suture (A, B, C $\times 140$; D $\times 70$).

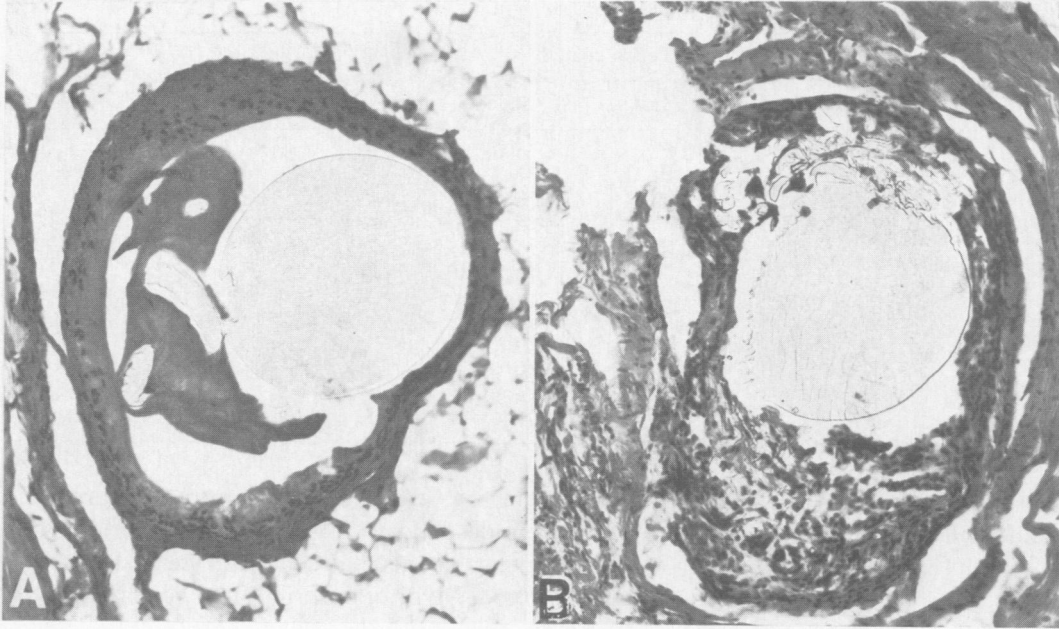


FIG. 2. In A, four comparatively large fragments of polypropylene are shown; three embedded in fibrous tissue. In B, multiple small fragments are seen above the suture ($\times 140$).

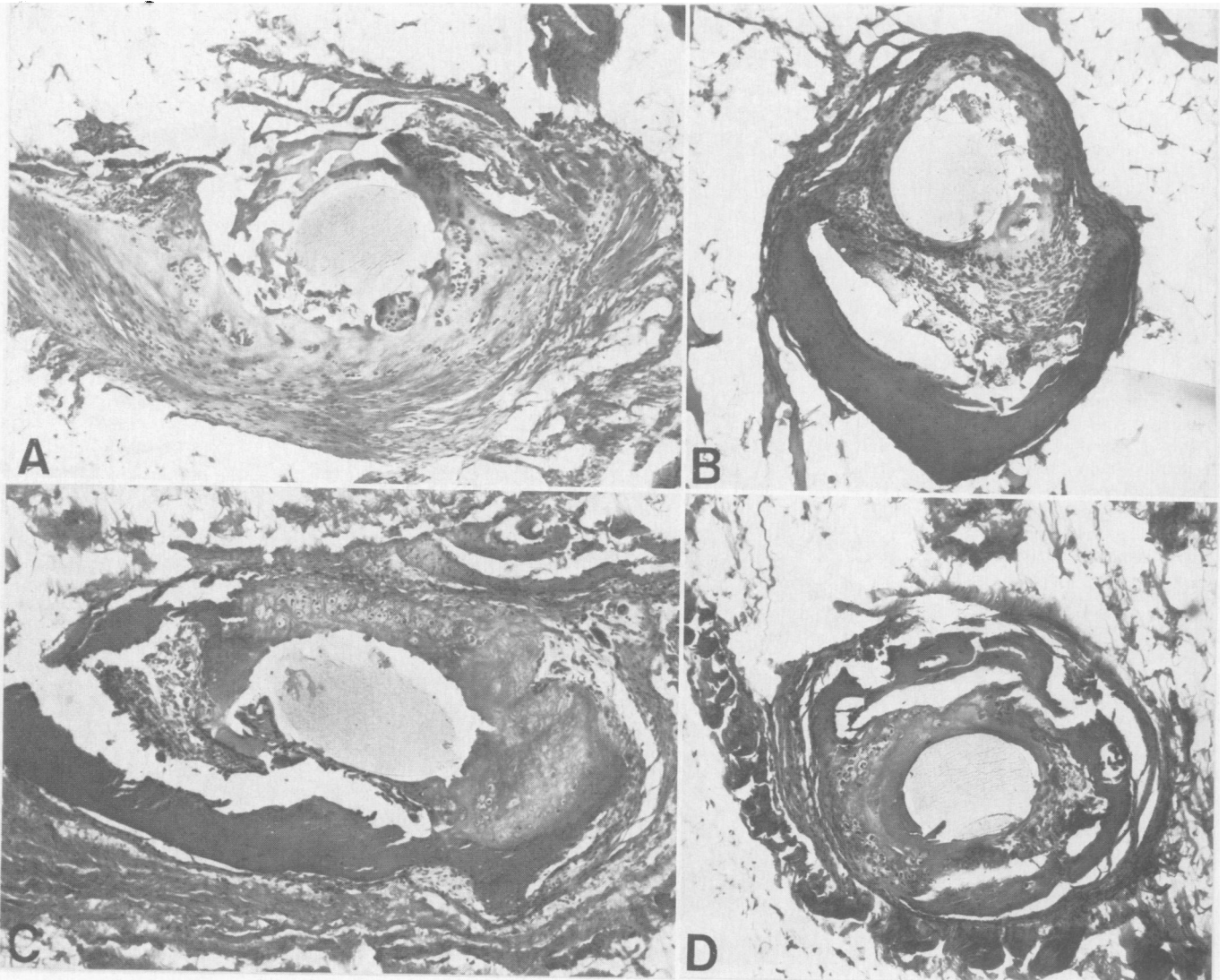


FIG. 3. Four examples of bone and cartilage formation around polypropylene. In addition, fragmentation is seen in A and B ($\times 70$).

growth as a cuff of tissue about a suture has been described as far as can be determined.

Also unexplained is the time the changes in or around the polypropylene developed. Divisions into two periods, 6–29 months and 30–60 months, shows 209 polypropylene sutures were examined in the first period and 142 in the second. In the first 29 months, 11 of the 14 instances of fragmentation were found and all of bone–cartilage formation. Conceivably, resorption of the bone and cartilage could have occurred in the older animals. In addition, the association of fragmentation with bone–cartilage formation in 5 of 9 cases of the latter suggests that the same abnormal process, chemical or otherwise, could be responsible for both.

Parenthetically, reexamination of the polypropylene sutures from the two year study showed no bone or cartilage formation.

Although in most operations, these minutiae of tissue reaction concerning polypropylene are of little consequence, it may be necessary to conduct further studies to determine if they have any significance.

References

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