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Research Note

Reactions to Bioabsorbable Suture Thread Embedded in Rat Subcutaneous Tissue

Yoshikazu Nakayasu[1,2], Saeka Matsuda[1], Keita Moriyama[1], Norimasa Okafuji[2], Akiko Mizohata[1], Masahito Shoumura[1], Toshiyuki Kawakami[2] and Naoto Osuga[1]

[1] *Department of Pediatric Dentistry, Matsumoto Dental University School of Dentistry, Shiojiri, Japan*
[2] *Department of Hard Tissue Research, Matsumoto Dental University Graduate School of Oral Medicine, Shiojiri, Japan*
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Abstract: We examined the subcutaneous tissue reactions in rats to bioabsorbable suture thread using histopathological methods. Using Wister rats, Vicryl®, a bioabsorbable suture thread, was embedded into the subcutaneous tissue and histopathological examination was carried out after 4 weeks. Cholesterin crystals were used for the control. Furthermore, immunohistochemistry for CD68 was done. Histopathological examination showed proliferation of granulation tissues in both experimental and control groups. The majority of cells in the granulation tissues were macrophages and giant cells. Fibroblasts were also observed in the proliferating granulation tissues surrounding the embedded bioabsorbable suture thread. Immunohistochemistry revealed that macrophages and giant cells were positive to CD68. The results suggest that the embedded bioabsorbable suture thread is not only fabricated to undergo absorption but also for phagocytosis by macrophages and foreign body giant cells.

Key words: Tissue reactions, Bioabsorbable suture thread, Vicryl®, Rat

Introduction

In the medical field, may sutures used in the body are supplied according to their use. Bioabsorbable sutures are also sometimes used in oral surgery. Most bioabsorbable sutures are made of synthetic chemicals and typical examples include sutures made of glycolic/lactic acid polyester (Polyglactin)[1]. It is said that this bioabsorbable suture disappears by absorption after gradual hydrolysis *in vivo* as its name implies[2]. However, clinical reports mentioned that pathological changes were observed in areas where the suture was used clinically[3]. Therefore, tissue reaction to bioabsorbable suture in tha rat subcutaneous tissue was examined histopathologically. Results thereof were obtained, outlined and reported.

Materials and Methods

Vicryl® (Johnson and Johnson Co., Ltd., Tokyo, Japan) suture material composed of glycolic/lactic acid polyester, was implanted in the dorsal subcutaneous tissue of Wister rats (8 weeks, male) in a bundle. The rats were placed under general anesthesia by intraperitoneal injection of pentobarbital. The back of the rats were shaved and incised and the material was implanted into the subcutaneous tissue and then sutured. Four weeks later, the implanted tissue was removed as a block and fixed in 10% neutral buffered formalin. The specimens were embedded in paraffin, sectioned and then were subjected to hematoxylin-eosin staining for histopathological examination. In addition, immunohistochemical (IHC) staining for CD68 was also performed. Briefly, CD68 (100-fold dilution in PBS solution) was used as the primary antibody and Simple Stain Mouse MAX Po-(R) was used as the secondary antibody. The final color development was performed by DAB and hematoxylin was used for counterstaining. For the control, 10 mg of cholesterin crystals (Ch) were used.

Correspondence to: Dr. Naoto Osuga, Department of Pedatric Dentistry, Matsumoto Dental University School of Dentistry, Shiojiri, 399-0781 Japan; Tel and Fax: +81-263-51-2015: E-mail: osuga@po.mdu.ac.jp

Results

Histopathologically, in the experimental group (Vicryl®), a large amount of cell proliferation was observed in the implanted part. Specifically, the embedded suture was observed as voids of various sizes according to its directions and multinucleated giant cells proliferated around the longitudinal image of the suture (Fig. 1-a). The number of nuclei in giant cell was over 50 and its cytoplasm was huge (Fig. 1-b). Fibrous connective tissues including fibroblasts were interposed between aggregates of multinucleated giant cells around the suture. In the cross section of the area observed, cell proliferation was confirmed in a circular manner conforming to the shape of the suture. The proliferated cell mass was predominantly occupied by mononuclear amorphous cells. The cytoplasm of those cells was slightly basophilic and lightly stained and the central part is an empty space, some of which showed somewhat irregular cell contours. Tissues containing some fibroblasts were confirmed in the surroundings. There were some capillaries in an organized section that intervenes in the proliferating cell groups; many of which were hyperemic (Fig. 1-c). By IHC, both proliferating mononuclear cells and multinucleated giant cells showed CD68 positive reactions (Fig. 1-d).

In the control group, the mononuclear cells and multinucleated giant cells have irregular cellular outlines appearing similarly and were concentrated in the area where Ch was embedded. Large voids were observed as well (Fig. 2-a). Both cells showed intense staining for CD68 by IHC (Fig. 2-b).

Discussion

There are many studies that have investigated tissue changes after embedding bioabsorbable sutures in the body[4-9]. Many of them however, confirmed the growth of some granulation tissue after implantation but mentioned that the tissue reactions as well as the adverse effect on the tissues were weak[9]. Nevertheless, there are clinical reports of the occurrence of lesions caused by absorbable sutures *in vivo*[3]. As mentioned earlier, comprehensive description

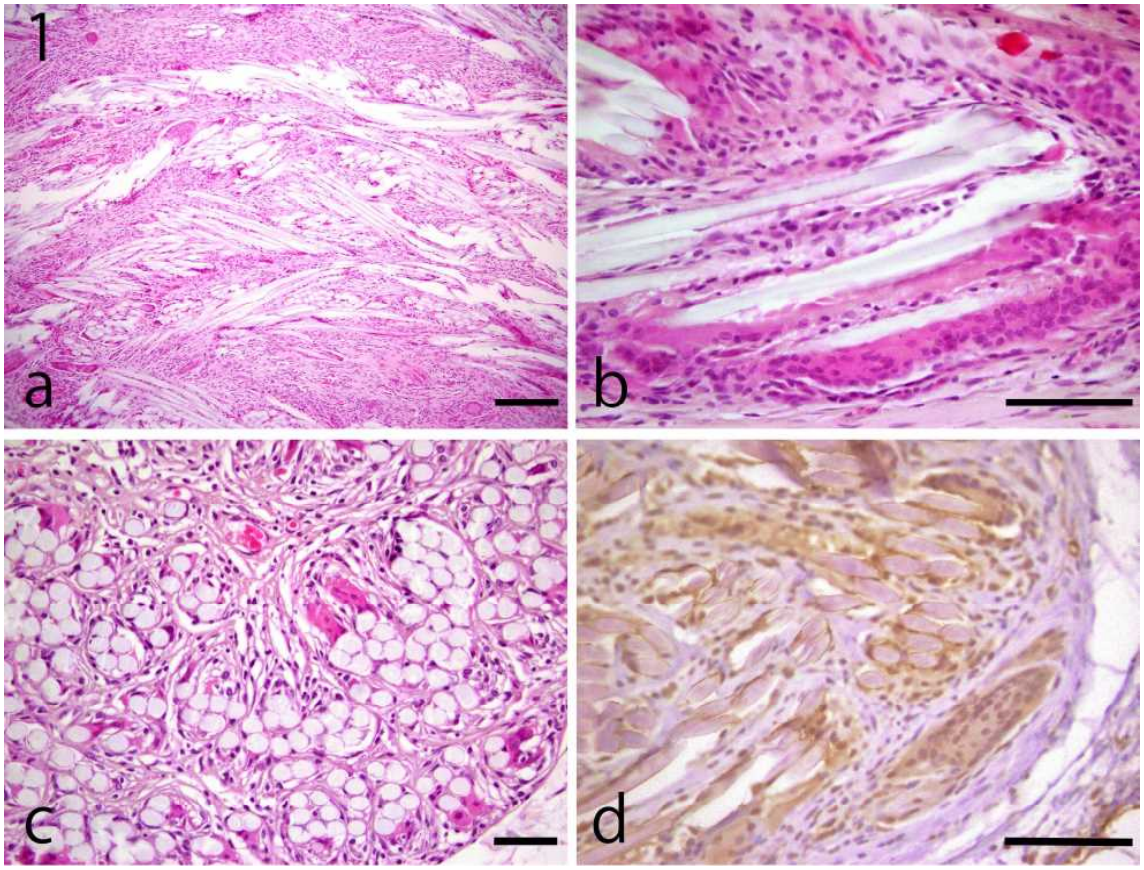

Figure 1. Longitudinal section of Vicryl® embedded in the tissues (a), High power magnification of Fig. 1 showing multi-nucleated giant cells around Vicryl® (b), High power magnification of cross section of Vicryl® embedded in the tissues (c), High power magnification of IHC showing CD68 positive reaction of giant cells (d). Scale bar=100μm.

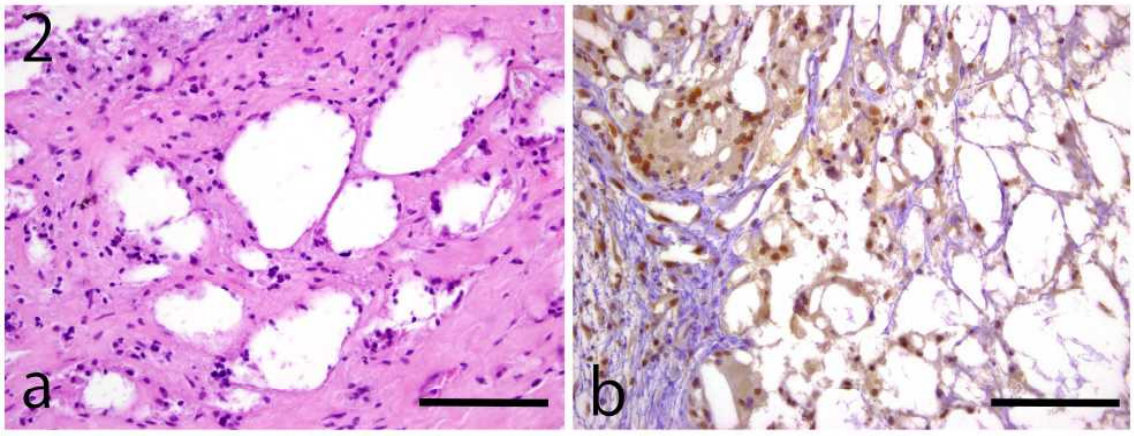

Figure 2. Control (Cholesterin) specimen showing granulation tissue formation in the embedded portion of the rat subcutaneous tissues (a), High power magnification of IHC for CD68 showing positive reactions of giant cells (b). Scale bar=100μm.

subcutaneous tissue response using a typical absorbable suture Vicryl® which is sometimes used in surgical procedures in the oral cavity[1)].

Mononuclear and multinucleated giant cell proliferation was observed in the dorsal subcutaneous tissue of rat where Vicryl® was implanted. Some fibrous tissues were found around and between monocytes and multinucleated giant cells. Interestingly, the mononuclear and multinucleated giant cells were positive to CD68 hence, they are foreign body giant cells formed by coalesence of macrophages. The central and peripheral parts of the cytoplasm of the macrophages were different in its staining ability. Moreover, the cells are round in shape and contain empty spaces. Those might be due to the differences in the degree of hydrolysis of bioabsorbable sutures incoporated into the cytoplasm through phagocytosis. In the control group using Ch, histopathological sections showed that macrophages and foreign body giant cells proliferated almost the entire area of the implantation site and the implanted Ch was actively phagocytosed. This finding is almost similar to the study of Sakai et al.[10)] where cholesterol crystals were embedded in subcutaneous tissues in mice.

of the behavior and tissue reaction to absorbable suture in the living tissue has not been elucidated. Therefore, we investigated the rat

In this experiment, since the observation was only done at four weeks after implantation, the proliferation of macrophage-based granulation tissue as a result of tissue reaction at the implantation site was only done in a short term observation and so the long term fluctuation of cell proliferation and other tissue reactions were not made clear. Therefore, in the future, we plan to clarify the dynamics of cell proliferation including prolonging the period of observation until the complete absorption of suture embedded in subcutaneous tissues. Moreover, since only one kind of bioabsorbable suture was used in this experiment, we would like to test other materials such as Vicryl Rapide® (Johnson & Johnson Co, Ltd., Tokyo, Japan) which has the same chemical structure but is bioabsorbed quickly.

Sakai et al.[10] used a system of bone marrow transplantation of GFP mouse as an experiment system to examine tissue response to Ch in subcutaneous tissues. Most cellular components of the granulation tissue growth were derived from bone marrow mesenchymal cells. In reference to this experiment, we will examine the origin of the cells that proliferate after implantation of bioabsorbable sutures.

Acknowledgments

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Conflict of Interest

The authors have declared that no conflict of interest.

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