

Healing Process of the Gingival Mucosa and Dental Alveolus Following Tooth Extraction and Suture with Polyglycolic Acid and Polyglactin 910 Threads. Comparative Histomorphologic Study in Rats

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The substance employed in the suture of the mucosa after dental extraction may influence the healing of the gingival mucosa as well as of the dental alveolus. Based on the superiority of the synthetic threads from the biocompatibility point of view, the objective of this study is to compare the reaction caused by the polyglactin 910 and polyglycolic acid threads used for suturing the gingival mucosa following upper incisor extraction in the rat.

Forty-eight animals were divided into two groups of 24 as follows: group I, just after the right upper incisor extraction, the gingival mucosa received a single suture with polyglactin 910 thread to approximate the edges of the wound; group II, the same procedure was done, but the mucosa was sutured with polyglycolic acid thread.

Six animals from each group were sacrificed at 3, 7, 15 and 24 postoperative days. The specimens were routinely processed in the histology laboratory. Six- μ m semi-serial slices were stained with hematoxylin and eosin for histomorphologic study.

The results demonstrate that the two kinds of suture materials cause an acute inflammatory reaction of short duration during the first few days. The polyglycolic acid causes an earlier fibroblastic and capillary proliferation than the polyglactin 910 thread.

Key Words: alveolar healing, suture thread, absorbable suture.

Introduction

Among the local factors that influence healing after tooth extraction, sutures play an important role. Suturing of the gingival mucosa facilitates epithelial regeneration and protects the blood clot in the initial stages of the healing process (Okamoto et al., 1990). On

the other hand, the suture material employed may delay the onset of cell proliferation. Thus, the sutures should not be irritating to the tissues, determining a short and mild inflammatory phase of healing (Grandini et al., 1971). They should not delay fibroblastic proliferation or loose traction strength during the exudative phase of tissue repair (Carvalho et al., 1986).

Several studies reporting the response of the oral mucosa to suture materials (Lilly et al., 1968, 1969; Wallace et al., 1970; Oliveira et al., 1985) indicate that synthetic materials present a superior behavior. Among these, polyester threads, both in superficial and deep sutures, promote a mild, short inflammatory reaction (Castro et al., 1974, 1978). Deep polyester sutures, however, result in a foreign-body reaction (Castro et al., 1978). A multiple filament, nonresorbable, stretched suture has been indicated for delicate flaps, such as those used in periodontal or periapical surgery and oral mucosa grafts (Carvalho et al., 1986). Other commercially available synthetic materials are the polyglycolic acid and polyglactin 910, largely used for deep sutures. Polyglycolic acid presents a simple molecular structure and absence of proteins, desirable features from the surgical standpoint, and is also very flexible, strong and easily manipulated (Soares et al., 1974). On the other hand, polyglactin 910, more recently available, is obtained from copolymerization of lactides and glycosides and transformed to fibers (Passeri, 1982). It presents excellent tissue compatibility, promoting discrete acute inflammatory reaction and absence of foreign body reaction (Reul, 1977).

These latter two absorbable suture materials, besides their main indication for deep sutures, may be used after tooth extraction, where resorbable sutures are indicated, mainly in cases where removal of nonresorbable sutures are to be avoided. The present study compares the polyglycolic acid and polyglactin 910 sutures when used for the suturing of the dental mucosa after tooth extraction, from the standpoint of tissue compatibility.

Material and Methods

A total of 48 male albino rats (*Rattus norvegicus*, albinus, Wistar) weighing 200 to 250 g were used in this study. The animals were fed a balanced diet (Anderson Clayton S.A.), before and during the experiment, with the exception of the first 24 hours after the surgical procedure and water was offered *ad libitum*.

Tooth extraction

Under general anesthesia through intraperitoneal infiltration of sodium thionembutal (Abbott S.A.) (approximate dose, 50 mg/kg body weight), the right upper incisor of all animals was extracted with specially adapted instruments (Okamoto and Russo, 1973).

Classification of groups

The 48 animals were divided into two groups of 24: group I - immediately after the extraction, the gingival mucosa was sutured with a single 4-0 polyglycolic acid suture (Davis + Geck Inc.) approximating the borders of the wound; group II - the same procedure was

carried out with a 4-0 polyglactin suture (Polivicril, Johnson and Johnson). The sutures were maintained for the duration of the experiment.

Histological processing

Six animals from each group were sacrificed by excessive sulfuric acid inhalation after 3, 7, 15 and 24 days. The right maxilla was separated from the left by an incision following the intermaxillary suture. Using straight scissors a second incision was made tangent to the distal surface of the last molar to separate the whole specimen from the gingival mucosa and the right dental socket.

The specimens were fixed in 10% formalin for 24 h and decalcified in sodium citrate and formic acid (v,v) (Morse, 1945), following routine laboratory procedures for obtaining 6- μ m semi-serial sections stained with hematoxylin-eosin for histological examination.

Results

3 Days

Polyglactin 910 - All specimens showed moderate epithelial proliferation of the gingival mucosa, covering approximately 1/3 of the socket. At adjacent areas an intense neutrophilic infiltrate can be observed. Some newly formed fibroblasts, capillaries and numerous macrophages are also found. (Figure 1A). The dental socket is filled with blood clot infiltrated by numerous macrophages. Close to the lingual wall of the middle and apical thirds, remainings of well-vascularized periodontal ligament, rich in fibroblasts, are encountered. At the middle third, close to the ligament, intense fibroblast proliferation is found, adjacent to some newly formed fibroblasts and small quantities of amorphous fundamental substance. Two specimens display resorption of the lingual bone wall at the cervical third, with numerous osteoclasts.

Polyglycolic acid - In four specimens a more intense epithelial proliferation can be found, with a less intense neutrophilic infiltrate of the surrounding tissue, plus intense fibroblastic and capillary proliferation (Figure 1B). The other two specimens are similar to those observed for the previous group.

The morphological characteristics of the dental socket close to the apical and middle thirds are comparable to those observed for the previous group. However, in some cases at the medium third, a greater area is occupied by fibroblastic proliferation. At the cervical third, the lingual wall is mildly resorbed, and some osteoclasts are found.

7 Days

Polyglactin 910 - In one of the specimens, gingival mucosa epithelium covers the entire socket, while in the remaining specimens it covers approximately 2/3 of the sockets.

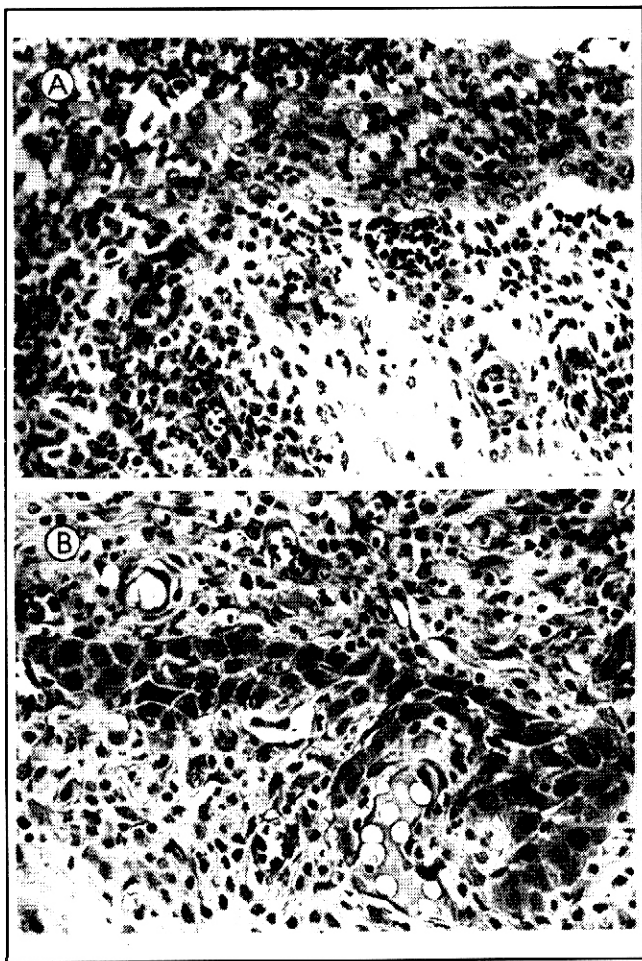


Figure 1 - A, Polyglactin 910, 3 days. Discrete epithelial proliferation. A few fibroblasts, newly formed capillaries and numerous macrophages can be seen close by. H.E. 250X. B, Polyglycolic acid, 3 days. Epithelial proliferation is more intense than for the other group. Intense capillary and fibroblastic proliferation. H.E. 250X.

The adjacent connective tissue shows, in some specimens, numerous macrophages and lymphocytes close to some neutrophils, especially near the suture material. In others, the tissue is more mature, exhibiting some lymphocytes and histiocytes (Figure 2A). The socket is totally filled with newly formed connective tissue presenting variable characteristics. At the level of the cervical third, newly formed bone is absent (Figure 2B), with exception of small areas close to the alveolar wall, where the beginning of appositional ossification can be found. At the level of the middle and apical thirds, newly formed trabeculae are found close to the lingual wall.

Polyglycolic acid - In all specimens, epithelium covers the entire socket and the adjacent connective tissue is more developed when compared to the previous group (Figure 2C). Collagen fibers are parallel to the surface epithelial cover. The socket, except for two

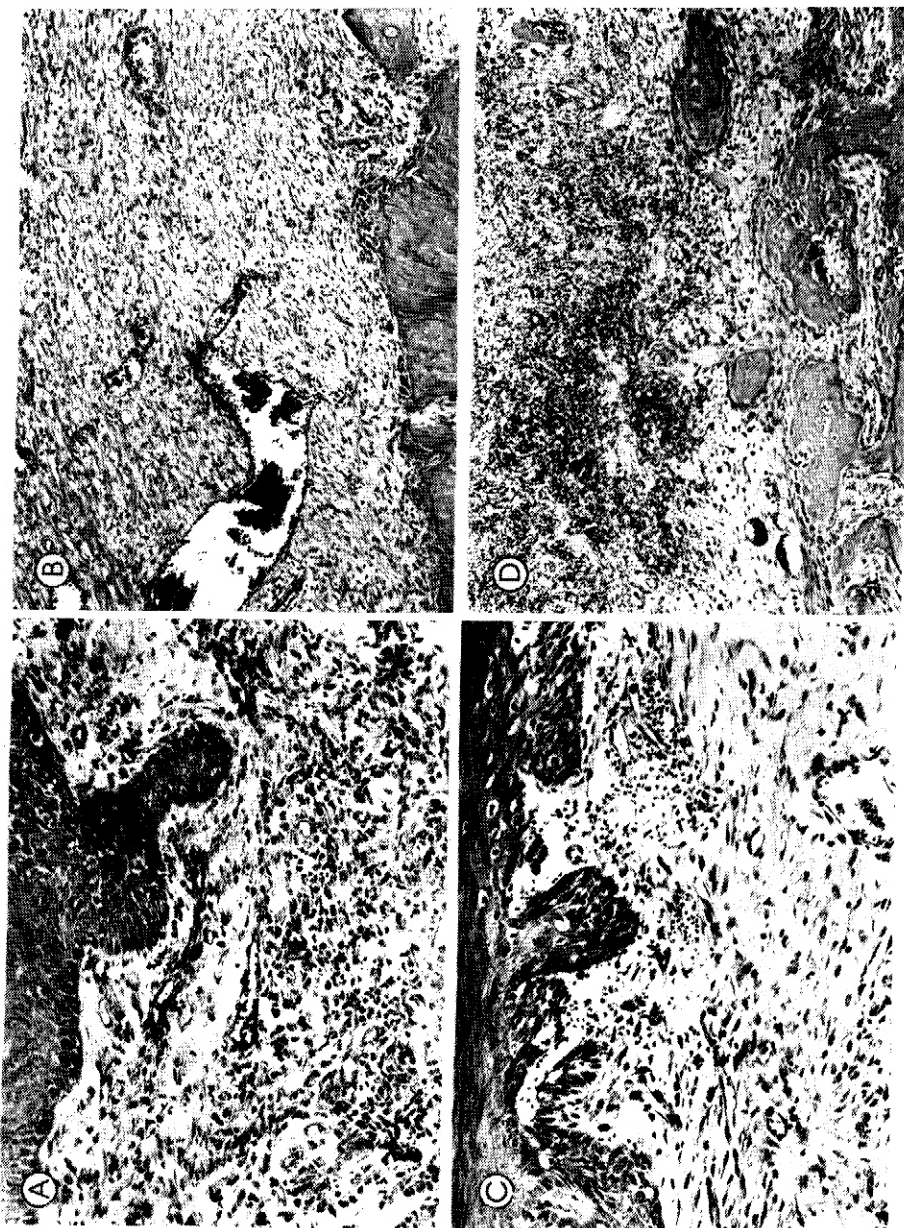


Figure 2 - A, Polyglactin 910, 7 days. B, Polyglactin 910, 7 days. C, Polyglycolic acid, 7 days. D, Polyglycolic acid, 7 days. Middle third of the dental socket showing thin bone trabeculae close to the bone wall. H.E. 63X.

cases, shows isolated trabeculae at the cervical third, close to the alveolar wall. The remaining animals present no bone differentiation at the cervical third, although the connective tissue is better developed than in the previous group. A more intense bone proliferation is found at the apical and middle thirds. Thin osseous trabeculae are seen close to the alveolar wall (Figure 2D).

15 Days

Polyglactin 910 - For all specimens, the epithelium covers the entire socket and the suture material is absent. At the level of the dental socket, thin bone trabeculae are present at the apical and middle thirds, filling approximately one half of the area. The spaces between the trabeculae are filled with well-vascularized connective tissue, rich in fibroblasts. At the cervical third, bone proliferation is discrete, with small scattered trabeculae (Figure 3A).

Polyglycolic acid - For all specimens, the epithelium covers the entire socket and the suture thread is absent. In the socket, close to the middle and apical thirds, thick trabeculae are found, filling 2/3 of the area. At the cervical third the trabeculae are thin and fill about one half of that area (Figure 3B).

24 Days

The socket is filled with thick well-defined trabeculae in both groups, showing reduced medullar spaces (Figure 3C).

Discussion

Suture material is considered superior when it causes little tissue irritation and a short, mild inflammatory reaction (Rosenberg et al., 1971). However, it must be stressed that superficial oral sutures are exposed to a humid, contaminated environment. Thus, to the inflammatory reaction evoked by the suture material may be added contamination of deeper areas due to the capillarity of the suture material. Multiple filament threads tend to enhance this factor when compared to monofilament materials. Local factors that may disturb the healing of the gingival mucosa, especially by delaying the exudative phase of the process, may also influence the healing of the socket (Okamoto and Russo, 1973). The choice of material for the suturing of the gingival mucosa is thus important for the healing socket.

Both polyglactin 910 and polyglycolic acid are excellent materials, although they cause an intense inflammatory reaction during the first few days after surgery. This inflammatory reaction, however, is usually short.

Comparing the materials, we could see a more favorable early reaction for the polyglycolic acid, both in the exudative as well as in the proliferative phase of healing. After 3 days, the fibroblastic and capillary proliferation occurred earlier for this material. The epithelium, as a result, totally covered the socket after 7 days. The repair of the bony socket

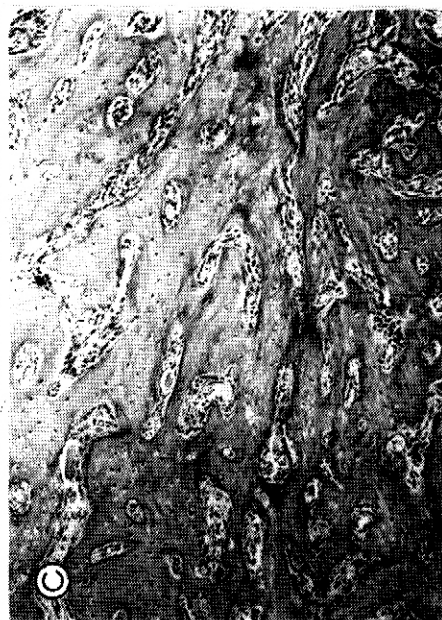
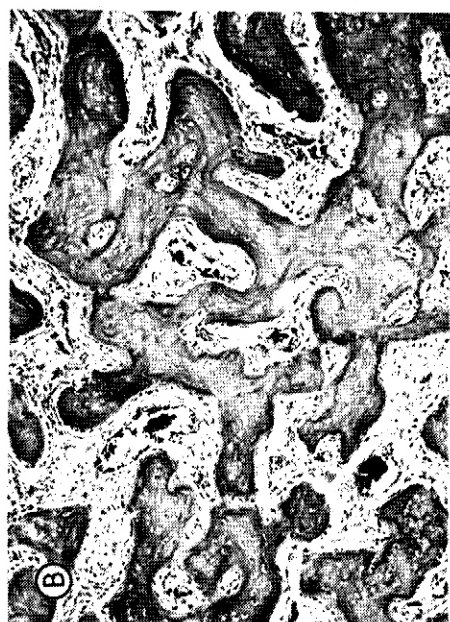


Figure 3 - A, Polyglactin 910, 15 days. Cervical third displaying discrete ossification. H.E. 63X. B, Polyglycolic acid, 15 days. Cervical third showing more intense ossification as compared to the other group. H.E. 63X. C, Polyglycolic acid, 24 days. Cervical third showing thick trabeculae. H.E. 63X.

was also faster for the polyglycolic acid group, especially at the cervical third. For the last period (24 days), the sockets were totally repaired for both groups, showing that the difference in the rate of healing is minor.

The more intense tissue reaction displayed for the polyglactin suture may be related to a possible greater capillarity effect, since both are multifilament threads. It probably does not relate to the chemical properties of the materials, since both present identical reactions when tested as buried sutures (Castro et al., 1978; Carvalho et al., 1985). We should point out that both materials show excellent biocompatibility and may be equally employed for deep and superficial oral sutures.

Conclusions

1. Both sutures promoted acute inflammatory reaction in the first few postoperative days.
2. The onset of fibroblastic and capillary proliferation at the level of the gingival mucosa occurs earlier with polyglycolic acid sutures. The same is true for the dental socket.
3. A discrete delay in socket healing was observed with the polyglactin 910 sutures.

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