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BIO-ABSORPTION EVALUATION PROCEDURE WITH GAMMA IRRADIATED SUTURE FOR BRACHYTHERAPY STRAND APPLICATION

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ABSTRACT

Bio-absorbable sutures are largely used to hold and wind tissues together in good apposition until completing the healing process, without needing future removal. There are some materials commonly used for these sutures, such as polyglycolide, polylactide, poly(ecaprolactone), mucosa or beef intestines. Some of these materials have marked or moderate tissue reaction, like mucosa or beef intestines, and could not be used for some delicate applications, like braiding brachytherapy seed strands. The best option for this application is Vicryl sutures, trade mark of Johnson&Johnson company. Vicryl has a bio-absortion time still a little long, for brachytherapy application, but it could be accelerated imparting a dose of ionizing radiation in the strand, before using it. In this work, it is shown the procedure where small hanks of Vicryl wires (fifteen centimeters unrolled), surgical diameter number 7-0 (~50 mm), were inserted into rats underskin and removed for mechanical and histological evaluation after 15, 30 and 60 days. Wire samples were irradiated with gamma doses of 10, 25 and 50kGy, besides those non-irradiated. Preliminary mechanical evaluation was carried out in a EMIC DL 2000 machine, using NBR 13904 standard normative test. Fifty grays caused great degradation on wires, preventing any traction evaluation. Small doses are promising for accelerating bio-absortion and the samples mechanical tests results will be the scope of a future work.

1. INTRODUCTION

Brachytherapy comprises very important techniques, of great cure indices around the world. Simply described, it is a cure from inside to outside, because the radiation sources are placed inside the tumor, through a small needle path which can not be

considered properly a surgery. Non reproduction capability of tumor cells and other radiation effects occur only at a small distance from the sources. The sources are like small seeds, grouped at dozens inside the tumor. It is crucial that no source leaves its place, because no other tissue has to be irradiated but the tumor. For such a scope, packaging of seeds inside a no core strand made by a bio-absorbable material has been of common practice. The strand is cut in the precise extension, with the precise number of seeds calculated by sofisticated simulation programs. The strand is introduced into the pacient through special needles with the sources inside. The strand is an additional protection tightly bound to avoid seed migration [1].

Bio-absorbable sutures are largely used to hold and wind tissues together in good apposition until completing the healing process, without needing future removal [2-5]. There are some materials commonly used for these sutures, such as polyglycolide, polylactide, poly(caprolactone), mucosa or beef intestines [4]. Some of these materials have marked or moderate tissue reaction, like mucosa or beef intestines, and should not be used for some delicate applications, like braiding brachytherapy seed strands. Due to their very low tissue rejection and bio-absorption made by hydrolyzable chemical bonds, the best option for this application is Vicryl sutures, based on poly(lactide-co-glycolide) (PLGA), trade mark of Johnson&Johnson company. Vicryl has a bio-absortion time still a little long, for some Brachytherapy applications, but it could be accelerated imparting a dose of ionizing radiation in the strand, before using it [6-7].

In this work it was shown the adopted procedure and first results of *in vivo* tests for evaluation of Vicryl sutures as the main candidate for braiding wire of brachytherapy strands. This is a preliminary work on these studies. Suture wires were irradiated in a 60 cobalt irradiator. Hanks of these wires were inserted into rats and timely extracted, as described in experimental methodology. Tissue evaluation has visual evaluation. Delicated strain-stress essays were performed in non-irradiated suture wires.

2. EXPERIMENTAL METHODOLOGY

In order to obtain the imposed very small diameter strand, sketched in Figure 1, to fit the internal wall of the medical needle, the suture surgical number 7-0 (~55 μm fiber diameter) was chosen.

Suture wire pieces were cut with fifteen centimeters long. Small hanks, surgical diameter number 7-0 (~50 mm), were inserted into rats underskin, see Figure 2, and removed for mechanical and histological evaluation after 15, 30 and 60 days. Wire samples were irradiated with gamma doses of 10, 25 and 50kGy, besides those non-irradiated.

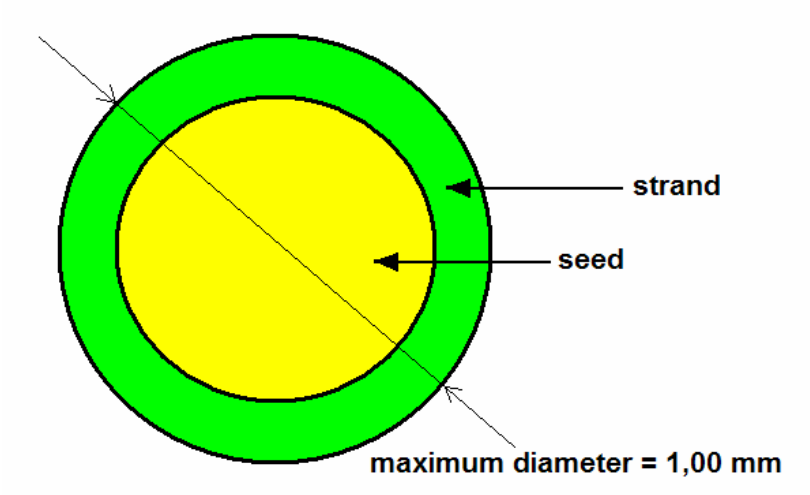

Fig. 1 – Sketch of a strand transversal cut. Seed diameter has 0,80 mm.

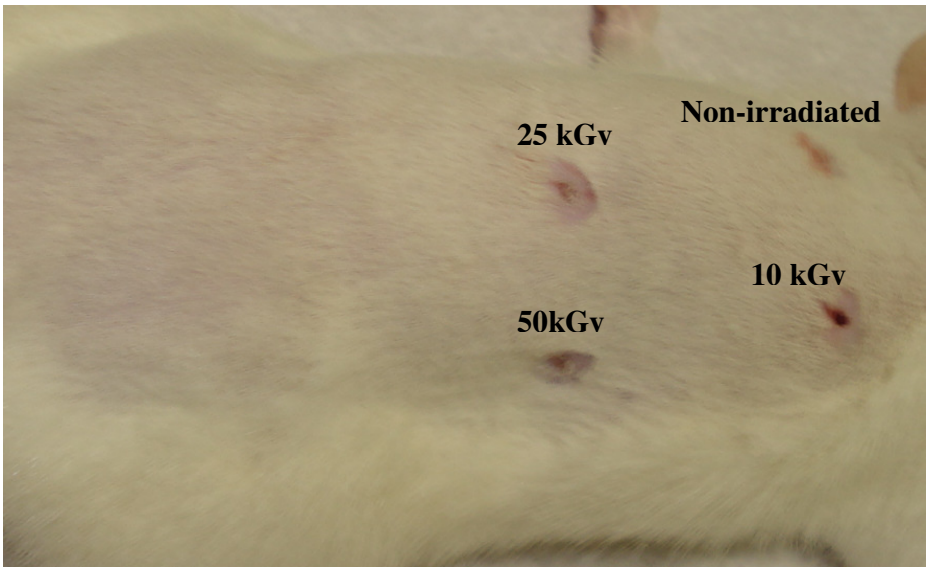

Fig. 2 – Irradiated suture 7-0 hanks implanted into rat backside.

Strain-stress (force versus elongation) mechanical evaluation was carried out in a EMIC DL 2000 machine, using NBR 13904 standard normative test [8]. Only non irradiated suture wires were tested because with only fifty grays of absorbed dose cause great degradation on wires, preventing any traction evaluation.

3. RESULTS

Strain-stress test in non irradiated sample wires give the results shown in Figure 3. It can be seen that this suture can suport only less than 1N before breaking.

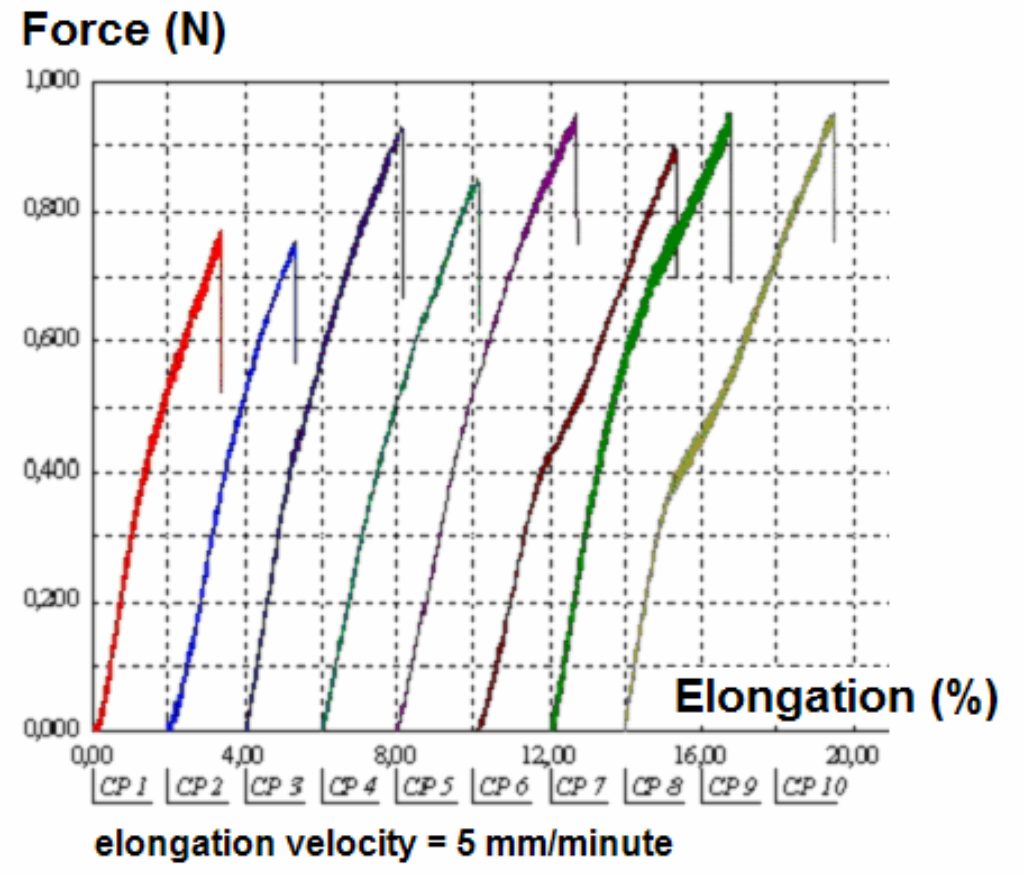

Fig. 3 – Tension until breakase, the mechanical test performed in non irradiated sample wires.

Some "shoulders" at sample 7 and 8 (from left to right) are small slidings of the suture knots during the mechanical test, and should not be considered. The mean value of yield strenght is 0,8 N.

After fifteen days, the first extraction from the rats, no wire had enough mechanical resistence to permit strain-stress mechanical test. The material had been almost completely bioabsorbed, as shown in Figures 4 and 5.

Fig 2. - Suture hanks almost completely bio-absorbed after 15 days.

Fig 3 - Hanks completely absent after 30 days.

3. CONCLUSIONS

The initial studies for evaluating suture wires, intended to be used as bio-absorbed strand, involving seeds for brachytherapy procedures, were present.

Mechanical strain-stress essay will be an important essay to give information on the bio-absorbable stage of the suture material implanted. Small doses are promising for accelerating the bio-absortion, not so intensely as 10 kGy. Mechanical tests in irradiated samples will be performed in a future work.

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