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Physical Property of Absorbable Suture (PLLA Ⅰ, PLLA Ⅱ, PLGA, PDO)

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Abstract. PLLA Ⅰ, PLLA Ⅱ, PLGA, and PDO are absorbable sutures that are degraded by enzyme hydrolysis in comparison with nonabsorbable sutures. The suture was prepared self-production by extruder. Weight loss of the samples, pH change, and the tensile strength were measured. As a result, it was confirmed that slow degradation of the PLLA Ⅰ, Ⅱ and PLGA. In addition, the tensile strength of PLLA held longest. In other words, it is suitable for sealing a lengthy healing period.

Keywords: PLLA, PLGA, PDO, Biodegradable suture

1 Introduction

The surgical site infection is one of the most common causes of postoperative complications such as anastomotic leakage or stricture. It is crucial, therefore, to make appropriate selection of suture material to help minimize the likelihood of contracting the infections.[1], [2]

A suture material used in surgery is categorized based on several factors such as material, physical shape and absorbability: for instance, absorbable and non-absorbable materials. Among many biodegradable Polymers, such as Poly(L-lactic acid)(PLLA), PLGA have attained a unique position in the field of biomedical materials because of their excellent mechanical properties and biological affinity. [3],[4],[5] In this work, important considerations will be elucidated about the long-term prediction of the Physical behavior of a biodegradable suture, using constitutive models.

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2 Methods

2.1 Suture Prepared

Poly(L-lactic acid)(PLLAⅠ Mw 200,000), Poly(glycolic –co- lactic acid)(PLGA Mw 200,000)Sutures were prepared by PURAC Ltd,. (Netherlands), And Poly(L-lactic acid)PLLAⅡ was prepared (0.15~0.199mm in diameter, Mw 180,000) by BMG Ltd,.(Japan)

Their diameter is 0.15~0.199mm. The suture was prepared self-production by extruder. Put the raw material in die size of 0.1~0.2mm, Input speed 25mm/min, take-up speed 70mm/min, temperature of 190℃ and then in a nitrogen atmosphere was let for six hours.

Polydioxanone(PDO) was prepared by SAMYANG Ltd,.(Korea) Its diameter is 0.15~0.199 mm.

2.2 In Vitro of PLLAⅠ, PLLAⅡ, PLGA and PDO

PLLAⅠ, PLLAⅡ PLGA, PDO was carried out in Phosphate Buffer Saline (PBS) solution with condition of pH7.4, and 37℃ for 60week.

2.3 Mechanical property of PLLAⅠ PLLAⅡ, PLGA and PDO

Mechanical properties(Tensile Strength)of the suture were measutred on a Universal Testing Machine QM100S of qmesys Ltd., equipped with 100g load cell at room temperature. At a testing speed of 30±5Cm/min, a 10cm suture length was stretched until breakage occurred and the peak force was recorded from the computer. It was measured according to FDA regulations. Mass measurement was used AND manufactured by HM-300. pH measurement was used Thermo Scientific manufactured by ORION STAR A211.

3 Results

3.1 pH change in the decomposition period

The chain scission by hydrolysis has an acid(-COOH) end group. Therefore The degradation lead to acid increases.[6] The pH of the PBS contained in the vial was measured. PLLAⅠ,Ⅱ and PLGA showed no change in pH over 50 weeks, In the case of PDO has started to change from 20 weeks.

3.2 Mass change in the decomposition period

The sample was observed for changes in appearance after drying for 24 hours. The mass was measured by HM-300 electronic balance. It was calculated by the following equation.

$$Weight\ loss\,(\%) = \frac{W_0 - W_t}{W_0 \times 100} \tag{1}$$

Weight loss of PLLAⅠ,Ⅱ and PLGA was started about 40week, The decomposition after 50 weeks are expected to be terminated. In the case of PDO suture according to Lin and Chu, After 70 days showed a weight loss of 3%, and 150 days overcome the loss rate was Significantly increased. namely PDO has the fastest degradation rate and The PLLAⅠ,Ⅱ have the slowest degradation rate(fig.1).

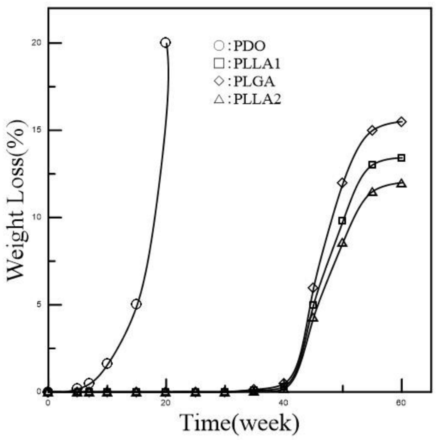

Fig. 1 Weight retention of sutures incubated in PBS at 37℃ during degradation.

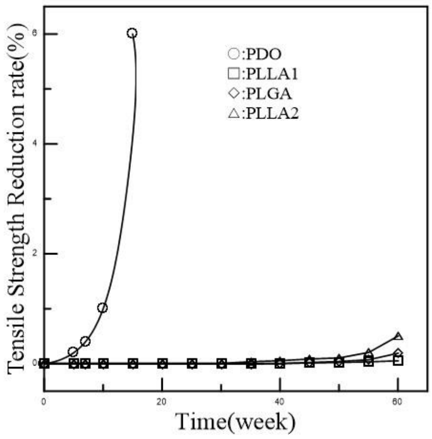

Fig. 2 Types of suture materials and degradation in tensile strength.

3.3 Change in Tensile Strength of the decomposition period

At week 40, the tensile strength reduction ratio of PLLAⅠ, PLLAⅡ and PLGA Slightly increased.

PLLAⅡ, PLGA tensile strength reduction ratio remained the same but a very small reduction from 35 weeks began. Only the PLLAⅠ did not change up to 40 weeks.

The deterioration in PDO tensile strength reduction ratio appeared completed by week 10 of the test with more than PLLA Ⅰ, Ⅱ and PLGA

In general, the deterioration in suture tensile strength was observed to be minimal with PLLA Ⅰ, followed by PLGA and PLLAⅡ, and then PDO (Fig. 2).

A decrease in suture tensile strength was noted in all 4 sutures with the PLLA Ⅰ suture showing the least deterioration followed by the PLGA suture.

4 Conclusion

The PDO suture has greater tensile strength reduction ratio when compared with PLLA Ⅰ, PLLAⅡ, and PLGA. Suture tensile strength decreases with time, and this decrease in its tensile strength is statistically significant up to week 10. The effects of pH and suture degradation are observed in this in vitro study, although these do not translate to statistically significant end points.

PDO showed a significant decrease in suture tensile strength from week 10 to week 18.

PLLA Ⅰ, PLLAⅡ and PLGA retained their tensile strength past the 35week of experiment with minimal deterioration in suture tensile strength.

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