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Collagen gels and matrices with lidocaine used in dentistry

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Introduction

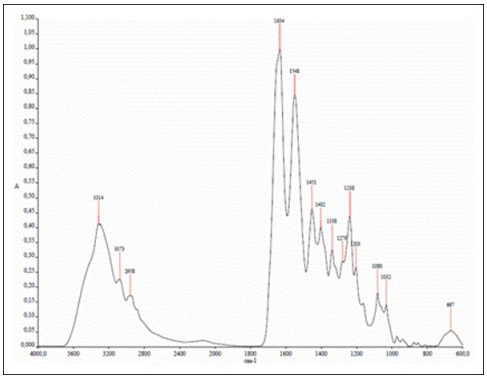
Collagen-based biomaterials are increasingly appreciated by specialists in dentistry. Although they enjoy remarkable attention, they are still under research and/or clinical trial. The purpose of the drug delivery systems (DDS) is the controlled release of drugs on the affected tissue. Several interdisciplinary fields as polymer science, pharmacy, chemistry, molecular biology and dentistry are involved in the development of such complex biomaterials.
Collagen is a suitable support for drug delivery, offering the advantage of a natural biomaterial with haemostatic and wound healing properties. Lidocaine belongs to the local anesthetics class and it is used to relieve the pain by stopping nerves from sending pain signals.

Objectives

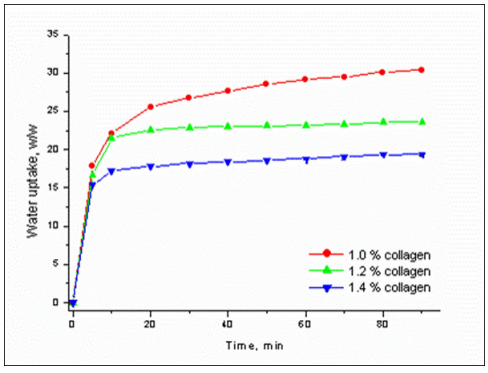
The aim of this study is developing wound dressings in form of collagen spongious matrices with lidocaine as drug for their using in dentistry.

Material and Methods

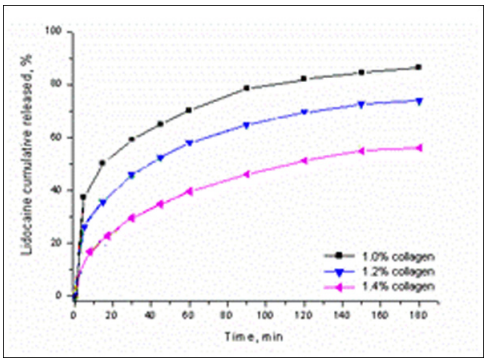
Type I fibrillar collagen gel having a concentration of 1.71% (w/w) was extracted from calf hide by the currently used technology in Collagen Department. Lidocaine was purchased from Sigma-Aldrich and glutaraldehyde (GA) was obtained from Merck (Germany). Sodium hydroxide and phosphate buffer solution (PBS), pH, 7.4 were of analytical grade.
Collagen hydrogels with concentrations of 1.0, 1.2 and 1.4% in collagen and 0.1% lidocaine were obtained in aquous solutions, at 7.4 pH. These hydrogels were freeze-dried using the Christ Model Delta 2-24 LSC freeze-dryer, Germany and proper collagen matrices (spongious forms) were obtained.
FT-IR spectrum measurements were recorded by FT-IR spectrophotometer of Perkin Elmer type Spectrum 100.
The water absorption was calculated using the method previous described [4].
In vitro release of lidocaine was determined in triplicate at 37° C using a modified USP paddle method ("sandwich" device). The amount of lidocaine released was spectrophotometrically determined at 263 nm.
Clinical trials were carried out on 40 pacients with the cronical apical parodontitis and with rest roots for who have been performed extractions.
For 10 of this patients the alveols were lets to heal naturraly-the witness lot and the rest of 30 patients were divided in 3 groups coresponding to the collagen concentrations(1.0, 1.2 and 1.4% in collagen/the group A, B, C).



FT-IR spectra for collagen matrix with 1% collagen and 0.1% lidocaine



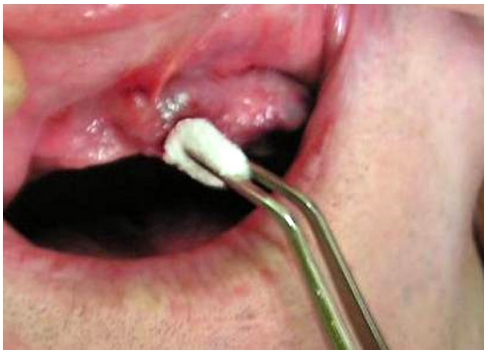
Water uptake for collagen matrices



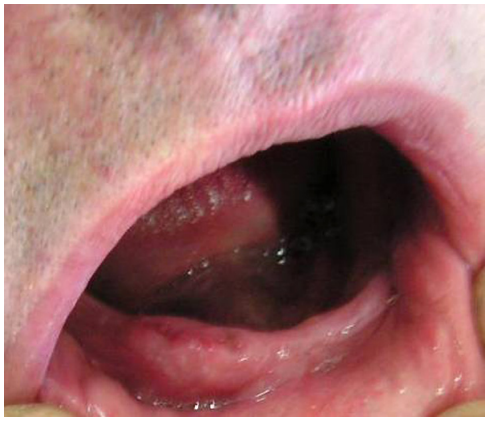
In vitro lidocaine release from collagen matrices

Results

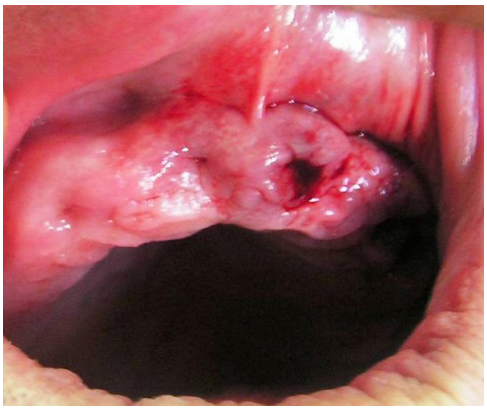
The infrared spectra of collagen exhibit several features characteristic for the molecular organization of its molecules: amino acids linked together by peptide bonds give rise to infrared active vibration modes amide A and B (about 3330 and 3080 cm-1, respectively) and amide I, II, and III (about 1650, 1550 and 1250 cm-1, respectively).
Figure 1 shows the FT-IR spectrum for matrix with 1% collagen and 0.1% lidocaine.
In the spectrum of the collagen matrix, shown in Figure 1, the five characteristic absorption bands can be observed at 3314, 2958, 1634, 1548 and 1238 cm-1. The characteristic collagen bands indicate that triple helix structure was preserved in all the samples.
Water uptake studies showed that swelling was influenced by the collagen concentrations (Fig. 2).
As the Figure 2 shows, the higher collagen concentration, slower is swelling ability.
The drug release was performed for collagen matrices in order to evaluate the amount of lidocaine released. The release profiles of lidocaine from the collagen matrices are presented in Figure 3.
Figure 3 shows that higher collagen concentrations produce the decreasing of the amount of lidocaine released.
The results for the lidocaine release are in close agreement with the spectral characteristics and water uptake data.
In comparison to the witness group at all the other three lots, the clinical parameters- coagulation, bleeding, healing time/immediate post-extractional, and healing time at 1, 3, 7 days post-extractional were improved.
The best results have been obtained in the group for which the matrices 1.4% in collagen concentration was applied (the lot C).
In this group, the healing of the alveole is highly set toward to the witness lot and better in comparison to the other two groups of patients. (Fig. 5-11)



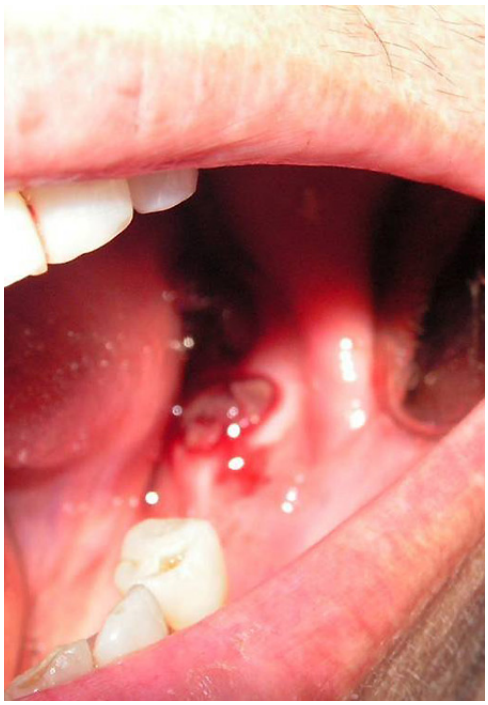
Healing with the collagen matrix



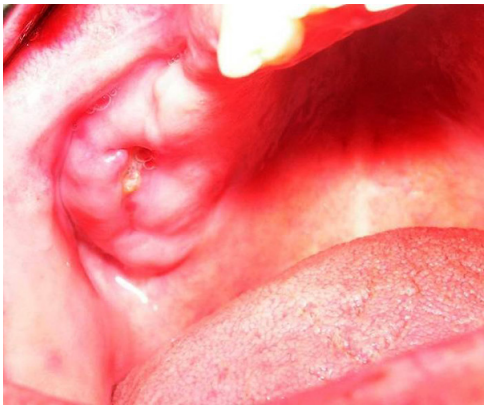
Healing with 1.4 collagen matrices



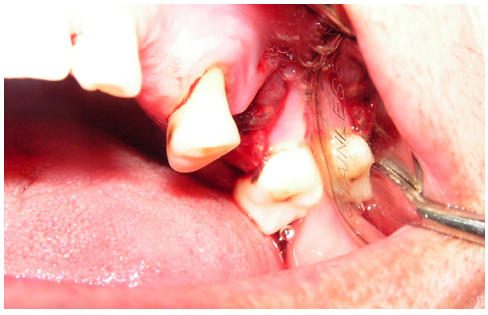
The witness alveole, 1.10, 1.2 collagen matrix



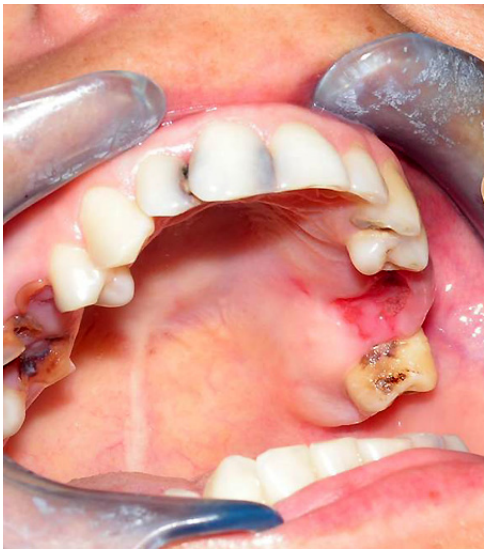
Healing with 1.o collagen matrices



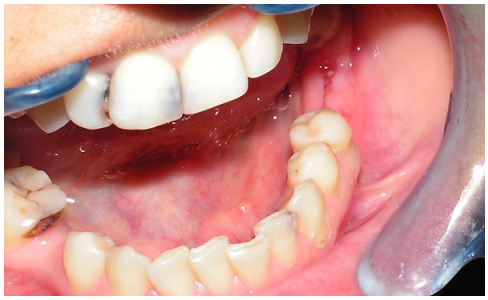
Healing with 1.4 collagen matrices



Healing with 1.0 collagen matrices



Healing with 1.2 collagen matrices



Healing with 1.4 collagen matrices

Conclusions

Collagen matrices containing lidocaine were obtained from proper gels at pH 7.4 by the freeze-drying process. The collagen matrices release lidocaine more slowly from samples with higher concentration in collagen.
Clinical trial reveals in vivo the quality of healing at 1,3,7 days post-extractional , decrease the pain of patients immediate after extraction and the shorter bleeding,coagulation and healing time in the three groups which was applied the collagen matrices comparison to the witness group.

Abbreviations

DDS: drug delivery systems

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Poster Faksimile: