

Examination of the influence to give a bone in rats by irradiation of atmospheric plasma

大気圧プラズマの照射が骨に与える影響の検討

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Several studies have proved that irradiation of atmospheric plasma promote the healing burn and cell proliferation, angiogenesis. So we hope that irradiation of atmospheric promote the healing of bone fracture as well as promoting the healing of soft tissue. In this report, we say the early experiment of the examination of the influence to give a bone by plasma irradiation.

We made bone fracture rat models that damage the coccyx by drill, and classified as plasma irradiation group or control group. Evaluation index was a volume of the coccyx, which was measured using X-ray CT. Consequently, quantity of osteogenesis of plasma irradiation is more than that of control.

1. Introduction

Conventionally, the plasma has been used for sterilization and cauterization hemostasis in medical field. However, in Drexel University, a study to use plasma for treatment is conducted[1]. In that study, treated plasma irradiation for a burn department diagnosed as having difficulty with spontaneous cure. As a result, the burn was cured two months after treatment. It was thought that plasma irradiation gave stimulation in a cell or a growth factor that factor for healing. In addition, we confirm promotion of the cell proliferation by plasma irradiation to NIH3T3 cultured cell and angiogenesis promotion by the plasma irradiation to the burn in rats[2,3]. We hope that irradiation of atmospheric promote the healing of bone fracture as well as promote the healing of soft tissue. In this study, we examinant of the influence to give a bone in rats by irradiation of atmospheric plasma.

2. Material and Method

2.1 Animals

We used Wistar rats, male, specific pathogen free, 8 week-old for making four bone fracture rat models. In this experiment, four bone fracture rat moles was classified plasma irradiation group or control group. Each rats were bred under the as possible same condition, and consumed the feed and the water freely.

2.2 Make method of the model

We damaged the fifth coccyx using a drill. The bone fracture was made to penetrate the bone. Figure 1 shows the cross section of the fifth coccyx of rat. There is a tail vein at both sides and tail artery at under the fifth coccyx. Therefore, the insertion of a drill went from 30 degree rotatory direction from the back to the left side.

We went through four procedures for make the bone fracture models. Frist, we was confirmed the position the fifth coccyx by X-ray image. Second, fifth coccyx was fixed vice after tissue of the 30 degrees left rotatory direction was removed only 10mm in height and 2mm in width. Third, fifth coccyx was damaged using a drill (K-21 desk- drill, Hozan Inc. Japan) of 1.5mm in diameter that we set 800rpm in revolution and 1mm in bottom dead centre height. At last, the injure part was performed astriction.

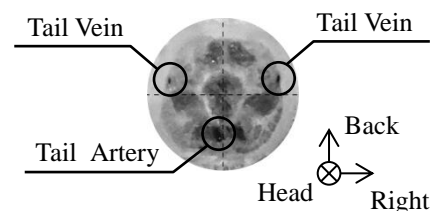


Fig.1 The cross section of the fifth coccyx

2.3 Outbreak and irradiation of the plasma

The frequency of the plasma irradiation was once a day. One irradiation time was 90 seconds. The distance was 10mm from the capillary tip.

Figure 2 shows the connection relation of the

plasma generator. The capillary (the inside diameter of the plasma outbreak department is 8mm, the inside diameter of the leader is 1mm) contains a tungsten electrode (a diameter is 1mm). And it installs a pipe-formed tungsten electrode outside. Tale 1 shows an outbreak condition of the plasma.

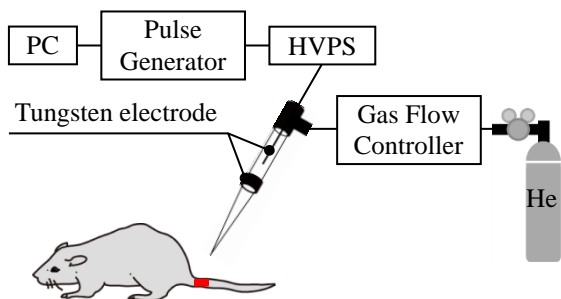


Fig.2 The connection relation of the plasma generator

Table.1 Outbreak condition of the plasma

Voltage (kVp-p)	Frequency (kHz)	Gas	Gas mass flow(L/min)
8.0	3.0	He	1.0

2.4 Measurement method

We used a volume of the fifth coccyx. And, the volume of the fifth coccyx was measured using X-ray CT (Lathata LCT-200, Hitachi Aloka Medical Ltd., Japan). The measurement time is just before and after (0week) bone fracture, and each week. We set the shooting condition of X-ray CT to low voltage on X-ray tube voltage and normal mode on shooting mode, $60 \times 60 \times 60 \mu\text{m}$ on voxel-size, 60 μm on thick.

3. Result and Discussion

Figure 3 shows the volume of the fifth coccyx at just before and after bone fracture, each week. Moreover, the bar in figure 3 shows an actual value (N=2). The bar indicating the volume of the 2week doesn't overlap. In addition, the increment of the mean of control group of early 2weeks is 15.5mm^3 that the mean of increment until 2week and that of plasma irradiation group is 21.0mm^3 . In this way, the mean increment of osteogenesis of plasma irradiation is more than that of control in early time (2week). It can be pressured that the plasma irradiation had osteogenesis to promote. The osteogenesis promotion is held responsible for angioplasty of the damaged tissue part was promoted by plasma irradiation.

However, the reliability of the results is low because there is little number of the samples and evaluation index is one. In addition, it makes

elucidating a cause of the osteogenesis promotion difficult that evaluation index is one.

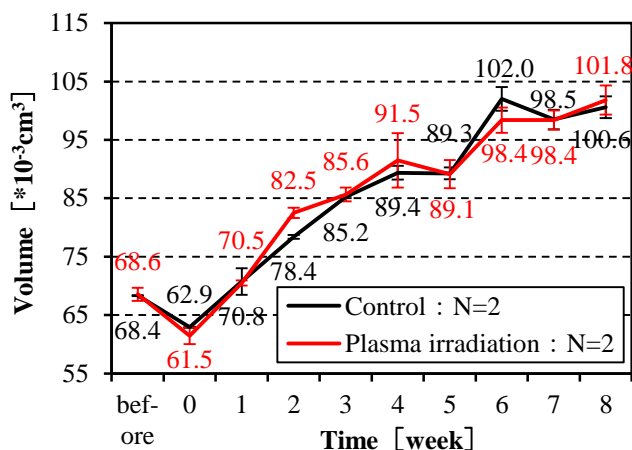


Fig.3 Volume of the fifth coccyx

4. Conclusion

In this report, we said the early experiment of the examination of the influence to give the bone by plasma irradiation. Bone fracture model was made by damaging a rat fifth coccyx of 8 weeks-old using a drill. Plasma was irradiated to bone fracture part of bone fracture. Measurement index is a volume of the fifth coccyx that was using X-ray CT. As a result, the mean increment of osteogenesis of plasma irradiation is more than that of control in early time (2week). But we think the problem seems to lie in the fact that results is low reliability because there is little number of the samples and evaluation index is one. Therefore, a further study of the case of plural samples is evaluated face in histologic and biochemical should be conducted.

References

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