INTRODUCTION
Over-stretched anterior cruciate ligament (ACL) injury with partial mid-substance laceration frequently occurs in various athletic accidents. For this type of ACL injury, we have had no therapeutic options in repairing the ligament injury itself because of poor healing potential of the ACL. Recent experimental studies, however, have reported that certain growth factors enhance healing in the injured medial collateral ligament [1, 2]. Therefore, there is a strong possibility that a therapeutic application of some specific growth factors can enhance healing in this type of ACL injury. No in vivo studies, however, have been conducted to clarify the effect of growth factor application on healing in the injured ACL, because there have not been appropriate models of such ACL injury. Recently, we have established a new over-stretched ACL injury model with partial mid-substance laceration [3]. The purpose of this experimental study is to evaluate the effect of intra-articular administration of TGF-beta1 and PDGF-BB, respectively, on this type of ACL injury.

MATERIALS AND METHODS
Thirty-six skeletally mature female Japanese White rabbits weighing 3.5+/-0.2 (Mean+/-SD) kg were used in this study. In each animal, the right ACL was injured using the following quantitative technique [3]. The anteromedial and posterolateral bundles of the ACL were transected at two different levels, the proximal one-third and the distal one-third levels of the ACL, respectively. The ACL was then stretched by applying an anterior drawer force of 10 N to the tibia at 90 degrees of knee flexion (Fig 1). Subsequently, the ACL length was irreversibly elongated to 110+/-2 % of the original length. Then, the rabbits were randomly divided into 4 groups of 9 animals each. In Group I, no treatment was applied around the injured ACL. In Group II, 0.2-ml fibrin sealant was applied as the sham treatment around the injured ACL. In Group III, 4-nanogram TGF-beta1 (R&D Systems, Minneapolis, MN) mixed with 0.2-ml fibrin sealant was applied around the injured ACL. In Group IV, 20-microgram PDGF-BB (R&D Systems, Minneapolis, MN) mixed with 0.2-ml fibrin sealant was applied around the injured ACL. No immobilization was applied after surgery in all four groups. The animals were allowed unrestricted activities in their cages. All animals were sacrificed at 12 weeks after surgery in each group. The 7 of the 9 rabbits were used for biomechanical evaluation, and the remaining 2 were used for histological observation. Nine knees randomly harvested from all left knees were used to obtain normal control data. In biomechanical evaluation, the anterior translation of the tibia to the femur was measured using a tensile tester with a 5-DOF fixture under +/-10N forces at 30, 60, and 90 degrees of knee flexion. The cross-sectional area was then measured with a non-contact optical method using a video dimension analyzer [4]. The structural properties of the femur-ACL-tibia complex (FATC) were determined in vivo.

RESULTS
Concerning failure modes, the ACL insertion was avulsed in all specimens in the normal control knees. Six out of the 7 specimens were avulsed in Group III, while 6, 6, and 5 out of the 7 specimens failed at the mid-substance in Groups I, II, and IV, respectively. The ANOVA demonstrated a significant difference in both the maximum load and the stiffness among the groups (p<0.0001). The maximum load (Fig 2) and the stiffness of Group III were significantly greater than those of Groups I (p=0.0345 and p=0.0272, respectively) and II (p=0.0041 and p=0.0048, respectively), although these two parameters of Group III were significantly lower than those of the normal control. On the other hand, Group IV did not show any significant differences in the maximum load and the stiffness, compared to Groups I and II (Fig 2). Concerning the anterior translation of the tibia to the femur (Fig 3) or the cross-sectional area of the ACL, the ANOVA did not show any significant differences in the A knee.

REFERENCES