BIOLOGICAL FIXATION IN A POROUS-SURFACE IMPLANT USING A YAG LASER

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Introduction
The use of prostheses with porous surfaces in cementless total hip arthroplasty now predominates. Beads are popular for use as a porous coating, but their mechanical strength may be insufficient because of displacement of some of the beads from the coating. In this study, we propose a new porous surface, created by making direct holes in the metal surface using a YAG laser. A titanium-alloy (Ti-6Al-4V) rod was used.

Methods
A Beads-type prosthesis was made by diffusion bonding pure titanium spherical beads to the rod; it was 13mm long and 4.5mm in outer diameter. The porous surface of a bead-type had an average pore size of 200 micrometers and an average total pore volume of 35 per cent (Fig. 1,2). A Laser-type was made by directly creating holes in the same rod surface using a YAG laser; it was 13mm long and 4.5mm in outer diameter too. The porous surface of a laser-type had an average pore size of 300 micrometers and an average total pore volume of 33.7 per cent (Fig. 3,4). Both implants were evaluated in vivo using the hemi-transcortical cylindrical model in beagle dogs. Seven adult dogs were used in total, three dogs were used for 6 weeks,fore dogs were used for 12 weeks. Four prostheses were implanted into each femur through the lateral cortex, for a total of eight of each type, and remained in place for 6 and 12 weeks. Except for the proximal implant, push-out tests were performed to measure the shear strength of fixation of the implants to the cortical bone. For observations of the implant-bone interface, decalcified specimens of the proximal femur were stained with toluidine blue and observed with an optical microscope.

Results
The mean shear strength at 6 and 12 weeks of the Laser-type was approximately 10.8 MPa and 14.5MPa (Fig. 5), and that of the Beads-type was approximately 12.8 MPa and 13.6 MPa (Fig. 6). There was no significant difference in interface mean shear strength between the groups. Bone ingrowth into pores was observed in both types and periods, a gap existed at the interface bone and the rod surface in the Beads-type, and some specimens of the Beads-type demonstrated displacement of some of the beads (Fig. 7,8).

Discussion
This study indicates that a porous surface created with a YAG laser might be useful not only for its shear strength, but also for bone ingrowth and strength of the surface itself.