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Growth Hormone on Titanium Alloy Endosseous Implants Enhances Their Osseointegration in the Rat Femur

Y. Segev*, G. Sovak*, A.Weiss*, I. Gotman**
*Department of Anatomy & Cell Biology, The Rappaport Faculty of Medicine, Technion_Israel Institute of Technology, P.O.Box 9649, Haifa 31096, Israel
** Department of Materials Engineering, Technion, Haifa 31096, Israel

Uncemented endosseous implants are widely used in restorative dentistry and orthopedics. Biological fixation of such implants requires apposition of bone onto implant's surface, a process named osseointegration [1]. Osseointegration progresses slowly, and requires long periods of unloading. Growth hormone (GH) is anabolic for bone, and is known to exert both direct effects as well as indirect effects, by stimulating hepatic secretion and local production of IGF-1 and other growth factors [2]. The aim of the present research was to study the systemic and local effects of GH on titanium alloy implants fixation.

Ti-6Al-4V pins were implanted in the distal femurs of 6-month-old Wistar female rats, for a period of one month. Animals in the systemic GH treatment group received daily 1 mg/kg body weight of rat GH; in the local application group, the pins were presoaked for 24 hrs prior to implantation in GH solution at two concentrations: 0.04 mg/ml (low GH) and 2 mg/ml (high GH). GH adsorption was verified by SDS-PAGE electrophoresis. To evaluate mineralization, animals received oxytetracycline 72 hrs before sacrifice; the results indicated an increase in mineralization rate in GH treatment groups in comparison to controls. Undecalcified femurs were examined by scanning electron microscope (SEM). Morphometric analyses were performed with an aid of ImagePro software, as described previously [3]. SEM revealed that in all animals the implants underwent fixation in bone, both within the distal epiphyses as well as in the diaphyses (Fig. 1A-D). Two parameters of osseointegration: bone volume (BV) and bone-implant contact (BIC) were measured on SEM images of cross-sections from femoral epiphyses and diaphyses. Bone volume was measured within a distance of 0.3 mm from implants' surface. The morphometric results indicate that the BV and BIC were increased in both the systemic GH treatment and in the GH adsorption groups in comparison to the controls, especially with the high GH-loaded pins (Table 1).

In conclusion, our findings revealed that GH enhances implant osseointegration in adult rats. GH was more effective when applied locally than systemically. Local administration of GH by adsorption directly onto the implants may improve implant fixation and prevent unnecessary systemic effects of GH.

References

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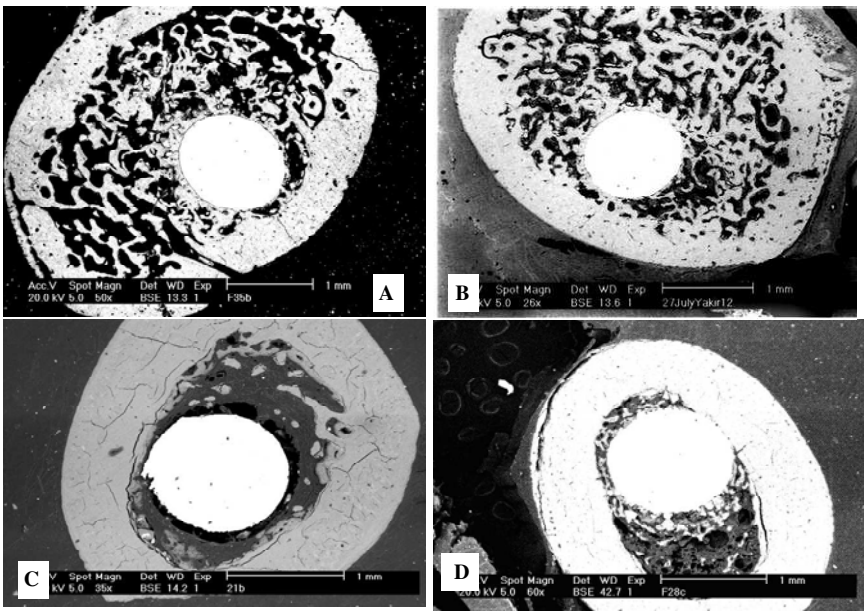

Fig. 1. SEM images of transverse sections of rat femurs. A,epiphysis-control implant; B, epiphysis-high GH; C, diaphysis-control implant; D, diaphysis-high GH implant.

Table 1. Effect of GH bone volume and bone-implant contact in the rat femur.

Site	Treatment	Bone volume (%)	p<	Bone-implant contact (%)	p<
Epiphysis	None (control)	57.4 ± 7.8	-	70.1 ±15.9	-
	Systemic GH	58.4 ±12.2	NS	80.6 ± 8.5	NS
	Low GH pin	55.6 ±15.8	NS	69.6 ±11.1	NS
	High GH pin	66.1 ±10.2	0.05	69.6 ±13.4	NS
Diaphysis	None (control)	33.1 ±10.4	-	54.1 ±13.9	-
	Systemic GH	31.2 ±17.1	NS	57.1 ±15.5	NS
	Low GH pin	43.7 ±11.4	0.06	70.3 ±14.8	0.08
	High GH pin	46.6 ± 8.8	0.03	69.4 ±13.4	0.08

BV and BIC were measured on SEM images with ImagePro. p-significance in comparison to control by ANOVA; NS-nonsignificant.

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