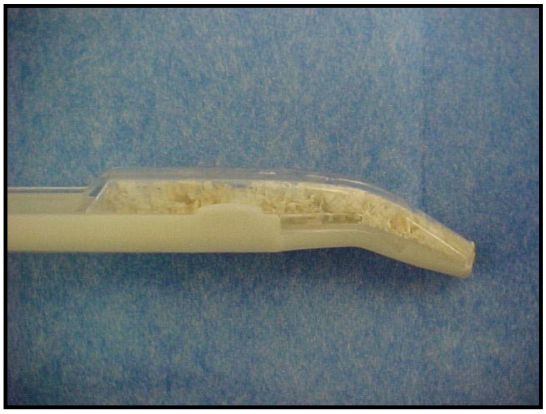
In vitro study on the bone volume of cortical bone lamellae collected with scraper technique for bone regeneration purpose.

Fabio Cavani, MSc; Alessandro Dentoni
C.G.M. S.p.A. – Medical Division Meta - Reggio Emilia (Italy) - 14th April 2004

Summary
The present in vitro study aims at estimating the increase in volume of the system of osseous lamellar chips and air obtained collecting bone with the device Safescraper© curve, compared to the volume of bone material actually collected from the patient.

Materials and methods
A bovine femoral bone was weighted and its volume was measured by immersion in water; dividing the mass by the volume a bone density of 1.61 g/cm^3 was obtained, in agreement with literature data.

Then, using two *Safescraper© curve* devices, some material was removed and collected from the previously hydratated bone.
With each of the devices two filled containers of osseous lamellar chips were collected, therefore reaching a total of 4 full containers.
The volume of one container is around 1.75 *cc*.



The container of the Safescraper® curve device filled with bone lamellae.

The collected bone material was entirely put in a graduated recipient, where it was possible to estimate the volume of the lamellae, around 13 *cc*, that makes around 3.25 *cc* of lamellae per container.

We stress that this volume refers to osseous chips that were not compressed in any way.

The material collected with 4 filled containers

Then the apparent density of the bone lamellae was calculated, that is the rate between their weight and their volume (including the air among the lamellae). The material was weighted, obtaining a mass of 1.5 *g*, which divided by the volume of 13 *cc*, brings an apparent density of about 0.12 g/cm^3.

Conclusions
The work shows that the apparent density of the lamellae (the ratio between their mass and the volume of the system consisting in the lamellae and the air among them) is less than one tenth of the bulk density of the bone, therefore showing that the volume of the graft material ready to be used for regeneration is more than ten times the volume of the bone collected from the patient.

This suggests for instance that, in the chosen test configuration, in order to obtain 10 *cc* of bone lamellae it would be necessary to collect less than 1 *cc* of bone from the patient, thanks to the increase in volume due to the lamellar morphology of the bone chips obtainable with *Safescraper© curve*.

Moreover, the volume of uncompressed osseous lamellae that can be obtained from a filled container (3.25 *cc*) is higher than the volume of the container itself (1.75 *cc*), because in the container the lamellae are compressed.

It is not possible to evaluate precisely the volume the osseous material will fill when grafted, because it is not possible to evaluate the pressure with which the chips will have to be compressed to fill an injured area for bone regeneration, because this depends on the kind of bone injury and on the chosen methodology.

The bone mass that can be collected in the container of *Safescraper© curve* is estimated in about 0.375 *g*, corresponding to a volume of material grafted from the bone surface of about 0.23 *cc*.

Bone volume collected to obtain a filled container	**Volume of osseous lamellae collected in the filled container**	**Volume of the same lamellae, uncompressed, outside the container**
0.23 *cc*	**1.75 *cc***	**3.25 *cc***

The table summarizes the data measured in this study in relation with about 375 mg of bone (a filled container)

The values obtained in this study are only guidelines for the *in vivo* use of the device, because in this case the collected osseous lamellae are mixed with blood.