A knitted scaffold for tissue engineering of the aortic valve

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Introduction
State-of-the-art tissue engineered aortic valves are not strong enough to withstand aortic blood pressure levels. We hypothesize that current scaffolds, on which the cells are cultured, do not have enough mechanical integrity and that they degrade too fast.

Objectives
The scaffold needs to be temporarily load-bearing, to allow the cells to gradually create their own strong matrix, especially in critical sites of the scaffold, such as the commissures (fig. 1). An appropriate mechanical stimulus must be provided to the cells to do so.

Scaffold
The firmly entangled structure of a polycaprolactone knit (Varitex, Haarlem) is used as the load-bearing part of a composite scaffold. This ductile polyester degrades over months and is FDA approved as an implantable material. The knitted valve is covered with fibrin gel, the major component of a blood clot (fig. 2).

Results
Valves cultured in the bioreactor showed to contain six times as much DNA as their static controls (fig. 5). The knitted valvular scaffold showed proper opening and it showed coaptation upon closing, although there was substantial leakage (fig. 6).

Discussion
Unlike previously produced scaffolds, this scaffold does not have weak connections at the areas most prone to tear. This scaffold induces cellular attachment and shows proper opening and closing. Dynamic stimulation of the constructs during cell culture enhances proliferation. Leakage of the scaffold should be reduced once cellular ingrowth has taken place.

References