3D Woven Polymeric Material for Cartilage Replacement

M.A. Sellés[1], E. Pérez-Bernabeu[2], S. Sánchez-Caballero[3], R. Pla-Ferrando[4]

[1] Departamento de Ingeniería Mecánica y de Materiales, Universitat Politècnica de València, maselles@dimm.upv.es

[2] Departamento de Estadística e Investigación Operativa, Universitat Politècnica de València, elenapb@eio.upv.es

[3] Departamento de Ingeniería Mecánica y de Materiales, Universitat Politècnica de València, sasanca@dimm.upv.es

[4] Departamento de Ingeniería Mecánica y de Materiales, Universitat Politècnica de València, rpla@mcm.upv.es

1. Introduction

One of the reasons for the realized improvements in quality of life has been the great success of orthopedic implants in the past forty years. Hip, knee, shoulder, spine and other implants have resulted in increased activity and reduced pain for millions of people worldwide. Advances in materials and designs have extended the useful life for total knee replacements (TKRs), so that modern implants are approaching two decades of useful average life. This is a welcome development, since revision of TKRs is more invasive and painful than initial TKRs, and the success rate and expected useful lives are lower. The recognized reluctance to require multiple revisions in a patient drives surgeons to delay first application of TKRs until the patient is either of sufficient age or until their natural joint becomes unbearably painful.

2. Methodology

An alternative to a TKR is an implant that effectively provides a new surface to the damaged areas of the femoral condyles and/or tibia compartments. An illustration of a candidate solution is shown in Figure 1, that exploits the material properties and capabilities of three-dimensional weaving. The implant is envisioned as a local correction to damaged cartilage, and as such should be pictured as a slug roughly 10-15 mm in diameter. In this way, it would be surrounded and partially anchored by cartilage.

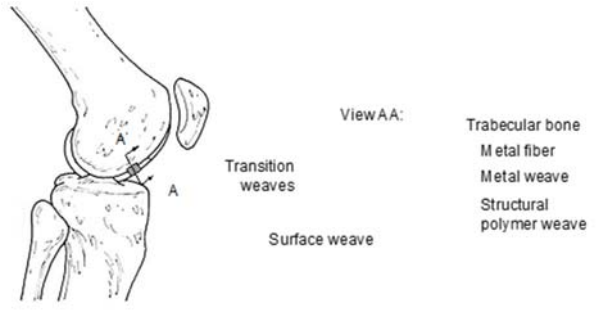

Figure 1. *Schematic illustration of the cartilage repair implant, shown on the knee*

Wear tests were conducted on three polyethylene terephthalate woven materials (as a part of the implant) using a pin-on-disk arrangement. These commercial fabrics were also welded on a Laser welding machine in order to improve the stiffness.

3. Results

Figure 2 compares the wear test results of original and welded material.

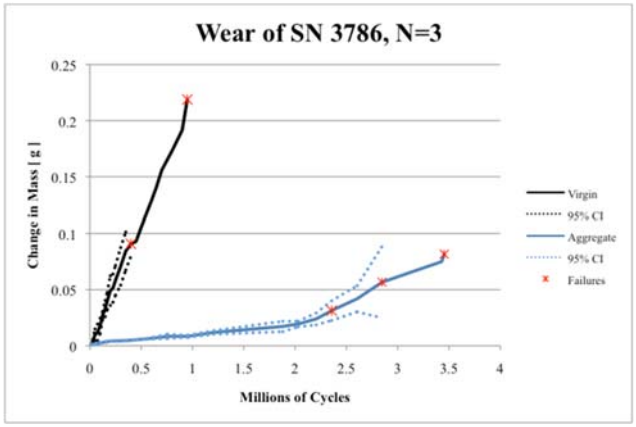

Figure 2. *Representative results from wear tests comparing original and welded material*

4. Conclusions

Surface welding was attempted on three fabrics to create welded versions of each type. The fabrics again welded uniformly with good repeatability. The fabrics were subject to wear testing with cobalt chrome pins in a lubricating bath of deionized water.

The welded-woven orthogonal fabrics outperformed the non-welded versions of the orthogonal fabrics. The wear rates were reduced by greater than 90% through nearly two million cycles; whereas the non-welded orthogonal fabrics failed by the one-millionth cycle.

5. Acknowledgements

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