1999 McGILL ORTHOPAEDIC UPDATE COURSE

THE KNEE : FROM THE NEWBORN TO THE ELDERLY

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FILAMENT STRUCTURE OF SYNTHETIC LIGAMENTS BIOMECHANICAL AND HISTOLOGICAL IMPORTANCE

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Should the bad resuits of first artificial ligaments lead to give up with the concept of their use? That was the attitude of many. But tne advantages they could bring to ligaments surgery were so impressive that the reason for these early failures had to be carefully studied before any decision

Beside technical surgical mistakes or bad indications the structure of the ligament itself had to be revised according to the mechanical stresses and biological environment which are specific.

Mechanical stresses:

Combine tension, flexion and torsion. Flexion and torsion vary with direction and placement of the tunnels but cannot be eliminated. Synthetic ligaments must be adapted to these types of stresses.

The previous ligaments were ail braided, woven or knitted. Tests were done on knee mechanical simulators reproducing torsion and flexion. They demonstrated that the ruptures were occuring at the crossing of the fibers by a reciprocal shearing process of one fiber on the other And this shearing process was inducing microparicules

It was concluded that the crossing of fibers had to be eliminated to increase the resistance to torsion and flexion.

This is wt)y the intra articular portionof the ligament is now made of free filaments which are longitudinal, parallel and pre-oriented clock wise or ccunter-clock wise for right or left ACl, due to the difference of torsion in eaoh knee. Fatigue tests in flexion torsion demonstrated a high!y significant improvernen; of the resistance of this structure.

Biological environment

When thinkIng to the long term, a synthetic ligament must be conceived as a scaffold around and inslde of which a biological tissue must get crganized.

This biological tissue may come from the healing process of the natural torn ligament, or from autologous transplant, or, but this is for the future, from cultures of fibroblast producing a mechanically efficient coilagen. The basic condition is to have a synthetic fiber which is « fibrobast friendly » .

This can be detected though hurnan fibrobasts In vitro culture on different types of synthetic fibers. We can then mesure the mass of cells after a given time and select the fiber on which the human fibroolasts are growing better and faster.

The selected fibers have then to be assembled in a structure that allows a high permeability to fibroblasiic ingrowth.

HIstological studies showed a highl'y' significant difference between the braided. woven or knitted structures and the free ftbers where the fibrcblastic invasion is at maximum.

For the time being one cannot prove the mechanical effic!ency of this ingrolNth But, at least. it prevents the rmcrocarticles to fall into the joint and eliminates the risk of synonovitis.This was shown by the clinical studies.

Conclusion:

The new generation of synthetic llgaments must be based on biomechanical and biological research Only on this condition and with respecting precIse surgical techniques and indications , their use is reasonable today Their previous « sentence to death » looks a kind of arbitrarv' to day. But still improvements have to be made before we can challenge the native ligament

POSTERIOR CRUCIATE RECONSTRUCTION. UPDATE ON TECHNIQUE AND RESULTS WITH THE LARS LIGAMENTS.

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As being disapointed by autogenous reconstructions. we designed a technique using synthetic ligaments with the help of a specific guide. Important points are :

1°) a 2 bundles reconstruction in chronics with placement and tensionning that must recreate the non isometric function of each main bundle.

2°) a precise femoral insertion of each bundle which can be determined by pre operative X-Ray. In acute injuries, we use one bundle as a synthetic scaffold, purely arthroscopically.

This procedure is eleven year old. Results of the first 5 year experience brought some modifications of technique and ligaments. But main principles remained. We report the results of a homogenous serie of 72 PCL reconstruction with a follow up of 24 to 73 months. There were 33 acutes and 39 chronics.

These patients were classified according to the « International PCL Study Group » recommandations in 4 grades. 22 patients (31%) were isolated PCL (grade I) ; 50 were combined lesions. Results were evaluated using the IKDC, modified for X-Ray laximetry. 94% of the acutes were A or B (excellent or good). 63% of the chronics were A or B. Results were depending on combined injuries, the worse being when postero lateral and lateral collateral ligament were involved. With these lesions in chronics a combined valgus osteotomy seems to be necessary. No complications due to the use of a synthetic ligament were noted.

It was concluded that the use of synthetic ligaments seems a good solution in PCL reconstruction. They resist much better than autogenous transplants which are unevitabely submitted to mechanical stresses in the post operative periode when they are fragilized by revascularization. Recentering the knee in acutes with a simple and no damaging arthroscopic procedure seems to allow a perfect healing of the torn PCL without elongation which results in practically normal knees in most of the cases. May be, we should consider to operate on acute PCL in young and active patients. Posterolateral lesions have to be treated simultaneously.