The tibialis tendon as a valuable anterior cruciate ligament allograft substitute – in vitro properties.

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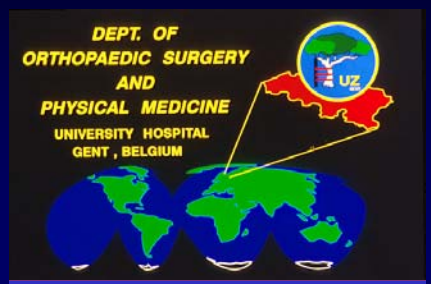

TENDON ALLOGRAFTS

GENERAL ORGAN DONORS
REMOVED IN 12H
STERILE CONDITIONS
FRESH FROZEN MIN 80°C
RELEASED WHEN STERILITY OK
READIED IN FYSIOLOGIC SOLUTION
AMBIANT TEMP
STERILITY CONTROL

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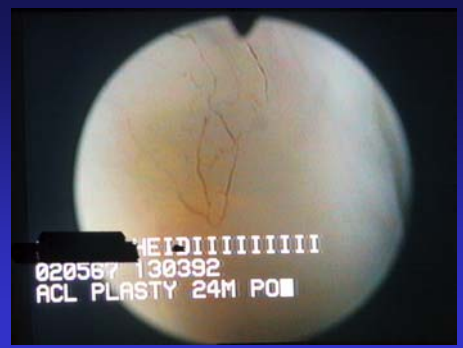

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Aim of the study:

- This study evaluates the biomechanical properties of human tendons: tibialis posterior (TP) and anterior (TA)) and bone-patellar-tendon-bone (BPTB).
- The potential to use these grafts in the reconstruction of anterior cruciate ligaments (ACL) in human is investigated.

Materials and Methods

48
allograft tendons

- Tibialis Anterior 16
- Tibialis Posterior 16
- BPTB 16

16
Single loped
Tibialis tendons

Materials and Methods

- Bone-Patellar-Tendon-Bone grafts were tested by applying traction at the bone ends, they were cut into cubes in order to clamp them without making contact with the tendon it self
- The two ends of the tibialis tendons were covered with blotting paper.

Materials and Methods

- The tensile strength of the tendons was tested with a standardized computerised traction machine (LR50K Lloyd)

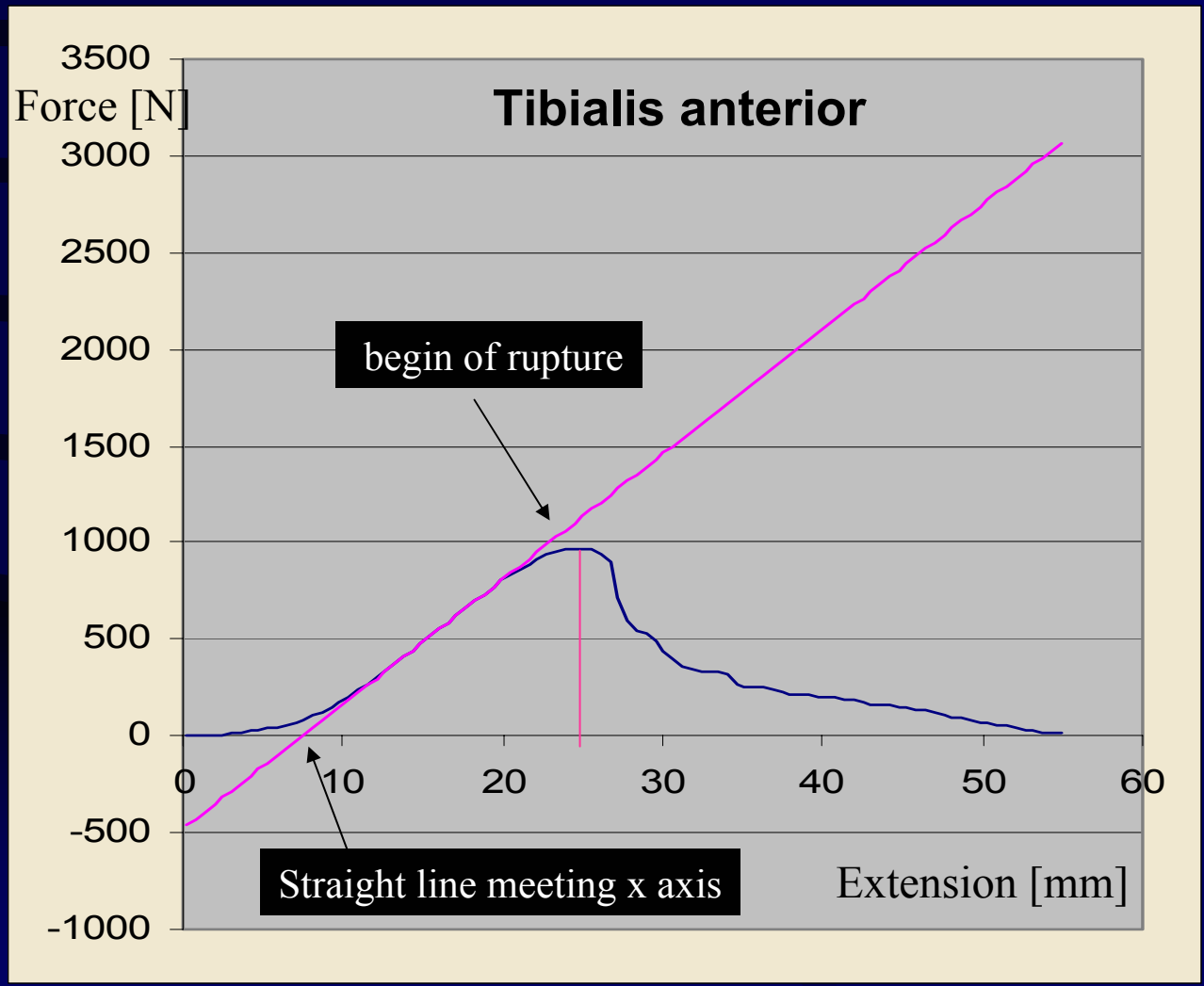
Materials and Methods

- The direction and similarity of traction.
- Moistness of the tendon.
- Constant speed of 6mm/min

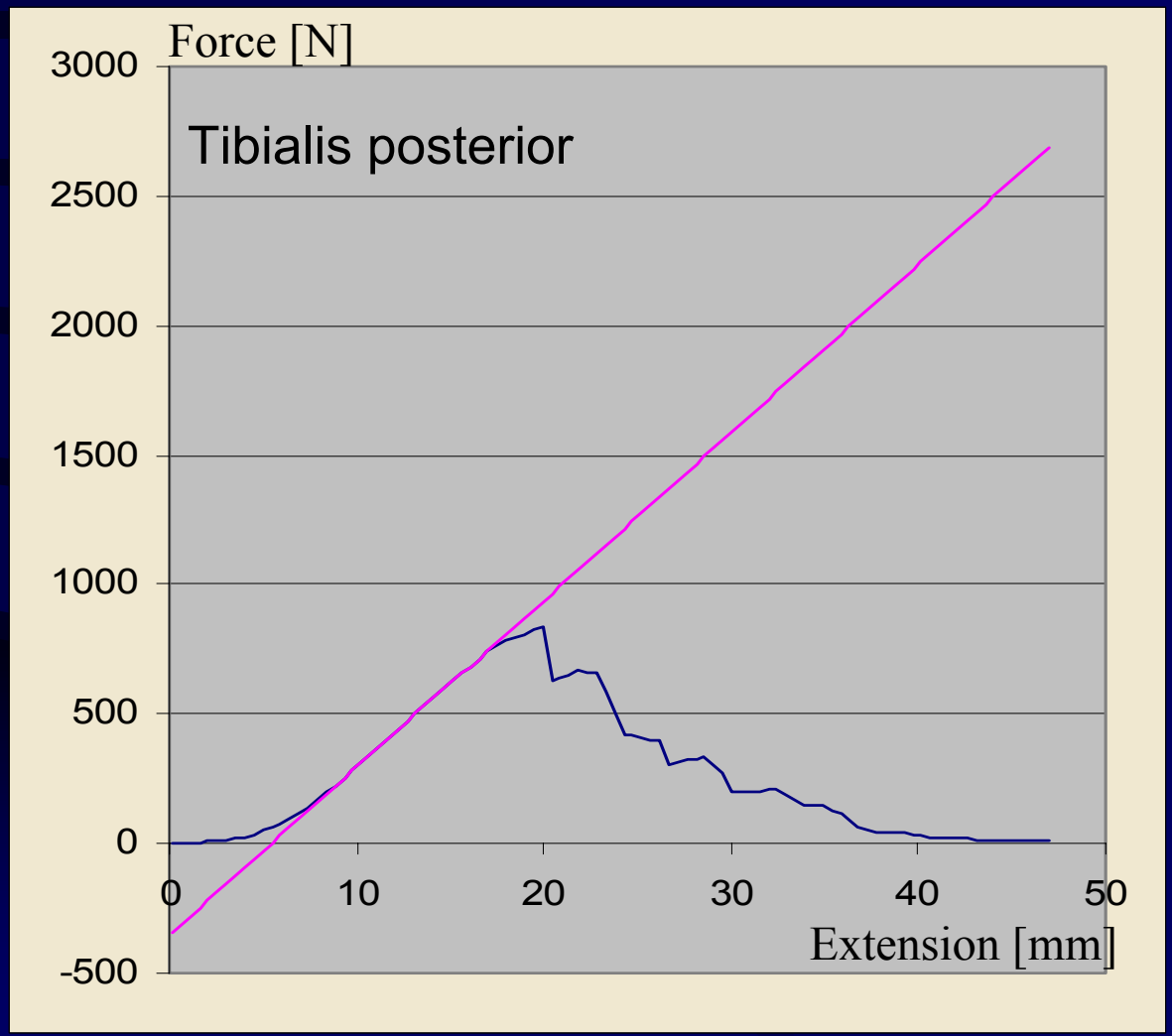
Materials and Methods

- The real extension of the graft was calculated by drawing a tangent to the curve by means of linear regression.
- The real starting point of the extension is taken as the intersection between this tangent and the x-axis.
- While the end point of extension is measured where the force reaches its maximum.

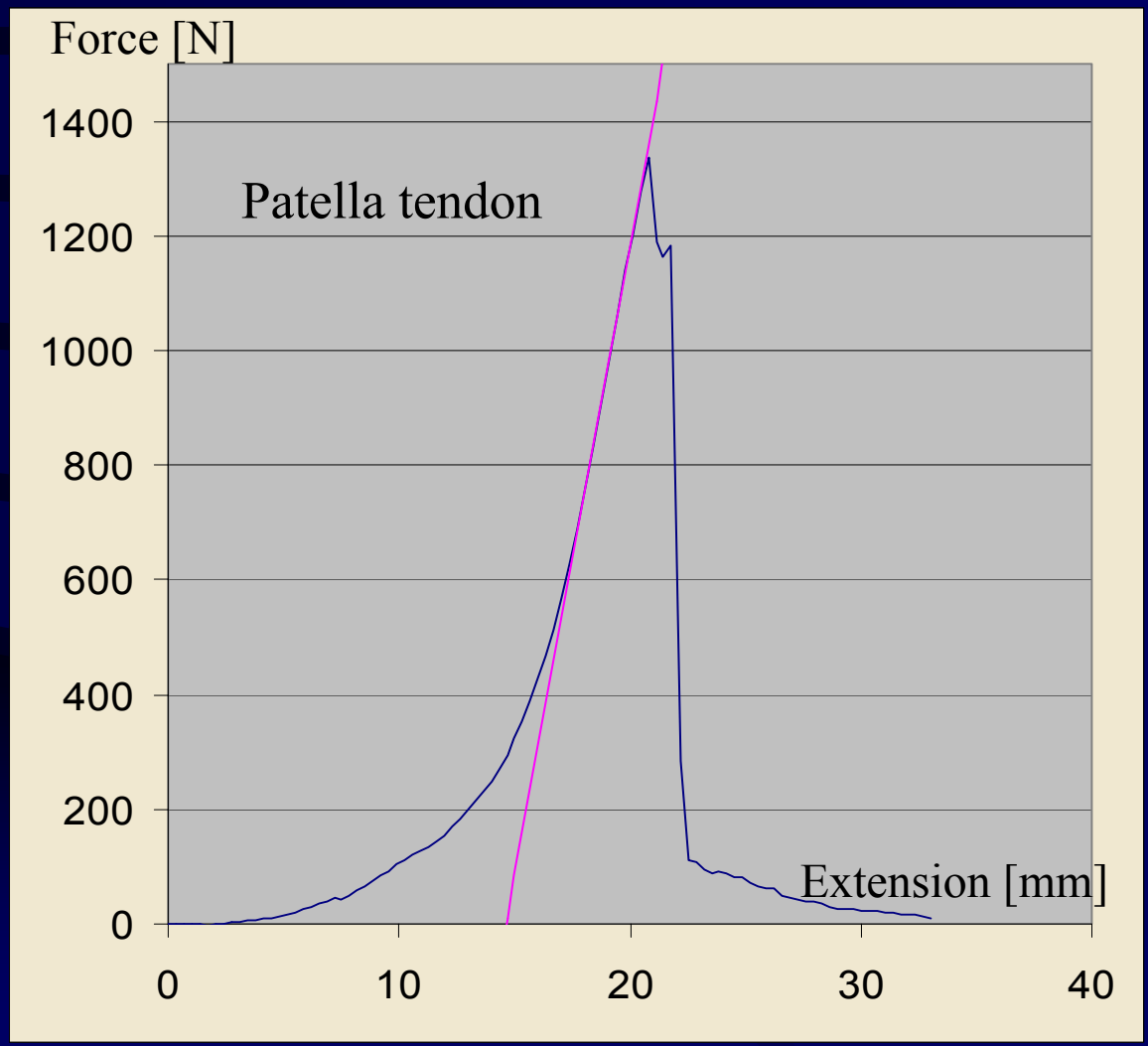
Materials and Methods



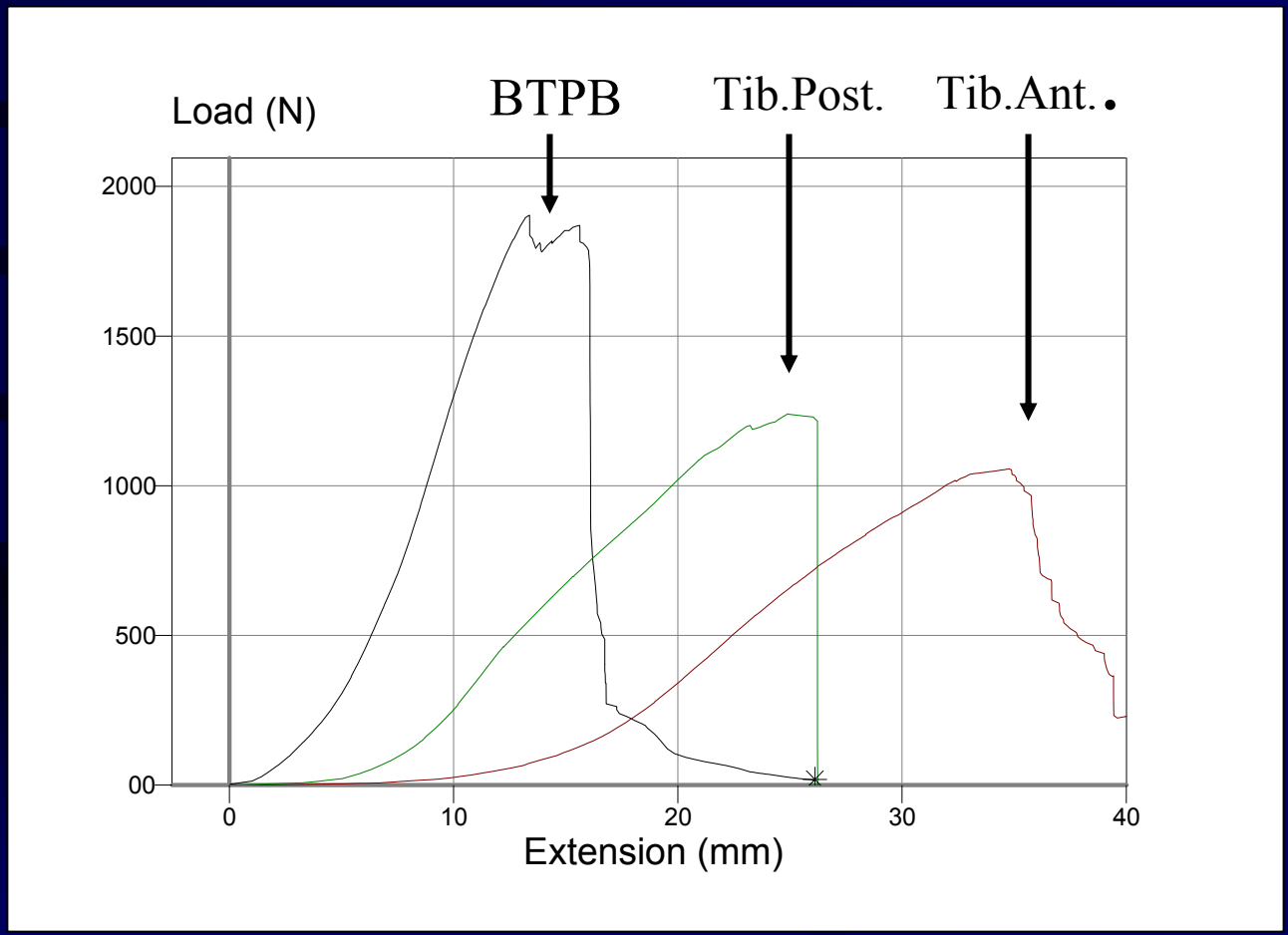
Materials and Methods



Materials and Methods



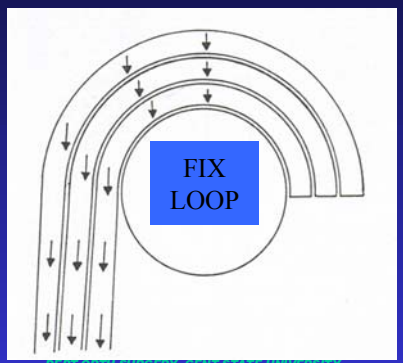
Results

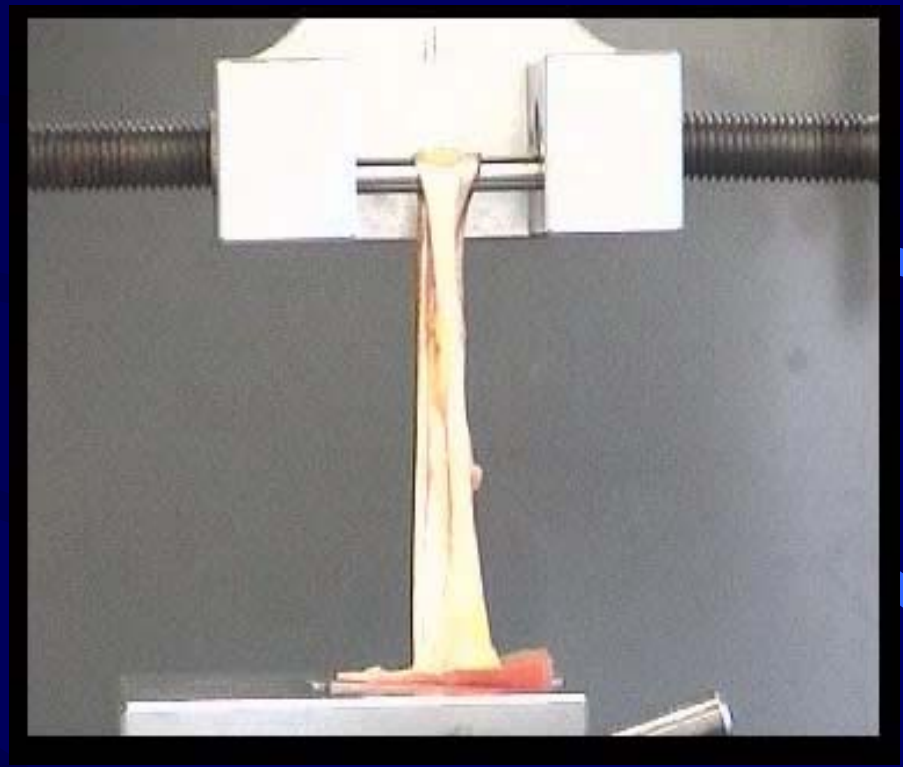

Load (N)
BTPB
Tib.Post.
Tib.Ant.
2000
1500
1000
500
00
0
10
20
30
40
Extension (mm)

Results

single loped tibialis tendon

- The single looped tibialis allografts were looped round 6 mm rod.





Results

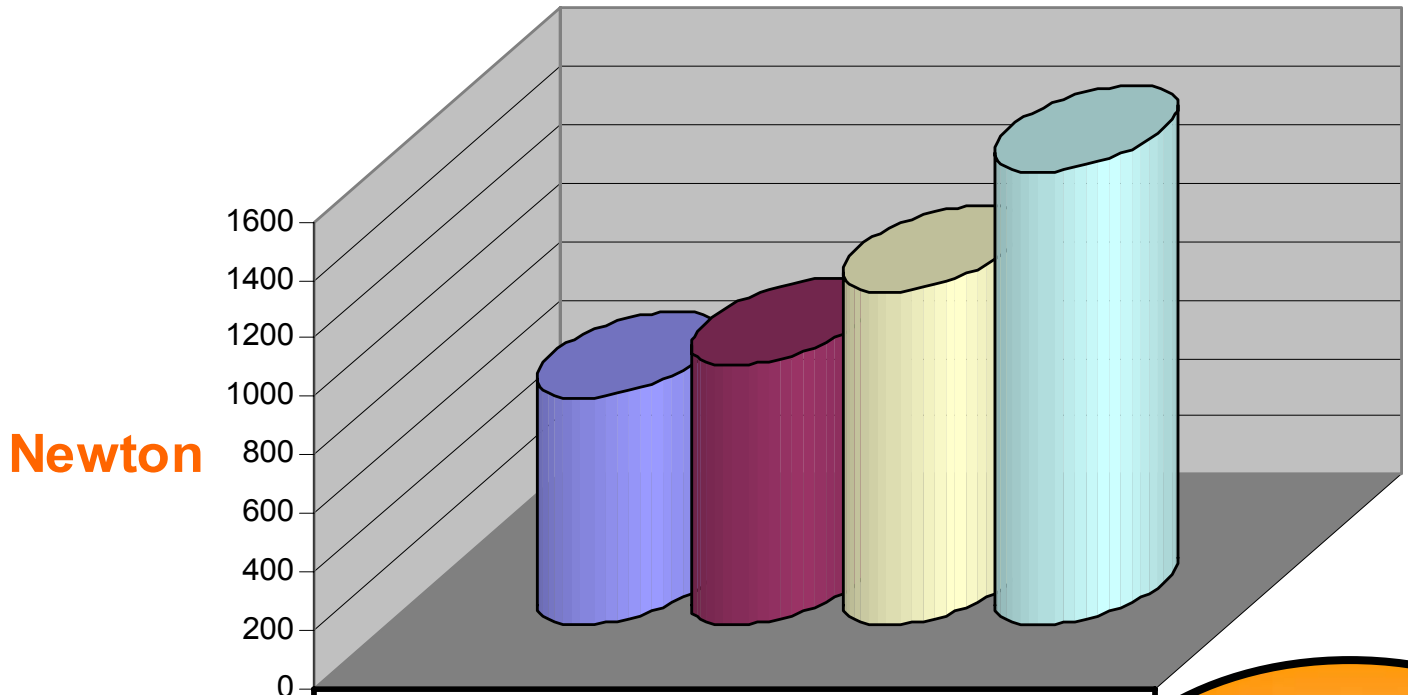
Patella tendon

- Attachment at the patella

- Attachment at the tibia

Results

Maximum Force before Failure

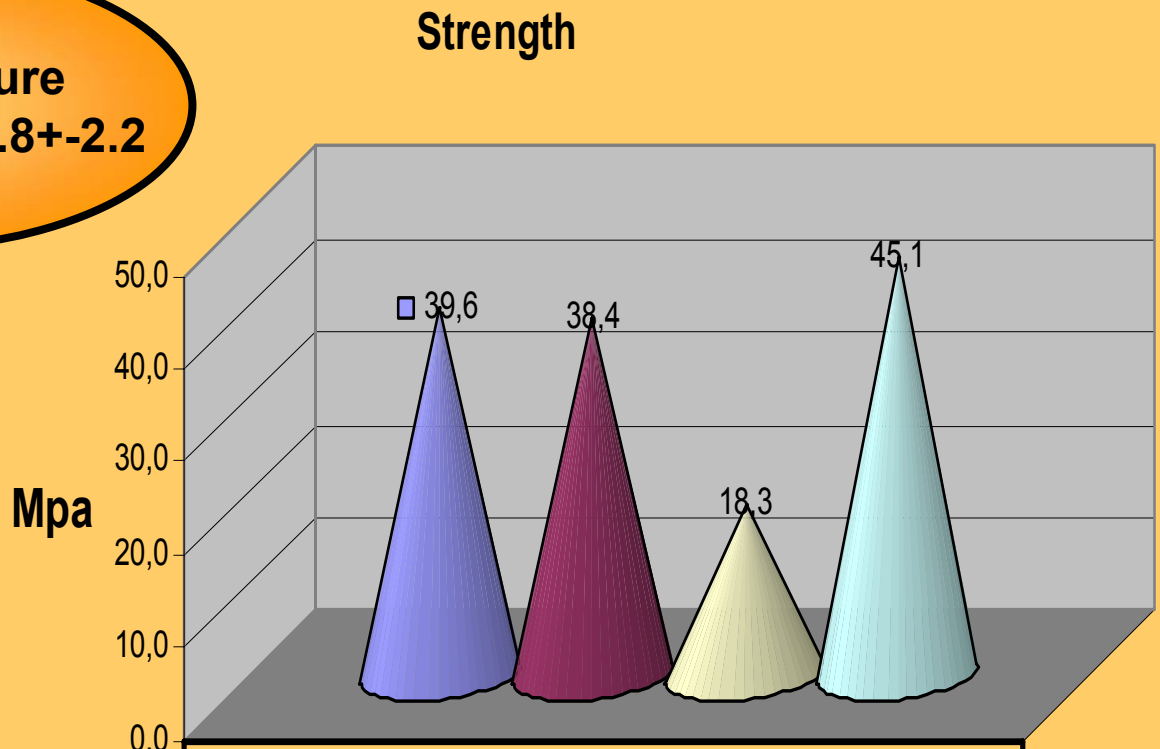


	1
Tibialis Anterior	777
Tibialis Posterior	889
BPTB	1139
Doubl-Stranded	1553

Max. load on ACL was 1.725 ± 269 [N] (NOYES)

Results

Strength failure by ACL was 12.8+-2.2



	1
Tibialis Anterior	39,6
Tibialis Posterior	38,4
BPTB	18,3
Double-Stranded	45,1

Results

Type of tendon	Surface area A [mm^2]	Max.load F_{max} [N]	Stiffness F/ΔL [N/mm]	Strength σ_t [MPa]	Extension ΔL [mm]
TA	20.6 (4.2)	776.9 (174.1)	60.9 (8.9)	39.6 (14.1)	14.7 (2.6)
TP	23.9 (4.4)	888.8 (258.6)	73.1 (21.4)	38.36 (14.2)	14.1 (2.7)
BPTB	67.8 (21.9)	1139.3 (397.5)	168.8 (53.6)	18.3 (9.7)	7.3 (1.5)
Single looped Tibialis tendons	36.2 (9,9)	1553 (249)	236.3 (41.7)	45.1 (10.2)	7.6 (1.2)

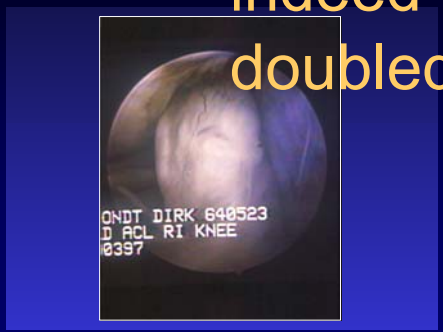
Conclusion

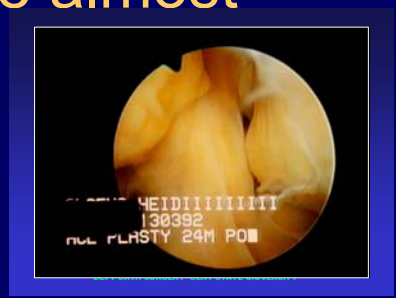
- Caution must be taken in comparing the results in this study with others

  **Clamp*: Specimens must be held with minimum slipping or crushing effects

  **Velocity of traction*: higher values of maximal force with higher crosshead speeds

- tensile properties are positively dependent on the number of strands, preliminary test with single looped tibialis tendons have shown that indeed the maximal force and stiffness are almost doubled.





Conclusion

- This study presents the mechanical properties of possible substitutes for the humans ACL using donor tissues.
- Compared with single-stranded BPTB, tibilias tendons (TA and TP) should be constructed as single loops.
- Other factors influencing the succes of reconstruction of ACL:
  - Graft preparation at surgery,
  - The adequate placement and fixation
  - Remodelling process
  - Immunogenicity, preservation
  - Sterilization, disease transmission and its effect on mechanical properties.

Thank You

Results

Age releated comparison

Tibialis anterior

16-49 year
4 tendons

Mean F_{max} [N]
742.64

Mean σ_t [Mpa]
35.014

50-82 year
13 tendons

Mean F_{max} [N]
774.55

Mean σ_t [Mpa]
38.608

Results

Age releated comparison

Tibialis posterior

16-49 year
5 tendons

Mean F_{max} [N]
628.14

Mean σ_t [Mpa]
26.058

50-82 year
10 tendons

Mean F_{max} [N]
816.015

Mean σ_t [Mpa]
32.769

Results

Age releated comparison

BPTB

16-49 year
2 tendons

Mean F_{max} [N]
1770.45

Mean σ_t [Mpa]
37.79

50-82 year
13 tendons

Mean F_{max} [N]
991.8

Mean σ_t [Mpa]
14.973

Results

Sex releated comparison

Tibialis anterior

Female
7 tendons

Mean F_{max} [N]
782.278

Mean σ_t [Mpa]
44.211

Male
10 tendons

Mean F_{max} [N]
756.38

Mean σ_t [Mpa]
33.249

Results

Sex releated comparison

Tibialis posterior

Female
6 tendons

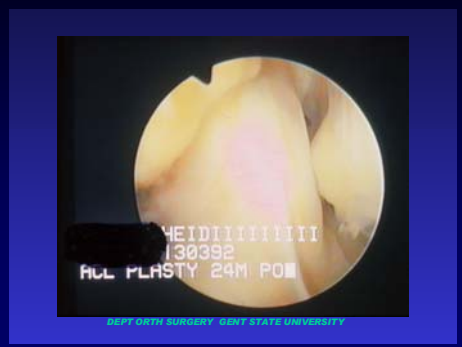
Mean F_{max} [N]
778.553

Mean σ_t [Mpa]
29.982

Male
9 tendons

Mean F_{max} [N]
894.47

Mean σ_t [Mpa]
30.899



Results

Sex releated comparison

BPTB

Female
8 tendons

Mean F_{max} [N]
1042.096

Mean σ_t [Mpa]
15.743

Male
7 tendons

Mean F_{max} [N]
1156.8

Mean σ_t [Mpa]
20.6

Materials and Methods

37
Tibialis tendon

15
Patella tendon

Tibialis Anterior
19
2 damaged

Tibialis Posterior
18
3 damaged