TECNICHE CHIRURGICHE ATTUALMENTE IN USO.

A.Ventura

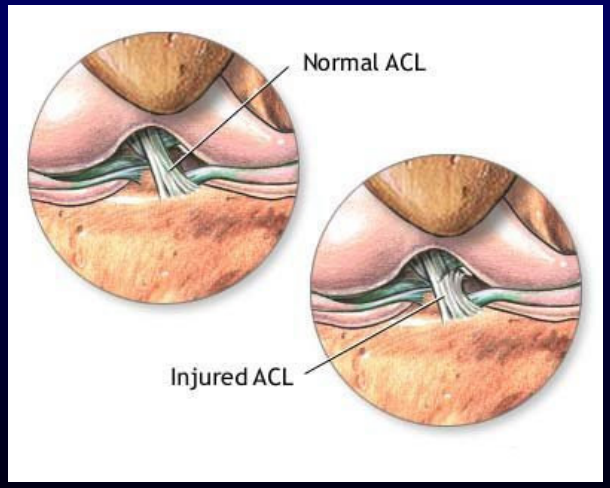
Istituto Ortopedico G. Pini Milano

LESIONE LCA: ETIOPATOGENESI E TRATTAMENTO

Milano 17 marzo 2004

INTRODUZIONE

NEGLI ULTIMI ANNI LE LESIONI DEL LCA SONO AUMENTATE



INTRODUZIONE

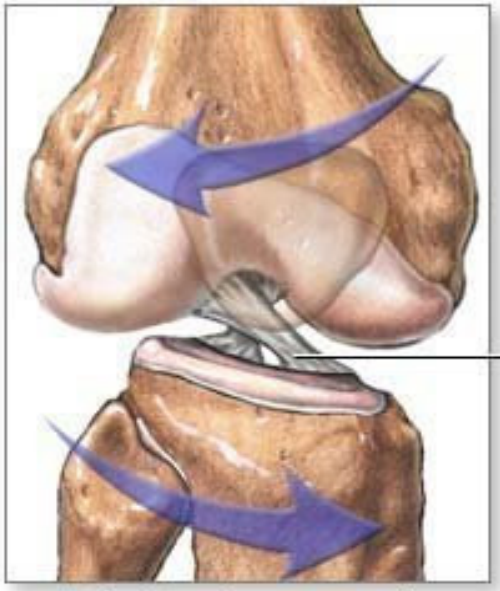
CAUSE:

REALE AUMENTO DELLE LESIONI

MIGLIORAMENTO DELLA DIAGNOSTICA

INTRODUZIONE

LESIONE DA SPORT



AUMENTO DEL N° DI LESIONI

INCREMENTO N° PARTECIPANTI

AGONISTI

(PROFESSIONISTI – DILETTANTI)

AMATORIALI ⬆

RICREAZIONALI ⬆

AUMENTO DEL N° DI LESIONI

INCREMENTO PRESTAZIONI SPORTIVE

AGONISTI ↑

(PROFESSIONISTI – DILETTANTI)

AMATORIALI ↑

RICREAZIONALI ↑

AUMENTO DEL N° DI LESIONI

ELEVATO AGONISMO

AGONISTI

(PROFESSIONISTI – DILETTANTI)

AMATORIALI

RICREAZIONALI

AUMENTO DEL N° DI LESIONI

PRECOCE INIZIO ATTIVITA' SPORTIVE

AGONISTI ↑

(PROFESSIONISTI – DILETTANTI)

AMATORIALI

RICREAZIONALI

AUMENTO DEL N° DI LESIONI

AUMENTO DEI SOGGETTI SPORTIVI IN ETA' ADULTA ED AVANZATA

AGONISTI

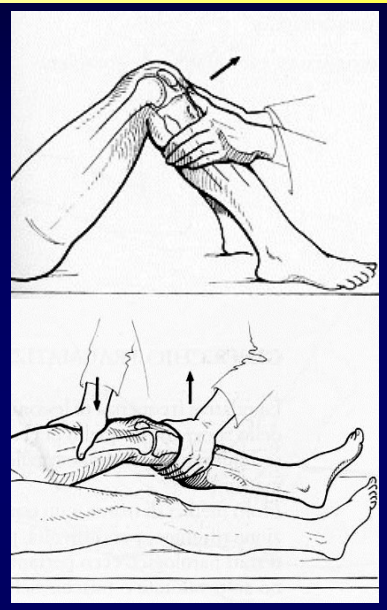
(PROFESSIONISTI – DILETTANTI)

AMATORIALI

RICREAZIONALI ⬆

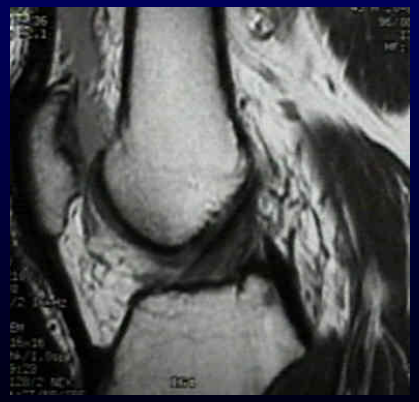
MIGLIORAMENTO DELLA DIAGNOSTICA

CLINICA



ARTROSCOPIA

STRUMENTALE

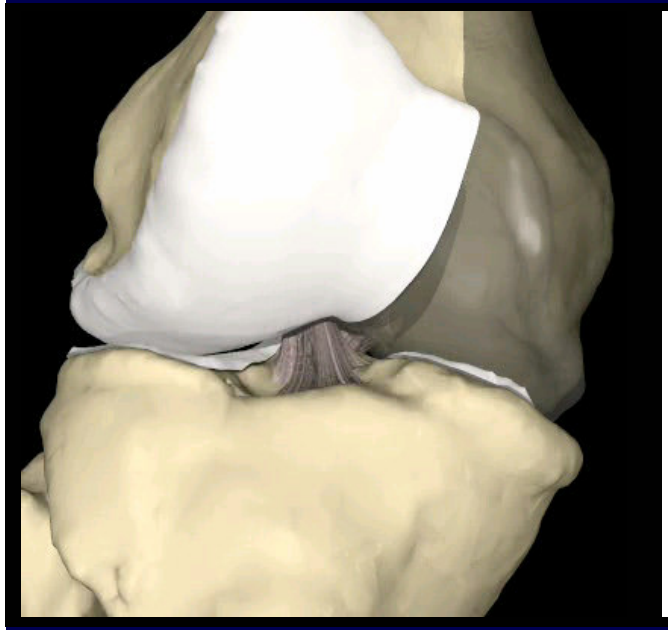


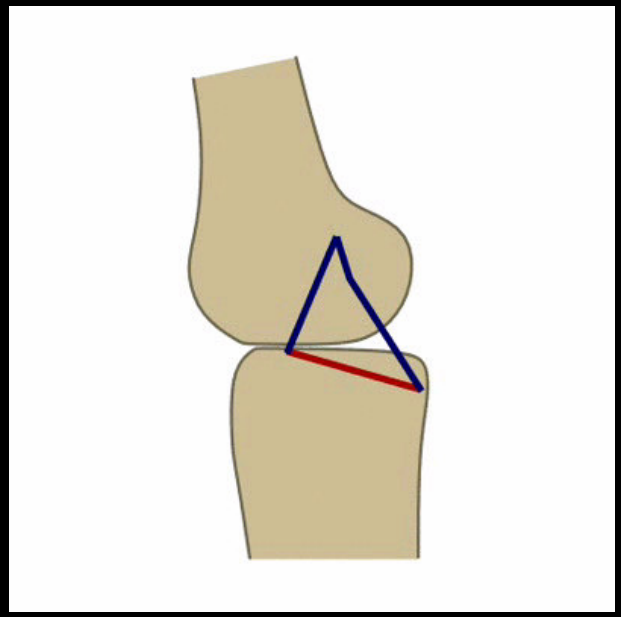
TRATTAMENTO

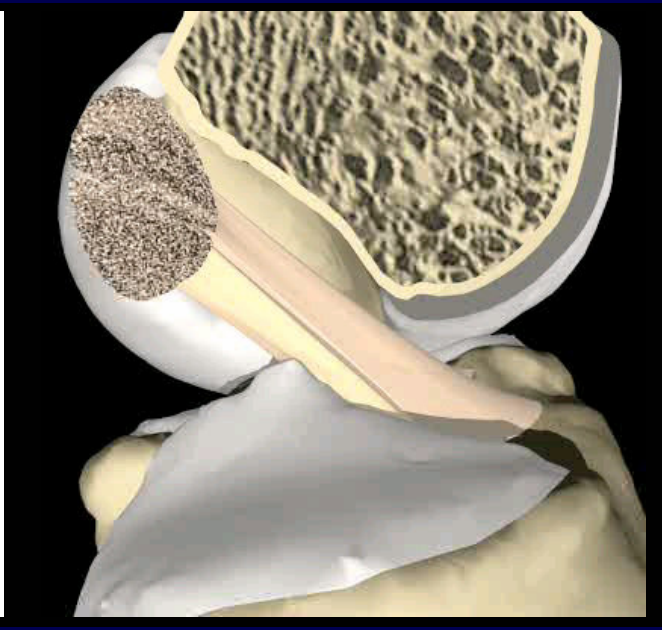
CRUENTO o NON CRUENTO?

BIOMECCANICA **FOLLOW-UP**

BIOMECCANICA







A.A. AMIS 2000

A. VENTURA 2001

BIOMECCANICA

A. VENTURA 2001

RISULTATI-1 BIBODALICO

Pop. in esame (media e DS sui 20 soggetti)

- CMJ-ms: 470.7 54.3
- CMJ-cm: 27.6 6.2
- SJ-ms: 429.2 64.6
- SJ-cm: 23.1 6.6

Controllo (media e DS) sui 20 soggetti

- CMJ-ms: 597.5 42.0
- CMJ-cm: 44.1 6.3
- SJ-ms: 541.6 39.7
- SJ-cm: 36.2 4.4

RISULTATI-2 MONOPODALICO

Pop in esame (media e DS)

- CMJ - ms: 291.2 58.9
- CMJ - cm: 10.8 4.0
- CMJ + ms: 318.3 57.6
- CMJ + cm: 12.8 4.4

Controllo (media e DS)

CMJ – ms: 418.1 31.9
CMJ – cm: 21.9 3.3
CMJ + ms: 424.9 34.4
CMJ + cm: 22.5 3.4

FOLLOW-UP

K.P. BENEDETTO (2000)

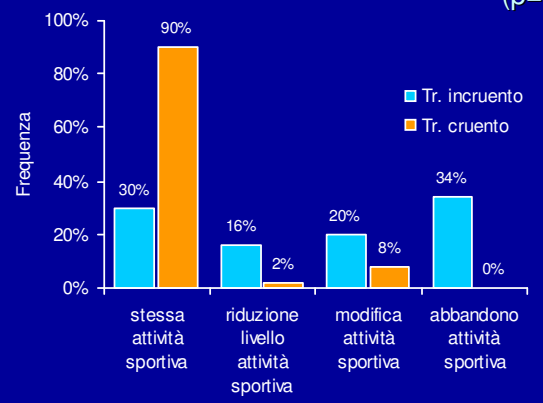
A. VENTURA (1999)

FOLLOW-UP

A. VENTURA (1999)

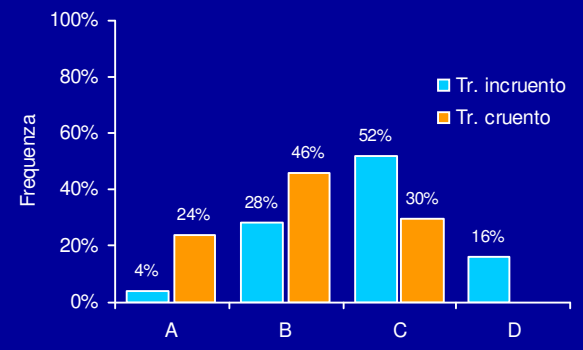
Valutaz. del ritorno alla pratica sportiva
Differenza livello Tegner (grado)

(p=0,0000)



Valutazione IKDC (grado)

(p=0,0213)



TIMING

"Pain, beginning reflex dystrophy, significant persistent haemathrosis and reactive synovitis at time of operation influence the outcome significantly whereas real acute ACL reconstruction lead to similar results as early secondary ACL reconstruction"

K.P. BENEDETTO (2000)

PROBLEMATICHE

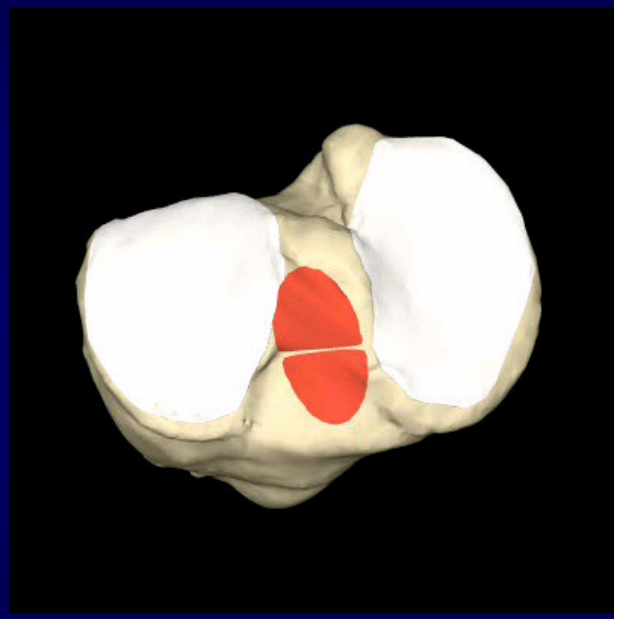
1. POSIZIONE DEI TUNNEL
2. GRAFT
3. FISSAZIONE
4. TENSIONAMENTO
5. RIABILITAZIONE

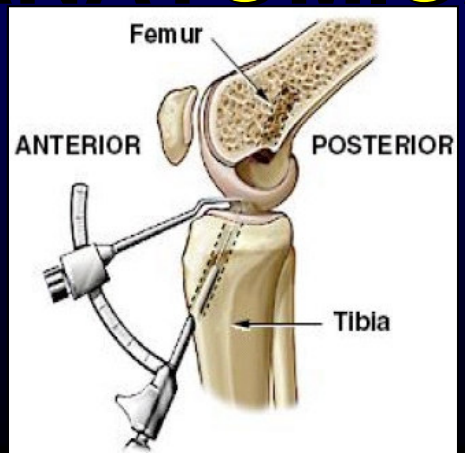
1. POSIZIONE DEI TUNNEL

ISOMETRIA

VS

POSIZIONE ANATOMICA

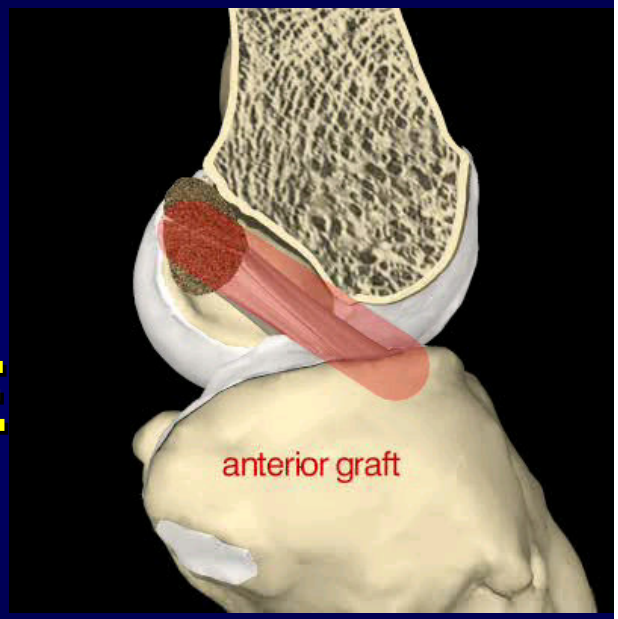




1. POSIZIONE DEL TUNNEL TIBIALE

EVITARE L'IMPINGEMENT SUL TETTO DELLA GOLA

2-3 mm POSTERIORMENTE AL FOOT-PRINT TIBIALE



1. POSIZIONE DEL TUNNEL FEMORALE

GINOCCHIO DESTRO: DA ORE 12 A ORE 10

GINOCCHIO SINISTRO: DA ORE 12 A ORE 2

R. LARSON SI ORE 12

S. HOWELL NO ORE 12

IN QUALSIASI CASO IL PIU' LONTANO E POSTERIORE

R.J. JOHNSON 2000

VALUTAZIONE DELLA POSIZIONE DEL TUNNEL FEMORALE

CORSO AVANZATO DI ARTROSCOPIA

Relazione, videotape,

ricostruzione su modelli plastici

RICOSTRUZIONE SU CADAVERE:

4 ECCELLENTI

8 ACCETTABILI

2 ROTTURA PARETE POSTERIORE

10 TROPPO ANTERIORE

12 INACETTABILI

36

24 !

D. KOHN

TRAPIANTO IDEALE

1. RIPRODUCE L'ANATOMIA DEL LCA
   (fascio AM e PL e i siti d'inserzion
2. RIPRODUCE LA BIOMEC
   (giovane adulto)
3. PERMET L COMPLETA INTEGRAZIONE
4. S NE INIZIALE
5. BA RBILITA' IN SEGUITO AL PRELIEVO
6. RAPIDA LIGAMENTIZZAZIONE

NON ESISTE !

2. GRAFT

"Autogenus graft choice is limited by the twin considerations of graft strength and donor site effects, an this leads to current practise being limited to the patellar, quadriceps, and hamstring tendon"

A.A. AMIS

2. GRAFT

Patellar tendon vs ST/Gr vs allograft

	Anatomy	Bio-mechanics	Biological Incorporation	Initial fixation	Graft site morbidity	Ease of graft harvest/prep
P.T.	Similar (does not reproduce ACL)	+ Stronger/Stiffer	+ bone healing (3-weeks)	+ Interference screw	Larger incision More dissection	Similar
ST/Gr	Similar (does not reproduce ACL)	"New data"	tendon bone healing 8-12 weeks	various fixation	?Smaller incision less post-op pain	Similar (may be more time consuming)
fresh frozen allograft (patella r tendon)	Similar (does not reproduce ACL)	PT vs AT	- slower incorporation	+ interference screws	none	The best (no anesthesia)

C.D. HARNER

2. GRAFT

What Does it Take to Replace the Human ACL?

Strength	1725 ± 269 N (Noyes)
	2160 ± 157 N (Woo)
Length	31 - 35 mm
Cross-sectional area: 31.3 mm^2	
Stiffness	182 ± 33 N/mm (Noyes)
	242 ± 26 N/mm (Woo)

Patellar tendon

Initial Tensile Properties

	Failure load (N)	Stiffness (N/mm)	Width (mm)
Noyes (1984)	2900 ± 260	685 ± 86	14.8
Cooper (1993)	2977 ± 516	454 ± 57	10
Muellner (1998)	3899 ± 298	507 ± 111	10

Hamstring tendons

Tensile properties

	Failure load (N)	Stiffness (N/mm)
Hamner (1999) DGST	4590 ± 674	861 ± 186
*Hamner (1999) DGST	2830 ± 538	455 ± 97
┼Hecker (1996) DGST	4140 ± 969	807 ± 164
┼Hecker (1996) Quad ST	3560 ± 742	855 ± 156

** no attempt at equal tensioning (not significantly stronger or stiffer than a doubled ST)*

┼ minimal difference in the tensile properties of young < 45 years old and old tendons > 50 years old

Quadriceps tendon

Tensile Properties

	Failure load (N)	Stiffness (N/mm)
Staubli (1996)	2376 ± 152	313 ± 50

not significantly different than the patellar tendon from the same specimens

Initial fixation strength and fixation site healing

Hybrid graft (bone-to-bone fixation on one side, soft tissue to bone fixation on the other)

2. GRAFT

St+G

T. ROTULEO

Initial Fixation Strength with interference screws
(femur-patellar tendon graft-tibia complex)

	Failure load (N)	Stiffness (N/mm)
Kurosaka (1987)	437 ± 90	58 ± 4
Steiner (1994)	423 ± 175	46 ± 24
Rowden (1997)	416 ± 166	51 ± 17

Isolated Patellar Tendon Femoral fixation

	Failure load (N)	Stiffness (N/mm)
Brown (1999) screw	710 ± 224	298 ± 36
Brown (1999) button	664 ± 132	207 ± 36
Seitz (1999) screw	938 ± 275	274 ± 58

Isolated Patellar Tendon Tibial fixation with interference screws

	Failure load (N)	Stiffness (N/mm)
Gerich (1997)	758 ± 139	49 ± 2
Seitz (1999)	705 ± 293	261 ± 46
Brown (2000)	506 ± 149	229 ± 58

Initial Fixation Strength (femur-DGST-tibia complex)

	Failure load (N)	Stiffness (N/mm)
Steiner (1994) 2 AO spiked washers	821 ± 219	29 ± 7
Brown (1996) EndoButton	699 ± 210	30 ± 6
Rowden (1997) EndoButton	612 ± 73	42 ± 23

Isolated hamstring femoral fixation after 1000 cycles (Brown 1999)

	Failure load (N)	Stiffness (N/mm)
8 x 23 mm Biointeference Screw	561 ± 70	257 ± 37
EndoButton (Endotape 20 mm)	644 ± 91	182 ± 20
EndoButton (Continous Loop 20 mm)	1345 ± 179	179 ± 39
LinX	687 ± 129	230 ± 32
Bone Mulch Screw	977 ± 238	257 ± 50
Transfix	934 ± 296	240 ± 74

Note: only fixation with biointerference screws failed under cyclical loading

Isolated hamstring tibial fixation (Howell 1999)

	Failure load (N)	Stiffness (N/mm)
Sutures/post	821 ± 193	70 ± 19
Staples	705 ± 174	174 ± 92
20 mm washer	930 ± 323	192 ± 61
Washerloc	821 ± 193	429 ± 269
Tandem washers	1375 ± 213	420 ± 180

INTEGRAZIONE OSSEA

T. ROTULEO	St+G
- 4-6 SETTIMANE	- 8-12 SETTIMANE
- NO ALLARGAMENTO TUNNEL	- ALLARGAMENTO TUNNEL

2. GRAFT

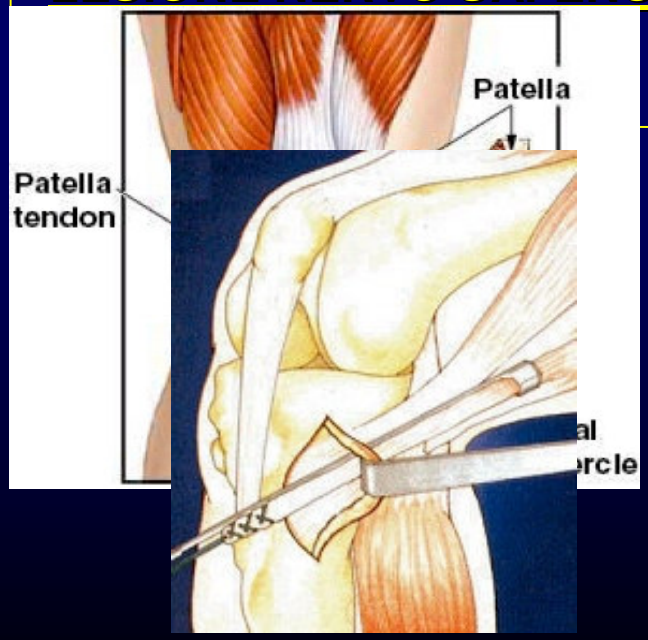
SITO DONATORE

T. ROTULEO

- DOLORE: 31-79%
- DOLORE FEMORO-ROTULEO: 13-47%
- DEBOLEZZA M. QUADRICIPITE: 10%
- FRATTURA ROTULA: 0.35-2-3%
- TENDINOPATIA ROTULEA: 6%
- <u>ROTTURA SISTEMA ESTENSORE</u>

St+G

- DOLORE: 6%
- <u>LESIONE NERVO SAFENO</u>



2. GRAFT

VANTAGGI

T. ROTULEO

1. PROPRIETA' MECCANICHE INIZIALI NON DIPENDENTI DAL TENSIONAMENTO
2. ELASTICITA' DI FISSAZIONE INIZIALE PIU' ALTA
3. MINORI POSSIBILITA' DI FALLIMENTO
4. CRESCITA DI OSSO SU OSSO NEL PUNTO DI FISSAGGIO
5. MINOR INCIDENZA DI ALLARGAMENTO DEI TUNNEL

St+G

1. MINOR DOLORE
2. GRAFT RESISTENTE E RIGIDO
3. MINOR PROBLEMI A LIVELLO DEL SITO DONATORE

T. QUADRICIPITALE

1. LARGA AREA DELLA SEZIONE DI TAGLIO
2. MINOR DOLORE DEL SITO DONATORE RISPETTO AL T. ROTULEO

2. GRAFT

SVANTAGGI

T. ROTULEO

1. MAGGIOR DOLORE
2. PROBLEMI A LIVELLO DEL SITO DONATORE
3. MAGGIORI RISCHI E COMPLICANZE DEL SITO DONATORE

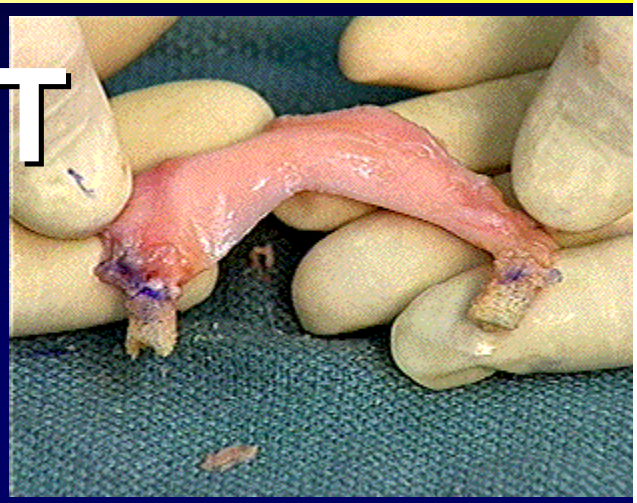
St+G

1. CURVA DI APPRENDIMENTO
2. TENSIONAMENTO DEI 4 CAPI
3. RIGIDITA' DI FISSAZIONE INIZIALE PIU' BASSA
4. LENTA INTEGRAZIONE OSSEA
5. ALLARGAMENTO DEL TUNNEL

T. QUADRICIPITALE

1. CURVA DI APPRENDIMENTO
2. DOLORE E COMPLICAZIONI SITO DONATORE
3. COSMESI

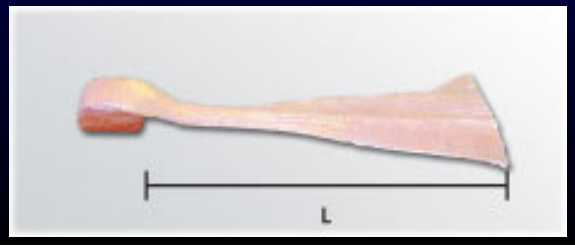
2. GRAFT



ALLOGRAFT

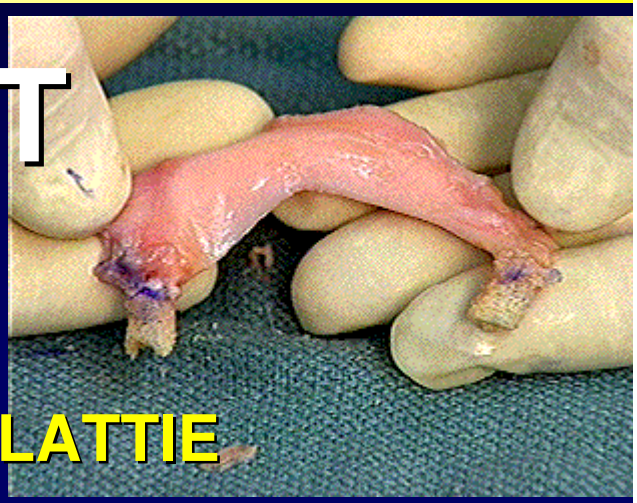
VANTAGGI

1. PICCOLA INCISIONE
2. DIMENSIONI VARIABILI DEL GRAFT
3. DIMINUZIONE DEL TEMPO CHIRURGICO
4. NESSUN PROBLEMA A LIVELLO DEL SITO DONATORE



2. GRAFT

ALLOGRAFT



SVANTAGGI

1. POSSIBILE TRASMISSIONE MALATTIE
2. EFFETTO SECONDARIO DELLA STERILIZZAZIONE SULLE PROPRIETA' MECCANICHE DEL GRAFT
3. POSSIBILE RISPOSTA AUTOIMMUNE
4. PROCESSO DI LIGAMENTIZZAZIONE RITARDATO

ALLOGRAFT: INDICAZIONI

1. SITUAZIONI NELLE QUALI NON C'E' ALCUNA ALTERNATIVA AUTOLOGA
2. RICOSTRUZIONE LEGAMENTOSA MULTIPLA
3. ROTTURA CRONICA DEL TENDINE ROTULEO
4. RICOSTRUZIONE LEGAMENTOSA IN PAZIENTI OLTRE I 40 AA
5. RICOSTRUZIONE LEGAMENTOSA IN PAZIENTI CON ARTROSI
6. REVISIONE CHIRURGICA DEI LEGAMENTI
7. RICOSTRUZIONE LEGAMENTOSA DOVE E' IMPORTANTE LA LUNGHEZZA DELL'INCISIONE CUTANEA
8. RICOSTRUZIONE DEL LCP
9. RICOSTRUZIONE DEI LEGAMENTI PERIFERICI E/O DELL'ANGOLO POSTERO-LATERALE

LEGAMENTI ARTIFICIALI

NOSTRA ESPERIENZA:

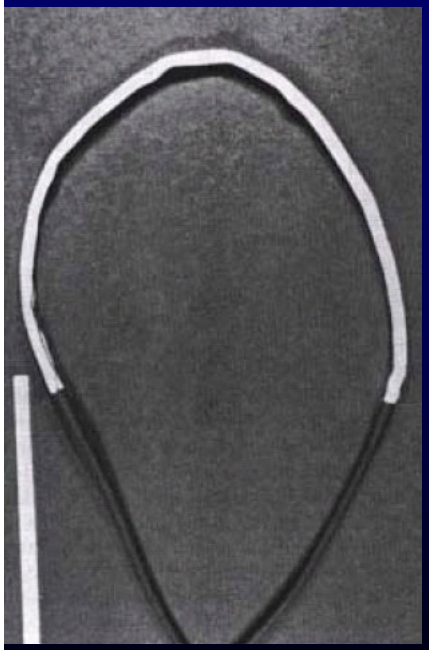
Pro-Flex

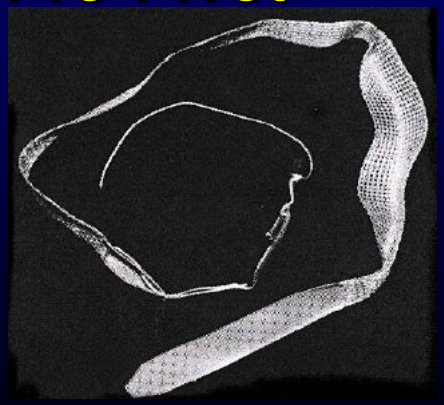
Trevira

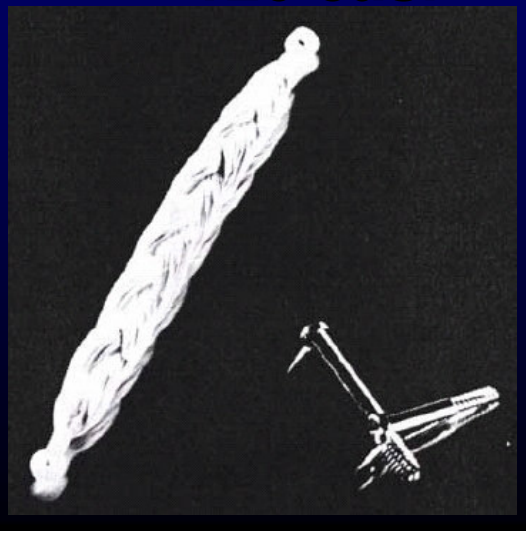
Pro-Pivot

1985-1990

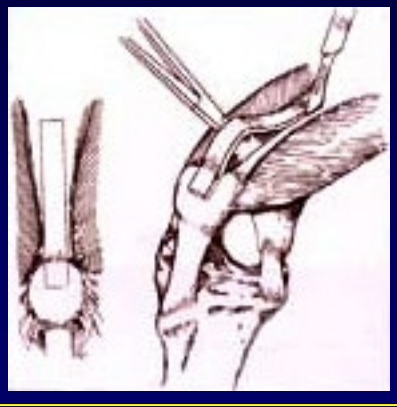
126 casi

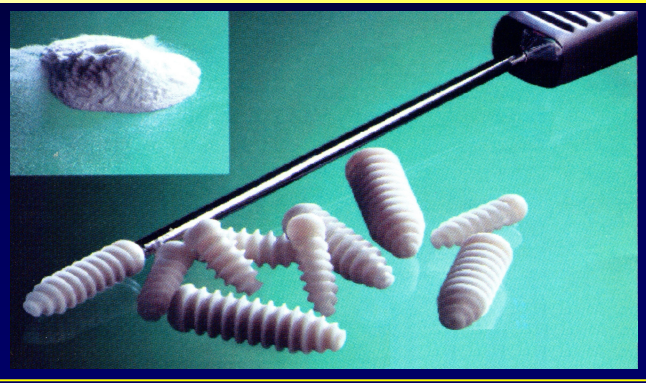






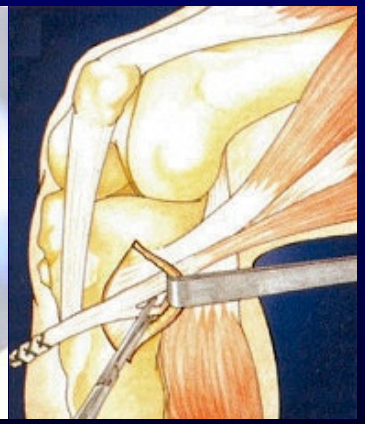
3. FISSAZIONE

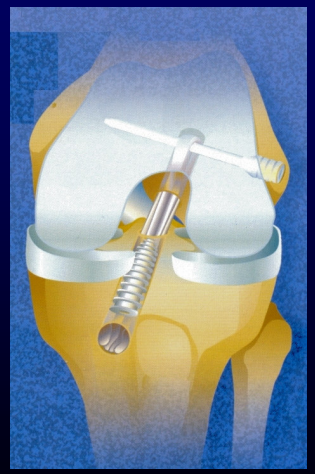




TIPO GRAFT

CONDILO FEMORALE o TIBIALE





3. FISSAZIONE

T. ROTULEO

FEMORE

Viti interferenziali

Viti transcondiliche

Endo-Button

TIBIA

Viti interferenziali

Initial Fixation Strength with interference screws
(femur-patellar tendon graft-tibia complex)

	Failure load (N)	Stiffness (N/mm)
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3. FISSAZIONE

T. ROTULEO

VITI TRANSCONDILICHE

VS

VITI INTERFERENZIALI

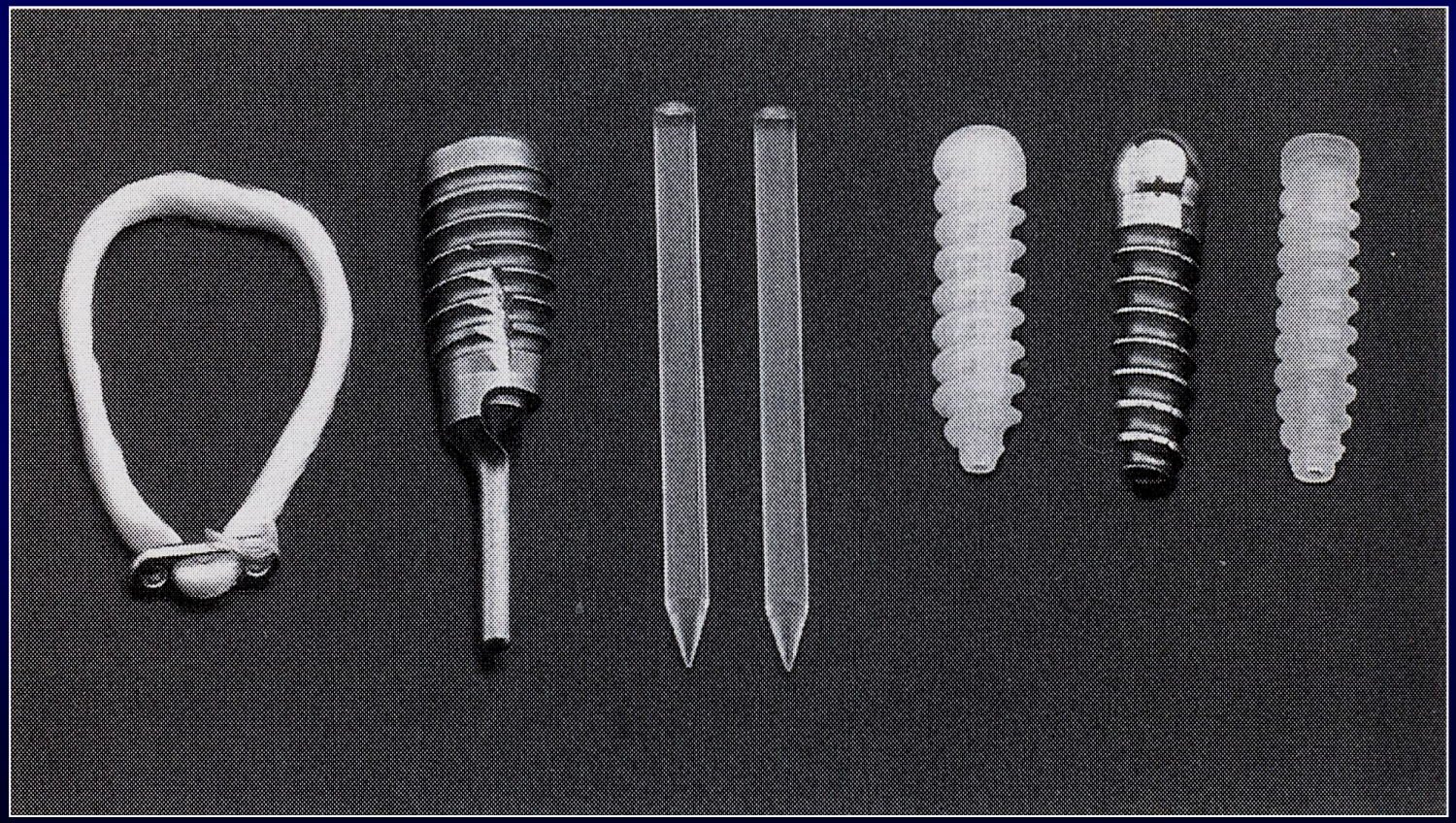
NESSUNA DIFFERENZA

(studio clinico)

P.P.MARIANI: Arthroscopy 2001

3. FISSAZIONE

St+G



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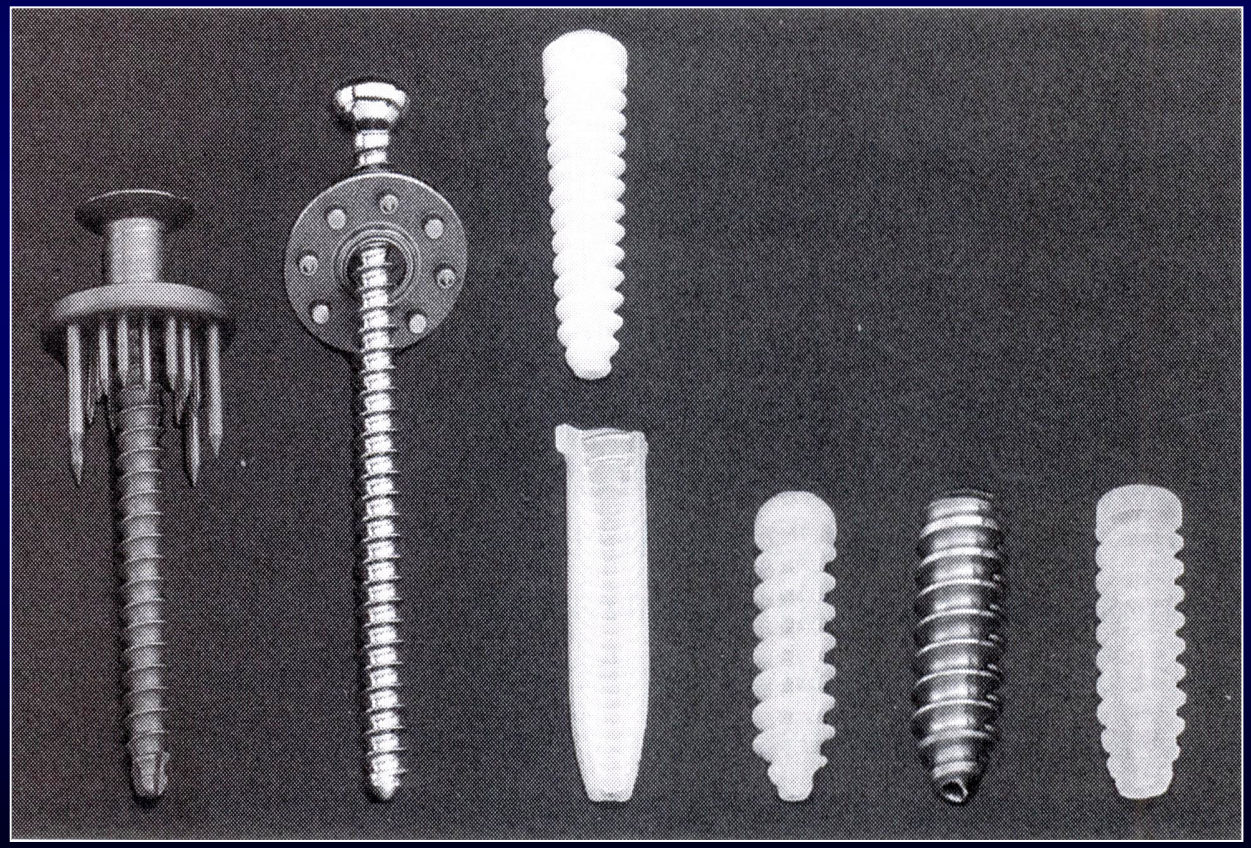


3. FISSAZIONE

St+G

FEMORE

Viti interferenziali

Viti transcondiliche

Endo-Button

TIBIA

Viti interferenziali

Viti

Results of Single-Cycle Loading after Cyclic Loading for Each Fixation Device

Fixation	N	Yield load (N) (mean ± SD)	Stiffness (N/mm) (mean ± SD)
EndoButton CL	10	781 ± 252	105 ± 13[a,b,c]
Bone Mulch Screw	10	925 ± 280	189 ± 38
RigidFix	10	768 ± 253	136 ± 13[a]
BioScrew	9	565 ± 137[d]	113 ± 15[a,e]
RCI screw	9	534 ± 129[d,f]	134 ± 23[a]
SmartScrew ACL	10	842 ± 201	162 ± 28

[a] Significantly different from Bone Mulch Screw ($P < 0.001$).
[b] Significantly different from RigidFix ($P < 0.05$).
[c] Significantly different from Smart Screw ACL ($P < 0.001$).
[d] Significantly different from Bone Mulch Screw ($P < 0.05$).
[e] Significantly different from SmartScrew ACL ($P < 0.01$).
[f] Significantly different from SmartScrew ACL ($P < 0.05$).

Results of Single-Cycle Loading after Cyclic Loading for Each Fixation Device

Fixation	N	Yield load (N) (mean ± SD)	Stiffness (N/mm) (mean ± SD)
WasherLoc	10	917 ± 234[a]	127 ± 22[b]
Tandem spiked washers	10	675 ± 190[b,c]	108 ± 26[b,d]
Intrafix	10	1309 ± 302	267 ± 36
BioScrew	10	567 ± 156[b,e]	125 ± 23[b,d]
SoftSilk	9	423 ± 75[b,f]	120 ± 18[b,d]
SmartScrew ACL	10	694 ± 173[b]	159 ± 25[b]

[a] Significantly different from Intrafix ($P < 0.01$).
[b] Significantly different from Intrafix ($P < 0.001$).
[c] Significantly different from WasherLoc ($P < 0.05$).
[d] Significantly different from SmartScrew ACL ($P < 0.05$).
[e] Significantly different from WasherLoc ($P < 0.01$).
[f] Significantly different from WasherLoc ($P < 0.001$).

PETTERI KOUSA et Al. Am J Sports Med 2003

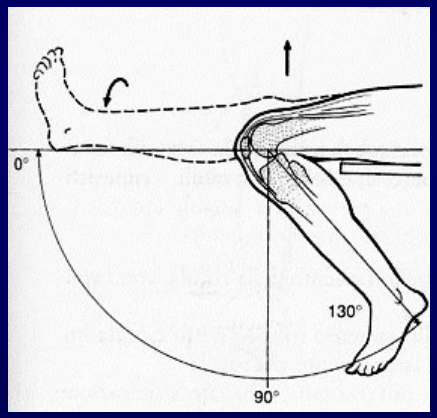
4. TENSIONAMENTO

NON ESISTONO STUDI CHE INDICANO LA POSIZIONE IDEALE PER LA FISSAZIONE DEL GRAFT

STEADMAN 90°

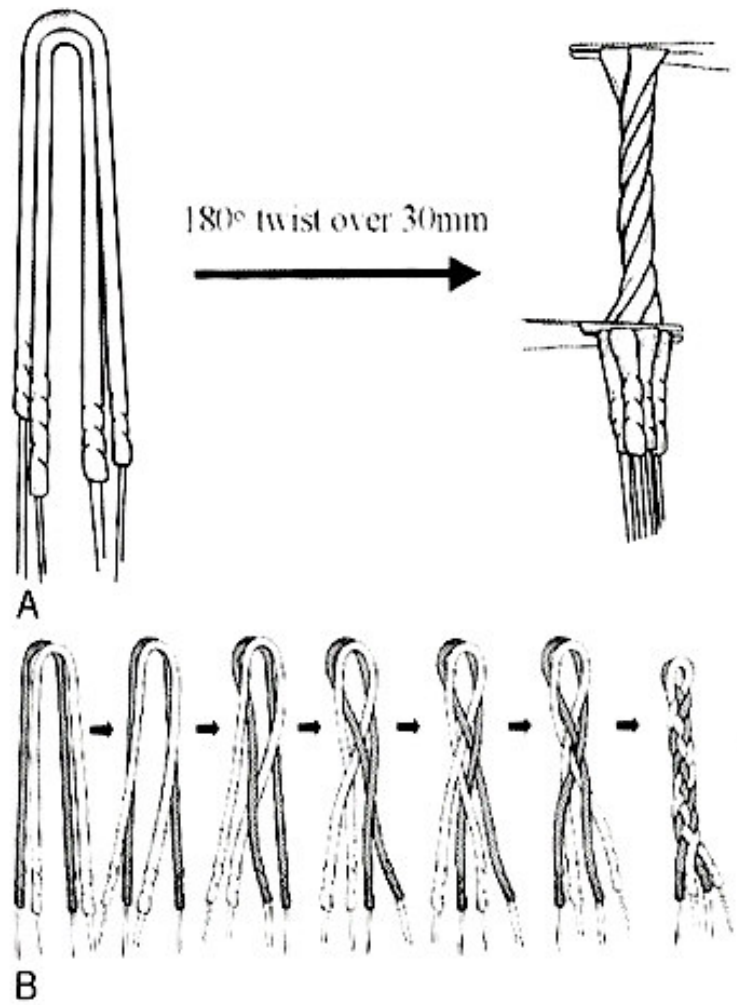
AGLIETTI 20°

AMIS 0°



LA TENSIONE APPLICATA E' SOGGETTIVA

4. TENSIONAMENTO



A, twisting technique; B, braiding technique.

4. TENSIONAMENTO

Hamstring Graft Preparation: Twisting, Braiding?

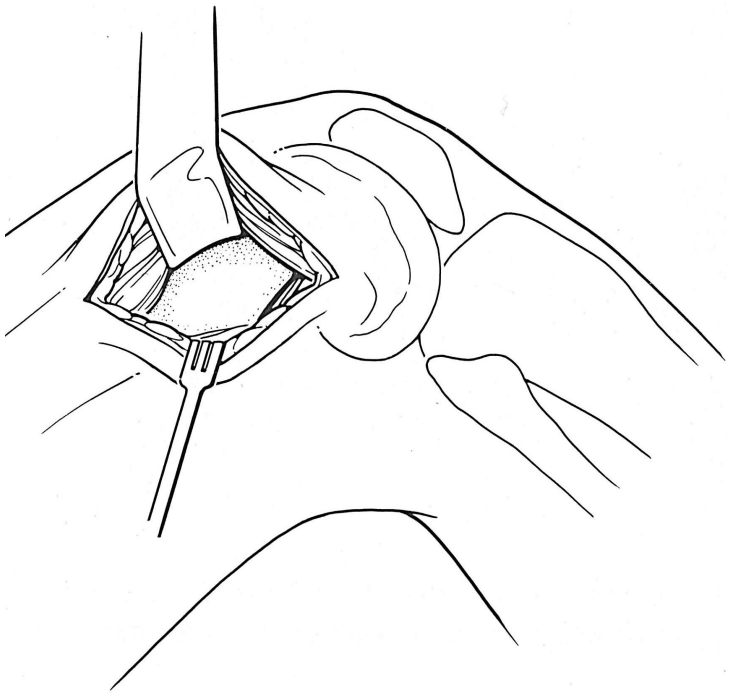
	Failure load (N)	Stiffness (N/mm)
Hamner (1995) DGST parallel equal tension	4590 ± 674	861 ± 186
Hamner (1995) DGST parallel no attempt at equal tension	2830 ± 538	455 ± 97
Brown (1999) DGST parallel	3334	759
Brown (1999) DGST twisted	2259	698
Wilson (1999) DGST braided	2421 ± 538	238 ± 71

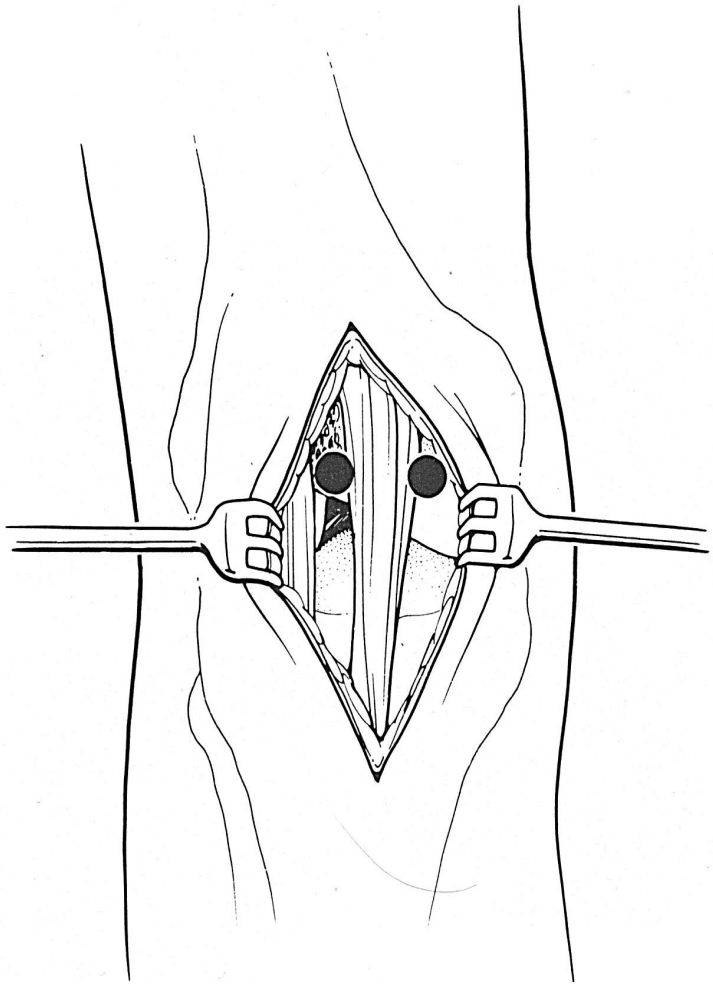
IL *BRAIDING* ED IL *TWISTING* SONO TECNICHE USATE NELLA COSTRUZIONE DI FUNI, CORDE E FILI DI SUTURA PER OTTENERE FLESSIBILITA' E MANEGEVOLEZZA, NON RESISTENZA

TECNICHE CLASSICHE

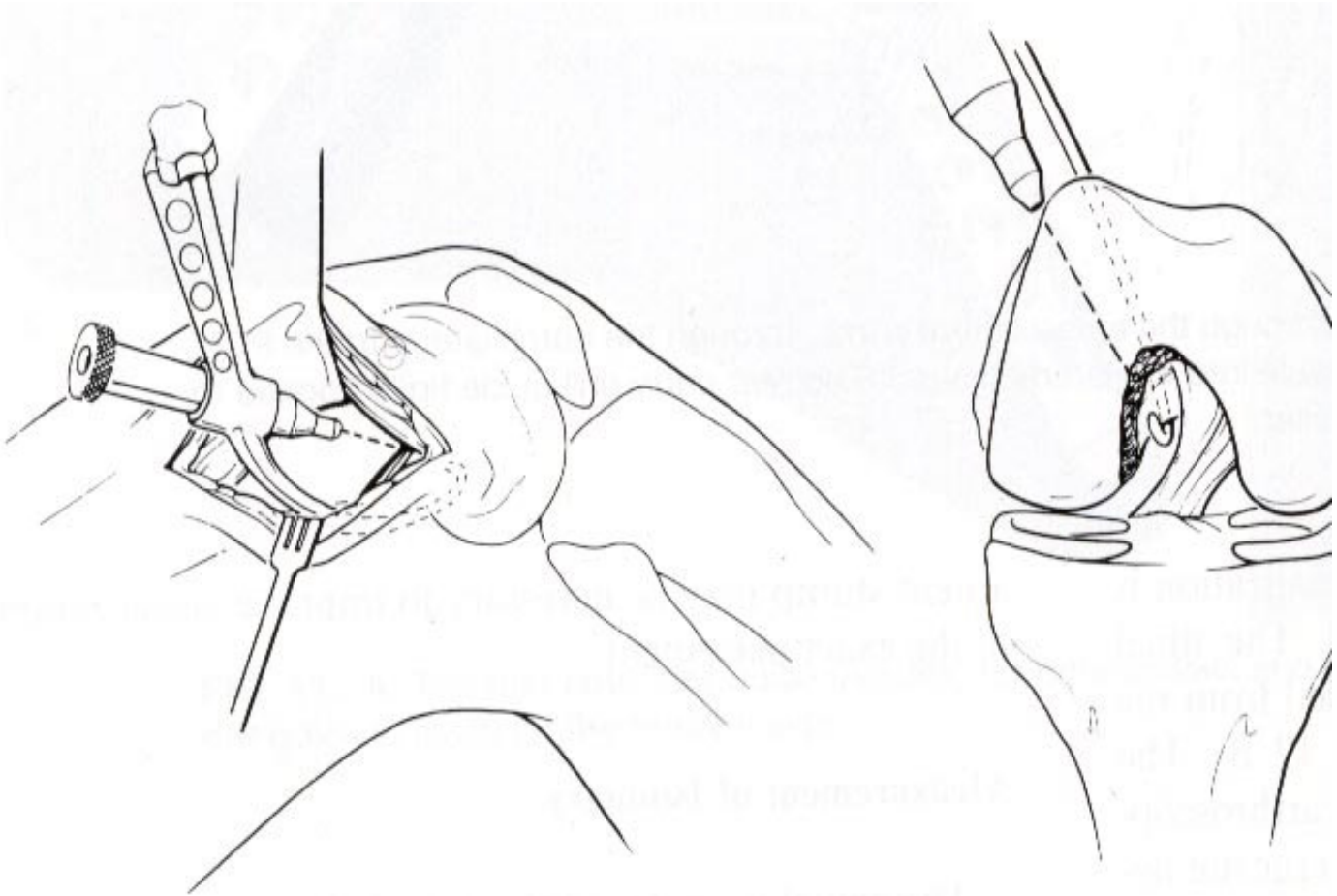
a. DUE INCISIONI
b. DOPPIO TUNNEL
c. TRANSTIBIALE

TECNICHE CLASSICHE:
a. DUE INCISIONI

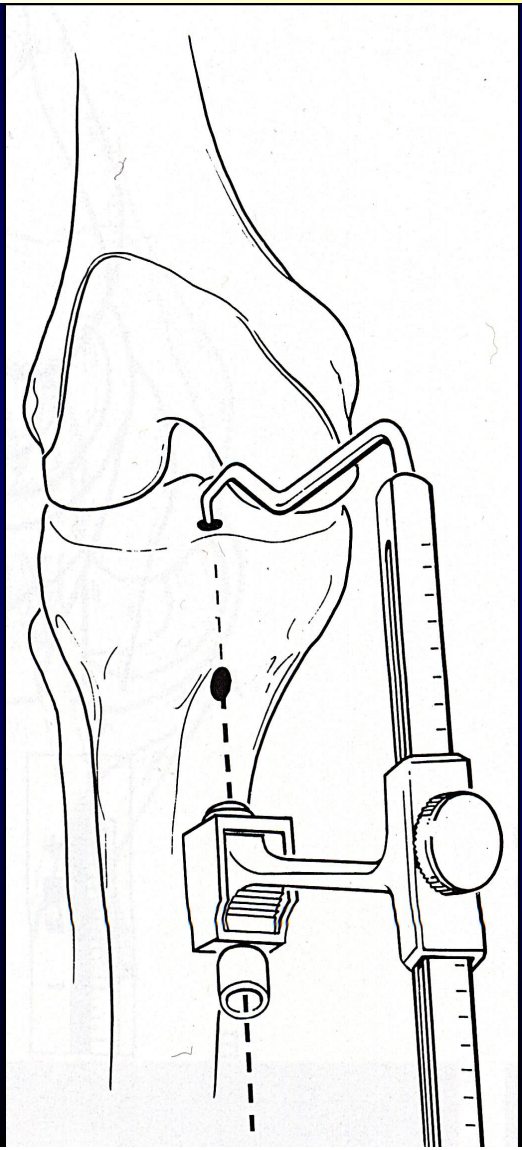




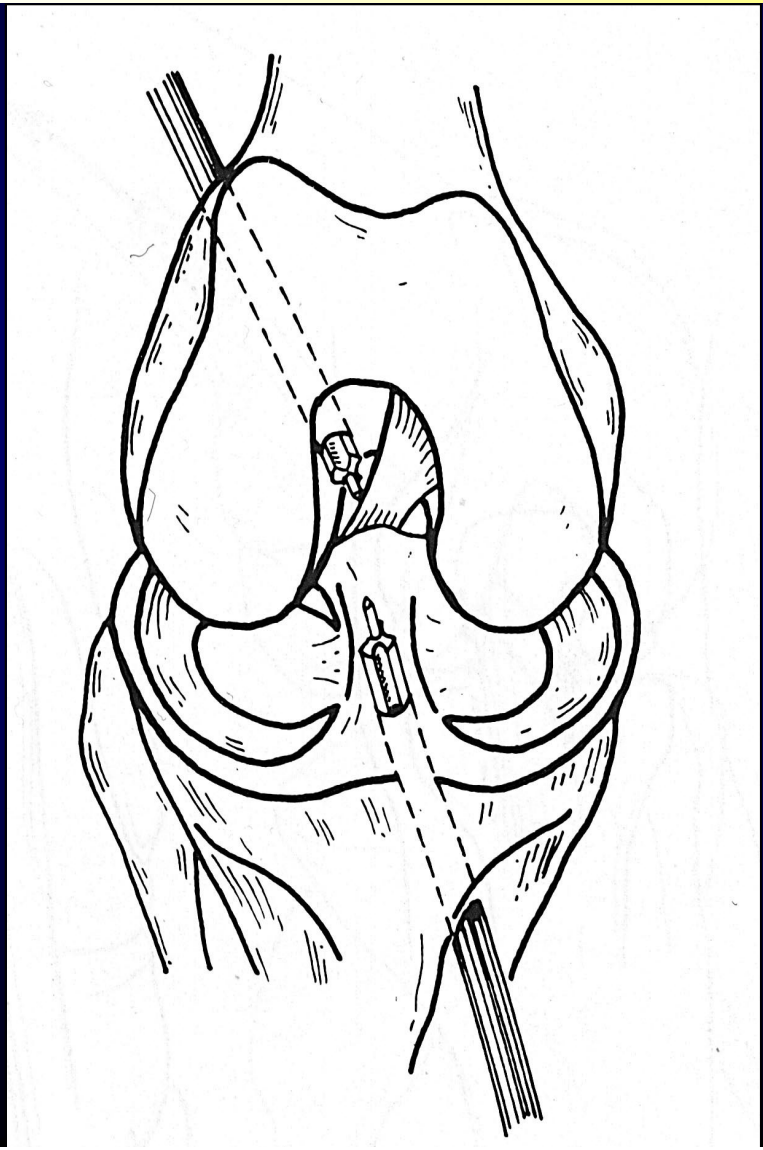
TECNICHE CLASSICHE:
a. DUE INCISIONI



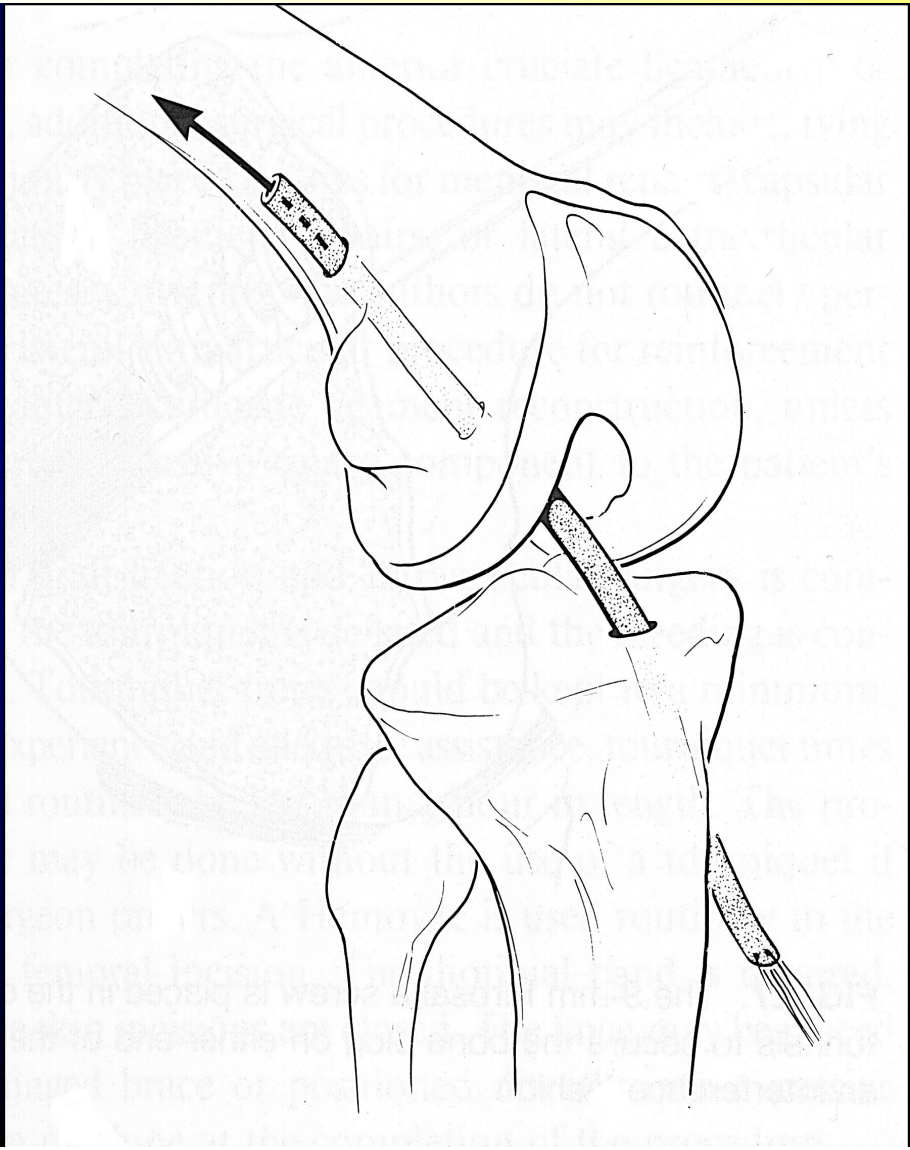
TECNICHE CLASSICHE:
a. DUE INCISIONI



TECNICHE CLASSICHE:
a. DUE INCISIONI

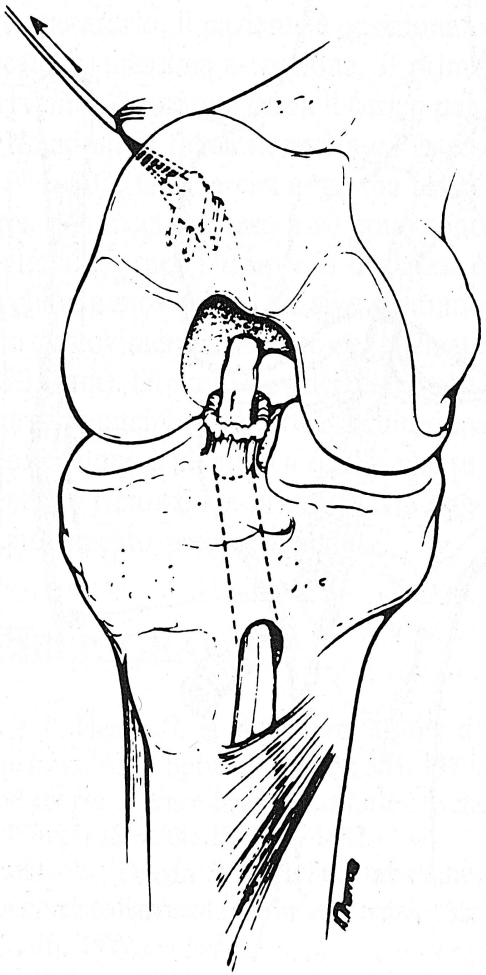


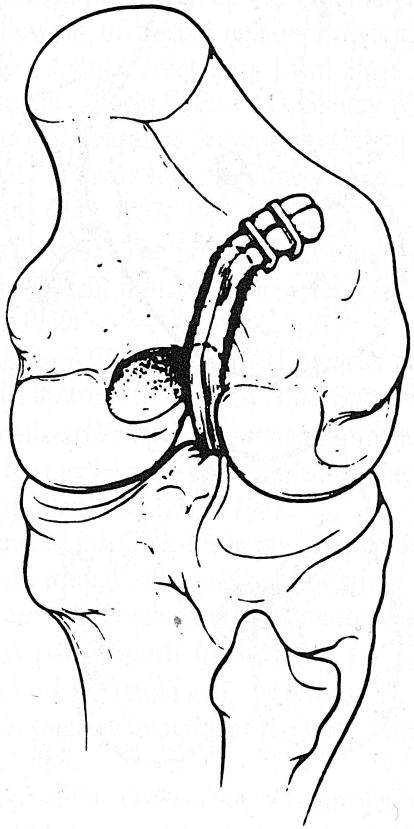
TECNICHE CLASSICHE:
a. DUE INCISIONI

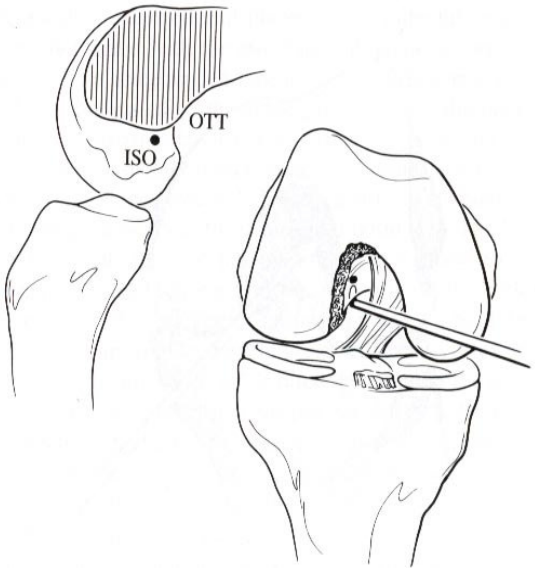


TECNICHE CLASSICHE:
a. DUE INCISIONI

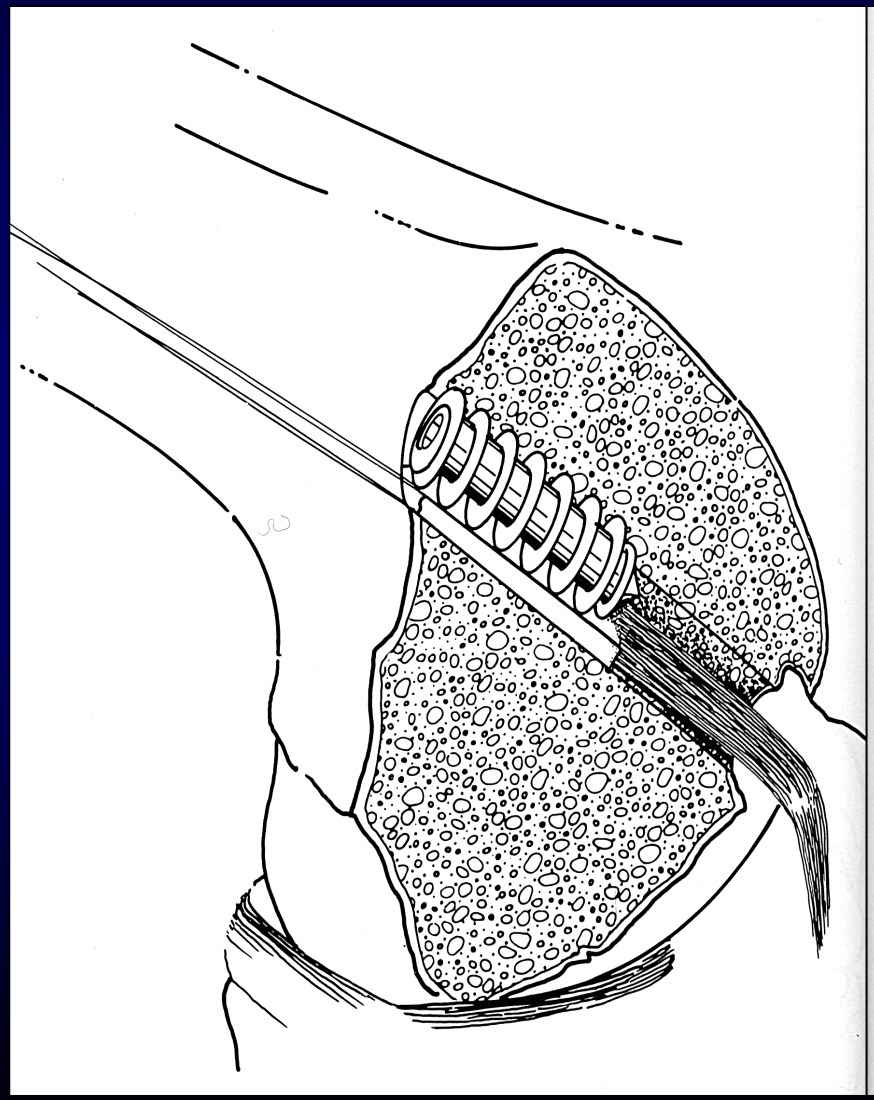
OVER THE TOP

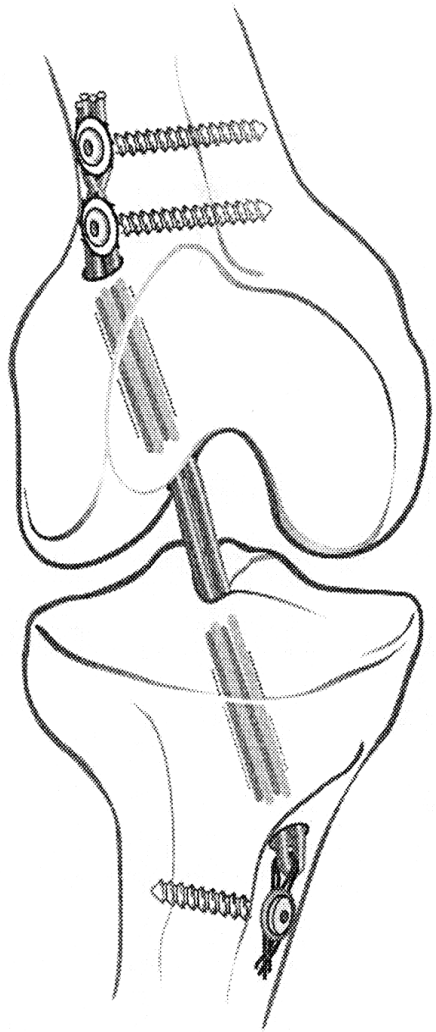






TECNICHE CLASSICHE:
a. DUE INCISIONI





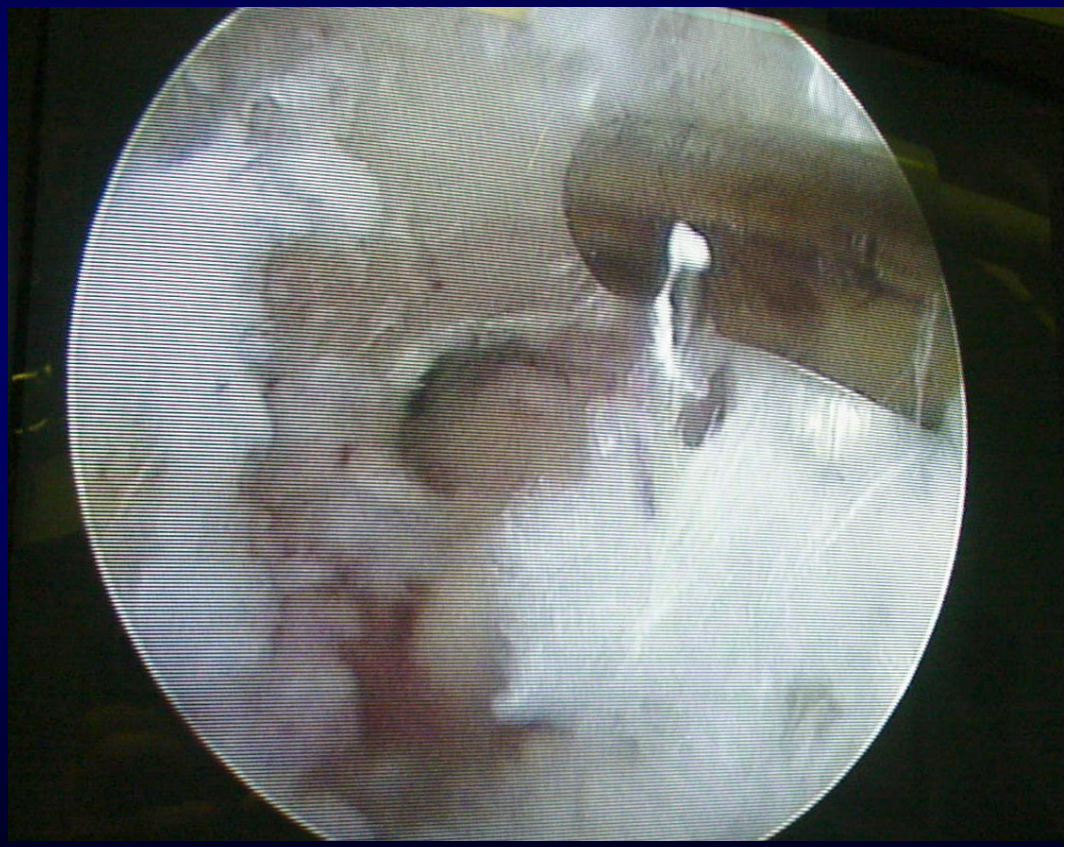
TECNICHE CLASSICHE:
b. DOPPIO TUNNEL

COMPLETAMENTE ARTROSCOPICA

IMPATTATORI

TECNICHE CLASSICHE:
b. DOPPIO TUNNEL

NON UTILIZZO DELLA
FRESA PER IL FEMORE



TECNICHE CLASSICHE: b. DOPPIO TUNNEL

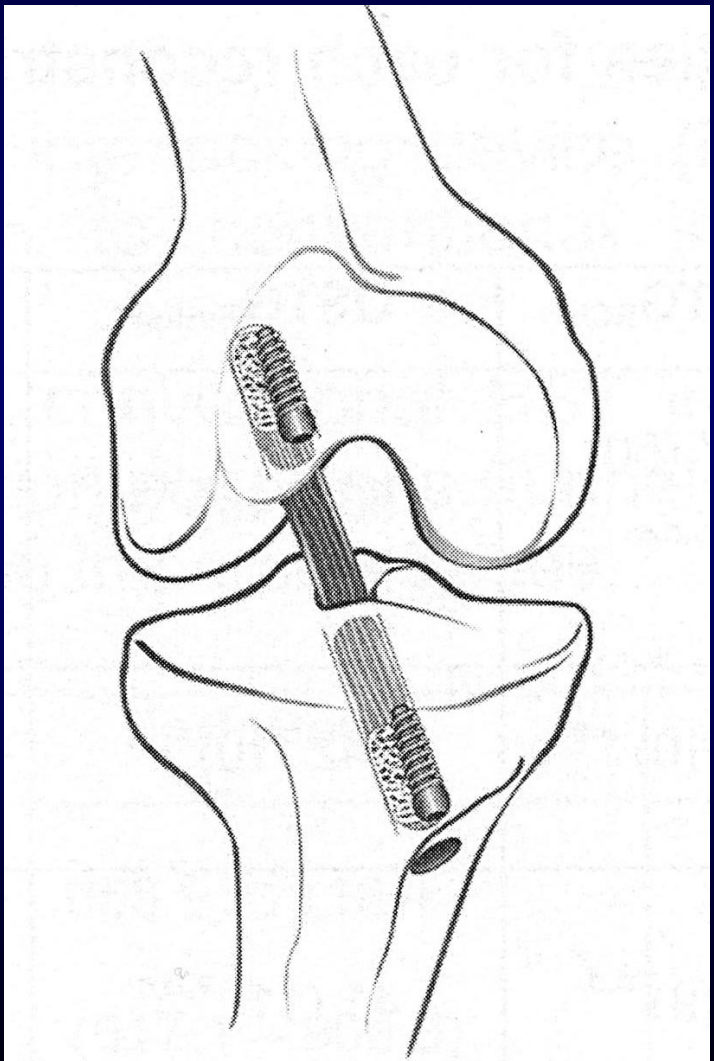
TUNNEL FEMORALE ESEGUITO DAL PORTALE

ANTERO-MEDIALE

TECNICHE CLASSICHE: b. DOPPIO TUNNEL

PERFETTO
ALLINEAMENTO CON

VITE INTERFERENZIALE



TECNICA DUE TUNNEL

SCELTA TRAPIANTO

SCELTA FISSAZIONE

TECNICA DUE TUNNEL

SCELTA FISSAZIONE

FEMORE

1. VITI INTERFERENZIALI

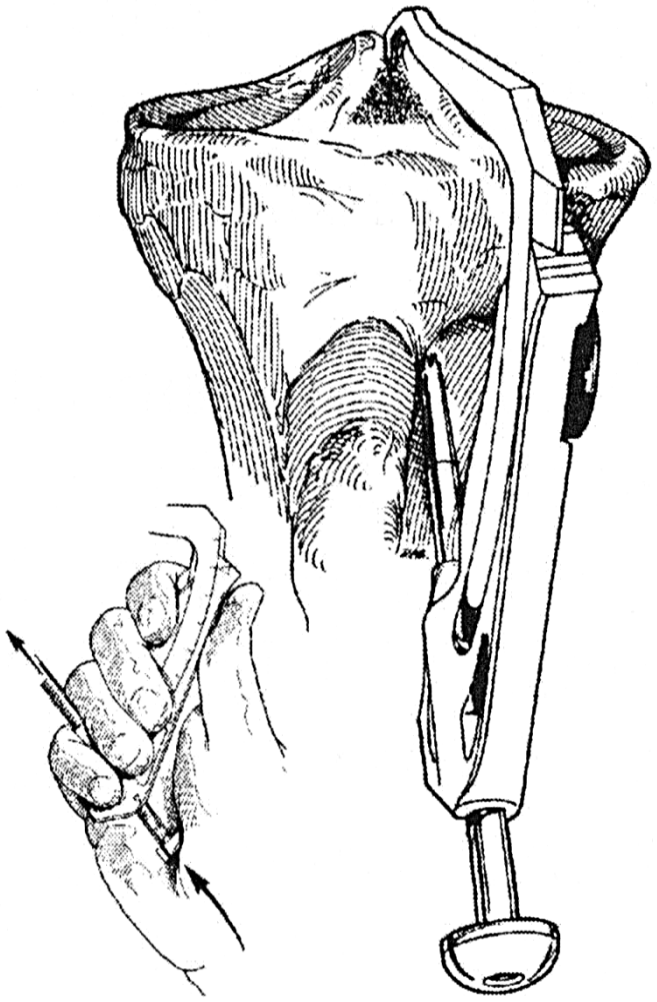
TECNICA DUE TUNNEL

SCELTA FISSAZIONE

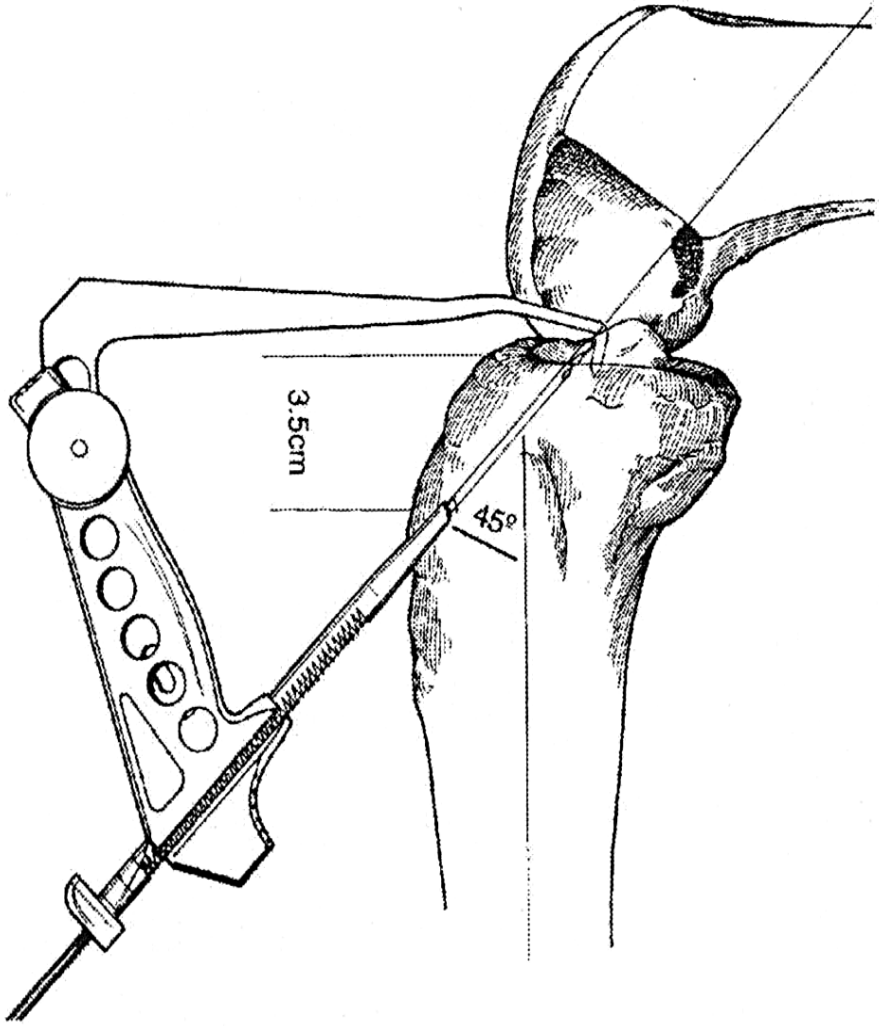
TIBIA

1. VITI INTERFERENZIALI
2. SISTEMI TRANSCONDILICI (Rigid-fix)
3. VITI MONO o BICORTICALI (Washer-loc)
4. VITI a ESPANSIONE (Intrafix)

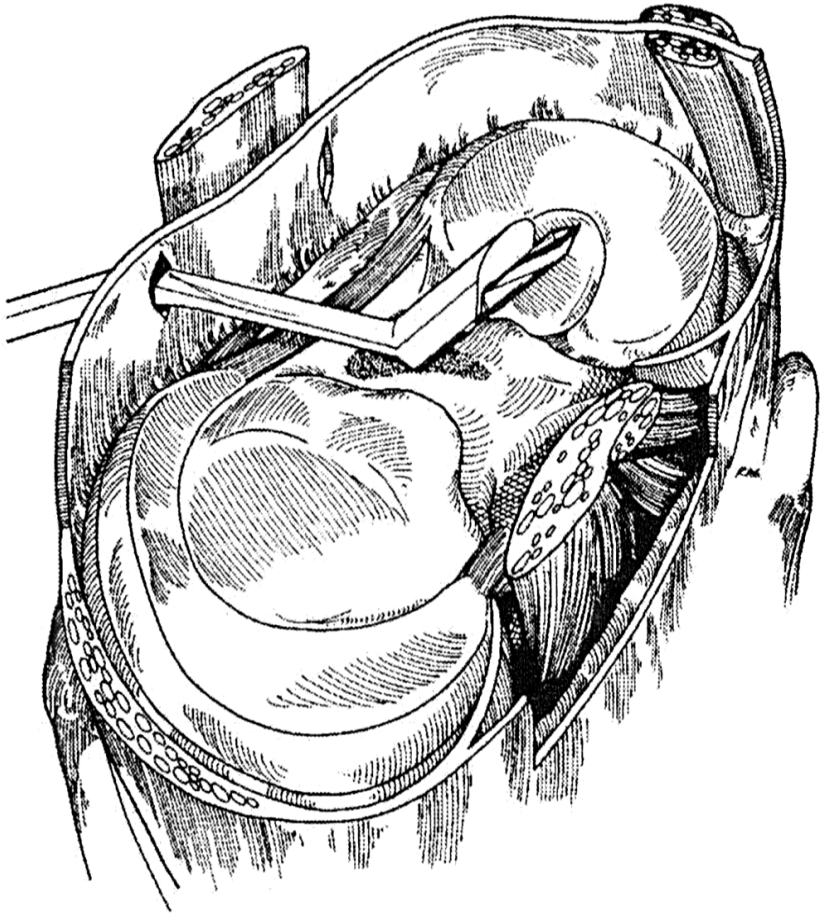
TECNICHE CLASSICHE:
c. TRANSTIBIALE

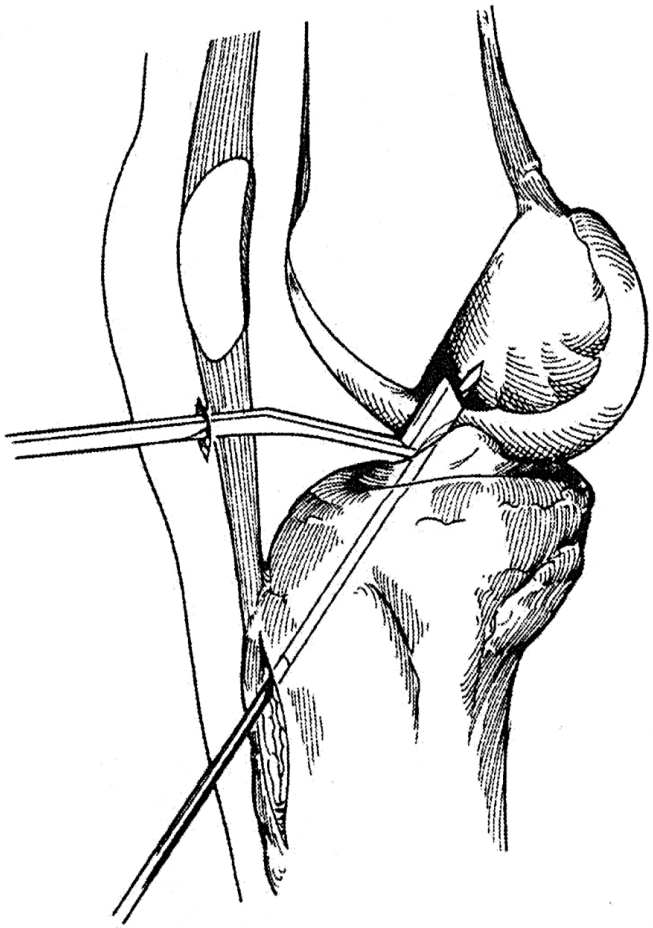


TECNICHE CLASSICHE:
c. TRANSTIBIALE

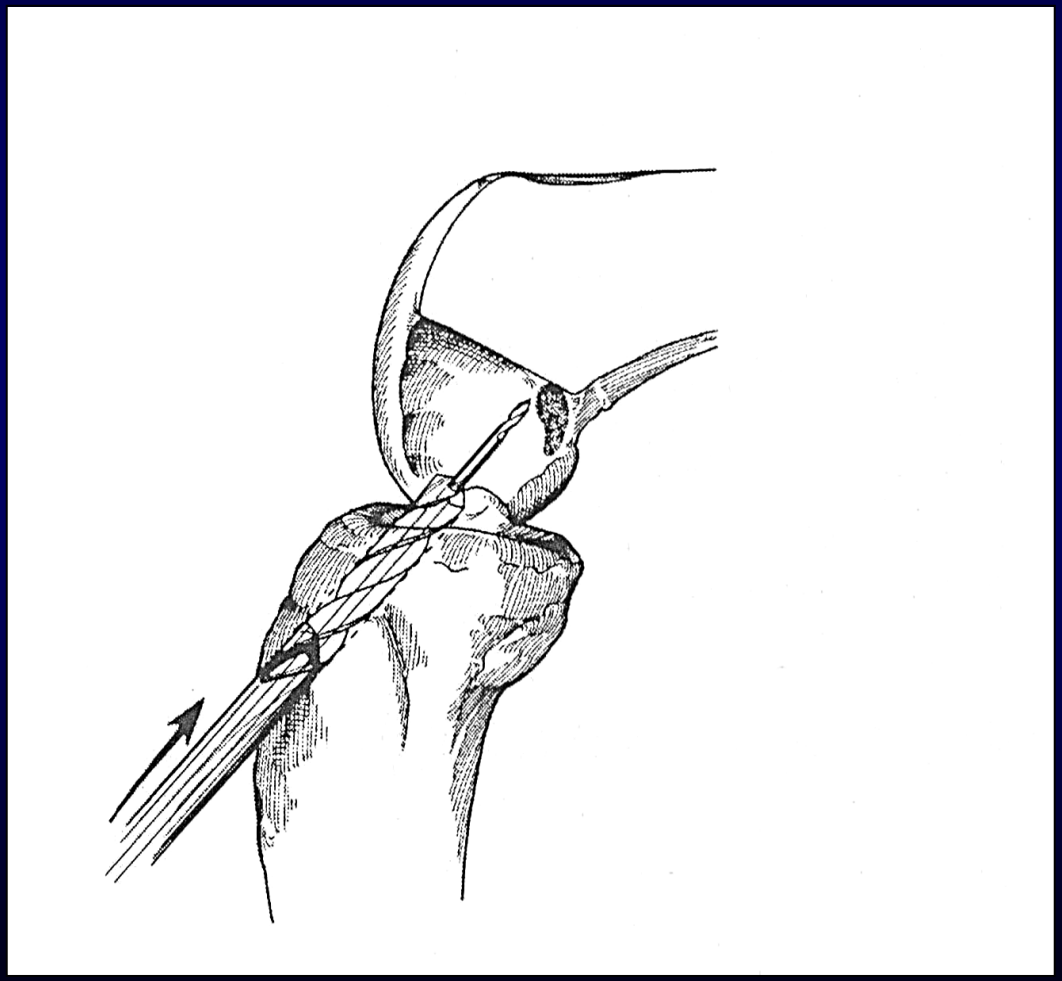


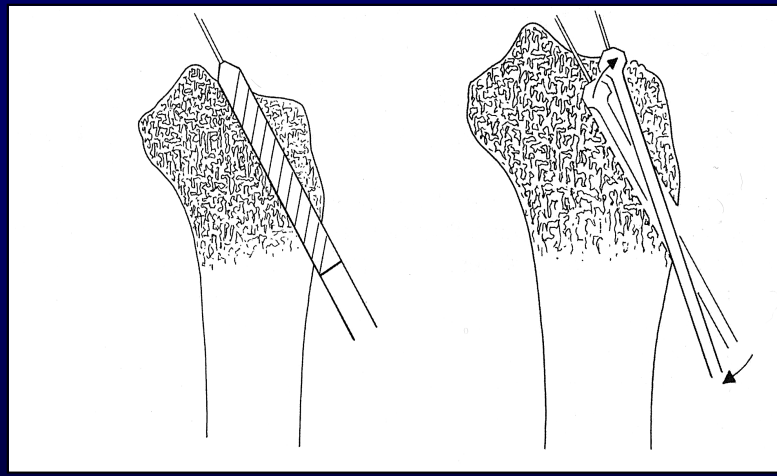
TECNICHE CLASSICHE:
c. TRANSTIBIALE



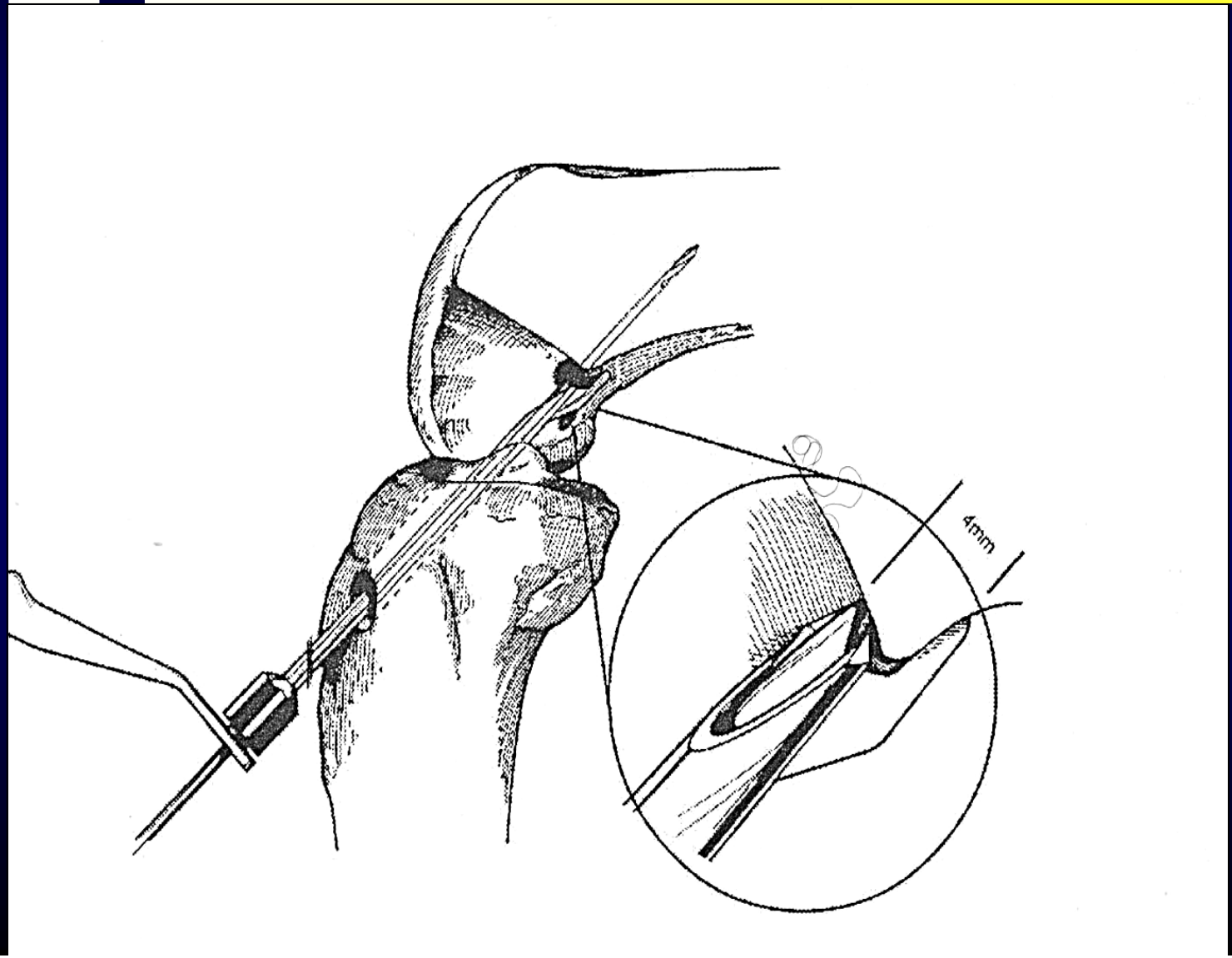


TECNICHE CLASSICHE:
c. TRANSTIBIALE

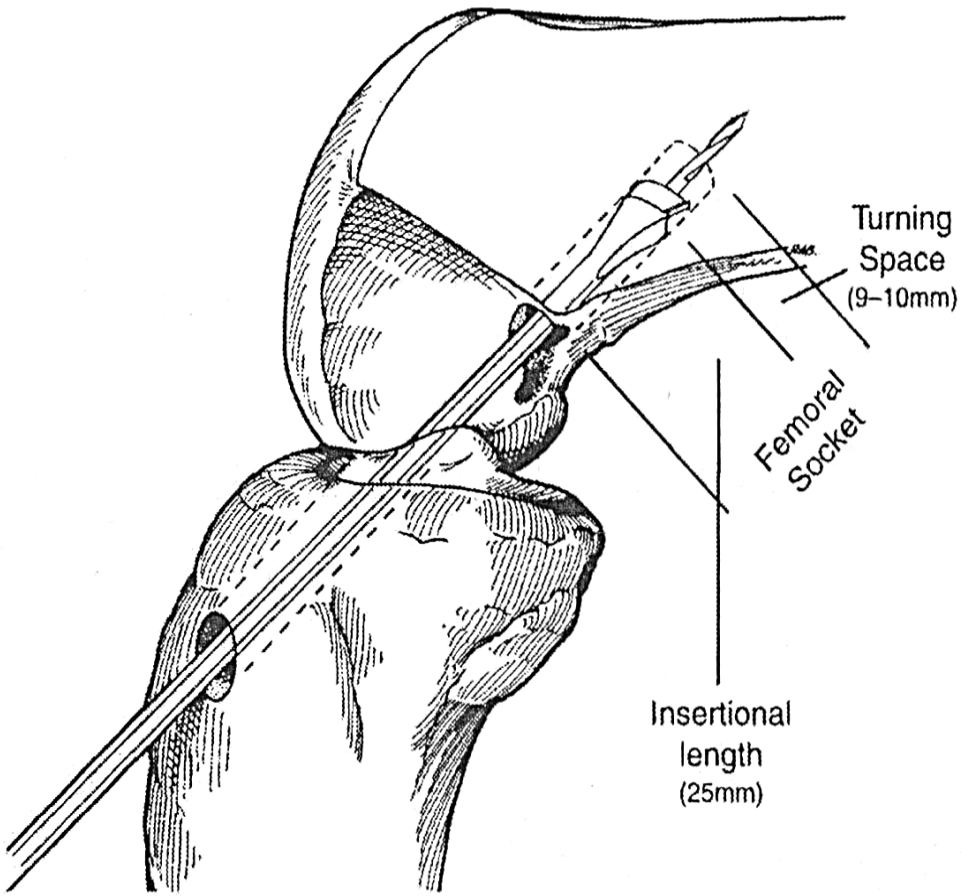




TECNICHE CLASSICHE:
c. TRANSTIBIALE



TECNICHE CLASSICHE: c. TRANSTIBIALE



TECNICHE CLASSICHE:
c. TRANSTIBIALE

SCELTA TRAPIANTO

SCELTA
FISSAZIONE

TECNICHE CLASSICHE: c. TRANSTIBIALE

SCELTA FISSAZIONE

FEMORE

1. **VITI INTERFERENZIALI**
2. **SISTEMI a SOSPENSIONE**

   (Endobutton, Cross-bridge)
3. **SISTEMI TRANSCONDILICI**

   (Cross-pin,Rigid-fix,Trans-fix, Bone-mulch)

TECNICHE CLASSICHE: c. TRANSTIBIALE

SCELTA FISSAZIONE

TIBIA

1. VITI INTERFERENZIALI
2. SISTEMI TRANSCONDILICI (Rigid-fix)
3. VITI MONO o BICORTICALI (Washer-loc)
4. VITI a ESPANSIONE (Intrafix)

TECNICHE CLASSICHE: c. TRANSTIBIALE

VANTAGGI

1. VELOCITA' ESECUZIONE
2. FACILE USO "FORCHETTA"
3. PASSAGGIO GRAFT

SVANTAGGI

1. POSIZIONE FEMORALE OBBLIGATA
2. DIREZIONE VITE INTERFERENZA FEMORALE

TECNICHE CLASSICHE

TECNICA ENDOSCOPICA

VS

TECNICA A DUE INCISIONI

↓

NESSUNA DIFFERENZA NEI RISULTATI

HARNER et al: Arthroscopy 10:502, 1994
ARCIERO et al. Arthroscopy 12:462, 1996
SGAGLIONE e SCHWARTZ, Arthroscopy 13:156, 1997

TECNICA DUE TUNNEL

VANTAGGI

1. CORREGGERE ERRORI
2. USO VITI INTERFERENZA
3. USO IMPATTATORI
4. PASSAGGIO CIELO APERTO

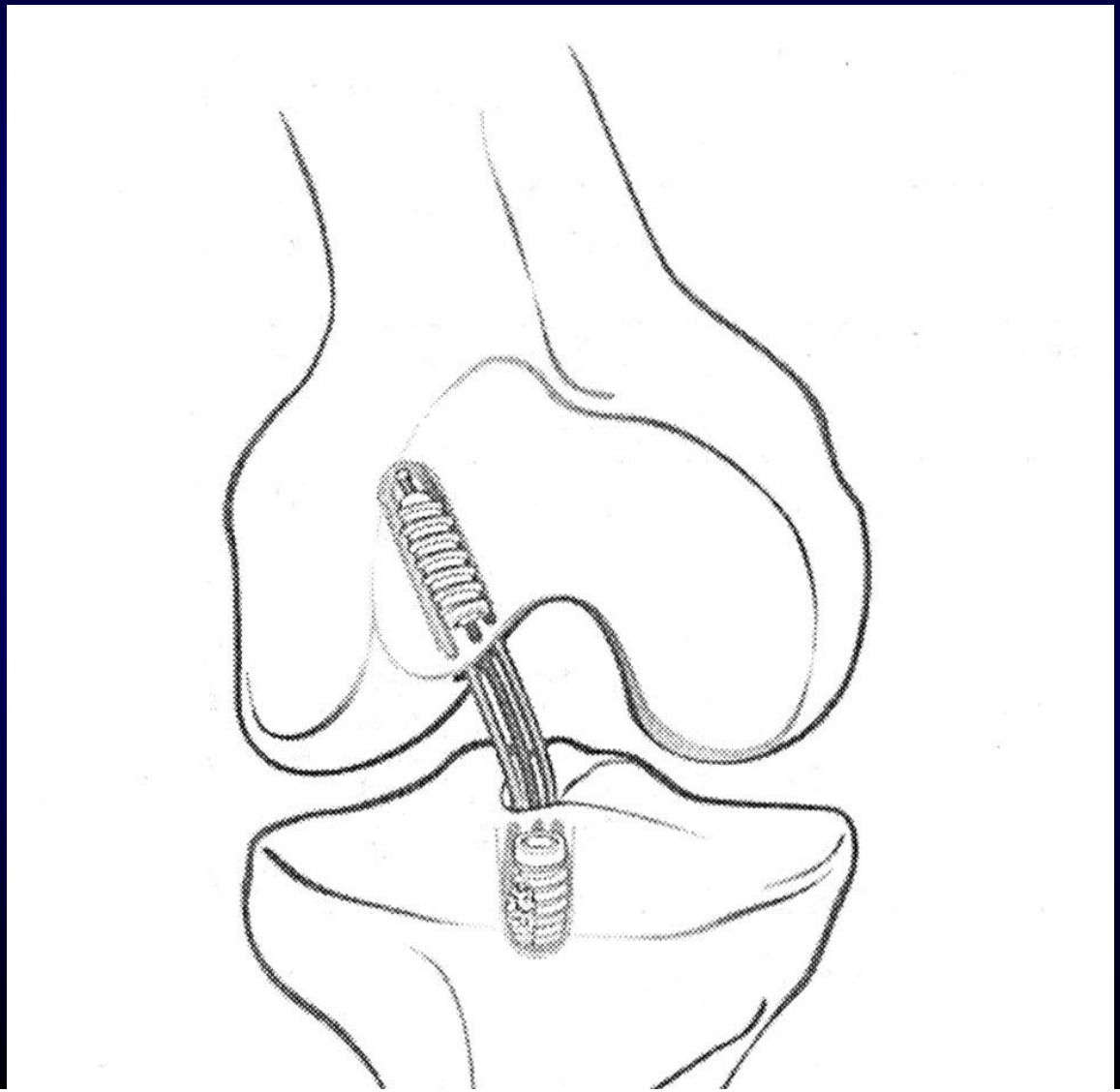
SVANTAGGI

1. TECNICA LENTA
2. TUNNEL FEMORALE SOGGETTIVO
3. LIMITAZ. SISTEMI FISSAZIONE FEMORALE
4. PASSAGGIO GRAFT
5. ROTTURA PARETE POSTERIORE

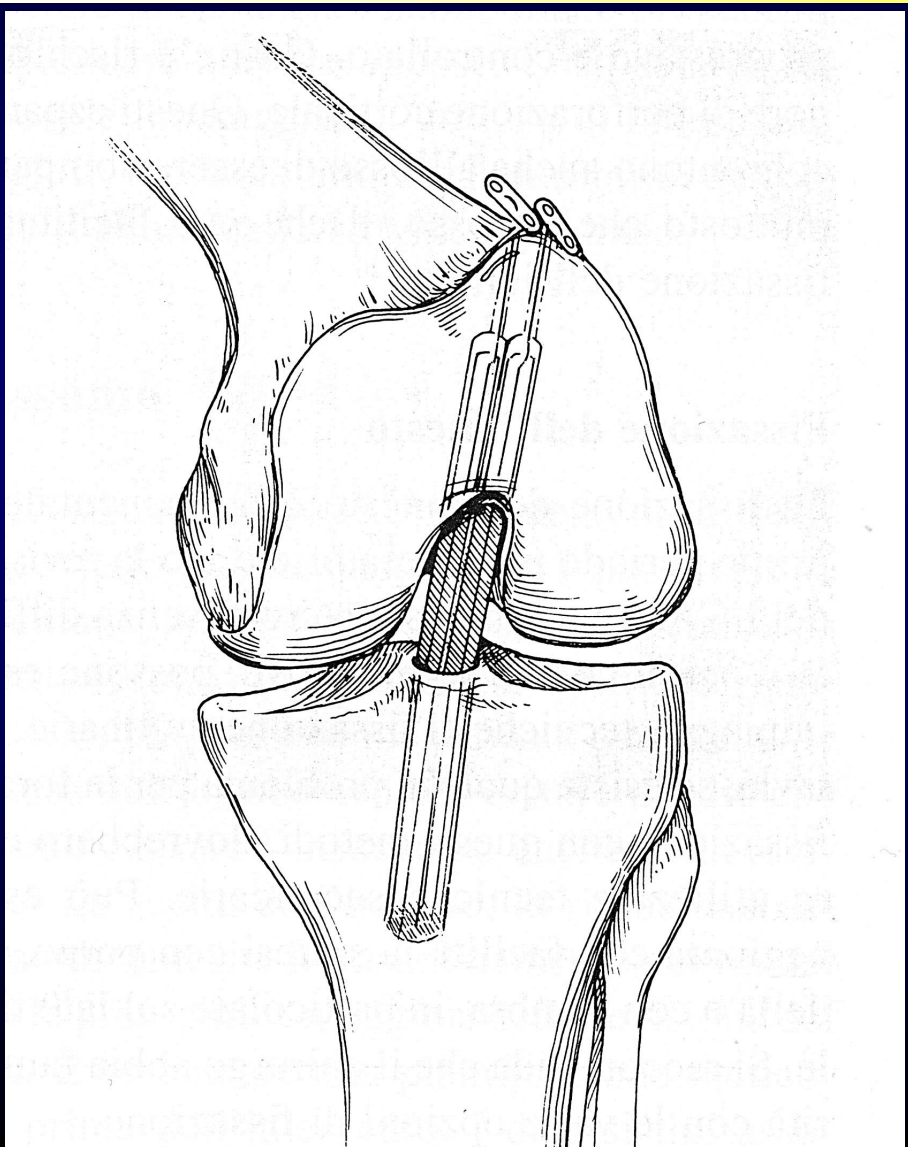
TECNICHE PARTICOLARI

1. ***ALL INSIDE***
2. **DOPPIO TUNNEL FEMORALE**
3. **DOPPIO FASCIO CON OVER THE TOP**
4. **DOPPIO TUNNEL TIBIALE**
5. **PER SOGGETTI CON SCHELETRO IMMATURO**

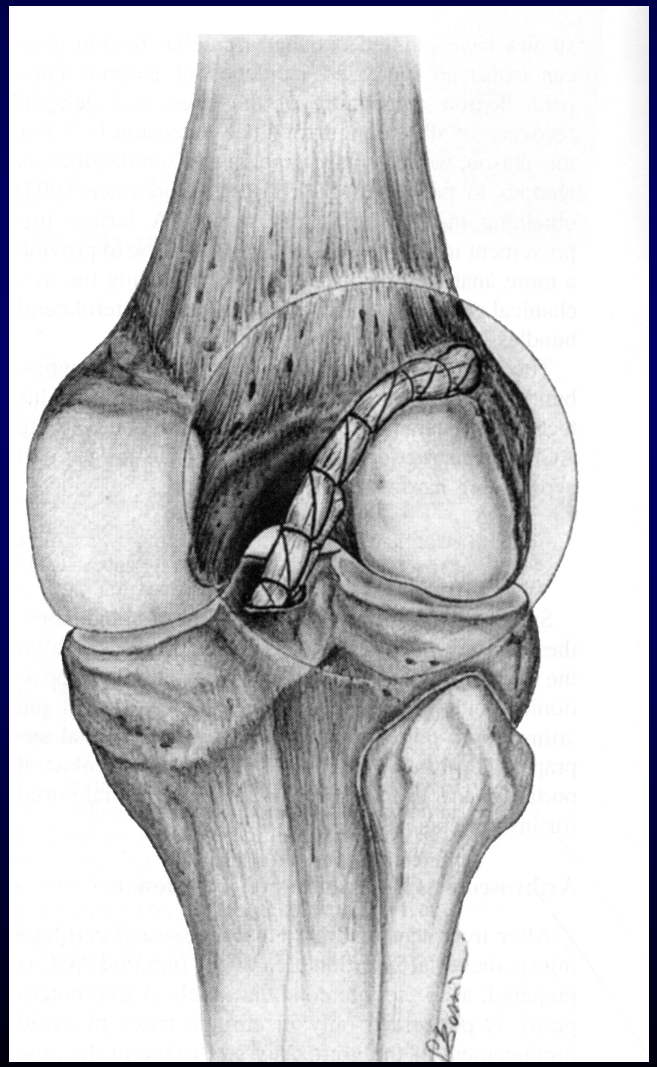
TECNICA ALL INSIDE

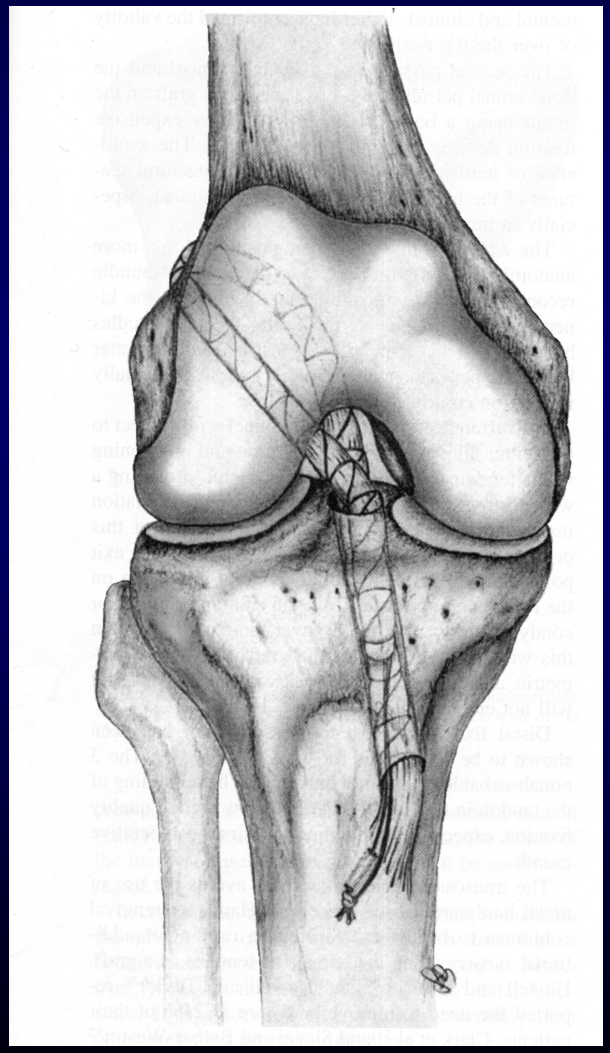


TECNICA DOPPIO TUNNEL FEMORALE

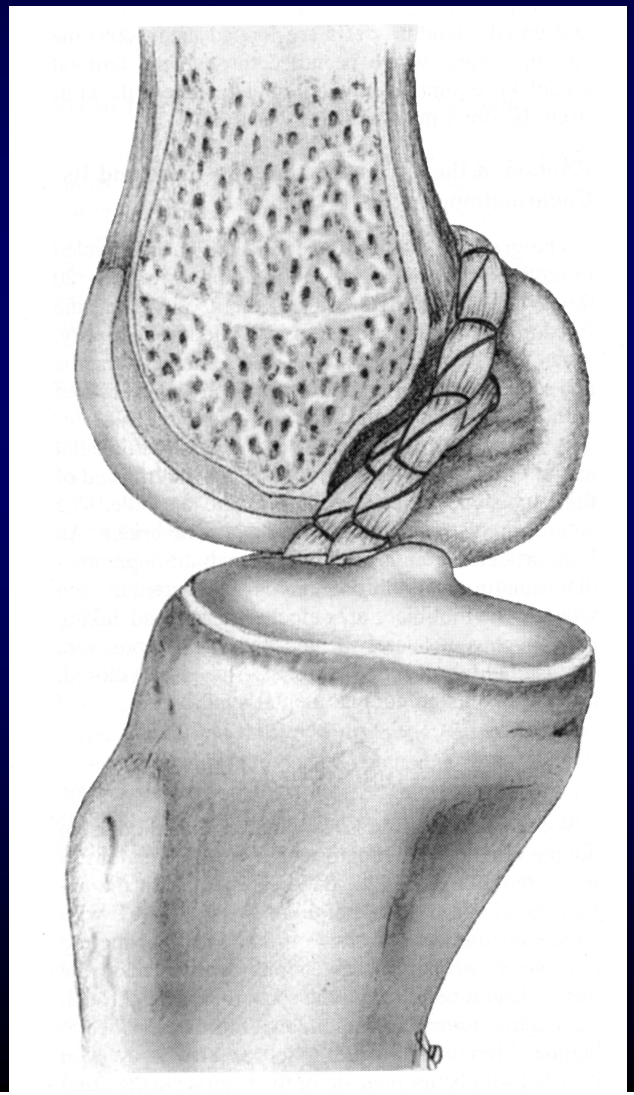


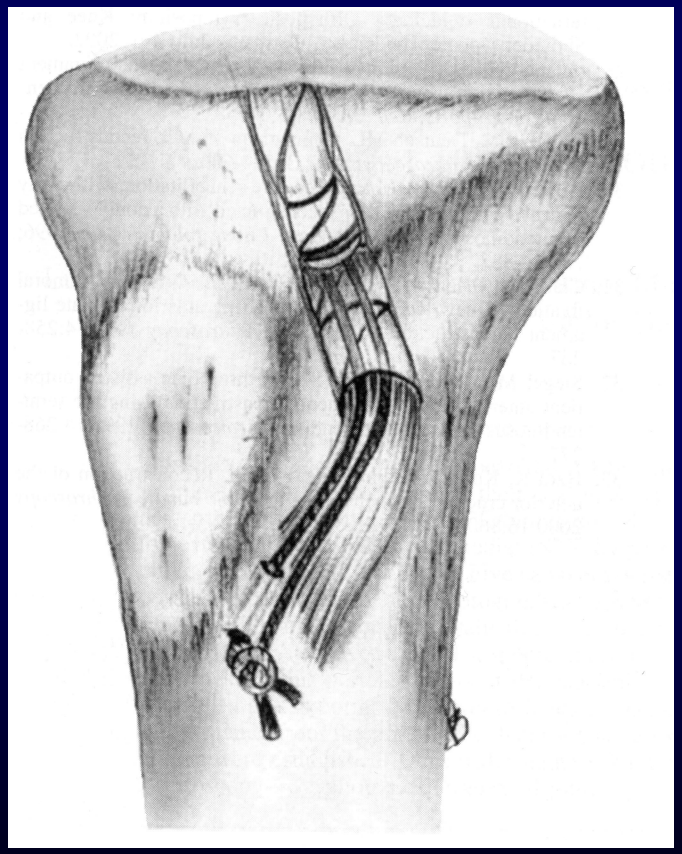
TECNICA DOPPIO FASCIO CON OVER THE TOP



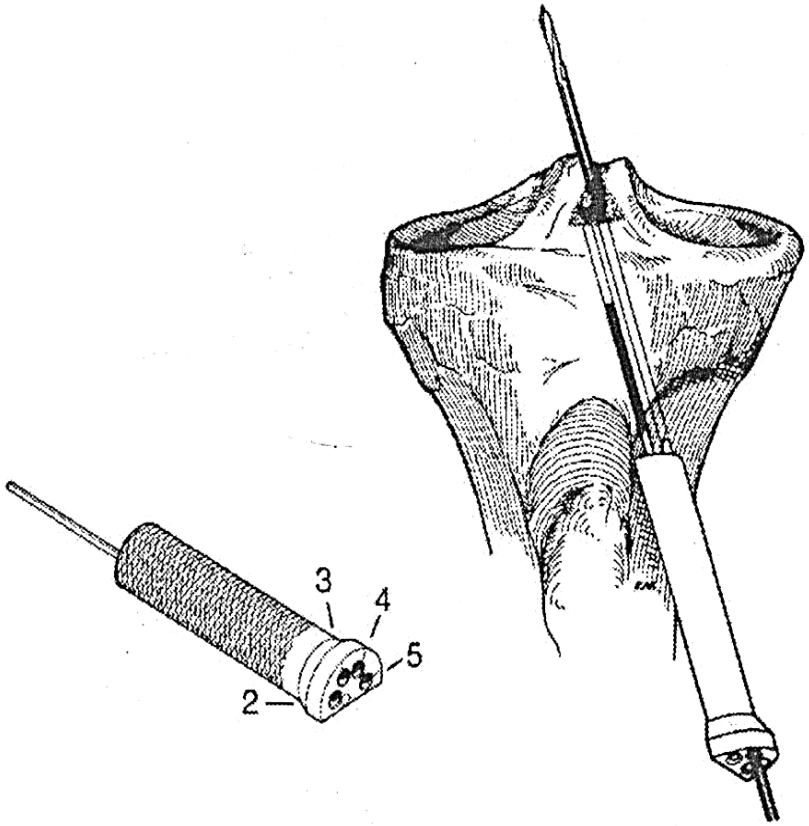


TECNICA DOPPIO FASCIO CON OVER THE TOP

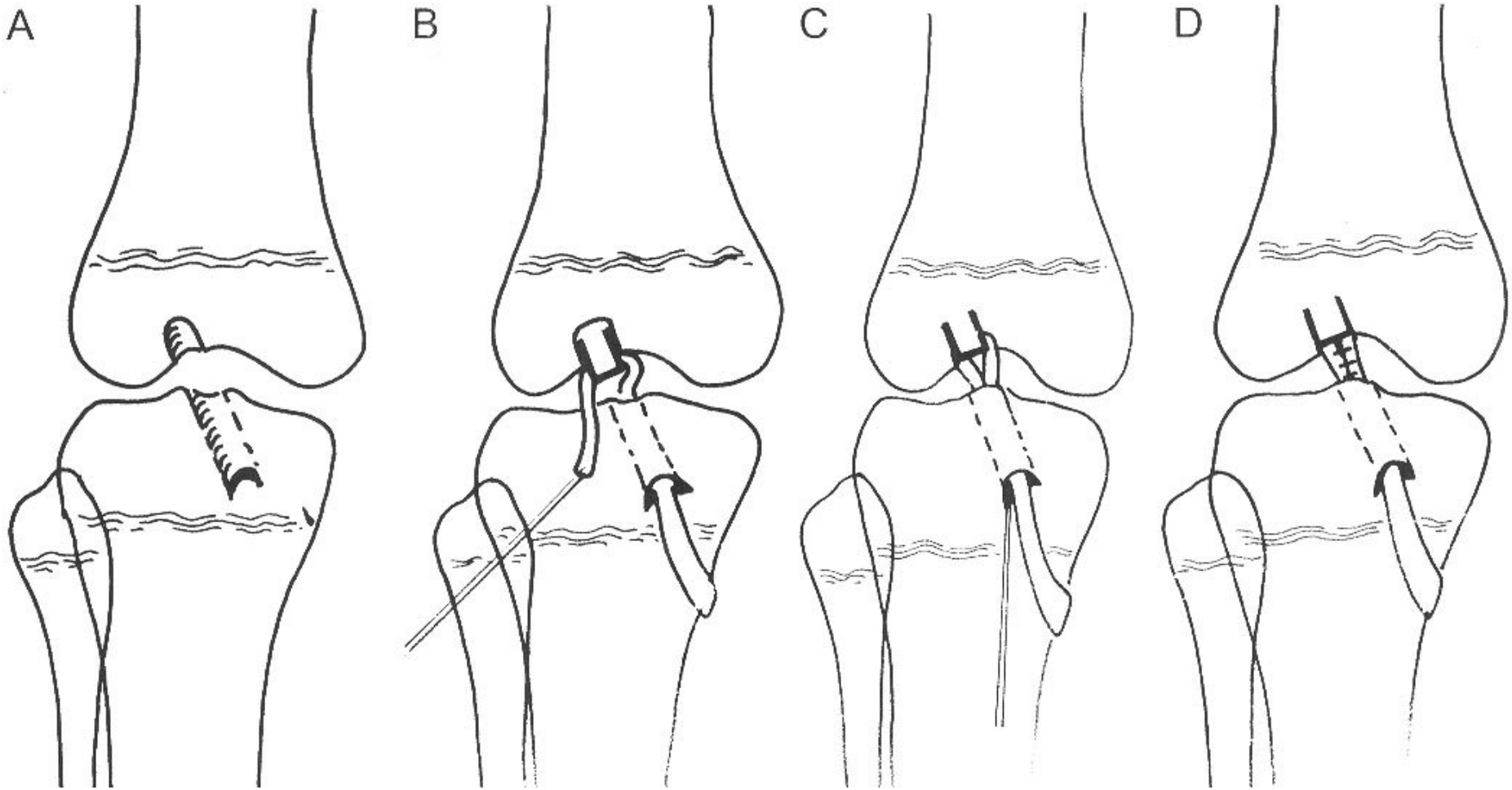




TECNICA DOPPIO TUNNEL TIBIALE



TECNICA PER SOGGETTI CON SCHELETRO IMMATURO

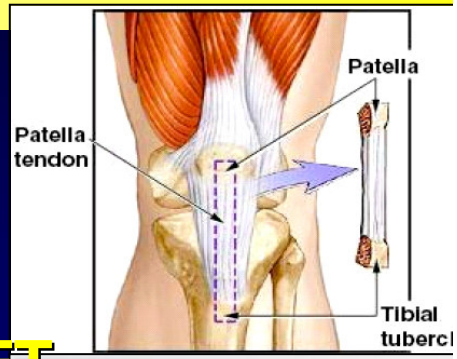


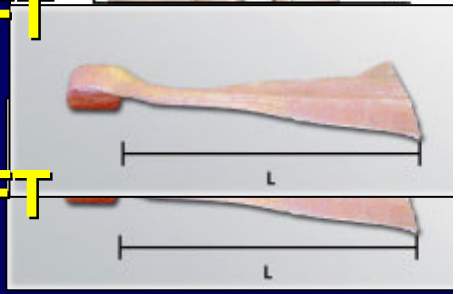
NOSTRE SCELTE

TRAPIANTO

SPORTIVO AGONISTA → ROTULEO

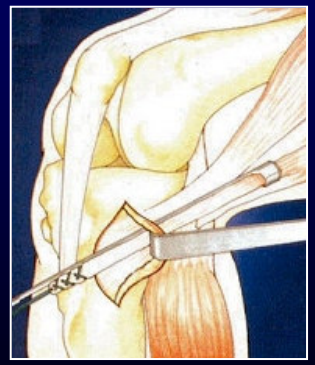
SPORTIVO AGONISTA → ALLOGRAFT





REINTERVENTI → ALLOGRAFT

NEGLI ALTRI CASI → St+G

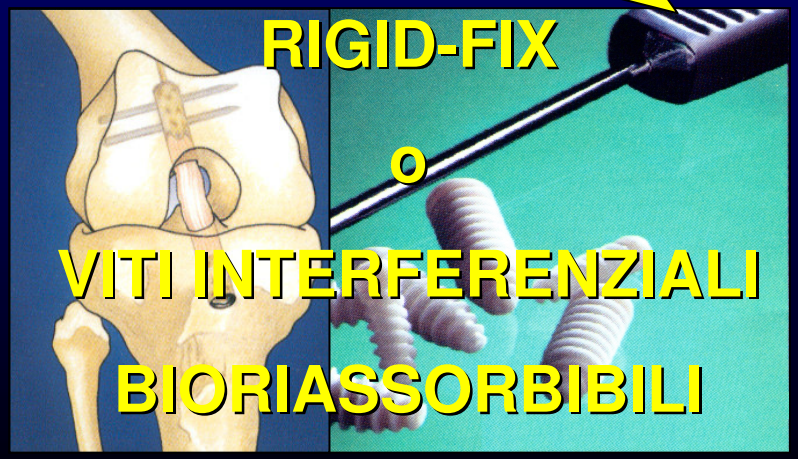


NOSTRE SCELTE

ROTULEO

FISSAZIONE
(A 20° DI FLESSIONE – MAX TENSIONE)

FEMORE



TIBIA

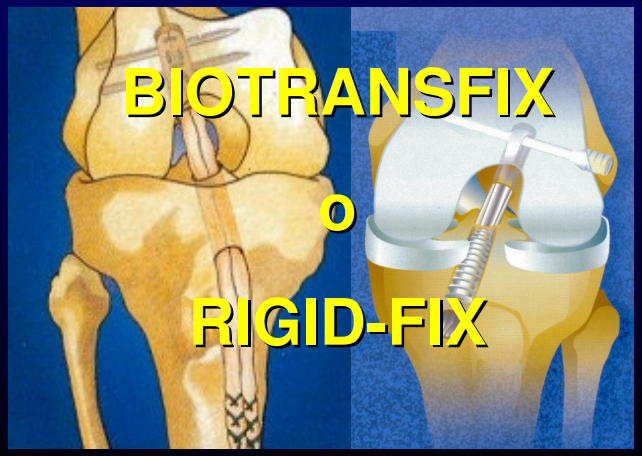
NOSTRE SCELTE

St+G

FISSAZIONE
(A 20° DI FLESSIONE – MAX TENSIONE)

FEMORE

TIBIA



NOSTRE SCELTE

TECNICA

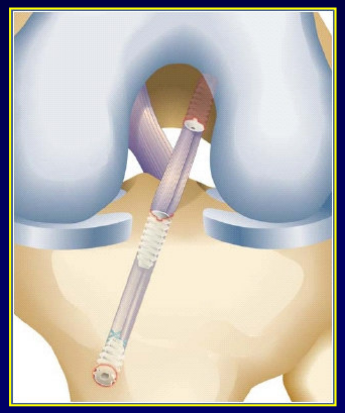
- TRANSTIBIALE

- A DUE TUNNEL

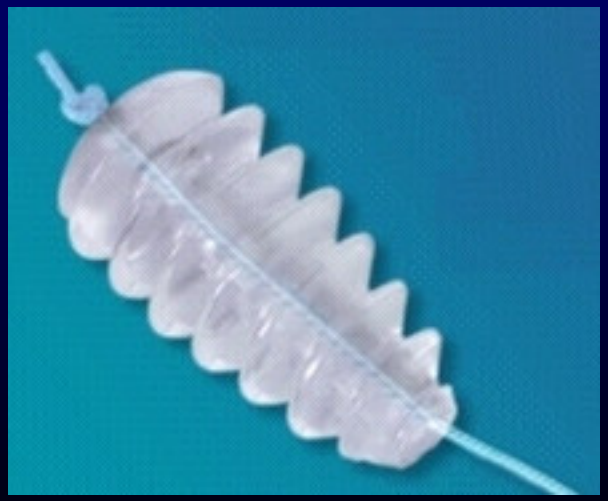
SOLO IN RARI CASI SELEZIONATI CON TENDINE ROTULEO E VITI INTERFERENZIALI

NOSTRE SCELTE

EVOLUZIONE



VITE TIBIALE BIORIASSORBIBILE PER VIA RETROGRADA

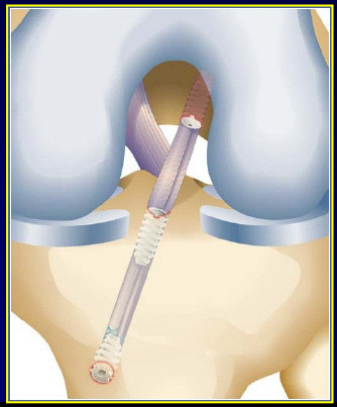


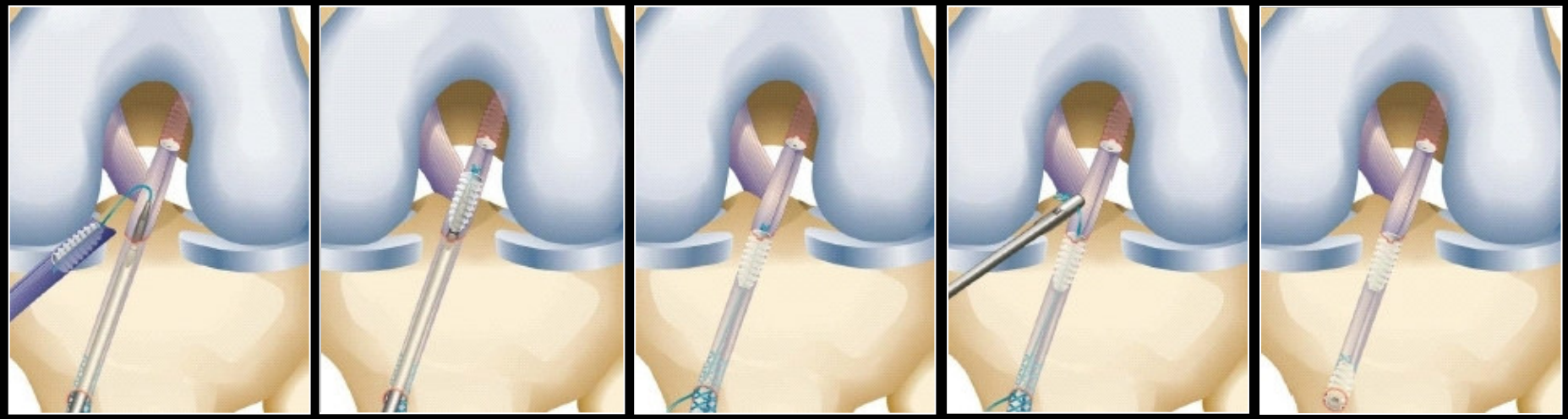
NOSTRE SCELTE

EVOLUZIONE

CENNI DI

TECNICA OPERATORIA





CONCLUSIONI

LA CHIRURGIA
(SCELTA DELLA TECNICA)
DEVE ADATTARSI AL PAZIENTE:
QUAL'E'
IL PAZIENTE TIPO?
RICREAZIONALE / AMATORIALE

CONCLUSIONI

>120-130 LCA / ANNO

>10 AA ESPERIENZA

↓

SCELTA

C.D. HARNER 2000

CONCLUSIONI

< 50 LCA / ANNO

↓

NO SCELTA

C.D. HARNER 2000