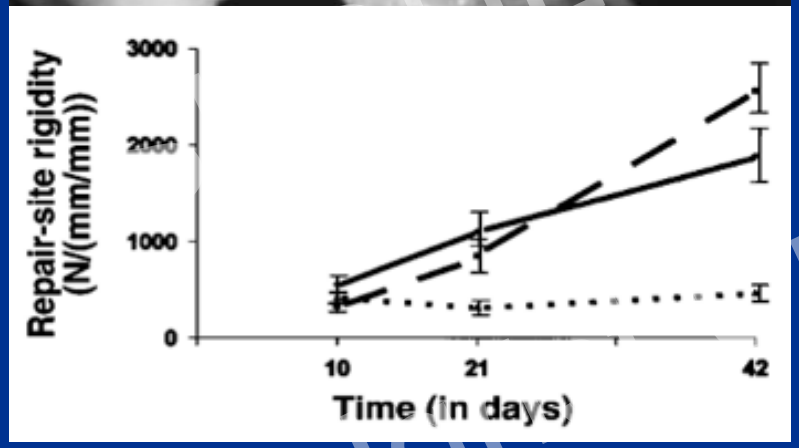
ROTATOR CUFF REPAIR

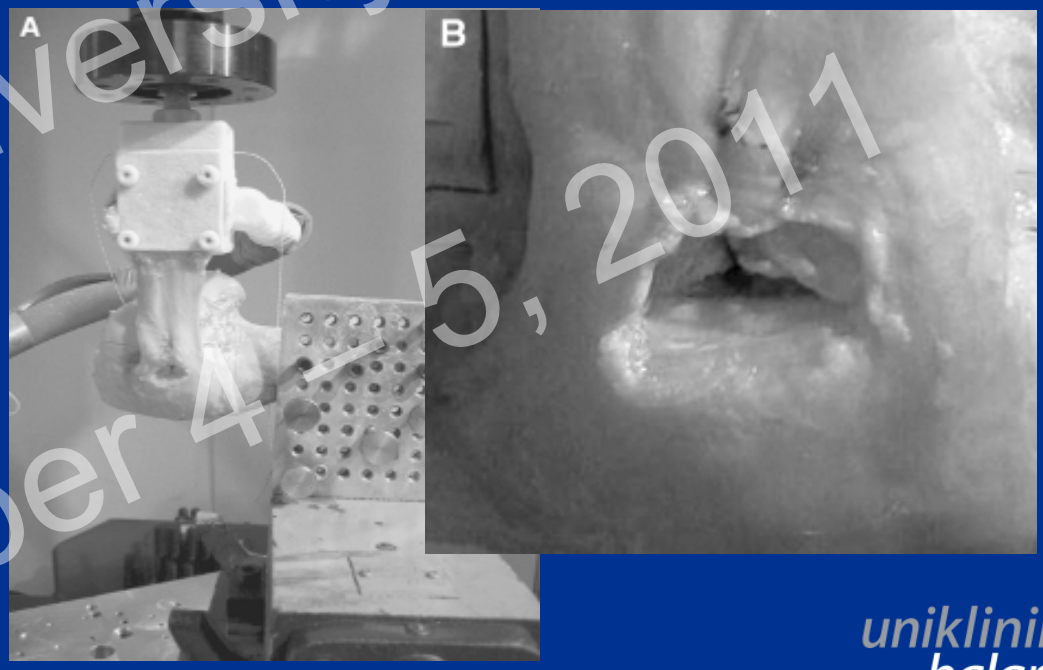
Clinical outcome
significantly better
without rerupture

Gerber et al,
JBJS 82-A, 505, 2000

HEALING



- If the gap at the time of repair is >3mm in dog flexor tendons, then the repair will fail to gain strength with healing.
- In experimental RC-repair, 5mm gap may be considered critical

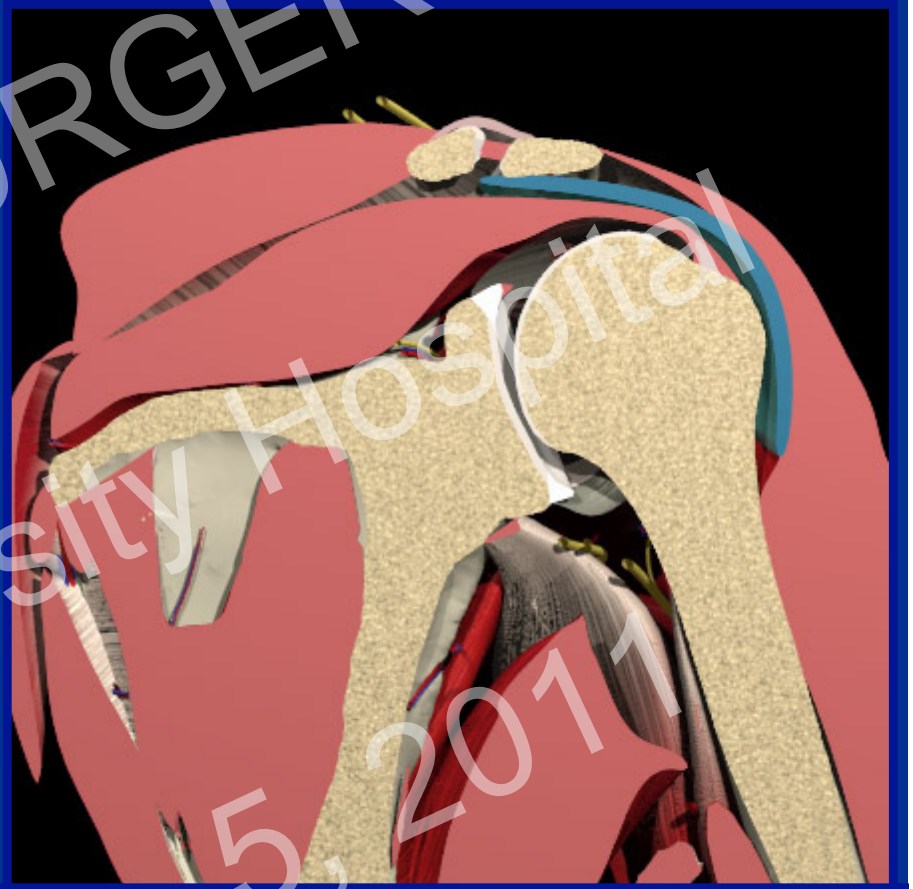


Gelberman R, JBJS Am 81; 975, 1999

Koganti A, AJSM, 2006

ELEMENTS LOAD CHAIN OF RC-REPAIR

1. Muscle
2. Tendon
3. Suture and stitch
4. Bone (humerus)

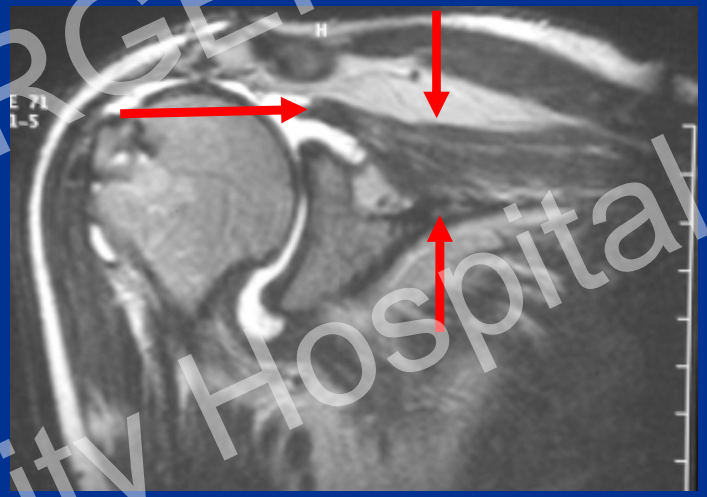


Any repair is only as strong as the weakest link in the load chain

MUSCLE

Radiological sequelae of tendon tear:

- Myotendinous retraction
- Atrophy
- Fatty “degeneration”



MUSCLE

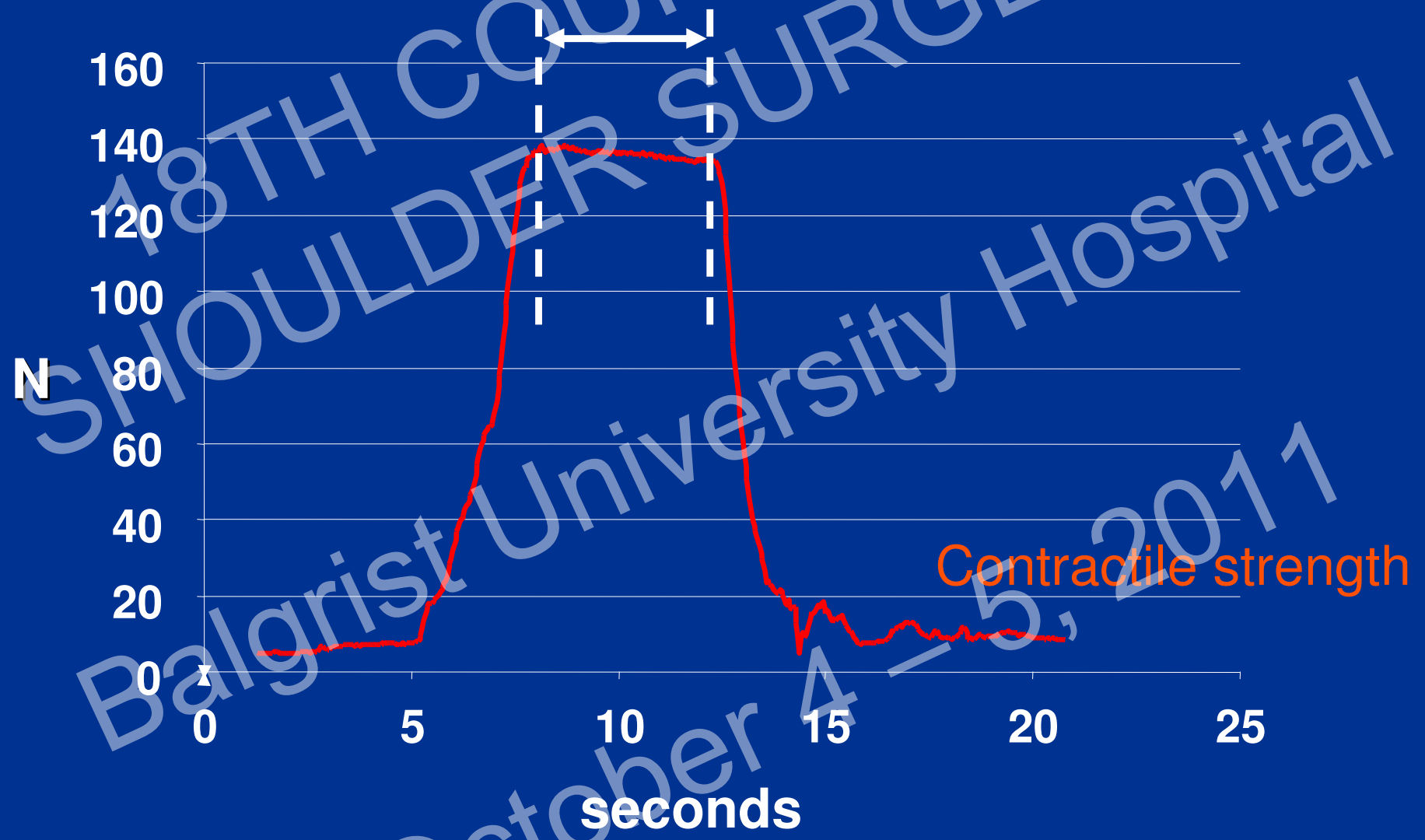
Tension measurement device*

Stimulation

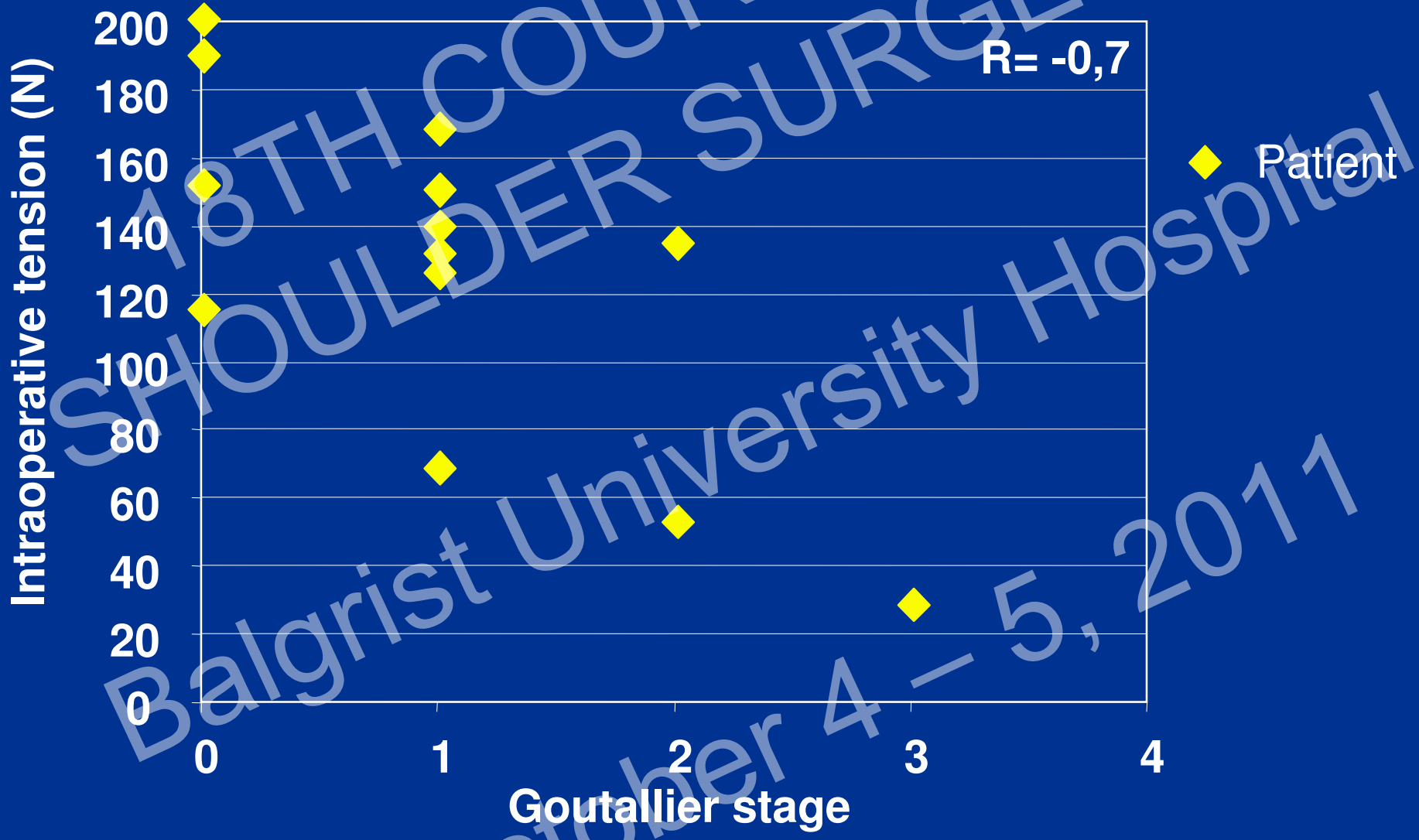
suprascapular nerve

*Hersche O, JSES 1998;7 393-6

MUSCLE



INTRAOPERATIVE TENSION VERSUS GOUTALLIER STAGES



Gerber C, Meyer DC, 2008. JSES

EXTRAPOLATION

		Goutallier	
	area RC*	0	2
m. supraspinatus	16%	166 N	97 N
m. infraspinatus	38%	*395 N*	*231 N*
m. subscapularis	46%	*477 N*	*280 N*

Gerber C, Meyer DC, 2008. JSES

*Bassett, J Biomech; 1990: 415

BEST TENDON STITCH IN-VITRO

Gerber C, JBJS; 1994, 76B,371-80

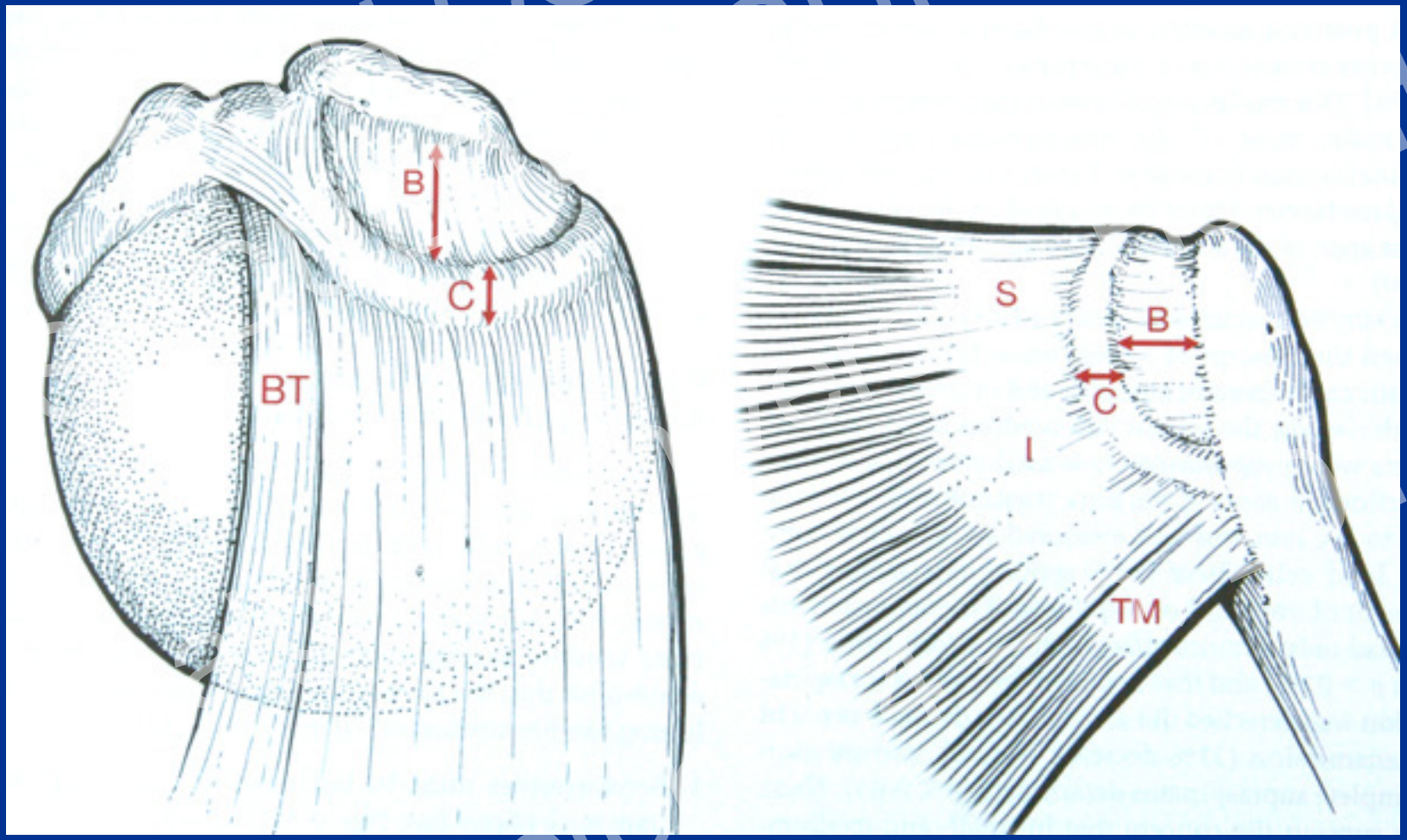
BEST TENDON STITCH IN-VITRO

Modified Mason-Allen stitch:

- **requires little tendon substance**
- **best resistance to cyclic load**
- **least gap formation**

BEST POSITION OF THE TENDON STITCH

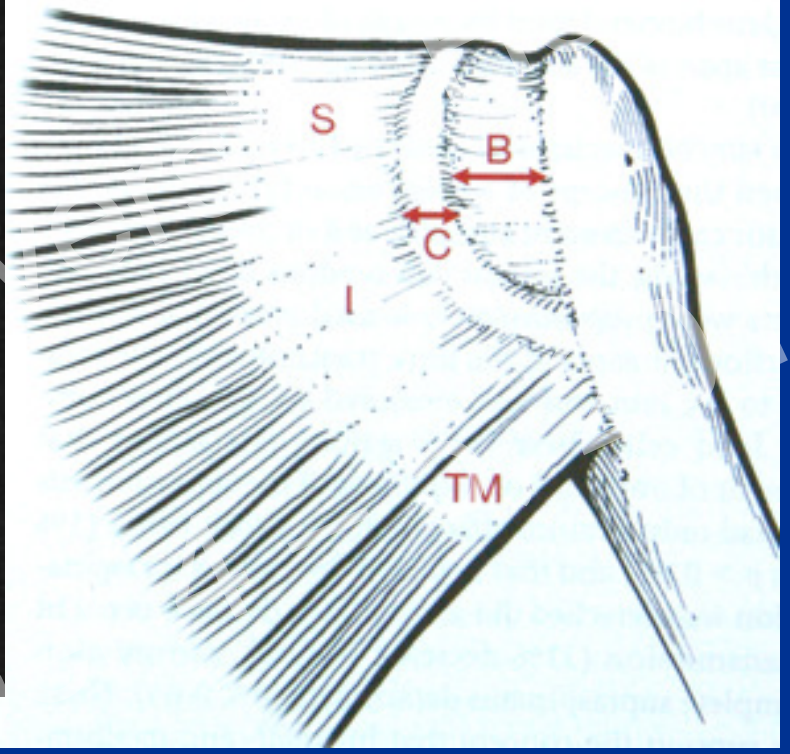
Human rotator cuff: Rotator cable



drawing from: Burkhart et al

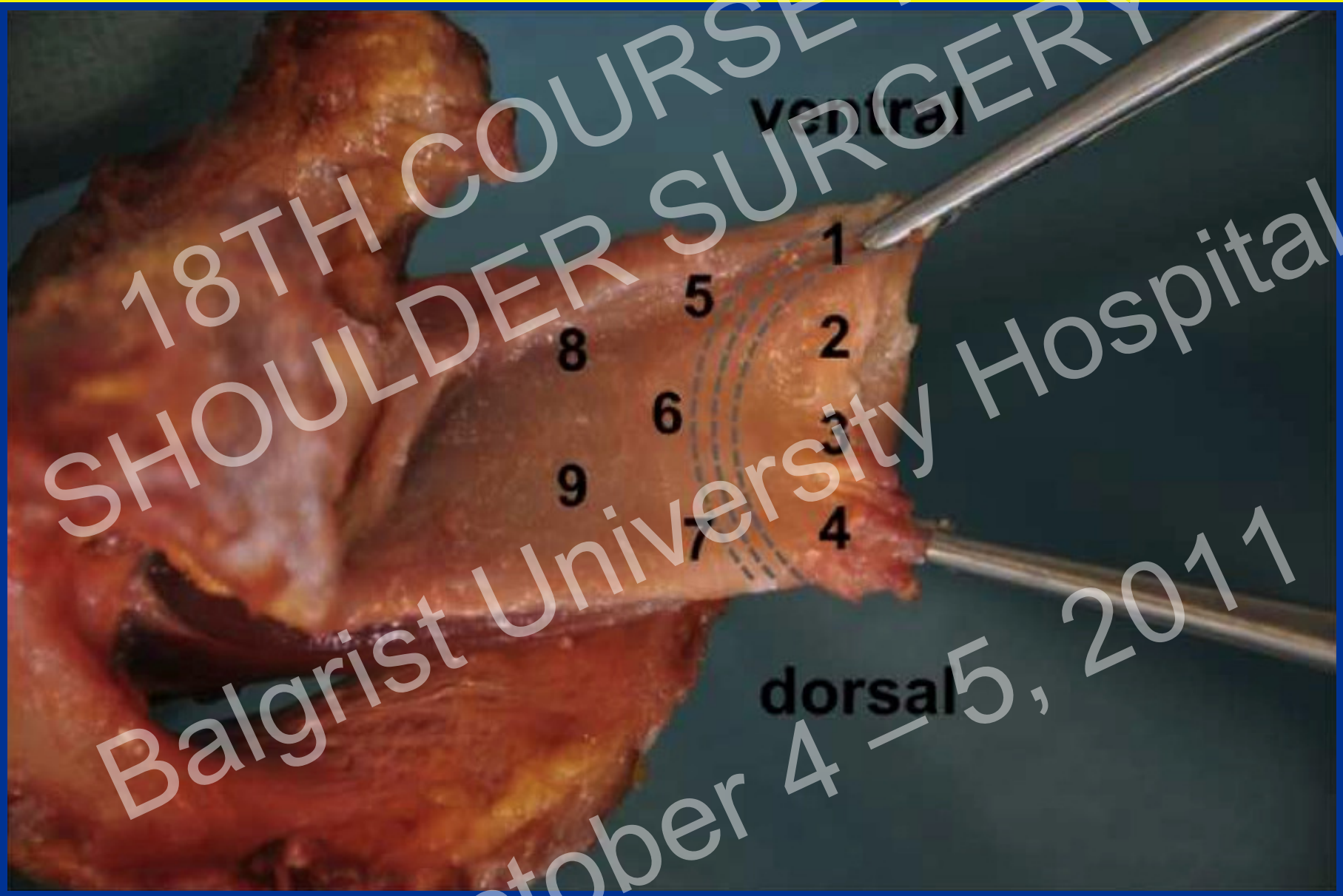
BEST POSITION OF THE TENDON STITCH

Human rotator cuff: Rotator cable



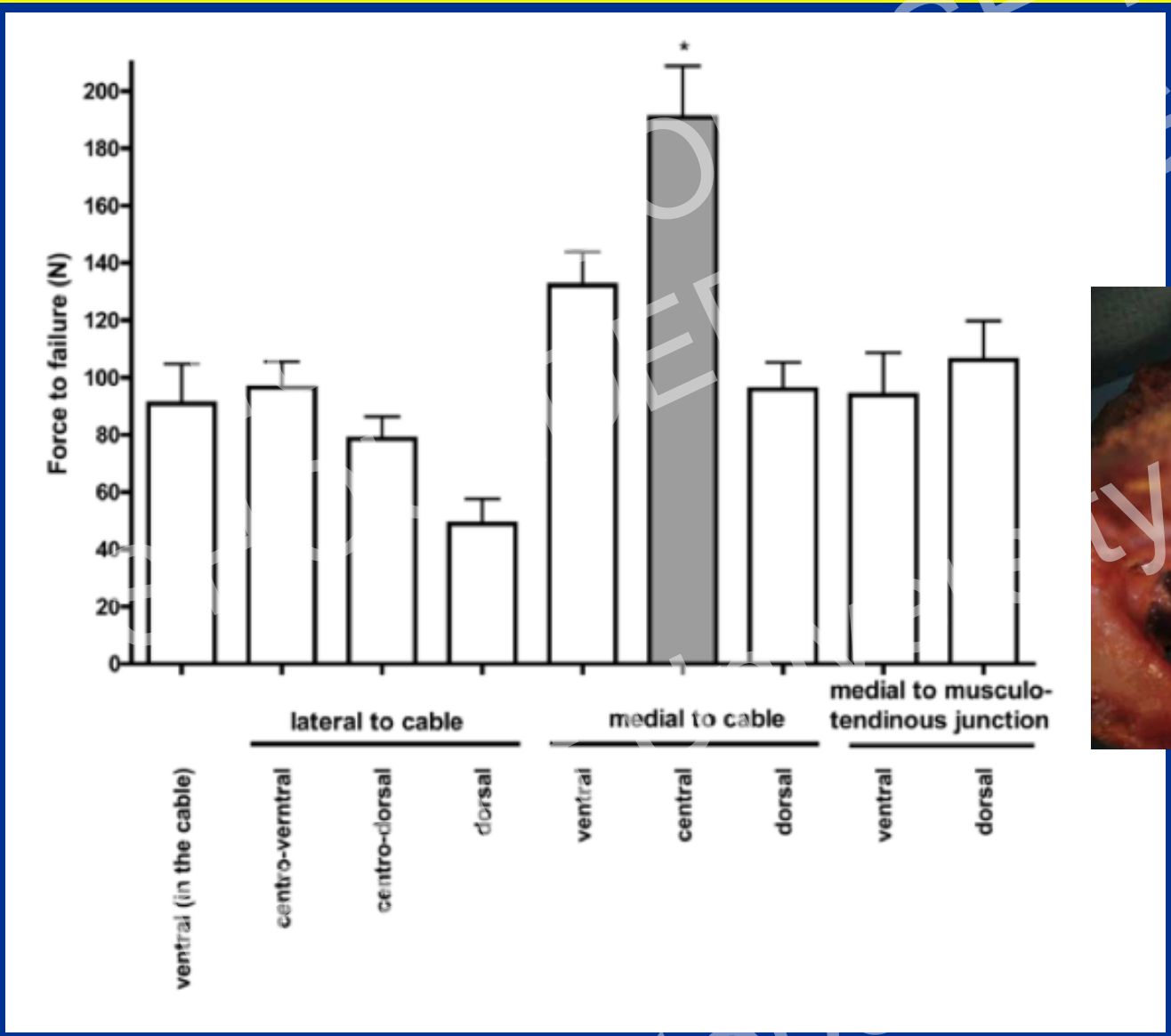
drawing from: Burkhart et al

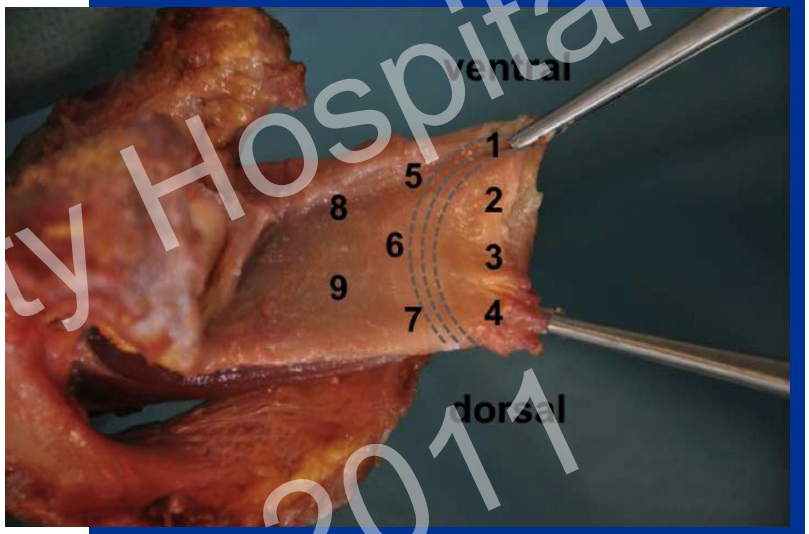
BEST POSITION OF THE TENDON STITCH



Wieser K, in submission 2011

BEST POSITION OF THE TENDON STITCH





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MUSCLE VS. TENDON STITCH

	Goutallier	
	0	2
m. supraspinatus	166 N	97 N
m. infraspinatus	*395 N*	*231 N*
m. subscapularis	*477 N*	*280 N*

Open repair 2x Ethibond 3 : **329 N***

Arthroscopic repair 2x Ethibond 2: **228 N****

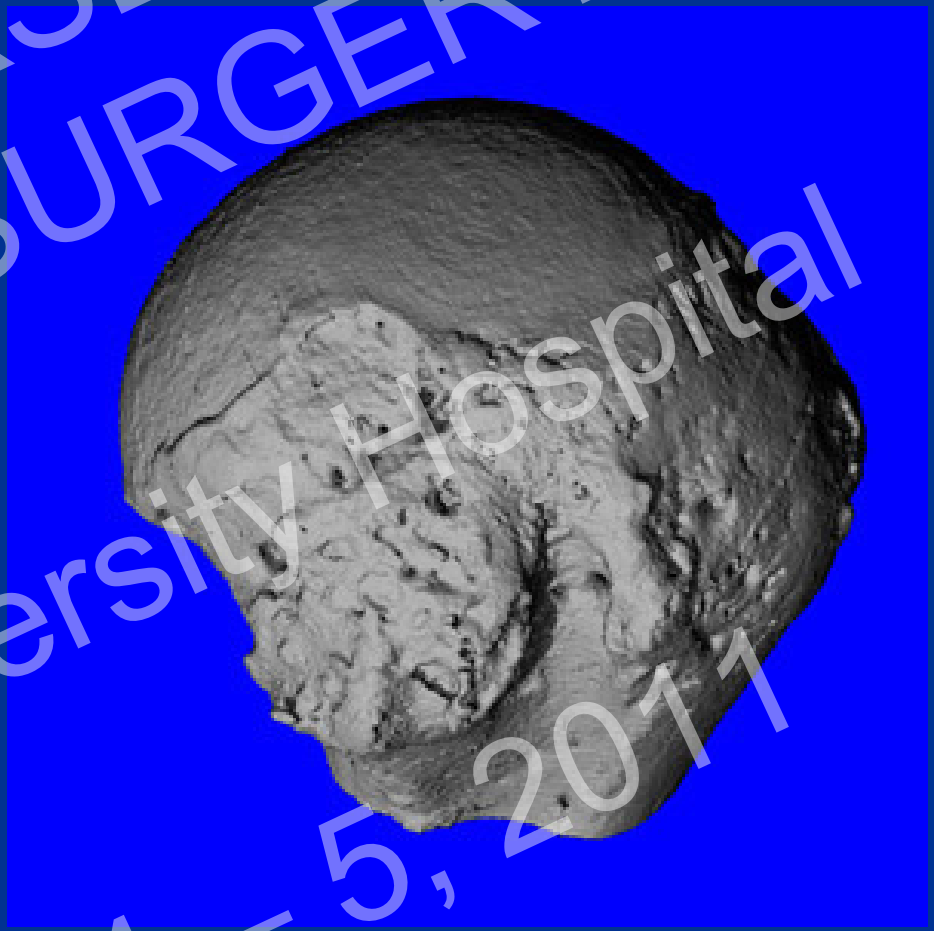
*Gerber, JBJS 81-A, 1999

**Schneeberger, JBJS 2003

MORE DANGER ?

BONE

Intact tendon



Ruptured tendon

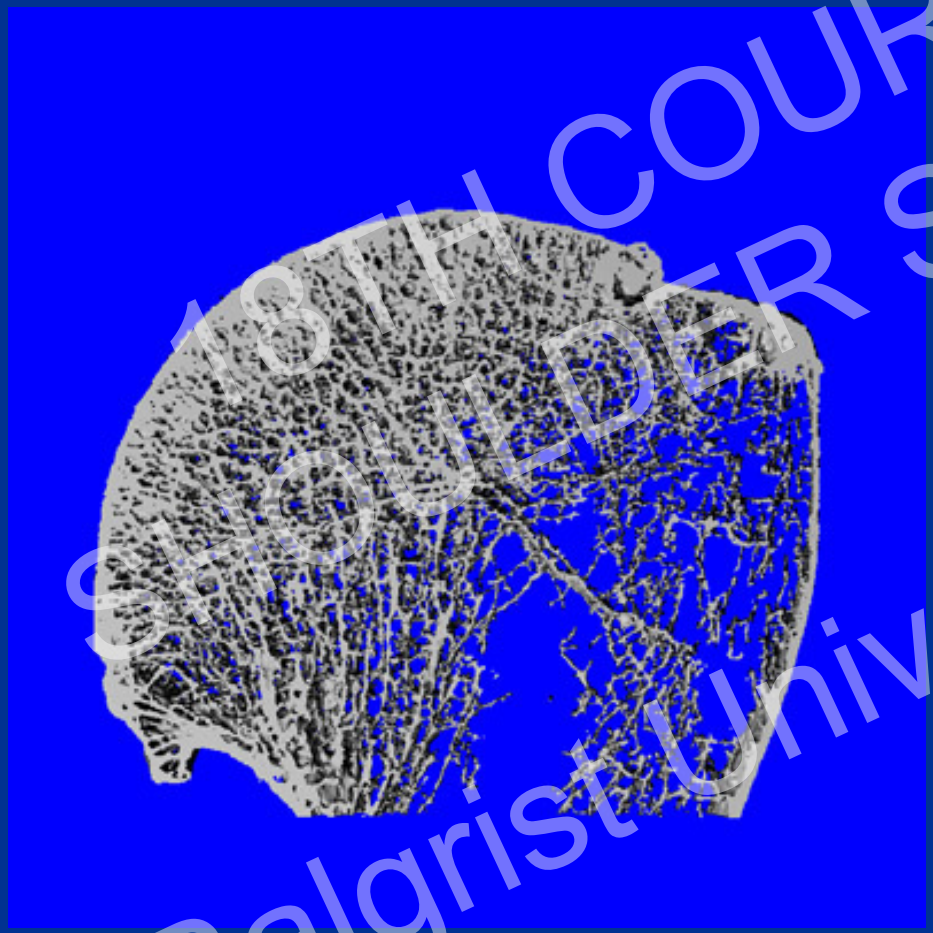
Meyer DC, JSES 2004, 333

BONE

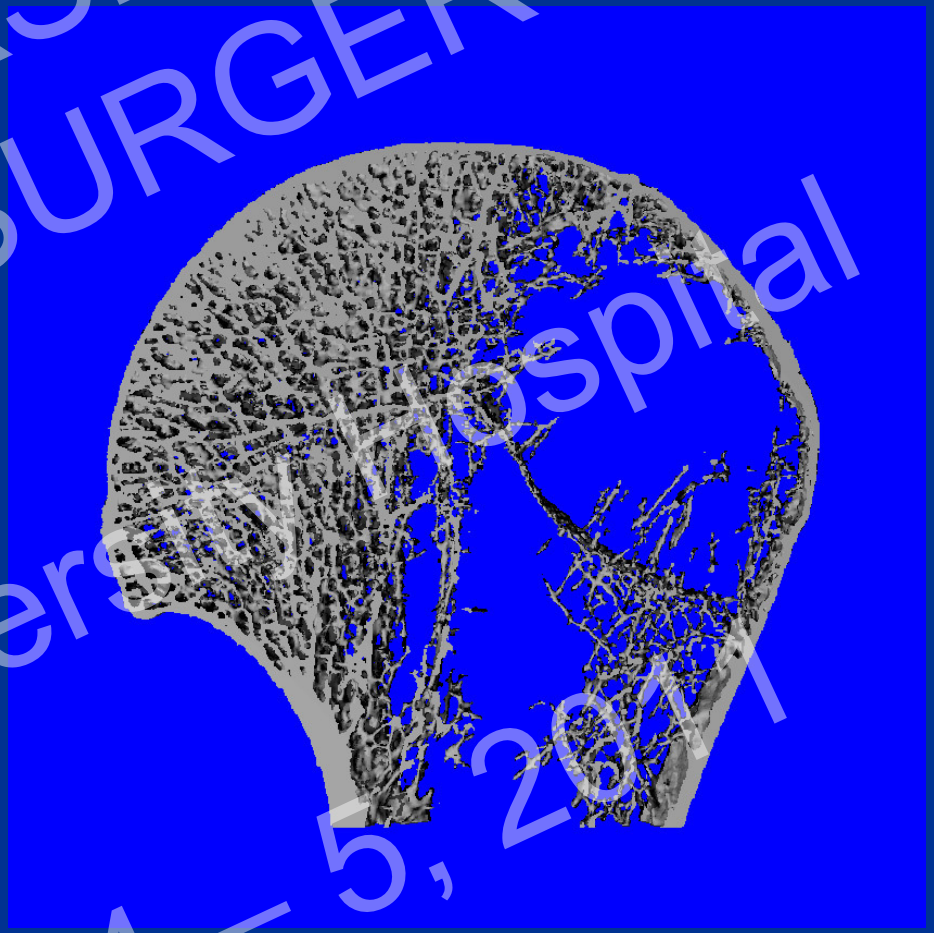
Intact tendon

Ruptured tendon

BONE



Intact tendon



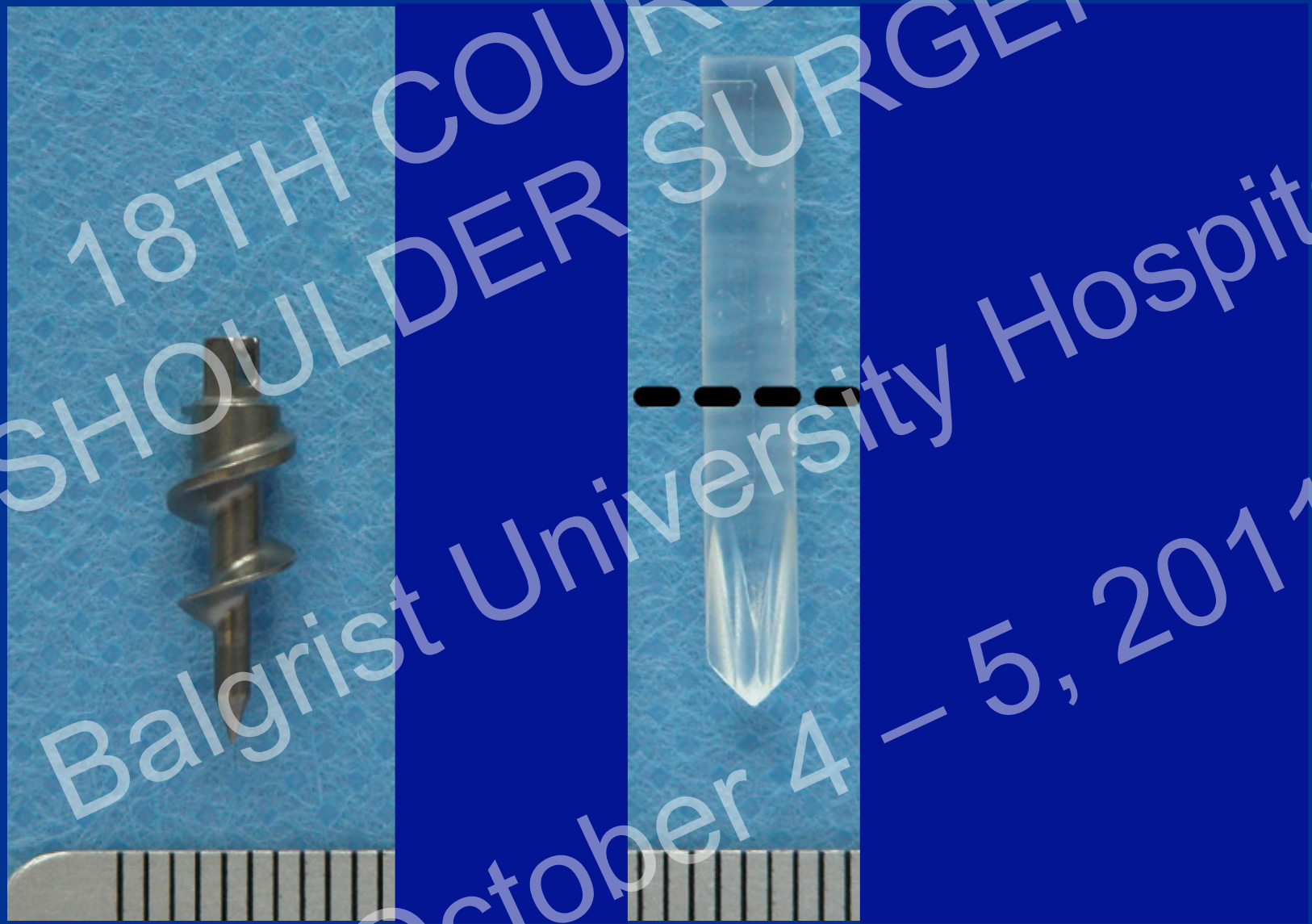
Ruptured tendon

Meyer DC, JSES 2004, 333

ANCHOR IN BONE

ANCHOR IN BONE

ANCHOR PULLOUT-STRENGTH VS BONE DENSITY



Meyer DC, CORR, 2006;442:143

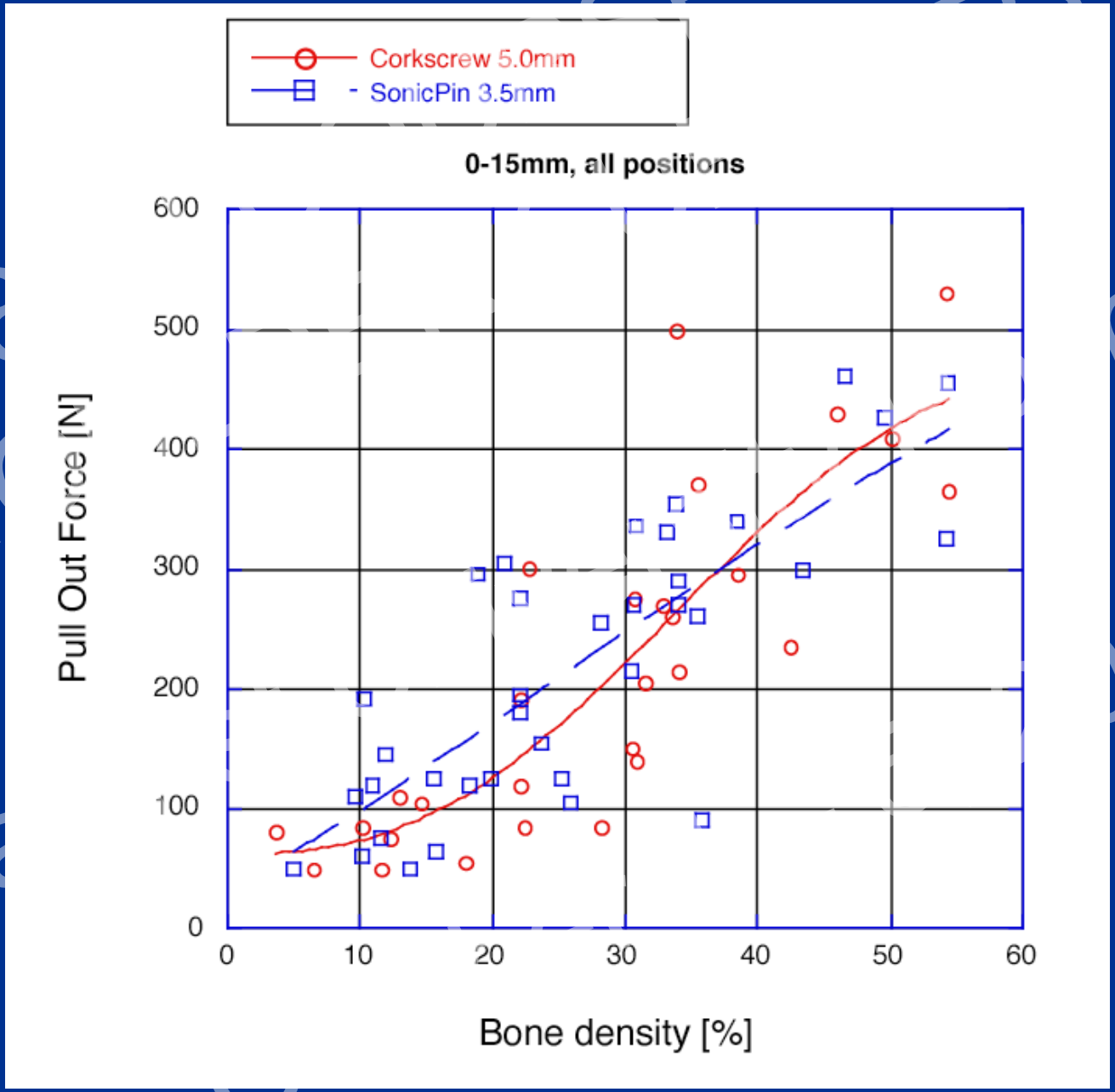
ANCHOR PULLOUT-STRENGTH VS BONE DENSITY

Meyer DC, CORR, 2006;442:143

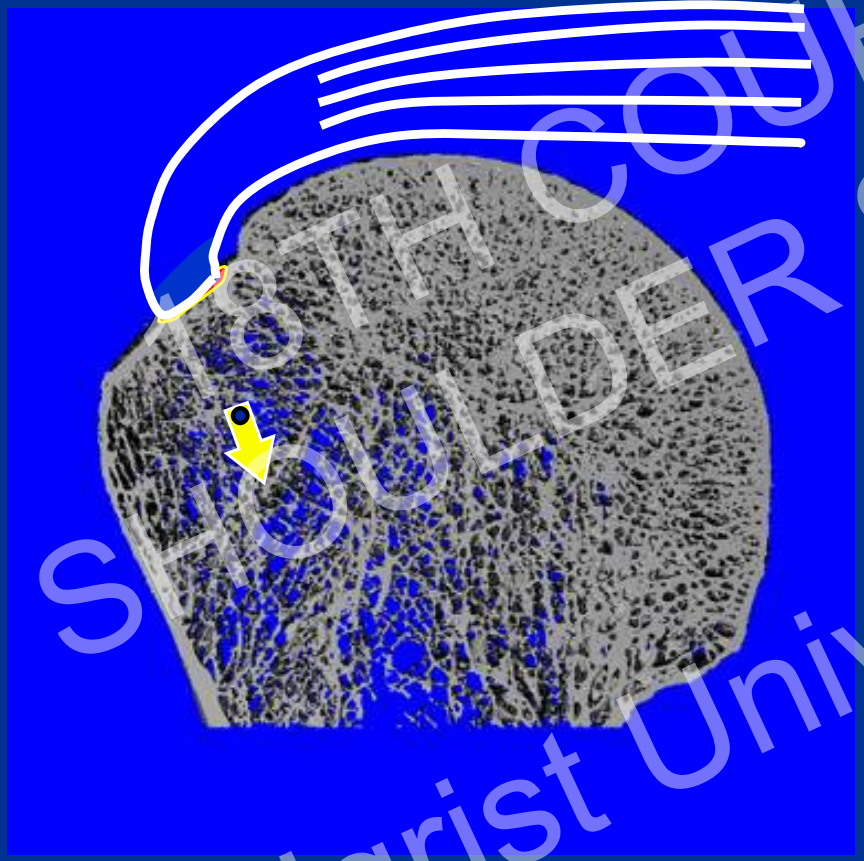
ANCHOR PULLOUT-STRENGTH VS BONE DENSITY

Meyer DC, CORR, 2006;442:143

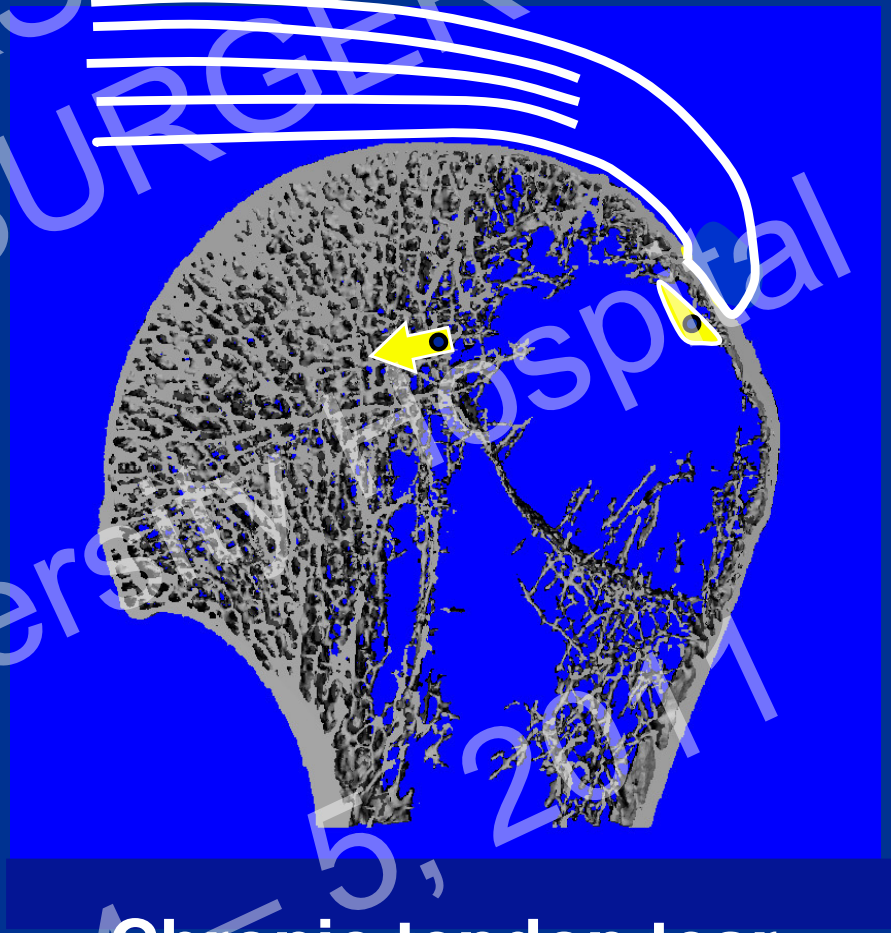
ANCHOR PULLOUT-STRENGTH VS BONE DENSITY



BONE

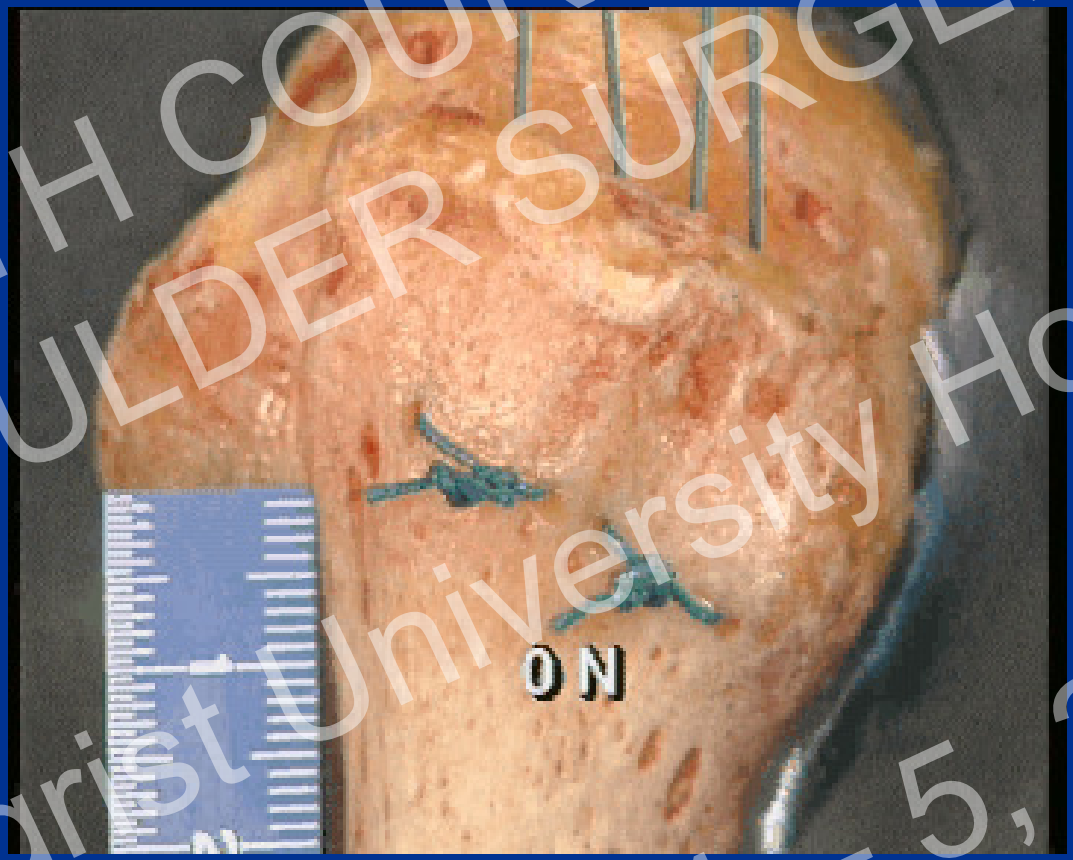


Recent tendon tear



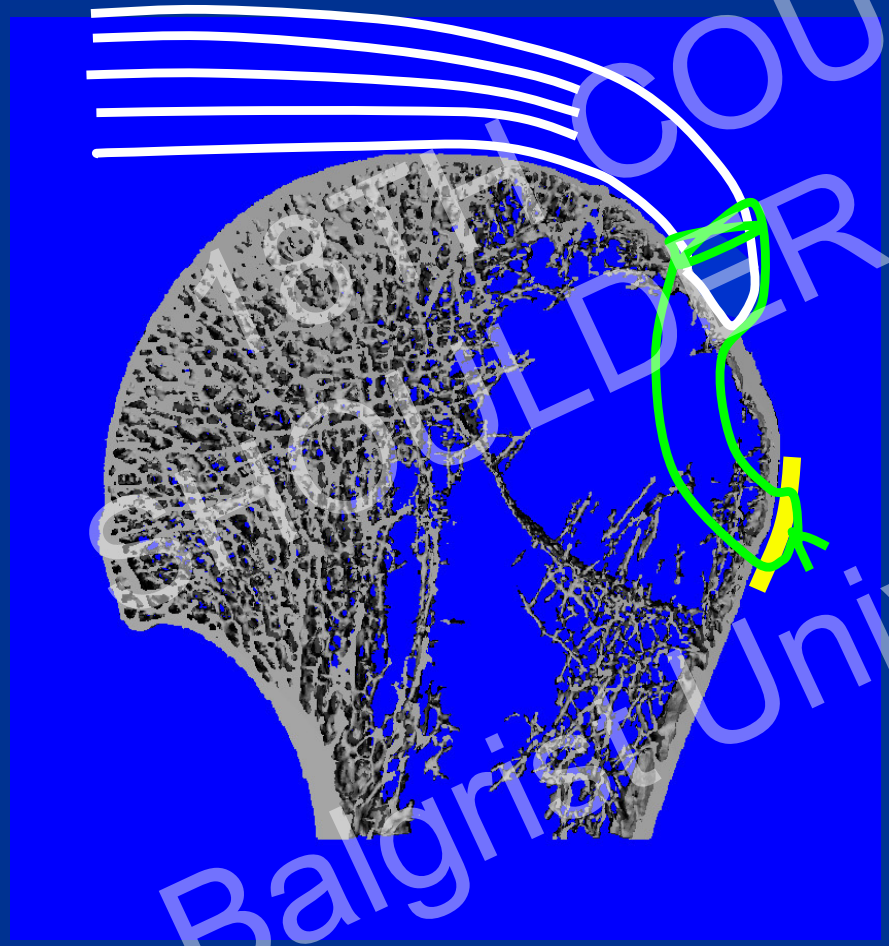
Chronic tendon tear

TRANSOSSEOUS FIXATION



Gerber C, JBJS ;1994, 76B,371-80

TRANSOSSEOUS FIXATION



Gerber C, JBJS ;1994, 76B,371-80

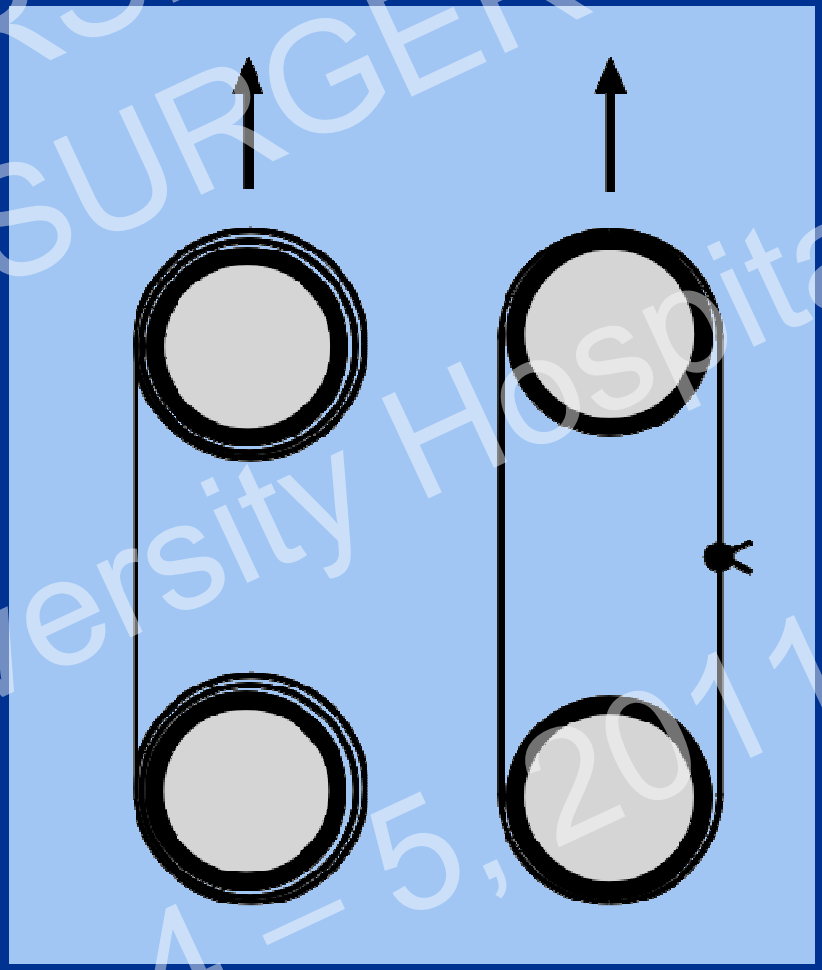
STRENGTHS OF SUTURE TYPES

Sutures tested (USP#2):

- Fiberwire
- Herculine
- Orthocord
- Ultrabraid

control:

- Ethibond
- PDS

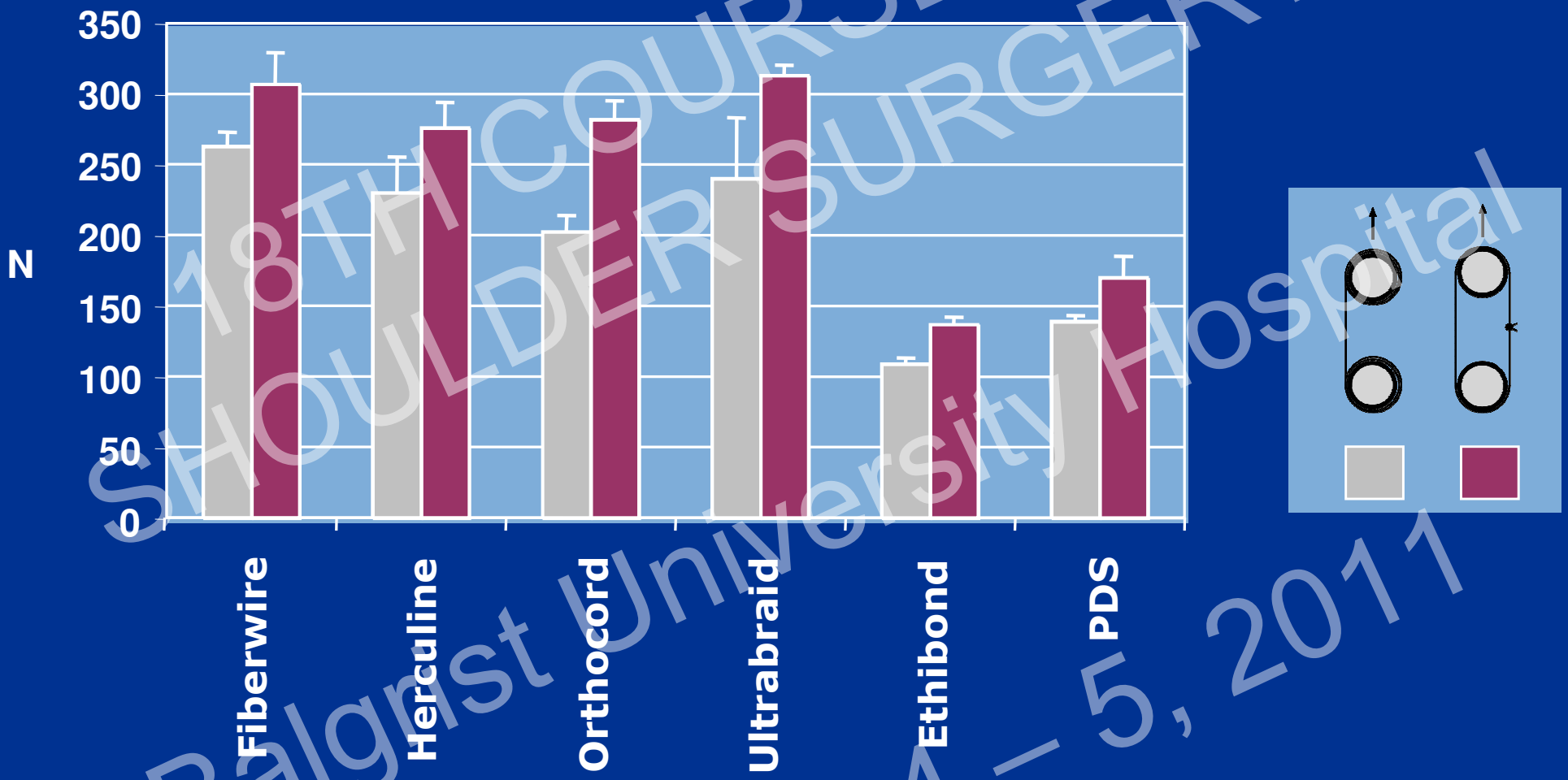


single strand without knot

loop, knotted

Wüest D, Arthroscopy 2007

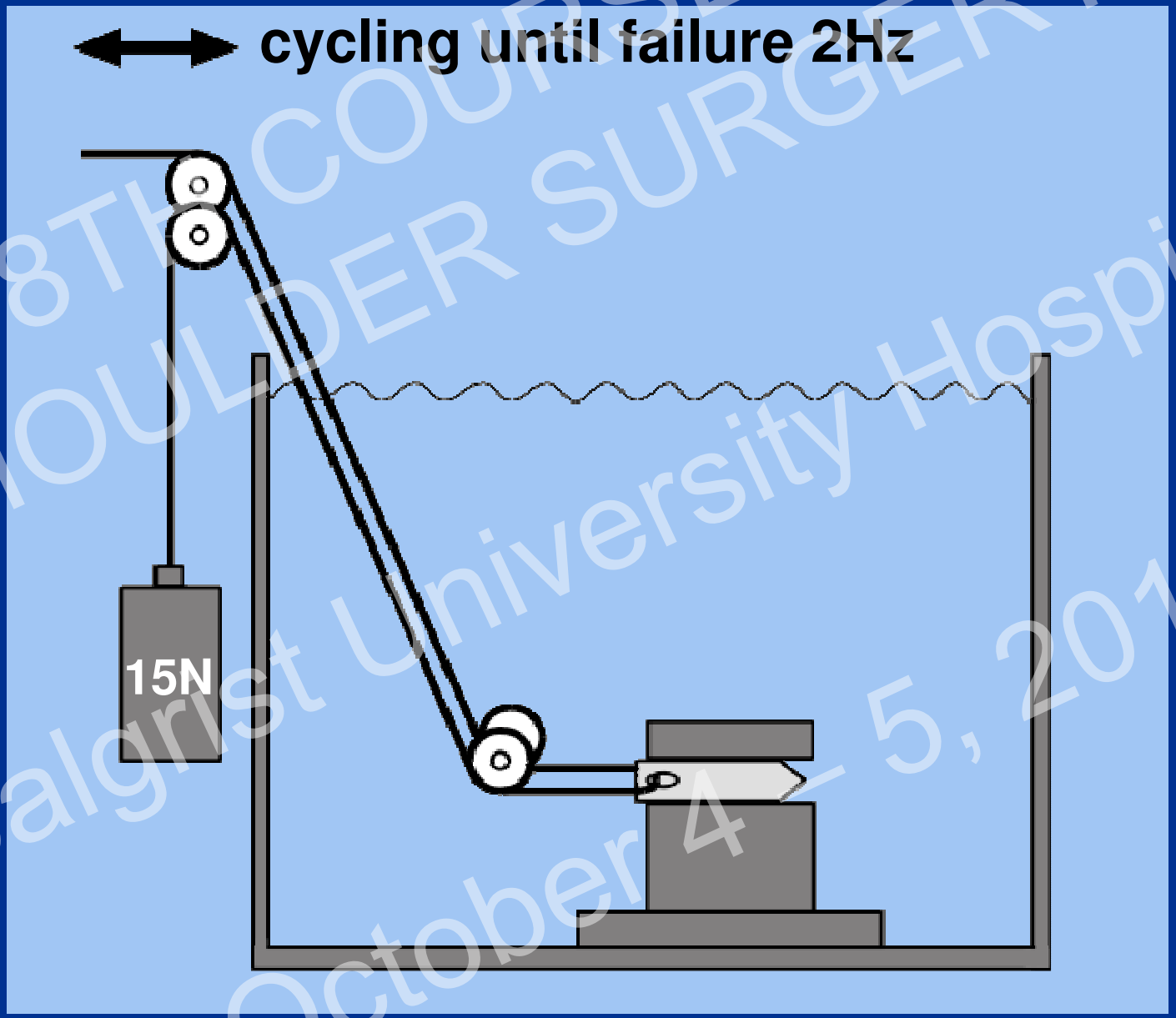
TENSILE TESTING



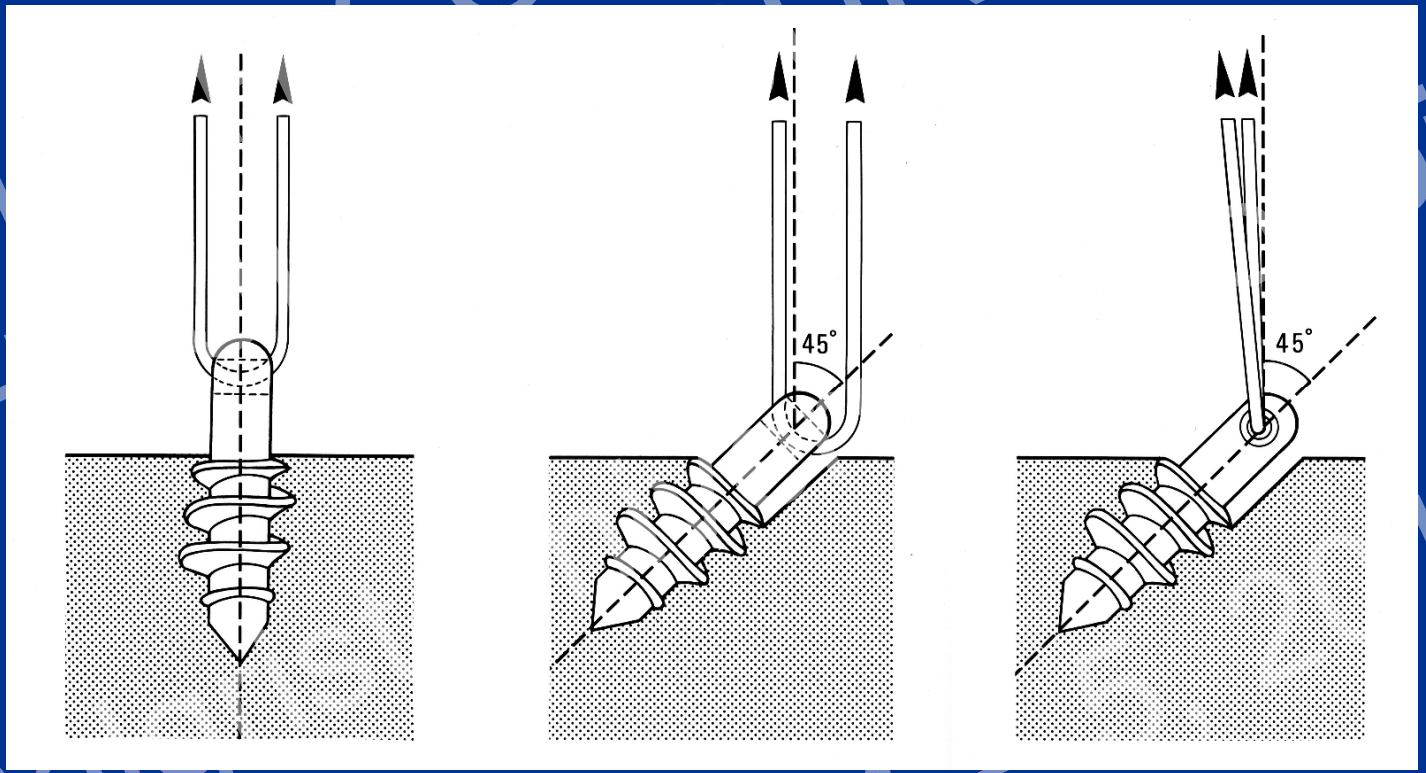
Size of knot: At least one double and four single slacks or six single slacks !

Wüest D, Arthroscopy 2007

CYCLIC TESTING ON ANCHOR EYELETS



SHARP EDGES

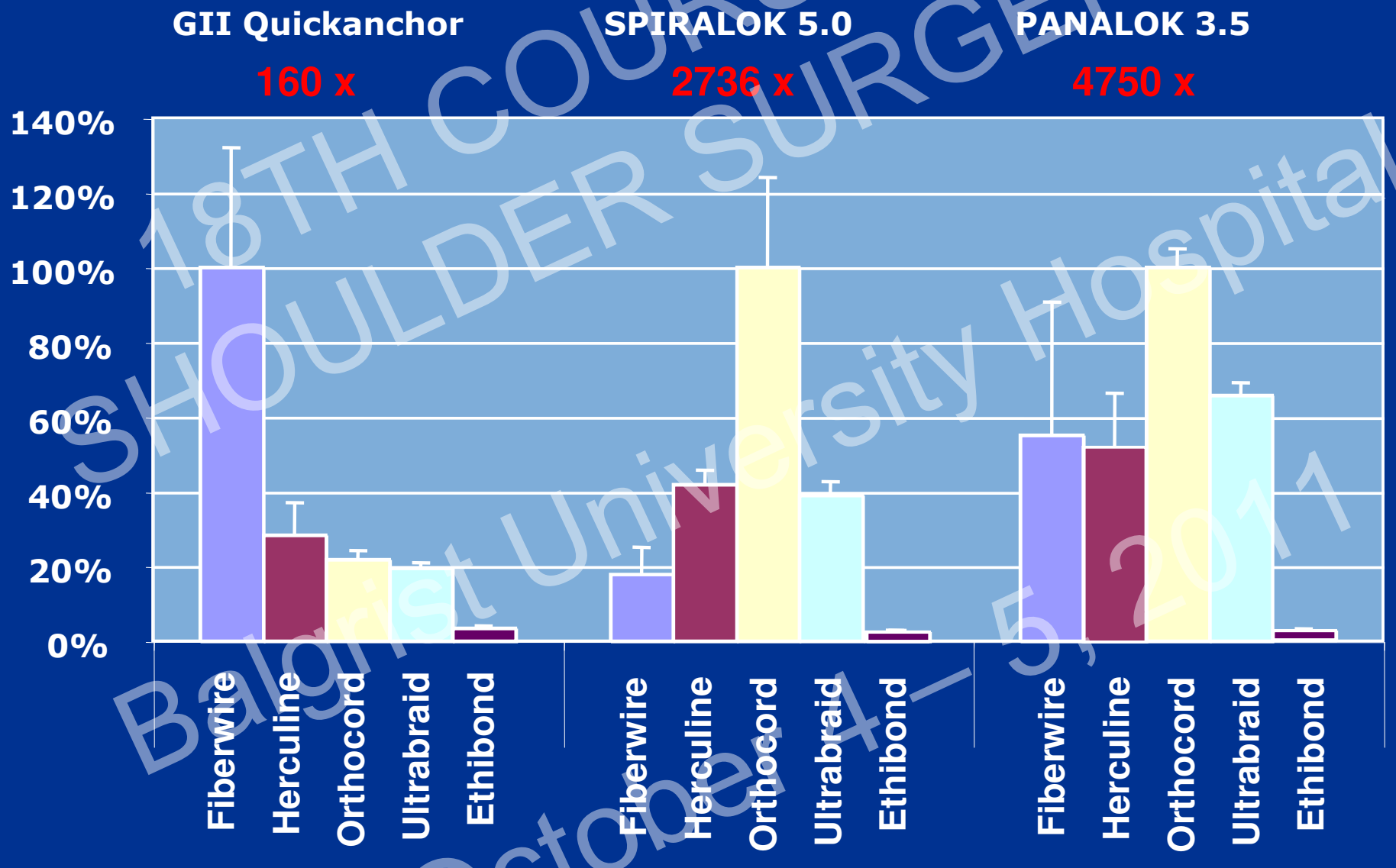


Meyer DC, Arthroscopy, 18(9), 1013-9

CYCLIC TESTING (Ethibond #2)

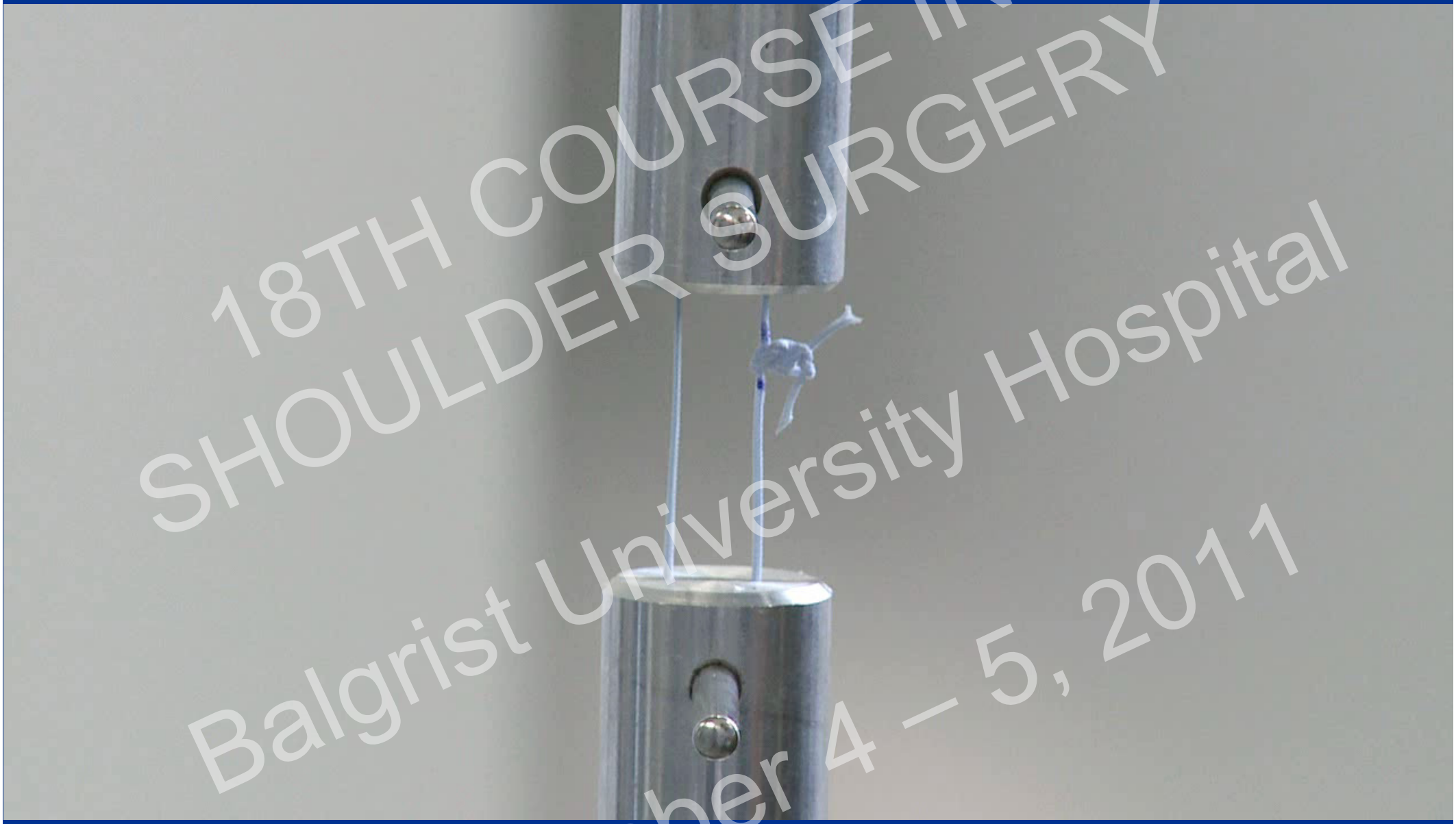
Reduction in single load strength: -80%

NUMBERS OF CYCLES UNTIL FAILURE (% OF BEST SUTURE)



Wüest D, Arthroscopy 2007

KNOTS IN FIBERWIRE



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Neuhofer S, in submission 2011

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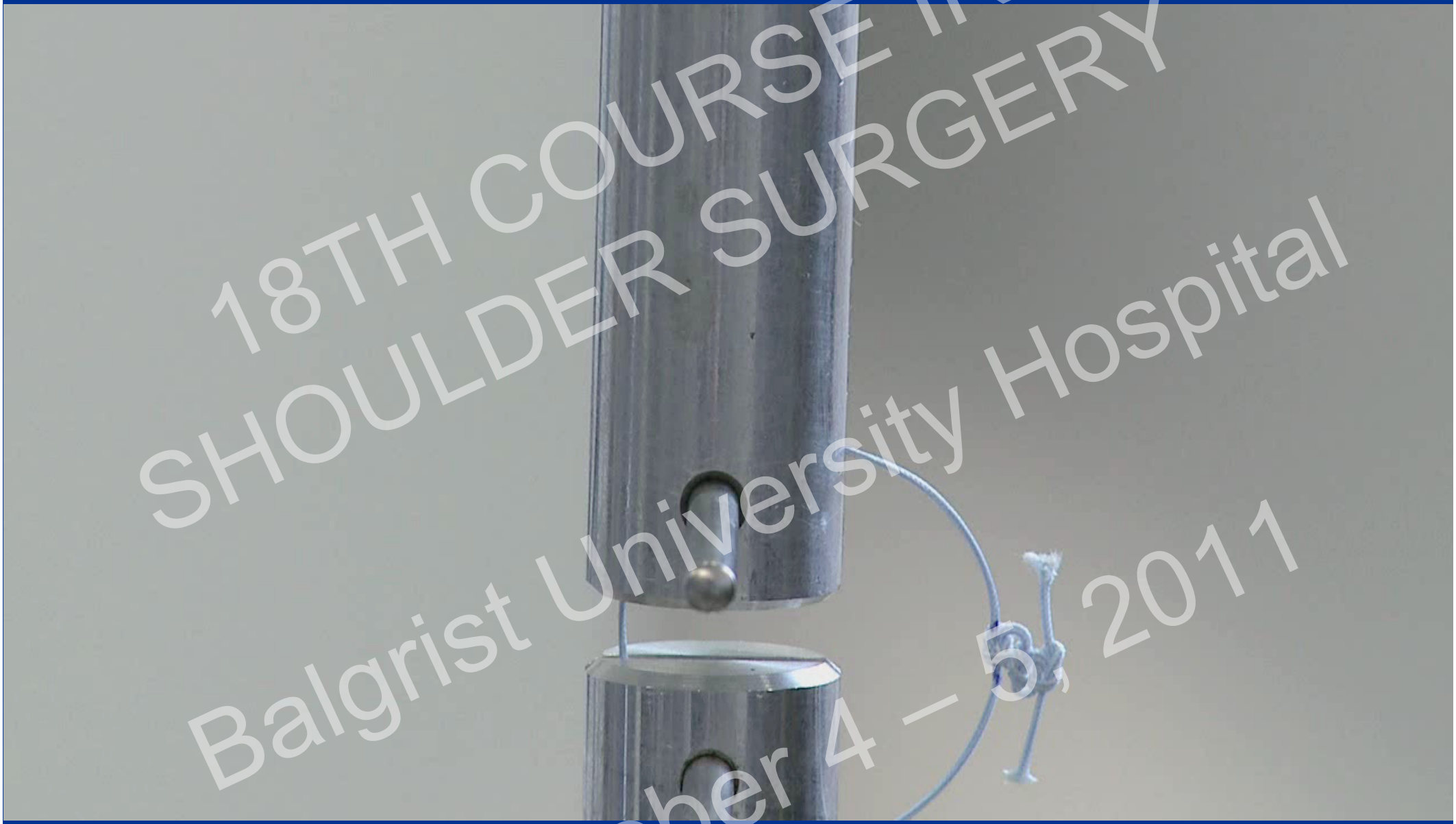
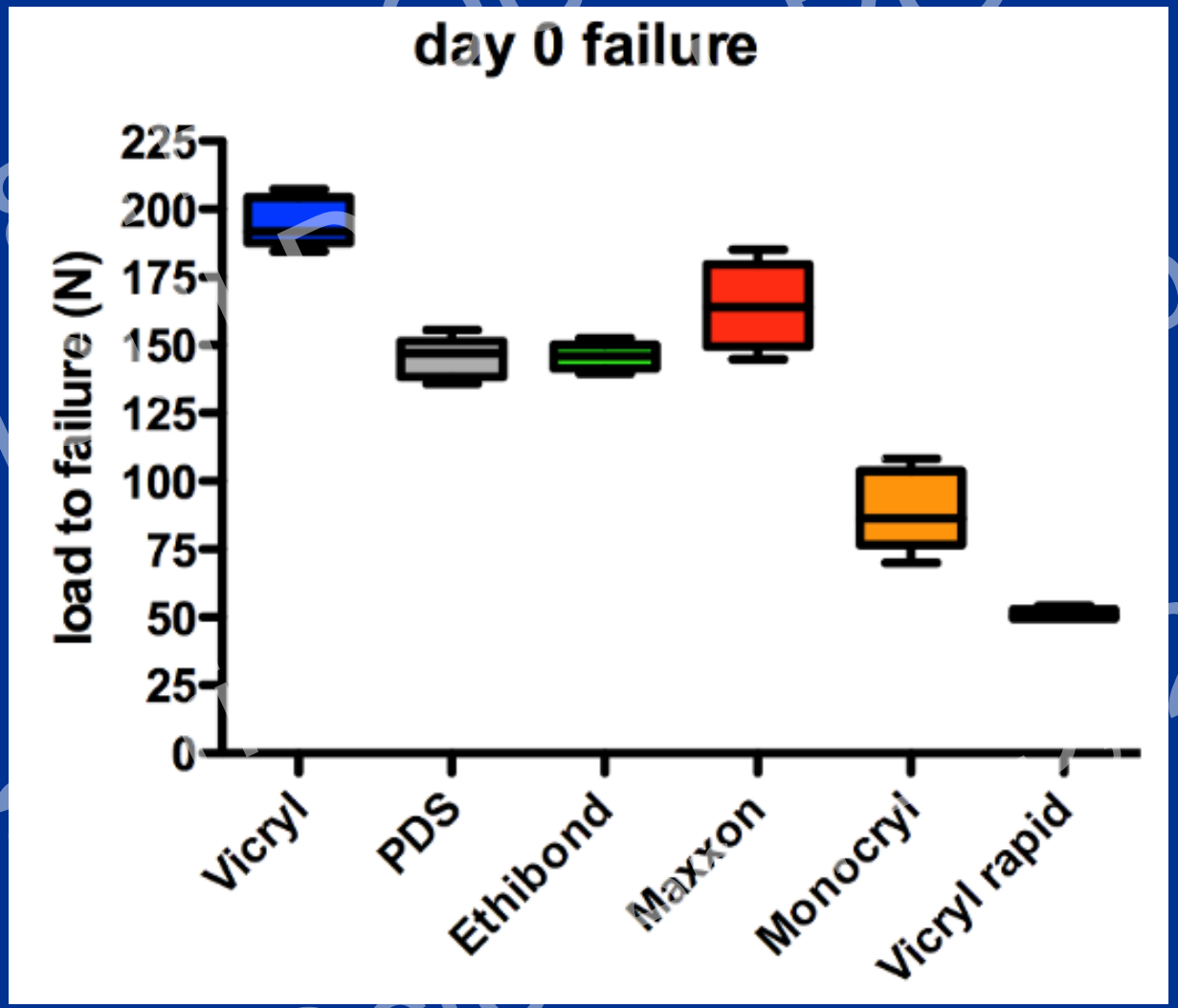
KNOTS IN FIBERWIRE



Neuhofer S, in submission 2011

DEGRADATION TIME OF SUTURES

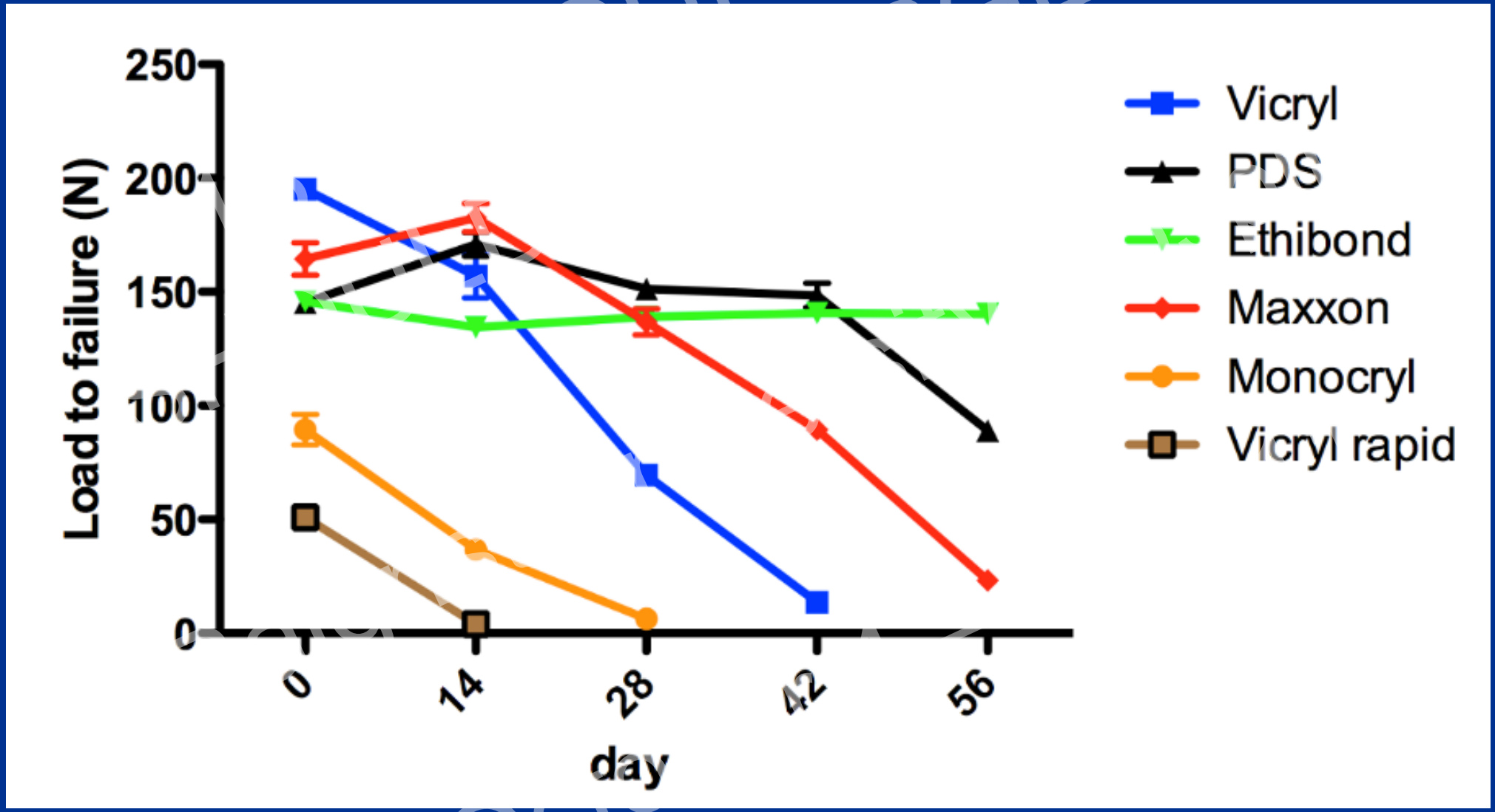
USP No 2/1 sutures degradable: (Ethibond control)



Müller D, 2011, in submission

DEGRADATION TIME OF SUTURES

USP No 2/1 sutures degradable:



Müller D, 2011, in submission

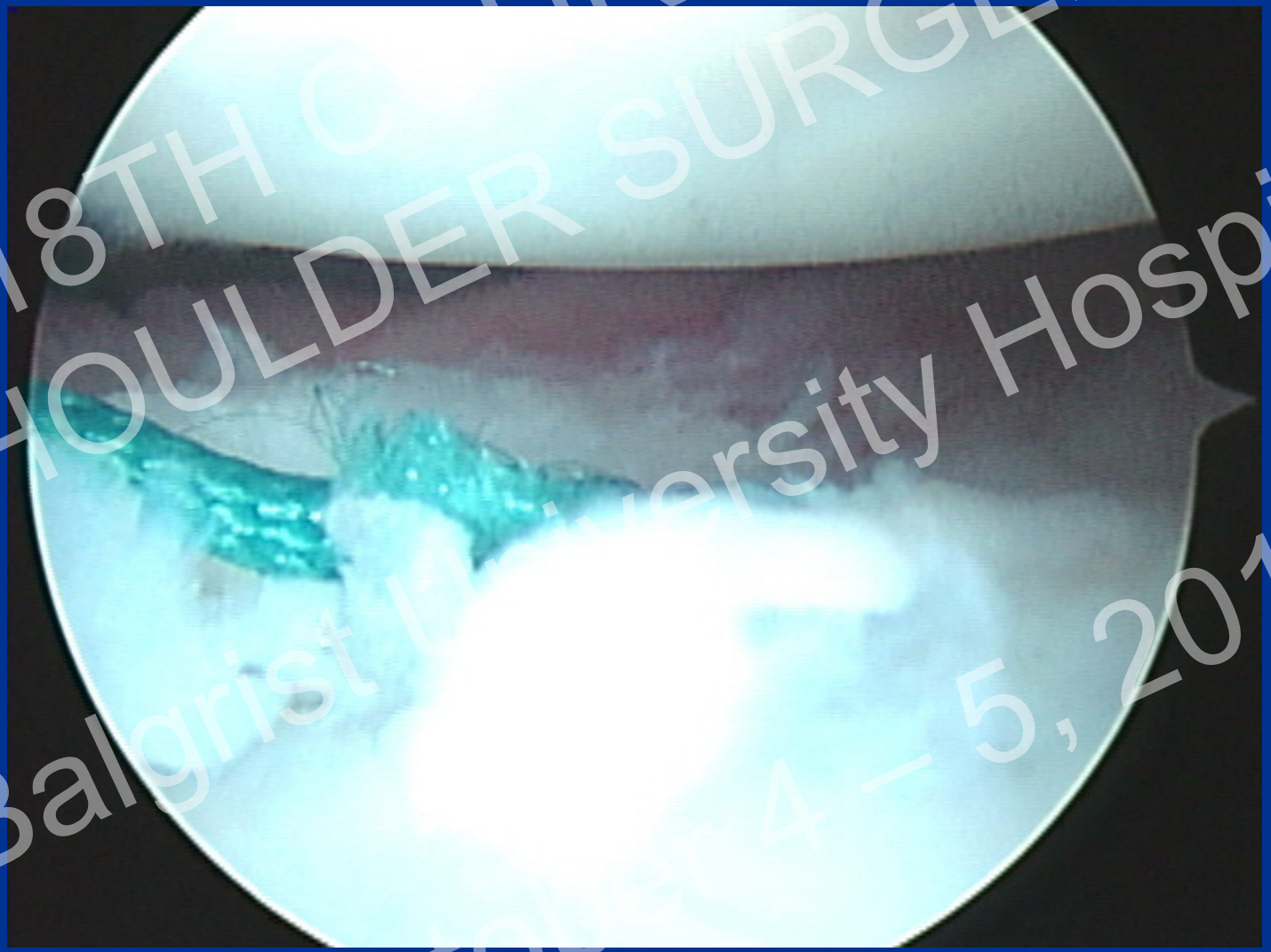
DEGRADABLE ANCHOR TESTING

Meyer DC, Arthroscopy, 2003 (2); 188

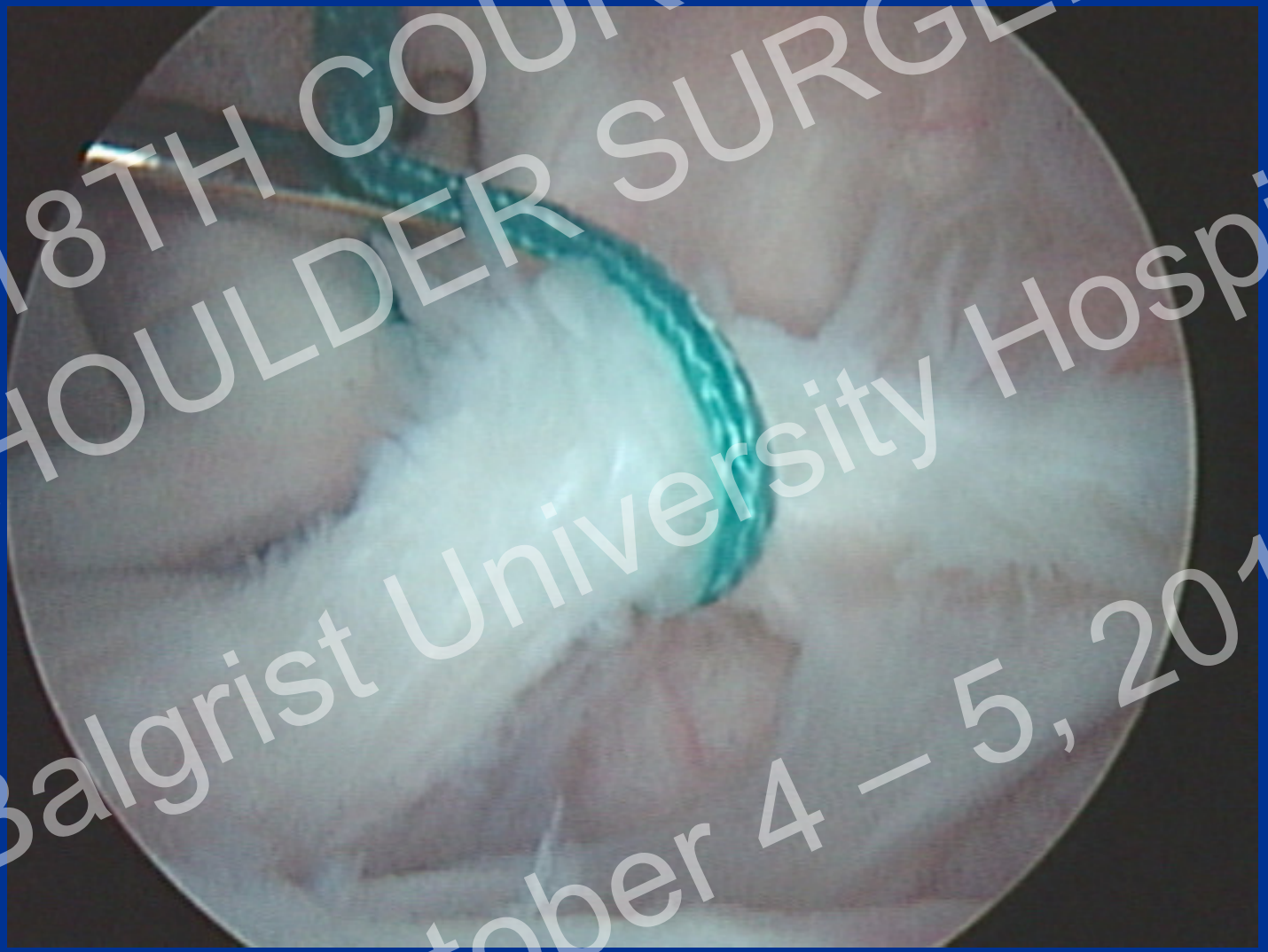
CONSTANT LOAD
TIME TO FAILURE (h)

Meyer DC, Arthroscopy, 2003 (2); 188

CLINICAL IMPLICATION



CLINICAL IMPLICATION



Meyer DC, Arthroscopy, 2004 (5); 521

CONCLUSION

Any repair will only be as strong as the weakest link.

No current repair technique is strong enough to resist repetitive action of the rotator cuff musculature.

FUTURE

18TH COURSE IN SHOULDER SURGERY

Balgrist University Hospital

October 4 – 5, 2011

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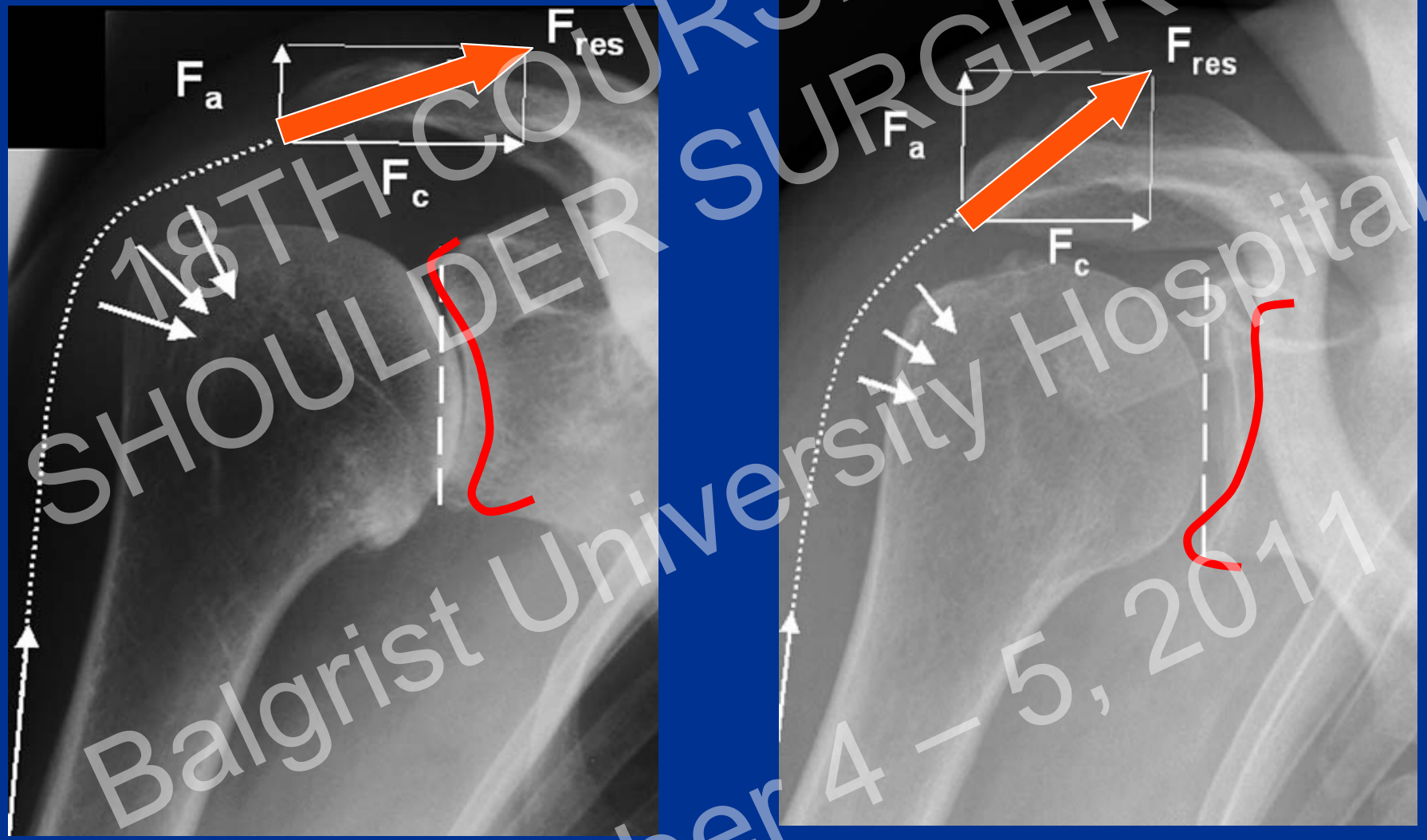
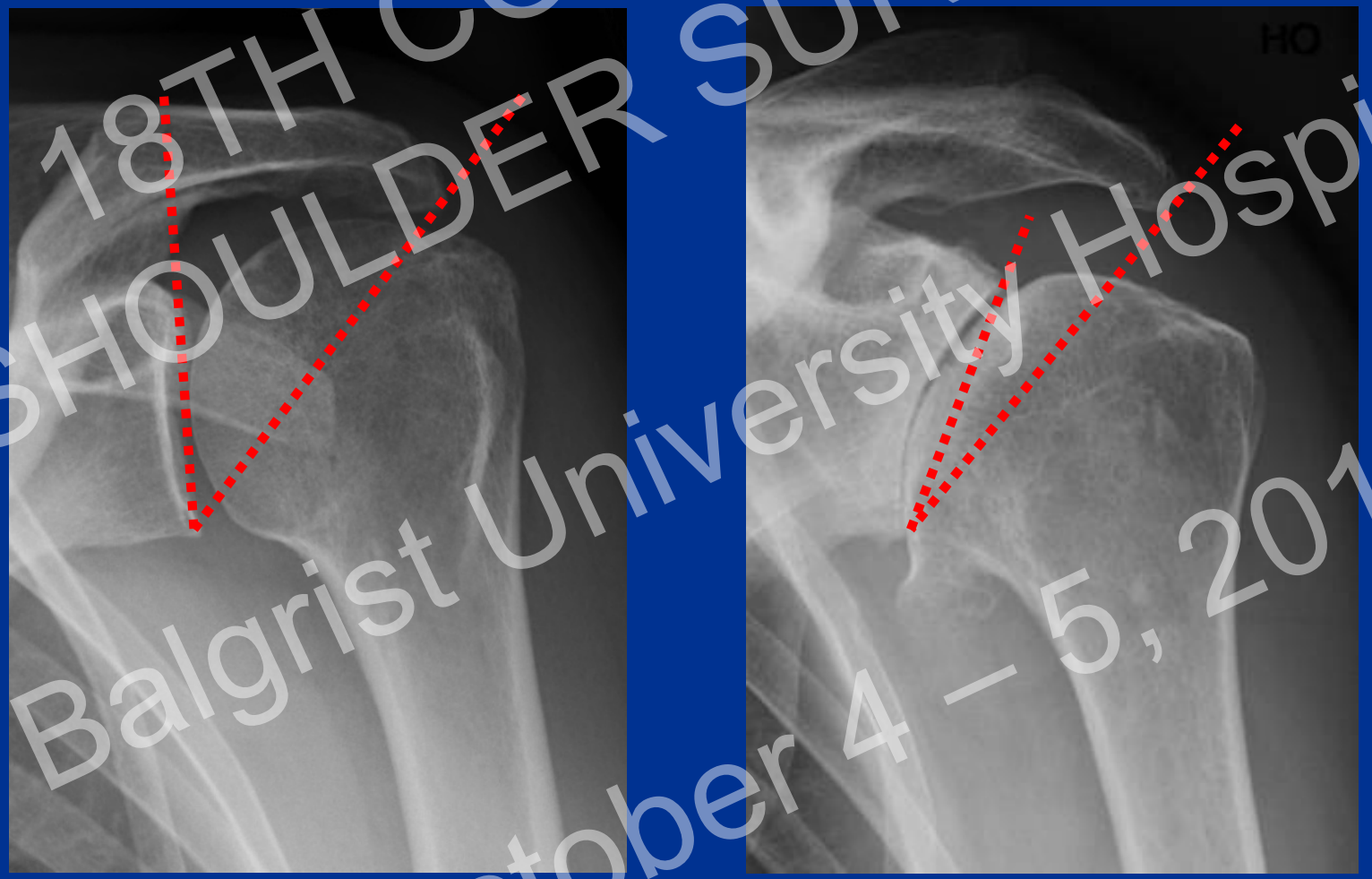
HYPOTHESIS



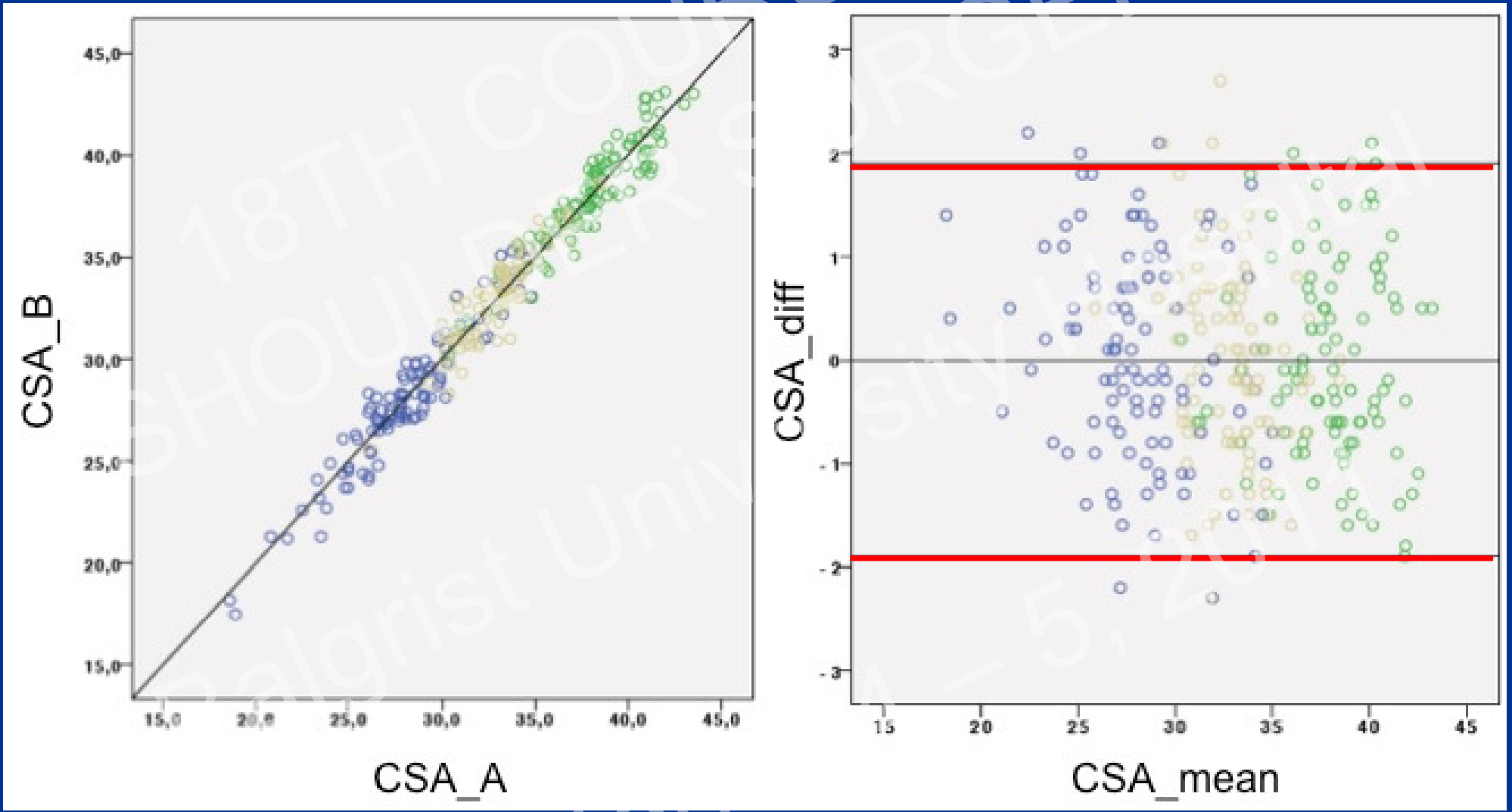
Nyffeler; JBJS Am 88(4):800-5, 2006

HYPOTHESIS

Critical Shoulder Angle (CSA)



INTER-RATER RELIABILITY



Bland-Altman

RESULTS

Group		Mean	SD	Minimum	Maximum
CTRL (n=94)	CSA	33.1°	2.3	26.8°	38.6°
	age	65.9	3.2	60	73
RCT (n=102)	CSA	38.0°	2.7	29.5°	43.5°
	age	58.1	8.5	44	77
OA (n=102)	CSA	28.1°	3.3	18.6°	35.8°
	age	68.7	8.9	47	85

$p < 0.0001$

CLASIFICATION

CSA (N=298)		Control	Osteoarthritis	Rotator cuff tear
1°: <30°	(N=82)	3.6%	95.2%	1.2%
2°: 30° to 35°	(N=114)	71.8%	18.2%	10.0%
3°: >35°	(N=92)	11.4%	2.9%	85.7%

CONCLUSION

Primary OA is associated with significantly smaller and degenerative RCTs with significantly larger CSAs than normal, asymptomatic shoulders.

FUTURE PERSPECTIVE


18TH COURSE IN
SHOULDER SURGERY
Balgrist University Hospital
October 4 — 5, 2011