

ALGORITHM IN EMERGENCIES

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CLINICA ORTOPEDICA II

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ISTITUTO ORTOPEDICO RIZZOLI

KNEE DISLOCATION CLASSIFICATION

Schenk classification

Grade	Injured Structures	Intact Structures
I	Single cruciate + collateral	ACL + collateral PCL + collateral
II	ACL/PCL	Collaterals
III M	ACL/PCL/MCL/ LCL + PLC	LCL + PLC
III L	ACL/PCL/LCL + PLC	MCL
IV	ACL/PCL/MCL/ LCL + PLC	—
V	Fracture dislocation	

Moore classification

Fracture-Dislocation of the Knee	
I	Split fractures through medial or lateral plateau
II	Complete fractures separating entire medial or lateral plateau
III	Rim avulsion fracture
IV	Rim compression fracture
V	4-Part fractures

Anatomic Knee Dislocation Classification System

Classification	Description
KD I	KD with PCL intact. Collateral ligaments may be injured.
KD II	KD with both PCL and ACL injured and collateral ligaments intact.
KD III ^a	KD with both PCL and ACL injured and one collateral ligament injured, either medial or lateral.
KD IV	KD with ACL, PCL, and both collateral ligament injury.
KD V	KD with a periarticular fracture

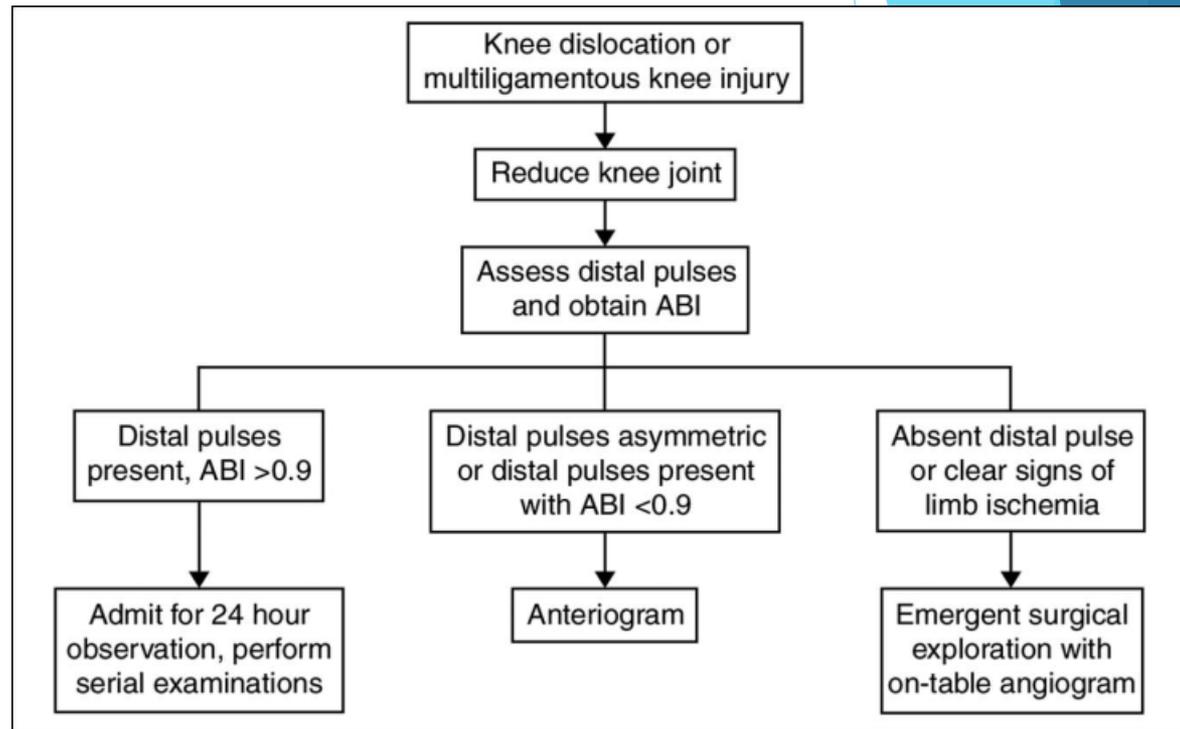
ALGORITHM FOR CONCOMITANT VASCULAR INJURY

OVERALL INCIDENCE: 20%

EXAMINATION INCLUDES
PALPATING DORSALIS PEDIS
AND POSTERIOR TIBIAL
PULSES

ABI: ANKLE-BRACHIAL-
INDICES (sensitivity in
detecting vascular injury ~
100%)

ANGIOGRAPHY
RECOMMENDED FOR
PATIENTS WITH
INSUFFICIENT PERFUSION
OR ANY ASYMMETRY IN P.E.



Lachman et al., Ortop Clin N Am, 2015
Boyce et al., J Am Acad Orthop Surg, 2015
Nicandri et al., Clin J Sport Med, 2009

NEUROLOGIC EXAMINATION

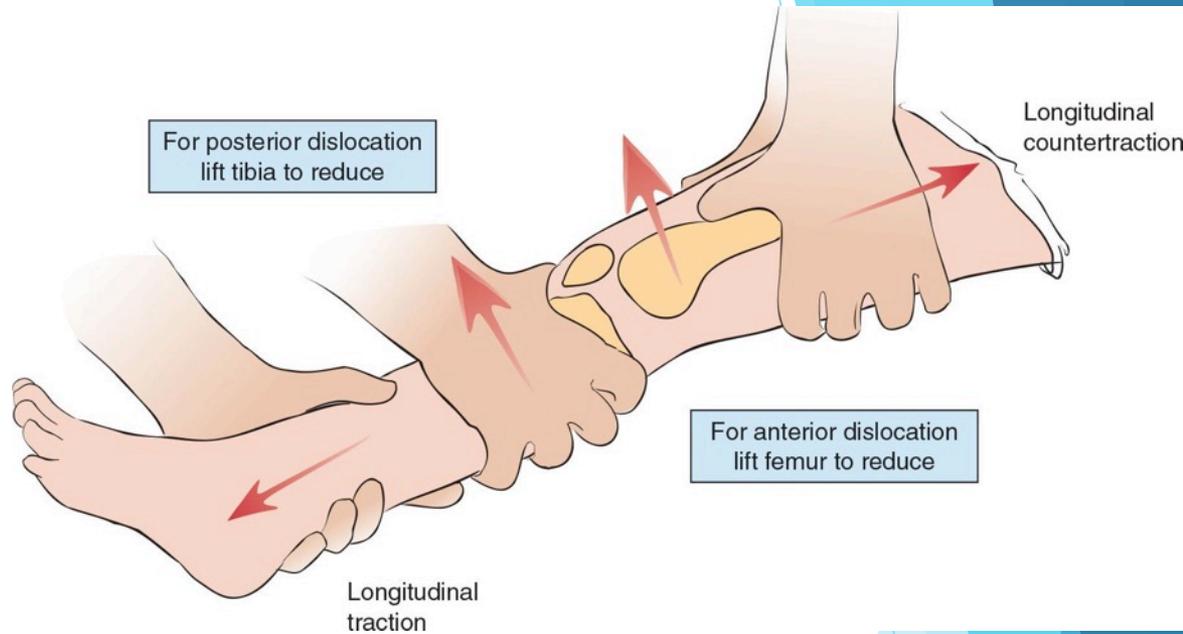
- ▶ INCIDENCE 4.5% - 40%
- ▶ COMMON PERONEAL NERVE MOST COMMONLY INJURED
- ▶ MOTOR EXAMINATION INCLUDES FLEXOR AND EXTENSOR ALLUCIS LONGUS, TIBIALIS ANTERIOR AND GASTROCNEMIUS
- ▶ IN CASE OF NEUROLOGIC DEFICIT -> RECOVERY UNPREDICTABLE



Lachman et al., Ortop Clin N Am, 2015

REDUCTION & IMMOBILIZATION

- ▶ AFTER NEUROVASCULAR EXAMINATION
- ▶ ESSENTIAL TO REDUCE AS SOON AS POSSIBLE
- ▶ SKIN NECROSIS CAUSED BY DELAYED REDUCTION IS COMMON
- ▶ ATTENTION TO «DIMPLE SIGN» (INCARCERATION OF MCL IN THE JOINT PREVENTING COMPLETE REDUCTION)



POSTREDUCTION IMMOBILIZATION

- ▶ GROSSLY UNSTABLE KNEE:

EXTERNAL FIXATOR FOR STABILITY AND SOFT TISSUES HEALING AND GRAFT PROTECTION IN CASE OF VASCULAR OR RECONSTRUCTIVE SURGERY

- ▶ NOT GROSSLY UNSTABLE:

KNEE IMMOBILIZER IS RECOMMENDED

CIRCUMFERENTIAL SPLINTING OR CASTING INCREASE THE CHANCE OF COMPARTMENT SYNDROME SECONDARY TO LIMITED MATERIAL COMPLIANCE

RADIOGRAPHIC EVALUATION

IMMEDIATE

AFTER REDUCTION:

- ▶ TO CONFIRM REDUCTION
- ▶ FRACTURE EVALUATION
- ▶ OVERALL KNEE ALIGNMENT

ASSOCIATED FRACTURES
INCIDENCE: 10-20%

SECONDARY

AFTER NEUROVASCULAR EXAMINATION AND STABILIZATION:

- ▶ CT
- ▶ MRI
- ▶ BOTH

Harner CD, Clin Sports Med, 1999

SURGICAL TIMING

- ▶ **EARLY OPERATIVE INTERVENTION (WITHIN 3 WEEKS):**
OPEN SURGERY DUE TO CAPSULAR DISRUPTION
PRECLUDING ARTHROSCOPIC ASSISTANCE (RISK OF FLUID
EXTRAVASION AND COMPARTMENTAL SYNDROME)

SEQUENCE:

1. PCL
2. ACL
3. COLLATERAL LIGAMENTS AND PLC PMC
REPAIR/RECONSTRUCTION

- ▶ **DELAYED INTERVENTION (AFTER 3 WEEKS):**

DIRECT REPAIR OF THE COLLATERALS IS NO LONGER
POSSIBLE AND RECONSTRUCTION WITH AUTOGRAFT OR
ALLOGRAFT IS NECESSARY

CONTROVERSIAL RESULTS



SURGICAL TIMING

Evidence-Based Medicine Series Systematic Review

Decision Making in the Multiligament-Injured Knee: An Evidence-Based Systematic Review

Bruce A. Levy, M.D., Khaled A. Dajani, M.D., Daniel B. Whelan, M.D.,
James P. Stannard, M.D., Gregory C. Fanelli, M.D., Michael J. Stuart, M.D.,
Joel L. Boyd, M.D., Peter A. MacDonald, M.D., and Robert G. Marx, M.D., F.R.C.S.C.

- ▶ EARLY OPERATIVE TREATMENT OF THE MULTILIGAMENT-INJURED KNEE YIELDS IMPROVED FUNCTIONAL AND CLINICAL OUTCOMES COMPARED WITH NONOPERATIVE MANAGEMENT OR DELAYED SURGERY
- ▶ REPAIR OF THE POSTEROLATERAL CORNER MAY YIELD HIGHER REVISION RATES COMPARED WITH RECONSTRUCTION

Arthroscopy, 2009

SURGICAL TIMING

Acute surgical management of traumatic knee dislocations – Average follow-up of 10 years

R.S. Khakha^{a,b}, A.C. Day^{a,*}, J. Gibbs^a, S. Allen^a, P. Hill^b, J. Hull^b, A. Perry^b, H. Chissell^b

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^b Frimley Park Hospital NHS Foundation Trust, Portsmouth Road, Frimley, Surrey GU16 7UJ, United Kingdom

- ▶ 56% ASSOCIATED INJURIES
- ▶ 22% CPN PALSY
- ▶ 11% POPLITEAL ARTERY INJURY
- ▶ 56% IKDC A-B
- ▶ 53% GOOD - EXCELLENT OUTCOME
- ▶ HIGH LEVEL OF OVERALL KNEE FUNCTION FOLLOWING ACUTE SURGICAL RECONSTRUCTION

Treatment protocol.

- Patient presents to A&E with a clinically dislocated knee
 - Managed according to ATLS principles
 - Neurovascular status of the affected knee is assessed and recorded
 - Pulses intact/perfused limb: proceed
 - Pulses not palpable, proceed to Duplex Doppler [if intact and no intimal tear: proceed]
 - Abnormality on Duplex Doppler, proceed to angiography
 - Knee is reduced with the assistance of anaesthesia
 - Neurovascular status is rechecked and if compromised, a vascular opinion requested
 - Theatre team informed and vascular injury dealt with appropriately followed by splintage of the limb
 - Vascular reconstruction performed using a reverse saphenous vein graft
 - MRI of the knee (Fig. 1).
 - Surgical plan
 - Collateral ligaments assessed
 - Grades 1–2
 - Managed conservatively in a brace
 - Grade > 2
 - LCL/MCL avulsion:
Suture anchor repair
 - LCL/MCL mid-substance tear
Reconstruction using allograft/LARS augmentation
 - Associated rotational instability/hyperextension on examination:
Posterolateral reconstruction using allograft/LARS augmentation: modified Larson technique
 - Consider LaPrade reconstruction when menisco-capsular tears noted on MRI
 - Stress views performed in theatre with image intensifier control (Fig. 2)
 - If ACL or PCL ruptured
 - Reconstructed with Hamstring/BTB graft or LARS augmentation
 - Intraoperative lateral II images while tensioning
 - PCL in 90° flexion
 - ACL in 30° flexion
 - All patients were placed in a range of movement brace set to 10°–90° for 6 weeks
- Early mobilisation with closed chain exercises

SURGICAL TIMING

Review

Early or delayed reconstruction in multi-ligament knee injuries:
A systematic review and meta-analysis

Erik Hohmann^{a,b,*}, Vaida Glatt^c, Kevin Tetsworth^{d,e,f,g}

^a Medical School, University of Queensland, Australia

^b Medical School, University of Pretoria, South Africa

^c Department of Orthopaedic Surgery, University of Texas Health Center, San Antonio, TX, USA

^d Department of Orthopaedic Surgery, Royal Brisbane Hospital, Herston, Australia

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^f Queensland University of Technology, Australia

^g Orthopaedic Research Institute of Australia, Australia

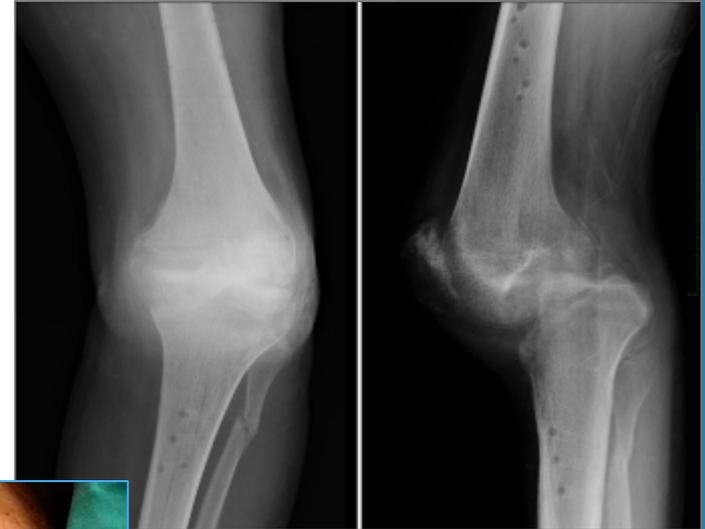
- ▶ SIGNIFICANTLY HIGHER LYSHOLM SCORE IN EARLY GROUP
- ▶ 31% OF PT. WITH EARLY SURGERY NORMAL OR NEAR-NORMAL KNEE VS. 15% OF PT. WITH LATE SURGERY
- ▶ TREND OF IMPROVED ROM

SURGICAL TIMING

- ▶ COMPLICATIONS HIGHER IN PT. WITH >3 LIGAMENTS AND IN EARLY TREATMENT (<3 WEEKS)
- ▶ KNEE STIFFNESS MORE COMMON IN PAT. WHO HAD >3 LIGAMENTS AND ACUTE
- ▶ KNEES WITH ALL 4 LIGAMENTS MORE REVISION SURGERY CASES
- ▶ INFECTION MORE COMMON IN THE OBESE GROUP

	N	Patients with complications (total complications of 43)	Hardware and or suture removal	Infection (surgical or antibiotic intervention)	Revision surgery	DVT/PE	Need for MUA and/or lysis of adhesions
Total Cohort	133	37 (28 %)	6	5	12	1	19
Sex							
Female	32	9 (28 %)	1	1	3	0	5
Male	101	28 (28 %)	5	4	9	1	14
Age (year)							
<25	76	20 (26 %)	4	1	6	0	10
≥25	57	17 (30 %)	2	4	6	1	9
Timing of surgery							
Acute <3 weeks	63	19 (30 %)	3	2	4	0	13*
Chronic >3 weeks	70	18 (26 %)	3	3	8	1	6*
Type of injury							
>2 Ligaments	51	21 (41 %)*	4	2	7	0	12*
2 Ligaments	82	16 (20 %)*	2	3	5	1	7*
Other orthopaedic injuries							
Yes	33	11 (33 %)	3	1	3	0	6
No	100	26 (26 %)	3	4	9	1	13
Concomitant non-orthopaedic injuries							
Yes	15	3 (20 %)	0	0	1	0	2
No	118	34 (29 %)	6	5	11	1	17
Associated vascular injury							
Yes	4	1 (25 %)	0	0	0	0	1
No	129	36 (28 %)	6	5	12	1	18
Associated peroneal nerve injury							
Yes	26	6 (23 %)	0	1	2	0	4
No	107	31 (29 %)	6	4	10	1	15

COMPLEX KNEE DISLOCATION NEED DIFFERENT MANAGEMENT



PROPOSED SURGICAL APPROACH

STAGED SURGERY WITH APPLICATION OF DYNAMIC EXTERNAL FIXATOR PLUS:

- PCL RECONSTRUCTION
- TREATMENT OF ASSOCIATED LESIONS

(FRACTURE, VASCULAR INJURY)



KNEE DISLOCATIONS GROUP

DEMOGRAPHYCS

(F.U. 1-4 YEARS)

Table 1. Patient characteristics

Patient	Sex	Age at injury (years)	Followup (months)	Body mass index (kg/m ²)	Open dislocation	Injured ligaments	Associated fractures	Neurovascular status	Surgery associated with EF implant
1	Male	47	45	32.2	No	ACL + PCL + MCL + LCL	No	No	PCL + MCL repair
2	Male	42	33	41.9	No	ACL + PCL + MCL + LCL	Tibial plateau	No	PCL + PLC repair + internal fixation
3	Male	20	10	22.4	Yes	ACL + PCL + MCL + LCL	No	No	PCL + MCL repair
4	Male	18	18	20.9	No	ACL + PCL + MCL + LCL	No	Popliteal artery	Popliteal artery bypass
5	Male	18	26	21.3	No	ACL + PCL	Tibial plateau	No	PCL + internal fixation
6	Male	27	22	28.8	Yes	ACL + PCL + MCL + LCL	No	No	Wound suture
7	Female	45	20	27.5	No	ACL + PCL + MCL + LCL	Tibial plateau	No	Internal fixation
8	Male	20	34	21.5	Yes	ACL + PCL + MCL	Patella	No	Patella TBW

EF = external fixator; MCL = medial collateral ligament; LCL = lateral collateral ligament; PLC = posterolateral corner; TBW = tension band wiring.

M. Marcacci , S. Zaffagnini, T. Bonanzinga CORR 2012

CLINICAL RESULTS

>60% NORMAL OR NEAR-NORMAL KNEES

Table 2. Clinical results

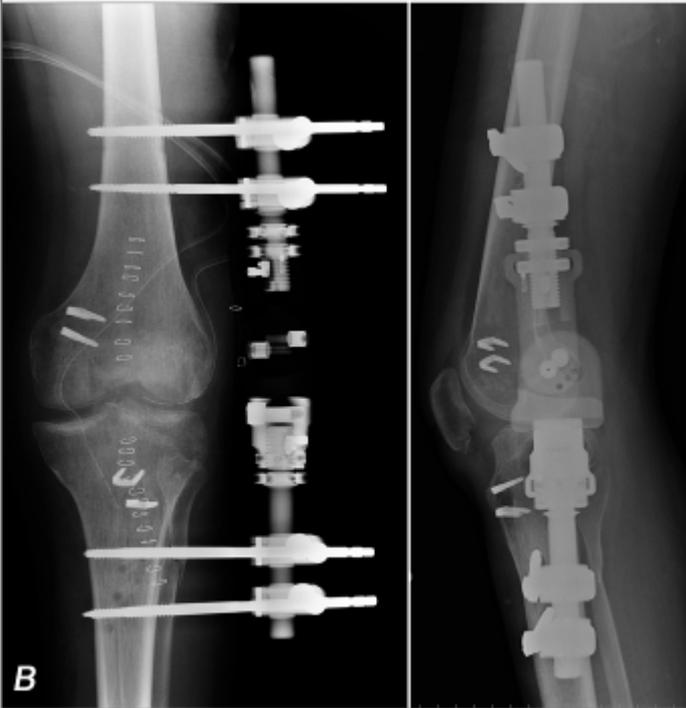
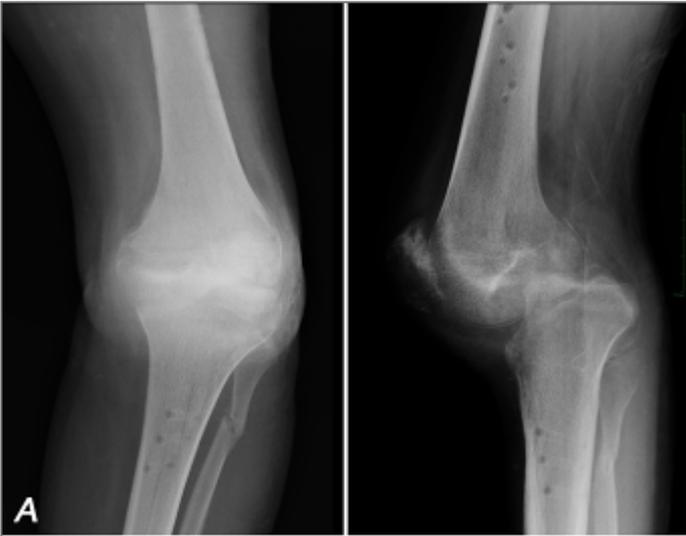
Patient	Lysholm score	IKDC (subjective) score	Tegner level	IKDC (objective) score	ROM	Loss of flexion	KT-1000 TM at MMT (mm)
1	68	67	3	B	0°–100°	20°	2
2	71	68	3	C	0°–110°	15°	4
3	62	61	3	C	0°–120°	15°	2
4	96	92	7	C	0°–140°	0°	6
5	82	78	4	A	0°–120°	5°	1
6	76	69	4	B	0°–115°	20°	2
7	75	73	4	B	0°–120°	10°	3
8	82	78	5	B	0°–130°	10°	3

IKDC = International Knee Documentation Committee; MMT = manual maximum test (side-to-side difference).

- STAGED SURGERY
- SOFT TISSUE PROTECTION
- KNEE STIFFNESS AVOIDANCE
- EARLY MOBILIZATION TO AVOID ARTHROFIBROSIS

M. Marcacci, S. Zaffagnini, CORR, 2012

Male , 21 Years Old



FEMALE 21 Y.



KNEE LUXATION

POPLITEAL ARTERY ISCHEMIA

FEMORO POLITEAL BY PASS

COMPARTIMENTAL SYNDROME

FASCIOTOMY

TEMPORARY KNEE
FIXATION WITH EXTERNAL FIXATOR

✓ EXTERNAL FIXATOR REMOVAL

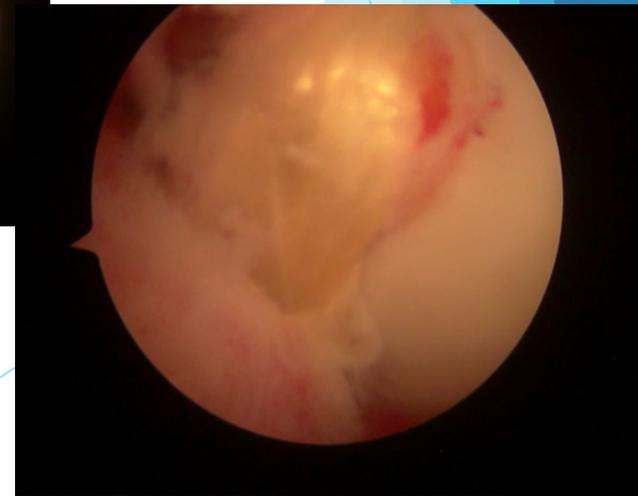
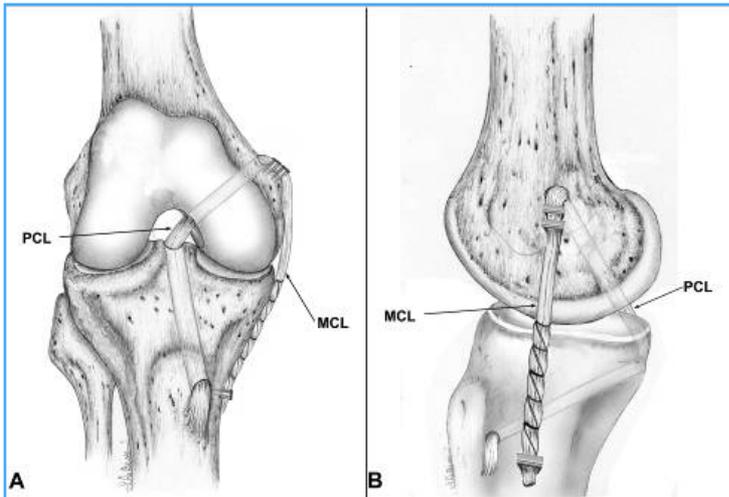
✓ NEXT SURGERY SCHEDULED:

LATERAL MENISCECTOMY (BUCKET HANDLE TEAR)

PCL REC. (G\ST)

MCL REC. (ALLOGRAFT)

25-3-2014 SURGICAL PROCEDURE



CONCLUSION

- ▶ ACCURATE PRE-OPERATIVE EVALUATION
- ▶ ACUTE(3 WEEKS) OR STAGED SURGERY ACCORDING TO DISLOCATION DEGREE (CUSTOMIZED TO PATIENT COMPLICATION)
- ▶ RECONSTRUCTION OR REPAIR OF ALL SOFT TISSUE STRUCTURE
- ▶ IN SEVERE CASE APPLICATION OF DYNAMIC EXTERNAL FIXATOR ALLOW:

STAGED LIGAMENT RECONSTRUCTION(EASIER)
EARLY ROM PROTECTING GRAFT TISSUES



Thank you!

Prof. Stefano Zaffagnini

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