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The effect of leg length discrepancy after hip replacement and options for corrections of inequality

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Definition

Limb length inequality (LLI)

Limb length discrepancy (LLD)

Leg length asymmetrical alignment (LLAA)

Epidemiology

Reported incidence 1-50%

Patient tend to tolerate shortening better than lengthening

Edeen J, Sharkey PF, Alexander AH: Clinical significance of leg-length inequality after total hip arthroplasty. Am J Orthop 1995
Ranawat CS, Rao RR, Rodriguez JA, Bhende HS. Correction of limb-length inequality during total hip arthroplasty. J Arthroplasty 2001;16:71520

Jasty M, Webster W, Harris W. Management of limb length inequality during total hip replacement. Clin Orthop 1996
Flecher X, Ollivier M, Argenson JN: Lower limb length and offset in total hip arthroplasty. Orthopaedics & Traumatology: Surgery & Research 2016

Overview

Average LLD 3 to 17 mm (retrospective series)

95-97% patients – no perception of LLD
(prospective series)

Observed trend in published papers –
smaller differences, growing perception

Williamson JA, Reckling FW. Limb length discrepancy and related problems following total hip joint replacement. Clin Orthop 1978

Ranawat CS, Rodriguez JA. Functional leg-length inequality following total hiparthroplasty. J Arthroplasty 1997

Flecher X et al.: Lower limb length and offset in total hip arthroplasty. Orthopaedics & Traumatology: Surgery & Research 2016

Woolson ST et al.: Results of a method of leg-length equal-ization for patients undergoing primary total hip replacement. J Arthroplasty 1999 T

Röder Ch et al.: Total hip arthroplasty: leg length inequality impairs functional outcomes and patient satisfaction, BMC Musculoskeletal Disorders, 2012

Risk factors of structural LLD

Narrow femoral canal

Short, varus femoral neck

Significant abnormal femoral diaphysis

Protruded acetabulum

Acetabular deformity

High BMI

Uncemented stem

Ahmad R, Sharma V, Sandhu H, et al. Leg length discrepancy in total hip arthroplasty with the use of cemented and uncemented femoral stems. A prospective radiological study. Hip Int 2009

Jasty M, Webster W, Harris W. Management of limb length inequality during total hip replacement. Clin Orthop Relat Res 1996

Risk factors of intolerance of LLD

Short posture

Female

Narrow pelvic width

Pre-existing scoliosis

Ipsi and contralateral ankle / knee deformity

Pr-existing abductors contracture

DDH

Early stage of hip OA

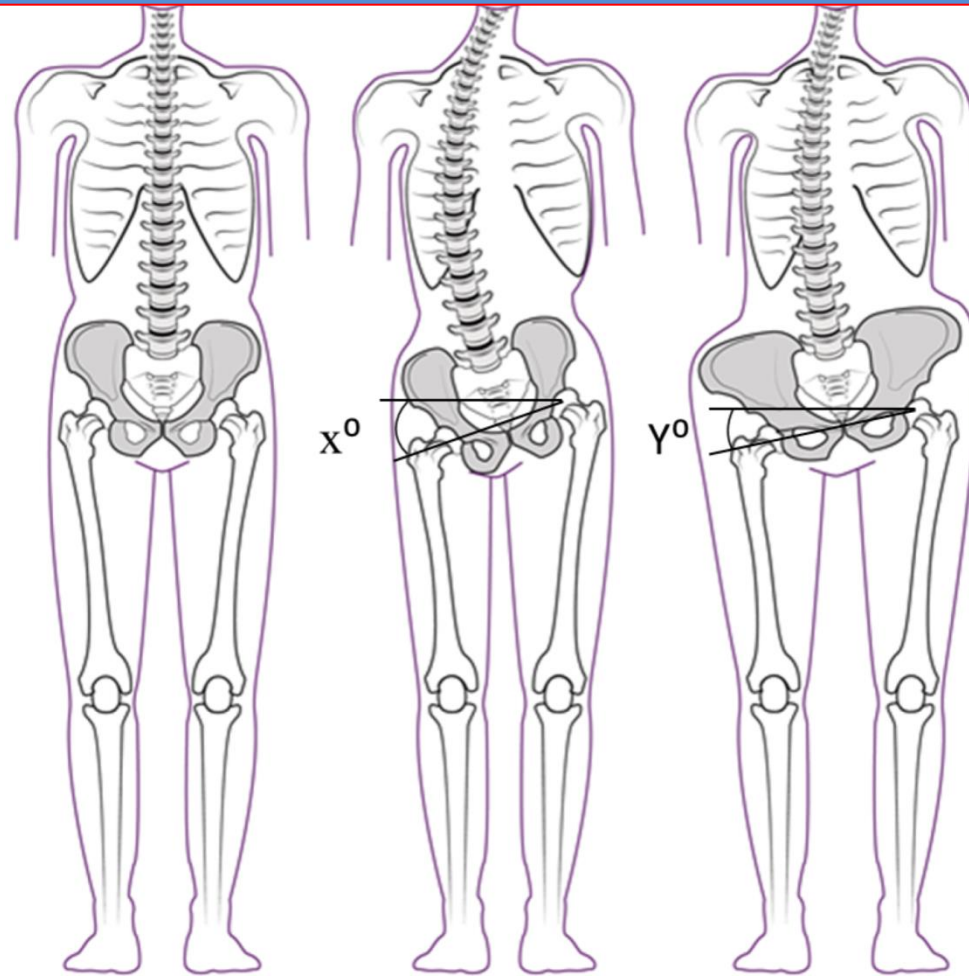
Demanding patients

Gurney B. Leg length discrepancy. Gait Posture 2002,

Ali A, Walsh M, O'Brien T, et al. The importance of submalleolar deformity in determining leg length discrepancy. The Surgeon 2014

Rubash HE, Parvataneni HK. The pants too short, the leg too long: leg length inequality after THA. Orthopedics 2007,

Pelvic width and obliquity effect on accomodation of LLD



Similar LLD, narrow pelvis has to adopt the greater scoliosis, angle $x > y$

Spontaneous inequality reduction

1 month post op: 14/100 patients perceived pelvic obliquity

6 months: 0/100

Ranawat CS, Rodriguez JA: Functional leg-length inequality following total hip arthroplasty. *J Arthroplasty* 1997

Mild discrepancy (10-15 mm) is well tolerated after 3-6 months in 85% patients

White TO, Dougall TW. Arthroplasty of the hip. Leg length is not important. JBone Joint Surg Br 2002

Postoperative LLD

Anatomical (structural)
Aparent (functional)

30% patients after THR perceived LLD (329 from 1114)

Only 36% (118 from 329) had measurable anatomical discrepancy

Patient perception of LLD and radiological presence of LLD do not correlate well

Wylde V, Whitehouse SL, Taylor AH, Pattison GT, Bannister GC, Blom AW. Prevalence and functional impact of patient-perceived leg length discrepancy after hip replacement. Int Orthop 2009

Benedetti MG, Catani F, Benedetti E, Berti L, Di Gioia A, Giannini S. To what extent does leg length discrepancy impair motor activity in patients after total hip arthroplasty? Int Orthop 2010

Material

115 Total hip arthroplasties (2015-2017)

69 - contralateral hip intact

46 – well functioning hip prosthesis

11 – perception of postoperative LLD
(reported at end of hospital stay)

9 – elongation

2 - shortening

Results

Perception of elongation – n=9

RTG measurement – positive n=3 (4, 5, 9 mm)
negative n= 6

Results

Perception of shortening – n=2

RTG measurement – negative n= 2

Results

3 months – post op asesesement n=11
(no shoe rise)

Perception of equality n=5

Perception of inequality n=6
(reduced intensity)

Results

1 year - post op asesement n=11

Perception of equality n=10

Perception of inequality n=1 (lenghtening)
(no shoe rise)

R

L



Male, 64 y-o, OFN with collapse, symptoms – 2 years, progressive shortening 1 year



Post – op. Patient not satisfied. Perception of persistent shortening. Low-back pain !!!



3 m-ths, reduced perception of LLD and minimal low back pain



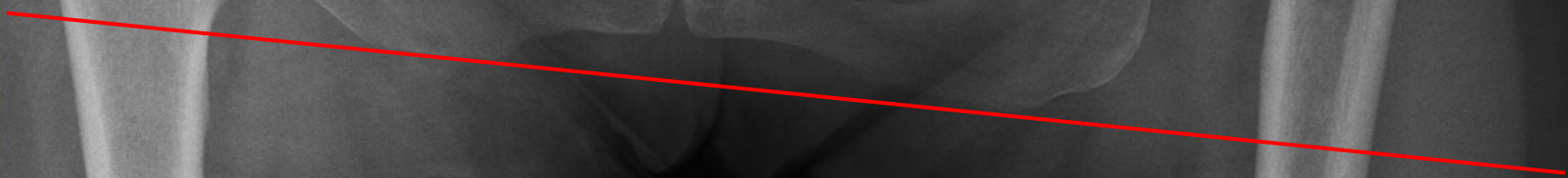
1 year post op. No low back pain, perception of equal leg lengths



2 years post op. No low back pain, perception of equal leg lengths



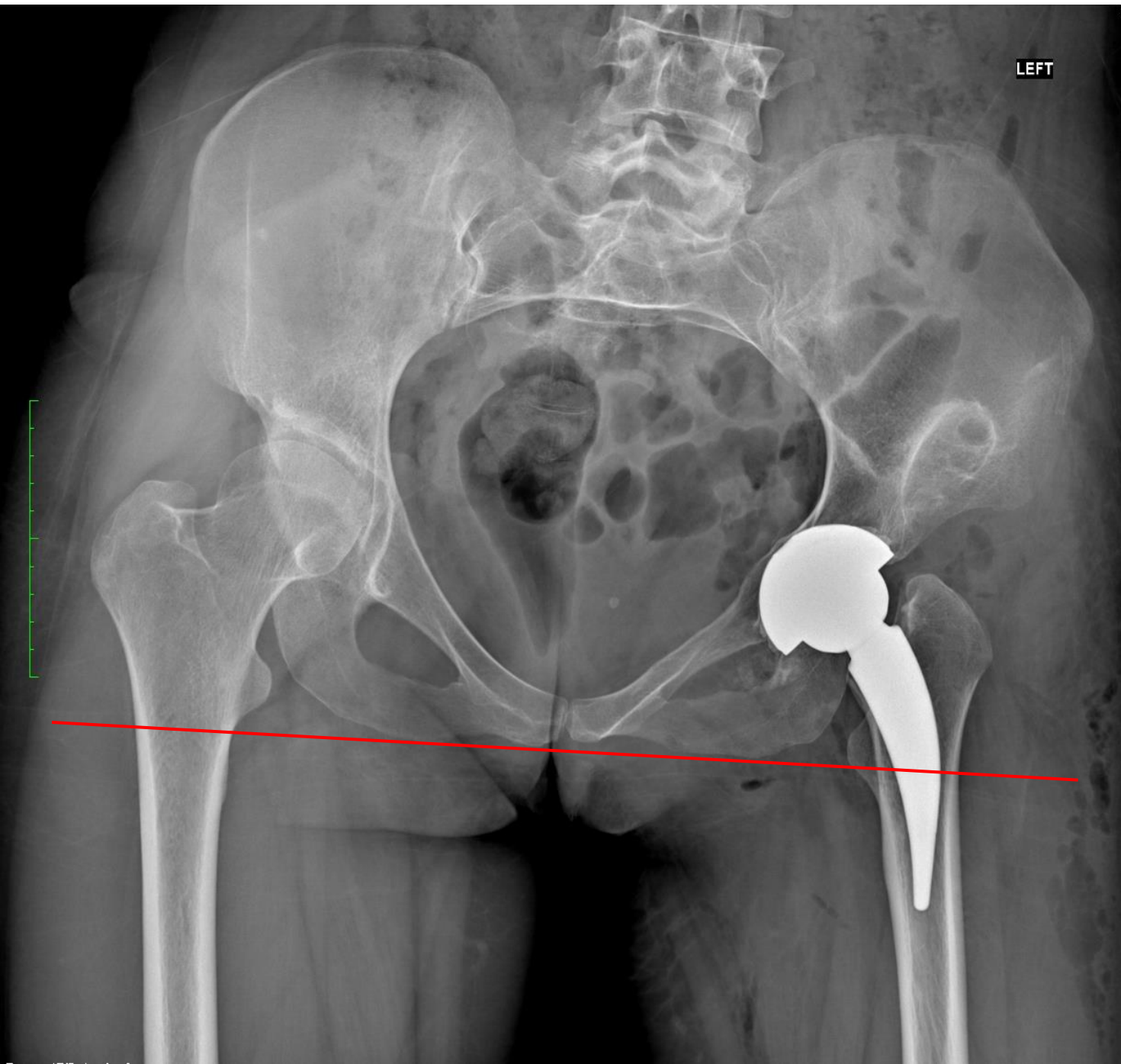
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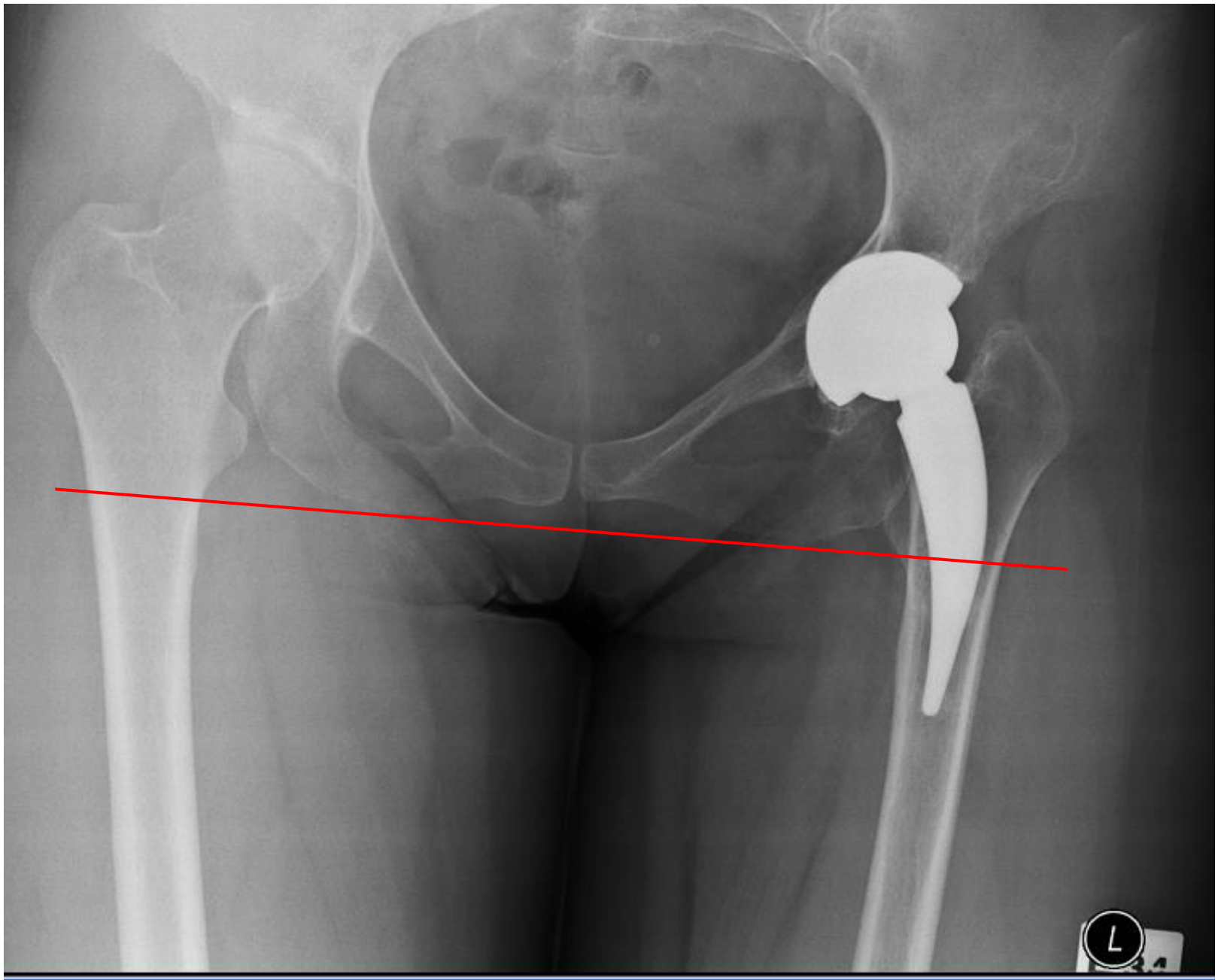
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Crowe IV

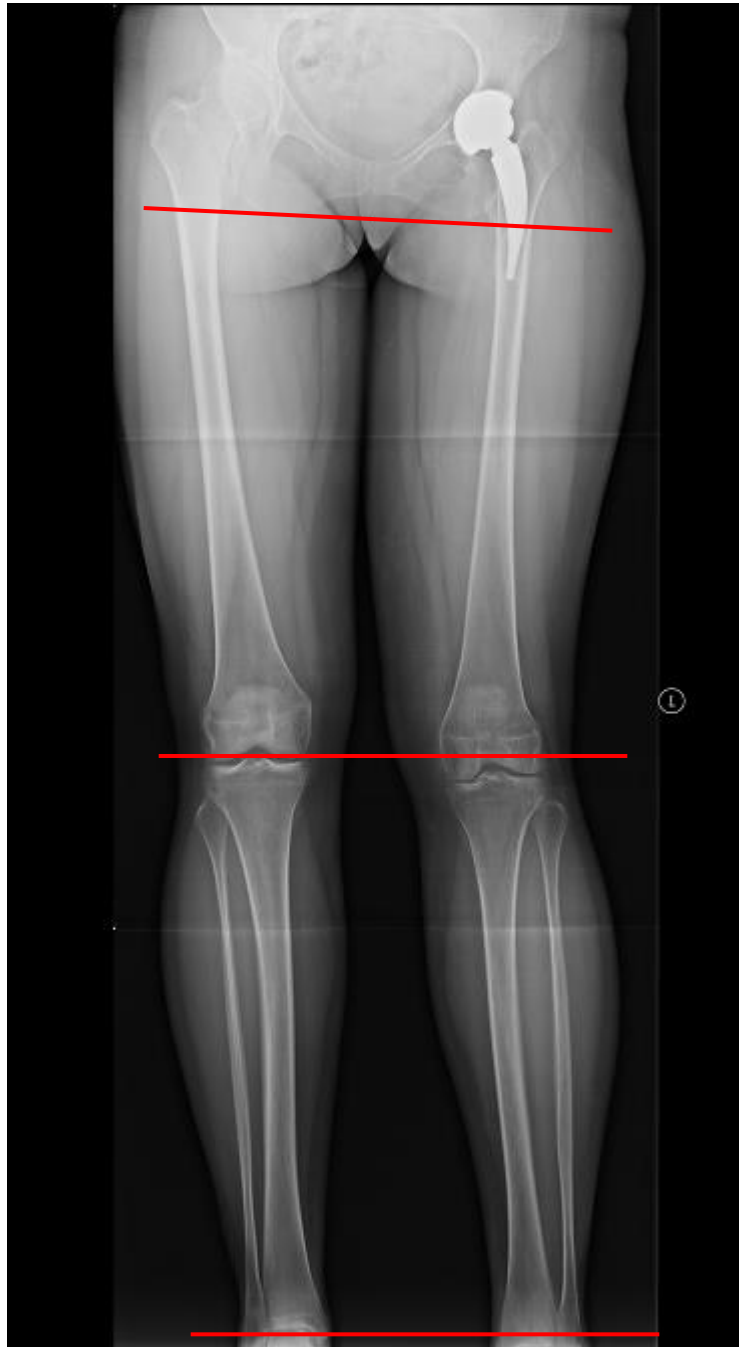
29 y.o.



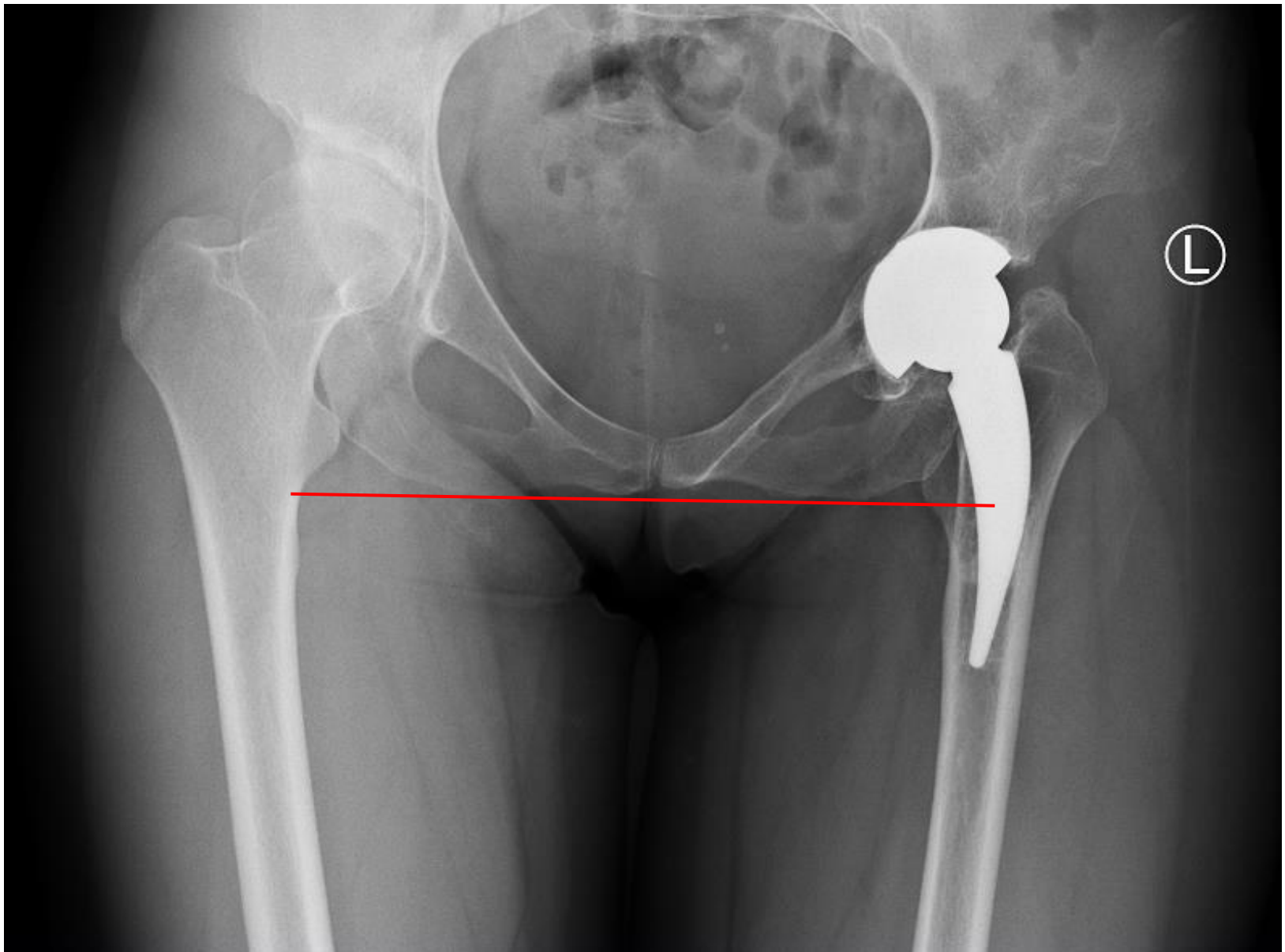
Post op
Anatomical and
functional
elongation



3 months – anatomical and functional elongation, reduced perception



Post op
1 year



Post op 3 years. No shoe rise

Results of LLD

Patient dissatisfaction

LLD the most common cause of litigation in US
fourth / fifth in Europe

Primary and secondary effects

Edeen J, Sharkey PF, Alexander AH: Clinical significance of leg-length inequality after total hip arthroplasty. Am J Orthop 1995
Ranawat CS, Rao RR, Rodriguez JA, Bhende HS. Correction of limb-length inequality during total hip arthroplasty. J Arthroplasty 2001;16:715-20

Jasty M, Webster W, Harris W. Management of limb length inequality during total hip replacement. Clin Orthop 1996;333:165-71

Flecher X, Ollivier M, Argenson JN: Lower limb length and offset in total hip arthroplasty. Orthopaedics & Traumatology: Surgery & Research 2016

Primary effect of LLD

Nerve paresis/paralysis

Proven correlation in majority of literature data. Lengthening more than 2-4 cm – significantly increase risk of neuronal injury

Limited ROM

shortening – bone-prosthesis-bone conflict

lengthening – muscle/ligament/capsule
contracture

Della Valle CJ, Di Cesare PE: Complications of total hip arthroplasty: neurovascular injury, leg-length discrepancy, and instability. Bull Hosp Jt Dis 2001

Dora C, Houweling M, Koch P, Sierra RJ. Iliopsoas impingement after total hip replacement: the results of non-operative management, tenotomy or acetabular revision. J Bone Joint Surg Br. 2007

Early secondary effect of LLD

Functional scoliosis

Low back pain

Deterioration of lumbar arthritis

Gait abnormalities

Iliopsoas impingement

Instability ?

Trochanteric bursitis /Greater Trochanteric Pain

Sayed-Noor AS, Sjöden GO: Greater Trochanteric Pain after Total Hip Arthroplasty: the incidence, clinical outcome and associated factors. Hip International 2006

Williamson JA, Reckling FW: Limb length discrepancy and related problems following total hip joint replacement. Clin Orthop Relat Res 1978

Late secondary effect of LLD

Low back pain

Structural scoliosis

DEGENERATIVE EFFECTS ?

Spine

Pelvis

Hips

Knees

Stress fractures ?

Increased wear, higher risk of failure ?

Late secondary effect of LLD

Increased wear, higher risk of failure ?

No valid data

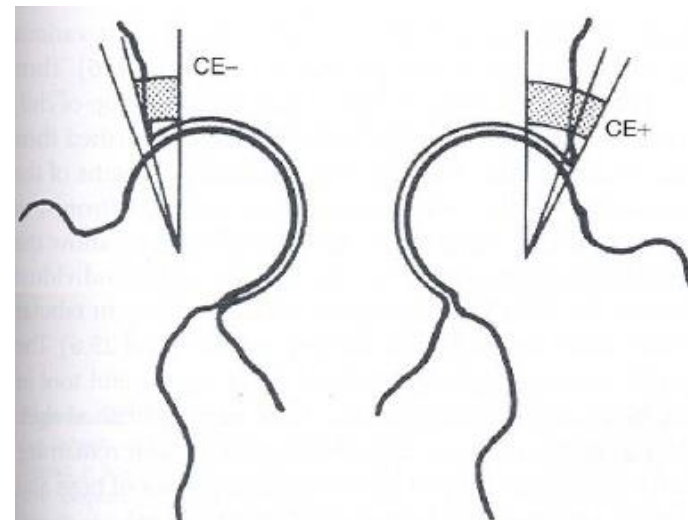
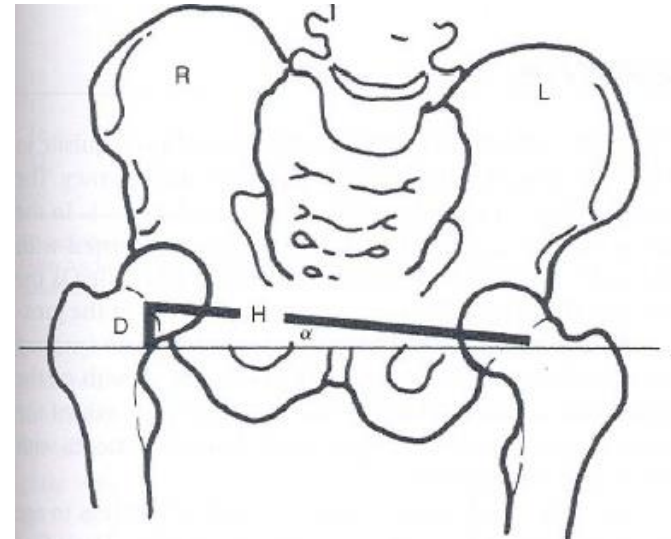
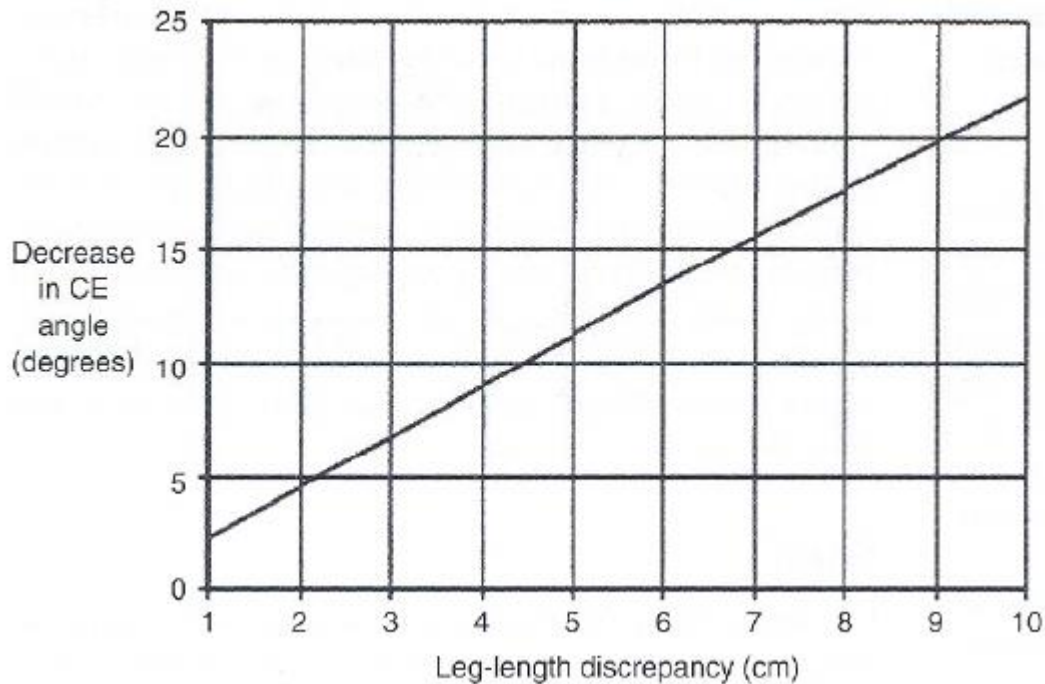
Retrospective series

Old type of implants

Does LLD influence on contralateral hip ?

Shortening THR leg

biomechanical effect of longer hip adduction:
reduction of CE angle



Risk of OA?

No valid data

Does LLD influence on ipsilateral knee ?

Suggested increased risk of secondary knee OA if LLD > 1 cm

If shortening resulted valgus knee
(small offset, hip adduction)

Proven increased risk of secondary knee OA

Donald R Noll : Leg Length Discrepancy and Osteoarthritic Knee Pain in the Elderly: An Observational Study. J Am Osteopath Assoc. 2013

Jackson BD et al.: Reviewing knee osteoarthritis--a biomechanical perspective. J Sci Med Sport. 2004

Yvonne M. et al.: Hazard of Incident and Progressive Knee and Hip Radiographic Osteoarthritis and Chronic Joint Symptoms in Individuals with and without Limb Length Inequality, J Rheumatol. 2010

Late secondary effect of LLD

Stress fracture ?

proven effect in athletes, military recruits

Stress fracture (foot, tibia, femur) on recruits

Limb equality 15.4%

Inequality 1 cm 46.2%

Inequality 1,5 to 2 cm 67%

73% fractures on lengthening side

Stress fracture incidence on runners with LLD 2 x higher vs control

McCaw, BT Bates (1991) Biomechanical implications of mild leg length inequality. J Sp Med 25(1): 10-13.

Bradley D Castellano (2011) Significance of Minor Leg Length Discrepancy. Chapter 35, Podiatry Institute, Georgia, pp.182

Problem after THR ?

NO DATA

Propylaxis of LLD

Identification patient at risk

Correct planning

- pelvic obliquity
- cup position
- level of resection
- stem position

Implant selection

Intraoperative techniques to control pre-op planning

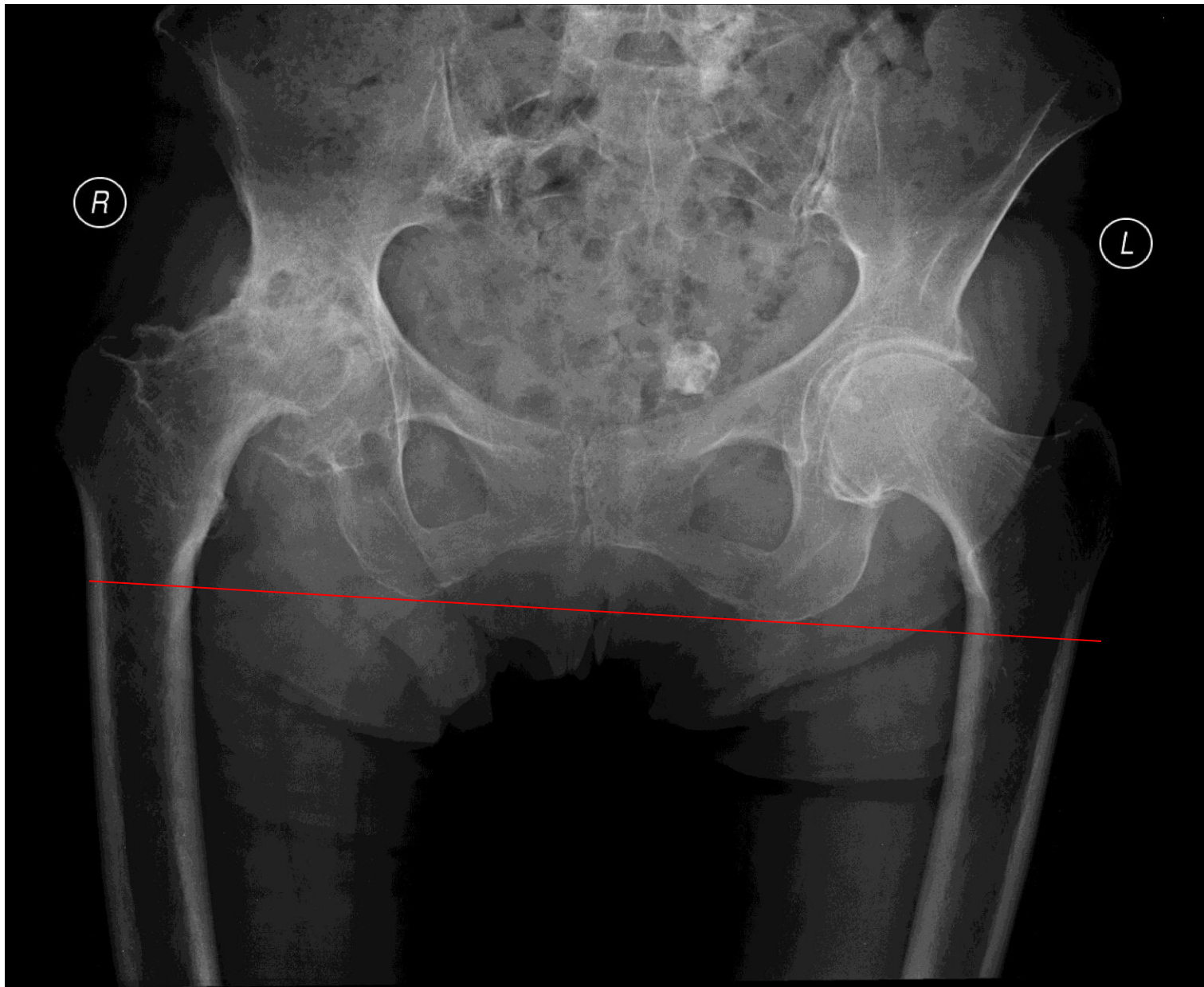
Pelvic obliquity

Corretive:

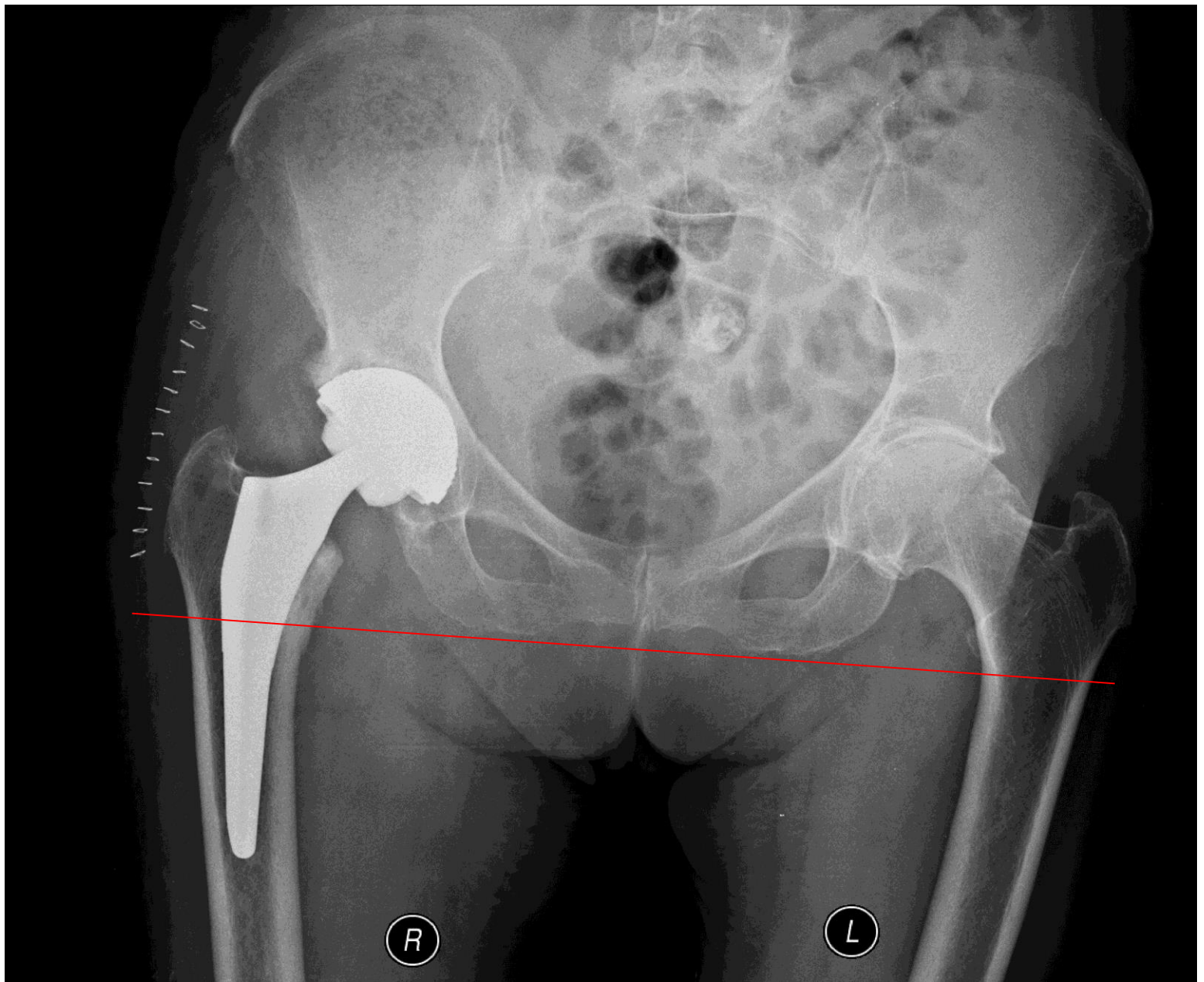
ignore in pre-op planning

NOT Corrective:

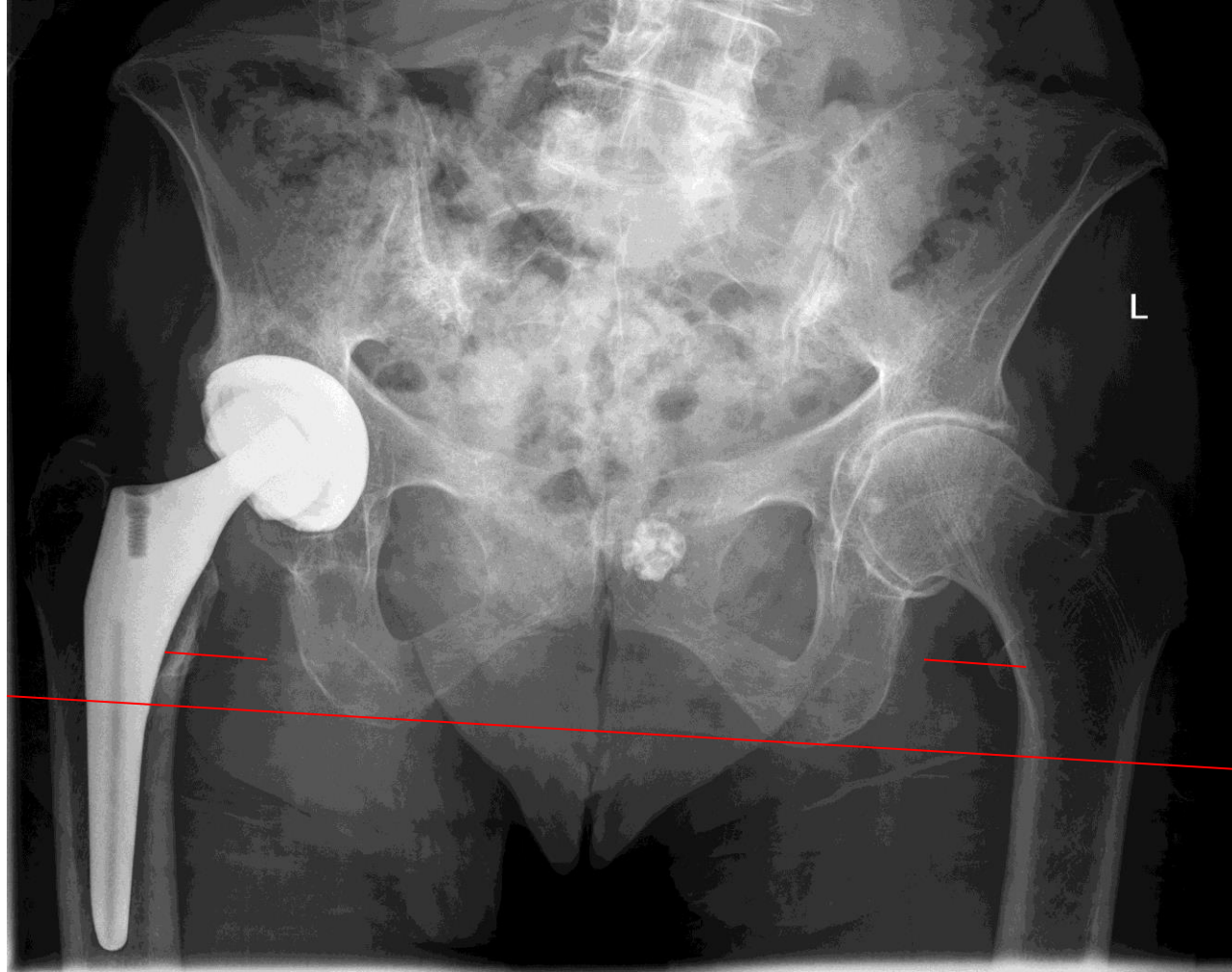
include in your plan



Pre-op anatomical and functional right leg shortening



Post-op anatomical lengthening, functional equality



Why ? 3 months post-op anatomical lengthening, functional equality

Non corrective degenerative lumbar scoliosis

Does modularity of primary implant help to avoid LLD?

Table HT25 Primary Total Conventional Hip Replacement by Reason for Revision and Type of Femoral Neck (Primary Diagnosis OA)

Reason for Revision	Number	Exchangeable		Fixed		
		% Primaries Revised	% Revisions	Number	% Primaries Revised	% Revisions
Loosening	179	1.8	25.9	2796	0.9	25.6
Prosthesis Dislocation	147	1.5	21.3	2359	0.8	21.6
Fracture	117	1.2	16.9	2148	0.7	19.7
Infection	75	0.7	10.9	1980	0.6	18.1
Lysis	13	0.1	1.9	253	0.1	2.3
Pain	17	0.2	2.5	202	0.1	1.8
Lea Length Discrepancy	7	0.1	1.0	162	0.1	1.5
Malposition	9	0.1	1.3	145	0.0	1.3
Instability	11	0.1	1.6	114	0.0	1.0
Implant Breakage Stem	20	0.2	2.9	99	0.0	0.9
Wear Acetabular Insert				98	0.0	0.9
Implant Breakage Acetabular Insert	10	0.1	1.4	92	0.0	0.8
Incorrect Sizing	7	0.1	1.0	83	0.0	0.8
Implant Breakage Acetabular	11	0.1	1.6	65	0.0	0.6
Metal Related Pathology	57	0.6	8.2	61	0.0	0.6
Wear Head	2	0.0	0.3	39	0.0	0.4
Implant Breakage Head	3	0.0	0.4	36	0.0	0.3
Heterotopic Bone				18	0.0	0.2
Tumour				14	0.0	0.1
Wear Acetabulum				13	0.0	0.1
Synovitis	1	0.0	0.1	2	0.0	0.0
Other	5	0.0	0.7	140	0.0	1.3
N Revision	691	6.8	100.0	10919	3.5	100.0
N Primary	10114			314513		

Non-operative management

Well reported improvement of symptoms in the absence of treatment

Shoe rise (wedge, orthoses) — 40-100% improvement reported

Postural, stretching exercises — good to excellent improvement in 90% patients 6 months to 1 year

Abraham WD, Dimon JH, 3rd. Leg length discrepancy in total hip arthroplasty. Orthop Clin North Am 1992

Konyves A, Bannister GC. The importance of leg length discrepancy after total hip arthroplasty. J Bone Joint Surg Br 2005

Indication for revision

Very few publications
Small series

0,3% all revisions

n=21

71% cup revision

14% stem revision

14% both elements

Table HT15 Primary Total Conventional Hip Replacement by Reason for Revision (Primary Diagnosis OA)

Reason for Revision	Number	Percent
Loosening	2975	25.6
Prosthesis Dislocation	2506	21.6
Fracture	2265	19.5
Infection	2055	17.7
Lysis	266	2.3
Pain	219	1.9
Leg Length Discrepancy	169	1.5
Malposition	154	1.3
Instability	125	1.1
Implant Breakage Stem	119	1.0
Metal Related Pathology	118	1.0
Implant Breakage Acetabular Insert	102	0.9
Wear Acetabular Insert	98	0.8
Incorrect Sizing	90	0.8
Implant Breakage Acetabular	76	0.7
Implant Breakage Head	39	0.3
Other	234	2.0
TOTAL	11610	100.0

Indication for revision

Reason for revision

Australian Register
Annual Report 2017

Operative management

Femoral head exchange

- simple in shortening – many options

- limited value in lengthening – frequently implanted short head

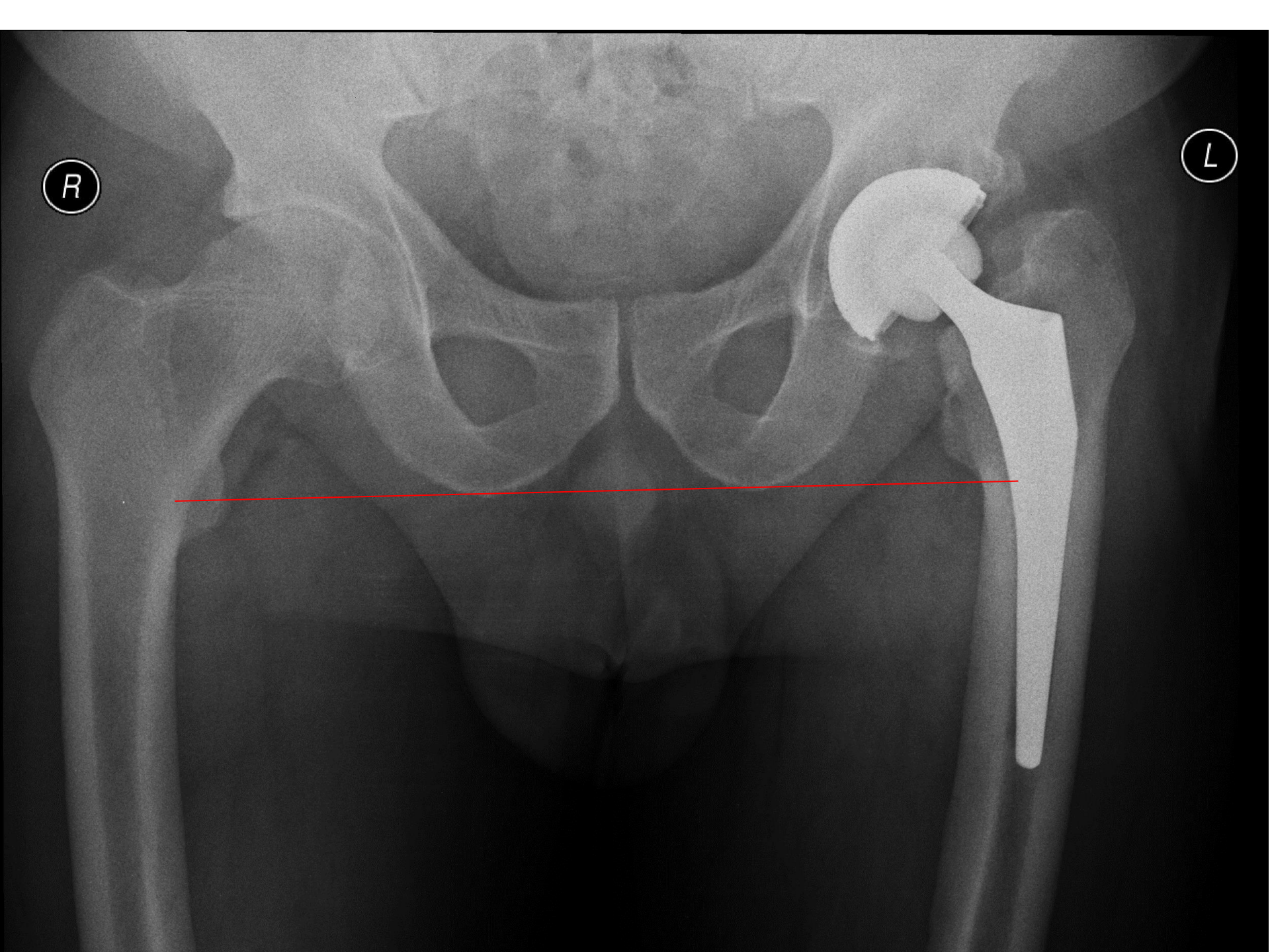
Change diameter of articulation

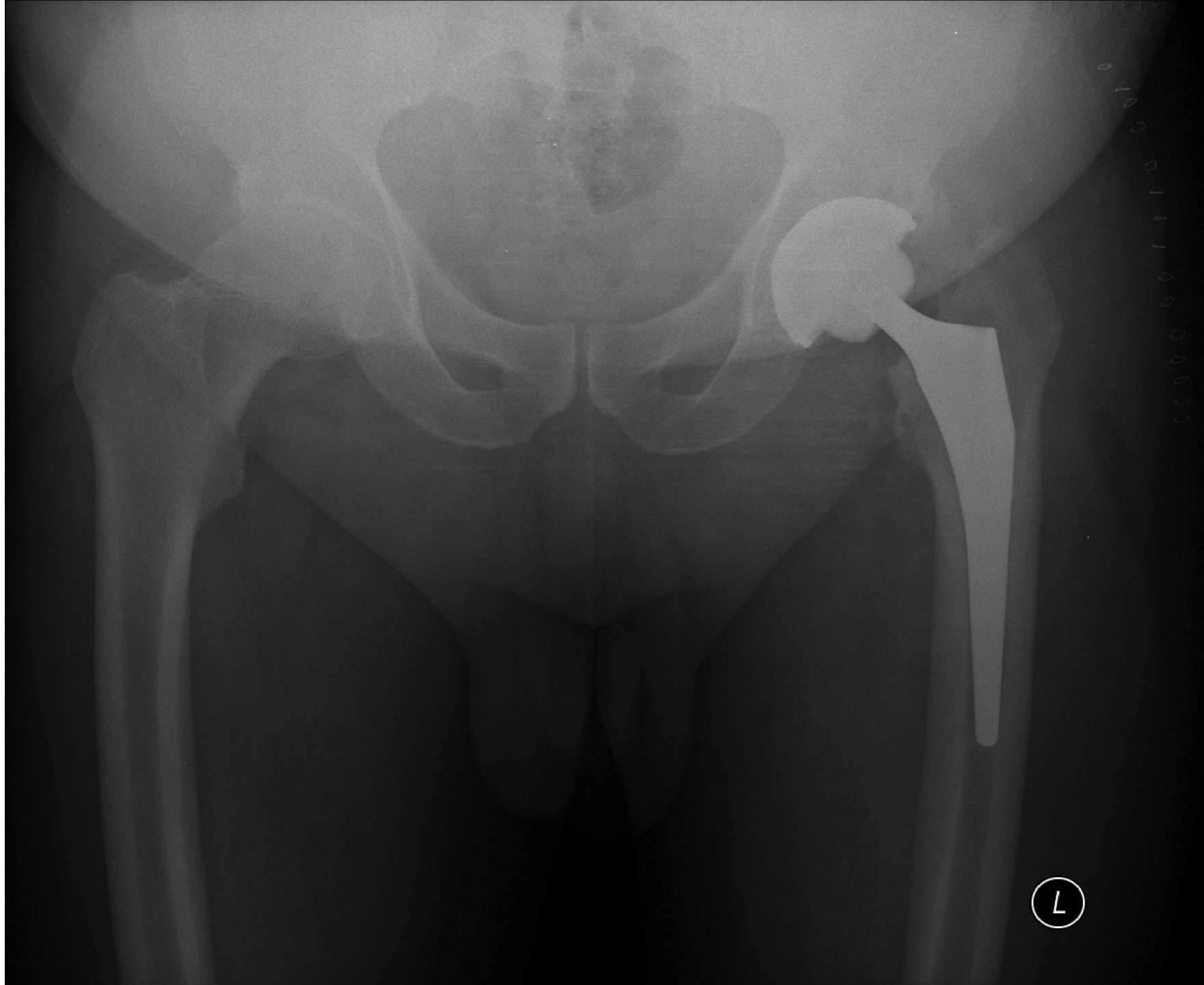
Stem / acetabular / revision

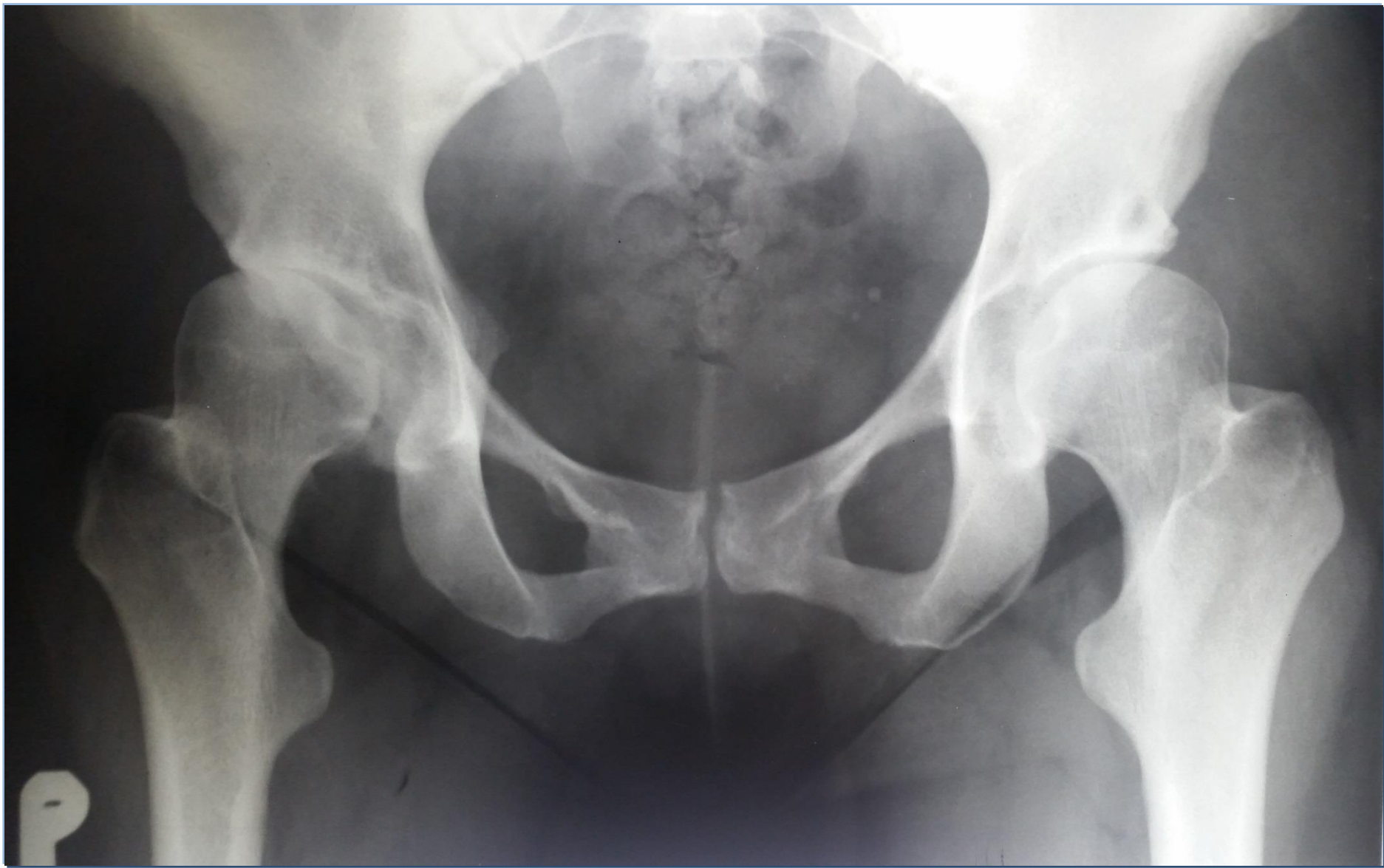
Heterotopic ossification resection

Soft tissue release

THR of the contra-lateral site?





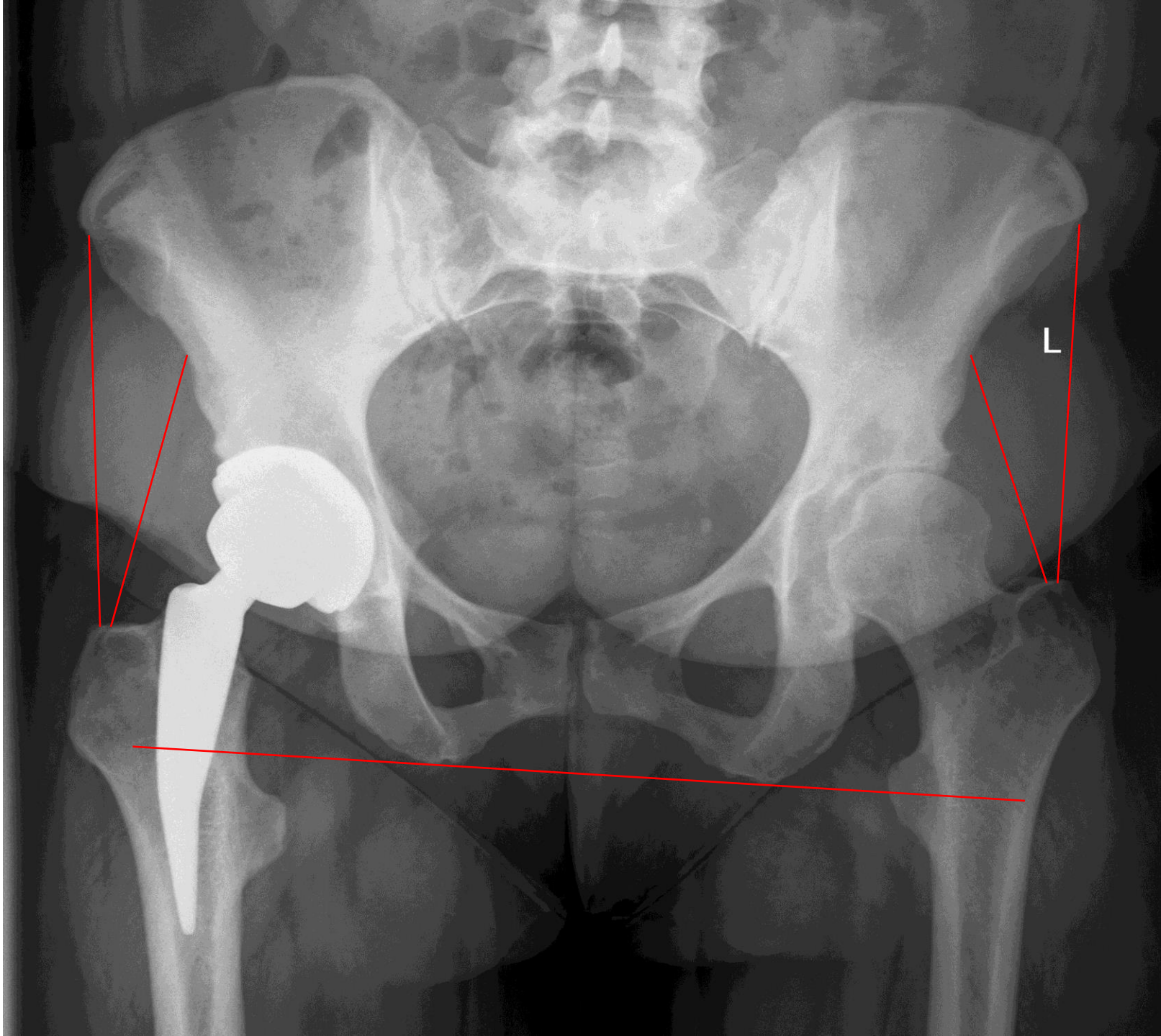




Incorrect implantation

Indication for stem revision

Significant elongation
Not tolerated
Shoe rise
Limping



Post-operative LLD

Best scenario - to prevent

High probability of reduction perception
with time

Uncommon indication for revision

What is acceptable LLD ?

Not perceived by patient



Thank you for attention



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