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Legg-Calvé-Perthes Disease

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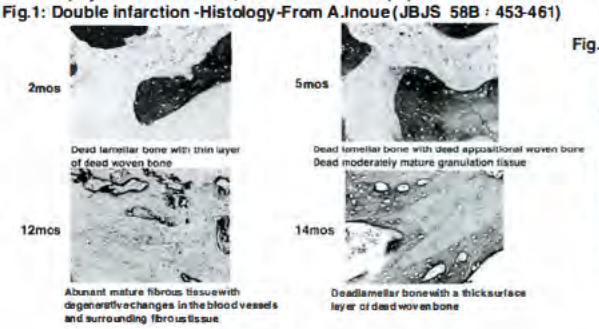
History of LCPD in Europe and USA

1909 Waldenström : Case reports like LCPD
1910 Legg, Calvé and Perthes reported some cases
1913 Perthes : Histology ; no infection
1914 Schwarz : Histology ; no infection
1918 Iselin : Blood flow
1919 Edberg : Histology; no infection
1920 Waldenström : denial of infection theory
1921 Phemister : Epiphyseal bone necrosis
1923 Axhausen : Bone necrosis due to ischemia
1926 Benzon : Experimental model study using bovine ; no success
1933 Faber : Arthrography ; intact of articular cartilage
1934 Leriche : Experimental model study using ligation of vessels ; no success
1953 Jonsaeter : Histology VS radiogram ; time-sequential changes
1953 Trueta : Microangiography ; changes of blood flow with aging
1966 Emr : Epiphyseal flattening of intact side
1971 Catterall : Radiographic classification
1973 Sanchis : Experimental model study using double infarction (DI) ; success
1974 McKibbin : Histology of human LCPD ; proving double infarction
1977 Stulberg : Long term follow up ; relationship between femoral head deformities at physeal closure and osteoarthritis at last follow-up
1977 Chiari : Treatment by Chiari operation
1980 Sutherland : Bone scintigram ; early detection of LCPD compared to radiogram
1980 Bohr : First report of MRI in LCPD
1984 Scloes : MRI report
1986 Eleanor : Epiphyseal flattening of intact side without deformities of articular cartilage
1987 Ippolito : Spica cast with non weight bearing for Catterall II to IV ; 38% of Stulberg I and II
1990 Coates: Femoral neck osteotomy for Catterall II to IV ; 58% of Stulberg I and II
1990 Henderson : Evaluation of MRI in LCPD
1997 Sebag : Dynamic gadlinium-enhanced subtraction MRI ; early diagnosis
2000 de Sanctis : Prognostic evaluation of LCPD by MRI

Histological Study

1930 K. Nagasaka : (J Hukuoka Medical Collage 23:108-54)
Necrosis of bone marrow and bone travecula
Secondary degeneration of articular cartilage
Breakage of growth plate
Reparative tissue around necrotic bone
1959 M.Yamaguchi : Pathological study according to stages of LCPD
T.Miyauchi : (Cent Jpn J Orthop Traumat 3:305-323)
First report of double infarction (DI) of LCPD ;
Necrosis of woven bone around necrotic bone travecula
1976 A. Inoue : (JBJS 58B : 453-461) (Fig.1)
Biopsy of human LCPD ; Double infarction (DI)

Fig.1: Double infarction -Histology-From A.Inoue (JBJS 58B : 453-461)



Blood flow

(Venography, Microangiography, Intraosseous pressure)

1933 Shinohara
1965 M. Hirayama : No blood flow from ligament teres artery even after on set of LCPD
1969 T. Matsumoto (J JOA 43 : 1013-1026)
Intercapsular pressure of the hip joint decrease and blood flow in the femoral head increase at slight flex-abuduction-internal rotation or slight flexion-abduction external rotation position of the hip joint
1977 K. Iwasaki : Double infarction was proved by intraosseous Venography of LCPD
1981 K. Iwasaki : (Clin Orthop 159:248-256)
Significance of ligament teres artery with LCPD
2000 T. Atsumi : (JBJS 82B:392-398)
Super selective angiography
Interruption of lateral epiphyseal arteries (68%)
No vascular penetration in weight-bearing portion of the femoral head

Image study

1926 K. Takagi : (J JOA 1:73-92)
Air arthrography
No cartilage deformity of the femoral head in spite of epiphyseal nucleus deformity
1954 Y. Masabayashi : (J JOA 27:420-426)
Arthrography ; Articular cartilage deformities according to stages of LCPD
Severe deformity on anterolateral portion of femoral head
1969 S.Matsumori : (Cent Jpn J Orthop Traumat 13 : 381-391)
Hypoplasia of femoral head on the intact side
2000 M. Hosokawa : (J Kyoto Pref Univ Med 109:541-550)
Time-sequential MRI study (Fig. 3,4), double infarction (Fig. 5) on MRI, outcome prediction on MRI score
Physeal deformity and arthicular cartilage width of femoral head of LCPD

Treatment

1984 Y. Sugioka : (Clin Orthop 184:12-23) (Fig.2)
Rotational osteotomy of femoral head for LCPD
1990 K. Tamura : (Cent Jpn J Orthop Trauma 33:598-560)
Modified A-Cast treatment ;
Stulberg evaluation 93% (Stulberg I and II)
1990 Y. Sugioka : (J JOA 64 : S96)
Congruency was all achieved by rotational osteotomy of femoral head for hinged abduction cases
1991 T. Atsumi : (Seikeigeka 42 : 721-716 in Japanese)
Rotational osteotomy of femoral head for hinged abduction cases ; Stulberg I and II ; 67%, III or IV ; 22%, V ; 11% for hinged abduction of LCPD

Fig.2 : Anterior rotational osteotomy of femoral head for LCPD

Recent MRI study of LCPD in Japan

1991 Y. Kumasaka (Pediatric Radiology;21 : 208-210)
Modified epiphyseal index for MRI in LCPD

1991 Y. Kumasaka (Nippon Acta Radiologica ;51:1232-1239)
Changes in the cartilaginous contour of LCPD-calculation on T1-weighted MR images

1992 M. Oshima (Europ J Radiol 15: 107-112)
Initial stage of LCPD-comparison of three-phase bone scintigraphy and SPECT with MR imaging
A.Uno:(J Pediat Orthop 15:362-367)
Comparison of MRI with bone scintigraphy

1999 M.Hosokawa:(J Pediat Orthop 8-B:161-164)
Preliminary report on usefulness of MRI for outcome prediction in early-stage LCPD

Fig.3: Time-sequential changes of LCPD on MRI

Healing process (Stulberg I)

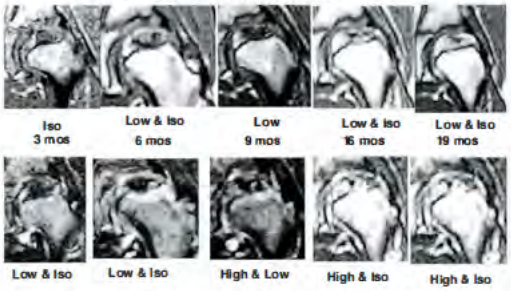


Fig.4 : Time-sequential changes of LCPD on MRI

Delayed healing process (Stulberg III)

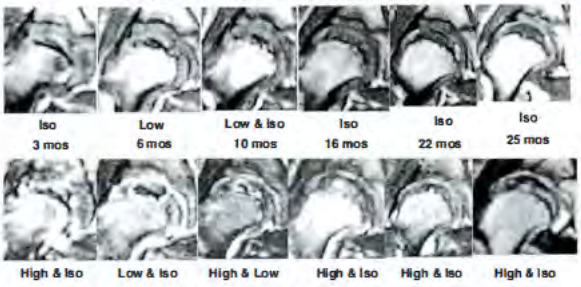
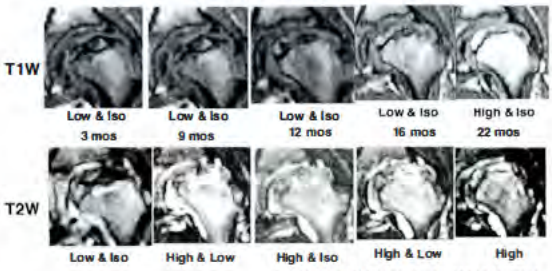


Fig.5: Time-sequential changes on MRI

Delayed healing (Stulberg III)



Double infarction in weight bearing area

MCS (Multi Center Study) of LCPD in Japan organized by JPOA

Numbers of Institutes for MCS : 93
Case 725 (783 hips)
Gender: Male 656, Female 78, No check 10
Age at diagnosis: 2Y4M~ 15Y1M, Ave. 7Y1M
Affected side: Rt. 284, Lt. 380, Both 58, No check 3
Body Height: 82.5 cm ~ 166 cm, Ave.118.0 cm
Body Weight: 12 kg ~ 75 kg, Ave. 23.9 kg

Catterall	Classification		Catterall					
I	31	4.3%	I	6	11	2	0	0
II	110	15.2%	II	35	26	8	3	0
III	352	48.6%	III	50	87	55	10	4
IV	215	29.7%	IV	18	46	42	22	0
unclear	17	2.3%		I	II	III	IV	V
						Stulberg		

Herring	Classification		Herring					
A	70	20.4%	A	23	15	4	0	0
B	361	49.8%	B	56	113	56	8	2
C	148	20.4%	C	5	33	37	17	2
unclear	146	20.1%		I	II	III	IV	V
							Stulberg	

Age at diagnosis VS Outcomes (Stulberg evaluation)

Age	I	%	II	%	III	%	IV	%	V	%	Total
4≦	20	40.1	14	28.6	13	26.5	2	4.1	0	0.0	49
5≦	19	37.3	16	31.4	12	23.5	4	7.8	0	0.0	51
6≦	27	27.0	38	38.0	24	24.0	11	11.0	0	0.0	100
7≦	24	24.7	39	40.2	23	23.7	11	11.3	0	11.3	97
8≦	31	24.8	52	41.6	28	22.4	13	10.4	1	0.8	125
9≦	16	22.9	31	44.3	19	27.1	3	4.3	1	1.4	70
10≦	4	11.8	15	44.1	11	32.3	2	5.9	2	5.9	34
11≦	2	5.4	18	48.6	11	29.7	5	13.5	1	2.7	37
11>	2	8.3	5	20.8	10	41.7	4	16.7	3	12.5	24
Total	145		228		151		55		8		587

MCS for Perthes Disease

Outcomes (Containment Methods)

Stulberg	Total n=537	Cons. n=449	Ope. n=88
I	24.6 %	24.5 %	25.0 %
II	40.6 %	41.4 %	36.4 %
III	25.3 %	25.4 %	25.0 %
IV	8.2 %	7.8 %	10.2 %
V	1.3 %	0.9 %	3.4 %

Conservative NWB VS WB

Stulberg (n= 185) in Catterall III — IV

	I	II	III	IV	V	Total
FWB	4	19	8	4	0	35
%	11.4	54.3	22.9	11.4	0	
NWB	22	67	35	11	1	136
%	16.2	49.3	25.7	8.1	0.7	
PWB	4	2	6	2	0	14
%	28.6	14.3	42.9	14.3	0	

FWB: full weight bearing, NWB: non-weight bearing, PWB: partial weight bearing