

## Is conservative treatment really effective for Legg-Calvé-Perthes disease? A critical review of the literature

Riccardo Sinigaglia<sup>1</sup>, Albert Bundy<sup>2</sup>, Tosan Okoro<sup>3</sup>, Cosimo Gigante<sup>4</sup>, Sisto Turra<sup>4</sup>

<sup>1</sup>"Sandro Agostini" Spine Surgery Unit, Padua University Hospital, Padua, Italy

<sup>2</sup>Boston Ultrasound Consult Pc, Brookline, Boston, MA, USA

<sup>3</sup>Orthopaedics, Leicester General Hospital, Leicester, Coventry, UK

<sup>4</sup>Orthopaedic and Traumatology Unit, Padua University Hospital, Padua, Italy

### Summary

**Introduction.** The treatment of Legg-Calvé-Perthes Disease (LCPD) is controversial and not well defined. This literature review aimed to assess the quality of the evidence available to support the effectiveness of conservative LCPD treatment advocated by orthopaedic surgeons and(or) paediatricians. A secondary aim was to see if conservative treatments really modify the natural history of LCPD. **Materials and methods.** The review was performed mainly on the PubMed Database and based on the principles of Evidence Based Practice (EBP). Keywords used were Perthes disease, conservative treatment, containment treatment, review, and weight-relief. EBP is the integration of the best research evidence with clinical expertise and patient values of which there are five different levels of evidence: 1) Randomized Controlled Trials; 2) Prospective Cohort Study; 3) Case Control or Retrospective Cohort Study; 4) Case Series; 5) Expert Opinion or Individual Case Report. **Results.** Until 20th August 2005 there were 144 articles of clinical relevance about conservative treatment of LCPD: 16.7% of EBP level 5; 50.7% of level 4; 31.9% of level 3; none of level 2; and 0.7% of level 1. **Conclusion.** The quality of evidence that supports conservative treatment for children with LCPD is not of high quality. There is no scientific evidence that conservative treatments modify LCPD natural history. Containment, no containment and simple symptomatic treatment have comparable effectiveness. Prolonged weight-relief and(or) containment treatments are associated with social and psychological problems.

**Key words:** conservative treatment, containment treatment, perthes, review, weight-relief

## Czy leczenie zachowawcze jest naprawdę skuteczne w chorobie Legga-Calvé-Perthesa? Przegląd piśmiennictwa

### Streszczenie

**Wstęp.** Leczenie choroby Legga-Calvé-Perthesa (CLCP) jest sporne. Brak jest wyraźnych wytycznych. Ten przegląd piśmiennictwa ma na celu ocenić jakość dowodów wspierających efektywność zachowawczego leczenia CLCP, które ma wielu zwolenników wśród ortopedów oraz pediatrów. Drugorzędnym celem była ocena, czy leczenie zachowawcze naprawdę modyfikuje przebieg CLCP. **Materiał i metody.** Przegląd ten został przeprowadzony głównie na podstawie bazy danych PubMed, zgodnie z wytycznymi Evidence Based Practice (EBP). Słowa kluczowe użyte do wyszukiwania to: choroba Perthesa, leczenie zachowawcze, zapatrzenie ortopedyczne, przegląd, odciążenie. EBP jest połączeniem najlepszych wyników badań medycznych z doświadczeniem klinicznym i zalet dla pacjenta. Jest pięć poziomów tych doniesień: 1) badania randomizowane; 2) badania prospektywne; 3) badania retrospektywne lub porównanie wyników leczenia; 4) badanie porównywalnych przypadków; 5) opinie ekspertów i opisy przypadków. **Wyniki.** Do 20 sierpnia 2005 opublikowano 144 artykuły powiązane z aspektami klinicznymi zachowawczego leczenia CLCP: 16,7% z poziomu 5 EBP, 50,7% z poziomu 4 EBP, 31,9% z poziomu 3 EBP, żadnego z poziomu 2 EBP i 0,7% z poziomu 1. **Wnioski.** Jakość doniesień, które wspierają ideę zachowawczego leczenia CLCP nie jest zbyt wysoka. Nie ma naukowych dowodów, że leczenie zachowawcze modyfikuje przebieg CLCP. Leczenie z zastosowaniem zaopatrzenia ortopedycznego, bez jego użycia, i leczenie objawów mają porównywalną efektywność. Przedłużone odciążenie lub zaopatrzenie ortopedyczne wiążą się z problemami społecznymi i psychologicznymi.

**Słowa kluczowe:** leczenie zachowawcze, zaopatrzenie ortopedyczne, choroba Perthesa, przegląd piśmiennictwa, odciążenie

### Introduction

Since its first descriptions at the beginning of the 20<sup>th</sup> century, the treatment of Legg-Calvé-Perthes Disease (LCPD) is controversial and not well defined. This is due to its unknown aetiology and its various clinical pictures at presentation. Currently, one can't talk about therapy (where the focus is the resolution of the causes), but only about treatment, meaning any avenue by which a positive alteration is achieved in the disease's normal evolution. Despite LCPD generally having a self-limiting and benign course [1-5], many physicians continue to recommend conservative treatment like braces or weight-bearing, hoping that this improves the revascularization of the ischemic femoral head.

The primary aim of this literature review was to understand what the quality of the evidence available to support the effectiveness of conservative LCPD treatment prescribed by orthopaedic surgeons and paediatricians is. The secondary aim was to see if conservative treatments really modify the natural history of LCPD.

### Materials and methods

EBP is the integration of the best research evidence with clinical expertise and patient values. All articles constitute evidence, but some are more convincing, through virtue of their study design, than others [6]. There are five different levels of evidence:

- 1) Randomized Controlled Trials: All the patients enrolled at the same point in their disease course, and randomized to two different treatment;
- 2) Prospective Cohort Study: Patients with one treatment are compared with a control group of patients treated at the same time and usually at same institution;
- 3) Case Control or Retrospective Cohort Study: In Case Control patients with a particular outcome are compared with those who did not have that outcome; in Retrospective Cohort Study two treatment groups are compared, but the study is undertaken after treatment started or completed;
- 4) Case Series: A series of patients who underwent treatment and whose pre- and post-treatment status are compared. There is no control group, historical or otherwise.
- 5) Expert Opinion or Individual Case Report.

The search was conducted on PubMed Database, and the time scale extended until 20<sup>th</sup> August 2005.

The search terms were 'perthes' and, separately, 'weight-bearing' (54 citations), 'bed rest' (28 citations), 'thomas' (12 citations), 'sling' (2 citations), 'crutches' (11 citations), 'plaster cast' (61 citations), 'traction' (70 citations), 'containment' (112 citations), 'toronto' (6 citations), 'tachdjian' (6 citations), 'birmingham' (7 citations), 'petrie' (9 citations), 'newington' (3 citations), 'scottish rite' (15 citations), 'symptomatic treatment' (11 citations), 'rehabilitation' (55 citations), 'physical therapy' (30 citations). Only English or Italian manuscripts were selected. The search revealed 144 relevant articles which were read for abstract, methodology and results.

## Results

The 144 articles were subdivided according to the level of evidence: 24 (16.7%) of level 5; 73 (50.7%) of level 4; 46 (31.9%) of level 3; none of level 2; 1 (0.7%) of level 1 (Fig. 1). With regards to 'weight-bearing' as a search term, there were 76 (52.8%) articles. Of these, 14 referred to 'weight-bearing' as the primary search item, the other 61 to other words. Of these 76, 17 (22.4%) were of level 5; 30 (39.4%) of level 4; 29 (38.2%) of level 3; none of level 2 or level 1. Considering individually different weight-bearing methods, on prolonged bed rest there were 20 (13.9%) articles, 9 (6.2%) on Thomas stapes, 27 (18.8%) on broomstick plaster with weight relief stapes, 10 (6.9%) on Snyder sling, and 22 (15.2%) on traction. Between the 20 prolonged bed rest articles (14 referred to bed rest, 6 to other words) there were 6 (30%) of level 5; 7 (35%) of level 4; 7 (35%) of level 3; none of level 2 or level 1.

Between the 9 Thomas stapes articles (8 referred to thomas, 1 to another word), whose Thomas first description dates back to 1887, there were none of level 5; 2 (22.2%) of level 4; 7 (77.8%) of level 3; none of level 2 or level 1. Among the 27 broomstick plaster with weight relief stapes articles (22 referred to plaster cast, 5 to other words) there were 10 (37%) of level 5; 10 (37%) of level 4; 7 (26%) of level 3; none of level 2 or 1. Among the 10 Snyder sling articles (9 referred to sling or crutches, 1 to another word), of which the first description dates back to 1947 [7], there were 2 articles (20%) of level 5

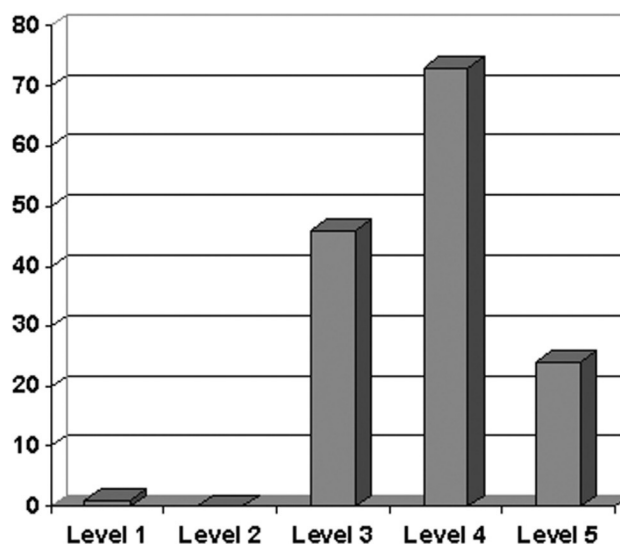


Fig. 1. Distribution of the 144 selected articles on Evidence Based Practice levels: 24 (16.7%) were of level 5 (Expert Opinion or Case Report); 73 (50.7%) of level 4 (Case Series); 46 (31.9%) of level 3 (Retrospective Cohort Study); none of level 2 (Prospective Cohort Study); 1 (0.7%) of level 1 (Randomized Controlled Trials).

Ryc. 1. Udział artykułów na określonym poziomie Evidence Based Practice wśród 144 wybranych publikacji: 24 (16,7%) poziom 5 (opinia eksperta lub opis przypadku); 73 (50,7%) poziom 4 (badanie porównywalnych przypadków); 46 (31,9%) poziom 3 (badania retrospektywne); żadnego na poziomie 2 (badania prospektywne); 1 (0,7%) poziom 1 (badania randomizowane).

evidence; 4 (40%) of level 4; 4 (40%) of level 3; none of level 2 or level 1. The 22 traction articles (17 referred to traction, 5 to other words) were subdivided as follows: 6 (27.3%) of level 5; 11 (50%) of level 4; 5 (22.7%) of level 3; none of level 2 or level 1.

On containment there were 111 (77.1%) articles. 85 were referred to containment, 26 to other words. Of these 111, 14 (12.6%) were of level 5; 56 (50.5%) of level 4; 40 (36%) of level 3; none of level 2; 1 (0.9%) of level 1.

Taking various containment methods into account, on Toronto brace there were 2 (1.4%) articles. Both of them referred to 'toronto' as a search term and were of level 4 evidence. The first one was Bobeck's first description in 1968 [8] of this bilateral hip abductor and internal rotator long brace.

The Tachdjian brace was described for the first time on 1968 too [9]. On this weight-relief brace, which maintained the ipsilateral hip in abduction and internal rotation, there were 2 (1.4%) articles: 1 referred to tachdjian, 1 to another word. These 2 articles were of level 4 and level 3 evidence respectively.

The Birmingham brace was described for the first time by Harrison in 1969 [10]. This weight-relief brace maintained the ipsilateral hip in flexion, abduction and internal rotation. On this brace there were 4 (2.8%) articles, both referred to 'Birmingham' as a search term. Of these, 1 was of level 4 evidence, 2 of level 3, and 1 of level 1. On the use of the Petrie plaster, whose first description [11] dates back to 1971, there were 16 (11.1%) articles. The Petrie plaster maintains bilateral hip abduction and internal rotation. Among these 16 articles



Fig. 2. A Legg-Calvé-Perthes disease young patient in his Atlanta Scottish Rite brace.

Ryc. 2. Młody pacjent z chorobą Legg-Calvé-Perthes w swoim aparacie.

(7 referred to petrie, 9 to other words), there were 1 of level 5; 8 of level 4; 7 of level 3; none of level 2 or 1.

On the Newington brace there were 4 (2.8%) articles (3 referred to Newington, 1 to another word). Of these, 2 were of level 4 and other 2 of level 3. The Newington brace's first original description by Curtis [12] dates back to 1974. It maintains bilateral hip abduction and internal rotation, with knee-stabilizing shells and foot-ankle sections in-situ.

Finally the Atlanta Scottish Rite brace was considered (Fig. 2), and Purvis' first description dates back to 1980 [13]. This short brace maintains bilateral hip abduction, flexion and external rotation. On this brace there were 17 (11.8%) articles (8 referred to Scottish rite, 9 to other words): 1 of level 5; 8 of level 4; 8 of level 3.

On other conservative treatment methods, we considered symptomatic treatment and physical rehabilitation. On symptomatic treatment there were 10 (6.9%) articles (4 referred to symptomatic treatment, 6 to other words): 5 of level 4, the other 5 of level 3. On physical rehabilitation there were 17 (11.8%) articles (11 referred to rehabilitation, 6 to other words): 5 of level 5; 8 of level 4; 3 of level 3; none of level 2 or 1.

## Discussion

The aim of LCPD treatment is the prevention of deformation of the femoral head. To obtain this, two different conservative methods or concepts were tried in the 144 studies collated: weight relief and containment. The aim of weight relief is to prevent necrotic femoral head collapse due to the body weight. Weight relief was the most popular therapeutic concept for the first half of the last century [14]. With this concept the following adjuncts were used in chronological

order: prolonged bed rest, Thomas stapes [15], broomstick plaster with weight relief stapes [16], Snyder sling [7], and traction [17]. Complications of the weight relief method include muscular atrophy, osteopenia, dysmetria, reduction in thoracic kyphosis, urolithiasis, social-emotional problems, and, last but not least, especially with the increasing importance of health budgets, the high costs for hospitalization [18].

It has subsequently become evident that the weight relief concept was not biomechanically valid, because compressive muscles forces operating across the hip create greater intra-articular pressures than those produced by weight bearing. In 1966 Salter recommended containment to relieve pressure from the edge of the acetabulum. The aim of containment is maintenance of articular congruity to aid femoral head-acetabulum reciprocal remodeling [19]. To obtain this, it is necessary for the acetabulum to contain the femoral head, through 45° abduction, 10° flexion and internal rotation of the affected hip [8-12, 19]. The containment methods were several braces and casts such as the Toronto brace [8], the Tachdjian brace [9], the Birmingham brace [10], the Petrie plaster [11], Newington brace [12], and the Atlanta Scottish Rite brace [13].

In 1975 it was realized that containment treatments play no part in modifying the natural history of LCPD [20-23]. George T. Rab [24-25] and Allen [26], with their gait analyses studies, confirmed that the containment concept did not have a valid and demonstrable biomechanical basis.

So the question to be answered is: what is the quality of the evidence available to support the effectiveness of the LCPD conservative treatment prescribed by orthopaedic surgeons and(or) paediatricians? Does the conservative treatment really modify the natural history of LCPD? Based on this study, it can be affirmed that very little comparative research is able to evaluate the effectiveness of various therapeutic interventions. The evidence upon which conservative treatment is based is not of high quality. In fact the greater part of the articles were Case Series (50.7%) and Case Control or Retrospective Cohort Studies (31.9%). There were no Prospective Cohort Studies and only one (0.7%) of the articles was a Randomized Clinical Trial [27], which demonstrated the use of pulse electromagnetic frequency (PEMF) in LCPD treatment.

The majority of the studies had a small number of subjects, short or no follow-up, small or no control groups, inappropriate experimental designs and(or) statistical analysis. Moreover various clinical and(or) pathological classifications were used. These classification systems had poor correlation. So the valuation of the various results was very ambiguous. Several studies [21, 28-38] affirmed that there is no statistical evidence on major effectiveness of containment versus no containment in conservative treatment, and of these versus the simple symptomatic treatment. So there is no scientific evidence that conservative treatments modify the natural history of LCPD.

This study confirms that LCPD usually has a self-limiting and benign course [1-4]. Since 1982 [39] it has been known

that 57% of LCPD affected children have excellent or good follow-up results without any therapy. In 1992 Turra [40] demonstrated a clear improvement of radiographic pictures at the end of growth as a continuum versus the end of the treatment. Bone has a residual remodeling capacity in growing children, and there is a reciprocal remodeling capacity between the two congruent joint surfaces involved in LCPD [40].

The various conservative treatments, including weight-bearing and containment, are very expensive. Besides the economic cost, there are the high psychological implications to the affected child [41-44]. In fact, conservative treatment of LCPD may be associated with different kinds of growth disturbances [41-44]. There are demonstrated deficits in social, academic and sexual behavior as compared with patients operatively treated [42], and some authors [43] suggested a correlation with attention deficit hyperactivity disorder (ADHD). In fact these treatments play havoc with the child's life and routine, they are no longer self-sufficient, and feel handicapped [41-44]. This then becomes a real managerial problem for the family.

In conclusion the quality of evidence that supports conservative treatment for children with LCPD is not of high quality. There is no scientific evidence that conservative treatments modify LCPD natural history. Containment, no containment and simple symptomatic treatment have comparable effectiveness. Prolonged weight-relief and (or) containment treatments are associated with social and psychological implications.

## References

- [1] Catterall A.: *The natural history of Perthes' disease*. J. Bone Joint Surg. Br., 1971; 53: 37-53.
- [2] Blakemore M. E., Harrison M. H.: *A prospective study of children with untreated Catterall group I Perthes' disease*. J. Bone Joint Surg. Br., 1979; 61: 329-333.
- [3] Herring J. A., Neustadt J. B., Williams J. J., Early J. S., Browne R. H.: *The lateral pillar classification of Legg-Calve-Perthes disease*. J. Pediatr. Orthop., 1992; 12:143-150.
- [4] Cooperman D. R., Stulberg S. D.: *Ambulatory containment treatment in Perthes' disease*. Clin. Orthop., 1986; 203: 289-300.
- [5] Grasmann H., Nicolai R. D., Patsalis T., Hövel M.: *The treatment of Legg-Calve-Perthes disease. To contain or not to contain*. Arch. Orthop. Trauma Surg., 1997; 116: 50-54.
- [6] Goldberg M. J.: *Is there evidence that traditional and/or alternative cerebral palsy intervention are effective?* [in:] *Attualità in Ortopedia pediatrica*. Turra S. ed, Key Congress & Communication S.r.l., Padova 2003, 194-196.
- [7] Snyder C. H.: *A sling for use in Legg-Perthes' disease*. J. Bone Joint Surg., 1947; 29: 524.
- [8] Bobechko W. P., McLaurin C. A., Motloch W. M.: *Toronto orthosis for Legg-Perthes disease*. Artif. Limbs, 1968; 12 (2): 36-41.
- [9] Tachdjian M. O., Jovett L. D.: *Trilateral socket hip abduction orthosis for the treatment of Legg-Perthes' disease*. J. Bone Joint Surg., 1968; 50: 1972.
- [10] Harrison M. H. M., Turner M. H., Nicholson F. J.: *Coxa plana. Results of a new form of splinting*. J. Bone Joint Surg., 1969; 51: 1057-1069.
- [11] Petrie J. G., Bitenc I.: *The abduction weight-bearing treatment in Legg-Perthes' disease*. J. Bone Joint Surg. Br., 1971; 53(1): 54-62.
- [12] Curtis B. H., Gunther S. F., Gossling H. R., Paul S. W.: *Treatment for Legg-Perthes disease with the Newington ambulation-abduction brace*. J. Bone Joint Surg., 1974; 56(6): 1135-1146.
- [13] Purvis J. M., Dimon J. H. 3rd, Meehan P. L., Lovell W. W.: *Preliminary experience with the Scottish Rite Hospital abduction orthosis for Legg-Perthes disease*. Clin. Orthop., 1980; 150: 49-53.
- [14] Edsberg B., Rubinstein E., Reimers J.: *Containment of the femoral head in Legg-Calve-Perthes' disease and its prognostic significance*. Acta Orthop. Scand., 1979; 50(2): 191-195.
- [15] Beeker T. W.: *The results of treatment in Legg-Calve-Perthes disease using a Thomas splint*. Arch. Chir. Neerl., 1967; 19(4): 275-289.
- [16] Harrison M. H., Menon M. P.: *Legg-Calve-Perthes disease. The value of roentgenographic measurement in clinical practice with special reference to the broomstick plaster method*. J. Bone Joint Surg. Am., 1966; 48(7): 1301-1318.
- [17] Meyer J.: *Treatment of Legg-Calve-Perthes disease. Assessment of therapeutic results with particular reference to the value of traction in bed*. Acta Orthop. Scand., 1966; S86: 9-111.
- [18] Katz J. F.: *Conservative treatment of Legg-Calve-Perthes disease*. J. Bone Joint Surg. Am., 1967; 49(6): 1043-1051.
- [19] Salter R. B.: *Legg-Perthes disease: the scientific basis for the methods of treatment and their indications*. Clin. Orthop. Relat. Res., 1980; 150: 8-11.
- [20] Snyder C. R.: *Legg-Perthes disease in the young hip-does it necessarily do well?* J. Bone Joint Surg., 1975; 57(6): 751-759.
- [21] Uyttendaele D., de Kelver L., Croene P., Fabry G.: *Conservative treatment in Perthes' disease: a comparison between containment and non containment methods of treatment*. Acta Orthop. Belg., 1980; 46(4): 414-422.
- [22] Reimers J.: *Incidence of full containment of the femoral head after Legg-Calve-Perthes disease and in the "normal" hip*. J. Pediatr. Orthop., 1985; 5(2): 199-201.
- [23] Kendig R. J., Evans G. A.: *Biologic osteotomy in Perthes disease*. J. Pediatr. Orthop., 1986; 6(3): 278-284.
- [24] Rab G. T.: *Determination of femoral head containment during gait*. Biomater. Med. Devices Artif. Organs, 1983; 11(1): 31-38.
- [25] Rab G. T., Wyatt M., Sutherland D. H., Simon S. R.: *A technique for determining femoral head containment during gait*. J. Pediatr. Orthop., 1985; 5(1): 8-12.
- [26] Allen B. L. Jr.: *Graphic analysis of femoral growth in young children with Perthes' disease*. J. Pediatr. Orthop., 1997; 17(2): 255-263.
- [27] Harrison M. H. M., Bassett C. A. L.: *The results of a double-blind trial of pulsed electromagnetic frequency in the treatment of Perthes' disease*. J. Pediatr. Orthop., 1997; 17(2): 264-265.
- [28] Marklund T., Tillberg B.: *Coxa plana: a radiological comparison of the rate of healing with conservative measures and after osteotomy*. J. Bone Joint Surg., 1976; 58(1): 25-30.
- [29] Edvardsen P., Slordahl J., Svenningsen S.: *Operative versus conservative treatment of Calve-Legg-Perthes disease*. Acta Orthop. Scand., 1981; 52(5): 553-559.
- [30] Cotler J. M.: *Office management in Legg-Calve-Perthes syndrome*. Orthop. Clin. North Am., 1982; 13(3): 619-627.
- [31] Vila Verde V. M., Gomes Peres J. F., Costa B. A.: *Value of the head-at-risk concept in assessing the prognosis in Legg-Calve-Perthes disease*. J. Pediatr. Orthop., 1985; 5(4): 422-427.
- [32] Kamegaya M.: *Comparative study of Perthes' disease treated by various ambulatory orthoses*. Nippon Seikeigeka Gakkai Zasshi, 1987; 61(7): 917-932.
- [33] Meehan P. L., Angel D., Nelson J. M.: *The Scottish Rite abduction orthosis for the treatment of Legg-Perthes disease. A radiographic analysis*. J. Bone Joint Surg., 1992; 74(1): 2-12.
- [34] Fulford G. E., Lunn P. G., Macnicol M. F.: *A prospective study of nonoperative and operative management for Perthes' disease*. J. Pediatr. Orthop., 1993; 13(3): 281-285.
- [35] Poussa M., Yrjonen T., Hoikka V., Osterman K.: *Prognosis after conservative and operative treatment in Perthes' disease*. Clin. Orthop., 1993; 297: 82-86.
- [36] Wang L., Bowen J. R., Puniak M. A., Guille J. T., Glutting J.: *An evaluation of various methods of treatment for Legg-Calve-Perthes disease*. Clin. Orthop., 1995; 314: 225-233.
- [37] Aksoy M. C., Caglar O., Yazici M., Alpaslan A. M.: *Comparison between braced and non-braced Legg-Calve-Perthes-disease patients: a radiological outcome study*. J. Pediatr. Orthop. B., 2004; 13(3): 153-157.

- [38] Grzegorzewski A., Snyder M., Kozłowski P., Szymczak W., Bowen R. J.: *Leg length discrepancy in Legg-Calvé-Perthes disease*. J. Pediatr. Orthop., 2005; 25(2): 206-209.
- [39] Catterall A., Pringle J., Byers P. D., Fulford G. E., Kemp H. B.: *A review of the morphology of Perthes' disease*. J. Bone Joint Surg. Br., 1982; 64(3): 269-275.
- [40] Turra S., Frizziero P., Gigante C.: *Evoluzione a distanza del morbo di Perthes*. Riv. It. Ortop. e Trauma. Ped., 1992; 8(2): 307-317.
- [41] Rosar V. W.: *Perthes and Parents: The care of your child with Legg-Calvé-Perthes Disease*. Charles C Thomas Publisher, Springfield 1963.
- [42] Price C. T., Day D. D., Flynn J. C.: *Behavioural sequelae of bracing versus surgery for Legg-Calvé-Perthes disease*. J. Pediatr. Orthop., 1988; 8(3): 285-287.
- [43] Loder R. T., Schwartz E. M., Hensinger R. N.: *Behavioural characteristics of children with Legg-Calvé-Perthes disease*. J. Pediatr. Orthop., 1993; 13(5): 598-601.
- [44] Lahdes-Vasama T. T., Sipilä I. S., Lamminranta S., Pihko S. H., Merikanto E. O., Marttinen E. J.: *Psychosocial development and premorbid skeletal growth in Legg-Calvé-Perthes disease: a study in nineteen patients*. J. Pediatr. Orthop. B., 1997; 6(2): 133-137.