Arthrodiastasis in the Management of Perthes' Disease

Systematic Review of Literature and Meta-analysis

Submitted for partial fulfillment of Master's Degree

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Abstract

Introduction: This systematic review explores the relevant literature to assess the efficacy of the use of arthrodiastasis in the management of Perthes disease. Until this moment, arthrodiastasis is not well established for its use in Perthes disease as opposed to other containment procedures. Furthermore, there are no clear indications for its use in this disease.

Methodology: 12 articles were matched to the inclusion criteria and all articles were reviewed and radiological and clinical data was collected and compiled.

Results: a significant increase in postoperative range of motion compared to the preoperative ones was found. Final Stulberg classification was ascertained showing majority of patients ending with stages two and three. Complications were also assessed with majority of them being superficial pin tract infections.

Conclusion: the use of arthrodiastasis is a valid treatment option for Perthes disease however more articles need to be produced showing comparative data of arthrodiastasis versus other containment procedures.

Keywords- Arthrodiastasis, Perthes' Disease, LCPD, Hinged Distraction

Introduction

Perthes' disease is one of the most common pediatric disorders. It is an aseptic, noninflammatory, self-limiting, idiopathic, avascular necrosis of capital femoral epiphysis in a child. Although it has been discovered around a 100 years ago, its exact cause remains unknown. [1]

Treatment of Perthes', disease could be either preventive, remedial, or salvageable in nature depending on several factors, but mainly the time at which the child was diagnosed. The aim of treating Perthes' disease is to prevent secondary degenerative arthritis of the hip in adult life. This could be achieved by preventing the femoral head from being deformed if the child is diagnosed early, by minimizing the complications of early deformation of the femoral head if it has already occurred, and by salvaging hips with established deformation of the femoral head. [2]

NATURAL HISTORY

Perthes' disease is a self-limiting disorder as temporary avascularization of the blood supply of the femoral head occurs followed by restoration to normal vascularity within 2 to 4 years. Single or recurrent episodes of interrupted blood supply of the femoral head occur.

Once the blood supply to the femoral head is affected, a chain reaction of events occurs.

(1) Avascular necrosis of part or all of the epiphysis occurs, and the necrotic bone is resorbed by osteoclasts.

(2) The weakened trabeculae collapse and the epiphysis fragments.

(3) Woven bone is laid down on the periphery of the epiphysis and over a period of time this woven bone is replaced by mature lamellar bone and the epiphysis heals completely.

(4) Hypertrophy of the synovium, Ligamentum Teres, and the articular cartilage occurs. These soft tissue changes along with muscle spasm initiate femoral head extrusion that tends to increase progressively.[3]

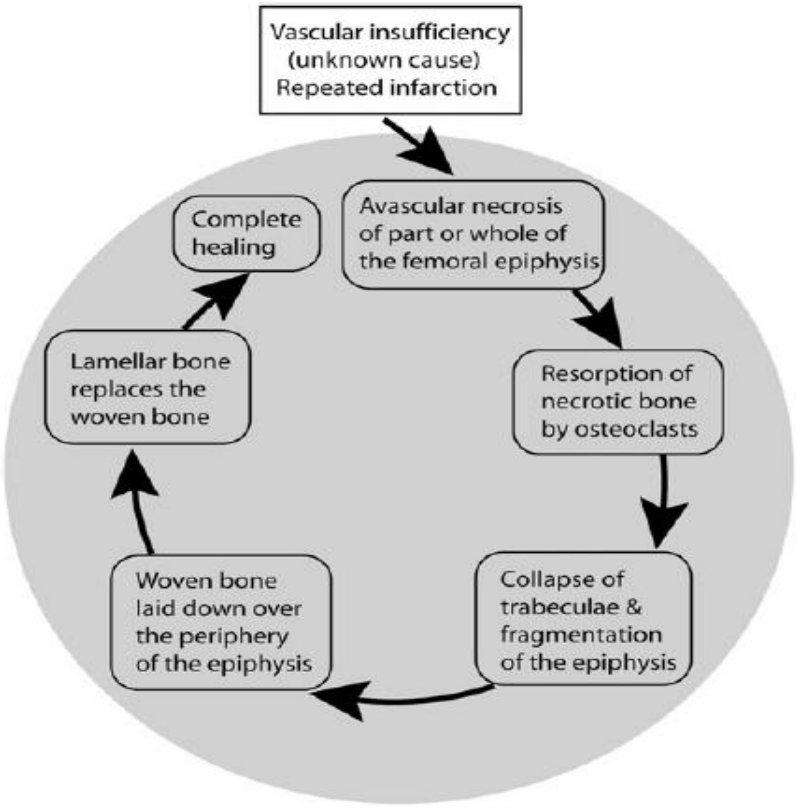

Figure (1): Cycle of events explaining the pathophysiology of Perthes Disease [4]

The extruded femoral head, when subjected to stresses that pass across the acetabular margin, lead to irreversible deformation of the femoral head. A little remodeling of the femoral head may then occur. Any residual femoral head deformity and joint incongruity will then persist throughout life. Evidence has clearly shown that irreversible deformation occurs when the disease has progressed to the late stage of fragmentation or soon after. Variables that make femoral head deformity worse are

femoral head weakening and significant loading. Femoral head weakening correlates with the extent of head involvement. Loading depends on the patient's activity level, type of activities, and weight. Intervention should necessarily precede the onset of irreversible deformation of the femoral head.[3]

The natural evolution of Perthes' disease could be clearly identified on plain radiographs. The disease passes through the stages of avascular necrosis, fragmentation, and reconstitution (Stages I-III) before the disease finally heals (Stage IV). The stages of avascular necrosis, fragmentation, and reconstitution can be further divided into early and late stages [Stages Ia, Ib, IIa, IIb, IIIa and IIIb] [*see Figure 2*]. In untreated children, femoral head extrusion increases as the disease progresses; in the initial stages of the disease the increase in extrusion is gradual but extrusion abruptly increases in the late stage of fragmentation (Stage IIb), often exceeding the critical 20%. There is evidence that the femoral head deformation occurs during the late stage of fragmentation or in the early part of the stage of reconstitution. This vital knowledge enables us to divide the disease into an early part (i.e., before femoral head deformation begins) and the late part (i.e., after the femoral head has begun to deform). It follows that treatment aimed

at preventing femoral head deformation must be instituted in the early part of the disease if it is to be effective. It needs to be emphasized that any treatment instituted at the late stage of fragmentation (Stage IIb) or thereafter is not preventive but either remedial or salvage in nature.[5]

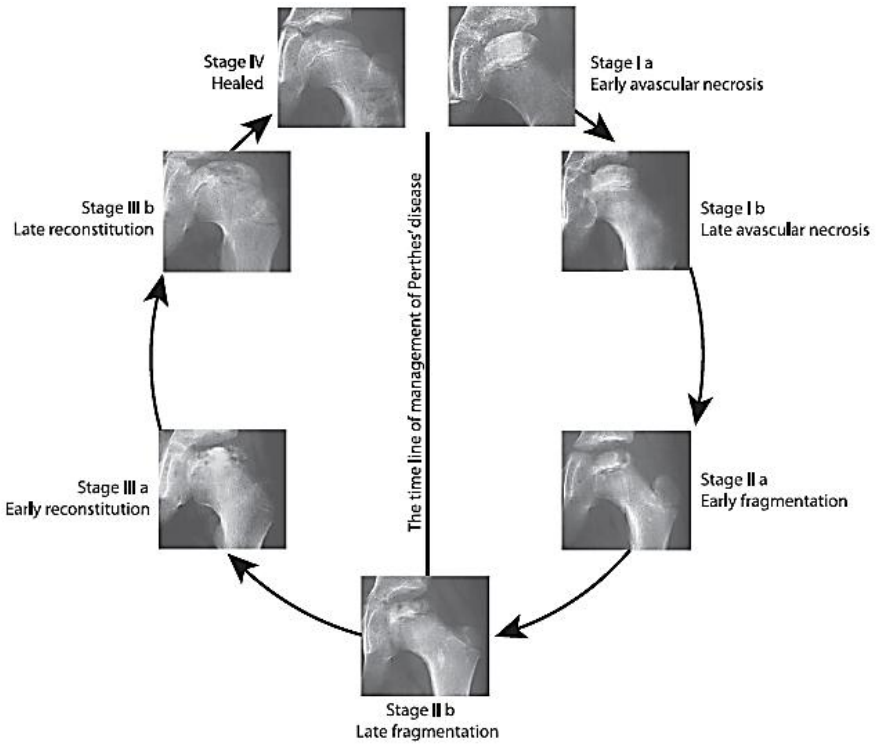

Figure (2): Radiographic stages of Perthes Disease as classified by Waldestrom[4]

The best treatment for Perthes' disease is still unknown. The main principles of treatment have traditionally been relief of loading and containment. No treatment has been shown convincingly to be significantly effective in improving the outcome of Perthes' disease or

of influencing its course. This is partly due to the difficulty in evaluating the effect of treatment on a disease that has a variable course, duration and outcome, but also because of methodological difficulties such as lack of a control group and patient selection.[6]

There are several methods of classification of Perthes disease. Stulberg classification, which is used as assessment of the prognosis of Perthes disease, is one of the most common *[see Table (1) and Figure (3)]*. It assesses the congruency of the acetabulum and head of femur at skeletal maturity. The table below describes the classes, radiological findings and prognosis of each Stulberg class.

Table (1): shows the Stulberg classification, with radiological signs and prognosis of each class[7]

Class	Description	Radiologic aspect	Prognosis
I	Spherical congruency	Normal	Good
II	Spherical congruency; Loss of head shape <2mm	Spherical head with one or more of the following findings: coxa magna, short femoral neck, upper located great trochanter, obliquus acetabulum	Good
III	Aspherical congruency; Loss of head shape >2mm	Non-spherical head but not flat	Mild-to-moderate arthritis
IV	Aspherical congruency	Flat head and acetabulum	Poor: moderate arthritis
V	Aspherical incongruency	Flat head, normal neck and acetabulum	Bad: severe early arthritis

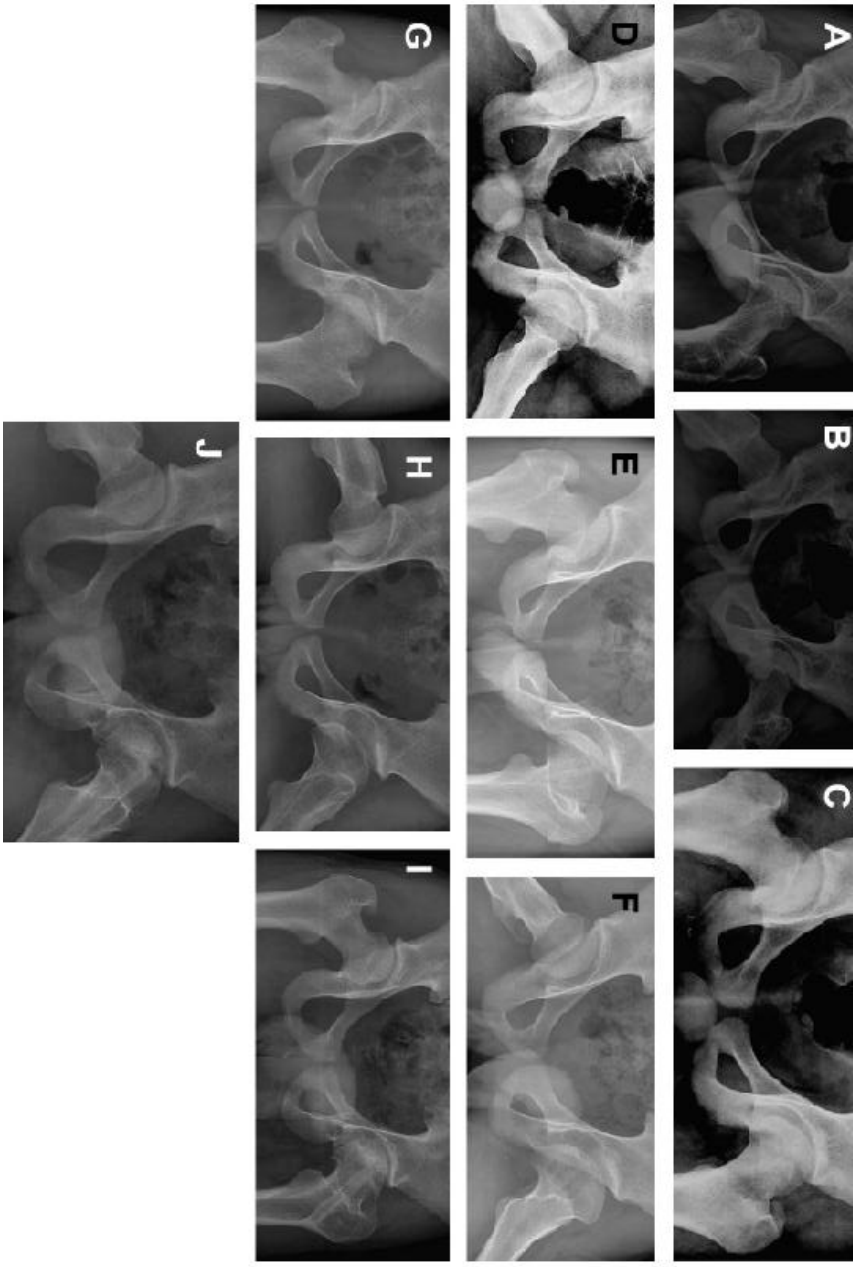

Figure (3): Multiple examples of Stulberg outcome. Stulberg class I (A, B), class II (C,D), class III (E,F), class IV (G,H) and class V (I,J).[3]