Systematic Review on Intra articular Hip Osteotomies in Adolescents

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Abb.	Meaning
AP	Anteroposterior
MFCA	Medial femoral circumflex artery
AVN	Avascular necrosis
SCFE	Slipped capital femoral epiphysis
AVG.	Average
M	Male
F	Female
Rt	Right
Lt	Left
N	Number
NA	Not Available
HHS	Harris Hip Score
WOMAC	Western Ontario and McMaster Universities
THA	Total Hip Arthroplasty
ITO	Intertrochanteric Osteotomy

Introduction

Developmental and acquired abnormalities of the hips are common in childhood and can lead to persistent hip deformity as the child grows into adulthood. Regardless of the underlying cause and initial treatment, certain common abnormalities in the shape and alignment of the proximal femur persist, which can result in femoroacetabular impingement. Femoroacetabular impingement can lead to pain, cartilage damage and predispose the hip to early osteoarthritis .(1,2,5)

Recent advances in surgical technique have permitted safe surgical dislocation of the adult hip, allowing not only full inspection of the joint but also dynamic assessment of femoroacetabular contact during hip motion. Reshaping the proximal femur through head-neck osteoplasty with or without a proximal femoral osteotomy can also be accomplished We questioned the effectiveness of the surgical dislocation approach in correction of pediatric and adolescent hip deformity. More specifically, we first asked whether patients achieved short-term pain relief by assessing the change in WOMAC scores after surgery as well as looking at the conversion to arthroplasty or fusion, and if the underlying abnormality has any bearing on the clinical outcome. We then identified the complications (including nerve palsy, osteonecrosis, nonunion/delayed union of osteotomy) and determined whether complications were affected by the complexity of the reconstruction. Finally, we describe additional procedures performed after the index operation.(2,9)

Osteotomies of the proximal femur to address biomechanical deformities are traditionally performed at the intertrochanteric and subtrochanteric levels and therefore are extra capsular. Even with transtrochanteric rotational osteotomies at an extra-intracapsular level, the distance to the joint can be large, leading to secondary deformities, such as leg shortening and varus or valgus of the knee, which are undesirable in most instances. The extent of these associated deformities depends largely on the degree of the primary correction and on the distance to the joint level. Except for leg shortening, such adverse side corrections can be minimized by modifications of the technique and optimal implant selection; however, they could be more efficiently eliminated by performing the correction directly at the level of the deformity.(16,17,18)

A better comprehension of the vascular supply to the femoral head has allowed the establishment of the technique for safe surgical dislocation of the hip. Routine surgical dislocation has led to a better appreciation of the pathophysiology of hip and prompted intra-operative, dynamic studies on hip vascularization, which, in turn have led to a more detailed understanding of the perfusion process. Based on this detailed knowledge, safe approaches to the circumference of the neck of the femur have been developed, and new techniques, such as true femoral neck osteotomy, and even femoral head osteotomy, have become realistic options.(16,17)

Review of literatures

Applied Anatomy & Biomechanics of Hip Joint

The hip joint is a ball and socket joint. The 'ball' is the upper end of the thigh bone (femur) and this sits in the 'socket' which is called the acetabulum. The acetabulum is part of the pelvic bone. Surrounding ligaments and muscles help to stabilize the hip joint.

The femur is the longest bone in the body. The area at each end of the femur (or any other long bone in the body) is called the epiphysis. Growth of the long bones of the limbs is a slow process and is usually not fully completed until about age 18 or 20 years. Whilst long bones are growing, the epiphysis is separated from the main part of the bone (called the shaft, or the diaphysis) by some cartilage known as the growth plate (epiphyseal plate).Eventually, the epiphysis at each end fuses with the diaphysis to form a complete bone. In the femur, the epiphysis that is nearest to the hip is called the upper, or capital, femoral epiphysis.(10)

Vascular Anatomy:

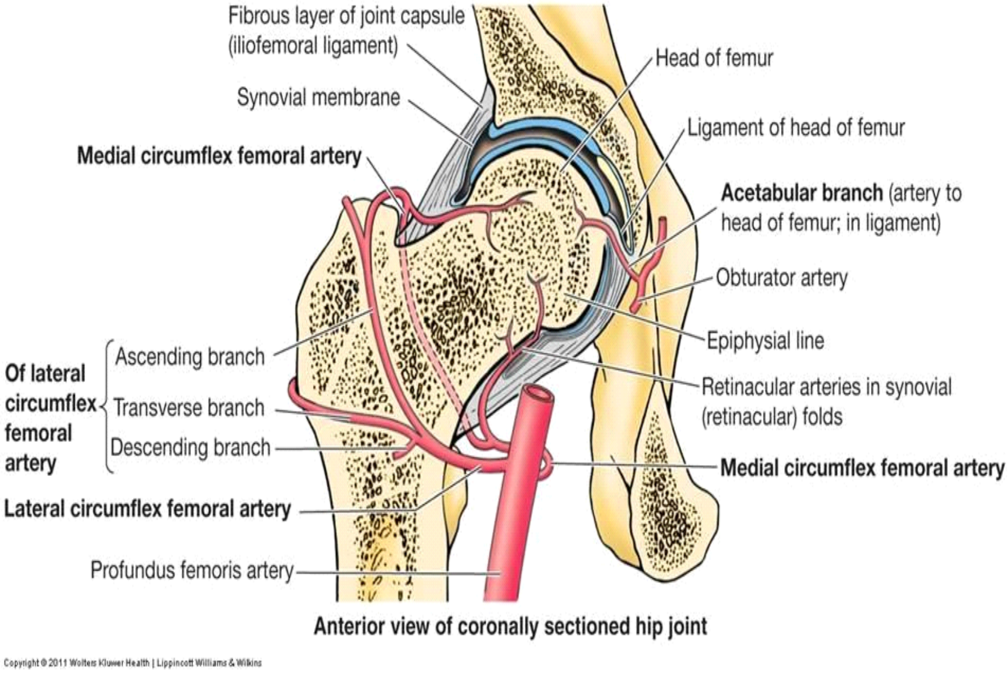

Figure (1): Vascular anatomy of the femoral head and neck from anterior aspect

Biomechanics of Hip Joint

The hip is a modified ball joint with 3 main axes at right angles to each other and thus 3 degrees of freedom of movement. The femoral head is largely spherical, while the acetabulum is horseshoe-shaped with a central depression and a caudal recess. The femoral head tapers where it joins the femoral neck in the section of bone not covered by cartilage. The direction of the femoral neck is characterized by two factors: its inclination and anteversion. The femoral neck inclination (or femoral neck-shaft angle) is also known as the CCD angle (Center-Collum- Diaphysis angle) Fig.(2). This decreases during human development from birth to adulthood from 150° to approx. 130° **.**

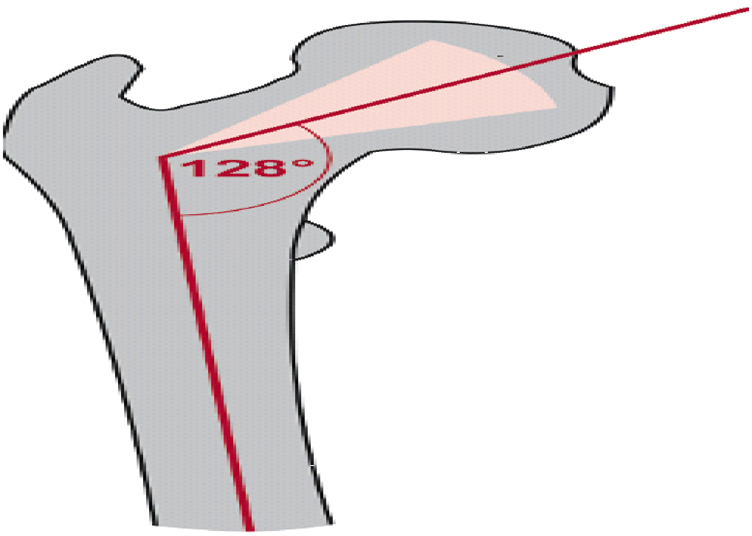

Figure (2): Measurement of the neck-shaft angle: The center of the femoral head is located with the aid of a circular template. The center of the femoral neck is also determined at its narrowest point. The two points are joined, and the resulting straight line forms the femoral neck axis. The angle formed by this line with the shaft axis constitutes the neck-shaft angle (the colored zone shows the normal range).

Anteversion refers to a forwardly projected open spatial angle formed between the femoral neck and the frontal plane or the plane of the knee condyles. This angle also declines during life from approx 30° at birth to around 15° in adulthood angles using a conversion table. While not a highly accurate method, it is just as accurate as measurement by ultrasound or clinical measurement **.**

In a double-leg stance, only external forces act on the hip via the weight of the body. The pelvis rests on both femoral heads. No muscle forces are required in the frontal plane. The situation is different for a single-leg stance or during the stance phase while walking. In the latter case, the hip of the stance leg bears the weight not only of the head, trunk and arms but also of the swing leg (*Fig. 3).* Because of this one-sided supporting of the pelvis by the hip of the stance leg, muscle forces must act to prevent the dropping of the pelvis on the swing leg side, thereby substantially increasing the joint forces compared to the double-leg stance scenario. The maintenance of balance requires a lever system with a pivot point located in the center of the head. The acting forces are greatly dependent on the anatomical circumstances.

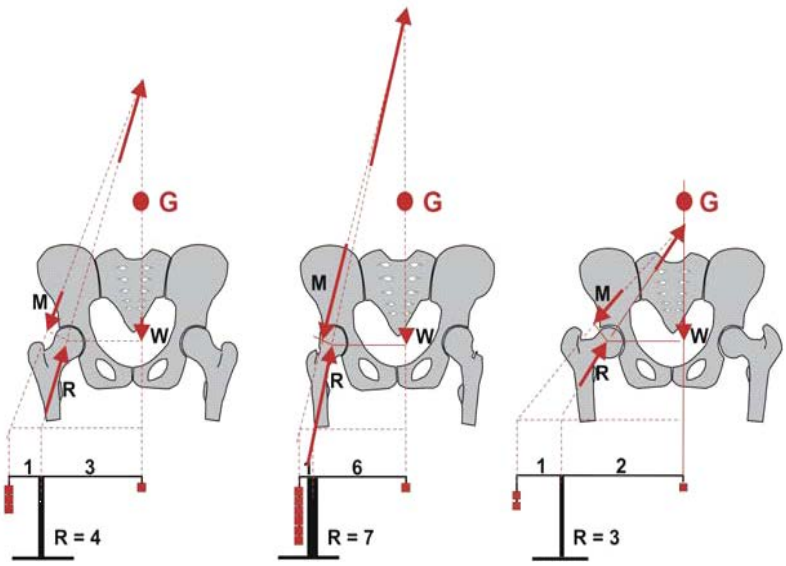

Figure (3): Forces in the hip according to Pauwels: a in the normal hip: b valgus hip; c varus hip. The diagram shows the effect produced by a change in the lever arms on the acting forces (G Center of gravity, W Body weight, R Force resultant in the hip, M Forces of the abductors).

In a normal hip, the force resultant acting on the hip is approximately four times the body weight *Fig. (3).* If the femoral neck angle is greater than normal, and the lever arm of the abductors correspondingly shorter, the force resultant increases. The reverse situation applies with coxa vara, in which the femoral neck angle is smaller, thus lengthening the lever arm of the abductors However, Pauwels' calculations are based on a two dimensional model and can only provide rough approximations. *Fig.(3).* By no means should one conclude that an increased