



THE STEADMAN CLINIC
AND
STEADMAN PHILIPPON
RESEARCH INSTITUTE

PERIACETABULAR OSTEOTOMY

FUNCTIONAL RESTORATION FOR PATIENTS WITH DYSPLASTIC HIPS

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HIP AND PELVIS RECONSTRUCTION

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Introduction

Periacetabular Osteotomy is a hip preserving procedure performed to correct a congenital deficiency of the acetabulum: acetabular dysplasia.

About the Acetabulum

Two parts comprise the hip joint: a ball on the upper end of the thigh bone (femur), called the head of the femur, and a socket in the pelvis known as the acetabulum. The hip joint, like other joints, is made up of specialized structural elements that serve as precisely fitting moving parts. The head of the femur rotates freely with-in the smooth, concentric surface of the acetabulum. An extremely low friction tissue, hyaline cartilage, lines this joint as well as others in the human body. The friction between two hyaline cartilage surfaces is much less than the best man-made bearing.

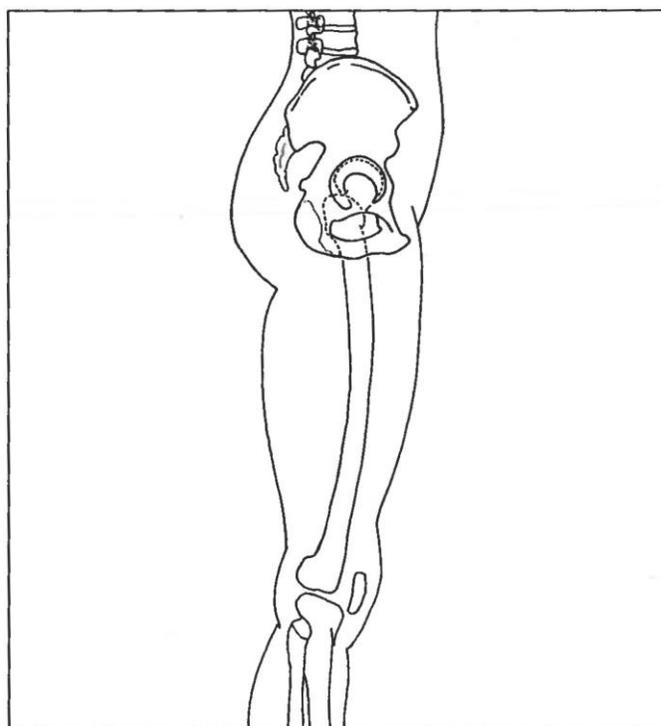
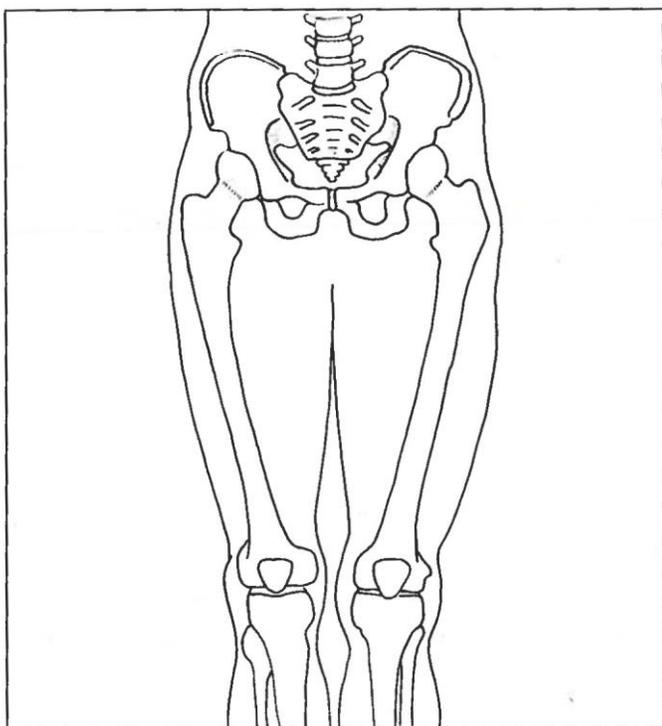
A normal acetabulum "covers" the upper (superior) portion of the head of the femur as well as a partial portion of the front (anterior) and back (posterior) of the femoral head.

About Acetabular Dysplasia

Acetabular dysplasia is a condition defined by inadequate development of an individual's acetabulum. The resulting acetabulum is shallow and "dish shaped" rather than "cup shape". The upper portion (roof) of the acetabulum is obliquely inclined outward rather than having the normal horizontal orientation. Because of these abnormalities, the superior and usually anterior femoral head are incompletely covered by this dysplastic acetabulum.

Individuals with acetabular dysplasia usually develop through childhood and adolescence without symptoms or knowledge of their abnormality. By the age of 30, however, the patient typically experiences pain from their hip and they often seek medical evaluation and an X-ray discloses the abnormality (acetabular dysplasia). Other patients may have been treated for hip problems as an infant or child.

Acetabular dysplasia is often also associated with abnormalities in the shape of the upper femur which may contribute to the patient's hip symptoms.



Front and sideviews of the pelvis and hip joint in the body.

Acetabular dysplasia is associated with an abnormally high stress on the outer edge (rim) of the acetabulum which leads to degeneration of the articular cartilage (arthritis). It is also possible for break-down of the acetabular labrum (rim cartilage of the acetabulum) or a fatigue fracture of the rim of the acetabulum to occur as a result of this rim overload. Any one or a combination of these conditions can cause hip pain sufficient for the patient to seek medical evaluation and treatment.

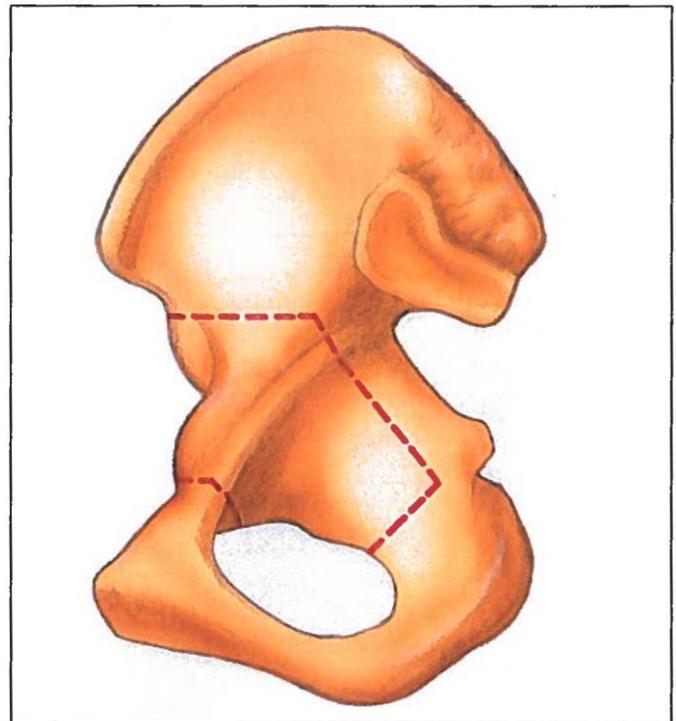
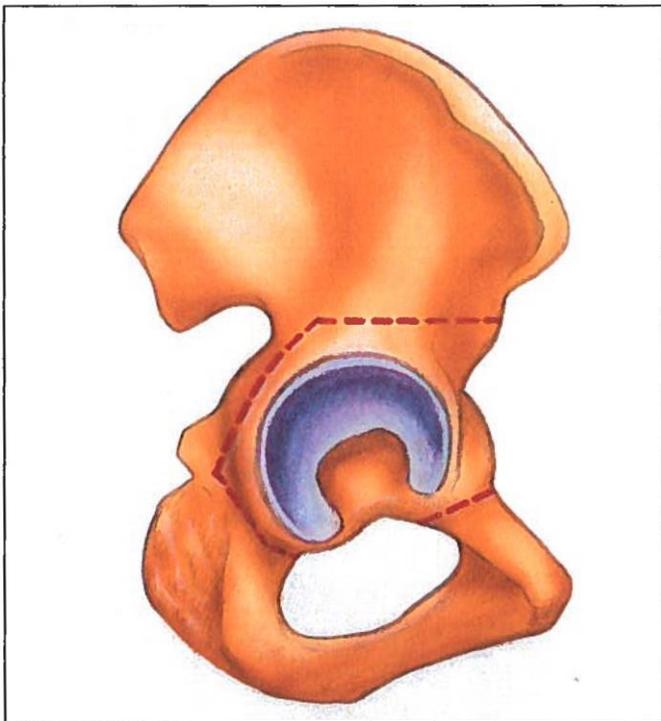
When the diagnosis of acetabular dysplasia is made, the X-ray also usually shows a sign of arthritis which is most commonly an acetabular cyst though increased bone density, a femoral head cyst, osteophytes (bone spurs), and/or cartilage thinning may also be present. If the dysplasia is left uncorrected worsening of the arthritis is predictable and often progresses to a severe status within a few years and sometimes even a few months. For the patient, this means

increasing hip pain, progressive loss of hip motion, and worsening functional capabilities.

About Periacetabular Osteotomy

Periacetabular Osteotomy (PAO) is a surgical treatment for acetabular dysplasia that preserves and enhances the patient's own hip joint rather than replacing it with an artificial part. The goal is to alleviate the patient's pain, restore function, and maximize the functional life of their dysplastic hip.

PAO is a procedure that was developed and first performed in 1984 in Bern, Switzerland by Professor Reinhold Ganz with the assistance of Jeffrey Mast, M.D. (an American surgeon from Sparks, Nevada who was spending a year's sabbatical leave with Prof. Ganz). Dr. Joel Matta's personal association with Prof. Ganz and Dr. Mast made him aware of the very good initial results of this innovative procedure.



Outer (left) and inner (right) views of the right side of the pelvis (the innominate bone). The acetabulum is seen on the outer aspect of the bone. The red line indicates where the bone is cut for PAO.

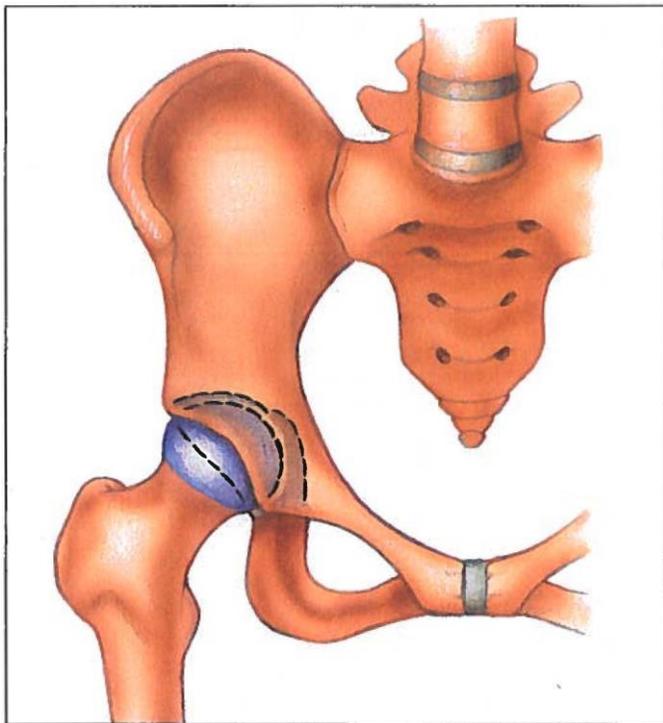
About Periacetabular Osteotomy Continued

In 1987 Prof. Ganz invited Dr. Matta to assist with several PAO surgeries in Bern and shortly following this Dr. Matta performed his first PAO surgeries in Los Angeles. Extensive prior surgical experience with the pelvis and hip was a prerequisite for all three of these surgeons to make the early development of PAO surgery successful.

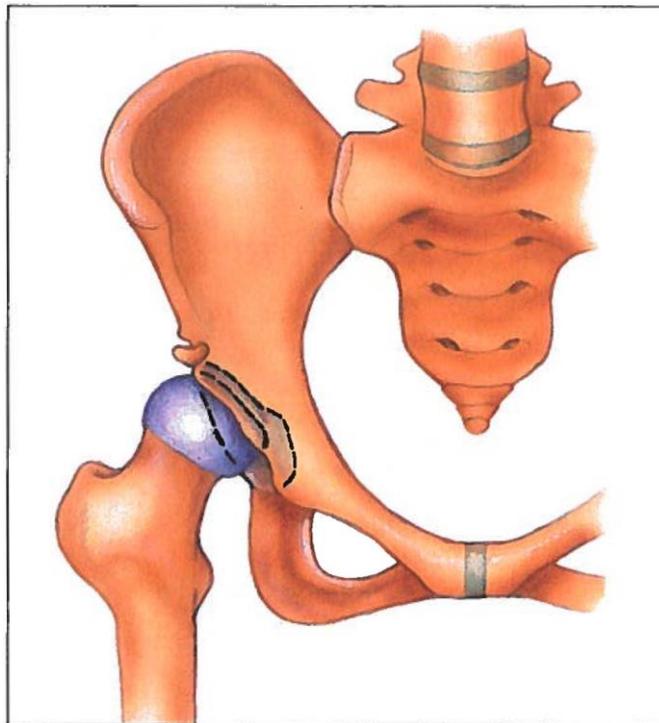
"Periacetabular" means around the acetabulum. "Osteotomy" means to cut bone. Simply put, the PAO cuts the bone around the acetabulum that joins the acetabulum to the pelvis. Once the acetabulum is detached from the rest of the pelvis by a series of carefully controlled cuts, it is rotated to a position of ideal coverage as dictated by the specific acetabulum's unique anatomy. PAO thereby reorients the acetabulum by changing its rotational position. The dysplastic roof that incompletely covers the femoral head is brought over the head to give the head a normal coverage and also brings the roof from an oblique to a horizontal position.

Other subtle changes typically also occur. Anterior coverage may increase. Also, the shortening of the extremity and lateralization of the joint which are often a part of acetabular dysplasia can also be improved. Individual cases of dysplasia however present with their own unique deficiencies and the PAO must often be tailored to solve these unique problems. X-rays taken during surgery confirm the correct position of the acetabulum and screws (typically 2) are inserted into the bone to maintain the acetabulum's new corrected position during bone healing.

A proximal femoral osteotomy (cutting and repositioning the bone of the upper femur) is also advisable in about one out of 10 patients who undergo PAO surgery in order to correct abnormalities related to the femur. The indication for this is not always known until during the PAO operation. The femoral osteotomy is then completed during the same surgery though a second incision if necessary.



Hemi-pelvis with normal acetabulum and femur.



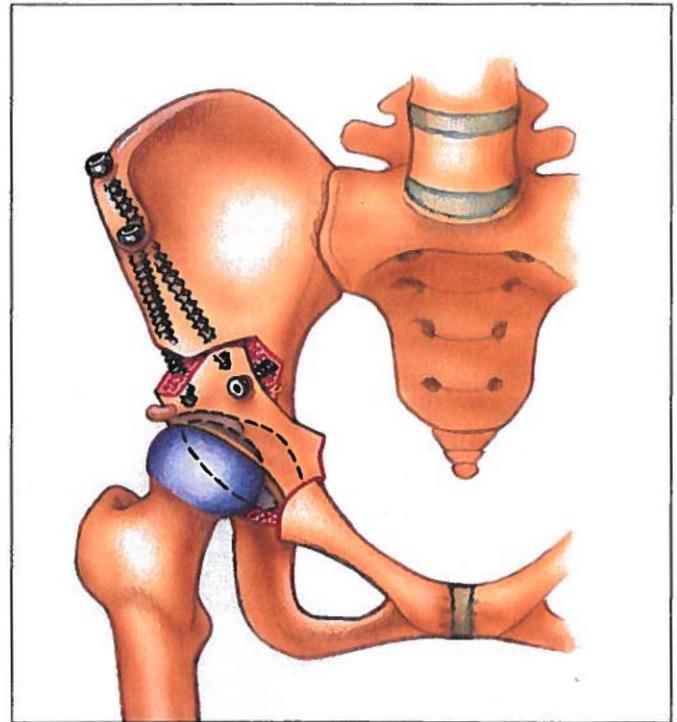
Hemi-pelvis with dysplastic acetabulum and femur.

Potential Surgical Complications

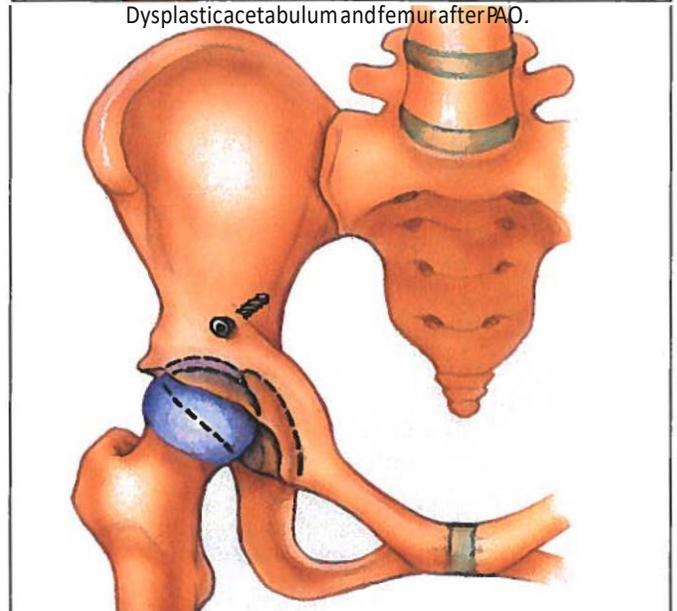
As with any other major hip surgery, there is some risk of complications. Surgical wound infection and injury to major nerves or arteries is possible. Non-union (lack of healing) of the bone following the osteotomy is also possible. Dr. Matta's experience with this operation since 1987 however has shown PAO to be a relatively safe operation with the chance for any one of these complications to be less than one percent.

Post-Operative Care

Patients spend the two hours following surgery in the recovery room where nurses closely monitor them. The patient will spend 1 – 3 nights in the hospital. The medical specialists care for the patient pre- and post-operatively. Included among the team's post-surgical priorities are pain management, preventing infection, and the prevention of deep vein thrombosis (blood clots in large veins), and pulmonary embolus (blood clots traveling through veins to the lungs). Patients begin physical therapy as soon as possible to improve hip motion and muscle function and to learn to use appropriate assistive devices such as crutches or a walker. During the first six weeks following surgery, the injured hip should bear no more than a limited weight of 30 pounds. Placing full weight on the operated side prior to bone healing can cause the screws to bend or break and the osteotomy to lose its position. Too vigorous exercise such as resistive exercise against weights can also cause failure. If failure occurs, re-operation may be necessary, and the chance of developing arthritis is greatly increased. X-rays will be taken after surgery for a final assessment of the result.



Dysplastic acetabulum and femur after PAO.



Acetabulum and femur after healing of PAO and removal of two screws.

After Discharge

The usual hospital stay is 1 to 3 days and depends on how rapidly pain subsides and progress in physical therapy. At discharge pain medication is prescribed as well as an anticoagulant to prevent blood clots. Some degree of pain after discharge is natural which may increase or decrease on different days, but the general trend should be toward decreasing pain. Some patients may sense an occasional "click" or "pop" in or around the hip. Numbness and a tingling sensation are common around the incision area. Patients however experiencing severe or consistent pain or having redness, swelling and/or wound drainage should consult with the doctor. Follow-up outpatient visits are necessary to monitor progress by X-ray and physical examination. The first follow-up visit is usually scheduled about 6 weeks after surgery and the second at 3 months.

At 6 weeks after the surgery, the patient is allowed to be full weight bearing and work toward discontinuing use of the crutches. Muscle strengthening exercises, often with the help of a physical therapist, are also started. Progress in walking depends on return of muscle strength. The majority of patients are walking without support by 2 months after the surgery. Subsequent follow-up visits are at 1-year and

2 years after surgery and then at 2-year intervals.

A minority of patients request removal of one or more screws that were used to fix the PAO and this can be performed as an outpatient procedure that does not interrupt a patient's continued full function.

Why is an Osteotomy Preferable to Total Hip Replacement?

During the past 15 years there has been a renewed and growing interest in adult hip osteotomy. Osteotomy was used more frequently as a treatment for adult hip problems before the advent of Charnley's low friction arthroplasty (the first successful artificial hip joint) in the 1960's. The encouraging early good results regarding function and pain relief after Charnley total hip replacement in young patients led many surgeons to abandon osteotomy. Osteotomy was considered to be difficult and have results that were less predictable and less satisfactory to the patient. Despite the good initial results of total hip replacement, the long-term follow up of these patients has shown increasing problems, especially in the young active population. Osteolysis (bone loss) associated with loosening of the bone to hip prosthesis (artificial hip) bond



Pelvis x-ray of a 15-year-old girl with bilateral hip pain secondary to acetabular dysplasia and early arthritis.



Pelvis x-ray of the same patient 2 years after right PAO and 2.5 years after left PAO. Two screws have been removed on the left. The acetabular dysplasia has been corrected and her hip function is normal.

plagues those patients who outlive the longevity of their artificial hip. Hip revision surgery for the failed total hip can present significant problems particularly for the patient with osteolysis. These failures of Charnley's hip prosthesis have stimulated the production of hundreds of new hip prosthesis designs to solve the problems of loosening and osteolysis. Unfortunately, the overwhelming majority of new designs have not performed as well as the original Chamley prosthesis, and none have been proven better in long term follow of young patients. Therefore, despite that the modern hip replacement has been used for more than 30 years, its problems for active young to middle aged adults have underscored the importance of preserving the hip rather than replacing it.

Osteotomy should not be thought of as an inferior second choice to total hip replacement that the young patient with early arthritis must undergo because he or she is too young for total hip replacement. The results after PAO, which preserves the patient's own hip, justify its use and the long-term results can be better than what the patient could have obtained from a hip replacement. The patient's own hip is a living tissue with self-maintenance capabilities, whereas deterioration with time is inevitable for an artificial part. The sensory capabilities of the joint are preserved, and the patient can continue to remain as active as symptoms, or their lack of, permits. The patient with a total hip replacement, however, always must be cautioned regarding possible hip dislocation and be restricted from vigorous activity.

Results of Periacetabular Osteotomy

From 1987 through 2006 Dr. Matta performed 135 periacetabular osteotomies. Final follow-up of these patients has shown the results of examination to be:

Excellent	(close to normal function)	27%	} 76%
Good	(ability to work and do some exercise activity but may have problems with vigorous activity)	49%	
Fair	(hip function is impaired but no further surgery is yet required)	15%	
Poor	(hip function is significantly impaired and further surgery is often necessary)	8%	

Note Regarding Poor Results

The majority of patients with poor results did not have an immediate poor result but were benefited by the PAO for a variable period (up to 12 years) before requiring further surgery.

Treatment of Poor Results

For patients who develop a poor result sometime after their PAO surgery the cause is typically advancing hip arthritis. These patients are almost always best treated by total hip replacement surgery. For these patients the previous PAO has typically enhanced the acetabular bone with the increased femoral head coverage. Enhancement of a dysplastic acetabulum contributes to the success of a later total hip replacement by making the stability of the prosthetic acetabulum more reliable.

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