

Derleme

**CANINE HIP DYSPLASIA AND IT'S TREATMENT USING THE TRIPLE PELVIC
OSTEOTOMY (TPO) METHOD**

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Köpeklerde Kalça Displazisi ve Triple Pelvik Osteotomi (TPO) Yöntemi ile Sağaltımı

Özet: Kalça displazisi; genç köpeklerde femur başının luksasyonu ya da sublüksasyonu, erişkin köpeklerde orta veya şiddetli eklem hastalığıyla seyreden kalça eklemine gelişim bozukluğu ile karakterize bir lezyondur. Kalça displazisi genç köpeklerde; çabuk yorulma, ayağa kalkarken zorlanma, tavşan gibi koşma, aralıklı ya da devamlı bir topallık belirtileriyle ortaya çıkar. Erişkin köpeklerde bu belirtilere ek olarak, ilerleyici eklem hastalığı nedeniyle; ağrı duymu, kas atrofisi, sallantılı yürüyüş ve sürekli topallık gibi semptomlar, da katılır. Kalça displazilerinde doğru tanı; yaş, ırk, anamnez, fiziksel bulgular ve radyografik değişikliklerin birlikte ele alınmasıyla konur. Kalça displazisinin sağaltımında; hayvanın yaşına, ağırlığına, fiziksel ve radyolojik bulgulara ve hasta sahibinin ekonomik durumuna göre konservatif ya da operatif yöntemler kullanılmaktadır.

Triple Pelvik Osteotomi (TPO), en az düzeyde radyolojik belirti gösteren dejeneratif eklem hastalığı ya da coxofemoral eklem sublüksasyonu bulunan genç köpeklerin sağaltımı amacıyla kullanılan bir yöntemdir. Kalça displazisinin TPO ile sağaltımındaki amaç, bacağın fonksiyonunu geliştirmek ve dejeneratif eklem hastalığının ilerlemesini yavaşlatmak ya da durdurmaktır. TPO'da, pelvise cerrahi yaklaşım 3 farklı noktadan yapılır. Asetabulum'un aksiyal rotasyonu; pubis'e ostektomi, ilium ve ischii'ye yapılan osteotomiler ile sağlanır. Osteotomiyi takiben hayvanın yaşına ve displazinin derecesine bağlı olarak ilium'a 20°, 30° ya da 40°'lik "Canine Pelvic Osteotomy" plakası (CPOP) yerleştirilir.

TPO uygulamasını takiben, implant zayıflığı, pelvik kanal daralması, ischiatic, pudendal ve obturator sinirlerin hasarı ve tarsal eklem hiperekstansiyonu gibi komplikasyonlar görülebilir.

Anahtar Kelimeler: Kalça displazisi, triple pelvik osteotomi, köpek.

Summary: Hip dysplasia is a lesion characterised by the developmental disorder of the hip joint, manifesting itself in medium or severe joint disease in adult dogs and luxation or subluxation of the femoral head in

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young dogs. Hip dysplasia in young dogs manifests itself with signs of rapid exhaustion, difficulty in standing up, bunny-hopping and intermittent or persistent lameness. In adult dogs, in addition to these signs, symptoms such as pain, muscle atrophy, a swinging gait and persistent lameness are also observed due to advancing joint disease. Correct diagnosis in cases of hip dysplasia is made by taking into account such factors as age, breed, history, physical findings and radiographic changes. In the treatment of hip dysplasia, conservative or surgical methods are used depending on the age and bodyweight of the animal, the physical and radiological findings and the financial status of the patient owner.

Triple Pelvic Osteotomy (TPO) is a method used for the treatment of young dogs suffering from either degenerative joint disease exhibiting a minimal level of radiological signs or those with subluxation of the coxofemoral joint. The aim of treating hip dysplasia with TPO is to develop the function of the leg and to delay or prevent the advance of degenerative joint disease. In Triple Pelvic Osteotomy, surgical approach to the pelvis is achieved from 3 points. The axial rotation of acetabulum is performed by pubic osteotomy, ilial osteotomy and ischial osteotomy. Following osteotomy, depending on the age of the animal and the degree of the dysplasia, a 20°, 30° or 40° "Canine Pelvic Osteotomy Plate" (CPOP) is placed on the ilium.

Following TPO, complications such as implant weakness, narrowing of the pelvic canal, damage to the ischiadic, pudendal and obturator nerves and hyperextension of the tarsal joint may be encountered.

Key Words: Hip dysplasia, triple pelvic osteotomy, dog.

Introduction

Hip dysplasia is a lesion characterised by the developmental disorder of the hip joint, manifesting itself in medium or severe joint disease in adult dogs and luxation or subluxation of the femoral head in young dogs (1). This disease was first described by Schnell in 1935 (10, 17, 19).

While hip dysplasia occurs due to multifactorial causes, the most significant factors in its development are genetic structure and nutrition (8, 17, 19).

Hip dysplasia usually occurs in medium and large breed puppies between 5-10 months of age. It is observed together with degenerative joint disease in adult dogs. The most susceptible breeds are St. Bernard and German Shepherd Dogs. However, many dog breeds are affected by this disease. Hip dysplasia is very rarely seen in cats (8, 17).

Hip dysplasia in young dogs manifests itself with signs of rapid exhaustion, difficulty in standing up, bunny-hopping and intermittent or persistent lameness. In adult dogs, in addition to these signs, symptoms such as pain, muscle atrophy, a swinging gait and persistent lameness are also observed due to advancing joint disease (2, 6, 8).

In the physical examination of the patients, pain perception during external rotation and abduction of the hip joint, atrophy in the pelvic muscles and rapid exhaustion is observed. In the examination under sedation or general anaesthesia, laxity in the hip joint is noticeable. This sign however, is not apparent in adult dogs due to fibrous tissue proliferation. In the physical examination of hip dysplasia, the Ortolani, Barlow and Barden tests are used. Clinical examination findings may not always be consistent with radiographic findings. Correct diagnosis in cases of hip dysplasia is therefore made by taking into account such factors as age, breed, history, physical findings and radiographic changes (2, 4, 8, 10, 17).

Radiological examination is done with symmetrical ventro-dorsal (VD) radiographs of the pelvis and both femurs. The dog is positioned in dorsal recumbency. The hindlegs are straightened to the point where the stifle and tarsal joints are fully extended. The legs are rotated slightly inwards in order to centralize both patellas dorsally. In radiological evaluation, the Norberg angle is used to determine whether or not the hip joint is dysplastic. The Norberg angle is between 55° and 115°. The smallest degree of angle reveals the greatest degree of laxity in the hip joint. Joints with a Norberg angle of 105° or above and those with over 50% of the femoral head within the acetabulum are classified as normal joints (6, 13, 17, 20).

One other radiographic diagnosis method is the Distraction Index (DI). Passive hip joint laxity is measured using this method (7, 15). This is a reasonably reliable method in the early diagnosis of hip dysplasia and degenerative joint disease (1, 18). This method is based on the distance measured between the geometric centres of the femoral head and the acetabulum. While a DI of over 0.7 reveals excessive laxity of the hip joint, a DI of under 0.3 indicates good joint stability (7).

The Orthopedic Foundation for Animals (OFA) has classified the radiological congruity between the femoral head and the acetabulum in hip dysplasia in 6 stages (8, 20). These are:

Excellent Hip Joint: Has a well-defined, "C" shaped acetabulum. The acetabulum covers 75% or more of the femoral head.

Good Hip Joint: Has a well-defined, "C" shaped acetabulum. The acetabulum covers 60-75% of the femoral head.

Fair Hip Joint: While slight arthritis and irregularities are observed in the acetabulum, subluxation has not yet occurred. The acetabulum covers 50-60% of the femoral head.

Slightly Dysplastic Hip Joint: There is either slight subluxation or a shallow acetabulum. Minimal secondary changes have occurred within the joint. The acetabulum covers 40-50% of the femoral head.

Medium-degree Dysplastic Hip Joint: Intermediate subluxation and secondary changes are present in the hip joint. The acetabulum covers 25-40% of the femoral head.

Severely Dysplastic Hip Joint: There is severe subluxation and distinct secondary changes. The acetabulum covers less than 25% of the femoral head (2).

Clinical signs may not always be consistent with radiological findings. There may be no clinical signs present even in cases with radiologically medium or severe dysplasia (6, 8). Several neurological and orthopaedic diseases exhibit similar clinical signs to hip dysplasia. In young dogs, panosteitis, osteochondrosis, epiphyseal detachment, hypertrophic osteodystrophy and lameness due to cruciate ligament ruptures must be differentiated from hip dysplasia. On the other hand, in adult dogs, symptoms occurring due to neurological (cauda equina) and orthopaedic (cruciate ligament ruptures, polyarthritis, bone tumours) disorders must be differentiated from hip dysplasia (2, 6, 8).

In the treatment of hip dysplasia, conservative or surgical methods are used depending on the age and bodyweight of the animal, the physical and radiological findings and the financial status of the patient owner. Acupuncture, a controlled diet, housing in a confined area or medication all provide an acceptable degree of clinical recovery in young dogs. In cases where conservative treatment is ineffective or the disease is advanced, preventative, alleviating or restorative surgical interventions are employed (2, 6, 8, 11).

Preventative Surgical Intervention

Triple Pelvic Osteotomy (TPO): This will be discussed in detail below.

DARthoplasty: This is a method modified from human medicine for the treatment of hip dysplasia. It is based on the principle of widening the dorsal acetabular ridge. It is used in cases where treatment with TPO has failed or those where the acetabulum has filled due to joint laxity or where the dorsal acetabular ridge is formed weakly (11).

Intertrochanteric Osteotomy: This method is used to correct the abnormal inclination and anteversion angles of the femur. The inclination angle is the angle between the femoral neck and the long axis of the femur. This angle is approximately 145° in healthy dogs. In most of the dogs with hip dysplasia, the inclination angle increases by $30-35^{\circ}$ (coxa valga). This causes subluxation in the hip joint and disruption of stability. The anteversion angle indicates the relationship on the coronal plane between the long axis of the femoral neck and the femoral condyles. This value is approximately 27° in healthy dogs. Increases in the anteversion angle cause further cranial protrusion of the femoral head. This, in turn, causes subluxation and a decrease in joint stability (2, 11, 14).

In this method, an osteotomy is carried out between the major and minor trochanters. A wedge-shaped bone segment is removed from the medial of the osteotomy line. The area of osteotomy is fixed using either a specific plate or the tension band technique. As a result of this procedure, the femoral head is directed towards the depths of the acetabulum. Joint stability increases. The desired values following surgery are 135° for the inclination angle and $5-10^{\circ}$ for the anteversion angle (2, 11).

Increasing the Length of the Femoral Neck: This method is employed in cases where hip joint instability is caused by a short femoral neck. This condition is usually observed in dog breeds such as Chow Chow and Akita. Increasing the length of the femoral neck enables the femoral head to adopt a more medial and varus position (2, 11, 14).

Alleviating Procedures

Pectineal Tendon or Muscle Surgery: The pectineus muscle is among the adductor muscles of the hindleg. Severance of this muscle reduces adductor forces and increases abduction of the hip joint. This procedure provides better congruity between the acetabulum and femoral head. It is usually carried out bilaterally (2, 11).

Restorative Procedures

Excision Arthroplasty: This method is based on the complete removal of contact between the joint surfaces of the acetabulum and femoral head. It is important for the osteotomy site to be extremely smooth in order to prevent pain (2, 11).

THR (Total Hip Replacement): This method involves the implantation of an acetabulum model of high density plastic and a stainless steel or titanium femoral head and neck. For implantation, the femoral head and neck are removed. The medullary canal is prepared for insertion of the implant. The acetabulum is also widened and prepared for surgery. The operation is completed using a prosthesis with or without cement, designed especially for veterinary use. THR is a surgical method carried out after complete closure of the growth plates (11, 12, 14).

Triple Pelvic Osteotomy (TPO)

TPO is a method used for the treatment of young dogs suffering from either degenerative joint disease exhibiting a minimal level of radiological signs or those with subluxation of the coxofemoral joint. It was first described in 1969 by Hohn and Janes. The aim of treating hip dysplasia with TPO is to develop the function of the leg and to delay or prevent the advance of degenerative joint disease (4, 9, 16). The purpose of TPO is to axially rotate the acetabulum to completely cover the femoral head and by increasing the joint surface between the joints, to alleviate the forces acting on the joint and to increase joint stability (4, 5, 9, 13, 14).

TPO is the preferred technique for 4-8 month-old young dogs which have not yet completed their bone development (14).

TPO is contraindicated in cases of advanced degenerative joint disease, a shallow acetabulum or neurological disease (14).

The inguinal region and both sides of the pelvis are clipped for surgery. The patient is given general anaesthesia and then put into lateral recumbency on the operation table with the leg to be operated on uppermost. The site is disinfected and prepared for surgery (8, 14, 17).

In Triple Pelvic Osteotomy, surgical approach to the pelvis is achieved from 3 points (Fig 1). The axial rotation of acetabulum is performed by pubic osteotomy, ilial osteotomy and ischial osteotomy (8, 10, 13).

The operation begins with osteotomy of the pubis. The related leg is held at a 90 abduction position and a skin incision of 5-6 cm is made starting from the pubis on the inside of the leg and which is perpendicular to the median line between the pectineus and gracilis muscles. The pectineus muscle is separated from its attachments by blunt dissection. This procedure makes it easier to approach the lateral portion of the pubis. After the abductor magnus muscle and other soft tissue are removed together with the periosteum, a bone segment of 1-2cm is removed from the pubis using an oscillating bone saw. During this

procedure care must be taken not to damage the obturator nerve which passes by the cranio-lateral of the obturator foramen. The removed bone segment is kept to be used as a bone graft in the ileal osteotomy. The operation site is closed surgically (3, 4, 8).

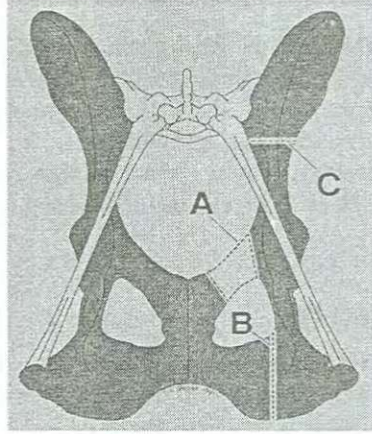


Figure 1. Triple pelvic osteotomy and osteotomy lines; (A) pubic osteotomy, (B) ischial osteotomy, (C) ilial osteotomy are shown (from Slocum and Slocum).

Şekil 1. Triple pelvic osteotomi ve osteotomi hatları; (A) pubis osteotomisi, (B) ischii osteotomisi, (C) ilium osteotomisi gösterilmektedir (Slocum ve Slocum'dan).

The skin incision for ischii osteotomy is made above the ischial tuberosity, parallel to it until the point where the ischiadic arc begins on the lateral. The incision is approximately 5-6cm long. Some of the connections in the area where the internal obturator muscle attaches to the ischial tuberosity are cut. Soft tissues are separated by blunt dissection and the obturator foramen is reached. Using the oscillating bone saw, an osteotomy is done to the ischii from the outside inwards, parallel to the long axis of the pelvis. After the osteotomy procedure is completed and the plate for axial rotation is fixed, the end of the ischial tuberosity is fixed with a metal ligature. The incision in the ischii is left open until osteotomy of the ilium is completed. The site is then closed routinely (3, 4, 6, 8).

In the third stage, osteotomy of the ilium, which provides axial rotation of the acetabulum, is carried out. The site of the ilium osteotomy is from the ilium wing up to the level of the major trochanter. Following a skin incision of approximately 10-15cm, the subcutaneous adipose tissue and gluteal fascia are dissected. The gluteus muscle is exposed and separated from the tensor fascia latae. Starting from the origin of the rectus femoris muscle, the profound and medial gluteal muscles are dissected subperiostally. The tissues are retracted and ilium osteotomy is done immediately caudal to the sacroiliac joint. During this procedure, care should be taken not to damage the ischiadic nerve which courses medial to the ilium (3, 6, 8).

Following osteotomy, depending on the age of the animal and the degree of the dysplasia, a 20°, 30° or 40° degree "Canine Pelvic Osteotomy Plate" (CPOP) is placed on the ilium (3, 5, 6). The plate is first fixed to the portion caudal to the ilium using 3 screws of 3.5mm width. The same procedure is then carried out on the cranial portion of the ilium by rotating the ilium (Fig. 2). Fixation is then completed. After the plate is fixed, the line of osteotomy in the ischii is fixed using cerclage wire. The operation site is closed surgically (3, 6, 14).

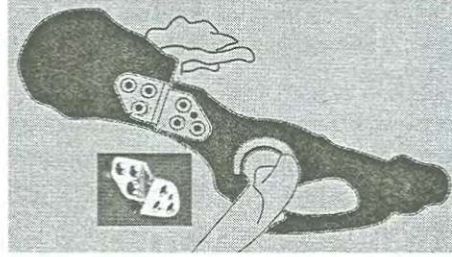


Figure 2. Application and appearance of canine pelvic osteotomy plate (from Slocum and Slocum).

Şekil 2. Canine pelvic osteotomi plakasının görünümü ve uygulanaşı (Slocum ve Slocum'dan).

The fixed CPOP provides fixation in 8 points through 6 screws and 2 cerclage wires (Fig. 3). Thus, insufficiencies due to fixation are minimised (14).

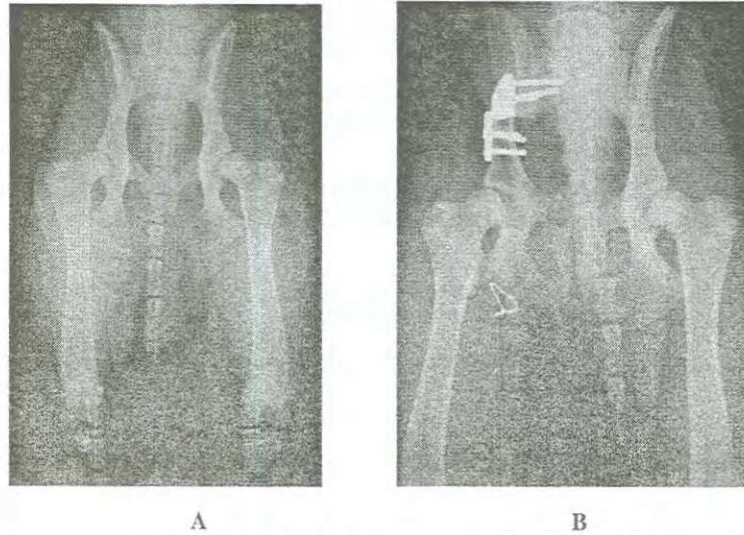


Figure 3. Radiographic appearance of a dog with bilateral hip dysplasia; (A) before TPO and (B) after unilateral TPO (from Altunatmaz *et al.*)

Şekil 3. Bilateral kalça displazili bir köpeğin; (A) TPO öncesi ve (B) tek taraflı TPO uygulaması sonrasındaki radyografik görünümü (Altunatmaz ve ark.'dan)

In the postoperative period, antibiotics are administered to the patient for a week. Movement of the patient is limited for 8 weeks until bone healing is radiologically complete. Passive extension and flexion movements are carried out on the hip joint (2, 6, 8).

Prognosis depends on the bodyweight of the patient and postoperative physiotherapy. While results are good or excellent for lightweight patients, in others, the degree of lameness is usually less than before the operation (8, 14).

Following TPO, complications such as implant weakness, narrowing of the pelvic canal, damage to the ischiadic, pudendal and obturator nerves and hyperextension of the tarsal joint may be encountered (4, 6, 9).

This article was prepared to share the information with our colleagues, of diagnostic methods for hip dysplasia and that successful results can be achieved with TPO used for the treatment of this condition.

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