



Pelvic Apophyseal Injury in Children -A Guide for Medical Professionals Involved in Contact Sports



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Abstract

Pelvis consists of 5 main apophysis with several ligament and tendons attach to it. They fuse around 14 years in girls and 16 years in boys. They form a weak zone of attachment to the main pelvic bone and are prone to injury particularly during contact sports. These injuries should be kept into consideration by sports trainer at the side line, physical therapist, physicians, physician assistants and nurse practitioners involved in the treatment of children with pelvic injuries. Early diagnosis and treatment is associated with good functional outcome.

Introduction

Pelvis consists of several apophysis. Several ligaments and tendons insert at these sites [1,2]. Acute injury mainly during sports can result in increased load on muscles, tendons, and ligaments and can lead to apophyseal injury in youngsters. Main apophysis of pelvis are Ischial tuberosity, anterior superior iliac spine (ASIS), anterior inferior iliac spine (AIIS), superior corner of the pubic symphysis, and iliac crest [1]. There is recent increase in incidence in Pelvic apophyseal injuries due to increased contacts ports at the level of middle and high school [3]. We have reviewed anatomy, epidemiology, mechanism of injury, diagnosis and treatment of Pelvic apophyseal injuries in children and teenage population involved in sports.

Anatomy

All the main five apophysis of pelvis have separate center of ossification. They do not articulate with any other bone directly [1,2]. They are not responsible for longitudinal growth of the bone but they provide bony contour [1]. They provide attachment to the muscles of both abdomen and lower extremity.

The main Apophysis with muscles attached to it in the pelvis are [1,4,5]:

1. Anterior superior iliac spine: Sartorius, Tensor Fascia Lata

2. Anterior inferior iliac spine: Straight head of Rectus Femoris
3. Iliac crest: Multiple abdominal muscles
4. Pubic Symphysis: Adductor longus, adductor brevis, gracilis, obturator externus
5. Ischial tuberosity: Biceps femoris, semimembranosus, semitendinosus

Iliac apophysis fuse around 14 years (Range 10-18 years) in girls and 16 years in boys (Range 13-20 years) with range 10-18 years in girls and 13-20 years in boys [4,5]. They fuse at age later than fusion of epiphysis. The zone of attachment of apophysis to the parent bone is weak during development and is responsible for Apophyseal injury before fusion and muscle sprain after its fusion [6].

Epidemiology

The Pelvic Apophyseal injuries are more sports related than any other injuries [7-11]. The incidence varies from 80-100% according to different studies. In general population, male have incidence range from 68.5-90%. It could be due to more males involved in contact sports. Based on different studies Pubic symphysis is the least involved Apophyseal injury (0-3.5%). Ischial tuberosity is the

most common involved apophyseal injury (22.2-53.7%) followed by Anterior inferior iliac spine (14.8%-20%) and Anterior Superior Iliac spine (19.2%-40.8%). Iliac crest is also one of the less common sites for apophyseal injury (1.5-5%). The average age ranged from 13.8 to 15.2 years with range extending from 11-17 years indicating it involved mainly students in middle and high school.

Mechanism of Injury

As discussed above, epiphyseal plates and apophysis are the weakest and muscles, tendons and ligaments are stronger before puberty; therefore, kids involved in contact sports are more vulnerable to injuries while the same mechanism will cause muscle or ligament sprain in adults [7]. The main mechanism is sudden severe contraction of the muscle in an unfused apophysis. The pull is caused by sudden severe concentric or eccentric contraction of a large muscle to either accelerate or decelerate the body mass. The other rare mechanism is sudden passive lengthening of the muscle in case of dancers and cheerleaders which involved ischial tuberosity [10].

In most of the cases, injury is from indirect force over pelvic apophysis from the muscle of the lower extremity except in case of Iliac crest where injury is caused by pull from abdominal muscles: external oblique, internal oblique or rectus abdominis muscle. It is caused mainly by sudden twist of the trunk and less commonly by direct blow over the iliac crest [7]. Ischial tuberosity avulsion injury is mainly from sudden stopping during sprinting activity causing hamstring group of muscles to fire to reverse the motion and overloading ischial tuberosity. Injury to anterior superior and anterior inferior iliac spine is mainly from sprint activity or kicking. Pubic symphysis avulsion injury is mainly from forceful hip adduction against resistance [7,8].

Diagnosis

History and physical examination play an important role in the diagnosis of the injury. The athletes report sudden onset of pain associated with a 'pop' during sprinting, gymnastics, or contact sports [3,7]. Site of the pain is also important where pain is located in buttock or upper hamstring area in Ischial tuberosity avulsion injury, site of pain is anterior in anterior superior or anterior inferior iliac spine and iliac crest injury. Pain is over groin in Pubic symphysis avulsion injury [3,7-9]. Active hip extension and knee flexion are painful and passive hip flexion causes discomfort for Ischial tuberosity avulsion injury. Active hip flexion is painful and passive hip extension causes discomfort for ASIS and AIIS avulsion injury and in iliac crest injury [7].

Differential diagnosis include sprain of the muscles which is more common after fusion of the Apophysis. Other differential diagnosis includes Apophysitis and Tumor [3,5,7]. Anteroposterior and oblique radiograph show avulsed fragment and is the first investigation of choice. However, CT scan gives better information regarding amount of displacement of the fragment as well as it helps in detection of non-displaced fragment. MRI is helpful in

diagnosing Apophyseal injury in children in whom ossification of the Apophyseal ossification center has not started [12]. In rare case, bone biopsy may be needed to rule out neoplasm in long standing case of Apophyseal injury associated with exostosis [12].

Treatment

Early diagnosis of the apophyseal injuries is important for the management. Delay in diagnosis can result in improper management of fracture and increased chances of delayed union, displacement of fracture and non-union [3,10,11]. Majority of the Apophyseal fractures are treated nonoperatively. McKinney et al. [13] has recommended non weight bearing for first 2 weeks followed by progressive weight bearing for next 3-6 weeks. Kaneyama et al. [14] has recommended return to full sporting activity around 3-4 months.

Based on treatment options McKinney et al. [13] classified Pelvic Apophyseal fractures:

1. Type 1-Non-displaced fractures
2. Type 2-Displacement up to 2cm
3. Type 3-Displacement greater than 2cm
4. Type 4-Symptomatic nonunion or painful exostosis

Different authors have recommended surgical intervention for type III and IV fractures [13]. Surgery is also recommended for type II Ischial tuberosity fractures with causing neurologic symptoms. It includes open reduction and internal fixation of majority of type III fractures [13,14]. Arthroscopic excision of the painful exostosis has also been recommended [3,15]. There are also chances of heterotopic ossification of the bone after excision of the avulsed fragment and may need repeat surgery [16].

Conclusion

1. Pelvic apophyseal injuries are common in middle and high school students involved in sporting activities like sprinting, gymnastics or contact sports and should be kept into consideration by physicians or other medical personnel involved in treatment of sports related pelvic injuries.
2. Careful history and physical examination with investigations which include x-rays, CT scan, MRI and bone scan play important role in the diagnosis.
3. Early diagnosis and non-operative management has been successful in majority of the patients.
4. Surgical intervention is indicated for fractures with more than 2cm displacement at the time of diagnosis and for painful nonunion and exostosis.

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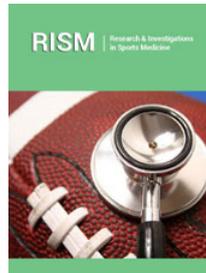
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