Extensive Implant Reaction in Failed Subtalar Joint Arthroereisis: Report of Two Cases

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Abstract Foreign body synovitis with extensive granulomatous giant cell reaction to refractile polyethylene debris is a complication of subtalar arthroereisis not previously reported. We present two cases whereby STA-peg implants were used to treat bilateral painful flexible flatfoot deformities in children. Two boys, presented at 7 and 10 years of age, 2 years after STA-peg procedures and tendo-Achilles lengthening for painful flatfeet. They each had minimal subtalar motion and pain at the sinus tarsi. Radiographs demonstrated surgical defects in the calcaneus with surrounding high signal on the magnetic resonance imaging (MRI) in the subchondral bone of the calcaneus and talus. Both patients failed conservative management and had their implants removed with good relief of their pain. Histology was submitted at the time of implant removal. We present the radiographic and pathologic findings seen in these two patients with failed subtalar arthroereisis due to extensive implant reaction. The pathologic process seen in these patients is a previously unreported complication of this procedure. We do not recommend arthroereisis in the treatment of painful flexible flatfoot in children.

Key words arthroereisis · pes planus · children · subtalar synovitis

Introduction

Flexible flatfoot in children is one of the most common disorders encountered by the pediatric orthopedic surgeon.

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The true incidence is unknown, in part, because there is poor agreement on strict clinical and radiographic criteria for defining a flatfoot and also because most people with this condition never seek treatment. There are multiple components of a flexible flatfoot deformity including: a depression of the longitudinal arch on weight bearing, plantar flexion of the talus relative to the calcaneus, plantar medial prominence of the talar head, abduction of the forefoot at the talonavicular joint with subluxation of the navicular laterally on the talar head and valgus positioning of the heel. It is believed by some that flexible flatfeet in children, if left untreated, may lead to disabling secondary deformities and foot pain in adolescence or early adulthood, although this has never been substantiated. [1, 2]

Despite the absence of any convincing evidence that flexible flatfeet actually lead to functional problems or pain, many authors have recommended surgical treatments for children with painless flexible flatfeet. [1, 3–5] Among the procedures recommended, subtalar arthroereisis utilizing a high molecular weight polyethylene implant is considered to be a minimally invasive procedure. The reported advantages of this technique over other surgical methods are that it can be done through a small incision with little postoperative immobilization and a rapid recovery. [3]

Chambers [6] first described arthroereisis in 1946 as a technique for the treatment of pediatric pes planus utilizing a bone block to fill the sinus tarsi and limit hindfoot eversion. In 1977, Miller [5] advocated the addition of an Achilles tendon lengthening to the arthroereisis procedure, and described using a triangular bone graft obtained from the posterolateral portion of the calcaneus and placed in an osteotomized segment of the anterolateral facet of the calcaneus, just behind the calcaneocuboid joint. In 1983, Smith [3] popularized the use of a polyethylene peg implant to prevent excessive anterior shift of the talus during hyperpronation. By placing the peg in the calcaneal notch, thereby eliminating the associated abnormal forward movement of the talus, the coexistent components of pronation such as calcaneal eversion, adduction, and plantar flexion of the talus are prevented.

Despite reports of good outcomes, subtalar arthroereisis has associated complications such as persistent pain, avascular necrosis of the talus, sinus tarsi, intraosseous cystic formation in the talus, subluxation of the prosthesis, and subtalar joint arthrosis [7–11]. We report two cases with a previously undescribed complication of extensive implant reaction after failed subtalar arthroereisis with polyethylene peg implants (STA-peg). Review of the literature failed to show any reports, to date, of histopathologic examination of implant reaction in cases of failed STA-peg procedures.

Case reports

Case number 1

M.K. presented to our clinic at 7 years of age with complaints of bilateral foot pain. He had a history of bilateral painful flatfeet ever since he was a small child. He was initially treated with orthotics and physical therapy, then at 5 years of age, he underwent a subtalar arthroereisis with an STA-peg implant and Achilles lengthening by a podiatrist at

an outside institution. A sinus tarsi approach was utilized, with insertion of a trephine perpendicular to the floor of the sinus tarsi into the calcaneus. This was followed by placement of the polyethylene implant into the calcaneus using a press fit technique without polymethylmethacrylate. He had no relief of his symptoms following this procedure.

On presentation to our clinic 2 years after his surgery, his pain severely limited his athletic activities and limited his walking to no more than three blocks and was also interfering with his abilities at school. On exam, he had flexible flatfeet with reconstitution of his arch when standing on his toes. He had had minimal subtalar motion and tenderness at the sinus tarsi bilaterally. There was crepitus upon passive motion of the subtalar joint. He had better correction of the appearance of his flatfoot on the right side compared to the left. Dorsiflexion of his ankles was limited to 5° past neutral with his knees extended, with 45° of plantar flexion on examination.

Radiographs of the feet demonstrated surgical defects and outlines of the pegs in the calcanei (Fig. 1). Also noted was some arthrosis in the posterior facet of the subtalar joint. The AP roentgenograms demonstrated increased

Fig. 1. a through d AP and lateral radiographs of right (a,b) and left (c,d) feet demonstrating reactive bone in the calcanei around the implants

Fig. 2. **a** and **b** Oblique coronal and sagittal fast spin echo MR images of the ankle demonstrate moderate osseous reaction around the implant with a margin of high signal and sclerosis

talonavicular angles with lateral displacement of the navicular on the talar head. The lateral talocalcaneal angle was increased with talonavicular joint breach. A magnetic resonance imaging (MRI) of both feet revealed the polyethylene peg in the anterolateral portion of the calcaneus with the horizontal platform of the peg between the non-articular surfaces of the talus and calcaneus laterally. The peg was surrounded by high signal on MRI in the subchondral bone of the talus and calcaneus (Fig. 2).

Despite conservative management, including more physical therapy, he eventually underwent implant removal 3 years after his index procedure. The implant and surrounding tissue were surrounded by scar tissue and inflamed synovium. Specimens were sent for histologic examination (Fig. 3), which demonstrated sclerotic synovium with chronic granulomatous reaction to refractile polyethylene shards. After removal of the implants and a brief period of immobilization, the patient had improvement of his pain. He required UCBL orthotics for 1 year after surgery and has had continued relief at 3-year follow up. He is now able to participate in full athletic activities without pain.

Case number 2

P.T. presented at age 10 years with a similar history, 2 years after a subtalar arthroereisis with an STA-peg implant and tendo-Achilles lengthening by a podiatrist at an outside institution. He failed to improve after the procedure and had persistence of pain, which eventually confined him to a wheelchair if he was to walk more than one block. Upon presentation to our clinic, his incisions were well healed bilaterally. He had a residual flatfoot deformity on the left, which was greater than the right. When standing on his toes, his arches reconstituted

Fig. 3. **a** Photomicrograph showing histiocytic and foreign body giant cell reaction to shards of polyethylene particles (H&E $\times 25$). **b** Photomicrograph of same field on polarized microscopy confirming the presence of refractile polyethylene particulate debris (H&E $\times 25$ polarized microscopy)

Fig. 4. AP radiograph of both feet showing reactive bone (arrow) around the implant in the anterior aspect of the left calcaneus

bilaterally, and his right hindfoot went into varus; however, the left remained in valgus. Plantarflexion of the ankles was 30°, dorsiflexion was 15°. Inversion and eversion were 10° each, bilaterally. He had tenderness over the sinus tarsi on the left side only and tenderness with inversion of the left foot. Radiographs (Fig. 4) demonstrated reactive bone in the calcaneus around the polyethylene implant. The MRI (Fig. 5) demonstrated peritarsal subluxation consistent with flatfeet and hyperintensity consistent with erosion of the anterior talus and calcaneus. His symptoms continued

despite physical therapy and orthotics. He subsequently underwent removal of the implants at our institution. At the time of surgery, extensive synovitis was noted. Specimens were submitted for pathological examination, which revealed moderate hypertrophy and hyperplasia of the synovium with extensive foreign body granulomatous giant cell reaction to refractile polyethylene debris. Focal areas of chronic inflammation were also noted. These findings were identical to those recognized in case number 1.

Discussion

Pes planus is very commonly seen in the pediatric population, most of which are flexible. Most authors currently agree that flexible flatfoot may be considered an anatomic variant and is not a disabling deformity. The usual indication for surgery in the presence of a flexible flatfoot is pain that does not respond to nonoperative management. Numerous surgical procedures to correct flatfoot have been described over the last century. Although most of the procedures can alter the shape of the arch, there are no studies that show that they alter function or prevent future deformities.

Arthroereisis is a term applied to procedures that limit but not eliminate the motion of a joint with abnormal mobility. Reports have described the use of various materials for subtalar joint arthroereisis including a bone plug, silicone, poly-L-lactic acid and ultra-high weight polyethylene. This procedure has been popularized in the podiatric community [1–3, 6].

Complications reported in the literature are common and wide ranging. The most commonly seen complication is continued severe postoperative pain with failure to reconstitute the longitudinal arch on weight bearing and a residual flatfoot deformity [7]. Marked loss of motion of the subtalar joints is also seen and is associated with

Fig. 5 a and b Sagittal and oblique coronal fast spin echo MR images demonstrating osseous remodeling in the calcaneus with high signal and sclerosis about the implant consistent with an indolent osteolytic response

arthrosis at the talonavicular and subtalar joints. Rockett et al. [9] described bilateral intraosseous cysts in the talus after subtalar arthroereisis with an STA-peg implant. The cyst contained clear, thick, yellow gelatinous fluid in conjunction with an eroded implant that was “sitting loosely in the calcaneus” [9]. Pathologic review of the cyst material was described as “an interosseous ganglion but with no signs of detritic synovitis or debris” [9]. Siff and Granberry [8] reported on avascular necrosis of the talus which was diagnosed 10 years after the original procedure. It was postulated that the patient developed a foreign body reaction to polyethylene debris within the talus resulting in the avascular necrosis.

The two patients in this study had painful flatfeet treated by subtalar joint arthroereisis using a polyethylene peg implant placed in the subtalar joint. In both instances, the patients had persistent pain, after the arthroereisis procedures, which became progressively worse with time. Upon removal of the polyethylene implants from the subtalar joint, there was noted to be extensive polyethylene debris with granulomatous reaction. The pathologic process seen in these patients has not been reported previously as a complication of subtalar arthroereisis, although it is certainly a well-recognized complication of polyethylene implants. Both patients had similar presentations, procedures, and outcomes, with relief of their symptoms after removal of the implants. In light of these findings, we recommend that any surgeon who performs this procedure should warn their patients of this potential complication.

Furthermore, we believe that persistent or recurrent foot pain after subtalar arthroereisis with a polyethylene implant warrants excision of the implant.

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