ONE-STAGE PANTALAR ARTHRODESIS FOR ANKLE-FOOT DEFORMITY IN POST-POLIOMYELITIS PATIENTS

Jui-Teng Chien, Lian-Chen Wu

Post-poliomyelitis foot deformity remains a challenging problem to orthopedic surgeons, though its incidence has decreased greatly. The purpose of this retrospective study was to evaluate the surgical outcome in patients with paralytic foot deformity associated with poliomyelitis. Between 1998 and 2002, seven patients with a history of prolonged, severe, and rigid equinocavovarus deformity secondary to poliomyelitis underwent one-stage deformity correction and pantalar arthrodesis. Their average age at the time of surgery was 54 years and the average follow-up was 22 months. Fixation with multiple cannulated screws, bone staples, or K-wires was used in all patients. After surgery, no vascular insufficiency or skin sloughing developed. At the latest follow-up, solid arthrodesis was achieved in all patients and none of the deformities recurred. Painless plantigrade feet were achieved in all patients but one. Leg length discrepancy averaged 2.7 cm (range, 2-4.5 cm), which was managed with shoe lifts.

In conclusion, with stringent preoperative evaluation, meticulous surgical technique, and highly compliant postoperative cast protection, one-stage deformity correction and pantalar arthrodesis can be successfully accomplished in patients with severe, rigid equinocavovarus deformity secondary to poliomyelitis.

Key words: Pantalar arthrodesis, poliomyelitis, ankle, foot, deformity

INTRODUCTION

In Taiwan, poliomyelitis was highly endemic in the 1950s and 1960s. With the implementation of national immunization program in 1968, the number of cases was reduced dramatically. Deformities of the lower limb in most post-polio patients develop as a result of muscle imbalance, with various patterns of involvement, such as equinus, equinovarus, calcaneovarus, or equinocavovarus deformity. Gravitational forces make the ankle susceptible to equinus deformity after paralysis. If the peroneal muscles are paralyzed, varus deformity of the hindfoot may develop as a result of weight-bearing on a
laterally unstable foot. With long-standing equinus deformity, midfoot cavus deformity along with cock-up of the great toe and clawing of the lesser toes may ensue.

In adults, severe equinovarus or equinocavovarus deformity secondary to poliomyelitis in adult patients can be difficult to treat. Various treatment methods, including bracing, correction with external fixation, and one-stage or two-stage open correction, have been used. The purpose of this study was to evaluate the clinical and radiographic outcome of one-stage open correction, osteotomy, and pantalar arthrodesis in seven patients with paralytic foot deformity developing after poliomyelitis.

MATERIALS AND METHODS

Between January 1998 and December 2002, we treated seven women with post-poliomyelitis foot and ankle deformity by performing pantalar arthrodesis. The indications for surgery were pain, deformity, instability, and limited walking distance.

Clinical Evaluation

All patients were clinically examined to assess the deformity of the ankle and foot, the level of activity, the walking tolerance, and any problems with wearing shoes. In all patients, the involved side was atrophic and the muscle power was weaker than the healthy side. All patients had a rigid equinocavovarus deformity with good protective plantar sensation. Claw toe deformity, especially with cock-up deformity of the great toe, was seen in five patients, and a weak extensor hallucis longus (EHL) muscle with drooping of the great toe was seen in the other two patients. All patients had painful callosities, which were mainly over the metatarsal area or along the lateral border of the foot. Six patients could wear ordinary shoes, but the abnormal load quickly caused wear on the shoes. Only one patient (case 1) was unable to wear any kind of shoes because of her extremely deformed foot.

Six patients had been given braces or orthoses during childhood, but only one (case 2) had undergone lengthening of the Achilles tendon, which was done at the age 4 years. One patient (case 1) had right hip dysplasia with secondary osteoarthritic change, and she underwent total hip replacement six months before her foot surgery. In another patient (case 3), both lower extremities were involved, but symptoms were more severe on the right side than on the left. The Table summarizes the patients' clinical data.

Radiographic Evaluation

Weight-bearing and non-weight bearing anteroposterior and lateral radiographs of the ankle and foot were obtained preoperatively and at each postoperative visit. Fusion was determined by means of radiographic consolidation of the sites of arthrodesis.

Illustrative Case Report

A 55-year-old woman with poliomyelitis and

Table. Patient details and treatment outcomes.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (yr)</th>
<th>Sex</th>
<th>Side</th>
<th>Main deformity</th>
<th>Associated deformity</th>
<th>F/U (month)</th>
<th>LLD (cm)</th>
<th>Clinical outcome</th>
<th>Radiographic outcome</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>55</td>
<td>F</td>
<td>R</td>
<td>Equinocavovarus</td>
<td>Claw toe</td>
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<td>3</td>
<td>Satisfied</td>
<td>Arthrodesis</td>
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<td>2</td>
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<td>F</td>
<td>L</td>
<td>Equinocavovarus</td>
<td>Claw toe</td>
<td>20</td>
<td>2</td>
<td>Satisfied</td>
<td>Arthrodesis</td>
</tr>
<tr>
<td>3</td>
<td>43</td>
<td>F</td>
<td>R</td>
<td>Equinocavovarus</td>
<td>Claw toe</td>
<td>15</td>
<td>2</td>
<td>Satisfied</td>
<td>Arthrodesis</td>
</tr>
<tr>
<td>4</td>
<td>52</td>
<td>F</td>
<td>L</td>
<td>Equinocavovarus</td>
<td>Claw toe</td>
<td>18</td>
<td>4.5</td>
<td>Satisfied</td>
<td>Arthrodesis</td>
</tr>
<tr>
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<td>R</td>
<td>Equinocavovarus</td>
<td>Flail EHL</td>
<td>16</td>
<td>2.5</td>
<td>Satisfied**</td>
<td>Arthrodesis</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
<td>F</td>
<td>R</td>
<td>Equinocavovarus</td>
<td>Claw toe</td>
<td>21</td>
<td>2</td>
<td>Satisfied</td>
<td>Arthrodesis</td>
</tr>
<tr>
<td>7</td>
<td>58</td>
<td>F</td>
<td>L</td>
<td>Equinocavovarus</td>
<td>Claw toe</td>
<td>25</td>
<td>3</td>
<td>Satisfied</td>
<td>Arthrodesis</td>
</tr>
<tr>
<td>Average</td>
<td>54</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

* Leg length discrepancy
** The patient had residual pain on ambulation with crutch support
atrophy of the right lower limb had severe painful disability of her right foot since early childhood. Examinations revealed a severe, rigid equinovarus deformity, clawing of all toes, and thick painful plantar hyperkeratosis (Figure 1). The deformity was so profound that she could not wear any form of shoe on the affected foot. Correction with Ilizarov method had been offered at another institution when she was young. She also had dysplastic osteoarthritis of the right hip and underwent hip replacement six months before the index surgery. Radiographs revealed moderate arthritic changes and marked subluxations over the tibiotalar, subtalar, and talonavicular joints (Figure 2-A).

Z-lengthening of the tendo Achillies (TAL) was first performed with the patient in the supine position. A 10-cm lateral incision was then made from a point 3 cm above the fibular tip to the fourth metatarsal base. A 2.5-cm segment of distal fibula was osteotomized to expose the tibiotalar joint. After the cartilage was removed, the tibiotalar joint was stabilized in 0° dorsiflexion with two 6.5-mm cannulated screws. For pes cavus, a 3-cm longitudinal incision along the medial border of the foot was deepened through the fat to the level of the fascia. The fascia was cut transversely while tension was applied by placing the metatarsophalangeal joint in dorsiflexion. Given the presence of the long-standing, rigid cavus deformity, a Cole-type anterior closing wedge tarsectomy was performed by removing a wedge of bone from the
navicular, the cuneiform, and the cuboid. The talocalcaneal joint and calcaneocuboid joint were fixed with staples in neutral supination/pronation to create a plantigrade forefoot (Figure 2-B). Osteotomy of the base of the first metatarsal was performed to treat clawing of the great toe and was fixed with a K-wire. Bulky dressing and a posterior splint were then applied.

After the sutures were removed two weeks later, a non-weight bearing below-knee fiberglass cast was applied. Partial weight-bearing was begun at six weeks after surgery. Changing of the cast, inspection of the wound and soft tissue, and monthly radiographic examination were performed until union was achieved. Solid pantalar arthrodesis was achieved with a painless, plantigrade foot (Figure 3-A). The painful callosities disappeared, and the patient was allowed to walk and bear weight as tolerated (Figure 3-B).

RESULTS

The average age of the patients at the time of surgery was 54 years old (range, 43-60 years) and the average follow-up was 22 months (range, 15-44 months). Successful arthrodesis of all joints was achieved in all patients. The average time of postoperative cast immobilization was 4.5 months. TAL and plantar fasciotomy were done in all seven patients. Dorsal wedge osteotomy of the first metatarsal base was done in four patients because the cock-up deformity did not resolve after plantar fasciotomy and wedge tarsectomy. Tightening of the EHL was performed in the two patients with a drooping great toe.

The results were evaluated in terms of the level of satisfaction with the procedure, pain, walking and standing endurance, stair-climbing, and ability to return to work. At the latest follow-up, all patients reported satisfaction and great improvement in terms of pain, walking, standing, and climbing. Only one (case 5) reported residual pain on ambulation with crutch support. Five patients returned to their previous work. A plantigrade gait was achieved in all patients. All patients had mild limping due to weakness of the involved limb. The average leg length discrepancy was 2.7 cm (range, 2-4.5 cm), and all patients used shoe-lifts to compensate for the inequality. Painful callosities resolved in five patients, and the remaining two had mild, asymptomatic calluses on the lateral aspect. Patients would choose to have the surgery again.

Complications

After surgery, no vascular injury or soft tissue sloughing was seen. Four patients had marked

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Fig. 3: Case 1. One year after surgery, photograph showed full weight-bearing on the right foot (A) and the disappearance of plantar hyperkeratosis (B).
erythematous swelling that persisted for two weeks, but this subsided without signs of infection after leg elevation and anti-inflammatory medication. No patient underwent additional surgeries except for removal of the K-wires for metatarsal osteotomy fixation, which was done in two patients.

DISCUSSION

Equinocavovarus deformity is characterized by ankle equinus, hindfoot varus, midfoot cavus, and forefoot adduction. Such deformity is often seen in patients with poliomyelitis, congenital clubfoot, Charcot-Marie-Tooth disease, or post-traumatic nerve dysfunction.

In patients with foot and ankle deformities occurring after poliomyelitis, soft tissue procedures are performed in children younger than 12 years or in patients with a flexible deformity. In contrast, bony procedures are used in skeletally mature patients with long-standing deformity or in those with secondary osteoarthritic changes over the adjacent joints. In adults with fixed post-poliomyelitis equinovarus or equinocavovarus foot in which abnormal stress loading causes arthritic changes, a combined soft tissue and bony procedure is usually required to achieve satisfactory correction and successful arthrodesis.

Because the pattern of paralysis varies widely, numerous combinations of deformity can be seen in different patients. Each patient must be assessed on an individual basis so that an ideal surgical procedure can be selected. Although pantalar arthrodesis can reliably address deformity and arthritis, all motions of the ankle, the hindfoot, and the midtarsal joints are sacrificed. Therefore, in young patients with limited degree of deformity and minimal arthritic changes, soft tissue realign followed by triple arthrodesis is considered first. On the other hand, in elderly patients with low demands who have severe deformities and significant arthritic changes, pantalar arthrodesis is a useful salvage option for such end-stage conditions.

In earlier years, pantalar arthrodesis was principally performed to treat neuromuscular disorders such as poliomyelitis, myelomeningocele, and cerebral palsy. More recently, the procedure has been used in cases of post-traumatic and inflammatory arthritis, nonunion after ankle arthrodesis, and failed total ankle arthroplasty. With improved techniques, outcomes have improved but non-union, malunion, and residual deformity are still reported. Debates on the techniques of pantalar arthrodesis focus on mainly the staging of the procedure and the methods of fixation.

For complex and rigid deformities, one-stage pantalar arthrodesis is a technically demanding procedure. With all joints around the talus fused, no reserve compensation occurs through any adjacent joint. Good results can be achieved only with precise bony alignment in multiple planes. Barret et al reviewed the results of 83 pantalar arthrodesis procedures in 69 patients and concluded that, in terms of fusion and complication rates, the one-stage procedure compares favorably with a two-stage procedure (i.e., triple arthrodesis followed by ankle arthrodesis or vice versa).

In addition to the bony alignment, soft tissue contracture due to a prolonged history of deformity further complicates the procedure. Soft tissue problems occur frequently in open procedures. Therefore, some authors advocate a gradual, “bloodless” correction with external fixations such as use of the Ilizarov apparatus to treat the complex foot and ankle deformities. In 1996, Oganesyan et al reported excellent result with the use of a hinged distraction apparatus to correct equinocavovarus deformity in 65 patients, including 14 patients with previous poliomyelitis. They contended that open, operative intervention was often associated with soft tissue complications, such as skin sloughing and infection, or with bony complications, such as pseudarthrosis. However, their patients had a high incidence of residual deformity and pin tract infection, and the total duration of correction plus casting was as long as 6 months. In contrast, none of our patients developed any soft tissue problems, even those with the most severe and rigid deformities. We also observed no residual deformity or pseudarthrosis.

Options for fixation include screws, plates and screws, intramedullary rods, or external fixation. Intramedullary nail fixation for pantalar fixation has
gained popularity in recent years. On testing for tibiotalocalcaneal fixation, it is much stiffer biomechanically than using two or three screws. However, the risk of stress fracture at the tip of the nail or around the locking screws is a great concern10. We routinely use cannulated lag screws for fixation of the tibiotalar or tibiotalocalcaneal joint (Figures 4 and 5) because they are relatively inexpensive, they can provide fixation and compression, and they are less technically demanding than other options11. The strength of screw fixation is usually sufficient if the fixation is supplemented with adequate cast protection.

In conclusion, our excellent results indicate that one-stage pantalar arthrodesis is a feasible and effective option for the treatment of severe, rigid post-polio foot and ankle deformity.

Fig. 4: Case 4. (A) A 52-year-old woman with equinocavovarus deformity of the left foot due to poliomyelitis. (B) Anteroposterior and lateral radiographs revealed marked subluxation and arthritic changes over the ankle, subtalar, and midtarsal joints.

Fig. 5: (A) One year after surgery, photograph showed plantigrade foot with full weight-bearing. (B) Radiograph demonstrated solid pantalar arthrodesis. Cannulated screws were used for tibiotalocalcaneal joint fixation, and the subtalar and midtarsal joints were fixed with staples and K-wires.
REFERENCES