ORIGINAL ARTICLE

The short-term effect of an anchor in treatment of congenital vertical talus in infants

Ze-xing Zhu MD¹, Wei Lei MD², Lu-yu Huang MD²

¹Department of Orthopaedics, Gen Hosp of the Second Artillery, Beijing, and ²Department of Pediatric Orthopaedics, Xijing Hospital, The Fourth Military Medical University, Xian, China

Objective: To investigate the short-term effect of a mini anchor in treatment of congenital vertical talus (CVT) in infants.

Methods: From February 2006 to March 2008, seven patients (nine feet) with CVT were treated in the authors' hospital by the Kumar method combined with transferring and fixing the tendon of the anterior tibial muscle to the head of the talus with a mini anchor. There were five girls and two boys, aged from 10 to 42 months (mean, 18 months). All the feet had a rocker-bottom when the infants were taken to the hospital by their parents and none of them could walk independently. All cases were followed up in the outpatient department, and the Hamanishi and Adelaar standards were used to evaluate the radiograph and clinical results, respectively.

Results: All cases were followed up for 20 to 29 months (mean, 24 months). The parents of these infants were all satisfied with this operation, and five infants can now walk independently. At the most recent follow-up, seven feet were fine and two good according to the Adelaar standard, and six feet were good and three fine according to the Hamanishi standard.

Conclusion: The short-term effect of an anchor in treatment of CVT in infants was satisfactory with no recurrence nor talus necrosis.

Key words: Abnormalities; Suture anchors; Talus

Introduction

Congenital vertical talus (CVT) or rocker-bottom flat-foot is a type of congenital foot anomaly with unknown etiology and low incidence. CVT usually can be detected at birth by the presence of a rounded prominence on the medial and plantar surfaces of the foot due to an abnormal location of the head of the talus and dislocation of the talonavicular joint (Figs 1a, 2a). A definite diagnosis can easily be made by lateral view radiographs (Fig. 1b). Reduction of the talus and talonavicular joint is undertaken once the foot has developed. The Kumar method is the most widely used surgical technique for treating CVT in infants, but recurrence and avascular necrosis of the talus often lead to failure¹. In order to prevent these complications some scholars have modified the Kumar method, for example by transferring and fixing the tendon

of the anterior tibial muscle to the head of the talus with steel thread. However, the method still has some drawbacks and complications. In view of the advantages of a mini anchor, such as its simplicity, stability and minimal invasiveness², the present authors used a mini anchor to fix the tendon of the anterior tibial muscle to the head of the talus, in addition to using the Kumar method, to treat CVT in infants.

Materials and methods

Data

From February 2006 to March 2008, seven patients (nine feet) with CVT were treated in our hospital by the Kumar method combined with transferring and fixing the tendon of the anterior tibial muscle to the head of the talus with mini anchors. There were five girls and two boys, aged from 10 to 42 months (mean, 18 months). Only two severe abnormalities of the feet were identified at birth by their typical appearance, the other feet being diagnosed when the abnormality had advanced. All the feet had a rocker-bottom when the infants were taken to the hospital by their parents and none of them could walk

Address for correspondence Lu-yu Huang, MD, Department of Pediatric Orthopaedics, Xijing Hospital, The Fourth Military Medical University, Xian, China 710032 Tel: 0086-138-92862266; Fax: 0086-029-8477213; Email: wen6407@163.com

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Figure 1a–b Female infant, 5 years old, diagnosed with CVT 3 years ago. (a) The appearance of the CVT. (b) Lateral view radiograph showing a TAMBA of 57° (normal value is $3.3^\circ \pm 6.4^\circ$).

independently. The preoperative average talar axis–first metatarsal base angle (TAMBA) was 64° (56° – 78°).

Surgical technique

The surgery was performed with the patient in the supine position under general anesthesia. An air tourniquet was fixed on the thigh with a pressure of 15–20 Kp and released every 40–50 min to allow some circulation.

The first incision was made on the medial side of the Achilles tendon which was lengthened by Z-plasty in infants aged 18 months or more, or shortened as required in younger children. The Achilles tendon was not joined up again until the talus had been reduced through the other two incisions, because in some cases it was necessary to perform a capsulotomy of the posterior ankle and subtalar joints.

The second incision was made on the lateral side of the foot, centering over the sinus tarsi. The extensor digitorum brevis was exposed carefully without destroying the blood-supply of the talus from the sinus tarsi laterally, and reflected distally. All restrictive structures around the extensor digitorum brevis were released, including the posterior talofibular and calcaneofibular ligaments.

The third incision was made on the medial side of the foot, centering over the medial surfaces of the

prominent head of the talus. The head of the talus and medial part of the talonavicular joint were exposed in order. The capsule and all restrictive ligaments attached to the navicular bone and calcaneus on the medial and dorsal aspects of the head of the talus, including the dorsal talonavicular, plantar calcaneonavicular and talocalcaneal interosseous ligaments, were released to mobilize the talus. The tendon of the anterior tibial muscle, which was sometimes contracted, was exposed, cut off as distally as possible from the navicular bone, and reserved. The navicular bone was pushed down from its upward dislocation with the thumb, while the talus was gently simultaneously elevated into the correct position using a small blunt periosteal elevator. The restrictive structures in the three incisions were again released to reduce the forefoot and calcaneus from their abnormal locations. Next, a 2.0 mm-diameter Kirschner wire was inserted from the posterior process of the talus through its neck into the navicular and entocuneiform bones to maintain the reduction, and stabbed out between the first and second metatarsal bones. If necessary, another 2.0 mm-diameter Kirschner wire was inserted to maintain the reduction of the talocalcaneal joint. Anteroposterior and lateral radiographs were taken to confirm reduction of the vertical talus. After that, a hole was drilled on the dorsum surface of the head of the talus with a special appliance for the mini anchor. Then a mini anchor (length 5.4 mm, diameter 1.8 mm, tensile force 14 lbs) was inserted into the hole, ensuring that the two opposite wings on the mini anchor were parallel with the main axis of the talus. With the ankle in a dorsiflexed position, the reserved tendon of the anterior tibial muscle was fixed to the dorsal surfaces of the head of talus with two pieces of Ethibone suture and atraumatic needles at the end of the mini anchor (Fig. 2b). Finally, the talonavicular ligament was reconstructed, after which the wound was closed in layers.

Figure 2a Diagram showing the anatomy of CVT.

Postoperative management

A long leg cast was applied to hold the foot in a normal position with the knee flexed for 12 weeks. After the pins

Figure 2b Diagram showing the appearance after transferring and fixing the tendon of the anterior tibial muscle to the head of talus with a mini anchor.

had been removed, a short leg cast was substituted for the long leg cast and left on for 6 weeks. After this cast had been removed, an ankle orthosis was used for 6 months, after which the patients were allowed to walk with full weight bearing.

Follow-up

The Hamanishi standard³ was used to evaluate the radiographic results. TAMBA < 10° is considered to be good, 10°–30° fine, 30°–60° semiluxation, and > 60° dearticulation.

The postoperative clinical results were assessed by the Adelaar standard⁴, which includes six items. These are poor cosmetic appearance, ankle and subtalar loss of mobility, prominent talar head, loss of the medial longitudinal arch, hindfoot valgus, and abnormal evidence of wear. One point is deducted from the original six points for each of these scoring criteria. A score of six points is good, less than four points is poor and between them is fair.

Results

All patients underwent surgery successfully, and were followed up for 20 to 29 months (average, 24 months). The postoperative X-ray films showed that a good reduction of the talus had been achieved in all feet (Fig. 1c, d). At the most recent follow-up, all feet had a good cosmetic appearance with no recurrence or avascular necrosis of the talus. The parents of these infants were all satisfied with this operation, and five of the infants were able to walk independently.

The average TAMBA was 1° (7°–8°) when the Kirschner wire was removed, and 4° (0°–12°) at the last follow up. According to the Hamanishi standard, six feet were good and three fine (Fig. 1e).

Nine feet had a good cosmetic appearance, but five feet had lost the medial longitudinal arch, two of them also had hindfoot valgus. Two feet still had evidence of abnormal wear, and these infants were unable to walk with full weight bearing. According to the Adelaar standard, seven feet were fair and two good (Fig. 1f).

Figure 1c–d (c) Female infant, 5 years old, diagnosed with CVT 3 years ago. Antero-posterior and (d) lateral radiographs 12 weeks postoperatively.

Figure 1e–f (e) Female infant, 5 years old, diagnosed with CVT 3 years ago showing the lateral radiograph 2 years postoperatively. The arrow points out the mini anchor which is in the cartilage in front of the talus and the TAMBA is 2°. (f) The external appearance 2 years postoperatively.

Figure 3 (a) A photograph of the mini anchor. (b) The method of fixation.

Discussion

Congenital vertical talus (CVT) is a rare type of congenital foot anomaly of unknown etiology, possibly being associated with congenital Fryns syndrome and neuromuscular disorders⁵. The pathology of CVT includes dislocation of the talonavicular joint, talipes valgus, maldevelopment of the talus and abnormality of the talocalcaneal joint⁶. Appropriate surgery as early as possible is the treatment of choice for CVT in infants, the purpose of the operation being to reduce the talus, metatarsal bone and calcaneus to their correct anatomical positions, remodel the instep and maintain the reduction^{7,8}. Manipulation and cast-only treatment are inadequate because reduction of the talonavicular joint cannot be sustained by conservative means alone⁹.

CVT in infants is usually treated by the Kumar method, which was first reported by Kumar SJ *et al.*¹⁰ The key factor in this operation is the degree of release of the soft tissue, which is directly related to the postoperative complications. The main postoperative complications are recurrence of CVT and avascular necrosis of the talus. Incomplete release usually leads to recurrence, while excessive release can decrease the rate of recurrence but increases the risk of avascular necrosis of the talus. Therefore, in this study, we released only the medial and dorsal aspects of the head of the talus and some restrictive ligaments in its ventral aspect, including the plantar calcaneonavicular and talocalcaneal interosseous ligaments.

Ensuring stabilization of the reduced talus after removal of the Kirschner wire is very important, so it is necessary to do something to maintain the reduction. To achieve this objective, transferring and fixing the tendon of anterior tibial muscle to the head of talus has been proposed. Because the tendon of the anterior tibial muscle is usually contracted in CVT, it is necessary to lengthen it

by “Z”-plasty and reflex it through a hole drilled in the head of the talus. In order to drill a big enough hole for the tendon, it is necessary to expose the whole head of the talus. However, this would result in complete disruption of the blood supply to the talus, which could lead to its avascular necrosis. Furthermore, the tendon would be disrupted for months postoperatively and then recurrence would occur. The traditional way to fix the tendon is by threading steel-wire through the talus to a button under the footplate. This results in the tendon being drawn too tightly, and many complications can ensue, such as local infection and necrosis of the skin. Worst of all, the steel-wire may spiral in the tissue, necessitating removal by another operation.

However, a suture anchor can solve these problems. This is one of Johnson & Johnson's products (New Brunswick, NJ, USA) which were introduced into China in 2004 and are designed to provide stable conjunction between bones and tendons⁷. The mini anchor is just one version of these products with a diameter of 1.8 mm. It is composed of a bone anchor which has two crooks on opposite sides for fixing the anchor into the bone stably, and two pieces of Ethibone suture with atraumatic needles for fixing the tendon (Fig. 3a, b). Because of its advantages of tiny body, simplicity of manipulation, stability of fixation and minimal invasiveness, the anchor is usually used to fix extensor tendon to the distal phalanx or to repair the accessory ligaments of the metacarpophalangeal joints.

Because of these advantages, a mini anchor was used to fix the tendon of anterior tibial muscle to the head of talus in CVT patients in this study. It was then no longer necessary to lengthen the tendon of the anterior tibial muscle and penetrate the talus. Simple manipulation means shortening of the operation time, which is very important

in infants. Fixation provided by the anchor is stable, even though the tiny body of 1.8 mm diameter invades minimally and the blood supply to the talus is retained maximally. In addition, fixation of the anchor is not through the center of the talus and does not affect its development. In this study, all cases had good cosmetic appearance with no recurrence or avascular necrosis of the talus. This indicates that fixation with a mini anchor can prevent recurrence and avascular necrosis of the talus. However, the long-term effects of anchors in treatment of CVT in infants needs further investigation.

Disclosure

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