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Congenital Talipes Equinovarus in Spina Bifida: Treatment and Results

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Summary: The results of the surgical treatment of clubfoot deformity in spina bifida by radical posteromedial-lateral release (PMLR) are presented. In all cases, the Cincinnati incision was used and the tendons excised, including the anterior tibial tendon. In 21 feet, a special K-wire was used to derotate the talus in the ankle mortise. The minimum follow-up was 2 years. The average age at surgery was 14 months. The overall results showed 63% good, 14% fair, and 23% poor results. In the 21 feet in which the talus K-wire was used, 76% had a good result, 14% fair, and 10% poor. The results were also analyzed based on the motor level. In the thoracic/high lumbar level, 50% had a poor result. In the low lumbar and sacral level groups together, of 45 feet, five had a poor result. This study shows that a radical PMLR can produce an overall good and fair result in 77% of the cases. The use of the K-wire to derotate the talus led to an improvement in the result. The tendon excision leading to a flail foot corrects any residual muscle imbalance. The poor results seen in the thoracic/high lumbar patients are likely to be related to the lack of weight bearing in view of their motor paralysis. **Key Words:** Clubfoot—Myelomeningocele.

Foot deformities are quite common in patients with spina bifida. Because the greater majority will require braces for ambulation, a supple, plantigrade, and braceable foot is the final goal of any treatment. In our experience, ~30% of all children with spina bifida are born with a clubfoot deformity. These feet are quite rigid, resembling those seen in arthrogryposis multiplex congenita. Their response to serial manipulation and casting is quite poor, with most requiring surgical treatment. However, serial casting should be used to stretch the taut soft tissues before surgery. Casting must be done with caution because localized pressure commonly leads to skin-pressure ulceration. The recurrence rate after surgery is higher than that in the idiopathic type. The lack of normal muscle surrounding the ankle joint and the lack of weight bearing may contribute to the high recurrence rate.

The pathoanatomy of congenital talipes equinovarus (TEV) has been described by Carroll et al. (1), Herzenberg et al. (9), Goldner (6), McKay (11,12), and Downey et al. (5). It is now well accepted that the talus and os calcis have a rotational malalignment in association with talonavicular-calcaneocuboid subluxation.

Carroll et al. (1) showed that to achieve adequate correction, the external rotation of the talus must be fully corrected; only after this is achieved can the os calcis be aligned under the talus. It has also been reported by Howard and Dias (10) that in idiopathic TEV, talus derotation by a special K-wire technique led to better correction of the hindfoot deformity.

The current literature on clubfoot in spina bifida shows a complete absence of studies dealing with its surgical treatment by soft-tissue procedures. The most recent studies reported the authors' experience with talectomy.

We report the results of our experience in the treatment of clubfoot deformity in patients with myelomeningocele by a radical PMLR in which the Cincinnati incision (2) was used.

MATERIALS AND METHODS

Since 1981 at our institution, 36 children with spina bifida had congenital clubfoot deformities. A total of 63 feet (17 girls and 19 boys) underwent radical PMLR through the Cincinnati incision. Twenty-seven had bilateral clubfoot deformities, and nine were unilateral. The average age at surgery was 14 months (range, 7–72). The average follow-up was 86 months (range, 24–145). All surgeries were performed by the senior author (J.C.N.). The motor-level distribution was as follows: thoracic/high lumbar level, 11 patients (18 feet); low lumbar level, 19 patients (34 feet); and sacral level, six patients (11 feet). All cases were initially treated by manipulation and serial casting followed by an ankle-foot orthosis (AFO) splint until the date of surgery.

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Operative procedures

All cases (63 feet) underwent a radial PMLR through the Cincinnati incision. Most of the tendons (tendo Achilles, flexor digitorum longus, flexor hallucis longus, peroneus brevis and longus, and anterior tibial tendon) were excised for ~2.5 cm in length. In all cases, a complete circumferential release of the subtalar joint was performed, including release of the interosseous ligament. The talonavicular joint was opened medially, inferiorly, and superiorly. The calcaneocuboid joint was approached from the lateral side, and a complete capsulotomy was performed. In 21 feet, a special technique to derotate the talus was introduced. A temporary K-wire was placed in the posterolateral aspect of the talus to facilitate medial rotation of the talus in the ankle mortise (Figs. 1–3). Because the talar rotation is maintained by this K-wire, the navicular is reduced anterior to the talar head. This reduction is maintained by a second K-wire driven through the body of the talus, through the anterior part of the navicular, and exiting on the dorsum of the foot. The temporary talar K-wire is then removed. The calcaneus is then reduced under the talus to its normal position, and a second K-wire is driven through the talocalcaneal joint to maintain proper alignment. In 57 feet, a plantar fascia release was performed through a separate plantar incision.

Postoperatively, a well-padded, long-leg splint was applied with the ankle in slight plantar flexion to decrease any tension at the suture line. After 10–12 days, the splint was removed and replaced by a short-leg cast with the foot held in neutral position for 6–8 weeks. Both K-wires were then removed, and an AFO brace was prescribed for indefinite day and night use. The parents were instructed to perform daily foot manipulation, consisting of dorsiflexion at the ankle and abduction of the forefoot. Because it is very important to begin weight bearing immediately after the final postoperative cast removal, we encourage ambulation in the child with low lumbar or sacral level spina bifida or standing with the help of a standing frame in the high-level child. Nineteen patients were placed in a standing A-frame to maintain an upright position.

FIG. 2. The abnormal rotation of the talus is seen. The K-wire is used to derotate the talus to its normal position.

Complications

No major complications were seen. Five cases of minor pin-tract infection were seen, requiring either a short course of oral antibiotics or an early removal of the K-wires. All cases resolved well with this treatment modality.

RESULTS

The final result was based on a clinical evaluation of the foot alignment. The following grading system was used.

Good result: the foot showed a normal hindfoot valgus and a well-aligned forefoot, not requiring any further surgery. All of these feet were braceable.

Fair result: the hindfoot alignment was normal, but the forefoot deformity (such as adduction, supination, or cavus) was present, requiring further surgical treatment.

Poor result: a hindfoot and forefoot deformity was present, requiring either a second PMLR or a talectomy. These feet were not braceable.

By using these criteria for the entire series, 40 (63%) feet had a good result. Nine (14%) feet had a fair result,

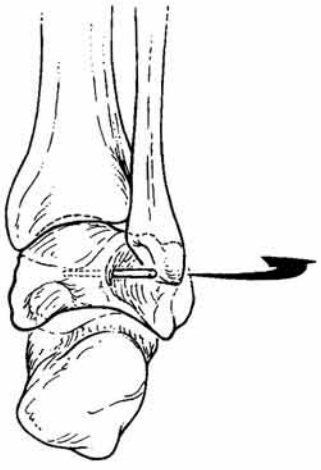

FIG. 1. Posterior view of the ankle and talus. The K-wire is inserted in the posterolateral surface of the talus. Note the external rotation of the talus in the ankle mortise.

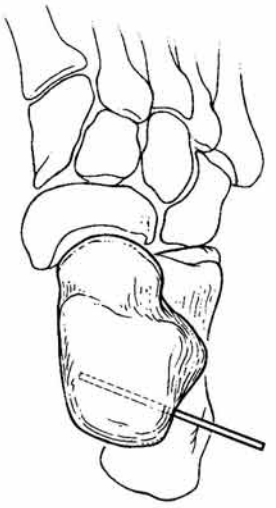

FIG. 3. With the talus in a normal alignment and the talonavicular joint reduced, a second K-wire is then used to maintain this correction.

TABLE 1. *No K-wire talus group, clinical results*

Feet	Percentage	Result
24	57	Good
6	14	Fair
12	29	Poor

and 14 (23%) feet had a poor result. In the 42 feet in which K-wire talar derotation was not used, 24 (57%) feet had a good result, six (14%) feet had a fair result, and 12 (29%) feet had a poor result.

Combining good and fair results, 71% had an acceptable result (Table 1). In 21 feet in which the talar K-wire surgery was used, 16 (76%) feet had a good result, three (14%) feet had a fair result, and two (10%) feet had a poor result. Combining good and fair results for this subgroup of feet, 90% had an acceptable result. A statistical analysis was performed on surgery outcome for the two populations to identify any significant differences in expected outcome. The good and fair results were combined so that the outcome data could be approximated by a discrete binomial distribution. The probability of success p was defined as the probability of obtaining either a good or fair surgical outcome. The probability of failure q was defined as the probability of obtaining a poor surgery outcome. A one-sided test of significance was performed to compare probability of successful surgery outcome and identify whether the talar K-wire surgery provided a significantly greater improvement in probability of success. The null hypothesis, no difference in probability of successful surgery outcome, was compared with the one-sided alternative hypothesis; the probability of successful outcome was greater for the talar K-wire surgery. A significant improvement in the probability of successful surgery outcome was determined ($p < 0.083$) from the available data.

The result in relation to the motor level in 18 feet in patients with a thoracic/high lumbar level spina bifida was eight feet with a good result, one foot with a fair result, and nine (50%) feet with poor results. In the lower lumbar level patients (34 feet), 27 had a good result, five had a fair result, and two had a poor result. In the sacral-level patients (11 feet), five had a good result, three had a fair result, and three had a poor result (Table 2). Fifty percent of the feet in the thoracic/high lumbar level patients had a poor result. Combining the low-lumbar and sacral-level groups (45 feet), only five (10%) feet had a poor result. In two patients (four feet), no additional surgery was done for recurrent deformities because of their thoracic/high-lumbar level and nonambulatory and mental retardation status.

TABLE 2. *Motor level, clinical results*

Level	Good	Fair	Poor	Total feet
Thoracic lumbar	8	1	9	18
Low lumbar	27	5	2	34
Sacral	5	3	3	11

TABLE 3. *Poor-result group: subsequent surgeries*

Feet	Surgery
5	Talectomy
2	Talectomy & lateral column shortening
2	PMLR revision & lateral column shortening
1	Cuboid osteotomy
4	No surgery

PMLR, posteromedial-lateral release.

The subsequent surgeries performed in feet with a poor result are shown in Table 3.

The incidence of poor and fair results is higher in spina bifida when compared with the surgical results in idiopathic clubfoot. Bone deformities, inadequate muscle function, poor articular surfaces, and fibrous tissue are present in congenital clubfoot (1,5,8,9,11,15,18) and are even more severe in spina bifida. Abnormal external rotation of the talus in the ankle mortise and calcaneal internal rotation are important deformities associated with clubfoot (1). Correction of these deformities is important to achieve a good result.

Because these patients do not have active dorsiflexors and evertors of the feet, after surgery and cast removal, the use of a below-the-knee brace, early weight bearing, and walking are important parts of the postoperative care.

Sharrard and Grosfield (16) showed that in spina bifida, few feet could be corrected by one operation using medial release. They frequently required two, three, and even four operations before the deformity could be brought under control. Smith and Duckworth (19) showed poor results in 25 feet, and only three cases had a good result after surgical treatment. Recurrence rates ranging from 27 to 46% after extensive PMLR have been reported in patients with myelomeningocele (4,13,14). Sherk and Ames (17) showed that in cases treated by talectomy, all poor and fair results occurred in patients with high motor level myelomeningocele. Menelaus (13) showed that talectomy has a useful place in the management of rigid TEV in spina bifida.

In this series, 63% of the feet treated by a radical PMLR had a good result, 14% a fair result, and 23% a poor result. The use of a K-wire to derotate the talus (21 feet) clearly improved the results (Table 4), with only 10% showing poor results. Talus derotation is a very important part of the surgical correction.

Nine feet developed a progressive adduction deformity. The growth imbalance between the lateral and medial column is the only explanation for this problem. In all cases, the adduction deformity was distal to a reduced talonavicular joint. Eight feet underwent further surgery,

TABLE 4. *K-wire talus group, clinical results*

Feet	Percentage	Result
16	76	Good
3	14	Fair
2	10	Poor

with a closing-wedge osteotomy of the cuboid and an opening-wedge osteotomy of the medial cuneiform performed.

In the high-level child, 50% had a poor result. These children have limited walking ability and spend most of their time in a wheelchair. We believe that the lack of enough weight bearing can explain this higher incidence of poor results.

We call our procedure a "radical" PMLR because all tendons are excised, not lengthened. Most if not all of these children have no active musculature below the knee, so that tendon excision does not cause any functional impairment and should decrease the recurrence rate. When compared with results of other reported series (16), our results are superior.

CONCLUSION

This study showed that a radical posteromedial release with tendon excision, not lengthening, can produce an overall good and fair result in 71% of cases. However, when the talar K-wire derotation technique was used, the results improved to 90%, clearly indicating how important it is to achieve correction of talar and calcaneal rotational malalignment. Weight bearing after cast removal, the use of an AFO brace to control the foot during the day and the use of an AFO splint at night are also important parts of the postoperative care. Strict adherence to these principles will lead to improved results.

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