A New Technique for Talonavicular Pseudoarthrosis (El-Zahaar Technique)

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Abstract. Talonavicular (TN) pseudoarthrosis is the most common of nonunions after triple fusion of all the joints included in the arthrodesis. This is due to increased shearing movements at the horizontally placed joint following abolition of movements at the subtalar and calcaneo cuboid joints.

A trial of changing the direction of the TN pseudoarthrosis from horizontal to vertical was hypothesized to enhance bone healing at the nonunion. Twenty-three patients of established nonunion at the TN joint were subjected to this method by excising a cube of bone centered at the TN pseudoarthrosis and replacing it in its original bed with a 90° rotation, so that the horizontally placed TN pseudoarthrosis became vertical, abolishing the shearing stresses on the nonunion. All the pseudoarthrosis showed healing within 6–8 weeks with no need for bone grafting and prolonged immobilization. Excellent results were obtained regarding pain during walking and standing. No cases were reported with Sudeck’s atrophy.

Materials and Methods

Since 1984, 23 patients with talonavicular pseudoarthrosis were treated by 90° rotated cubic osteotomy centered at the talonavicular pseudoarthrosis and followed up until the time of writing this study. Their ages ranged between 11 and 32 years with an average of 19 years.

Only two patients were over 20 years of age, while the majority were below 20 years, with an average of 16.2 years. There were more males (16 patients, 69.7%) than females (7 patients, 30.3%). Bilaterally affected cases were not represented in our series. Talonavicular pseudoarthrosis was found here as a complication after triple arthrodesis in all cases except one who took place after fracture navicular bone (4.3%). Poliomyelitis with its various foot deformities was chiefly responsible for triple fusion in this series (13 patients, 56.5%). Spasmodic flat foot represented the second indication for triple arthrodesis (4 patients, 17.4%), followed by fracture calcaneus (3 patients, 13%) and then congenital talipes equinovarus in two patients at a rate of 8.7%.

Introduction

In triple fusion, the complication of talonavicular (TN) pseudoarthrosis is more common than at other included joints in fusion (calcaneo cuboid or subtalar joints). This is due to its anatomical situation and shape. Hicks [1] proved that there are synchronous movements taking place at these three joints, so abolition of movements in one or two of these joints will reflectively increase stresses on the other. The calcaneo cuboid and the subtalar joints are flat joints, so they are more stable than ball-and-socket joints. Also, the rate of nonunion at these flat joints is much less than that of the talonavicular joint which is a ball-and-socket joint horizontally placed.

This study, which started in 1984, examines a procedure of changing the direction of movements at the talonavicular from horizontal to vertical in order to abolish the effect of forces increasing the shearing movements at the talonavicular pseudoarthrosis.

Technique

Exposure of the talonavicular joint is best performed through a direct anteromedial approach. Using a small knife and current, the soft tissue at the site of nonunion is excised to freshen the pseudoarthrosis, leaving a somewhat wide space. A cube of bone centered at the site of nonunion is osteotomized and excised, the side length of which varies between 1.5 and 2 cm according to the size of foot bones, especially the navicular and head of talus. That excised cubic part is then replaced in its same bed with a 90° rotation, so that the horizontal line of pseudoarthrosis becomes vertically orientated. Thus, the two bones of nonunion will be held by the cancellous bone of the vertically placed cubic bone graft. The joint space in its new position will be closed and compressed during the reinsertion of the rotated cubic bone graft. Internal fixation will not be needed as well as the bone grafting. Wound closure in layers in the same direction

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Table 1. Classification of cases with talonavicular pseudoarthrosis.

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<tr>
<th>Diagnosis</th>
<th>No.</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Poliomyelitis</td>
<td>13</td>
<td>56.5%</td>
</tr>
<tr>
<td>Spasmodic flat foot</td>
<td>4</td>
<td>17.4%</td>
</tr>
<tr>
<td>Fracture calcaneus</td>
<td>3</td>
<td>13%</td>
</tr>
<tr>
<td>Cong. talipes equinovarus</td>
<td>2</td>
<td>8.7%</td>
</tr>
<tr>
<td>Fracture navicular</td>
<td>1</td>
<td>4.3%</td>
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All the patients had well-established nonunion at the talonavicular articulation. The shortest period of pseudoarthrosis was 10 months while the longest was 16 months, with an average of 14.5 months.

of the incisions can be sutured followed by a below-knee plaster cast immobilization for 6 weeks. Early weight bearing and walking can be encouraged after 2 weeks.

Results

All the patients were followed up radiographically for early detection of any bony displacement and bone healing. All the patients except one (95.5%) showed bone healing at the end of the sixth week. Only one case (4.4%) needed an additional 2 weeks' prolongation of the immobilization period. Also, no case was recorded with nonunion at the sides of rotated cubic graft or with avascular necrosis at the sides of the cubic graft. Suudeck's atrophy of the foot bones was not encountered as a complication of the procedure.

After prolonged follow-up, the site of auto grafting by the 90° rotated cubic showed no fracture and healing became straighter.

Preoperatively, talonavicular pain during standing and walking were the chief symptoms urging the surgical interference. Postoperatively at 10 weeks, only one case (4.3%) experienced mild pain, which did not interfere with daily living activity. Two patients (8.7%) described pain and continued to use analgesics intermittently, while 86.9% (20 out of 23 patients) had no pain with no need for analgesics, and were very happy with the results.

Table 2. Results of postoperative pain following healing at the 90° rotated cubic bone graft.

<table>
<thead>
<tr>
<th>Pain</th>
<th>No.</th>
<th>Percent</th>
</tr>
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<tbody>
<tr>
<td>No pain</td>
<td>20</td>
<td>86.9%</td>
</tr>
<tr>
<td>Moderate, requiring intermittent analgesics</td>
<td>2</td>
<td>8.7%</td>
</tr>
<tr>
<td>Mild, not interfering with daily living activity</td>
<td>1</td>
<td>4.3%</td>
</tr>
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No case was complicated by recurrence of deformity even after prolonged follow-up, and there were no osteoarthritic changes at the non-excised edges of talonavicular nonunion through the whole follow-up period.

Discussion

Pseudoarthrosis of the talonavicular joint is the most common complication and cause of recurrence of deformity after triple arthrodesis of the foot. In a series of 143 triple fusions performed by Miltner in 1931 [2], and followed up for 10 years, there were unsatisfactory results in 25 cases (17%), and TN pseudoarthrosis represented the majority of the unsatisfactory results. Crego and McCarron [3] studied 1100 stabilizing operations of the feet, in the majority of which triple arthrodesis was used. The follow-up period was 14 years, and insufficient solid bony union was listed among the recurrent deformities. Talonavicular pseudoarthrosis was reported at a rate of 13.5% in the series of Patterson et al. [4]. Wilson et al. [5] recorded that TN pseudoarthrosis was the most common site of nonunion at a rate of 10.3% in their series of 301 triple fusions.

A low incidence of TN pseudoarthrosis occurred in the series of Williams et al. [6] at a rate of 3.5%.

In addition to recurrence of deformity, pain and disability in walking are the most common indications for active interference to treat the problem of TN pseudoarthrosis. All the procedures mentioned for treating the nonunion at the TN articulation can be summarized as follows: excision of the pseudoarthrosis and insertion of cancellous bone graft accompanied by prolonged immobilization for not less than 3 months. Prolonged immobilization is the most common cause of Suddeck's atrophy, which adds to walking and standing disabilities. Also, bone grafting aggravates the problem by increased broadening of the foot and by addition of another wound at a different site.

Fig. 1. Talonavicular non-union fixed by one staple.
Hicks [1] considered that, although the TN joint is a ball-and-socket joint, it is actually one half of a two joint complex. It shares the subtalar joint in forming the talocalcaneonavicular complex and the calcaneo cuboid joint in forming the midtarsal joint complex. It also shares in their motion about the appropriate axis. These motions occur simultaneously in both joint complexes through the TN joint. This complex mechanical situation is perfected as the axes of the two joint complexes pass through the center of the sphere formed by the TN joint.

Functionally during standing and walking the talocalcaneonavicular joint complex allows the rotation between the leg and fixed foot, while the midtarsal joint complex allows the rotation between the hind- and the foreparts of the foot. The existence of the TN joint as part of the two-joint complex increases its functional importance as it links and smooths the movement between the leg and the hind- and the foreparts of the foot [7].

If movement is only abolished in either the subtalar and/or the calcaneo-cuboid joints by fusion, movements in the TN joint will freely occur, and more stresses will be added to the original stresses of the this joint, which will interfere with expected fusion of the nonunited joint even after the insertion of a bone graft.

So for successful healing or union of a nonunited TN joint due to any cause, especially after failed triple arthrodesis, the mechanics of movements of the TN joint must be changed in favor of bone healing. Biomechanically, to abolish the effect of any force, the direction of the stresses should be changed in a perpendicular manner. So, changing the joint line of the nonunited TN joint from the horizontal to the vertical plane will convert the shearing movement hindering union into compression forces enhancing healing.

Due to the change of the TN joint’s line direction into its antagonist in a perpendicular direction, the stress of forces falling on the TN joint during walking and standing will not affect the area of nonunion in its new position, and the bone healing will take place in this area over a period of not more than 6 weeks. This will cut the period of plaster fixation in half, avoiding the disabling and painful Sudeck’s atrophy, which may also interfere with bone healing.

Also, walking and standing can be permitted early, as they will add to compression forces on the new position of the joint, which has its good economic and psychological effects. Even the use of plaster immobilization is not needed, but it is used here to help in immobilization of the cubic osteotomy done to obtain the new joint position.

References

1. Hicks JH. The mechanics of the foot and the joint. J Anat 1953; 87:345