Successful Treatment of Buerger’s Disease with Intramedullary K-wire: The Results of the First 11 Extremities

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Objective. This study describes a new technique for treatment of Buerger’s disease, developed to stimulate angiogenesis, using a Kirschner wire placed in the medullary canal of the tibia. The aim of the study was to evaluate clinical and radiological effects of this technique in patients where medical and surgical therapy had failed.

Material and methods. Eleven extremities (six patients) with Buerger’s disease were treated with the intramedullary Kirschner wire technique. Inclusion criteria were chronic critical ischemia, Rutherford Grade II or III, with major arterial occlusion shown by Doppler examination and angiography; failure to respond to non-surgical and surgical treatment; and the need for strong analgesics.

Results. The mean follow-up time was 19 months (range, 13–25 months). Satisfactory remission in each patient was obtained within 6 weeks of intervention. A significant improvement in clinical manifestations including reduced rest pain and increased claudication distance was observed. Foot ulcers completely healed after Kirschner wire intervention.

Conclusion. Despite short-term follow-up and small patient series, the intramedullary Kirschner wire technique can be expected to achieve relief of pain and a decrease in major amputations in patients with Buerger’s disease in whom medical and surgical therapy had failed. However, comparative studies with longer follow-up should be done to confirm the benefits of this new treatment.

Keywords: Angiogenesis; Medullary canal; K-wire; Buerger’s disease; Ischemia.

Introduction

The treatment of ischemic vascular diseases of the limbs remains a significant challenge. Unfortunately, if medical and surgical salvage procedures fail, amputation can be an unavoidable result for these patients. To decrease the amputation rate, different bone procedures including corticotomy, distraction, and periosteal stripping have been performed. However, these procedures can lead to disturbance of the vascular blood flow of bone and increase infection risk as defined in the literature. In the current study, as a less invasive technique, where a Kirschner wire (K-wire) was placed in the medullary canal of the tibia to stimulate angiogenesis, was used. The aim of the study was to evaluate whether clinical improvement, secondary to stimulation of angiogenesis, can be achieved by using the intramedullary K-wire technique in patients with the chronic critical ischemia of Buerger’s disease.

Material and Methods

Between January 2001 and December 2002, 12 consecutive patients diagnosed with Buerger’s disease with chronic critical ischemia, graded II or III according to the classification of Rutherford et al., were reviewed retrospectively after approval of our institution’s Ethical Committee. All of these patients had major arterial occlusions shown by Doppler examination, the need for strong analgesics, and previous failed non-surgical and surgical attempts. Six out of 12 patients were excluded for this study because of life-threatening ischemia requiring urgent amputation (n=2), vascular reconstruction suggested by the surgeon (n=2), diabetes (n=1), and rejection of treatment (n=1). The remaining six patients (11
extremities) were treated with the intramedullary K-wire (IKW) technique. There were five men and one woman. The average age was 43.6 years (range, 31–63 years), and the mean follow-up was 19 months (range, 13–25 months).

Angiography was performed by using automatic pumps, which standardizes the amount of radio-opaque materials, before the surgical intervention and 5 weeks postoperatively by the same radiologist (R.K.). Preoperatively, femoropopliteal arterial occlusion (Cases 1-R, 2-R, 4-L and 6-L, two of which had been treated with femorotibial bypass graft), and crural arterial occlusion (remaining limbs) were reported by the radiologist. Corkscrew-shaped collateral circulation that extended from the sites of arterial occlusion to the periphery of the feet was also noticed.

The ankle brachial index (ABI) was calculated before the operation and at the last follow up. All arterial signals around the ankle and the foot were accepted as positive, even those that were monophasic.

**Surgical technique**

The tibia at the level of the tibial tuberosity was drilled medially and laterally by using a 3.2-mm drill bit toward the medullar canal (Fig. 1). Using drill hole, a 1.8-mm K-wire was inserted into medullar canal up to the middle of the tibial diaphysis under fluoroscopy control. A transverse 1.8-mm K-wire was then inserted into the proximal tibia metaphysis parallel to the tibia plateau. This wire was attached to an Ilizarov external fixator ring. Stabilization of fixation was completed by insertion of an additional two half pins and one K-wire. The intramedullary K-wires were attached to a cannulated rod and the cannulated rod was connected to a motor unit.

**Postoperative care**

The patients were allowed to ambulate with assistance postoperatively. On the fifth postoperative day, the IKWs began to be pulled gradually back (0.25 mm four times a day, total 1 mm/day), and this was continued for 4 weeks. The fixator was removed in the sixth week.

**Results**

All patients reported that they stopped smoking after the surgical procedure. No patient reported pain at rest at the last follow up. The preoperative and follow-up data, including ABI, the use of analgesics, and clinical results according to the classification of Rutherford et al., are summarized in Table 1.

As subjective criteria, angiographic results in all extremities showed increasing visible collateral vessels during the fifth postoperative week. The vascular occlusions remained unchanged.

The ulcers healed in six limbs in a mean of 48 days (range, 38–55 days). Partial foot amputations, including mid-tarsal amputation in two feet and Boyd amputation in one foot, were performed in patients who developed gangrene on their toes before the K-wire intervention. The surgical wound after

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Fig. 1. Photos showing fixator application from anterior (A,B) and lateral (C,D) view.
amputation healed in a mean of 24.6 days (range, 22–28 days). Throughout the follow-up period, no patients needed a major amputation.

Discussion

Stimulation of angiogenesis with a transverse and longitudinal distraction of bone has been reported commonly in the Russian literature. Recently, some experimental and clinical studies also supported that angiogenesis might be stimulated by distraction osteogenesis. In addition, Kelkar used split corticotomy and periosteal elevation to create an inflammatory response instead of distraction and found an increase of vascularity. Despite successful results, some studies showed that corticotomy with periosteal stripping could cause bone healing problem because of decreasing the cortical bone perfusion and increase infection risk. It is obvious that elimination of corticotomy and periosteal stripping by using IKW technique can reduce local complications related to open surgery.

On the basis of clinical experience, Buerger’s disease tends to recur in the years following intervention. We believe that an intervention that can be performed repeatedly has an advantage. From this perspective, the IKW technique is more repeatable than the other bone procedures.

Undoubtedly, cessation of smoking helps the treatment of patients with Buerger’s disease; however, all patients included in this study had stopped smoking after previous surgery. Also, relief of pain and claudication or healing of ulcers after surgery cannot be explained by the cessation of smoking alone.

This study also has some limitations. Newly formed vessels defined postoperatively may not be visible preoperatively by angiography because of arterial obstruction, and this is probably not neoangiogenesis. This could be the result of arteriogenesis, the conversion of preexistent collateral arterioles into large conductance arteries. However, even in the absence of confirmed neoangiogenesis, the clinical improvements in all the patients in the present study are encourage the further use of this new technique.

In conclusion, our short-term results demonstrate that the IKW technique can be expected to achieve relief of pain and a decrease in major amputations in patients who have Buerger’s disease, in whom previous medical and surgical therapy has failed. Further comparative studies with longer follow-up should be performed to confirm the benefits of this new treatment.

Table 1. Characteristics of 11 extremities

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (years)</th>
<th>Site</th>
<th>Previous operations (first/second)</th>
<th>Chronic limb ischemia*</th>
<th>Follow-up time (months)</th>
<th>ABI</th>
<th>Ulcer healing time (days)</th>
<th>Using analgesic</th>
<th>Scale for clinical status at follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>63</td>
<td>R</td>
<td>OS/Right FTR</td>
<td>1</td>
<td>25</td>
<td>0.2</td>
<td>25</td>
<td>None</td>
<td>Pre, Post</td>
</tr>
<tr>
<td>2</td>
<td>48</td>
<td>R</td>
<td>Right FTR</td>
<td>6</td>
<td>25</td>
<td>0.4</td>
<td>21</td>
<td>None</td>
<td>Pre, Post</td>
</tr>
<tr>
<td>3</td>
<td>46</td>
<td>L</td>
<td>CS/OS</td>
<td>6</td>
<td>21</td>
<td>0.4</td>
<td>21</td>
<td>None</td>
<td>Pre, Post</td>
</tr>
<tr>
<td>4</td>
<td>42</td>
<td>R</td>
<td>CS/OS</td>
<td>5</td>
<td>21</td>
<td>0.4</td>
<td>21</td>
<td>None</td>
<td>Pre, Post</td>
</tr>
<tr>
<td>5</td>
<td>31</td>
<td>L</td>
<td>CS/OS</td>
<td>5</td>
<td>15</td>
<td>0.7</td>
<td>15</td>
<td>None</td>
<td>Pre, Post</td>
</tr>
<tr>
<td>6</td>
<td>31</td>
<td>L</td>
<td>CS/OS</td>
<td>5</td>
<td>13</td>
<td>0.4</td>
<td>13</td>
<td>None</td>
<td>Pre, Post</td>
</tr>
</tbody>
</table>

* According to the classification of Rutherford et al. **Female **36 CU 52

| Foot ulcer | CU:52 Pre, postoperative FwU follow-up R/F. Right L. JFT, FTR femorotibial revascularization; CS, closed sympathectomy; OS, sympathectomy with open-surgical procedures: NSAI, non-steroidal anti-inflammatory; FU, foot ulcer; CU, cruris ulcer. **Female **
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