Total Knee Arthroplasty in Charcot's Joint

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Abstract: The authors report three cases with neuropathic (Charcot) knee joint due to tabes dorsalis in which total knee arthroplasty (TKA) was performed. Three cases (5 joints) were observed for more than 8 years after TKA. No ataxia was seen before or after surgery. The postoperative clinical course had been satisfactory in two cases (3 joints) for 9–10 years after TKA with no evidence of loosening. Although the other case had medial condylar fracture of the right upper tibia during postoperative treatment, the clinical course of the right knee had been satisfactory over the 7 years since revision arthroplasty using a tibial component with a long stem. This case also had loosening of the left tibial component 8 years after TKA. Total knee arthroplasty appears to be useful for the treatment of Charcot's joint with no ataxia at Eichenholtz' stage of coalescence and reconstruction if (1) proper surgical techniques to establish good ligamentous balancing and bony alignment by releasing ligaments are employed; (2) an adequate amount of bone is resected and remaining bony defects are reinforced with bone graft; (3) long-stem components are used on both the femoral and tibial sides. Key words: total knee arthroplasty, Charcot's joint.

Neuropathic joint (Charcot's joint) is associated with central or peripheral nerve lesions. It is pathologically characterized by severe destruction, pronounced new bone formation, and elongation of the supportive structures and is clinically characterized by relative painlessness and severe deformity with instability. Since the description of arthropathy associated with tabes dorsalis by Charcot* in 1936, these arthropathies have been called Charcot's joint. However, the report of Mitchell† in 1831 is generally believed to be the first recognition of arthropathy secondary to nerve lesions. According to Eichenholtz, Charcot's joint can be radiologically classified into stages of fragmentation, coalescence and reconstruction. Progression is generally slow but may be rapid on rare occasions.

Early diagnosis of this disease is extremely difficult, and in a great majority of cases it cannot be discovered until the stage of coalescence, when articular function is severely destroyed, requiring surgical intervention. Naturally, conservative treatments such as bracing and protective weight bearing are effective if early diagnosis is made. Johnson and Harris and Brand stressed that early recognition and conservative treatment may alter the course of this disease.

Arthrodesis with a variety of techniques has been performed for surgical treatment of Charcot's knee joint. However, the results have been variable, and solid arthrodesis has been generally difficult to obtain. Drennan et al. emphasized that success in arthrodesis is promoted by adequate bone resection, complete synovectomy, and rigid internal fixation. Attempts to improve function further by performing total knee arthroplasty (TKA) for Charcot's joint have been few and largely unsatisfactory. In recent years, however, some authors have reported that artificial joint arthroplasties were successful in patients with Charcot's joint, indicating that artificial joint arthroplasty is not necessarily contraindicated for this condition.
We report three cases (5 joints) with Charcot's knee joint due to tabes dorsalis in which TKA was performed. These cases were observed for more than 8 years after TKA. The purpose of this paper is to review the usefulness of TKA for Charcot's joint and the surgical techniques used for this procedure.

Case Reports

Case 1

A 57-year-old woman began to have swelling and slight pain in both knees in 1974.

She visited the First Hospital of Nippon Medical School in Tokyo in May 1979 after no improvement was observed following conservative treatment conducted by her family physician. Clinical course was observed using braces for the prevention of knee deformity under the diagnosis of Charcot's joint due to tabes dorsalis. However, she was hospitalized in October 1979 for surgical treatment since walking became difficult due to marked deformity and swelling.

She had a moderate physique with good nutrition. Neurological tests showed tabes dorsalis. Standard screening tests of serum for syphilis were positive, while those of cerebrospinal fluid for syphilis were negative. Roentgenographic findings of bilateral knees were in Eichenholtz' stage of coalescence. Right and left TKAs were performed in November 1979 and February 1980, respectively, using Yoshino total knee prostheses.15

Approximately 10 years after surgery, bilateral knee joint functions were preserved in good condition with no instability or pain. The range of motion was 0°–90° on the left side and 15°–80° on the right side. She could walk for more than 500 m outdoors using a T-cane (Table 1). Roentgenograms showed no apparent radiolucent lines on the femoral side bilaterally. Although radiolucent lines were partially present on the tibial side bilaterally, they were only 1 mm wide and no evidence of loosening was present. A radionuclide bone scan showed increased uptake in the fusion of the bony fragments in the left patellofemoral joint and right posterior femoral condyle, as well as high uptake in the left and right medial and posterior tibial condyles (Fig. 1).

Case 2

A 66-year-old woman began to complain of swelling, deformity, and pain in her left knee joint in 1979.

She was initially treated conservatively by her family physician. In October 1980, however, she visited the First Hospital of Nippon Medical School because it had become difficult for her to walk due to marked deformity and pain in the left knee joint. She was hospitalized the next year for surgical treatment under the diagnosis of Charcot's joint due to tabes dorsalis.

She had a moderate physique. Nutritional status was also moderate. Neurological tests showed tabes dorsalis. Standard screening tests of serum for syphilis were positive, while those of cerebrospinal fluid for syphilis were negative. Roentgenographic findings were in Eichenholtz' stage of coalescence. In February 1981, a left TKA was performed using Yoshino total knee prostheses. A tibial component with a long stem was used since stress fracture was noted in the tibia during surgery.

Approximately 9 years after surgery, left knee joint function was relatively good, with no instability or pain. The range of motion had decreased to 30°–45°. Partly due to age, she was able to walk only about 500 m outdoors using a T-cane (Table 2). Roentgenograms showed no evidence of loosening. No radiolucent line was present on the tibial side. Although 1–2 mm wide radiolucent lines were seen on the femoral side, they appeared approximately 2 years after surgery, and no progression had been

Table 1. Function of Knee Joints in Case 1

<table>
<thead>
<tr>
<th></th>
<th>Right Knee</th>
<th></th>
<th>Left Knee</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preoperative</td>
<td>Postoperative</td>
<td>10 Years</td>
<td>Preoperative</td>
</tr>
<tr>
<td>Pain</td>
<td>±</td>
<td>–</td>
<td>–</td>
<td>±</td>
</tr>
<tr>
<td>ROM</td>
<td>0°–100°</td>
<td>0°–90°</td>
<td>15°–80°</td>
<td>0°–110°</td>
</tr>
<tr>
<td>FTA</td>
<td>185°</td>
<td>178°</td>
<td>178°</td>
<td>190°</td>
</tr>
<tr>
<td>Instability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lateral</td>
<td>+</td>
<td>–</td>
<td>–</td>
<td>+</td>
</tr>
<tr>
<td>anteroposterior</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Walking ability</td>
<td>indoors only (with a T-cane)</td>
<td>approximately 500 m (with a T-cane)</td>
<td>more than 500 m outdoors (with a T-cane)</td>
<td></td>
</tr>
</tbody>
</table>

ROM, range of motion; FTA, femorotibial angle.
Fig. 1. Anteroposterior roentgenogram of the knees in case 1. (A) Right knee; (B) left knee. From left to right: preoperative knees, showing moderate medial joint destruction; postoperative knees; knees 10 years after TKA. (C) 99m-technetium-diphosphonate scintiscan of the knees 10 years after TKA.

noted since then. Radionuclide bone scan showed increased uptake on the femoral side (Fig. 2).

Case 3

A 57-year-old woman began to have pain in her right and left knee joints in 1967. In 1977, she visited the Tokyo Metropolitan General Hospital of Bokutoh because of difficulty in walking due to marked deformity and pain in both knee joints. The diagnosis of Charcot's joint due to tabes dorsalis was made. Next year, she was hospitalized for surgical treatment.

She had a moderate physique with good nutrition. Neurological tests revealed findings of tabes dorsalis. Standard screening tests of serum for syphilis were positive. Roentgenographic findings of bilateral knees were in Eichenholtz' stage of coalescence. Left and right TKAs were performed in August and September, 1978, respectively, using Yoshino total knee prostheses. Right revision arthroplasty was carried out on the tibial side using a tibial component with a long stem in January 1979 after she suffered a fall during postoperative treatment (October 1978) and had a medial condylar fracture of the upper tibia.

As of December 1986 (approximately 8 years after the operations), knee joint function was good on the right side but poor on the left side. There was no pain or instability in the right knee, which had a range of motion of 10°–115°. The left knee showed varus instability of approximately 5°. There was slight pain in this knee when walking. The range of motion was 10°–115°. She could walk only about 200 m outdoors using a T-cane (Table 3). Although roentgenograms showed radiolucent lines on both the right femoral and tibial sides, there was no evidence of loosening, with these lines being partial and only about 1 mm wide. Radiolucent lines 1–5 mm wide were seen in the left femoral and tibial sides along almost the entire circumference, suggesting the presence of loosening (Fig. 3).

Table 2. Function of the Left Knee Joint in Case 2

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>Postoperative</th>
<th>9 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ROM</td>
<td>0°–110°</td>
<td>15°–95°</td>
<td>30°–45°</td>
</tr>
<tr>
<td>FTA</td>
<td>160°</td>
<td>170°</td>
<td>170°</td>
</tr>
<tr>
<td>Instability lateral</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>anteroposterior</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Walking ability</td>
<td>indoors only (with a T-cane)</td>
<td>more than 500 m (with a T-cane)</td>
<td>approximately 500 m (with a T-cane)</td>
</tr>
</tbody>
</table>

ROM, range of motion; FTA, femorotibial angle.
Fig. 2. (A) Roentgenogram of the left knee in case 2. From left to right: preoperative knee, showing severe medial joint destruction; postoperative knee; knee 9 years after TKA. (B) 99m-technetium-diphosphonate scintiscan of the left knee 9 years after TKA.

Table 3. Function of Knee Joints in Case 3

<table>
<thead>
<tr>
<th></th>
<th>Right Knee</th>
<th>Left Knee</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preoperative</td>
<td>Postoperative</td>
</tr>
<tr>
<td>Pain</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>ROM</td>
<td>0°–135°</td>
<td>0°–100°</td>
</tr>
<tr>
<td>FTA</td>
<td>185°</td>
<td>170°</td>
</tr>
<tr>
<td>Instability</td>
<td>lateral</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>anteroposterior</td>
<td>-</td>
</tr>
<tr>
<td>Walking ability</td>
<td>unable</td>
<td>more than 500 m (with a T-cane)</td>
</tr>
</tbody>
</table>

ROM, range of motion; FTA, femorotibial angle.

Fig. 3. Roentgenogram of bilateral knees in case 3. (A) Right knee; (B) left knee. From left to right: preoperative knees, showing severe medial joint destruction; postoperative knees; knees 8 years after TKA.
The patient died due to cerebral apoplexy in January 1987, when a revision arthroplasty for the left knee was being considered.

Discussion

Etiologic and pathogenic theories of Charcot’s joint remain controversial. Assuming that the trauma theory proposed by some investigators, such as Eloesser,6 is right, treatment should be aimed at minimizing abnormal stress applied to the joint surface by accurately correcting the articular alignment.

Conventional methods used for this purpose in knee joints include conservative treatment such as bracing and protective weight bearing and surgical treatment such as osteotomy.10 These treatments may be effective for early-stage cases associated with only mild destruction or localized lesions of the knee joint, but are not indicated for the more commonly seen late-stage cases with significant disability resulting from marked destruction. Under the circumstances, arthrodesis has been considered as the surgical treatment of choice and has been most commonly performed.

However, we were not fully satisfied with the results of arthrodesis as a surgical treatment of first choice and believe that TKA must be performed in order to obtain better therapeutic results. We therefore performed TKA in three Charcot’s joint cases (5 knee joints) and followed up the subsequent clinical course. Of the five joints, four had been functioning well for more than 8 years (range, 8–10 years) with no loosening. In retrospect, our TKA techniques at that time were very poor compared to those used now. Total knee prostheses available at that time (monocentric type) were also rudimentary. It is noteworthy that the postoperative clinical courses had been satisfactory despite these disadvantages.

Indications and techniques of TKA in patients with Charcot’s joint are discussed below based on findings obtained in our three cases. In case 1, total knee prostheses of ordinary type had produced satisfactory results probably because preoperative bone destruction was mild. Excellent postoperative clinical course had been observed in case 2, with no radiolucent line around the tibial component with a long stem. Total knee prostheses of ordinary type failed on bilateral knees with marked bone destruction in case 3. However, the right knee, in which revision arthroplasty was performed using a tibial component with a long stem, had been functioning well for approximately 8 years with no loosening.

From these findings, it can be reasonably concluded that TKA can produce good results in patients with Charcot’s joint if it is performed using currently available advanced total knee prostheses (eg, metal-backed tibial components and polycentric-physiological kinematic prostheses) and elaborate surgical techniques (eg, to establish proper balancing of lateral and medial soft tissues and accurate bony alignment by releasing ligaments, resecting an adequate amount of pathologic bone, and reinforcing remaining bony defects with bone graft). At present, we think that knee prostheses with a long stem should be used on both the femoral and tibial sides for the treatment of Charcot’s joint not only in cases with severe bone destruction, but also in cases with mild destruction in order to distribute stress sufficiently to normal bone tissues.

One of the most important factors that must be taken into consideration when performing artificial joint arthroplasty for the treatment of Charcot’s joint is the roentgenographic stage. According to Eichenholz,5 the destructive process of Charcot’s joint is completed at the stage of reconstruction. In fact, the results of arthroplasties performed at an early stage of Charcot’s joint have been found to be disastrous.8,9 We performed TKA at Eichenholz’ stage of coalescence in all our cases. We believe that TKA at the stages of coalescence and reconstruction can be successful if an adequate amount of pathologic bone is resected and remaining bony defects are augmented with bone graft, and if components with a long stem are used on both the femoral and tibial sides. We think that in addition to the use of total knee prostheses of ordinary type, insufficient bony resection was responsible for the failure in case 3.

Although symptoms of tabes dorsalis (eg, Argyll Robertson pupils, decreases in vibratory and deep sensations, and decreases in or loss of deep tendon reflexes) were present in all three of our cases, no ataxia was seen before or after surgery. This also appears to be a critical factor in the success of TKA.

In general, TKA is contraindicated for Charcot’s joint. Actually, however, there are few reports of TKA conducted in Charcot’s joint patients. Poor results appear to be mainly attributable to the use of rudimentary total knee prostheses such as hinged-type prostheses, poor surgical techniques, intervention at an early stage, or the presence or development of ataxia. It is therefore critical to conduct TKA in Charcot’s joint patients when all of the above-mentioned conditions for success are met.

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