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Total knee arthroplasty after osseous ankylosis of the knee joint

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Objective: A knee fusion is associated with considerable restrictions, including the inability to sit properly, use public transportation, and climb stairs. The purpose of this study is to report and discuss our cases of spontaneous ankylosed knees which were taken down and underwent total knee arthroplasty (TKA).

Methods: Six patients who experienced spontaneous ankylosis of the knee undergoing conversion to TKA between 2003–2012 were enrolled retrospectively in this study. The etiology was childhood pyogenic arthritis in 2 patients, intraarticular fractures in 2, gunshot in 1, and juvenile rheumatoid arthritis in 1. The clinical data were recorded with the use of the Hospital for Special Surgery (HSS) knee rating system, Western Ontario and McMaster Questionnaire (WOMAC), and Visual Analog Scale (VAS), preoperatively and postoperatively at final follow-up.

Results: The average follow-up time was 86 months (range: 22–126 months). At the final follow-up, the average range of active flexion was 85° (range: 75–95°). Postoperative average HSS knee rating system was improved from 19.5 (range: 18–22) to 57.49 (range: 46–80), WOMAC was improved from 39.75 (range: 36.4–43) to 62.41 (range: 50.8–74.5). VAS was improved from 9.5 (range: 7–9) to 2.8 (range: 2–4). A pyogenic infection developed in 2 patients; 1 was managed by debridement, and 1 was managed by arthrodesis 2 years later.

Conclusion: The ability to walk and sit in a normal fashion is of great importance for patients. With good preoperative planning and careful handling, gratifying results are possible with TKA.

Keywords: Knee ankylosis; knee arthrodesis; knee fusion; total knee arthroplasty.

Level of Evidence: Level IV Therapeutic Study

A solid fusion of the knee is considered the most successful treatment for intractable pyogenic and tuberculosis arthritis or varying arthritis.[1] Even though arthrodesis in a good position is still considered the most satisfactory treatment for malpositioned ankylosis of the knee, a successful fusion does not guarantee a satisfactory result.[1,2] Knee fusion is associated with considerable restrictions, including the inability to sit properly, use public transportation, and climb stairs.[3] The social discrimination patients may experience as a result of their dis-

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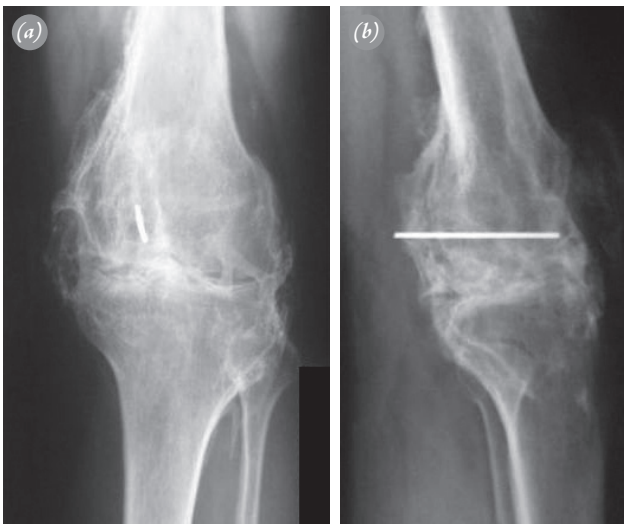

Fig. 1. **(a,b)** Preoperative anteroposterior and lateral radiography of the patient with intra-articular fracture-related ankylosis.

ability can even drive them to attempt suicide or ask for amputation.[1,4] Less drastically, a patient with a fused knee uses a greater amount of energy than the average person when walking, which lowers their endurance and causes lower back pain due to the excessive hiking of the ipsilateral hip.[1,2]

As surgical experience has grown, total knee arthroplasty (TKA) has been applied successfully to more challenging reconstructive cases.[1] However, there are few reports of TKA applied to cases of osseous ankylosis and formal knee fusions in the literature.[5–10]

The purpose of the study is to report and discuss our cases of spontaneous ankylosed knees which were taken down and underwent TKA.

Patients and methods

Six patients with a knee of spontaneous ankylosis undergoing conversion to TKA between 2003–2012 were enrolled retrospectively in this study. There were 4 women and 2 men. The mean age at the time of conversion was 35 (range: 24–45).

The etiology of the ankylosis was childhood pyogenic arthritis in 2, intraarticular fractures in 2 (Figure 1a,b), gunshot in 1 (Fig. 2a,–c) and juvenile rheumatoid arthritis in 1. There was no evidence of active pyogenic infection at the time arthroplasty in any of the knees. The sagittal position of the knee ankylosis ranged from 0–30° with no motion in 4 and 10° of flexion with a movement of 10° and 20° in 2, respectively.

The clinical data were recorded with the use of the Hospital for Special Surgery (HSS) knee rating system,[11] Western Ontario and McMaster Questionnaire (WOMAC),[12] and Visual Analog Scale (VAS), preoperatively and postoperatively at final follow-up.

All of the procedures are performed by 1 senior surgeon under epidural anesthesia and tourniquet control. Anterior midline skin incision was followed by medial parapatellar arthrotomy with tuberositas tibia osteoto-

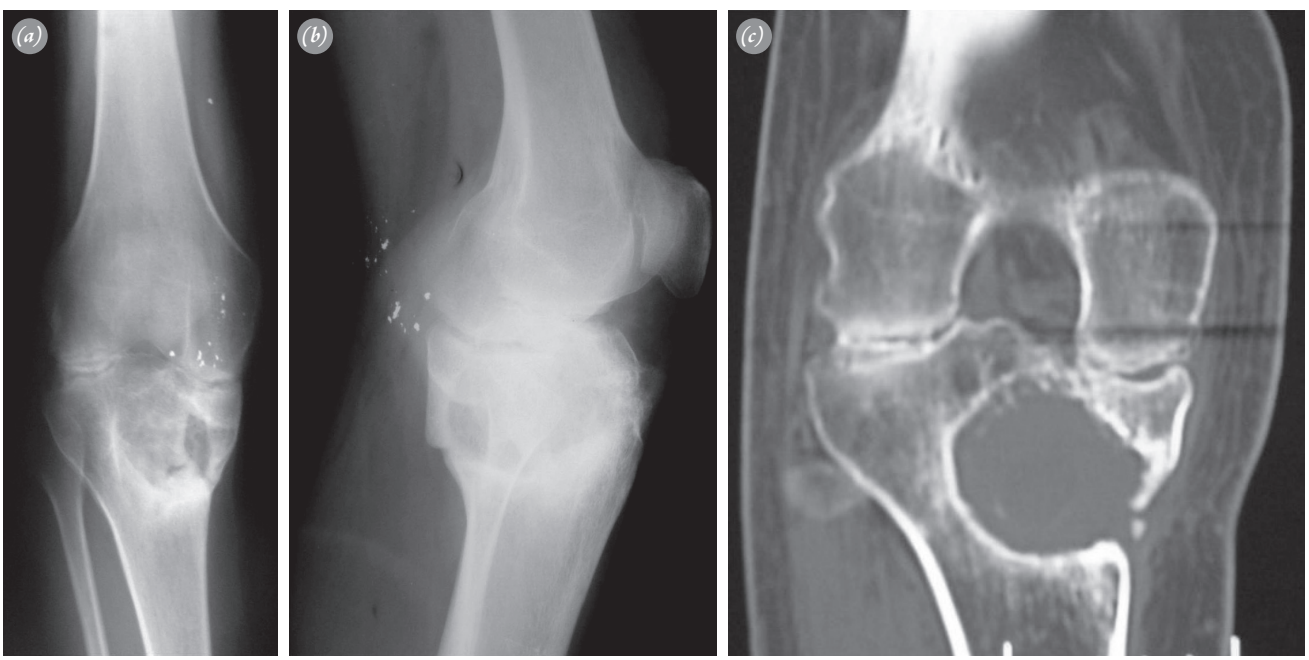

Fig. 2. **(a,b)** Preoperative anteroposterior and lateral radiography of the patient with gunshot-related fracture ankylosis. **(c)** Preoperative computed tomography of a patient with gunshot-related fracture. Osseous defect is shown in detail.

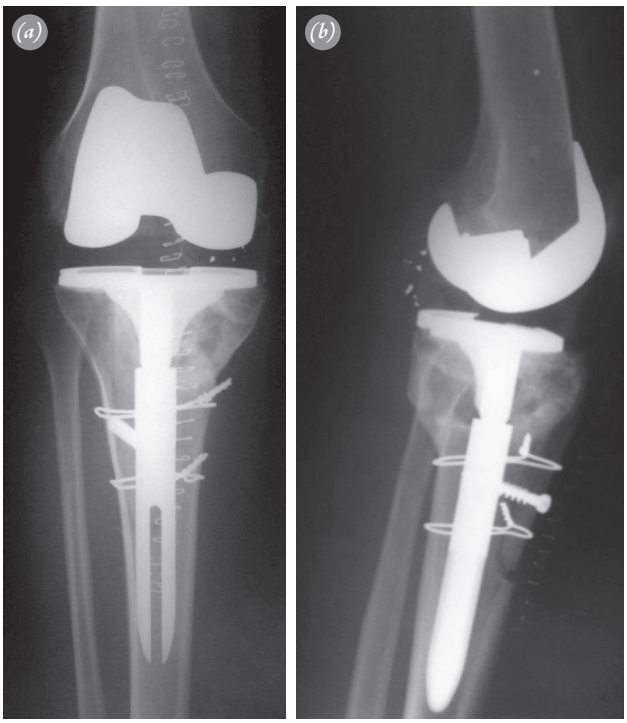

Fig. 3. **(a,b)** Postoperative anteroposterior and lateral radiography of the patient with gunshot-related fracture treated by condylar constrained TKA.

my in all of the procedures, as described by Young.[13] The fusion was osteotomized at the junction of femur and tibia with meticulous attention to preserve the soft tissues around the knee. An intramedullary jig was used for femoral and tibial resection. Condylar constrained total knee arthroplasties (CCK) (Genesis® II Total Knee Replacement, Smith&Nephew, Inc., Memphis, TN, USA) were performed in all procedures (Figure 3). All prostheses were implanted with cement. Tuberositas tibia osteotomies were fixed by a 4.5 mm cancellous screw and/or cable according to the osteotomized bone quality. Pie-crusting was performed on the quadriceps tendons in order to improve range of motion (ROM). Closure of the arthrotomies was completed at an angle of 45° of knee flexion in order to prevent extension lag.

Patients were mobilized on postoperative Day 1 and remained partially weight-bearing for 6 weeks until bony healing. Continuous passive motion (CPM) device was used with an angle restriction of 45° after postoperative Day 2 for 5–7 days until discharged. Thereafter, physiotherapy was continued for 4 weeks, during which period ROM increased.

Results

The average follow-up time was 86 months (range: 22–126). At final follow-up examination, the average range of active flexion was 85° (range: 75–95°). There was 10° of extension lag in 2 patients. Postoperative average HSS knee rating score improved from 19.5 (range: 18–22) to 57.49 (range: 46–80). Postoperative average WOMAC score improved from 39.75 (range: 36.4–43) to 62.41 (range: 50.8–74.5). VAS score improved from 9.5 (range: 7–9) to 2.8 (range: 2–4). None of the knees had instability more than 5 mm in mediolateral and anteroposterior plane on stress tests.

A pyogenic infection developed in 2 knees: 1 in a patient with etiology of gunshot (3 months postarthroplasty) and 1 in a patient with etiology of fracture-related ankylosis (4 weeks after postarthroplasty). In the gunshot patient, the allograft was used to fill the osseous defect of the proximal tibia. The allograft was removed, and the osseous defect was filled with antibiotic-impregnated cement during debridement. Six months after debridement, reinfection occurred, which was managed with several debridements and antibiotherapy. Two years from the first debridement, the prosthesis was removed because of persistent infection, and arthrodesis was performed. The delay in performing arthrodesis was due to the patient's insistence on achieving a mobile-bearing knee. The fracture-related ankylosis patient was treated by debridement and intravenous antibiotics for 6 weeks, and there was no recurrence at the time of final follow-up. Staphylococcus epidermidis was identified from the culture specimen which was taken intraoperatively during the debridement of both patients.

None of the patients had skin necrosis. There was no radiolucency, patella baja, or patella alta on the radiographs. Patients' data are given in Table 1.

Discussion

Although knee fusion is associated with considerable restrictions–including the inability to sit properly, use public transportation, and climb stairs–to takedown a fused knee and perform knee arthroplasty has a high rate of complications such as skin necrosis, infection, quadriceps tendon rupture, patellar fracture, and septic loosening.[1,3,14,15] Additionally, joint replacement in young patients is controversial because of duration of fixation, wear, and fatigue properties of the material over time.[16] Indications for takedown of fused knees are complex and require the presence of sufficient musculoskeletal and neurovascular structure with consideration to the patient's motivation and the surgeon's extensive experience in TKA surgery.[3]

Sixty-five to 70° degrees of knee flexion is needed for the swing phase of the normal gait, 90° of knee flexion is needed to climb stairs, and 105° of knee flexion

Table 1. Patients' preoperative and postoperative data.

Patient	Age	Sex	Etiology	Preop motion	Postop motion	Preop HSS	Postop HSS	Preop WOMAC	Postop WOMAC
1	43	F	Pyogenic infection	Ankylosis at 30° flexion	–10/80	20	58	39.4	63.2
2	26	M	Gun shot	Ankylosis at 15° flexion	0/90	18	49	38.2	62.9
3	40	M	Traffic accident (IA* fracture)	10° flexion contracture and 10° flexion	–10/90	19	46	40.2	50.8
4	45	F	Pyogenic infection	Ankylosis at 30° flexion	0/80	20	64	41.3	70.5
5	32	F	I.A. fracture	10° flexion contracture and 20° flexion	0/95	22	80	43.0	74.5
6	24	F	JRA**	Ankylosis at full extension	0/75	18	48	36.4	52.6

*IA: Intra articular fracture; **JRA: Juvenile rheumatoid arthritis.

is needed to rise independently from a chair.[7] In the literature, ROM after turndown of fused knees to knee arthroplasty was reported as 74–101° of flexion.[1,3,5,16] Mullen also stated that improvements of flexion had no significant difference between rheumatoid and osteoarthritic ankylosed knees.[6] There was only 1 rheumatoid ankylosed knee in our series, which showed ROM improvement that was less than that of the knees with other etiological reasons of ankylosis; however, 1 case is not sufficient to reach a conclusion. While quadricepsplasty has been used to improve ROM, some authors advocated not lengthening quadriceps muscle and claimed that with time and exercise, ROM improves through the first year postoperatively.[1,7,10,17] We only performed pie-crusting instead of lengthening by tenoplasty. Tissue expanders are as useful as quadricepsplasty for managing quadriceps contractures.[18] Cameron insisted on the importance of immediate mobilization to manage quadriceps contracture; however, 2 cases in that study required immobilization for 10 days, after which the patients were able to obtain 35° of flexion. He stated that if the initial ROM is 35–45°, with time and exercise it will improve.[2,8] Aggressive postoperative physical therapy is also important to overcome the extensor mechanism contracture.[7] We were able to manage our cases with assisted physiotherapy for 4 weeks after surgery, and the results were comparable with the literature. We believe that gradually increasing the flexion degree as Cameron stated is an effective tool for increasing flexion.

Schurman emphasized an extensive surgical approach to provide adequate exposure of the knee as well as to reestablish the anatomical joint line.[7] Quadricepsplasty facilitates exposure and avoids patellar tendon avulsion as tibial tuberosity osteotomy.[10] Some authors prefer V-Y quadricepsplasty instead of tibial tuberosity osteotomy because of the reattachment difficulty on osteoporotic bone and stemmed tibial component, as well as the risk of avulsing patellar tendon as Naranja reported 3 of 13 cases.[1,5,10,15] Henkel reported performing tibial tuberosity osteotomy in all cases without complications related to this procedure.[3] We preferred tuberositas tibia osteotomy in 6 cases as an extensive surgical approach, and we saw no long-term complications related to this approach.

In patients with spontaneous osseous ankylosis, the supporting soft tissues, including the collateral ligaments are usually intact, making the use of semi-constrained prostheses possible; during surgery, care and attention must be given to preserve these ligaments.[7,16] Adequately preserved soft tissue sleeves are able to provide soft tissue stability.[5] If the collateral ligaments are absent or deficient, than the use of constrained total knee prosthesis is recommended.[17,18] Usage of hinged TKA must be kept in mind while performing knee arthroplasty on a patient who has had surgical arthrodesis to provide additional stability, regardless of the high rates of loosening and infection.[1] However, Schurman insisted on not performing TKA on a patient who has had surgical arthrodesis previously due to the high rate of infection and loosening.[7] We performed condylar constrained prosthesis in all cases, and during follow-up there were no complications related to prosthesis type.

Complications following this surgery are high and mostly related to soft tissue problems such as skin necrosis, quadriceps tendon rupture, adhesion, and arthrofibrosis.[1–3,16] The skin status around the knee joint is crucial for this surgery. The high rate of skin necrosis at the edges of up to 50% warrants careful handling of the flaps, and tissue expanders may be beneficial, as well as avoiding overstuffing of the anterior compartment.

[3,5,16,19] The incidence of skin edge necrosis is not related to the chosen surgical approach.[1]

Adhesion and arthrofibrosis are significant complications with loss of ROM.[1,3,8] According to Shiu-Bii Lien, et al., the possible causes of arthrofibrosis include not performing V-Y quadricepsplasty, mismatch of patellofemoral tracking, and not performing aggressive rehabilitation postoperatively.[2] Although we did not perform quadricepsplasty in any of the cases, we had no complications.

Postoperative infection is another significant complication in the reported series, consisting of both reactivation of initial infections and newly occurring infections. [1,5,8,15] Infection rates are between 5.5–23.5% in the literature.[1,5,8,15] While some of the infections were managed by long-term antibiotics, some were managed by debridement, 2-stage revisions, removal of the prosthesis with arthrodesis, and amputations.[1,5,8,15] Even though Holden emphasized that TKA is a contraindication, Kim et al. had satisfying results in patients with previous septic or tuberculosis infection and stated that the only contraindication for replacement is active pyogenic or tuberculosis infection.[1,17] We had 2 patients with pyogenic infection-related ankylosis and saw no complications related to this etiology as reactivation of the initial infection at the time of final follow-up.

Despite the risks and complications in the present series and in the literature, the ability to walk and sit in a normal fashion is important for patients. In the present series, all patients preferred mobile knees to fused knees and were satisfied with their increased flexion range, regardless of the angle, and pleased to be socialized following knee surgery. The number of the patients in this series is too small to make a recommendation, but in light of the literature, with good preoperative planning and careful handling, gratifying results are possible.

Conflics of Interest: No conflicts declared.

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