Conversion total knee arthroplasty after arthrodesis using rotatory hinge revision system

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Objective
Patients with knee arthrodesis experience many daily activities and limitations affecting their life quality. The purpose of this study was to report and discuss the outcome of our cases of knee arthrodesis converted to total knee arthroplasty.
Patients and methods
In the period from August 2015 to December 2017, the authors conducted a prospective study that included six patients (one female and five males) with sound knee arthrodesis. All patients underwent conversion total knee arthroplasty using rotatory hinge revision system. Patients' ages ranged from 35 to 66 years. Patients were evaluated using Knee Society Clinical Score and Knee Injury and Osteoarthritis Outcome Score.
Results
The average follow-up period was 24.5 months (18–36 months). At the final follow-up, average knee flexion was 87.5° (70°–100°). Knee Society Clinical Score and Knee Injury and Osteoarthritis Outcome Score score increased form an average of 31.8 (28.4–34.8) preoperatively to 66.6 (58.6–74.4) at the final follow-up. The authors had an average final Knee society score of 67.6, ranging from 53 to 78. Three cases experienced postoperative complications, representing 50% of the study group, two cases had superficial wound infection, and a case had skin edge necrosis; all were successfully managed, with no long-term complications.
Conclusion
Conversion total knee arthroplasty is a hope for patients who cannot tolerate the effect of knee arthrodesis in their lives. Awareness of the risks, proper patient selection, good preoperative planning, and adequate management of complications can help the patients to have satisfactory results.

Keywords:
knee fusion, conversion, rotatory hinge, total knee arthroplasty

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Introduction

Knee arthrodesis has been performed since the early 1900s [1]. Its main indications were to treat tuberculosis of the knee, severe osteoarthritis, and juvenile arthritis of the knee [2]. Nowadays, knee arthrodesis is still a treatment option as a limb salvage procedure. It can be used as a treatment option in cases of failed total knee arthroplasty, periarticular neoplasm, unreconstructable post-traumatic arthritis, and chronic infection [3].

The goals of a successful arthrodesis are to achieve knee stability and pain relief, leading to enhanced patient mobility [2]. Nevertheless, even with a sound uncomplicated arthrodesis, patients experience functional disability that cannot be tolerated by many of them. Daily activities such as sitting down, using high stairs, using public transportation, and shutting the door while using a small restroom may be difficult or even sometimes impossible [4].

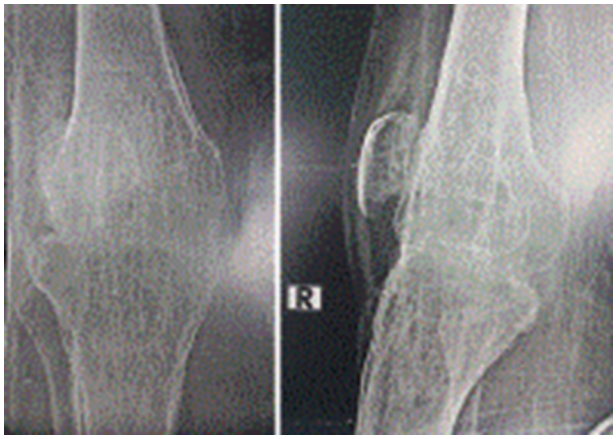
With an arthrodesed knee, the patient must do excessive hiking of the ipsilateral hip while walking; this requires more energy, decreasing the patient's endurance and causing low back pain. Moreover, owing to the absence of the buffering effect of a mobile knee, the ipsilateral hip can be easily subjected to be damaged by the direct impact [5] (Fig. 1).

For those patients who can no longer tolerate the aforementioned obstacles, the only hope is to regain some knee motion. This can be tried by taking down the arthrodesis and applying a total knee prosthesis. Although a high incidence of complication is reported after conversion arthroplasty of a sound knee arthrodesis (3), new advancements in prosthetic

Figure 1

Left hip osteoarthritis in a case with left knee arthrodesis.

Figure 2



Anteroposterior and lateral views of the knee.

design and the surgical techniques may carry a hope for those patients.

Patients and methods

In the period between August 2015 and December 2017, a prospective study was conducted involving six cases (one female and five males). Patients were referred from orthopedic surgery outpatient clinic experiencing complications after undergoing knee arthrodesis. This study was approved by the Ethics Committee of the department of Orthopedic surgery, Faculty of Medicine, Ain Shams University.

Median patients' age was 50 (35–66) years. The indications for the arthrodesis were complications after various fractures in three patients, rheumatoid arthritis in two, and one case of tuberculous arthritis. The median period between arthrodesis and conversion arthroplasty was 3.5 years (1.5–7 years).

Figure 3

Incision over the old scar.

Inclusion criteria

Patients with sound arthrodesis but the immobile joint negatively affecting their lifestyle and willing to undergo the operation after understanding its risks were included. All our six patients considered undergoing the conversion arthroplasty because they could not tolerate the daily life limitations which the immobile knee dictated on them.

Exclusion criteria

The following were the exclusion criteria:

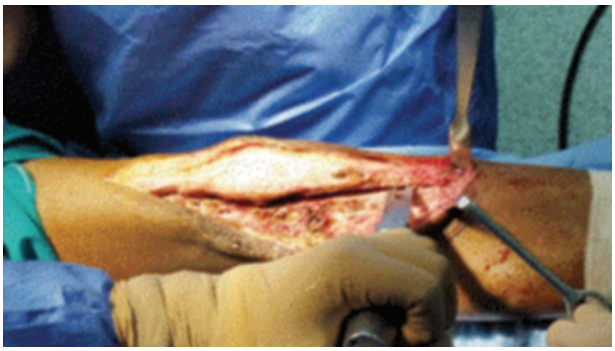
(1) Active acute, subacute, or chronic infection.
(2) Patellectomy.
(3) Quadriceps femoris muscle deficiency.
(4) Bad skin condition.
(5) General condition problems, making the patient unfit for anesthesia.

Preoperative evaluation was done for all patients, including full history taking, physical examination, and radiological examination. Physical examination included soft tissues evaluation and examining quadriceps femoris muscle (rectus femoris is tested during active hip flexion, rest of the muscle is tested for tone, consistency, and static contractility). Radiological examination included anteroposterior and lateral views of the knee (Fig. 2). Laboratory tests included routine preoperative investigations plus acute phase reactants to detect possibility of occult infection.

An informed consent was taken from each patient after discussing the procedure, the possible risks and complications, the expected outcomes, and the rehabilitation program.

Incision over the old scar was used for all patients to minimize tissue damage (Fig. 3). Tibial tuberosity osteotomy was performed (Fig. 4), which was later

Figure 4



Tibial tuberosity osteotomy.

fixed back in place by two cancellous screws. In cases where patella was found to be fused to the femur, an oscillating saw was used to separate it. Three of the six patients still had the implants used for arthrodesis; for these patients, the implant was removed (Fig. 5).

The level and direction of the osteotomy were determined under image intensifier guidance, being 2.5 cm inferior to the lateral femoral epicondyle, 2.7 cm inferior to the medial femoral epicondyle, and transverse to the long axis of the tibia (3,6) (Fig. 6).

Double-level fusion osteotomy was performed guided by the smallest gap spacer taking meticulous care to preserve soft tissue and bone stock (Fig. 7). The osteotomy was carried out using an oscillating saw till reaching the posterior cortex, and then the posterior cortex is removed by a rongeur in piecemeal fashion to avoid injury to the posterior vascular structures. All of the arthrodesis we converted were well aligned, so we had no troubles dealing with common peroneal nerve tractional injuries after correction of a valgus fixed arthrodesis. Medial and lateral collateral ligaments were examined, especially the medial collateral ligament, being the most important for stability [6]. In all our patients, we used rotatory hinge revision arthroplasty system (NexGen RH Knee Zimmer Inc., Warsaw, Indiana, USA) to avoid instability owing to insufficient ligamentous stabilizers.

Once osteotomy was complete, gradual knee flexion became possible followed by removal of the osteotomy segment. Conventional femoral and tibial side preparation was followed, and then trial reduction was performed with temporal fixation of the previously osteotomized tibial tuberosity to its place. Flexion range was then examined. In all the patients, we encountered tight quadriceps femoris, so V-Y quadricepsplasty was performed. An inverted V

Figure 5

Fusion using an intramedullary nail.

Figure 6

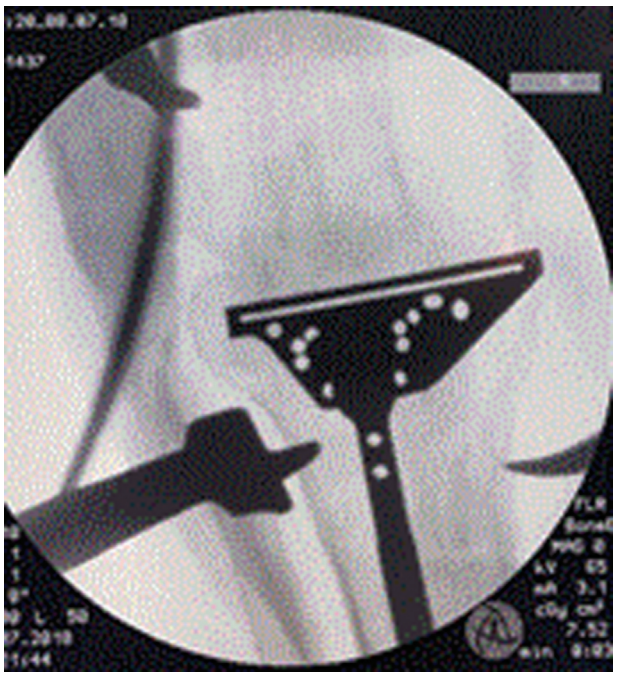
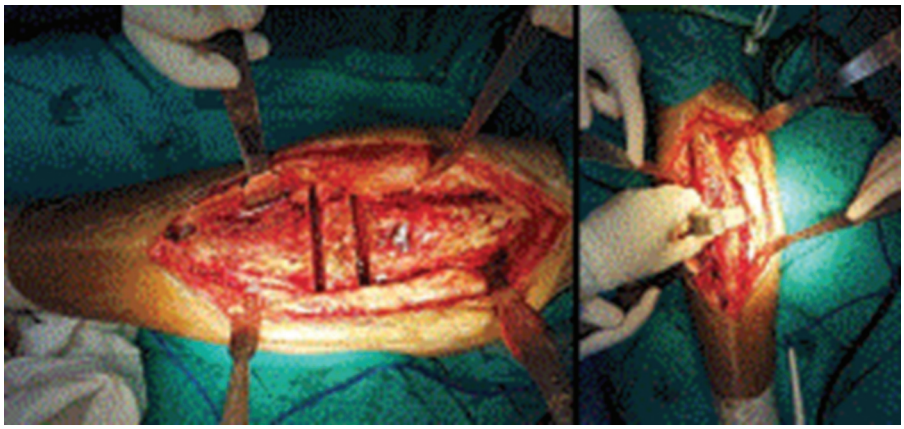


Image intensifier guidance.

incision was made at the musculotendinous junction of the quadriceps, and then knee was flexed to 45° and the tendon was then sutured as Y shape (Fig. 8).

Tibial tuberosity was securely fixed in place (Fig. 9); closed suction drainage was used for all patients and removed after 24–48 h. Wound was closed in anatomical layers, and the patient was put in

Figure 7



Double-level fusion osteotomy.

Figure 8

Femoral and tibial preparation and prosthesis insertion.

graduated hinged knee brace, which was adjusted to immobilize the knee in full extension for the first 48 h.

Patients were instructed to begin partial weight bearing on the second day postoperatively. After 48 h postoperatively, the brace was readjusted to allow flexion to 30°. After which, continuous passive motion device was used to mobilize the knee in the allowed range; this was continued till patient discharge.

Physiotherapy continued for 4 weeks with a gradual increase in the range of motion and periarticular muscle strengthening exercises.

At follow-up visits, we recorded the range of motion using a goniometer. We used the Knee Society Clinical Score [7] to evaluate the clinical outcome, with the best mark being 100 and the lowest being 0. Moreover, the Knee Injury and Osteoarthritis Outcome Score (KOOS) [8] was measured preoperatively and postoperatively to assess the functional results.

KOOS is an extension of the Western Ontario and Mc-Master Universities Osteoarthritis Index [9,10]. We used the Arabic version of KOOS questionnaire translated by Almangoush *et al.* [11].

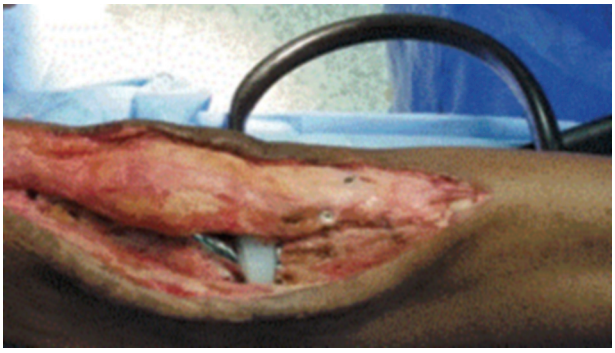
An radiography was done the second day postoperatively and on regular follow-up intervals (Fig. 10).

Results

We had an average surgical time of 114 min (95–135 min). Estimated blood loss was 1100 ml on average (700–1540 ml). The average hospital stay was 5.5 days (4–8 days).

The average follow-up period was 24.5 months (18–36 months), and no patient was lost during follow-up (Tables 1–3).

Figure 9



Tibial tuberosity fixed with two screws.

Complications

Of the six patients, three had complications. Two of them had superficial wound infection, and they were managed by surgical debridement and intravenous antibiotics; for both, the infection resolved, and there were no signs of recurrence till final follow-up.

One patient experienced superficial wound edge necrosis of an area of 4-cm diameter and was

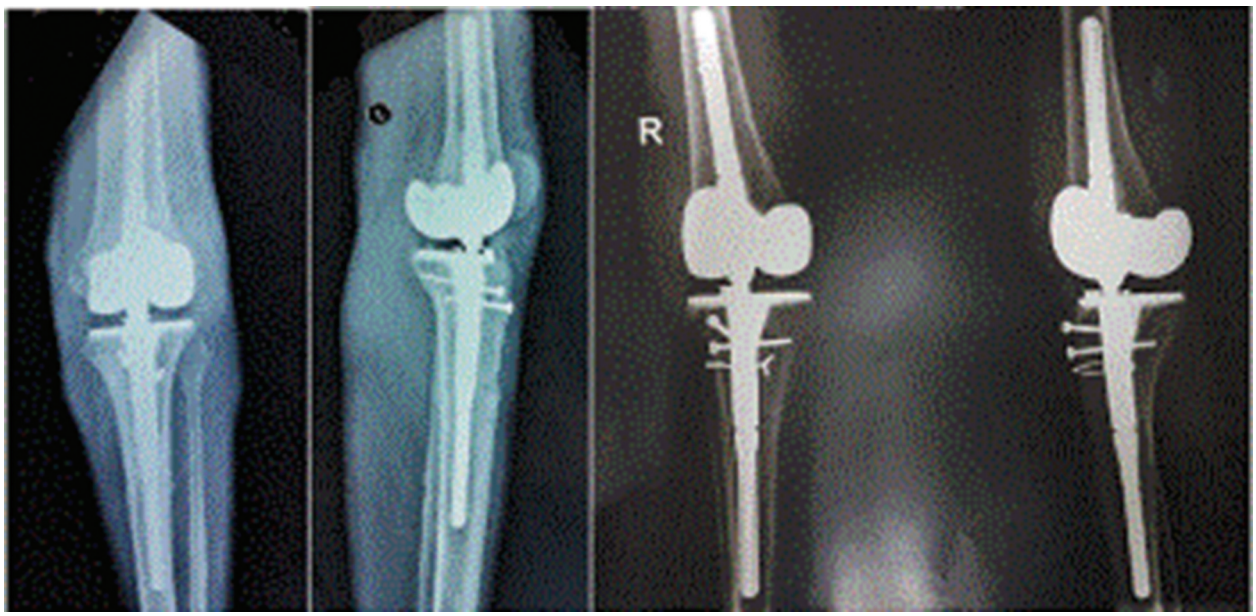
Table 1 Intraoperative and postoperative ranges in degrees

Patient's number	Maximum intraoperative range after wound closure	Maximum range at final follow-up	Extension lag at final follow-up
1	85	80	0
2	95	90	5
3	75	70	0
4	110	100	5
5	115	100	10
6	90	85	0
Average	95	87.5	3.33

Table 2 Knee society clinical rating system score at final follow-up

Patient's number	Knee society score
1	66
2	67
3	53
4	78
5	72
6	70
Average	67.66

Figure 10



Postoperative radiographies.

Table 3 Knee Society Clinical Score and Knee Injury and Osteoarthritis Outcome Score preoperative and at the final follow-up

Patient's number	Preoperative KOOS	Final follow-up KOOS score
1	30.2	60.8
2	34.8	66.2
3	28.4	58.6
4	32.2	74.4
5	34.2	70.6
6	30.8	68.4
Average	31.8	66.6

KOOS, Knee Society Clinical Score and Knee Injury and Osteoarthritis Outcome Score.

managed by debridement and split-thickness skin graft, after which, the wound healed uneventfully.

Discussion

Although knee arthrodesis can provide a solution to some serious knee problems, not all patients accept the effect of an immobile knee on their lives. Even patients with successful arthrodesis may ask for amputation as an end solution to the daily limitations they face [12].

Another alternative is to convert the arthrodesed knee to total knee arthroplasty, so knee mobility can be regained, allowing the patients to resume some of the life activities they have lost.

In normal gait, 67–70° of knee flexion is needed to achieve a normal swing phase, to climb stairs, a 90° knee flexion is needed, and to rise from a chair, a 105° knee flexion is needed [13].

In our study, we had a final average knee flexion of 87.5° (70°–100°); as a result, our patients could resume many of their daily activities once more. The range of flexion we achieved is comparable by what we find in many similar studies, reporting an average of 74–101° of knee flexion after conversion arthroplasty [4,14–16].

Clemens and co-workers had performed a study in which they converted 8 arthrodesed knees to a total knee arthroplasty; they had an average final Knee society score of 58, ranging from 47 to 74 (17). These results quite match with our results, with an average Knee society score of 67.6, ranging from 53 to 78.

All our six patients were satisfied by the operation. The preoperative KOOS score increased form an average of 31.8 (28.4–34.8) to 66.6 (58.6–74.4) at the final follow-up. This was mainly owing to the increase of the score of the daily activity in the questionnaire. Although we had an incidence of complications of 50%, yet all of them were controllable and did not affect the rehabilitation program at the long term. This is not far from what Cameron and Hu [18] got in their study which included 17 patients with follow-up period up to 10 years; they had a complication rate of 53%.

We encountered two cases of superficial wound infection, representing 33.3% of the cases. The two cases presented early and responded well to intravenous antibiotics. Henkel *et al.* [4] encountered an infection rate of 29%, whereas Clemens *et al.* [17] had an infection rate of 25% in their study.

Jauregui *et al.* [19] performed a comprehensive literature search to evaluate all studies about conversion of a surgically arthrodesed knee to a total knee arthroplasty included in the literature from January 1980 until July 2015. They found the incidence of skin edge necrosis to be 21%. We had one case of skin edge necrosis (representing 16.7%), which was managed successfully by surgical debridement and partial thickness skin graft. The low incidence of skin edge necrosis in our study may be owing to the careful selection of patients, as we did not perform the operation for any patient showing skin problems.

Conclusion

Despite the risks and the relative high rate of complications, we believe that unsatisfied patients with knee arthrodesis have a chance to regain many of the daily activities they were unable to perform. The keys of successful conversion knee arthroplasty are good patient selection, proper surgical technique, and adequate management of complications. Patients' ambition for regaining a better life quality should not be underrated. Of course, risks and complications should be explained to the patients in details. We think that if patients with knee arthrodesis cannot adapt with the limitations their immobile knee imposes and they have no contraindications for conversion arthroplasty, then they can be offered to undergo the procedure, which has a fairly good chance to improve their life quality.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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