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Are Complications Associated With the Repiphysis® Expandable Distal Femoral Prosthesis Acceptable for Its Continued Use?

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Abstract

Background   Reconstruction of the distal femur after resection for malignant bone tumors in skeletally immature children is challenging. The use of megaprostheses has become increasingly popular in this patient group since the introduction of custom-made, expandable devices that do not require surgery for lengthening, such as the Repiphysis® Limb Salvage System. Early reports on the device were positive but more recently, a high complication rate and associated bone loss have been reported.

Questions/purposes   We asked: (1) what are the clinical outcomes using the Musculoskeletal Tumor Society (MSTS) scoring system after 5-year minimum followup in patients treated with this prosthesis at one center; (2) what are the problems and complications associated with the lengthening procedures of this implant; and (3) what are the specific concerns associated with revision of this implant?

Methods   At our institute, between 2002 and 2007, the Repiphysis® expandable prosthesis was implanted in 15 children (mean age, 8 years; range, 6–11 years) after distal femoral resection for malignant bone tumors. During this time, the general indication for use of this implant was resection of the distal femur for localized malignant bone tumors in pediatric patients. Alternative techniques used for this indication were modular prosthetic reconstruction, massive (osteoarticular or intercalary) allograft reconstruction, or rotationplasty. Age and tumor extension were the main factors to decide on the surgical indication. Of the 15 patients who had this prosthesis implanted during reconstruction surgery, five died with the implant in situ or underwent amputation before 5 years followup and the remaining 10 were evaluated at a minimum of 5 years (mean, 104 months; range, 78–140 months). No patients were lost to followup. These 10 patients were long-term survivors and underwent the lengthening program. They were included in our study analysis. The first seven lengthening procedures were attempted in an outpatient setting; however, owing to pain and burning sensations experienced by the patients, the procedures failed to achieve the desired lengthening. Therefore, other procedures were performed with the patients under general anesthesia. We reviewed clinical data at index surgery for all 15 patients. We further analyzed the lengthening procedures, implant survival, radiographic and functional results, for the 10 long-term survivors. Functional results were assessed according to the MSTS scoring system.

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Complications were classified according to the International Society of Limb Salvage (ISOLS) classification system.

Results   Nine of the 10 survivors underwent revision of the implant for mechanical failure. They had a mean MSTS score of 64% (range, 47%–87%) before revision surgery. At final followup the 10 long-term surviving patients had an average MSTS score of 81% (range, 53%–97%). In total, we obtained an average lengthening of 39 mm per patient (range, 17–67 mm). Exact expansion of the implant was unpredictable and difficult to control. Nine of 10 of the long-term surviving patients underwent revision surgery of the prosthesis—eight for implant breakage and one for stem loosening. At revision surgery, six patients had another type of expandable prosthesis implanted and three had an adult-type megaprosthesis implanted. In five cases, segmental bone grafts were used during revision surgery to compensate for loss of bone stock.

Conclusions   We could not comfortably expand the Repiphysis® prosthesis in an outpatient setting because of pain experienced by the patients during the lengthening procedures. Furthermore, use of the prosthesis was associated with frequent failures related to implant breakage and stem loosening. Revisions of these procedures were complex and difficult. We no longer use this prosthesis and caution others against the use of this particular prosthesis design.

Level of Evidence   Level IV, therapeutic study.

Introduction

Limb salvage after tumor resection in a skeletally immature child, particularly in the lower limb, is challenging. The primary goal of surgical treatment is complete removal of the tumor with adequate margins. Reconstruction is particularly difficult because of the relatively small anatomic size, reduced growth in the surgically treated limb resulting in a potential limb-length discrepancy, and the high functional and mechanical demands of young, active patients [1, 14, 21]. Expandable prostheses have been developed to address the problem of limb-length discrepancy, compensating for lost growth potential and maintaining good function of the treated joint [5, 19, 24, 25].

The introduction of expandable prostheses that can be lengthened without the need for invasive surgery or general anesthesia made this type of reconstruction increasingly popular. The Repiphysis® prosthesis was the first expandable endoprosthesis commercially available worldwide, with a lengthening mechanism that did not require any surgery. The device was introduced by Wright Medical Technology (Arlington, TN, USA) and received approval from the FDA

in 2002. The Repiphysis® Limb Salvage System was later acquired by MicroPort Orthopedics Inc (Arlington, TN, USA), which is the current manufacturer of the implant [20]. Initially, there were positive reports on short-term results of the implant [6, 11, 17, 26], but there have been increasing concerns regarding high complication rates and poor function at longer followup [3, 4, 16, 22].

We therefore analyzed our experience with the Repiphysis® prosthesis in 10 patients younger than 12 years, who had survived 5 or more years after treatment for a malignant bone tumor of the distal femur. We asked (1) what are the clinical outcomes using the Musculoskeletal Tumor Society (MSTS) scoring system after 5-year minimum followup in patients treated with this expandable prosthesis; (2) what are the problems and complications associated with the lengthening procedures of the implant; and (3) what are the specific concerns associated with revision of the implant?

Patients and Methods

We performed retrospective clinical and radiographic evaluations of all pediatric patients (younger than 12 years) who underwent reconstruction of the distal femur with the Repiphysis® custom-made expandable prosthesis after resection, between 2002 and 2007 at one institute, for a malignant bone tumor. The patients in this study were identified from an observational prospective study.

Between 2002 and 2007 at our institution, the Repiphysis® custom-made, expandable prosthesis was implanted in 15 patients who underwent resection of the distal femur for a malignant bone tumor. The series included nine male and six female patients, with a mean age of 8 years (range, 6–11 years). The diagnosis was high-grade osteosarcoma in 14 patients and Ewing's sarcoma in one. All patients received pre- and postoperative chemotherapy according to well-established protocols [9, 10].

During that period, our general indications for using this implant were resection of the distal femur for localized malignant bone tumors in pediatric patients. During the same time, for similar indications, we used an adult-type of modular prosthesis in five patients (all 12 years old), a modular megaprosthesis with a smooth tibial stem in eight patients (between 9 and 12 years old), one intercalary reconstruction after resection through the epiphysis, four rotationplasties (in patients younger than 7 years or with very large tumors), two other types of expandable prostheses (mechanical lengthening through a small incision), and two osteoarticular allografts. Age and tumor extension were the main factors leading to the decision to use this expandable implant. In general, we opted for the

expandable prosthesis when patients were between 7 and 12 years old, had an expected potential limb length discrepancy of at least 4 cm, good clinical and radiographic response to preoperative chemotherapy, possibility to save the primary neurovascular bundle, and with at least 8 cm of longitudinal tumor extension from the joint line. This might have resulted in a selection bias compared with other approaches.

One patient died because of drug toxicity during chemotherapy. Two patients had a local recurrence and underwent an above knee amputation at 6 and 19 months after the index surgery. Each died of diffuse disease at 11 and 28 months followup, respectively. Three other patients had lung metastases during followup. Two of them died at 20 and 28 months after the primary surgery (one of the patients had undergone implant removal at 8 months followup because of a postoperative infection). None of these patients underwent the lengthening program and their functional results, complications, or revision procedures are not included in this study. The other patient who had lung metastasis is alive and in complete remission 85 months after thoracotomy and wedge resection of the lung nodules. Ten long-term surviving patients underwent the lengthening program and we evaluated implant survival and functional outcome for these patients only. Mean followup of this group of patients was 104 months (range, 78–140 months).

The Repiphysis® custom-made, noninvasive expandable prosthesis uses a telescopic lengthening mechanism composed of a titanium tube embedded in a polyethylene housing cylinder (Fig. 1). The energy to lengthen the implant is stored in a compressed spring inside the titanium tube. The end of the titanium tube is flared and engages in the polyethylene cylinder, locking it into place. When lengthening is required, an external electromagnetic field is generated by a coil, which is placed circumferentially to the extremity at the level of the implant. The coil heats and softens the polyethylene cylinder, allowing for the titanium tube to disengage from its housing. At this stage, the compressed spring partially releases and expands, sliding the titanium tube out of the polyethylene cylinder, lengthening the implant. Once the flared part of the tube reaches a new and cooler portion of polyethylene, it is locked back in place, limiting further expansion [18, 20, 26]. According to the manufacturer [20], it takes approximately 20 seconds to obtain 0.8-mm expansion of the prosthesis, but this is variable and further lengthenings are estimated in a table in the manufacturer's instructions. It is not possible to reverse the lengthening obtained with each expansion. It is recommended that the procedure be performed under fluoroscopic guidance. Lengthening of the device can be performed without anesthesia or sedation in an outpatient setting according to the manufacturer [20]
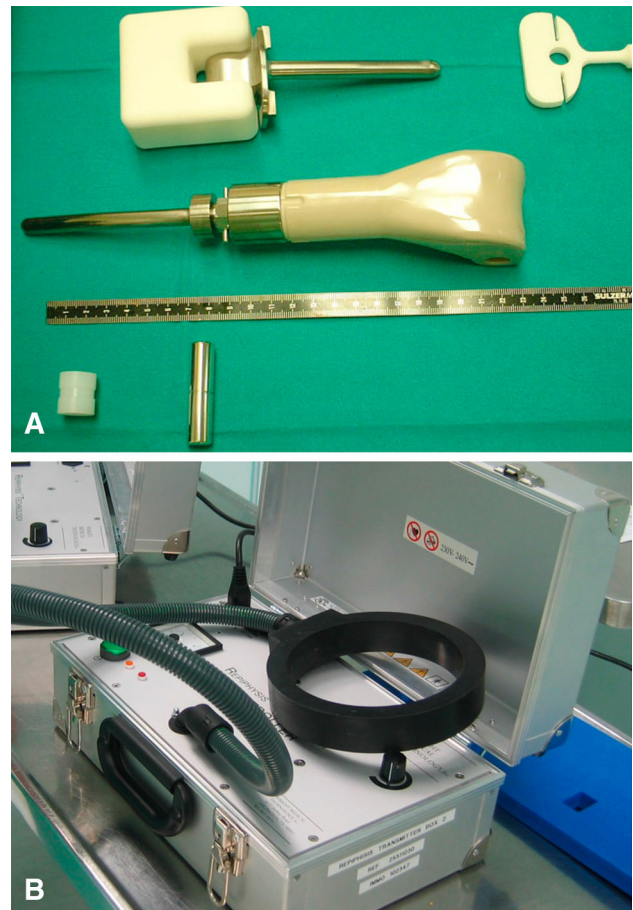

Fig. 1A–B (**A**) The Repiphysis® prosthesis and (**B**) the generator of the external electromagnetic field are shown.

and Ness et al. [18]. The maximum expansion capacity of the prosthesis depends on the length of the prosthesis, and indirectly, on the length of the resected bone. According to oncologic principles, the resection level was at least 2 cm proximal to the tumor extension, as measured on preoperative MR images. The custom-designed prosthesis was usually between 0.5 and 1 cm longer than the planned distal femoral resection segment to gain some initial lengthening at the time of reconstruction. In this series the prosthesis varied in length from 126 mm to 202 mm, with a lengthening capacity ranging from 3.5 cm to 11 cm.

All study patients underwent distal femur resections for bone sarcomas, according to oncologic principles, and wide surgical margins were achieved in all cases. Cement was used to fix the stem of the femoral component in all but one patient. In this patient's reconstruction surgery, a plasma-coated, uncemented stem was inserted in the femoral canal; with the records available in this retrospective study, we were unable to ascertain why this approach was chosen for this patient. In all cases, the proximal tibia was shaved minimally and the stem was

Table 1. Patient data

Patient number	Age, (years)/sex	Oncologic outcome	Followup (months)	Revision surgery/explantation Repiphysis	Time to revision (months)	Reason for revision	MSTS at revision surgery (%)
1	9/M	CDF	140	Expandable	49	Breakage	47
2	11/M	DOD	20				
3	8/F	DOD	11	AKA		LR	
4	9/F	CDF	126	Adult type	79	Breakage	47
5	8/M	CDF	101	Expandable	55	Loosening	87
6	11/M	DOD	28	AKA		LR	
7	8/M	CDF	114	Expandable, bone	67	Breakage	77
8	7/M	CDF	110	Expandable, bone	48	Breakage	63
9	9/F	NED	100	Adult type, bone	71	Breakage	77
10	7/F	CDF	96				
11	6/M	CDF	96	Expandable	61	Breakage	50
12	9/M	DTOX	2				
13	9/M	DOD	28	Cement spacer	8	Infection	
14	8/F	CDF	81	Adult type, bone	56	Breakage	57
15	7/F	CDF	78	Expandable, bone	76	Breakage	73

CDF = continuously disease free; NED = no evidence of disease; DTOX = dead due to chemotherapy toxicity; DOD = dead of disease; Expandable = revision with another type of expandable prosthesis; Adult type = revision with a modular conventional megaprosthesis; AKA = above knee amputation; LR = local recurrence; bone = segmental massive bone allograft; MSTS = Musculoskeletal Tumor Society functional score.

inserted in a press-fit manner to cause the least possible damage to the proximal tibial growth plate, as it maintains growth at the level the proximal tibial physis [8, 17]. Postoperatively, the patients were instructed to immediately bear weight as tolerated but to refrain from impact activities.

We retrospectively studied the medical records for clinical details (including age, sex, weight, tumor site, diagnosis, and resection length), and implant characteristics (implant length, stem diameter, stem length, expansion capacity). Furthermore, we analyzed clinical, radiographic, and oncologic outcomes. Functional results were assessed in patients who had survived their disease at final followup, according to the MSTS scoring system [7]. We focused specifically on implant survival, complications, limb-length discrepancy, lengthening procedures, and revision surgery. Complications were classified according to the International Society of Limb Salvage (ISOLS) classification system [13].

Results

Nine of 10 patients underwent revision of their prosthesis for mechanical failure. Before revision these nine patients had a mean MSTS score of 64% (range, 47%–87%). At final followup, the 10 long-term surviving patients had an

average MSTS score of 81% (range, 53%–97%). We then focused our review of patient data on implant survival and revision surgery (Table 1).

The first seven lengthening procedures (in three patients) were attempted in an outpatient setting with the patients receiving no anesthesia. However, these procedures were unsatisfactory because of the difficulties for patients who reported sudden pain and burning sensations during lengthening. Moreover, it became clear that without complete muscle relaxation, only limited lengthening was achievable. The following 39 lengthening procedures were performed with the patients under general anesthesia on a day-hospital basis (Fig. 2). In all procedures, the manufacturer guidelines for the prosthesis were observed and instructions for the duration of each lengthening session were strictly followed. A total lengthening of 390 mm was obtained in 46 lengthening sessions which means an average lengthening of 39 mm per patient (range, 17–67 mm) (Table 2). Although the procedures were performed in a standardized manner, great variability of expansion ranging from 0 to 20 mm was observed. Postlengthening inflammation of the thigh with pain, stiffness, febrile responses, and radiographic appearance of a radiolucent layer around the prosthetic body (Fig. 3) were observed in six patients and became a consistent set of findings after their third lengthening procedure. Their temperature varied

Fig. 2A–C (**A**) A plain radiograph of the Repiphysis® distal femoral prosthesis before lengthening is shown. (**B**) Application of the external electromagnetic field with the patient under general anesthesia and (**C**) fluoroscopic control of the lengthening procedure are shown.

between 38° and 39° Celsius and disappeared spontaneously within 3 days without antibiotic treatment.

Nine patients had clinical and radiographic signs of implant failure (metallic debris in the soft tissues, progressive stem loosening, breakage of the spring, or implant instability) and underwent complete revision of the primary implant at a mean of 62 months (range, 48–79 months) after the index procedure. In all but one case, the femoral stem was revised with a noncemented stem, which fits either an expandable or modular adult-type prosthesis of the implant system we have most experience with in our department. In the remaining case, a custom-made expandable prosthesis of a different system was manufactured to fit a well-fixed cemented stem from the Repiphysis® implant.

The most common cause of revision was spring breakage (eight patients [89%]), an ISOLS type 3A complication. A consistent finding during revision surgery

was the presence of extensive metallosis with a dark greenish-gray pseudocapsule surrounding the prosthesis (Fig. 4). One patient underwent revision surgery for aseptic femoral stem loosening after 55 months, which is considered an ISOLS type 2B complication. In five cases during revision surgery, a segmental allograft was used around the residual host bone-stem interface to compensate for lost bone stock in the short residual proximal femur segment and to improve the femoral stem fixation (Fig. 5).

The five male patients who needed revision surgery for implant failure were still skeletally immature (11–13 years old) at the time of the revision surgery. Their implants were revised with other types of expandable megaprostheses (Fig. 6). Four had their implants revised to an expandable prosthesis that can be lengthened through a small incision, and one had a prosthesis implanted that can be lengthened without surgery through application of an electromagnetic field. Three of these patients required further implant

Table 2. Followup data for the patients

Patient number	Age (years)/ sex	Total lengthening	Revision of Repiphysis®	Further revisions (months from Repiphysis® revision)	Final limb length discrepancy	MSTS at final followup (months)
1	9/M	17 mm	Expandable	Adult type (95)	−1.5 cm	16
2	11/M*					
3	8/F*					
4	9/F	31 mm	Adult type		−3 cm	26
5	8/M	48 mm	Expandable	DAIR for infection (9)	0 cm	27
6	11/M*					
7	8/M	43 mm	Expandable, bone		−1.5 cm	23
8	7/M	67 mm	Expandable, bone	Expandable (26), adult type (62)	−2 cm (EPD)	22
9	9/F	31 mm	Adult type, bone		−1 cm	26
10	7/F	23 mm			−3.5 cm	
11	6/M	40 mm	Noninvasive expand		−2.5 cm	26
12	9/M*					
13	9/M*		Cement spacer			
14	8/F	50 mm	Adult type, bone		0 cm	29
15	7/F	40 mm	Expandable, bone	Expandable	−3 cm	23

Expandable = mini-invasive mechanically expandable prosthesis; Noninvasive expand = noninvasive expandable prosthesis; bone = segmental massive bone allograft; DAIR = débridement, antibiotics, and implant retention; EPD = epiphysiodesis; MSTS = Musculoskeletal Tumor Society; *= did not undergo lengthening.

revision and their final limb length discrepancy ranged from 1.5 to 2.5 cm. Three female patients (13–15 years old at revision surgery) underwent revision surgery with implantation of an adult-type megaprosthesis and had a final limb length discrepancy ranging from 0 to 3.5 cm. Another female patient (13 years old) with 5-cm limb shortening at the time of revision surgery had implantation of a mini-invasive expandable prosthesis. In one patient, a contralateral epiphysiodesis of the distal femur and proximal tibia was performed to avoid progression of the limb length discrepancy.

Discussion

Limb-salvage surgery in skeletally immature children is a challenging problem for orthopaedic surgeons because of the need to create a functional and durable reconstruction, minimize postsurgical complications, and address the problem of potential limb length discrepancy [24]. The introduction of less-invasive expandable prostheses is purported to allow for implant expansion without further surgical interventions and without use of general anesthesia, making this type of reconstruction increasingly popular in the treatment of skeletally immature children with malignant bone tumors of the extremities [6, 11, 12, 15, 17, 26, 27]. However, we found that use of a particular expandable prosthesis was associated with many complications, resulting in failure of the prosthesis, inability to achieve

Fig. 3 A plain radiograph shows an inflammatory reaction, 24 hours after a lengthening procedure. The patient presented with thigh pain, fever, and swelling around the implant. A radiolucency is visible around the prosthetic body. The symptoms regressed spontaneously in the following 48 hours.
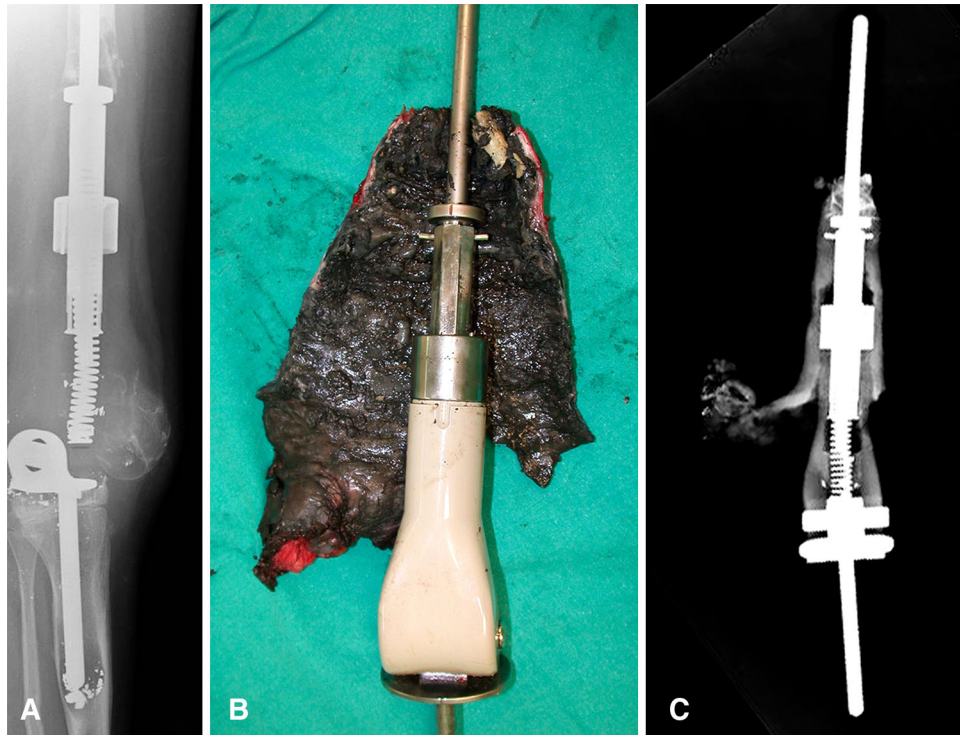
Fig. 4A–C (**A**) The radiograph shows signs of implant failure including metallic debris in the soft tissues and breakage of the spring. (**B**) The explanted prosthesis shows the periprosthetic membrane with extensive metallosis and a dark greenish-gray pseudocapsule. (**C**) The radiograph shows the removed implant at revision surgery.

lengthening, and the need for surgical interventions and revisions.

There are limitations to our study. Five of our patients died within short followup, so only 10 patients are included in our study. However, findings from the 10 patients were sufficiently concerning to lead us to recommend against the use of the Repiphysis® prosthesis. Other limitations included possible selection bias of cases as there are several reconstructive options for the specific reconstruction site in the age group of our patients, all with different surgical techniques, possible complications, rehabilitation programs, costs, and functional goals.

Our series confirms the tendency that with longer followup, the functional results deteriorate, owing to mechanical failure. However, the improved MSTS scores at final followup (on average 81%), compared with scores at revision (average, 64%), show that complex revision surgery can restore function. Our study included 10 patients with a mean age of 8 years and a minimum followup of 5 years (mean of nearly 9 years). To our knowledge, this study presents the longest followup of the Repiphysis® implant published to date. The Repiphysis® expandable prosthesis was the first noninvasive expandable endoprosthesis commercially available. Originally called the Phenix prosthesis (Phenix Medical, Paris, France), it has been used in Europe since the early 1990s and in the United States since the late 1990s [23]. Early reports showed promising preliminary results [11, 17, 26], with good-to-excellent function and a relatively low complication rate. MSTS scores in the early series with relatively short followup varied from 81.7% to 90% [2, 11, 17, 18, 22], but in the only previous series with an average followup of more than 6 years, the final MSTS score was on average 67% [4] (Table 3).

With respect to lengthening of the device, our study revealed a complication of the prosthesis that to our knowledge has not been previously reported. The Repiphysis® expandable prosthesis failed to expand for us as stated by the manufacturer, therefore only partially maintaining the noninvasiveness. Owing to pain and burning sensations the patients felt around the implant during the lengthening procedures, these had to be performed with the patients receiving general anesthesia. This has not been reported in previous studies of this implant. Wilkins and Souberain [26] mentioned very mild discomfort during the lengthening procedures which could be managed with oral analgesics. Patient age could partially explain the difficulties in pain management with our patients. Our patients were younger, with a mean age of 8 years at index surgery, whereas in other series the patients were older than 10 years [2, 4, 11, 18, 22]. Furthermore, the amount of lengthening was unpredictable and difficult to control. We
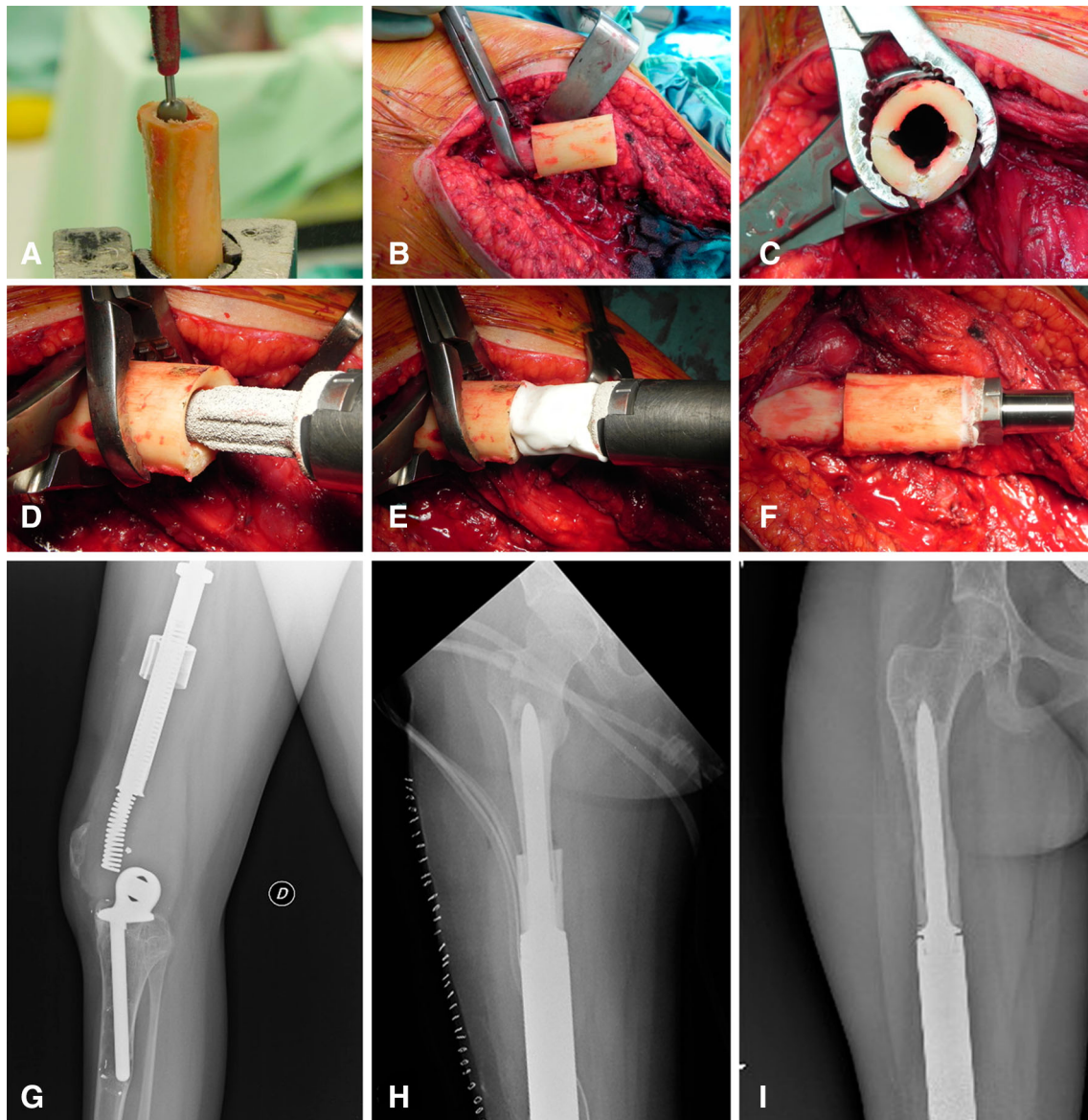
Fig. 5A–I The intraoperative photographs show (**A**) preparation of the segmental cortical allograft; (**B**) application of the allograft to the host bone; (**C**) preparation of the stem wings distally in the segmental cortical allograft; (**D**) stem introduction; (**E**) the distal part of the stem with a thin mantle of cement, just before complete introduction; and (**F**) final stem placement. The plain radiographs show (**G**) the prosthesis before revision, (**H**) immediately postoperative, and (**I**) 40 months after revision surgery.

performed 46 expansions in 10 patients, with an average of 8.4 mm per expansion. However, we observed gradual reduction of lengthening capacity. Generally, after the first three lengthening procedures of each prosthesis, the same exposure time to the electromagnetic field led to less lengthening. This might be related partially to the compressed spring, which as it gradually gets released, loses stored energy and expansion capacity. In addition, the increasing resistance of a thick fibrotic tissue around the implant, as seen in all revision surgeries, might influence the lengthening capacity. Although the problem of metallosis and periprosthetic fibrosis has been reported [3, 4], the

difficulties controlling the amount of lengthening has not been addressed. Gitelis et al. [11] reported one case of failure to lengthen. Another potential disadvantage of this implant is that there is no possibility to reverse the lengthening achieved in case of overlengthening. We have not experienced overlengthening in our patients, but there is a potential risk for nerve damage through stretching if this happens accidentally, which cannot be resolved easily by shortening the implant.

Nine of 10 long-surviving patients underwent revision surgery of the implant, all but one because of mechanical failure of the implant. All revision surgeries were
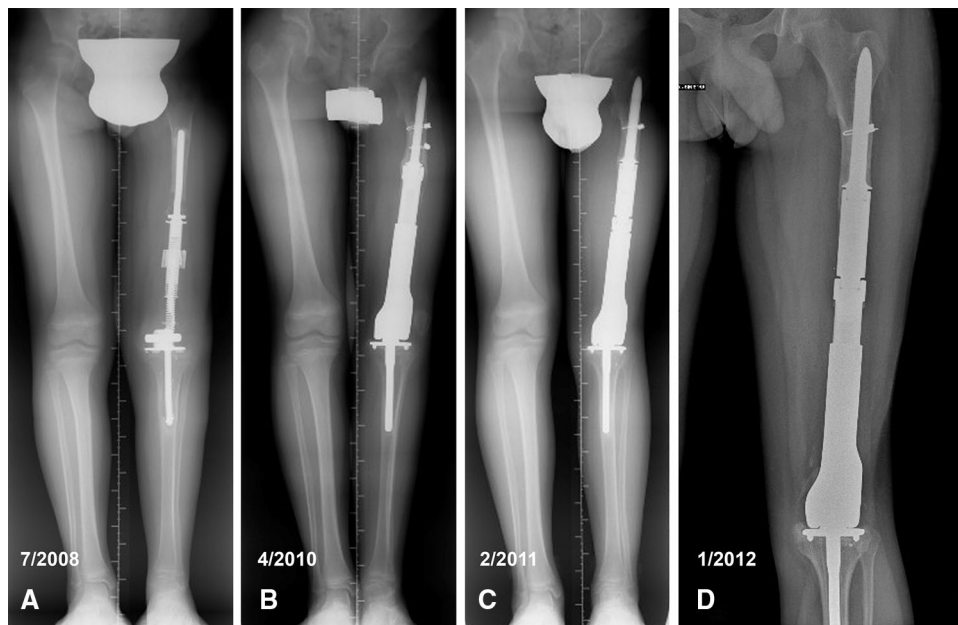
Fig. 6A–D Sequential radiographs show (**A**) spring breakage of the Repiphysis® prosthesis in 2008, followed by (**B**) revision surgery in 2010 with another type of expandable prosthesis, and radiographic controls after expanding the new prosthesis in (**C**) 2011 and (**D**) 2012.

Table 3. Summary of literature on outcomes of Repiphysis® expandable prosthesis

Study	Number of patients	Followup (months)	Cases revised (%)	MSTS scores (%)
Wilkins & Souberain [26]	6	14	2/7 (29)	NA
Neel et al. [17]	15	21.5	8/15 (53)	90
Gitelis et al. [11]	16	24.8	7/16 (44)	83.5
Beebe et al. [2]	12	38	7/12 (58)	81.7
Ness et al. [18]	13	46	6/13 (46)	73
Saghieh et al. [22]	12	61.7	7/12 (58)	90
Cipriano et al. [4]	10	72	8/10 (80)	67
Current study	10	104	9/10 (90)	81

MSTS = Musculoskeletal Tumor Society; NA = Not available.

performed between 4 and 7 years after implantation of the prosthesis. The relatively early failures, before obtaining complete lengthening, and generally before the patients reached skeletal maturity, led to the need for revision with a second expandable implant in six patients. It was possible to revise the implant with an adult-type megaprosthesis in only three female patients. The most common complications of the Repiphysis® expandable implant have been reported [3, 4, 16, 22]. Infection, spring breakage, aseptic loosening, and fracture are well-recognized problems that often lead to revision of the implant, and with longer followup the percentage of revision surgeries seems to increase. In our study, one implant was removed for early postoperative infection and one implant was revised because of aseptic loosening. However, the most frequent reason for revision was prosthetic failure attributable to

spring breakage (eight cases). Younger patient age and longer followup in our current series compared with previous studies [2, 11, 17, 22] might have influenced the results. Longer followup obviously exposes the implant to more risks of failure. Younger age at index surgery could influence the results through less compliance by the patient and a relatively more pronounced change of body weight and length. In addition, the biologic properties of bone (such as elasticity, bone turnover, tendency for stress shielding) are age dependent.

Cipriano et al. [4] stressed that extensive loss of bone stock in the metadiaphyseal area was frequent and an important complication of the implant. The bone loss might be attributable to extensive stress shielding of a cemented stem in young patients with high bone remodeling. Metal and polyethylene debris associated with high wear of the

implant material might play a role in osteolytic processes resulting in stem loosening and bone loss, both of which increase the complexity of future operations. The manufacturer of the Repiphysis® implant suggests using cement for the femoral stem fixation [20] which can lead to more bone loss and the need for revision surgery. A well-fixed stem could be left in place and used to attach another implant, but this requires a custom-made adapter with the Repiphysis®, thereby increasing the costs and complexity of this relatively expensive implant system. In the series of Cipriano et al. [4], two patients had to be undergo revision surgery with a total femoral replacement owing to extensive bone loss. We noticed similar loss of bone stock. We could avoid implanting total femoral replacements, but we used segmental allografts in five cases to achieve good proximal stem fixation of the revision implant and avoid use of an adapter component or total femoral implant.

In our series, the Repiphysis® prosthesis was associated with frequent failures and problems during lengthening procedures. Although lengthenings in our patients were in the range of values reported by others [2, 4, 11, 22], the majority of our procedures were painful for the patients if anesthesia was not used. We also were not able to control the amount of expansion during each lengthening procedure and the amount of expansion tended to decrease with time. We confirm that the implant showed unacceptable fragility and mechanical failure before obtaining the complete limb lengthening expected, with the need for revision with a second expandable implant. Furthermore, revision was a complex and difficult procedure although the functional results for our patients were improved. We have not used the Repiphysis® prosthesis since 2008 and have been using another type of expandable implant. Based on our findings and those of others [3, 4, 16], we caution against the use of this particular prosthesis.

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