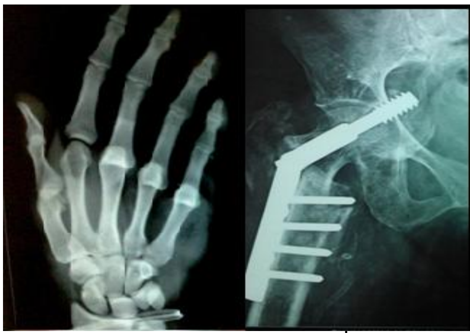

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Comparision of knee range of movement by using static verses dynamic spacer in total knee infection

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Abstract
Introduction: Prosthetic joint infections (PJIs) of total knee arthroplasty (TKA) are the one of the most dreaded complications resulting from TKA. Although different methods of treatment protocols are followed around the world, a two staged exchange arthroplasty is the considered gold standard for PJI's. The purpose of the present study was to determine the recovery of knee ROM in patients undergoing two stage revision total knee arthroplasty with either dynamic or static antibiotic loaded cement spacers.
Methods: This was a retrospective case series performed between 2016 and 2019, Patients with a documented TKA infection that under-went a two-stage revision of both the femoral and tibial component of their TKA were included into the study. A total number of 44 patients who were treated with a spacer made of antibiotic-loaded acrylic cement were included. Twenty two patients were treated with temporary static spacer and 22 patients were treated with dynamic spacers.
Results: At 6 months post operative visit, none of the patients had a recurrence in infection. Knee flexion was higher in dynamic spacer group at 2 week, 3 months and 6 months during the post operative period when compared to static spacer group the operation time of revision implantation was also shorter for dynamic spacer group.
Conclusion: Our study results suggest that patients treated with dynamic spacer had a faster recovery in terms of range of motion of the knee, and shorter operating time for reimplantation. Our results support the use of dynamic spacers in an infected TKA that are treated with two-stage revision of arthroplasty.

Keywords: Knee range, verses dynamic spacer, knee infection

Introduction
Prosthetic joint infections (PJIs) of total knee arthroplasty (TKA) are the one of the most dreaded complication resulting from TKA. Their incidence is approximately 1.5 – 2.5% and is associated with severe morbidity, mortality of approximately 2.5% and increase in cost of expenditure [1, 12, 14]. Although different methods of treatment protocols are followed around the world, a two staged exchange arthroplasty is the considered gold standard for PJI's. The protocol consists of removing components, debridement and placement of antibiotic impregnated cement with administration of culture sensitive antibiotics. Revision arthroplasty is then performed once infection is eradicated [5, 16].
While there have been few reports of immediate re-implantation that were successful, desirable results were often seen when revision arthroplasty was delayed by a minimum period of six weeks with rates of control of infection over 90% - 96% [2, 4, 8]. The major disadvantage in two-stage revision arthroplasty is that the period between procedures is often associated with decrease mobility, instability of the joint, and pain. Re-implantation is often difficult because of arthrofibrosis. Approximately 25% of patients have a less than desirable result owing to delay between the procedures [3, 6, 9, 13].
To overcome the above mentioned difficulties, temporary joint spacers have been introduced. Antibiotic impregnated static spacer block technique has been used. The static blocks do not allow flexion of the knee between the two stages of surgery resulting in bone loss, muscular atrophy and decreased range of motion post re-implantation [7, 10]. Although many adaptations of temporary spacers have analysed, including different types, shapes and sizes. The purpose

of the study is to compare recovery of range of motion between static and dynamic spacer block. We retrospectively examined a series of patients with periprosthetic infection that were treated with two stage revision surgery.

Materials and Methods

This was a retrospective case series performed between 2016 and 2019, Patients with a documented TKA infection that under-went a two-stage revision of both the femoral and tibial component of their TKA were included into the study. The diagnosis of an infected TKA was based on the clinical presentation, the erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), radiographs, culture and gram staining of the periprosthetic infected tissue.

A total of 49 patients underwent a two-stage revision during period of the study. Six patients were excluded from the study: 2 patients received an arthrodesis and 3 patients were lost to follow up.

This resulted in a total number of 44 patients who were treated with a spacer made of antibiotic-loaded acrylic cement. Twenty two patients were treated with temporary static spacer and 22 patients were dynamic spacers. Figure 1, demonstrates dynamic and static spacer blocks during a 2 staged revision knee arthroplasty.

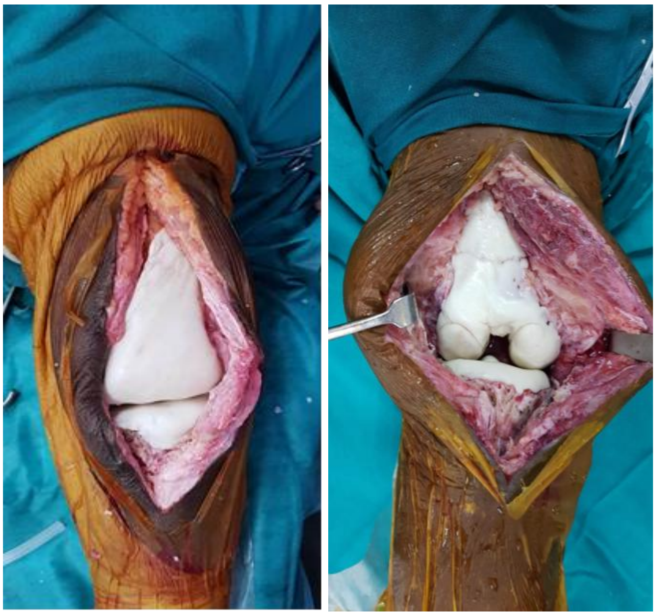

Fig 1: Demonstrates dynamic and static spacer blocks during a 2 staged revision knee arthroplasty

Operating Procedure

All revisions were performed by, or under supervision of the same surgeon. The procedures included 1) removal of femoral and tibial component along with poly and implantation of the antibiotic loaded temporary spacer, 2) treatment with antibiotics from culture and sensitivity report, and 3) removal of temporary spacer and revision TKA with a new implant. The temporary spacer was either a static spacer or a dynamic spacer moulded to the joint cavity. The antibiotic cement used for the spacer block contained Gentamicin 1g and Vancomycin 2g was added on custom basis. A mould was used for femoral and tibial components. A second stage surgery was performed only three weeks after three knee aspirations tested negative for any organism.

Rehabilitation

After the component removal and placement of temporary spacer, patients were advised to mobilize from the second post-operative day under the care of a physiotherapist. For patients with temporary static spacer blocks, cast or long knee immobilizers were advised to avoid knee motion and were allowed to bear weight as tolerated, but were also advised to range of motion exercises while non weight bearing. Intravenous and oral antibiotics were administered for 3 weeks and 3 weeks respectively depending on the sensitivity of the infective organism.

After re-implantation with new prostheses, static spacer group were allowed full weight bearing mobilization in a long knee brace to avoid knee flexion, where as the dynamic spacer group were allowed full bodyweight bearing with knee mobilisation using walker frame support. Passive ROM exercises were performed using and CPM machine.

Clinical assessment

Both groups were evaluated at 2 weeks, 3 months and 6 months post-operatively after re-implantation of new prosthesis. During the follow up, range of motion was measured using standard goniometer against anatomical landmarks.

Other surgery related parameters such as bone loss, ligament status, duration of surgery and type of the implantation spacer were obtained and collected.

Statistical analysis

Statistical analysis was performed using SPSS 24.0 (SPSS Inc., Chicago, Illinois, USA). Baseline demographics were compared using unpaired t-test. The chi-square test was used to compare differences in percentages between the groups. Non-parametric tests were used for data that did not follow a normal distribution. The range of motion across static and dynamic spacers was analysed using a 2-way ANOVA. A p-value of less than 0.05 was considered statistically significant.

Results

Both the groups were similar in demographic parameters baseline. Age across both the groups was similar ($p = 0.12$). The duration of temporary spacer being in-situ was 18 weeks for (range 13-37) for static spacer and 20 weeks for dynamic spacer (range 14-40) (Table 1).

Table 1: Patient Characteristics

		Static Spacer (n=22)	Dynamic Spacer (n=22)	p-value
Age		62 ± 13	58 ± 11	0.65
Gender (male/female)		14/8	10/12	0.15
Primary Diagnosis	OA	18	15	
	RA	2	3	
	Secondary OA	2	4	
TKA in situ (years)		4.6 ± 1.2	4.8 ± 3.4	0.36
Temporary spacer in situ (weeks)		16.3 ± 4.2	18.5 ± 2.1	0.43
Operation time	Spacer	104 ± 21	98 ± 25	0.64
	Revision TKA	173 ± 33	143 ± 32	0.001

Recovery of knee range of motion

No statistically significant difference was found in ROM between the groups preoperatively (p=0.25). At 2 weeks, 3 and 6 months post-operative, the knee ROM of patients with dynamic spacers was significantly higher compared to static spacer (*p*< 0.05) (Table II). The ROM of both groups increased significantly following revision implantation with new prostheses. The recovery of knee ROM across groups was lower in group with static spacer than dynamic spacer (ANOVA, p = 0.04). Shown in figure 2.

During removal of components and placement of a temporary spacer, no osteotomy of tibia tuberosity was done in either group. During revision implantation, an osteotomy of tibial tuberosity was performed in 2 patients in static spacer group and in 3 patients in dynamic spacer group (p=0.88). The duration of surgery was comparable during primary surgery (p=0.69). The duration of surgery during the revision implantation was significantly shorter in dynamic spacer group (p = 0.007).

No patients in both the groups tested positive for presence of infection after revision implantation at 6 months follow up. At the time of removal of primary components and placement of spacer, 13 patients and 11 patients had culture positive infection in static and dynamic spacer groups respectively. In all cases, clinical signs of infection were present.

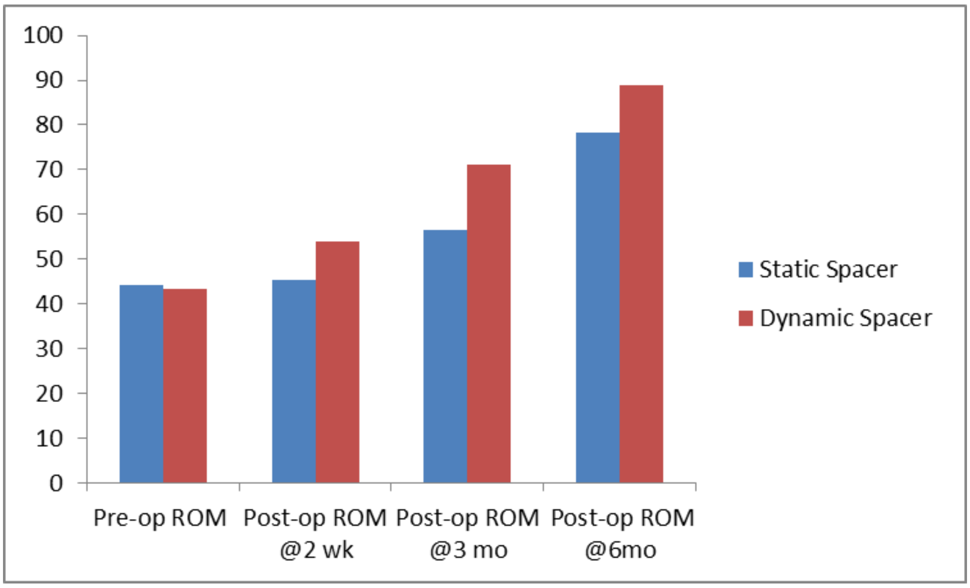

Fig 2: Bar chart showing recovery of ROM

Table 2: Recovery of Range of motion

		Static Spacer (n=22)	**Dynamic Spacer**	**p – value**
Preoperative ROM		44.2 ± 16.4	43.4 ± 7.6	0.45
ROM after revision TKA	2 weeks	45.3 ± 8.1	54 ± 11.6	0.07
	3 months	56.4 ± 14.5	71 ± 12.6	0.01
	6 months	78.2 ± 16.7	89 ± 17.9	0.01

Discussion

The purpose of the present study was to determine the recovery of knee ROM in patients undergoing two stage revision total knee arthroplasty with either dynamic or static antibiotic loaded cement spacers. Our results indicated that dynamic spacers have a greater recovery of ROM at 2 weeks, 3 and 6 months post-operatively.

Control of infection was similar in both the procedures. At 6 months postoperative follow-up none of the patients had signs of recurrent infection. Our results suggested that both static and dynamic antibiotic impregnated spacers are equally effective in successful treatment of an infected TKA, similar to findings from earlier studies [10, 11, 15].

The operating time during the revision implantation was significantly shorter in group treated with dynamic spacers. We attribute this to lower scar tissue adhesions and limited soft tissue contraction.

The patients who had tibial tuberosity osteotomies, both in static and dynamic spacer group. As tibial tuberosity osteotomy is associated with immobilization in long knee brace. Still, patients who underwent dynamic spacer had greater recovery of ROM.

The dynamic spacer appeared to better in view of rehabilitation. The ROM was better than the static spacer group during any postoperative visits. At 6 month follow-up visit mean knee ROM was 90^0 in dynamic spacer group. The mean knee ROM in static spacer group was 56^0 and 78^0 during 3 and 6 months postoperative visits. With 90^0 knee flexion patient will be able to perform various daily activities like sitting in a chair, walking and climbing a flight of stairs.

The main limitation of our study is the small sample size. Our department has shifted to use of dynamic spacers in 2018.

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