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Revision Total Knee Arthroplasty for Bone Loss Choosing the Right Degree of Constraint

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ORIGINAL ARTICLE

Revision Total Knee Arthroplasty for Bone Loss Choosing the Right Degree of Constraint

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Abstract

Background: ***The number of revision total knee arthroplasties (TKAs) is increasing due to the prevalence of primary TKAs.***

Aim: ***To evaluate the early results of revision knee arthroplasty for different types of bone loss using constraint knee prostheses.***

Methods: ***This prospective study was carried out on 30 patients aged 18 years or older, both sexes, with type 2 and type 3 bone loss. Patients were divided into two groups: Group 1 (n=21) who had type 2 bone loss, and group 2 (n=9) who had type 3 bone loss. The study was done after approval from the Ethical Committee Al-Azhar university hospitals from March 2021 to May 2024.***

Results: ***There were strong significant correlations between Outcomes and Pre Knee Society score (KSS), Pre (SF-36) score and Pre-Western Ontario and McMaster Universities Osteoarthritis (WOMAC). In Univariate and multivariate correlation regression, there were strong significant correlations between outcomes and Pre KSS, Pre short form (SF)-36 score and Pre WOMAC (P<0.0001).***

Conclusions: ***The prostheses with a lower degree of constraint provide more superior functional outcome. The only exception is that patients undergoing revision arthroplasty for infection who have type II or III bone defect may benefit from the use of linked constraint prosthesis.***

Keywords: Total Knee Arthroplasties; Bone Loss; Constrained Condylar Knee; Anderson Orthopaedic Research Institute

1. Introduction

As a result of the increased incidence of primary total knee arthroplasties (TKAs), revision total knee arthroplasties (rTKAs) are on the rise .[1]. Compared to TKAs, rTKAs are more complicated due to the additional bone loss that compromises the stability of the implant .[2] Periprosthetic infection, implant loosening, wear and osteolysis, periprosthetic fracture, or damage during primary implant removal all contribute to bone loss in TKA .[3]

In order to achieve successful total keratoplasty (TKA), it is imperative to take into account various factors. These include meticulous preoperative planning, precise evaluation of the host bone quality and defect characteristics (including location and type), selection of the primary component and the level of ease or difficulty associated with its removal, surgical approach, joint line restoration and alignment, degree of constraint required to ensure a stable construct and capability to fix durable components, and ultimately, the maintenance of an infection-free environment .[4]

Bone loss determines which management strategies are applied to each type of bone defect. Classifications systems one of the most used and best quantitative classification systems is that of the Anderson Orthopaedic Research Institute (AORI); this provides the location and size of the defect as well as treatment recommendations for each individual defect. This categorization is determined by the state of the metaphyseal component of the bone. Three categories are included in this classification. In a Type 1 defect, the metaphyseal bone is whole, with the exception of minor cystic lesions in cancellous bone and intact cortical bone near the original joint line, without affecting the component stability. [5]

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A Type 2A defect is characterized by cancellous metaphyseal bone loss in both femoral condyles and/or the entire tibial plateau, whereas a Type 2B defect involves damaged metaphyseal bone in one condyle or hemi-plateau. A Type 3 defect is characterized by inadequate loss of femoral and/or tibial metaphyseal bone, potentially resulting in harm to the attachments of the collateral ligaments and patellar tendon .[5]

The condition of collateral ligaments and the extent of bone loss influence constraint selection.[6] Primary posterior-stabilized designs may be utilized in cases where minimal bone defects and intact ligaments are present.[6] Conversely, when ligaments are absent or disrupted, and there is moderate to severe bone loss, hinged prostheses become indispensable .[7] Condylar-constrained knee (CCK) prostheses are nonhinged, semi-constrained implants that serve as a superior substitute for hinged prostheses in cases of moderate severity characterized by moderate bone loss and ligament insufficiency (though not absence) .[8]

This study was conducted with the aim of assessing the initial outcomes of revision knee arthroplasty utilizing constraint knee prostheses for different types of bone loss.

2. Patients and methods

This prospective study was carried out on 30 patients aged 18 years or older, both sexes, with type 2 and type 3 bone loss.

Family members or the patient themselves gave written informed consent. The study was conducted with ethical committee approval Al-Azhar university hospitals from March 2021 to May 2024.

Exclusion criteria were primary TKA, type 1 bone loss, non-constraint prostheses, metabolic bone disease, active infection, multiple revision, and local tumours.

The patients were categorized into two groups: Group 1 (n=21) who had type 2 bone loss, and group 2 (n=9) who had type 3 bone loss.

All patients were undergone: detailed history and a full physical examination [Pain (severity of Pain, analgesic regime, activity related Pain, and presence of night pain, Pain evaluated preoperative by: Pain according to visual analogue scale (VAS Score), Knee society score (KSS) and Short Form-36 Quality of Life system (SF-36) score, and Western Ontario and McMaster Universities Osteoarthritis (WOMAC) score), disability and impaired function (Pain and loss of movement, and difficulty walking, stair ascending capability and use of ambulatory aids), details of the previous surgery (Etiology of primary total knee, timing of surgery, and any reported complication), general condition was taken in full details with special attention (Chest diseases, cardiac diseases or previous admission in coronary care unit,peripheral vascular diseases: ischemia, previous history of deep venous thrombosis, claudication pains, systemic diseases: diabetes mellitus, hypertension, 2 patients (10%) were hypertensive, 4 patients (20%) were diabetic and hypertensive while the remaining 14 patients (70%) were free from co – morbidities, and any suspicion of infection], physical examination [General assessment (cardiovascular examination, blood pressure, chest examination, abdominal examination, and hip and spine examination), and complete local examination (Deformity, state of skin condition and site of previous scar, instability, motion range, and comprehensive neurovascular evaluation of the impacted leg)], and radiological examination and planning: Long film weight-bearing A-P, and lateral radiographs, routine investigations: complete blood picture, and special investigations: Doppler U/S for vascular disease and echocardiography for cardiac patients.

Preoperative preparation:

One hour prior to the operation, prophylactic antibiotics were administered to all patients. Decreased molecular mass Heparin was consistently administered as a preventive measure against deep vein thrombosis.; it was usually stopped 12 hours before the operation and continued for thirty-five days postoperative (40 I.U. once daily or every 12h if the patient had a risk factor for DVT as varicosities or obesity). The affected limb was prepped with Betadine on the night of surgery.

Operative technique:

Epidural anaesthesia was used in all patients. A urinary catheter was inserted during the initial forty-eight hours to facilitate the patient's comfort and to collect urine for the purpose of measuring urinary output. A limited the number of participants were present in the operating room. Traffic in and out of the theatre was minimized as possible. A tourniquet (400 mmHg) was utilized in every case. Disposable sterile draping was utilized frequently. Foot and side stopper fixed to the table.

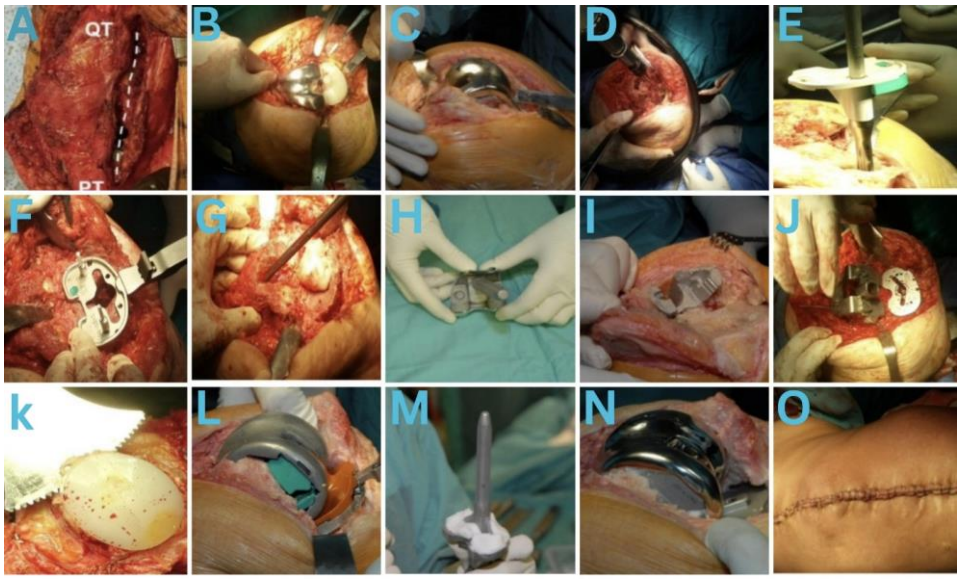

Figure 1: (A) Medial para-patellar arthrotomy, (B) removal of PE insert, (C) removal of the femoral component, (D) tibial preparation, (E) tibial trial with augment, (F) determining tibial rotation, (G) femoral preparation, (H) femoral component with augment, (I) Inserted femoral cone, (J) femoral box preparation, (K) patellar preparation, (L) trial reduction, (M) hybrid cementation of prostheses, (N) final protheses with augment (O), and closure of the skin by staples

The surgical technique:

Midline skin incision on the old scar was used in all cases. Deep approach: The medial para-patellar arthrotomy was the main approach. Figure 1A Removal of PE inserts: to facilitate the exposure of the femoral component. Figure 1B Removal of the femoral component: In revision cases due to loosening or infection, removal of the component is easy. In cases in which the component is well fixed to the bone (e.g. instability), removal is difficult and needs small sharp osteotomies, such as a Gigli saw and electric saw, to preserve as much bone as possible. Figure 1C Tibial components were removed. Tibial medullary canal preparation: After removing the tibial component, we removed any cement and other debris. The tibial canal was prepared using reamers of gradually increasing sizes (starting with 9 mm diameter) till cortical sensation was achieved. Figure 1D The optimal sizing of the tibial component was determined by the sizing tray. Non-contained defects were treated with modular wedges and blocks until circumferential contact was maintained between the augmented trial tibial baseplate and the tibial cortex. Figure 1E trial components were inserted for assessment of size, fitting, position, and rotation of the prosthesis. The rotational alignment of the tibial tray was ascertained by cauterizing the medial third of the tubercle of the tibia. The tibial component axis they should be parallel to this axis to avoid internal rotation. Combined intra and extramedullary instrumentations were used to check (double-check) the rotation of the tibial components. Another method used to check rotation was the matching of the tibial tray curve and plateau curve. Figure 1F

Femoral medullary canal preparation: After removal of the femoral component, cement and debris, gradual reaming to the canal was done by beginning with a 9mm reamer and gradually increasing in size till cortical sensation was achieved. Eccentric reaming was avoided. To ensure a 6˚ valgus angle, we attached the Standard Revision Cut Block to the Revision IM Guide, then a Straight Stem Extension Provisional, which corresponds to the diameter of the last reamer (used as a guide). Figure 1G Femoral size was determined. Dealing with femoral bone defects is very important to maintaining normal joint lines, secure fixation of the femoral component, and equality of extension and flexion gap. Using the epicondyles, the attachment points for the collateral ligaments. Additional soft tissue dissection may be required to visualize the epicondylar axis and identify the epicondyles. After establishing proper rotation of the component, a trial femoral component was used with a stem, which is either straight or offset, to ensure the proper position of the component. Establishing flexion and extension gaps and stability: Stability in flexion was (flex gap balancing) according to the situation during balancing. Figure 1H, and I

The femoral box was supported with provisional augments and stemmed to ensure proper positioning. It was then fixed with screws, and the stem removed to make the box bone cut and, if necessary anterior and posterior chamfer. Figure 1J

It was not always necessary to revise the patellar component. A well-fixed component from the same system was left. If the component was loose or incompatible, or there was PE wear in the

button of the patella, it was revised, making sure that there was sufficient bone for the new patellar component. Figure 1K Before the final prosthesis implantation, a trial reduction was performed to determine whole limb alignment, soft tissue balancing, and patellar tracking using the no-thumb method. Figure 1L

The metal augment was securely fixed to the femoral and tibial components by screws. Proper stem position and fixation were ensured. Bone cement was applied to the surface of the tibia, and the undersurface of the tibial component was used to implant the tibial side first; then, the femoral side was implanted in the same manner. PE trial was used to impact the cement and prosthesis, and then the final PE was inserted. Lastly, the patellar component was added. CCK prostheses with long stems that were cemented were utilized in this study. Figure 1M, and N

Closure: Release of the tourniquet before closure for proper haemostasis and insertion of a suction drain was routine in all cases. Meticulous closure of the arthrotomy was performed using tight, interrupted eight-shaped Vicryl 2 sutures. Subcutaneous closure by inverted Vicryl 0 sutures. Closure of the skin by staples. A light dressing of the wound and above-knee elastic stocking or crepe bandage. Figure 1

Postoperative care:

Anticoagulant treatment was continued. I.V. fluids were taken for two days. H2 blockers or proton pump inhibitors were given till discharge, C.B.C, exercises, radiology: Long A-P film [Limb alignment: anatomic tibiofemoral angle, component size, position (mediolateral), inclination (A-P, Varus-Valgus), tibial surface coverage, cementation, metal augment, and ligamentous laxity], and lateral view: Femoral notching, component: size, posterior tibial slope, femoral component flexion-extension, patellar position in relation to the joint line, metal augment, recurvatum-flexion deformity, and skyline views: for patellar tracking.

At three weeks, six weeks, three months, and six months, follow-up appointments were planned.

Statistical analysis

Statistical analysis was done by SPSS v26 (IBM Inc., Armonk, NY, USA). Quantitative variables were presented as mean and standard deviation and compared between the two groups utilizing an unpaired Student's t-test. Qualitative variables were presented as frequency and percentage (%) and were analyzed utilizing the Chi-square test or Fisher's exact test when appropriate. Pearson correlation was done to estimate the degree of correlation between two quantitative variables. Logistic regression was also used to estimate the relationship between a dependent variable and one (univariate) or more independent variables (multivariate). A two-tailed P value < 0.05 was considered statistically significant.

3. Results

Table 1. Patient characteristics and anthropometric data of the studied patients (n = 30)

		TYPE 2 (N=21)	TYPE 3 (N=9)	P VALUE
AGE (YEARS)	Mean ± SD	66.4 ± 5.1	67.1 ± 5.2	0.21
	Median	60	60	
SEX	Male	15 (50%)	4 (13.3%)	0.88
	Female	6 (23.3%)	5 (16.7%)	
WEIGHT (KG)	Mean ± SD	81.1 ± 6.1	81.2 ± 6.2	0.92
	Median	70 (65 - 80)	70 (64 - 82)	
BMI (KG/M^2)	Mean ± SD	27.5± 3.1	27.7± 3.01	0.92
	Median	25	25	

Data are presented as mean ± SD or frequency (%). BMI: Body mass index.

Table 1 shows no significant difference between type 2 and 3 as regard age, gender, weight, or BMI.

There was high improvement in rotatory hinged knee (RHK) in septic condition. There was high improvement in CCK in aseptic condition regarding KSS, SF-36, WOMAC, and VAS score (P <0.05). No significant differences were detected between CCK and RHK regarding infection as a complication and non-progressive radiolucent lines as a radiographic result

Table 2. Comparison between CCK and RHK as regard KSS, SF-36, WOMAC, VAS score, complication, and radiographic results

			CCK	RHK	P VALUE
ASEPTIC					
TYPE 2	KSS	Pre KSS	38 ± 2.8	35 ± 2.5	0.32
		KSS (3 m)	40.8 ± 4	42 ± 7	<0.001*
		KSS (6 m)	41 ± 5	48 ± 7	<0.001*
	SF-36 score	Pre SF-36 score	60 ± 6	58 ± 5	0.71
		SF-36 score (3 m)	40 ± 5	35 ± 3	0.01*
		SF-36 score (6 m)	37 ± 2	32 ± 1	<0.001*
	WOMAC score	Pre WOMAC	19.0 ± 1.1	22.1 ± 1.4	0.71
		WOMAC (3 m)	19.5 ± 1.8	24.5 ± 2.1	0.01*
		WOMAC (6 m)	20.4 ± 2.01	27.5 ± 3.1	<0.001*
	VAS score	Pre VAS	55.0 ± 7.1	54.9± 7.43	0.71
		VAS (3 m)	31.0 ± 2.2	33.2± 4.9	0.01*
		VAS (6 m)	17.0 ± 2.2	18.2± 3.9	<0.001*
TYPE 3	KSS	Pre KSS	37 ± 3	36 ± 2.7	0.45
		KSS (3 m)	41 ± 5	40 ± 2	<0.001*
		KSS (6 m)	42 ± 8	41 ± 4	<0.001*
	SF-36 score	Pre SF-36 score	61 ± 6	59 ± 5	0.71
		SF-36 score (3 m)	41 ± 5	40± 4	0.55
		SF-36 score (6 m)	37 ± 1.5	36 ± 2	0.61
	WOMAC score	Pre WOMAC	21 ± 1.8	22± 1.9	0.71
		WOMAC (3 m)	19 ± 1.5	24± 3.5	0.01*
		WOMAC (6 m)	15 ± 1	24 ± 3	<0.001*
	VAS score	Pre VAS	60.1 ± 8.2	60.9± 8.22	0.71
		VAS (3 m)	41.0 ± 4.5	42.4± 6.1	0.01*
		VAS (6 m)	27.1 ± 2.5	30.2± 4.1	<0.001*
SEPTIC					
TYPE 2	KSS	Pre KSS	38 ± 2.8	35 ± 2.5	0.32
		KSS (3 m)	40.8 ± 4	42 ± 7	<0.001*
		KSS (6 m)	41 ± 5	48 ± 7	<0.001*
	SF-36 score	Pre SF-36 score	61 ± 6	65 ± 7	0.71
		SF-36 score (3 m)	37 ± 5	41 ± 3	0.01*
		SF-36 score (6 m)	31 ± 1	38 ± 2	<0.001*
	WOMAC score.	Pre WOMAC	19.0 ± 1.1	22.1 ± 1.4	0.71
		WOMAC (3 m)	19.5 ± 1.8	24.5 ± 2.1	0.01*
		WOMAC (6 m)	20.4 ± 2.01	27.5 ± 3.1	<0.001*
	VAS score	Pre VAS	54.0 ± 7.1	55.9± 7.8	0.71
		VAS (3 m)	33.0 ± 2.1	32.2± 4.8	0.01*
		VAS (6 m)	17.0 ± 2.2	18.2± 3.9	<0.001*
TYPE 3	KSS	Pre KSS	35 ± 3	38 ± 4	0.45
		KSS (3 m)	40 ± 2	42 ± 5	<0.001*
		KSS (6 m)	40 ± 3.8	42 ± 7	<0.001*
	SF-36 score	Pre SF-36 score	58 ± 5	62 ± 6.5	0.71
		SF-36 score (3 m)	40 ± 3	42± 4.5	0.55

		SF-36 score (6 m)	37 ± 1.5	38 ± 3	0.61
	WOMAC score	Pre WOMAC	21 ± 1.8	22± 1.9	0.718
		WOMAC (3 m)	19 ± 1.5	24± 3.5	0.01*
		WOMAC (6 m)	15 ± 1	24 ± 3	<0.001*
	VAS score	Pre VAS	60.1 ± 8.2	62.9± 9.22	0.71
		VAS (3 m)	41.0 ± 4.5	43.4± 6.5	0.01*
		VAS (6 m)	27.1 ± 2.5	30.2± 4.12	<0.001*
INFECTION			1	1	0.45
NON-PROGRESSIVE RADIOLUCENT LINES			1	0	0.44

Data are presented as mean ± SD. CCK: condylar constrained knee, RHK: rotatory hinged knee, KSS: knee society score, SF: short form, WOMAC: western Ontario and McMaster universities osteoarthritis, VAS: visual analogue scale *: significant as P value <0.05.

There was high improvement in rotatory hinged knee (RHK) in septic condition. There was high improvement in CCK in aseptic condition regarding KSS, SF-36, WOMAC, and VAS score (P <0.05). No significant differences were detected between CCK and RHK regarding infection as a complication and non-progressive radiolucent lines as a radiographic result. Table 2

Table 3. Correlations between Outcomes and risk factors

	R	P
PRE KSS	-.495-**	<0.0001 *
PRE (SF-36) SCORE	.498**	<0.0001 *
PRE WOMAC	.560**	<0.0001 *

r: correlation coefficient, KSS: knee society score, SF: short form, WOMAC: western Ontario and McMaster universities osteoarthritis, *: significant as P value <0.05.

This table shows that strong and significant correlations were observed between Outcomes and Pre KSS, Pre (SF-36) score and Pre WOMAC (P<0.0001). Table 3

Table 4. Univariate and multivariate Correlations between Outcomes and Pre KSS, Pre (SF-36) score and Pre WOMAC

	R	P
UNIVARIATE		
PRE KSS	0.348	<0.0001 *
PRE (SF-36) SCORE	0.471	<0.0001 *
PRE WOMAC	0.412	<0.0001 *
MULTIVARIATE		
PRE KSS	71.305	<0.0001 *
PRE (SF-36) SCORE	20.495	<0.0001 *
PRE WOMAC	25.595	<0.0001 *

r: correlation coefficient, KSS: knee society score, SF: short form, WOMAC: western Ontario and McMaster universities osteoarthritis, *: significant as P value <0.05.

In Univariate and multivariate correlation regression, Strong and significant correlations were observed. between Outcomes and Pre KSS, Pre (SF-36) score and Pre WOMAC (P<0.0001). Table 4

Case presentation

Case 1:

Age: 63 years, sex: Male, etiology of primary: Primary osteoarthritis, etiology of revision: Aseptic loosening, approach: Medial para-patellar arthrotomy, treatment of bone loss: Distal femoral augment for femoral defect and complete metal wedge for tibial defect, type of prothesis: Constrained condylar knee. Clinical data:

Preoperative: Tibiofemoral alignment: 16 degree varus, pain score: Continuous (10), range of motion: 70 (14), A-P stability: (10), M-L stability: (10), total knee score: 44, and total function score: 35 and postoperative: Tibiofemoral alignment: 4 degree valgus, pain score: Occasional (45), range of motion: 105(21), A-P stability: (10), M-L stability: (15), total knee score: 91, and total function score: 80. Figure 2

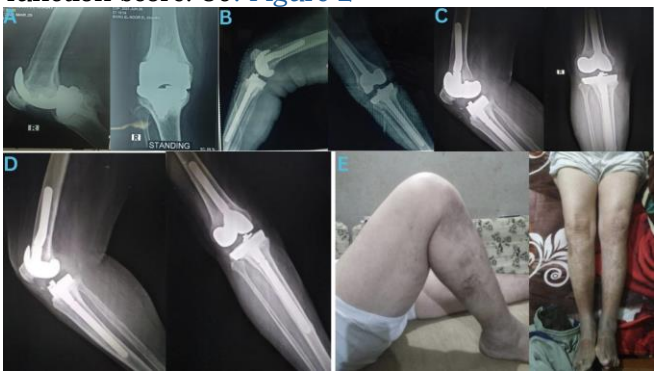

Figure 2. (A) Preoperative, (B) Immediate postoperative, (C) 3 months postoperative, (D) 6 months postoperative X ray AP & Lat, and (E) postoperative knee flextion and extention

Case 2:

Age: 70 years, sex: Female, etiology of primary: Primary osteoarthritis, etiology of revision: Infection, approach: Medial parapatellar arthrotomy with tibial tuberosity osteotomy, bone loss management: Cone for femoral defect and tibial wedge for tibial defect, and type of prothesis: Rotating hinged knee prothesis. Clinical data: Preoperative: Tibiofemoral alignment: 18 degree varus, pain score: Continuous (10), range of motion: arthrodesis, A-P stability: (10), M-L stability: (15), total knee score: 47, and total function score: 20 and postoperative: Tibiofemoral alignment: 5 degree valgus, pain score: Occasional (45), range of motion: 110 (22), A-P stability: (10), M-L stability: (15), total knee score: 92, and total function score: 80. Figure 3

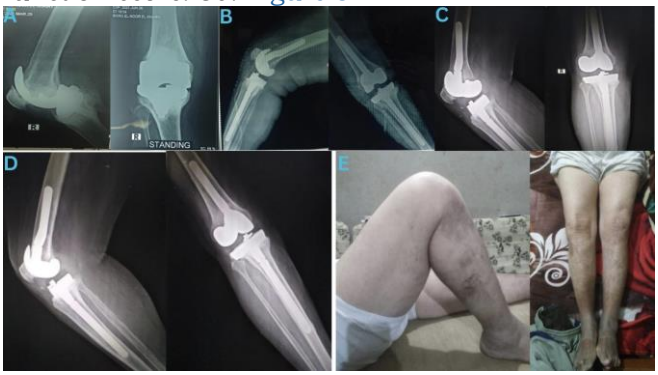

Figure 3. (A) Preoperative, (B) Immediate postoperative, (C) 3 months postoperative, (D) 6 months postoperative X ray AP & Lat, and (E)

postoperative knee flextion and extention

4. Discussion

Revision knee arthroplasty procedures have increased in tandem with the number of patients undergoing primary TKA, notwithstanding the progress made in instrumentation and the broader adoption of computer-assisted surgery. These developments have helped optimize the duration of hospitalization and rehabilitation subsequent to primary TKA. Instability, aseptic loosening and infection are the three most common factors contributing to revision arthroplasty .[1]

In this study we found that there was high significantly improvement in KSS SF-36, WOMAC, and VAS among RHK in septic condition while there was high significantly improvement in KSS SF-36, WOMAC, and VAS among CCK in aseptic condition.

Our results were supported by Shen et al.[9] who found that patients with septic AORI type II bone defects exhibited greater improvements in KSS with fully constrained hinged prostheses than with unlinked constrained prostheses. On the other hand, unlinked constrained prostheses demonstrated a more pronounced enhancement in KSS when implemented in situations involving aseptic AORI type III defects.

In contrast, patients with bone loss due to septic AORI II or III responded more favourably to RHK prostheses. In septic revision, a more constrained prosthesis may be required for improved clinical and functional outcomes due to the fact that prosthetic RHK designs permit significantly more aggressive capsuloligament debridement and, consequently, more effective infection eradication.

Walker et al.[10] in one of the initial publications on this topic raised questions regarding the clinical superiority of CCK implants in comparison to RHK implants. Subsequently, a comparison was made between the clinical outcomes of 33 CCK implants and 56 RHK implants; the RHK implants exhibited less residual laxity, which improved the KSCS but had no effect on the motion range or KSFS result.

Fuchs et al.[11] observed 26 rTKA for an average of 20.4 months using CCK or RHK and found no difference in the visual analogue score, Hospital for Special Surgery score (HSS), or KSS. Patients who had received a CCK implant and undergone multiple revisions for aseptic loosening exhibited statistically significant declines in perception of general health, general mental health, social functioning and mental component summary.

Donaldson et al.[12] Performed revision surgery in 48 cases that were excluded due to aseptic loosening and infection (flexion contracture of 15° or flexion of b70). A legacy-constrained condylar knee insert was administered to patients based on their intraoperative stability. The average ROM score increased by 45.0 points, while the average WOMAC score decreased from 58.3 to 36.9.

Hermans et al.[13] discovered that the condylar-constrained cohort experienced a mean improvement of 9.4 points in pain score, whereas the rotating hinged cohort improved by 26.4 points.

Regarding complications and radiographic outcomes, this study revealed a statistically insignificant difference between CCK and RHK.

Shen et al.[9] discovered that the use of hinges in AORI II and III defects during septic or aseptic revisions did not increase the incidence of infections or aseptic loosening. Relatively similar findings were recently reported by Yoon et al[14] and Malcon et al[15].

Barnoud et al.[14] found that radiolucent lines were detected on anteroposterior radiographs in two cases (6.7%) within the RHK group. The CCK group did not exhibit any radiolucent lines; however, the observed statistical difference ($p = 0.5$) was not significant.

It is our suggestion that prostheses featuring a reduced degree of constraint yield a more favorable functional outcome. Patients with type II or III bone defects who are undergoing revision arthroplasty due to infection may, however, benefit from the utilization of linked constraint prostheses.

Limitations: While the surgeons who operated on the patients differed, they all adhered to the same philosophical stance concerning the degree of constraint selection. In the absence of standardization, bone defects were addressed using different kinds of methods, including augmentation, bone grafting, and metal cones. Because of the comparatively limited patient population who were diagnosed with septic AORI types II and III, the conclusions that could be generalized to this group were restricted. Furthermore, the sample size of complications was insufficient, which could potentially introduce statistical bias.

4. Conclusion

Functionally, prostheses with a reduced constraint degree yield superior results. Patients with type II or III bone defects who are undergoing revision arthroplasty due to infection may, however, benefit from the utilization of linked constraint prostheses.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

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Conflicts of interest

There are no conflicts of interest.

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