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RESEARCH ARTICLE

KNEE DEFORMITIES AND KNEE REPLACEMENTS IN SAUDI POPULATION: OUR EXPERIENCE AND LITERATURE REVIEW

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Abstract

It takes precise alignment, adequate balance, and deformity correction to accomplish a successful total knee arthroplasty (TKA). In main TKA, this can be successfully achieved with a posterior stabilized (PS) design, either with or without sub-periosteal release. However, severe abnormalities with a major bone defect, stiffness, and instability are often associated with these disorders in some circumstances, such as knee osteoarthritis. Additional restrictive prostheses are required since it is extremely difficult to balance these anomalies with soft tissue release alone, even after main TKA. In this situation, the constrained condylar knee (CCK) design is the optimum choice. This study's primary objectives were to characterize the clinical outcomes, function recovery, and complications of patients who underwent primary CCK-TKA for severe knee osteoarthritis related knee deformity. The secondary aim was to find out the mid-term prostheses survival.

Methods: Between March 2021 and March 2022, 36 consecutive patients with knee osteoarthritis had cemented primary CCK-TKA. Twenty-Eight women and eight men, totaling 36 patients, had at least a 6 month follow-up for this retrospective analysis. We used the Knee Society Score (KSS), the Hospital for Special Surgery (HSS) score, and the roentgenographic evaluation form to assess the patients. The survival of prosthesis was assessed using Kaplan-Meier's survival analysis. The patients' follow-up periods averaged 12 month. The KSS knee score rose from 44 points (23–68) to 91 points (76–100) following surgery [$P < 0.001$]. Following the procedure, the mean KSS functional score rose from 20–75 points to 91 points (65–100) [$P < 0.001$]. The average HSS score rose from 51 points (27–83) to 91 points (75–100) following surgery [$P < 0.001$]. The average range of motion (ROM) also increased after surgery, going from 68.09° ± 35.99° (0°–120°) to 113.68° ± 8.90° (100°–130°) [$P < 0.001$]. The average hip-knee-ankle (HKA) angle was 180.24° ± 1.77° (175°–184°) following surgery, compared to 176.88° ± 14.48° (135°–199°) before to surgery.

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Radiolucencies were seen in thirteen knees, mostly on the tibial side. After an average follow-up of 12 month, 94.7% of prosthesis were still in use. Despite severe deformity, instability, and stiffness at a relatively young age, the mid-term follow-up of primary CCK-TKA in knee osteoarthritis gives satisfactory clinical and functional outcomes with 94.7% prosthesis survival. However, there are a few issues.

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Introduction:-

Total knee arthroplasty (TKA) is considered among the most common orthopedic surgical procedures, with more than 600,000 operations performed annually in the US and an expected increase of 673% in that number by 2030. Aseptic loosening and instability are among the most frequent failure mechanisms requiring revision TKA despite the excellent reported results, with registries reporting survivorship of > 95% after 10 years, despite the excellent reported results. [1, 2] After a total knee replacement, maintaining knee stability is essential for good implant survival over the long term. In total knee arthroplasty (TKA), severe axial deformities present a technical challenge because achieving satisfactory soft tissue balance is difficult. Additionally, flexed knees and medial and lateral compartment contractures frequently call for a thorough release that may leave residual instability [3]. A tibial post that is higher and squarer than the PS one and fits snugly between the condyles distinguishes condylar-constrained knee (CCK) prostheses. This stability limits varus-valgus and torsional moments and provides medial-lateral and anteroposterior (AP) stability. The non-modular, first-generation CCK implants had high rates of aseptic loosening [4] and patellar complications like fracture, mal tracking, and osteonecrosis. [5] With a modified patellofemoral articulation, second-generation CCK implants offer more medial-lateral stability and permit modular tibial and femoral stems to improve fixation, relieve stress, and distribute the load within the host bone. [6] Constrained condylar knee (CCK) can assist surgeons in enhancing implant stability when soft tissue balance is unsatisfactory; this is true both for primary TKA and revision. Revision surgery has historically been the most common indication for CCK use; other indications include soft-tissue-related instability, broad bone defects, and axial deformity [7].

Early studies with subpar results previously constrained the use of CCK for initial implants, but more recent studies have shown improved long-term survival rates. When there is significant instability, this makes it possible to choose CCK with greater assurance in primary replacements. [8] Due to redesigned patellofemoral surfaces, the second-generation CCK prosthesis also lessened some complications to the patella (such as fractures, incorrect tracking, and osteonecrosis)[9.] Increased levels of constraint have theoretical drawbacks, such as a higher risk of loosening brought on by the transmission of mechanical stress to the bone-cement interface and a subsequent increase in polyethylene insert wear, particularly of the tibial post, which results in a higher prevalence of osteolysis. [10, 11] However, numerous studies have shown that CCK implants in primary TKAs have positive short- to midterm outcomes. Additionally, in cases of severe coronal deformity and ligamentous laxity, range-of-motion (ROM), clinical, and radiographic outcomes appear to be comparable to those of standard PS implants [12, 13]. The objective of the present study is to assess the clinical outcomes and side effects of the Condylar Constrained prosthesis (Zimmer) used in primary knee arthroplasty in the Saudi population, along with a literature review.

Literature Review:-

A more constrained articulation is required in severe knee arthrosis with serious deformity related to a considerable increase in instability. Constrained condylar knee (CCK) prostheses are frequently used for revision surgery but can also help surgeons to improve implant stability in primary knee arthroplasty. The rate of complications has significantly decreased since the second generation of semi-constrained prostheses was introduced, resulting in a reasonable survival rate and functional score [14] .

Sabatini et al. (2017) aimed to evaluate the clinical results and side effects of two different types of CCK implants in TKA patients. 10 Zimmer constrained condylar knee implants (CCK) and 18 TC3 implants, two distinct implant types were utilized (DePuy Johnson & Johnson). Each patient had a severe deformity and was older than 75. During follow-up, all patients regained full extension, and no radiolucent lines were visible at the X-ray control. No peri-prosthetic fractures or deep infections were present. In cases of severe deformity that cannot be treated with precise soft tissue release, second-generation semi-constrained knee prostheses have been demonstrated to be a safe and effective treatment in primary total knee arthroplasty (TKA), particularly in elderly patients [15].

In their study, Mancino et al. (2020) sought to assess the clinical outcomes of CCK implants used in TKA with severe coronal deformity and intraoperative instability. They also sought to assess the reoperation rates and survivorship for septic and aseptic causes, radiographic outcomes, and the clinical outcomes of patients. Overall, 93.6% of people survived. Two knees (4.3%) were needed for revision due to periprosthetic joint infection. Patellar clunk syndrome necessitated a subsequent arthroscopy in one knee (2.1%). There was no information about any implant moving or becoming loose. In either flexion or extension, no knees reported varus-valgus instability. In primary TKA patients with significant coronal deformities and/or intraoperative instability, it was discovered that CCK implants offer good midterm survivability, on par with less constrained implants. CCK implants may be a good option with favorable clinical and radiographic outcomes in certain circumstances. Higher levels of constraint should be used cautiously, with less constrained implants being the first option [16].

Additionally, Kim et al. (2020) determined the long-term clinical and radiographic results of revision using the LCCK prosthesis, particularly regarding component fixation and the prevalence of osteolysis. Ninety-seven patients (114 knees) who underwent revision total knee arthroplasty using a Legacy Constrained Condylar Knee prosthesis (LCCK; Zimmer) and had at least five years of follow-up were included. At 19.2 years, the survival rate was 96% when the endpoint was reoperation for mechanical failure and 91% when the endpoint was reoperation for any reason. Around the parts of one knee, there was osteolysis all around. At a mean follow-up of 19.2 years, TKA with the LCCK provided good functionality, patient satisfaction, and implant survival in 91% of patients. Aseptic loosening and infection were the causes of the prosthesis's short lifespan [17].

León-Román et al. validated using inertial sensors with optical tracking systems as movement measurement tools in 2021 by comparing the tibial rotation of both implants. There were 16 cadaver knees used in total. Eight knees underwent RHK (Endomodel LINK) replacement, and the other eight received CCK prostheses (LCCK, Zimmer). Four continuous waveforms were used to measure the tibial rotation range of motion at full extension, 30°, 60°, and 90° flexion. Two inertial sensors were used with specialized software to make measurements, which contrasted with results from the motion capture camera, the industry's gold standard method. When inertial sensors and motion capture cameras were compared for accuracy, there were no statistically significant differences between them ($p > .1$); the mean error for tibial rotation was 0.21°. The RHK had a significantly higher tibial rotation than the CCK (5.25° vs. 2.28°, respectively). It was discovered that RHK, which is more akin to physiological values than CCKs, allows for more significant tibial rotation. The effectiveness and accuracy of inertial sensors for determining knee movement have been confirmed. Compared to CCK systems, RHK seemed to represent a lower degree of constriction.

Materials & Methods:-

Purpose

The study aims to assess the clinical outcomes and side effects of the Condylar Constrained prosthesis (Zimmer) used in primary knee arthroplasty in the Saudi population, along with a literature review.

Study objectives

- To assess the clinical outcomes of the Condylar Constrained prosthesis (Zimmer) used in primary knee arthroplasty in the Saudi population.
- To explore assess the side effects of the Condylar Constrained prosthesis (Zimmer) used in primary knee arthroplasty in the Saudi population, along with a literature review.
- To review current literature concerened with the clinical outcomes and side effects of the Condylar Constrained prosthesis (Zimmer) used in primary knee arthroplasty.

Study setting

During the last two decades, there has been an increase in the utilization rate of knee arthroplasty in many parts of the world. A disparity in the utilization rate of TKA according to demographic features is evident. For instance, women were found to have higher rates of TKA than men[18]. Additionally, there is an age difference in TKA

utilization rates; patients 75–79 years old have the highest TKA rates among both genders. Al-Omran reported a greater than 93% overall satisfaction of Saudi patients who underwent TKA, with improvements in pain and function of the joint. [19] Despite these results, the uptake of this corrective surgery is deficient in Saudi Arabia. A previous study found that 67% of a sample of Saudi patients suffering from advanced knee OA declined to undergo TKA [20]. No evidence has been found on the clinical outcomes and side effects of CCK in total knee replacement in the Saudi population. Hence, we conducted the present study.

Methodology:-

Study design: Retrospective and literature review study. Study population: patients with TKA in the Saudi population. Participant's Participant's age: above 60 years. Study groups: one group. Sample size is 36. Study Tools: A retrospective study of TKA patients, using CCK Zimmer system will be performed. All patients undergoing TKA using CCK Zimmer system, above the age of 60, will be included in the study. Patients' demographics, including age, sex, length of hospital stay, degree of deformity, lateral thrust, comorbidity, HGB (before and after), complications will be collected from patients' medical records. All patients done with medial parapatellar approach with cemented tkr system (zimmerlcck) with augments and stems as required. All patients done under regional block and received 2 g cefazolin and one gram iv, tranxenamic acid. The mean age was 66.0, the ration of male to female was (2: 10), ASA score was 3 or 2, pre and post op Hb; pre-operative Hb was 12.2 and post-operative Hb is 11, RA to OA is (2.2:10), transfusion was zero and oxford knee scoring system pre and post op; pre-operative was 22 and post-operative was 38. Patellar resurfacing were 7 cases. The clinical evaluations of patients at 2-, 6-, 12-month after surgery and every year will be collected. X-rays at 6, 12 months will also be collected. A review of the current literature will be performed using various databases, including Google Scholar, PubMed and MEDLINE. Ethical consideration: The review board will provide approval of the study protocol. Anonymity, privacy, and confidentiality issues were respected throughout the study; each participant will be given a code, and their data will be registered only under the regulation. Statistical Analysis: The SPSS program version 22.0 will be employed for data analysis. Descriptive statistics will be generated. A P-value ≤ 0.05 will be considered significant.

Table 1:- Total knee replacement in severe deformities.

Male to female	2:10
ASA Score	3
Pre- and postoperative HB:	
Pre	12.2 HB
Post-OP:	11
Oxford Knee Scoring System	(Pre-Op-22) (Post-38)
RA to OA	2.2:10
Patella resurfacing	7 cases
Transfusion	0

Results:-

Clinical Results

The average KSS knee score increased from 44 points (23–68) pre-operatively to 91 points (76–100) at the most recent follow-up [$P < 0.001$]. Out of the 36 patients, 33 (91.7%) were rated as excellent, and 3 (8.3%) as good. The average KSS functional score increased from 49 points (20–75) pre-operatively to 91 points (65–100) at the most recent follow-up [$P < 0.001$]. The average HSS score increased from 51 points (27–83) pre-operatively to 91 points (75–100) at the most recent follow-up [$P < 0.001$]. Similarly, the average ROM improved [$P < 0.001$] from 68.09° ± 35.99° (0°–120°) to 113.68° ± 8.90° (100°–130°) during the most recent follow-up (Fig. 1). After surgery, flexion contracture was present in one patient (2.8%) at a level of 5°, while the average preoperative flexion contracture was 17° (5°–45°) in 23 patients (63.9%). Comparably, 2 patients (5.5%) had a 5° pre-operative extension lag, however none of the patients experienced a post-operative extension lag.

Radiographic Results

Pre-operative radiographic assessment of weight-bearing AP radiographs showed that the average valgus deformity was 15° (7.5–25) in 18 (50%) patients and the average varus deformity was 12° (0°–30°) in 12 (33.3%) patients. In contrast, 6 individuals (16.7%) had a normal valgus angle between 3 and 7 degrees. At the most recent follow-up, no anomalies were discovered. The average HKA angle was 176.88° ± 14.48° (135°–199°) pre-operatively and 180.24° ± 1.77° (175°–184°) at the last follow-up (Figs. 2 and 3). Radiolucencies were evident in 13 knees; 3 on both sides

and 10 on the tibial side. However, all of these radiolucencies were less than 1 mm, and the radiographs that were taken immediately following the surgery showed them.

Figure 1:- Pre-operative X-ray: anteroposterior (AP) and lateral views and tele-radiography.

Prosthesis Survival

In all 36 situations, we utilized endpoint as a revision for whatever reason. At an average follow-up of one years, the prosthesis survival rate was 94.7% (95% confidence interval (CI) 82.3~ 99.4%)

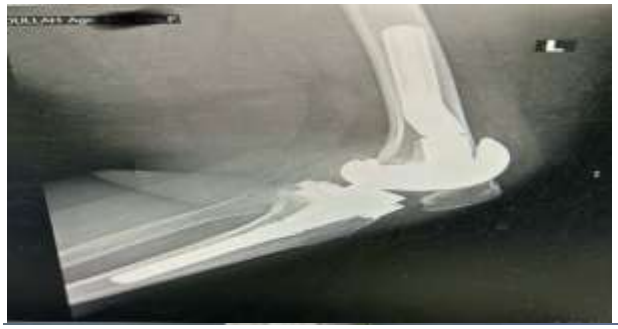

Figure 2:- Post-operative X-ray: Step cut medially, with 10 mm Augment.

Discussion:-

With a prosthesis survival rate of 94.7%, a great clinical outcome, and function recovery, the primary CCK-TKA successfully addressed the severe deformity with extensive bone defects, stiffness, and instability of the knee joint caused by knee osteoarthritis. This was our study's most important discovery. On the other hand, the rate of complications following surgery peaked at 14 percent. Lachiewicz and Soileau [27] conducted earlier study on the effects of second-generation primary CCK-TKA in 27 knees. At the latest follow-up, all the metrics demonstrated a significant improvement, including the KSS knee score, KSS functional score, and HSS score post-operatively. Using the KSS knee score, twelve (44%) were rated as excellent, fourteen (52%) as good, and one (4%) as fair. Ye et al. [25] studied the outcome of CCK-TKA in challenging primary and revision surgery at a mean follow-up of 12 month post-operatively and found no significant difference between the two groups. However, they found a significant improvement in the clinical ratings, with 92% of knees in the main CCK group showing good to excellent results [22]. Moreover, Lizaur-Utrilla et al. [26] provided a similar perspective, observing a significant improvement after surgery but not finding any discernible differences in the post-operative outcomes between patients receiving primary TKA for primary osteoarthritis. Lunebourg et al. discovered that while there was a significant variation in the post-operative scores of primary TKA, the post-operative scores of TKA following knee osteoarthritis were lower than those of the primary osteoarthritis group. Rather from being the product of the procedure's inherent success, this divergence might have come from the patients' poor preoperative conditions **.[24]**

With knee osteoarthritis, we evaluated the mid-term results of cemented primary CCK-TKA using the KSS knee score, HSS score, and KSS functional score. Consistent with previously published results, 94% of the patients exhibited severe deformity, stiffness, and instability before surgery, but their post-operative scores were excellent at the final follow-up. Our study also revealed a noteworthy improvement in post-operative range of motion. Our patients' preoperative range of motion (ROM), which was just 68° on average, was much better at the final follow-up, measuring 113° on average. The bulk of studies reported post-operative ROM of CCK prosthesis ranging from 89.4° to 117° [27, 28, 29–26], which is consistent with our findings. According to Maynard et al. [30], pre-operative ROM influences post-operative ROM. Although 24 (66,6%) of the knees in our study had pre-operative range of motion (ROM) of 90° or less, all of the knees' ROM improved satisfactorily after surgery, with all of them having ROM of 100° or higher. After reading this data, we can conclude that proper rehabilitation and adequate intra-operative balance are just as important to post-operative range of motion as pre-operative range of motion**.**

TKA dramatically improves the clinical and functional prognosis for knee osteoarthritis, but often has serious side effects [31]. Complications include infection, wound issues, rupture of the patellar tendon during surgery, stiffness, and mechanical loosening [32]. Numerous factors, including as severe joint deformity, implant misplacement, scarring from prior fracture surgeries, and scarring of soft tissue, might result in complications after TKA in knee osteoarthritis. Piedade et al. [31] state that having had prior knee surgery increases the likelihood of post-operative complications after total knee arthroplasty (TKA). The most common and terrible consequence after total knee arthroplasty (TKA) is prosthetic infection, which is also the main cause of reoperation [11]. Prior fracture or usage of a restricted prosthesis was found to be a risk factor for infection by Jamsen et al **.[32] .**

Out of the 36 patients in our study, 9 (25%) experienced overall problems in their knees, and 1 (2.7%) of those patients required revision total knee arthroplasty. According to earlier research [13, 33, 34,,35, 36], the total infection rate in primary TKA caused by knee osteoarthritis ranged from 3.4% to 9.6%. Only one patient (2.7%) required prosthetic removal 2.5 years after initial TKA due to prosthetic infection, even with the use of CCK in a very vulnerable patient group. Strict intraoperative aseptic measures and routine prophylactic antibiotic treatment

may be the cause of a comparatively low infection rate. The results of this study showed that the prosthesis survival rate was 94.7% (95% CI 82.3~99.4%), which was in line with earlier long-term follow-up research where the revision of any reason was used as an endpoint [33, 34]. There are various restrictions on our investigation. All the biases associated with a small sample size retrospective cohort research apply to our work. Another drawback is selection bias, since the chief operating surgeon made the decision on the prosthesis. Last but not least, the data shown here are from a single hospital and can be skewed by institutional and geographical factors.

Limitations

Limitations are clearly shown in. Only One patient underwent prosthesis removal followed by revision procedures because experienced a prosthetic infection 5 month after surgery. A patient with a conservatively handled non-displaced periprosthetic fracture surrounding the tibial stem reported a favorable outcome. Deep vein thrombosis (DVT) was present in three patients, although all of them made a full recovery following prompt diagnosis and critical care. A pre-operative radiographic evaluation revealed an average varus deformity of 12° (0°–30°) in 12 (30%) of the patients. One patient experienced asymptomatic patella baja, .

Conclusion:-

This study demonstrates that despite cases where the patient had a severe distortion and stiff of the knee joint at a relatively early age, mid-term follow-up of primary CCK-TKA in knee osteoarthritis offers good clinical and functional results, with 94.7% prosthesis survival. We may conclude from this research that CCK-TKA is an effective and practical treatment fo knee osteoarthritis. However, there are some problems. A definitive conclusion can only be reached after extensive observation.

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