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Review article

Total Knee Arthroplasty for Treatment of Post-Traumatic Arthritis: Systematic Review

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Abstract

Background: Post traumatic arthritis is one of the most common reasons for joint disability worldwide. The aim of this study was to review and discuss the functional outcomes as well as complications and survivorship related with total knee arthroplasty in the treatment of post traumatic arthritis. ***Methods:*** This is a systematic review which was conducted according to the PRISMA guidelines. In this study, we searched several data bases including PubMed, Cochrane Library and SCOPUS for English language clinical research studies whether prospective and retrospective studies in order to examines the use of total knee arthroplasty for the management of post traumatic arthritis. We assessed all relevant articles RESULTS: In this review, we included total of sixteen studies; ten studies were retrospective and six were prospective studies. The pooled results showed an increase in the range of motion and pain reduction after the surgery while the most common complications including infection, stiffness, intraoperative rupture of tendons, wound complications as well as osteolysis. Moreover, comparing the results with patients with osteoarthritis, patients with post traumatic arthritis needed more revisions especially for polyethylene wear. ***Conclusion:*** However, the high rate of complications reported with total knee arthroplasty, it is considered an effective treatment for post traumatic arthritis as it found to improve the range of motion and general functional outcomes.

Keywords: ***Total knee arthroplasty; Post-traumatic arthritis; Tibial plateau fracture; Distal femur fracture; Patella fracture***

Introduction

Post traumatic arthritis (PTA) conditions are considered one of the types of osteoarthritis with a difference that degeneration of cartilage that occurs in post-traumatic arthritis occurs because of sudden injury and not because of gradual wear and tear as in case of osteoarthritis [1]. However, knee joints arthritis can occur because of many causes [2], trauma is the most common factor for this condition. This trauma extends from the internal derangement of knee to intra-articular fractures as well as fracture dislocation [3]. This type of injury can be caused from sports, motor vehicle accidents (MVA), fall, and any other source of physical trauma. This injury could cause damage to the ligaments, cartilage and/or the bone itself and could change the mechanics of the joints [4]. Among all knee joints arthritis, post-traumatic knee arthritis account for 12 % of cases [5] with higher prevalence among young patients whom activity for daily living will be affected. There are many factors that is related to the development of PTA following injury to the knee including the mechanical imbalance because of ligamentous laxity, meniscal tears, and malalignment [6], release of pro-inflammatory cytokines into local tissue which lead to imperfect remolding of the cartilage and non-unions and malunions after fractures which cause PTA [7]. The management of PTA varies from a cosmbination of pharmacological and non-pharmacological strategies to operative interventions. Modification of normal activity, using of anti-inflammatory medications, ambulatory assist devises as well as physical therapy are considered the main strategies of non-operative treatment [8]. When these non-operative management failed, surgical options become an alternative management that ranges from arthroscopic debridement to arthrodesis [8]. Total Knee arthroplasty (TKA) is an option strategy for the management of end-stage post traumatic knee arthritis [4]. This surgery is not so simple and considered a technically challenge because of previous surgeries and scarring [9], problems related to secondary deformity, bone loss, poor bone quality, and ligament incompetence. This surgery in most cases is associated with higher rate of complications and accounts for more consumption of hospital resources and incurs a higher cost [10]. Among literature, we found conflicting reports considering the short and long term outcomes of TKA as well as associated perioperative complications [9,11,12]. The goal of this systematic review is to summarize the functional outcomes, complications, and survivorship of TKA performed for the treatment of PTA.

Methodology

This is a systematic review-based study that was conducted according to the PRISMA guidelines. A comprehensive electronic search with time and language restrictions was done. Several known databases were included Ex: PubMed, Cochrane Library, and SCOPUS in which all prospective and retrospective studies which examined the use of TKA in treatment of PTA were reviewed. Keyword that used include TKA and traumatic arthritis, Knee arthroplasty, Outcomes, Surgery, Arthritis, OA. Only English-language studies which examined short- and long- outcomes of TKA performed for traumatic arthritis were included. Moreover, references found in these studies were also reviewed to identify

additional articles of interest. Inclusion criteria included studies discussing TKA and traumatic arthritis, all types of fractures were included (Proximal tibia, patella and/ or distal femur), and all study methods, including case-control, cohort, randomized-controlled studies- prospective or retrospective. While exclusion criteria included studies focused on uno-compartment knee arthroplasty, osteotomy and/or patients with primary OA and case reports, case series, and biomechanics studies were excluded. In the first step two researchers reviewed the retrieved articles and removed the duplicates. In other steps, the researchers screened the title and abstract of the records and the ineligible studies were removed. Then, the authors surveyed the full-text of the remaining studies based on inclusion and exclusion criteria and the eligible studies were identified.

All included studies were reviewed for methodology including sample size, study design, year of publication and inclusion and exclusion criteria. Moreover, demographics factors of patients were examined as well as clinical outcomes including follow-up period, preoperative diagnosis, pain and functional outcomes. The main clinical outcomes considering the TKA after PTA included post-operative pain as reported by patients, patients reported function and knee range of motion (ROM). There are different criteria that was used to assess these outcomes including HSS score (Hospital for special surgery), IKS (International knee scores), KSS (knee society scores), KOOS (osteoarthritis outcomes scores) and oxford knee scores. KSS was the most common tool used to assess the outcome of TKA, it is a 200- points scoring system which ascribes a maximum of 100 points for function score as ability to walk, need for assistive devices and climb stairs and another 100 points for knee score including pain, ROM, stability and alignment. Moreover, all studies examined the complications of TKA after PTA and those were included in the analysis while six studies assessed the survivorship of TKA with an endpoint of any subsequent surgery of the same knee.

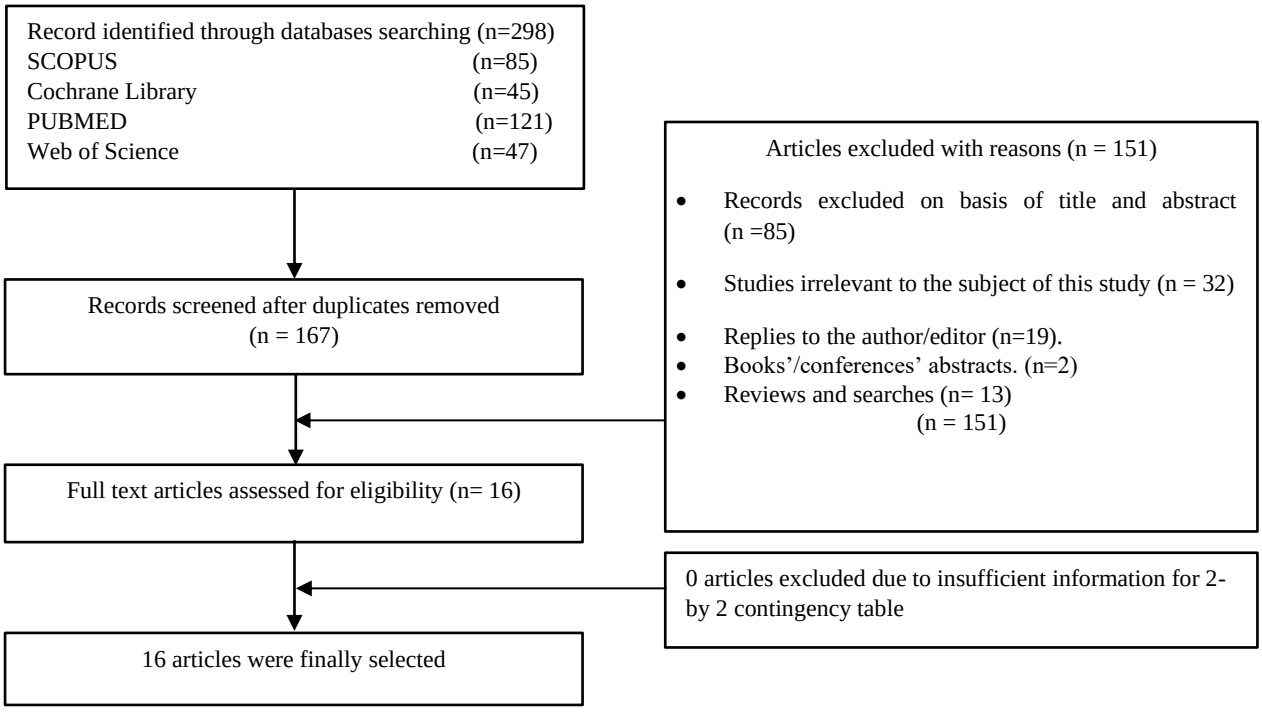

Figure 1: Flowchart summarizing the results of the literature search. TKA: Total knee arthroplasty

Results

Demographics

In this review, we included sixteen articles which met our inclusion criteria including ten studies of retrospective and four were prospective and two studies were prospective matched cohorts. All studies were conducted to examine patients with PTA due to fractures of proximal tibia, patella and/ or distal femur including non-unions or malunions in three studies. Moreosver, four studies were conducted to compare the patients with TKA to those with primary OAs while the average length of follow-up ranged between 3 and 15 years (Table 1).

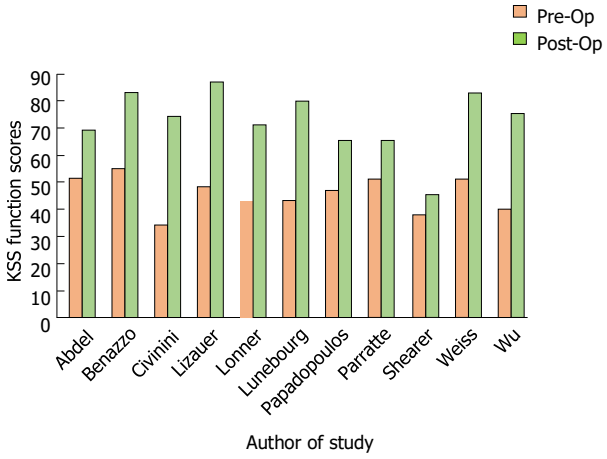

Figure 2: Comparison of pre- and post-operative Knee Society Scores function scores for patients who underwent total knee arthroplasty for treatment of post-traumatic arthritis. KSS: Knee Society Scores; Op: Operative.

Clinical outcomes

Among studies, fifteen studies assessed the functional outcomes of TKA for treatment of patients of PTA using different scoring system where eleven studies used KSS criterion and showed trends toward significant improvement between pre- and post- operative functions scores (**Table 2**). Study of Lizaur-Utrilla et al., reported no difference in the post-operative functional scores of patients with PTA when compared with patients with primary OA [13] while Lunebourg et al who used KOOS criteria reported significantly lower post operative scores of patients with PTA after TKA when compared with other patients with primary OA in all five functional outcomes including pain, symptoms, activity of daily living, sports activity and quality of life [9]. Among all studies which used KSS criteria in order to assess the knee and pain scores, all studies showed significant improvement in pre-and post-operative scores (**Figure 3**). Study of Lizaur Utrilla et al showed no significant difference in post-operative scores between patients of PTA and primary OA and no significant difference in WOMAC pain scores between PTA and primary OA patients [13]. In Weiss et al study, the authors showed that all patients reported at least mild pain before surgery while post-surgery, 83.9 % of them reported no pain [14].

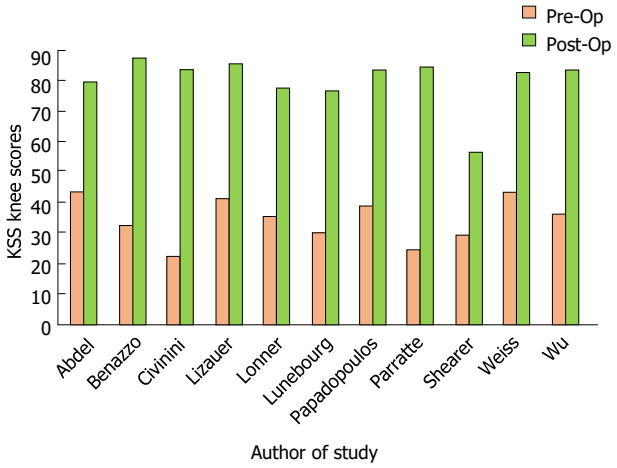

Figure 3: Comparison of pre- and post-operative Knee Society Scores knee scores for patients who underwent total knee arthroplasty for treatment of post-traumatic arthritis. KSS: Knee Society Scores; Op: Operative

Table 1: Demographic information of the studies included in this systematic review

Ref.	Type of study	Total patients	Males (%)	Mean age	Fracture types	Mean follow-up time	Outcome criteria scoring
Wu *et al* [15]	Retrospective	15	80	58	Tibia/femur	3	KSS
Scott *et al* [16]	Prospective matched cohort	PTA: 31 Cont: 93	26	66	Tibia	7	Oxford knee, SF-12
Bala *et al* [11]	Retrospective	PTA: 3509 Cont: 257, 611	PTA: 43 Cont: 35	N/A	Tibia/femur	N/A	CCI; Elixhauser
Benazzo *et al* [6]	Prospective	43	47	64	Tibia/femur/patella	6	KSS
Abdel *et al* [17]	Prospective	62	36	63	Tibia	15	KSS
Parratte *et al* [18]	Retrospective	74	46	63	Tibia/femur/patella (includes malunion)	4	KSS
Lizaur-Utrilla *et al* [13]	Prospective matched cohort	PTA: 29 Cont: 58	35	PTA: 57.3 Cont: 59.2	Tibia	7	KSS, SF-12, WOMAC
Lunebourg *et al* [9]	Retrospective	PTA: 33 Cont: 407	PTA: 55 Cont: 32	PTA: 69 Cont: 72	Tibia/femur	11	KSS, KOOS
Massin *et al* [19]	Retrospective	40	10	59	Tibia/femur	5	IKS
Papadopoulos *et al* [20]	Retrospective	47	21	65	Femur (includes malunions)	6	KSS
Lonner *et al* [5]	Prospective	30	50	60	Tibia/femur	4	KSS
Saleh *et al* [21]	Retrospective	15	27	56	Tibia	6	HSS, SF-36
Deschamps *et al* [22]	Retrospective	78	42	63	Tibia/femur (includes malunions)	4	SOO
Shearer *et al* [12]	Retrospective	47	62	48	Tibia/femur	4	KSS
Weiss *et al* [14]	Prospective	62	36	63	Tibia	5	KSS
Civinini *et al* [23]	Retrospective	25	36	57	Tibia	8	KSS

Moreover, among studies, ten studies had examined the impact of TKA on ROM and in all these studies, results showed a significant improvement in the mean arc of motion (**Figure 4**). The surgery showed a substantial gain in flexion [19]. Some included studies compared the ROM scores between patients performed TKA for PTA and those for primary OA. The finding of Lunebourg et.al. showed that degree of improvement in ROM in patients who performed TKA for PTA was greater than patients performed TKA for primary OA [9] and study of Lizaur Utrilla et al showed no significant difference in the final ROM between patients who underwent TKA whither for PTA or OA [13].

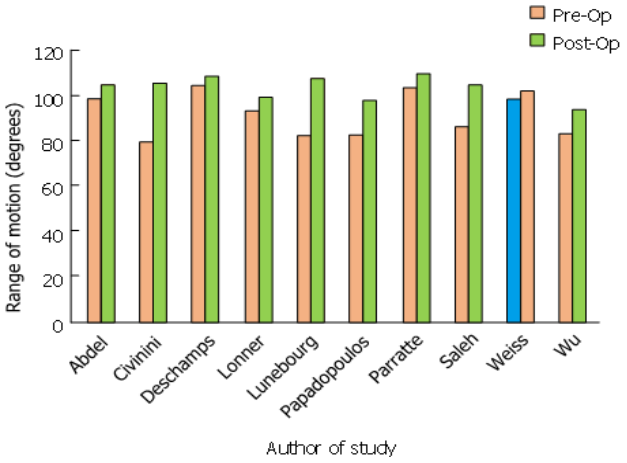

Figure 4: Comparison of average pre- and post-operative range of motions of the knee for patients who underwent total knee arthroplasty for treatment of post-traumatic arthritis. Op: Operative.

Complications

Among studies, nine studies examined complications resulted from TKA after PTA. The rate of total complications ranged between 14 % and 67 %. In study of Lizaur Utrilla et al, the authors reported significant differences in complications rate between PTA patients and Primary OA patients where complications rate was significantly higher in PTA patients [13]. Among reported complications, the most common ones included superficial infections, deep infections, stiffness, manipulation under anesthesia (MUA), rupture of tendons, wound complications, osteolysis/polyethylene wear, instability, and aseptic loosening (**Table 2**). When Bala et al, compared the complications with patients with primary OA, the authors found that patients with PTA had significantly higher rate of complications of cellulitis, wound complications and closed fractures than those with OA [11]. Moreover, the authors showed no significantly difference between the two groups in the rates of bleeding, osteolysis/polyethylene wear, MUA, broken prostheses, rupture of tendons or mechanical complications [11]. Furthermore, nine studies showed that the rate of revisions was between 3 and 18 %.

Table 2: Summary of complications observed with total knee arthroplasty for patients with post-traumatic arthritis

Ref.	Total	S Infxn	D Infxn	STIFF	MUA	ROT	WC	O/P	INST	AL	REVR
Scott *et al* [16]	35	13	3	9	1	6	1	1	0	1	1
Bala *et al* [11]	54	15	1	1	2	1	5	0	1	1	5
Deschamps *et al* [22]	18	1	1	1	1	1	1	1	1	3	13
Lunebourg *et al* [9]	21	1	6	6	1	1	1	1	1	3	9
Lizaur-Utrilla *et al* [13]	14	3	1	1	3	3	3	1	1	3	3
Papadopoulous *et al* [20]	19	1	6	1	1	2	4	1	2	1	13
Wu *et al* [15]	47	13	1	1	27	13	1	1	7	1	1
Shearer *et al* [12]	21	1	4	1	1	1	1	1	6	2	1
Abdel *et al* [17]	34	3	5	10	1	1	5	8	3	6	18
Benazzo *et al* [6]	21	1	2	5	1	1	1	1	1	2	7
Civinini *et al* [23]	32	4	4	8	1	4	4	1	1	4	1
Lonner *et al* [5]	57	1	10	1	1	3	6	1	1	1	1
Massin *et al* [19]	28	5	5	1	1	8	1	1	1	3	5
Parratte *et al* [18]	26	3	3	8	1	4	1	1	1	1	1
Saleh *et al* [21]	67	1	15	1	20	1	1	7	7	1	1
Weiss *et al* [14]	26	3	3	10	8	8	5	1	2	2	8

S Infxn: Superficial infections; D Infxn: Deep infections; STIFF: Stiffness; MUA: Manipulation under anesthesia; ROT: Rupture of tendons; WC: Wound complications; O/P: Osteolysis/polywear; INST: Instability; AL: Aseptic loosening; REVR: Revision rate.

Survivorship

Moreover, there was six studies among 16 included studies had assessed the survivorship of TKA among PTA patients with endpoint of any surgery on the operated knee after TKA. Study of Lizaur Utrilla et al, reported 90 % survival after mean follow-up of seven years with no significant difference between patients of PTA and those with primary OA [13]. Lunebourg et al, showed a survivorship rate of 79 % after mean follow- up of 11 years which is significantly lower than those with primary OA [9] and study of Abdel et al, who reported survival of 82 % after a follow-up of 15 years [17] (**Figure 5**).

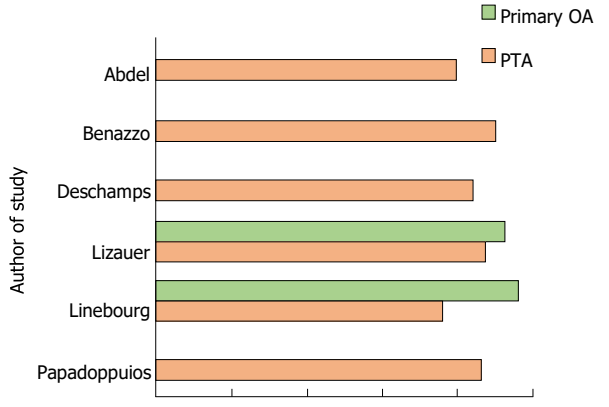

Figure 5: Comparison of survivorship at the longest time of follow-up of total knee arthroplasty performed for post-traumatic arthritis vs primary osteoarthritis. OA: Osteoarthritis; PTA: Post-traumatic arthritis

Discussion

In the previous literature, we found a paucity considering the outcomes of TKA in management of PTA. In this systematic review, we aimed to examine the current English literature in order to assess the clinical outcomes as well as perioperative complications and survivorship of TKA in the management of PTA.

There are many studies that used different scoring systems in order to assess the functional outcome of TKA in patients with PTA where the most of the studies used the KSS criteria which consisted of a functional and knee score. The functional score is consisted of assessment of patients of walking distance, his ability to climb stairs and the need for assistive devices while knee score consisted of patients reported pain, range of motion (ROM), alignment and stability [10]. The pooled results of this revie showed that most studies reported an improvement in the functional and knee scores of patients following TKA for PTA. One previous study conducted by Lizaur-Utrilla et al. reported that there were no significant difference in knee WOMAC pain scores of patients treated with TKA for PTA in comparison with patients treated from

primary OA [13]. Moreover, another study conducted by Lunebourg et al, showed that there was significant improvement in scores in patients with PTA however lower than reported in primary OA [9].

These finding showed that TKA is an effective treatment for PTA patients. It leads to functional improvement, as well as increased activity, range of motions, and reduced pain. Although there has been a good improvement in postoperative outcomes but less than in those with OA, it is reasonable to conclude that this difference may be due to differences in patients' preoperative status compared to patients treated for primary OA. Thus, the difference between post-operative PTA and primary OA patients is not because of the intrinsic success of the operative itself but rather because of the poorer preoperative status of patients with PTA compared with those with primary OA [9].

Six studies examined the presence of TKA for any cause as a final point. Lizaur-Utrilla et al [13] did not find a significant difference in survivorship between PTA patients and primary OA patients, and Lunenburg did note a difference [9]. This difference is probably due to differences in observation lengths. With the increase in the follow-up time, there appears to be a significant difference, as the TKA need for further revisions on the PTA patients which lead to reduce the survival of PTA compared to what was done for TKA performed to the primary OA. According to Abdel and others, most TKA reviews are made for polyethylene wear [17]. Since patients with PTA are more likely to be seen at an earlier age than primary OA, it is reasonable to at least partially contribute with the decreased survivorship of TKA in PTA patients because of increased use and wear due to the younger age of this patient's group [14]. Moreover, the difference in the TKA survivorship is due to the patients' population and not because of intrinsic success of the surgery. In previous study conducted by Stiehl et.al., the authors reported higher risk rates of failure in females and younger patients [24]. Therefore, there is a need for long-term studies in order to better understand the factors associated with survivorship of TKA in PTA patients.

In all studies including in this review, complications with TKA were reported including infection, wound complications, stiffness, osteolysis/ polyethylene wear and intraoperative rupture of tendons. In previous study conducted by Scott et al, the authors reported no significant differences in the overall rate of complications between patients had TKA for PT or primary OA [16]. In the same study, the authors found that the type of the complications itself differed among the two groups where wound complications and stiffness were reported in patients with TKA in more frequency in OTA [16]. In the study of Abdel et al, the authors reported that 90 % of the complications were occurred during the first two years of surgery however, the study assessed 15 years following-up [17]. This data showed that perioperative complications of TKA are more significant than those with long-term pattern [17]. However, the high rate of complications related to TKA, most of them did not affect the functional outcomes nor require further surgeries [13].

There are many factors that were found to be contributed with high rate of complications including that patients with PTA have previous inherent health challenge where in most cases with PTA, the disease cause severe joint deformity which is accompanied by arthrofibrosis and/ or malunion or nonunion of the fracture [11]. Another factor was that PTA patients in most cases had previous operations which compromise the soft tissue that surround the knee and thus these patients had higher risk for having infections and other wound complications [14]. Previous fracture surgeries in patients with PTA are significantly associated with increased risk for infection after TKA [25]. In previous study conducted by Piedade et al. the authors reported that pervious knee surgery increase the risk for post-operative complication in primary TKA [26]. Moreover, scarring of the tissue is another risk factor including fibrosis which complicate the exposure during surgery and positioning of the implant during the procedure [14,18]. Mispositioning has been found to have a significant negative impact on the long-term survival of TKA [27]. In order to prevent these complications, ensuring of proper positioning, preserving of skin and soft tissue vascularity and restore limb alignment should be conducted [20,28]. Moreover, most of studies that reported improvement with TKA, only few studies observed complications [6,15].

This study unfortunately had some limitations including inconsistency among studies considering the using criteria to assess the functional outcomes of TKA however, this did not affect the inter study comparison as most of the studies used the KSS scoring system. Another limitation was that however several fractures were examined in these studies, all the results were grouped in this revie. Moreover, there was a difference among the studies in the average length of follow up ranging between 3 to 15 years therefore, these complications were short- and long-term outcomes.

In conclusion, this study showed that TKA is an effective strategy in the treatment of PTA, and it improve the functional outcomes, range of motion as well as pain. Poorer preoperative status of patients with PTA may give an explanation for the difference found in the outcomes of TKA between PTA and primary OA. There is high rate of complications associated with TKA where most of them occurred in the perioperative period.

Conflicts of Interest

None

Funding Statement

None

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