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Original Research Article

SHORT-TERM CLINICAL AND FUNCTIONAL OUTCOMES OF UNCEMENTED PRESS-FIT TITANIUM RADIAL HEAD PROSTHESES FOR RADIAL HEAD/NECK FRACTURES: AN INSTITUTIONAL BASED STUDY

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ABSTRACT

Background: Radial head and neck fractures, particularly Mason Type II–IV injuries, often compromise elbow stability and function. Radial head arthroplasty has become an essential treatment option for comminuted or non-reconstructible fractures. Uncemented press-fit titanium prostheses are widely used due to their favourable biomechanical and biological properties. This study evaluates the short-term clinical and functional outcomes following radial head arthroplasty with an uncemented press-fit titanium implant. The aim is to assess the short-term clinical, radiological, and functional outcomes of patients undergoing uncemented press-fit titanium radial head arthroplasty for radial head and neck fractures. **Materials and Methods:** This prospective–retrospective observational study included 20 adult patients treated at SSG Hospital, Vadodara, between June 2020 and December 2021. Eligible patients were >20 years old with Mason Type II–IV radial head fractures or isolated radial neck fractures. Detailed clinical assessment, radiographic evaluation, and routine preoperative workup were performed. All surgeries were conducted under regional anaesthesia using the Kocher approach. An uncemented press-fit modular titanium prosthesis was used in every case. Postoperative rehabilitation included early mobilisation, with follow-up at 4, 6, and 12 weeks and 6 months. Clinical evaluation included pain, range of motion (ROM), and stability, while functional outcomes were assessed with the Mayo Elbow Performance Score (MEPS). Radiographs were analysed for implant alignment and complications. **Result:** The study population predominantly consisted of males (80%), with most injuries caused by falls (80%). Mason Type III fractures were the most frequent (65%). Postoperative complications were minimal, with elbow stiffness seen in only 20% of patients. At final follow-up, 80% reported no pain and demonstrated ROM arcs >100°, and all elbows were clinically stable. Functional recovery was excellent in 80% of patients and good in 20%, as per MEPS. No cases of implant loosening, heterotopic ossification, or nerve injury were observed. **Conclusion:** Uncemented press-fit titanium radial head prostheses provide excellent short-term functional outcomes, effective pain relief, stable elbow kinematics, and minimal complication rates. The procedure represents a reliable and safe option for managing complex radial head and neck fractures requiring arthroplasty.

INTRODUCTION

Radial head and neck fractures represent one of the most common patterns of elbow injury in adults and are particularly important because of their impact on both elbow and forearm function. The radial head acts as a secondary stabilizer to valgus stress, resists axial loading, and contributes significantly to the normal kinematics of forearm rotation. Disruption of this structure, especially when combined with ligamentous injury or additional fractures, can therefore lead to pain, instability, stiffness, and long-term functional impairment if not managed appropriately.[1] The clinical challenge is not only to achieve fracture union but also to restore a stable, mobile, and painless elbow that permits return to

work and daily activities. Historically, the understanding of radial head fractures was shaped by Mason's seminal description based on 100 consecutive cases, which introduced a classification system that remains the foundation for contemporary decision-making.[2] Mason's original three-type system distinguished undisplaced fractures (Type I), displaced fractures (Type II), and comminuted fractures involving the entire head (Type III), with later modifications adding fracture–dislocations as a fourth category. This framework is still widely used in clinical practice because it correlates broadly with treatment strategies, from non-operative care for simple fractures to fixation or replacement for more complex injuries.[3] Despite its age, the Mason classification continues to underpin both research reporting and operative indications in radial head trauma. Epidemiological studies have shown that radial head fractures account for a substantial proportion of elbow injuries in adults. Kaas et al. reported an incidence of approximately 2.8 per 10,000 inhabitants per year, with these injuries representing a significant share of all elbow fractures.[4] Subsequent registry-based analyses have confirmed that radial head and neck fractures constitute between 1.7% and 5.4% of all fractures and roughly one-third of elbow fractures in adults, with a bimodal distribution related to age and mechanism of trauma.[5] Younger patients more often sustain these injuries following sports or high-demand activities, whereas older patients are more likely to present after low-energy falls, often in the setting of osteopenia or associated injuries. This epidemiological profile underscores the need for treatment strategies that can accommodate both high functional demands in younger individuals and more fragile bone in older patients. Beyond simple intra-articular fractures, a large proportion of radial head injuries are now recognized to be part of complex injury patterns. These include fracture–dislocations, terrible triad injuries (elbow dislocation with radial head and coronoid fractures), and Essex–Lopresti lesions involving longitudinal forearm instability.[1,6] In such settings, restoration of the radiocapitellar articulation is crucial to re-establish elbow and forearm stability. When the radial head is severely comminuted and not amenable to stable anatomic fixation, excision alone can compromise valgus and axial stability, particularly when there is associated ligamentous insufficiency or coronoid involvement.[6] This has led to increasing reliance on radial head arthroplasty (RHA) as a reconstructive option in complex trauma. Treatment algorithms for radial head fractures have evolved considerably over the past decades. Non-operative management remains the mainstay for Mason Type I fractures and selected Type II injuries with minimal displacement and no mechanical block.[3,7] Open reduction and internal fixation (ORIF) is generally preferred for reconstructible fractures with a limited number of large fragments, allowing restoration of articular congruity and preservation of native bone. However, several clinical studies have demonstrated high rates of fixation failure, secondary displacement, nonunion, or restricted motion when ORIF is attempted in markedly comminuted fractures.[6] In these situations, radial head replacement with a metallic prosthesis has emerged as a more reliable option to restore joint congruence, maintain elbow stability, and permit early mobilization. The role of RHA in acute trauma has been reinforced by comparative studies showing that, for unstable, displaced fractures with multiple fragments, replacement can provide more predictable stability and functional outcomes than ORIF.[6] Modern designs include monoblock and modular implants, with variations in stem fixation (cemented vs uncemented), polarity (unipolar vs bipolar), and materials (usually cobalt–chromium or titanium alloys). In acute fracture settings, modular metallic prostheses allow intraoperative adjustment of head diameter and height, improving restoration of native anatomy and reducing the risk of "overstuffing" the radiocapitellar joint.[3,5] Uncemented press-fit stems, particularly in titanium, have gained popularity due to their theoretical advantages: bone preservation, shorter operative times, avoidance of cement-related complications, and facilitation of revision surgery if needed.[5,7]

MATERIALS AND METHODS

This was a combined prospective and retrospective observational study conducted in the Department of Orthopaedics, SSG Hospital attached to Baroda Medical College, Vadodara, Gujarat. The study period extended from June 2020 to December 2021. The primary objective was to evaluate short-term clinical and functional outcomes following radial head arthroplasty using an uncemented press-fit titanium radial head prosthesis in patients with fractures of the radial head and neck. Institutional ethics committee approval was obtained prior to commencement of the study, and all participating patients provided written informed consent. A total of 20 consecutive patients with radial head and neck fractures who underwent radial head replacement at our institution during the study period were included. Patients were admitted either through the outpatient orthopaedic department or the emergency casualty services. For each patient, demographic details (name, age, sex), occupation, mode of injury, relevant past medical and surgical history, and history of drug allergies were recorded. The sample size for this study was fixed at 20 patients and was not altered for either arm of the analysis.

Inclusion and exclusion criteria

Patients older than 20 years of age with Mason type II, III, or IV fractures of the radial head and those with isolated radial neck fractures with the fracture line not extending into the shaft were eligible. Only patients without major co-existing systemic comorbidities, who were medically fit to undergo

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surgery, were included. Patients younger than 20 years; those with Mason type I radial head fractures; compound fractures; associated neurovascular injuries; multiple prior surgical procedures on the same limb; or repeat trauma to the same limb after the index procedure were excluded from the study.

Methodology

On admission, all patients underwent detailed general and primary trauma evaluation with emphasis on airway, breathing and circulation, screening for associated head, chest, abdominal and limb injuries, followed by local examination of the elbow for swelling, deformity, wound status, skin condition, range of motion and distal neurovascular status, which was intact in all cases. Standard anteroposterior and lateral radiographs were obtained in every patient, with 3D CT scans performed when needed to delineate fracture morphology; fractures were classified according to the Mason system and immobilised in an above-elbow slab and sling until surgery. Preoperative workup included routine anaesthetic evaluation and optimisation with complete hemogram, blood sugar, renal and liver function tests, electrolytes, viral markers, ECG and chest radiograph, plus echocardiography in elderly or cardiac patients. After confirmation of fitness and written informed consent, the limb was prepared using standard aseptic protocols, intravenous paracetamol was given for analgesia, ceftriaxone was administered prophylactically, and all sizes of the uncemented press-fit titanium radial head prosthesis and instruments were checked. All procedures were performed under regional anaesthesia with a pneumatic tourniquet, with the patient supine and the forearm pronated; a posterolateral Kocher approach was used in all cases, developing the anconeus–extensor carpi ulnaris interval in pronation and performing a longitudinal capsulotomy to expose the radial head and radiocapitellar joint. Comminuted radial head fragments were excised and the radial neck cut at the head–neck junction or fracture level; fragments were reassembled to estimate native head size and guide selection of a modular titanium prosthesis, avoiding oversizing or over-lengthening. The radial canal was sequentially reamed and an uncemented press-fit stem with modular head was implanted after trialling to confirm radiocapitellar congruity, restoration of proximal radioulnar joint level and elbow stability and motion under fluoroscopy. The annular ligament and soft tissues were repaired and the wound closed in layers with sterile dressing; postoperative care included limb elevation, early mobilisation of fingers, wrist and shoulder, radiographs on day one to confirm implant position and, when permitted, initiation of gentle active elbow motion. Sutures were removed around day 15 and patients followed a home-based rehabilitation programme with activity restriction; clinical and radiological follow-up at 4, 6 and 12 weeks and at 6 months assessed pain, range of motion, function, implant status and complications, with outcomes graded using the Mayo Elbow Performance Score (excellent ≥90, good 75–89, fair 60–74, poor <60).

RESULTS

[Table 1] Demographic Characteristics (Age and Gender)

The study consisted of 20 adult patients with radial head and neck fractures. The age distribution showed that half of the patients (50%) belonged to the 31–40-year age group, making it the most commonly affected population. This indicates that such injuries predominantly occur in young to middle-aged adults, likely due to higher levels of outdoor activity and occupational demands. The 41–50-year age group constituted 25% of cases, while the 19–30-year group accounted for 20%, demonstrating that radial head fractures are also frequent in younger individuals. Only 5% of patients were above 50 years, suggesting that this type of injury is less common in older adults who may experience different fracture patterns due to osteoporosis.

Gender distribution revealed that males were predominantly affected, with 16 male patients (80%) and only 4 female patients (20%). This male predominance aligns with the occupational and lifestyle exposure commonly seen in fracture epidemiology, where males experience higher rates of high-impact or activity-related injuries.

[Table 2] Injury Characteristics (Mode of Injury and Fracture Type)

The majority of fractures in this study resulted from a fall, accounting for 80% of the cases. This suggests that low-energy trauma, such as a fall on an outstretched hand, remains the most frequent mechanism leading to radial head and neck fractures. Road traffic accidents (RTAs) accounted for the remaining 20%, representing higher-energy trauma mechanisms.

Regarding fracture classification, Mason Type 3 fractures (comminuted injuries) were the most common presentation, observed in 65% of patients. This high prevalence reflects the complexity of fractures requiring prosthetic replacement. Mason Type 2 fractures, which involve displaced but less comminuted fragments, were seen in 25% of cases. Mason Type 4 fractures, characterized by fracture dislocation of the elbow, were found in only 10% of patients. The higher proportion of Mason Type 3 fractures indicates that severe comminution is a major indication for radial head arthroplasty.

[Table 3] Trauma–Surgery Interval and Associated Comorbidities

Most patients (85%) underwent surgery within the first week following injury, reflecting early surgical intervention as the standard practice for complex radial head fractures requiring arthroplasty. A small proportion of patients (10%) underwent surgery between 1–2 weeks after the trauma, which may be attributed to delayed presentation or initial non-surgical attempts. Only one patient (5%) was

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operated on after more than two weeks, often due to associated injuries or medical conditions requiring stabilization before surgery.

Comorbidity assessment showed that a significant majority (85%) had no underlying medical conditions, indicating that the study population was generally healthy. Hypertension was present in 5% of patients, while diabetes mellitus was noted in 10% of cases. The low prevalence of comorbidities suggests that postoperative recovery and outcomes were less likely to be influenced by systemic diseases.

[Table 4] Postoperative Complications

The overall complication rate was low in this study. Elbow stiffness was the only complication observed, occurring in 4 patients (20%). This is a commonly encountered postoperative issue following elbow arthroplasty due to soft-tissue trauma and postoperative guarding. Importantly, no neurological complications such as PIN palsy were observed. Additionally, there were no cases of heterotopic calcification, capitohumeral arthritis, implant loosening, or postoperative infection. The absence of these complications indicates that the surgical technique used was safe and effective, and postoperative care was adequately managed.

[Table 5] Clinical Outcome Parameters (Pain, Range of Motion, Stability)

Pain assessment at final follow-up revealed that most patients (80%) experienced no pain, while 20% reported mild pain. No patient reported moderate pain, indicating excellent postoperative pain control and successful restoration of joint function.

Range of motion (ROM) outcomes were similarly positive. A large majority (80%) exhibited an arc of motion greater than 100°, demonstrating near-normal elbow mobility. The remaining 20% had an arc of 50–100°, while no patient had an arc less than 50°. These findings suggest that radial head arthroplasty with a press-fit titanium prosthesis reliably restores functional elbow mobility.

Stability assessment showed that all patients (100%) had a stable elbow joint postoperatively. None exhibited instability, highlighting the effectiveness of prosthetic implantation in maintaining joint congruence and ligament balance.

[Table 6] Functional Status and Final MEPS

Functional outcomes were highly satisfactory in this patient cohort. All patients were able to perform key activities of daily living, including feeding, maintaining personal hygiene, wearing a shirt, and wearing shoes. Additionally, 80% of patients could comb their hair, an activity requiring combined shoulder and elbow mobility, reflecting good overall limb function.

Final functional assessment using the Mayo Elbow Performance Score (MEPS) demonstrated that 16 patients (80%) had excellent outcomes, while the remaining 4 (20%) had good outcomes. No patients fell into the fair or poor categories. This distribution clearly shows that radial head arthroplasty using an uncemented press-fit titanium implant yields excellent short-term functional recovery and patient satisfaction.

Table 1: Demographic Characteristics (Age and Gender)

Parameter	Category	Frequency	Percentage
Age Group	19–30	4	20%
	31–40	10	50%
	41–50	5	25%
	51–62	1	5%
	Total	20	100%
Gender	Male	16	80%
	Female	4	20%
	Total	20	100%

Table 2: Injury Characteristics (Mode of Injury and Fracture Type)

Parameter	Category	Frequency	Percentage
Mode of Injury	Fall Down	16	80%
	Road Traffic Accident (RTA)	4	20%
	Total	20	100%
Fracture Type	Mason Type 2 (displaced)	5	25%
	Mason Type 3 (comminuted)	13	65%
	Mason Type 4 (fracture dislocation)	2	10%
	Total	20	100%

Table 3: Trauma–Surgery Interval and Associated Comorbidities

Parameter	Category	Number of Patients	Percentage
Trauma–Surgery Interval	< 1 week	17	85%
	1–2 weeks	2	10%
	> 2 weeks	1	5%
	Total	20	100%
Comorbidities	Hypertension (HTN)	1	5%
	Diabetes Mellitus	2	10%
	No comorbidities	17	85%
	Total	20	100%

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Table 4: Postoperative Complications

Parameter	Category	Frequency	Percentage
Complications	PIN palsy	0	0%
	Elbow stiffness	4	20%
	Heterotopic calcification	0	0%
	Capitohumeral arthritis	0	0%
	Implant loosening	0	0%
	Infection	0	0%

Table 5: Clinical Outcome Parameters

Parameter	Category	Number of Patients	Percentage
Pain	None	16	80%
	Mild	4	20%
	Moderate	0	0%
Arc of Motion	> 100°	16	80%
	50–100°	4	20%
	< 50°	0	0%
Stability	Stable	20	100%
	Unstable	0	0%

Table 6: Functional Status and Final MEPS

Parameter	Category	Number of Patients	Percentage
Functional Tasks	Comb hair	16	80%
	Feed	20	100%
	Hygiene	20	100%
	Done shirt	20	100%
	Done shoe	20	100%
MEPS Score	Excellent	16	80%
	Good	4	20%
	Fair	0	0%
	Poor	0	0%
	Total	20	100%

DISCUSSION

The present prospective–retrospective study of 20 patients treated with uncemented press-fit titanium radial head prostheses for radial head/neck fractures shows very favorable short-term clinical and functional outcomes, and these findings are broadly comparable to, or slightly better than, many previously published studies of radial head arthroplasty (RHA).

In the current study, the mean age was 36.7 years, with half of the patients in the 31–40-year group and 80% being male, and 80% of injuries due to simple falls. This reflects a relatively young, active cohort with predominantly low-energy trauma. Baek et al. reported on 24 patients undergoing radial head replacement for complex fractures with a higher mean age of 49.8 years (range 19–73), but a similar pattern of low-energy mechanisms and good outcomes, with a mean MEPS of 88.7 and VAS pain of 0.6 at a mean 59-month follow-up.[8]

Fracture complexity in this study was high, with 65% Mason type 3 and 10% Mason type 4 injuries, reflecting the typical indications for prosthetic replacement. Moghaddam et al. evaluated 85 comminuted radial head fractures treated with a modular metallic prosthesis; among the 75 patients reviewed, 28% were Mason III and 69.3% Mason IV, and the mean MEPI was 83.3 at 41.5-month follow-up.[9] Their cohort had an even higher proportion of Mason IV injuries than ours, but both studies confirm that RHA is mainly reserved for non-reconstructible, unstable fractures. Importantly, Moghaddam et al. also showed better functional scores in patients treated within 5 days of injury, which is consistent with our practice of operating early in most cases (85% within 1 week).

Our functional results at 6 months (80% excellent, 20% good MEPS, no fair/poor outcomes) compare favorably with classic long-term data. Harrington et al. reported on 20 patients with unstable elbow fractures treated with metallic radial head implants, with a mean follow-up of 12.1 years; 12 patients (60%) had excellent, 4 (20%) good, 2 (10%) fair, and 2 (10%) poor outcomes on a Mayo-based rating system.[10] While our follow-up is shorter, our 100% excellent/good rate suggests that short-term results with modern press-fit designs in a younger cohort can match or exceed the long-term functional distribution reported by Harrington et al., though durability beyond the short term still needs confirmation.

With regard to implant design, our study used an uncemented press-fit titanium stem in all cases and, at short-term follow-up, showed no radiographic loosening, osteolysis, or need for revision. This contrasts with the larger retrospective study of Flinkkilä et al., who reviewed 42 metallic press-fit radial head prostheses with a mean age of 56 years and mean 50-month follow-up: 25 implants remained well fixed, but 9 (21%) were removed for loosening and 3 remained in situ but radiographically loose, with a mean MEPS of 86.[11]

Range-of-motion (ROM) outcomes in this study were very satisfactory: 80% of patients achieved an arc of

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motion >100°, 20% between 50–100°, and none had <50°. Martín-Fuentes et al. reported on 44 elbows treated with radial head prostheses and observed a mean flexion–extension arc of about 108° and a pronation–supination arc around 135°, with roughly 82% of patients achieving satisfactory or good MEPS.[12] Our distribution, with all patients maintaining at least 50° of motion and the majority exceeding 100°, is consistent with these findings and suggests that early mobilization using an uncemented press-fit implant can reliably restore functional ROM comparable to other contemporary studies.

Elbow stability was fully restored in all patients in the present study, with 100% of elbows graded stable and no postoperative dislocations. This aligns with the midterm results of Nosenzo et al., who evaluated 17 irreparable radial head fractures treated with a bipolar press-fit prosthesis and reported MEPS outcomes of 10 excellent, 5 good, and 2 fair cases, with no persistent instability, although 3 implants required removal for early loosening.[13]

Pain and basic functional recovery in our patients were excellent: 80% reported no pain and 20% only mild pain; all patients could feed, maintain hygiene, and dress independently, and 80% could comb their hair. Eyberg et al., in a clinical study of radial head replacements, observed continued improvement in functional scores up to 9 months postoperatively and reported an absence of major complications such as infection or instability.[14]

Complication rates in this study were low and limited to elbow stiffness in 4 patients (20%), all of whom improved with physiotherapy; there were no cases of nerve palsy, heterotopic ossification, arthritis, infection, or implant loosening in the short term. Chen et al., in a meta-analysis comparing unipolar and bipolar radial head prostheses, found that both designs generally produced similar functional outcomes but that radiographic issues such as osteolysis and loosening were not rare, although often clinically silent.[15]

When our 80% excellent and 20% good MEPS distribution is viewed against broader literature, it falls at the upper end of reported results. In a systematic review, Heijink et al. concluded that most RHA studies achieved good or excellent functional outcomes in approximately 80–90% of patients but also highlighted revision rates that could approach 10–20% over mid- to long-term follow-up.[16]

The pattern and prevalence of complications observed here also contrasts with the failure mechanisms described in larger reviews. Viveen et al. systematically analyzed reasons for failure of radial head arthroplasty and found that stiffness, painful loosening, overstuffing, and instability were among the most frequent causes leading to revision or removal.[17] In our study, stiffness was the only complication and responded to conservative management, and there were no early signs of overstuffing or instability. This suggests that careful attention to implant sizing, avoidance of over-lengthening, and early rehabilitation—combined with the relatively low comorbidity burden (85% without systemic disease) in our cohort—may reduce the risk of the more serious failure modes described by Viveen et al., though longer observation is needed to confirm this trend.[17]

Finally, when compared with other studies that include older, more comorbid patients and a higher proportion of terrible triad or Mason type IV injuries, our younger cohort with predominantly Mason type III fractures and early surgery appears to achieve at least equivalent, and possibly superior, short-term outcomes in terms of pain relief, ROM, stability, and MEPS.

CONCLUSION

The use of uncemented press-fit titanium radial head prostheses in this study demonstrated favourable short-term clinical and functional outcomes, with reliable restoration of elbow stability and motion. Patients showed progressive improvement in pain, range of motion, and daily functional ability over successive follow-ups. Radiological assessments confirmed satisfactory implant positioning without early loosening or major complications. Overall, the procedure proved to be a safe and effective option for managing complex radial head and neck fractures.

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