IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 20, Issue 9 Ser.3 (September. 2021), PP 01-10
www.iosrjournals.org

Functional Outcome of Radial Head Arthoplasty in Mason type 3 and 4 fractures

Dr Vikash Kumar Jha[1,c] Prof (Dr.) H.C. Frank[2] , Asst prof (Dr.) H. Rahman[3]
Department of Orthopaedic Surgery , Gauhati Medical college & Hospital, Guwahati, Assam, India

Abstract*: Radial head fractures account for 30% of all elbow related fractures[3]. In complex injuries the radial head is actively involved, being a major structure of the humeroradial joint which constitutes the lateral column of elbow. Its integrity provides optimal support even in presence of medial collateral ligament lesion, or minor coronoid fractures[6]. Thus radial head fracture with greater comminution, if left untreated will catalyse complex functional impairment in which there will be block to prono-supination or flexion/extension[16] . The treatment of mason type 3 fractures have been in debate since decades between fixation or replacement[16,18]. Due to the substantial role in stability of elbow and forearm, it has aroused greater attention regarding replacement of the radial head with regard to creating a more biomechanically suitable fixation. The excision alone can alter elbow stability, whereas arthoplasty offers better results than isolated resection in cased with associated instability[4,19]. **Material and methods:** A prospective study on Radial head arthoplasty in 20 cases of mason type iii, iv were done in Gmch ,Guwahati, between May 2019-June 2020 with proper institutional ethical clearance and were followed up till 1year. **Results:** the mean MEPI score in our study was 92 which co relates to excellent p(<0.001) , mean ROM in our study with bipolar prosthesis was flexion/extension 120/-10 (p<0.001) pronation/supination 65/65.5 (p <0.001) **Conclusion:** Radial head replacement serves as an excellent primary stabilization with added benefits of early resumption of motion with a rapid integration of the patient in socio-economic life .*

Date of Submission: 25-08-2021 Date of Acceptance: 09-09-2021

I. Introduction

Radial head fractures are most frequent fractures encountered around the elbow [1] and they account for 4% of all fractures and more than 30% of all elbow related fractures, primarily in 44–47.9 years of active working individuals.[1,2,3] with M:F ratio 2:3[3] .
In complex injuries of the elbow, the radial head is actively involved. Being a major structure of the humero-radial joint constituting the lateral column of the elbow[4,5], Its integrity provides optimal elbow stability even in the presence of other minor
lesions, such as lesions of the medial collateral ligament (MCL) or minor coronoid fractures[6,7] .Thus a fractured radial head with comminution, left untreated can catalyse complex functional impairment in which movements of the elbow & forearm are grossly restricted, all of these would affect daily affairs of individuals[3,6]

The substantial role of radial head, in the stability of elbow joint and the forearm have aroused greater attention regarding replacement of the radial head with regard to creating a more biomechanically suitable fixation[5-7]. In cases with associated elbow instability, the most appropriate treatment is replacing the fractured radial head with prosthesis [10,14].In the rare situation in which the osteosynthesis is stable and there is no elbow instability, osteosynthesis could be performed [8,12,20] . Removal without arthroplasty can change elbow biomechanics and stability, which is why associated arthroplasty offers better results than isolated resection in cases without associated instability[5,13]

The outcomes and drawbacks of radial head excision are described in many studies, in thetreatment of complex fractures which lead to long term valgus instability,
longitudinal instability with positive ulnar variance and wrist pain , loss of strength and ulno - humeral degenerative changes[7,18] In Mason type III fractures, the vascular supply of the epiphysis proximal to the radial is limited to small intra-articular vessels, open reduction and osteosynthesis could also cause associated osteonecrosis[10,13]

Radial head removal would be contraindicated in patients with incompetent medial collateral ligament, interosseous membrane lesion or elbow dislocation and it has been related with pain, instability, proximal translation of the radius, osteoarthritis, loss of strength and cubitus valgus,mainly when there was some type of

under-lying instability[5,13,25] thus excision of radial should not be done in presence of associated elbow or forearm instability, as restoration of radio capitellar contact is essential[20,21].

This clinical study intends to assess the functional outcomes and complications of radial head arthoplasty in the treatment of unsalvageable communited radial head fractures Mason type III or type IV .

II. Material & Methods

The present study includes 20 cases of comminuted radial head fractures presenting to the Department of Orthopaedics ,Guwahati medical college and hospital, between May 2019 to June 2020 with proper institutional ethical clearance. In our study, we used metallic, titanium monoblock radial head prostheses

Inclusion criteria :

1.Mason type III & IV Radial head fracture

2. Essex lopresseti fracture

Exclusion criteria :

1. Mason type I & II Radial head fracture
2. Open fractures of the elbow

Tests of Normality - Kolmogorov-Smirnova & Shapiro-Wilk was used to derive p value.

Paired t –test was used to assess significance of findings with 95% confidence interval. All p - values less than 0.05 was taken as significant

In emergency department, The fractures were reduced in closed manner by supination – flexion technique and an above elbow slab was applied. Post reduction Check X-rays were taken to know the fracture pattern. The Limb was immobilized in a above elbow pop slab and collar and cuff sling.

Radiological examination –Anteroposterior and lateral view of the Elbow, AP and lateral view of the affected wrist, CT Scan with 3d reconstruction done.

PRE –OPERATIVE PREPARTION:

The diametrical size and thickness of the radial head prosthesis ,was determined pre- operatively by X ray, and CT scan measurement of the opposite elbow native radial head. The accurate determination of size in the affected elbow was hampered due to fracture, displaced fragments so the contralateral elbow was taken. Patient was explained about all advantages and disadvantages of the procedure and other treatment options available, and after proper counselling radial head replacement was done.

Surgical Approach

The surgical part was cleaned, prepared and drapped from mid arm to whole of hand. The Kocher's Posterolateral approach to the elbow was used to the elbow[6,9,16]. A curved incision beginning over the posterior surface of lateral humeral epicondyle and continuing downward and medially to a point over the posterior border of ulna, about 6cm distal to tip of olecranon[6,21]. Subcutaneous tissue and fascia were dissected in line of skin incision, deep dissection was carried out in kochers internervous plane, between anconeus and extensor carpi ulnaris[25].

The lateral ligament complex is exposed and examined for any rupture ,forearm is fully pronated to move posterior interosseous nerve away from the operative field[14,18]. Capsule of elbow joint is incised longitudinally at the annular ligament to reveal the underlying capitellum, and radial head. The capsule should not be dissected too far anteriorly as damage to the PIN can occurs, since it runs over the anterolateral portion of the elbow capsule. the LCL complex is in danger and proper care must be ensured not to release the origion or insertion of this ligament. Thus it is critical to stay anterior to the posterior border of the ECU[6,8,32].

The Exposed radial head is now seen & decision for reconstruction or replacement of the radial head undertaken.

Visual observation of lateral ulno–humeral joint gap is a reliable indicator of overlengthening following implantation of radial head prosthesis. This gap can be assessed after excision of the native head and after Implantation of the trial head[7,32]

Most proximal osseous extent of the radial head was on average , 0.9 mm more proximal than the lateral osseous edge of the coronoid. Proximal edge of the prosthesis should sit no more than 1 mm proximal to the corner of the lesser sigmoid notch on the coronoid [31,32]

If between sizes, smaller size was used[19,31].

Post Operative Care & Follow up:

Suction drain was removed the very next day. Wound was inspected and postoperative dressing was done , injectable antibiotics and analgesics were given for first 3days of postoperative period and switched to oral medications thereafter. Sutures were removed on the 14th postoperative day , and a Elbow Xray in AP and lateral views obtained . the patients were discharged with the forearm in an arm pouch, and were advised to perform shoulder, elbow, wrist and finger movements. Patients were advised against lifting heavy objects or exert the affected upper limb[35,37]. After discharge, patients were advised to review in ortho OPD for follow up after 2 weeks 6 weeks, 10 weeks and 14 weeks and 6 months the results were assessed after the procedure

After removal of POP Slab, Initiate elbow exercise program 5 times per day: Passive and active elbow ROM to full flexion & extension. Forearm pronation/supination with elbow at 90˚ flexion, Grip and wrist ROM immediately

In each follow up patients were assessed subjectively for the symptoms like pain, swelling and restriction of joint motion. The functional assessment of the patient was done according to Mayo Elbow Performance Score.

Variable	Definition	No. of points
Pain (max. 45 points)	None	45
	Mild	30
	Moderate	15
	Severe	0
Range of motion	Arc >100°	20
(max. 20 points)	Arc 50–100°	15
	Arc <50°	5
Stability	Stable	10
(max. 10 points)	Moderately unstable	5
	Grossly unstable	0
Function	Able to comb hair	5
(max. 25 points)	Able to feed oneself	5
	Able to perform personal hygiene tasks	5
	Able to put on shirt	5
	Able to put on shoes	5

Fig- 1 : Mayo elbow performance score

Ranking:

90- 100 point = Excellent **75-89 point = Good**

60- 74 point = Fair **Less than 60 point = Poor**

III. Results :

20 patients were studied with Mason type III , IV radial head fractures & treated by bipolar replacement radial head arthoplasty.

- Age ranged from 24-63 , with > 40% in 40-50 years age group, and 20% each in 5th and 6th decade. Males predominated the study with 75% of the cases. 65% of the cases visited emergency services.
- Most common MOI was fall on outstretched hands(45%) , followed by RTA(35%).
- In our study population, associated injury was only 20%
- Duration of surgery was mostly less than 120 minutes in 93.75% of cases, while with associated injury the duration of surgery was increased.
- In 16 cases, without associated injury the median time taken for surgery was 80 minutes,(p value 0.05) which is significant.
- Most of the cases were done within 2 weeks of injury , showing better results.
- In our study of 20 patients , 16 had excellent results (80%), 3 good(15%), 1 (5%) fair , with no poor outcome.
- The mean MEPS score at 6 months was 92 +/- 6.96, with 70 minimum score and 100 maximum score with p value of (< 0.0001).
- Elbow mean arc of flexion / extension was 10- 117.50 and pronation /supination was(65 +/- 6.05)/ (69+/-4.47) with p value(<0.0001)
- None of the patient altered hand dominance due to injury. There was no evidence of erosion or sclerosis of the proximal Radio-Ulnar joint , periprosthetic lucency.

- Only one patient had pain and stiffness at end of 6 month, and there was reduction in joint space of elbow with non alignment of radio capitellar axis.
- In 65% of cases there was no complication, while in 35% cases , the most common complication was pain on terminal movement in 3 caes (15%), one case of lateral epicondylitis (5%), 1 case of scar tenderness (5%), one case of heterotrophic ossification (5%).
- No cases was associated with over stuffing, distal neurovascular injury, deep infections.

Table -1 : Depicting MEPI score and its progress over time.

	MEPI SCORE					
	PRE OP	2ND WEEK	6TH WEEK	10TH WEEK	14 WEEK	6 MONTH
POOR	100.00%	100.00%	5.00%	0.00%	0.00%	0.00%
FAIR	0.00%	0.00%	85.00%	30.00%	5.00%	5.00%
GOOD	0.00%	0.00%	10.00%	70.00%	95.00%	15.00%
EXCELLENT	0.00%	0.00%	0.00%	0.00%	0.00%	80.00%

Fig 2: Bar diagram depicting MEPI score and its progress over time.

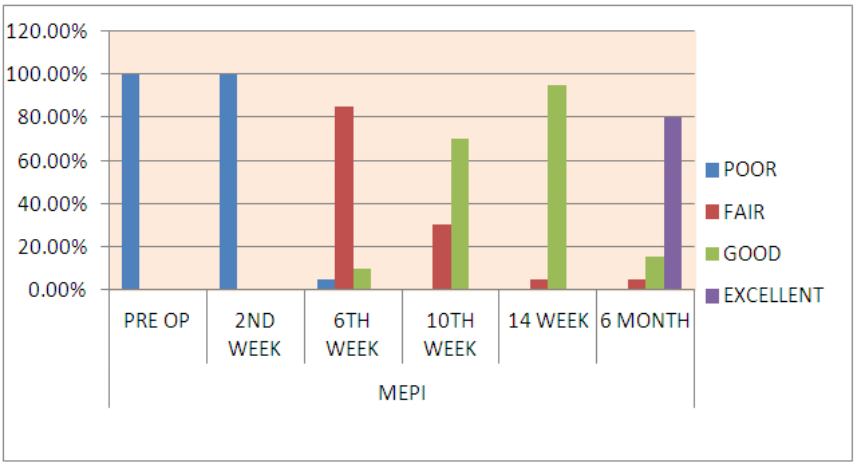

Fig-3: Depicting progress of MEPI score over time

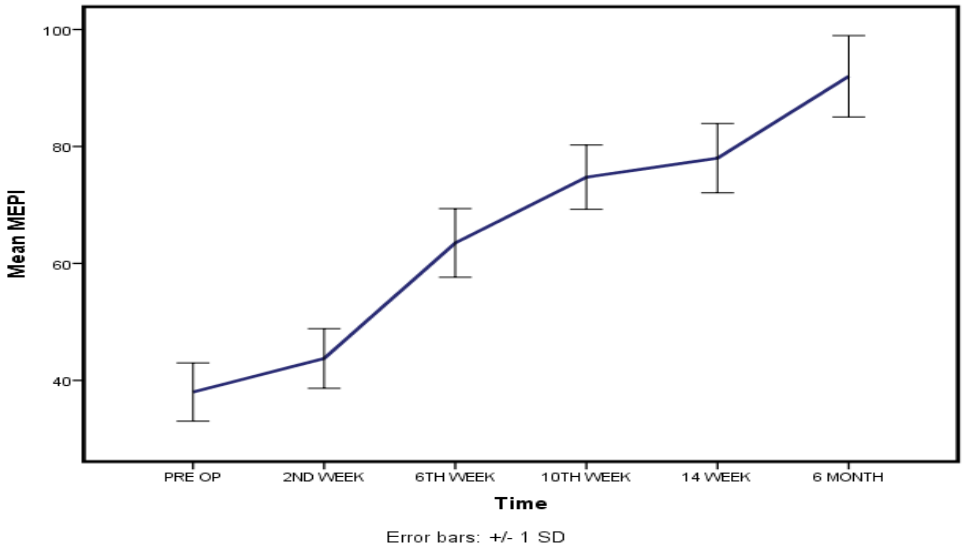

Table -2 : Depicting MEPI score and its progress over time.

	Mean (MEPI)	Min - Max	Median	Inter Quartile Range	p value
PRE OP	38.00+/-4.97	30-45	40	(32.5-40)	<0.0001
2ND WEEK	43.75+/-5.10	30-50	45	(40-48.75)	
6TH WEEK	63.50+/-5.87	50-75	62.5	(60-65)	
10TH WEEK	74.75+/-5.50	60-85	75	(70-80)	
14 WEEK	78.00+/-5.94	60-85	77.5	(75-83.75)	
6 MONTH	92.00+/-6.96	70-100	95	(90-95)	

IV. Discussion:

We describe 20 patients with mason type III & IV, treated with radial head arthoplasty in our premier institute. We prospectively studied the functional outcomes of radial head arthoplasty in mason type III radial head fractures and the outcomes were graded by Mayo elbow performance score(MEPS) and any associated complications noted.

In our study, >40% patients were in 40-50 years age group. Type iv fractures was common in 5th and 6th decade of life . kaas L reported the mean age of 48 years for radial head fractures , irrespective of the type of fractures involved. Madhukar et al [7] reported 34.9 years as their median age of injury . We have the similar findings in line with their study

Table -3 : Table comparing demographic profile:

Sl no	Reference	Male %	Female %	Age (most common)	side	Fracture (mason type)	MOI (MC)
1	Madhukar et al[7]	75.5	25	20-30(45%)	Left (51.1%)	Mason ii-51.5, mason iii-48.4%	foosh
2	Stănescu [18]	66	33	46.66yr	-	Mason iii -50%, iv -50%	-
3	Allavena et al[33]	72.2	27.2	44	-	Mason iii- 72%	foosh
4	Burkhart etal[35]	73	27	44	-	Mason iii- 84% , iv- 10%	-
5	Dotzis et al [27]	71	28	44.8	-	iii- 42%, iv - 57%	foosh
6	Flinkkila et al [28]	38	62	56	Left(57%)	iii- 41%, iv –59%	Fall from standing hieght
7	Grewal et al[20]	35%	65%	54	-	iii-9% , iv – 91%	foosh
8	Moro et al[37]	45%	55%	54+/- 14	-	iii- 40%, iv- 60%	-
9	Popovic et al [24]	62%	38%	51	-	Mason ii – 23%, iv – 77%	Foosh
10	Lamas et al [16,33]	39%	61%	51	-	iii- 57%, iv – 43%	foosh
11	Present study	75%	25%	20	Right (55%)	iii- 80%, iv -20%	foosh

Foosh- fall on out stretched hands

In our study there were 13 emergency admissions and 7 opd admissions, for which citing the role of RTA and the severity of injuries would be appropriate.

In our study , 15 persons were male and 5 respondents were females. The M:F ratio in our study was 3:1 . Kaas L[9,16] reported male :female ratio of 2:3 in his study in 2010. Radial head fractures occur mainly after fall on outstretched hand, which may occur at any age and sex., however we have found in >45% of cases , the mode of injury was fall on outstretched hand with the elbow partially flexed and pronated and RTA (DIRECT TRAUMA) cases constituted > 35% of cases. In our study the right side was predominantely involved in 55% of the cases. Madhukar et al [7] had also right sided predominant in their study [7, 33]

In our study, the associated injury was in 20% of the cases , with radial styloid process fracture, olecranon fracture , coronoid fracture an terrible triad injury . In one of the cases there was head injury where the treatment had to be delayed owing to the condition of the patient . However associated injuries are common in radial head fractures . Van riet et al reported in 2005, Kaas l et al in 2010[25], that clinically relevant associated injuries of the ipsilateral upper extremity were diagnosed in 39% of cases , a concomitant fracture of the ulna

occurs in 1.2-12% of the patient with a radial head fracture . In our study , incidence of associated injury was less than previous studies . It may be because our study population had injuries after simple fall on the ground with arms outstretched, while in other studies they had sports injuries, and high velocity trauma. However no conclusive evidence is present to support the finding .

Beingessner et al[24,35] reported increased elbow instability with ligament injury . since radial head arthoplasty has been shown to restore the axial and valgus stability reliably and to return to elbow kinematics to nearly normal levels in biomechanical studies. We opine that soft tissue heal properly in isolated fractures of radial head after radial head replacement ,but cases with complex injuries(Essex lopresseti fracture) are high energy trauma and healing of soft tissues are delayed/impaired , if not repaired, leading to elbow instability . However in our study we did not find any unstable elbow joint postoperatively . In other studies, LCL was repaired with repair of elbow capsule , but in complex injuries especially involving the proximal ulna fracture , special interest should be given to MCL integrity and repair.

The final arc of ulnohumeral motion averaged 115 degrees (range, 80–150 degrees) with flexion averaging 135 degrees (range, 90–150 degrees), with 10 degrees of average flexion contracture (range, 0–30 degrees), 75 degrees of pronation (range 45–90 degrees), and 70 degrees of supination (range, 50–90 degrees).[33]

Hannah meacher et al [4] used the elbow functional evaluation criteria by Broberg and Morrey, The outcome results were statistically significant in favor of radial head replacement.

In a recent study Duckworth et al.[10] found a 28% revision rate. Independent risk factors for failure were young age and the use of silicone implants. However, the study by French Society for the Shoulder and Elbow states, revision because of clinical failure was required in only 26 (8%) cases. Reasons for failure were loosening, instability, painful stiffness due to overstuffing, and/or radio-capitellar osteoarthritis[10]

E carita 2017 [24] results on 28 patients with an average follow-up of 49 months, they recorded. The ROM was found on average to be 107° of flexion–extension and 159° of pronosupination. Stability[24] was good in 25 cases, and the MEPS was 89, while one case of erosion of the capitellum surface due to overstuffing, we did not have any such cases they also reported two cases of heterotopic periprosthetic ossification., while we had also found two cases of heterotrophic ossification in our study .

In our study, we did not report any revision cases, however in one case with stiffness there might be provision of revision or removal of prosthesis., E carita 2017 [24] , also reported a very low revision rate of around 10% (3 cases out of 29). In one case, the revision was due to excessive length of the implant, with clinical and radiological signs of overstuffing

Table-4 : Comparison with MEPI score of different studies conducted -

Sl no	Name of author[reference]	Publication year	Study design	Location	Total no of patients	Mepi score At 6 months	P value
1	Madhukar et al [7]	2019	Prospective	India	15	78.33	0.453
2	Stănescu [31]	2017		Switzerland	6	87.5	-
3	Allavena et al[30]	2014	retrospective	Usa	22	79	-
4	Burkhart etal[35]	2001	Prospective	Germany	19	90.83	<0.05
5	Dotzis et al [33]	2006	prospective	France	14	6 excellent , 4 good, 1 fair, 1 poor	-
6	Flinkkila et al [29]	2012	retrospective	Finland	42	86	0.01
7	Grewal et al[20]	2006	prospective	Canada	24	82	-
8	Moro ET AL[26]	2010	prospective	Canada, london	24	87	-
9	Popovic et al [24]	2007	retrospective	Belgium	51	83	-
10	Lamas et al [36]	2010	prospective	Spain	47	{42 good to excellent}	-
11	Present study	2020	prospective	India	20	92 (excellent)	<0.0001

The mean MEPI SCORE in our study was 92, which co relates to excellent in the MEPI SCORE , the comparison with other studies are cited in the table above, good results in our studies can be due to , inclusion of young active individuals, less associated injuries low operative time and good adherence to post operative exercises and advices.

Table-5 :Mean clinical results for radial head arthoplasty [12].

Sl no	reference	Type of prosthesis	ROM	MEPS/MEPI
1	Carita E et al [26]	Cementless monopolar prostheses	Flexion-extension arc 107^0 Prono supination- 159^0	89
2	Laumonerie [12]	Guepar radial head prostheses	Flexion- 132^0 extension- (-12.9^0) supination 67.8^0 pronation 76^0	91.5
3	Lopiz[12]	radial head arthoplasty	Flexion-extension arc=(85.5^0)	6 excellent 3 good, 2 fair, 2 poor
4	Heijink[12]	Cemented bipolar radial head prosthesis	Flexion-extension arc=(129^0) Forearm rotation =(131^0)	13 excellent ,7 good, 3 fair, 1 poor
5	Kodde[12]	Pressfit bipolar radial head prosthesis	Flexion-extension arc=(126^0) Forearm rotation =(138^0)	17 excellent, 2 good, 7 fair, 1 poor
6	Allavena[20]	Modular bipolar radial head prosthesis	Flexion-extension arc=(100^0) Forearm rotation =(143^0)	79
7	Flinkkila[28]	Metallic radial head arthoplasty	Flexion-extension arc=(117^0) Extension deficit 20^0	86
8	DOTZIS A [33]	Judet bipolar prosthesis	Flexion-extension arc=$(14\text{-}140^0)$ Pronation/supination=$(87.5^0/84^0)$	Excellent 6, good 4, fair 1, poor 1
9	Ashwood N[12]	Metallic monoblock radial head prosthesis	Loss of Flexion=(10^0) Loss of Pronation = (12^0) Loss ofsupination=(12^0)	87
10	Moro JK[34]	Metal radial head arthoplasty	Flexion/extension=$(140^0/\text{-}8^0)$ Pronation/supination=$(78^0/68^0)$	80

V. Conclusion And Recommendation

There is a sound rationale to include Radial head arthoplasty into the therapeutic regime for comminuted radial head fractures, for which dependable internal fixation is not achievable (mostly in mason type iii, iv fractures) allowing anatomical reconstruction of the joint. Radial head replacement serves as an excellent primary and good stabilization as well with a added benefit of possibly early resumption of motion in the elbow joint under a rehabilitation treatment between 2½ and 6 months and a rapid reintegration of the patient in the socio-economic life and resumption of his day to day activities.

It also has very low complication rates and very low revision or removal rates, and the learning curve for the Radial head arthoplasty is not steep and is easily reproducible.

Photos for demonstration

CASE – Mason type iv radial head fracture at end of follow up

Pre op xray photo

Post reduction X-ray

Ct scan withn 3d reconstruction

Pre op determination of radial head size by taking X-ray of contralateral limb

Immediate Post op X-ray photo

Post op X-ray at 6 months

Clinical photographs at 6 months

Pronation of the forearm

Supination of forearm

Extension of bilateral elbow

Flexion at the bilateral elbow

Elbow extension –front view

Elbow flexion -side view

Bibliography

[1]. Heckman JD, McKee M, McQueen MM, Ricci W, Tornetta III P. Rockwood and Green's fractures in adults. Lippincott Williams & Wilkins; 2014 Sep 4. Green DP. Rockwood and Green's fractures in adults. Lippincott Williams & Wilkins; ninth edition.philadelphia:Wolters kluver; 2020:1415-95

[2]. Azar FM, Canale ST, Beaty JH. Campbell's operative orthopaedics book.SHOULDER AND ELBOW ARTHOPLASTY.13TH ed. Philadelphia: Elsevier Health Sciences; 2016 Nov 1.987-2248

[3]. Ring D, Jupiter JB, Zilberfarb J. Posterior dislocation of the elbow with fractures of the radial head and coronoid. JBJS. 2002 Apr 1;84(4):547-51.

[4]. Meacher H, Hermena S, Isaac S. Open Reduction and Internal Fixation Versus Radial Head Arthroplasty for Mason III Radial Head Fractures: Appraising the Current Literature Evidence. Cureus. 2020 Apr;12(4).

[5]. Zwingmann J, Bode G, Hammer T, Südkamp NP, Strohm PC. Radial head prosthesis after radial head and neck fractures–current literature and quality of evidence. Acta Chir Orthop Traumatol Cech. 2015 Jun 1;82:177-85.

[6]. McQueen MM. Epidemiology of fractures of the radius and ulna. Musculoskeletal trauma series: radius and ulna. Oxford: Butterworth-Heinemann. 1999.

[7]. Dr. Madhukar, Dr. Vinoth KR and Dr. Vijay Narasimman Reddy. Prospective comparative study of short term functional outcomes of radial head excision arthroplasty and radial head replacement arthroplasty in radial head fracture. National Journal of Clinical Orthopaedics. 2019; 3(1): 147-153

[8]. López Y, González A, García-Fernández C, García-Coiradas J, Marco F. Comminuted fractures of the radial head: resection or prosthesis?. Injury. 2016 Sep 1;47:S29-34.

[9]. Chanchpara G, Patil PV, Patil P, Gaonkar N, Lokare N, Gupta K, Solanki M, Alwani P, KIMS K. Treatment of Comminuted Radial Head Fracture with Modular Radial Head Replacement Prosthesis: A Case Report.

[10]. Bonnevialle N. Radial head replacement in adults with recent fractures. Orthopaedics & Traumatology: Surgery & Research. 2016 Feb 1;102(1):S69-79.

[11]. Yalcinkaya M, Bagatur AE, Erdogan S, Zorer G. Resection arthroplasty for Mason type III radial head fractures yield good clinical but poor radiological results in the long term. Orthopedics. 2013 Nov 1;36(11):e1358-64.

[12]. Catellani F, De Caro F, De Biase CF, Perrino VR, Usai L, Triolo V, Ziveri G, Fiorentino G. Radial head resection versus arthroplasty in unrepairable comminuted fractures Mason type III and type IV: a systematic review. BioMed research international. 2018 Jan 1;2018.

[13]. Contreras-Joya M, Jiménez-Martín A, Santos-Yubero FJ, Navarro-Martínez S, Najarro-Cid FJ, Sánchez-Sotelo J, Pérez-Hidalgo S. Radial head arthroplasty, 11 years' experience: A series of 82 patients. 6Revista Española de Cirugía Ortopédica y Traumatología (English Edition). 2015 Sep 1;59(5):307-17.

[14]. Jordan RW, Jones AD. Suppl-8, M8: Radial Head Fractures. The open orthopaedics journal. 2017;11:1405

[15]. King GJ, Zarzour ZD, Rath DA, Dunning CE, Patterson SD, Johnson JA. Metallic radial head arthroplasty improves valgus stability of the elbow. Clinical orthopaedics and related research. 1999 Nov(368):114-25.

[16]. Giannicola G, Sacchetti FM, Antonietti G, Piccioli A, Postacchini R, Cinotti G. Radial head, radiocapitellar and total elbow arthroplasties: a review of recent literature. Injury. 2014 Feb 1;45(2):428-36.

[17]. Choudhary BM, Kiswanth SP, Kumar RD. Is radial head resection a menace for the clinical outcomes of the elbow for comminuted radial head fractures?. Int J Res Orthop 2019;5:70-6.

[18]. Furry KL, Clinkscales CM. Comminuted fractures of the radial head: arthroplasty versus internal fixation. Clinical Orthopaedics and Related Research®. 1998 Aug 1;353:40-52.

[19]. Ring D. Radial head fracture: open reduction–internal fixation or prosthetic replacement. Journal of shoulder and elbow surgery. 2011 Mar 1;20(2):S107-12.

[20]. Ring D, Jupiter JB, Zilberfarb J. Posterior dislocation of the elbow with fractures of the radial head and coronoid. JBJS. 2002 Apr 1;84(4):547-51. Ring D, Jupiter JB. Current concepts review-fracture-dislocation of the elbow. JBJS. 1998 Apr 1;80(4):566-80.

[21]. N, Yoshida, and Tsuchida Y. ―Artificial Radial Head Replacement for Mason Type iii Comminuted Fracture.‖ Case Reports and Images in Surgery 1, no. 3 (2018)

[22]. Bennett JB. Radial head fractures: diagnosis and management. Journal of shoulder and elbow surgery. 1993 Sep 1;2(5):264-73.

[23]. Little CP, Graham AJ, Carr AJ. Total elbow arthroplasty: a systematic review of the literature in the English language until the end of 2003. The Journal of bone and joint surgery. British volume. 2005 Apr;87(4):437-44.

[24]. Morrey BF, Tanaka SH, An KN. Valgus stability of the elbow. A definition of primary and secondary constraints. Clinical orthopaedics and related research. 1991 Apr(265):187-95.

[25]. Lawton JN, Cameron-Donaldson M, Blazar PE, Moore JR. Anatomic considerations regarding the posterior interosseous nerve at the elbow. Journal of shoulder and elbow surgery. 2007 Jul 1;16(4):502-7.

[26]. Petscavage JM, Ha AS, Chew FS. Radiologic review of total elbow, radial head, and capitellar resurfacing arthroplasty. Radiographics. 2012 Jan;32(1):129-49.
[27]. Laumonerie P, Reina N, Kerezoudis P, Declaux S, Tibbo ME, Bonnevialle N, Mansat P. The minimum follow-up required for radial head arthroplasty: a meta-analysis. The Bone & Joint Journal. 2017 Dec;99(12):1561-70.
[28]. Acevedo DC, Paxton ES, Kukelyansky I, Abboud J, Ramsey M. Radial head arthroplasty: state of the art. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 2014 Oct 1;22(10):633-42.
[29]. Rosenblatt Y, King GJ. 36 Radial Head Replacement. Operative Techniques in Shoulder and Elbow Surgery. 2010 Oct 21:311.
[30]. Hotchkiss RN. Displaced fractures of the radial head: internal fixation or excision?. JAAOS-Journal of the American Academy of Orthopaedic Surgeons. 1997 Jan 1;5(1):1-0.
[31]. Athwal GS, Rouleau DM, MacDermid JC, King GJ. Contralateral elbow radiographs can reliably diagnose radial head implant overlengthening. JBJS. 2011 Jul 20;93(14):1339-46.
[32]. Doornberg JN, Linzel DS, Zurakowski D, Ring D. Reference points for radial head prosthesis size. The Journal of hand surgery. 2006 Jan 1;31(1):53-7.
[33]. El SS. Radial head replacement for radial head fractures. Journal of orthopaedic trauma. 2013 Jun;27(6):e137-40.
[34]. Yalcinkaya M, Bagatur AE, Erdogan S, Zorer G. Resection arthroplasty for Mason type III radial head fractures yield good clinical but poor radiological results in the long term. Orthopedics. 2013 Nov 1;36(11):e1358-64.
[35]. Ashwood N, Bain GI, Unni R. Management of Mason type-III radial head fractures with a titanium prosthesis, ligament repair, and early mobilization. JBJS. 2004 Feb 1;86(2):274-80.
[36]. Leppilahti J, Jalovaara P. Early excision of the radial head for fracture. International orthopaedics. 2000 Jul 1;24(3):160-2.
[37]. Roger P, RIET FV. History of radial head prosthesis in traumatology. Acta Orthopædica Belgica. 2007;73:1-2007

Dr Vikash Kumar Jha, et. al. "Functional Outcome of Radial Head Arthoplasty in Mason type 3 and 4 fractures." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 20(09), 2021, pp. 01-10.