Bryan-Morrey Approach: A Safe Approach for Intra-Articular Fractures of Distal Humerus

Syed Amir Jalil[1], Zeeshan Idrees[2], Asif Qureshi,[3] Shaikh Naeem Ul Haq,[4] Muhammad Waqaruddin Sheroze,[5] Bashir Ahmed Siddiqi,[6] Kashif Intikhab.[7]

[1]Head of Orthopaedics Department Karachi Medical and Dental College(KMDC) & Abbasi Shaheed Hospital(ASH)
[2]Senior Registrar Orthopaedics ASH
[3] Ex-Professor Orthopaedics KMDC/ASH
[4]Assistant Professor Orthopaedics DOW university of Health Sciences Karachi
[5] House Officer Orthopaedics KMDC/ASH
[6,7]Resident Medical Officer ASH

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Corresponding author:
Syed Amir Jalil
E mail: dramirjalil@yahoo.com

ABSTRACT

Objective: To determine the functional outcome of open reduction and internal fixation (ORIF) of intra-articular distal humerus fractures treated with Bryan Morrey approach.

Methods: This descriptive was conducted in Department of Orthopaedics Abbasi Shaheed Hospital Karachi from 1st January 2018 to 31st December 2019. All patients with intra-articular distal humerus fractures fulfilling the inclusion criteria were included. Open reduction and internal fixation was carried out in all patients using Bryan-Morrey approach. Functional outcome was assessed with Mayo Elbow Performance Index(MEPI) at the end of one year and graded as excellent (MEPI score 90 to 100 points),good(75-89),fair(60-74) and poor(<60).Stratification of data based upon age, gender, type of fracture and time since fixation was done and post stratification comparison of functional outcome was done.Chi square test was applied and *P* value calculated(*P* value < 0.05 was considered significant)

Results: We operated 35 patients of intra-articular distal humerus fracture with Bryan Moorey approach. Male patients were 23(65.8%) and female 12(34.3%). Mean age was 43.8±13.31(range 20 to 65) years. Right humerus was fractured in 21(60%), left in 10(28.6%) and bilateral in 4(11.4%). AO 31C1 fractures were noted in 10(28.6%) patients,31C2 in 15(42.9%) and 31C3 in 10(28.6%) patients. Excellent functional outcome was observed in 13 (37.1%) patients, good in 14 (40%), fair in 6 (17.1%) and poor in 2 (5.7%) patients. No statistically significant difference was found in functional outcome of male and female patients, different types of fractures and age below 40 years versus above 40 years(P value >0.05).However fractures fixed within 4 days of sustaining fractures showed better functional outcome than those fixed late(*P* value <0.05).No major complication reported.

Conclusion: Excellent and good functional outcomes were achieved in majority of our patients of intra-articular distal humerus fractures fixed with Bryan-Morrey approach. We therefore recommend Bryan-Morrey approach as a technique of first choice for all intra-articular distal humerus fractures.

Keywords: Bryan-Morrey, Fracture, Intercondylar humerus, Mayo Elbow Performance Index, Olecranon osteotomy.

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INTRODUCTION

Intra-articular fractures of the distal humerus are rare and accounts for only 2% of all adults fractures involving distal humerus.[1]These fractures are difficult to treat and are associated with stiffness and non-union.[2] Surgical exposure which allows access to both medial and lateral condyles along with articular surface is required for inter-condylar fracture fixation of distal humerus as both columns need fixation.[3] Various approaches have been described for surgical exposure of intra-articular distal humerus fractures. Posterior approach is the most popular and frequently used approach.[2] Among posterior approaches "Chevron-Olecranon" osteotomy is the most famous and is considered as the gold standard,

but this has been found associated high complication rates.[4] Other approaches have also been implied for exposure with fewer complications. These include triceps-splitting approach(Campbell), Triceps Tongue approach(Van Gorder),Triceps Reflecting Anconeus approach(TRAP),Para-Tricipital approach(Alonso Llames), Anconeus Flap Trans-Olecranon approach(AFT) and Triceps Reflecting approach(Bryan-Morrey).[5] However no consensus has been achieved regarding the ideal and preferred approach with superior safety profile and functional results.[6]

Bryan-Morrey introduced a new approach in 1982 known as "triceps-sparing" approach, initially designed for reconstructive surgeries.[7] This approach involves elevation of the triceps and maintaining its continuity with ulnar periosteum.[8] It is an easy approach, consumes less operative time and avoids the complications associated with olecranon osteotomy like non union and implant prominence.[9] Bryan-Morrey approach allows dissection in the internervous plane and avoids injury to the nerve branches in intermuscular space resulting in ultimate fibrosis and weakness of triceps muscle which is usually seen with Triceps Splitting approach.[10] Although Olecranon osteotomy has been considered traditionally to provide better exposure and wider visualization of the intra articular fracture fragments, studies have shown that the visualization was not significantly better than Bryan-Morrey approach.[11,12]Many studies have proved that fixation of intra-articular distal humerus fractures with Brian-Morrey approach resulted in excellent functional outcome without any major complications.[2,13,14]

In our institution intra-articular fractures of the distal humerus are fixed according to the individual surgeon's preference and surgical expertise. Since majority of our population belong to poor socio economic status and cannot afford re-surgery or treatment of complications which are usually associated with olecranon osteotomy. Therefore we conducted this descriptive study on Brian-Morrey approach. The objective of our study was to determine the functional outcome of open reduction and internal fixation(ORIF) of intra-articular distal humerus fractures treated with Bryan Morrey approach.The results of our study would be used to formulate standard guidelines for treating these fractures in our institution.

METHODS

This was a descriptive study conducted in Department of Orthopaedics Abbasi Shaheed Hospital, Karachi. The duration of the study was two years starting from 1st January 2018 to 31st December 2019.All adults patients of either gender and age with intra-articular distal humerus fractures presenting to OPD or Accidents and emergency Department of our hospital were included. Pathological fractures, open fractures, vascular injuries, previous fixations and poly trauma patients requiring fixation of other bones or interventions of other pathologies were excluded from our study. The study was approved by the Ethical Committee of our hospital. Informed written consent was obtained from all participants. Complete history, physical examination and relevant investigations were carried out in all patients. Anterio posterior and lateral radiographs and 3D CT scan of the elbow was done and fractures were classified according to the AO classification.15 Upon arrival all the patients were assessed and resuscitated according to ATLC protocol and elbow immobilized in backslab and sling and prepared for definitive surgery.

Surgical Technique

All the surgeries were performed under general anaesthesia and in lateral decubitus position. The same surgical team performed all the surgeries following a standard uniform surgical protocol for Brian-Morrey approach in all cases. The affected arm was placed over a support such that the elbow was in 90° flexion. A tourniquet was applied. A posterior center midline incision was given. Ulnar nerve was identified, isolated and retracted. Triceps muscle was lifted from the distal humerus and from olecranon triceps fascia from medial to lateral with a chip of olecranon bone in continuity with ulnar fascia. We put a sling on the proximal olecranon and retracted the proximal ulna for making the exposure better.(Fig I) Anatomic reduction of the trochlea was performed initially with k wires and later on with cancellous screws. Distal humerus was then connected with the columns. Fixation was done by dual columnar locking plate/3.5 mm reconstruction plates.(Fig II) After fixation of the fracture, the split triceps was sutured again. Drain was placed and wound closed in layers. Compression bandage was applied.

All patients received pre-operatively a single dose of 2nd generation cephalosporin(injection Cefuroxime) and it was continued for 72 hours post operatively. Drain was removed after 24 hours of surgery. Radiographs were advised on first post-operative to confirm fracture reduction. Gradual elbow assisted flexion and extension exercises were initiated along with supervised physical therapy

sessions three times a week with daily home exercise program for further 4 week. All the patients were followed first at 2 week intervals for two months and than at monthly interval for 24 months. In each visit radiological and functional assessment was done. At one year follow up final functional assessment was done using Mayo Elbow Performance Index(MEPI)[16] by an Orthopaedic consultant who was not part of this study. The MEPI results were interpreted as excellent (MEPI score 90 to 100 points),good(75-89), fair(60-74) and poor(<60).

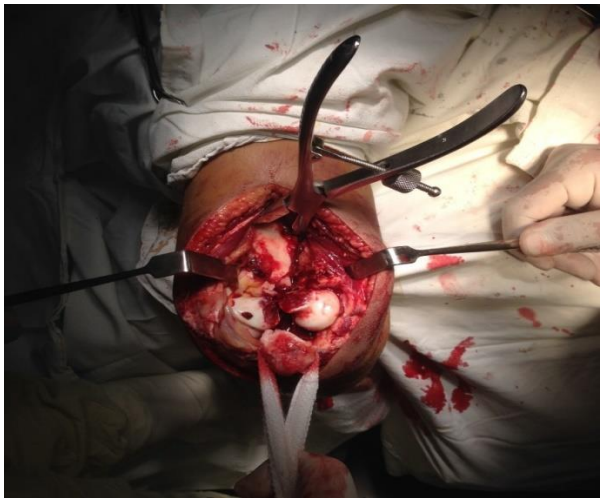

Figure I: Distal humerus fracture site exposed by using Bryan-Morray approach. Triceps are retracted after being splitted and olecranon process of ulna being retracted.

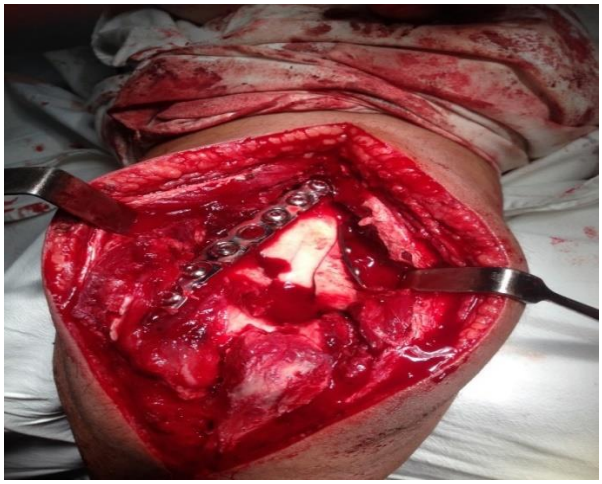

Figure II: Distal humerus fracture after anatomic reduction and plate fixation using Bryan-Morray Approach.

Data was analyzed using SPSS version 13. Mean and standard deviation was computed for numerical variables like duration of fracture and age. Whereas, frequencies and percentages were employed for categorical variables like functional outcome (MEPI score i.e. excellent, good or fair), gender, fracture type and site of fracture. Potential effect modifiers for functional outcome (MEPI score) like gender, side of elbow, age and type of fractures were stratified. Post stratification Chi square test was applied. *P* value < 0.05 was considered as statistically significant. Data presented in table where necessary.

RESULTS

This study had a total of 35 patients. There were 23 (65.87%) males and 12 (34.3%) female patients. Mean age of the patient was 43.82 ±13.31 years(range 20 to 65). Majority(77.1%,n=27) of the patients were more than 40 years of age while 8(22.9%) were less than 40 years. Right side distal humerus fracture was fractured in 21 (60%) patients, left in 10 (28.6%) and bilateral fractures were observed in 4 (11.4%) patients. The aetiology of fracture was fall in 21(80%) patients and road accidents in 14(40%) patients. AO 31C1 fractures were noted in 10(28.6%) patients,31C2 in 15(42.9%) and 31C3 in 10(28.6%) patients. Mean duration of fracture was 4.60 ±0.81 days. All fractures united. The average radiological union time was 11.4±5(range 8.4 to 14 months). Majority(57.1%,n=20) of the patients were operated in less than 4 days of sustaining the fracture while 15(42.8%) patients were operated more than 4 days. Excellent functional outcome was observed in 13 (37.1%) patient, good in 14 (40%), fair in 6 (17.1%) and poor in 2 (5.7%) patients. There was no statistically significant difference in the functional outcome between patients of age below 40 years and above 40 years(Table I) Similarly no significant difference was observed in the outcome of males and females (*P*= 0.665) patients and different types of AO fractures(Table II)

In patients operated within 4 days after fracture presentation, excellent outcome was observed in 5(38.5%), good in 10(71.4%) patients, while none had fair or poor outcome. Amongst patients who were operated after 4 days of fracture presentation, 8(61.5%) had excellent outcome, 4(28.6%) had good outcome, 6(100%) had fair and 2(100%) had poor outcome. A significant statistical difference was noted between these two groups (*P*=0.013). No major post-operative complication like nerve palsy, nonunion or implant breakage was noted in our study. Superficial surgical site infection was reported in 4(11.4%) patients which was resolved with antibiotics and dressing.

Table I: Age wise comparison of functional outcome in patients treated with Brian-Morrey approach.

Age (in years)	Functional Outcome				Total (N,%)	*P* value
	Excellent (N,%)	Good (N,%)	Fair (N,%)	Poor (N,%)		
≤40	4 (30.8)	4 (28.6)	0 (0)	0 (0)	8 (22.9)	0.378
>40	9 (69.2)	10 (71.4)	6 (100)	2 (100)	27 (77.1)	
Total	13 (100)	14 (100)	6 (100)	2 (100)	35 (100)	

Table II: Comparison of functional outcome on the basis of type of fracture.

Type of Fracture	Functional Outcome				Total (N,%)	*P* value
	Excellent(N,%)	Good (N, %)	Fair(N,%)	Poo (N, %)		
31-C1	6 (46.2)	4 (28.6)	0 (0)	0 (0)	10 (28.6)	0.415
31-C2	4 (30.8)	7 (50)	3 (50)	1 (50)	15 (42.9)	
31-C3	3 (23.1)	3 (21.4)	3 (50)	1 (50)	10 (28.6)	
Total	13 (100)	14 (100)	6 (100)	2 (100)	35 (100)	

Table III. Complications associated with Olecranon Osteotomy

S.No	Author's Name	Year of Publication	Total Number of patients	Olecranon Osteotomy complication	Other Complications
1	Kundel K[17]	1996	55	04 Olecranon non unions	None
2	Elhage R [18]	2001	39	01 Olecranon nonunion	01 infection due to K wire
3	Gupta R[19]	2002	13	None	01 wound infection requiring revision,4 migration of k wires requiring revision
4	Ring D[20]	2004	45	None	01 k wire loosening requiring revision with plate,12 cases had removal of k wire
5	Coles CP[21]	2006	70	01 delayed union of Olecranon	02 osteotomy fixation revisions,18 olecranon implant removal
6	Doornberg JN[22]	2007	19	None	02 infections of the wound
7	Greiner S[23]	2008	12	01 delayed union Olecranon	None
8	Sane AD[24]	2009	14	01 Olecranon non union	05 inadequate Olecranon fixation
9	Athwal GS[25]	2009	17	01 Olecranon non union	04 wounds infection

DISCUSSION

The traditional and most frequent surgical approach for treating intra articular distal humerus fractures utilizing Olecranon osteotomy has many complications as evident from literature review(Table III).We therefore treated these fractures with Bryan-Morrey approach and achieved excellent functional outcome in 13 (37.1%) patients, good in 14 (40%), fair in 6 (17.1%) and poor in 2 (5.7%) patients at the end of one year follow up. We had not documented any major complication requiring revision. Lakhey and sharma[26] treated 20 patients with Bryan-Morrey approach. All fractures united except one infective case treated with revision surgery.The mean range of motion was 115 degrees(range 85 to 130 degrees).These authors concluded that Bryan-Morrey is a simple and easy approach and is a procedure of choice to fix all intra articular distal humerus fractures. Fernandez-Valencia and colleagues[27] treated 12 intra-articular

fractures with Bryan-Morrey approach and noted mean Mayo Elbow Performance Score(MEPS) of 93.3 with loss of extension of the elbow of 14.6 degrees. These authors advocated that Brian-Morrey approach would be more appropriate in patients requiring total elbow prosthesis, ipsilateral humrus shaft fractures and in patients with previous implants in humerus.Jagadeesh[9] conducted a comparative study of 20 patients treated with Bryan-Morrey approach and 20 with Olecranon Osteotomy and at one year follow up noted no statistically significant difference between the Mayo Elbow Performance Score(MEPS) between the two groups. Extension lag of less than 10 degrees was noted in 6(30%) patients treated with triceps reflecting approach and 7(35%) patients had hardware prominence in olecranon osteotomy group. Jagadeesh concluded that Bryan-Morrey is as effective as Olecranon osteotomy with the added advantage of less operative time, less blood loss and minimal complication rate. Gupta[28] treated 60 patients with Brian-Morrey approach, Olecranon Osteotomy and Campbell's approach and documented no significant difference in functional outcome as assessed with MEPS score and complication rates. Iselin and Mett[4] treated 24 distal humerus fractures comprising of 5(20.8%) A2,1(4.1%) B2,2(8.3%)C1,9(37.5%) C2 and 7(29.1%) C3 fractures with Brian-Morrey approach and note excellent Mayo Elbow Performance Score(91) in majority while only two patients had satisfactory results. No statistical difference was found in terms of range of motion and muscle power when the operated elbow was compared with the normal elbow. No non union was reported. Sharmaa and John[29] conducted a systemic review and meta-analysis based upon 11 studies(5 comparative and 6 non comparative) and concluded that no significant difference in post operative elbow range of motion,Mayo Elbow Performance Score and complication rates among Bryan-Morrey approach,Triceps split approach and Olecranon Osteotomy approach.

In our study we found that was no statistically significant difference existed in the functional outcome between patients of age below 40 years and above 40 years. This was in contrast to Chen and Liao[30] study who treated 67 patients of intra-articular distal humerus fractures either with triceps sparing(n=34) or Olecranon osteotomy(n=33).They noted that no statistically significant difference was found between the two approaches in terms of post operative ROM, pronation and supination. However Mayo Elbow Performance Score(MEPS) after triceps sparing was excellent and good in 37.5% of patients with age more than 60 years while this rate had increased to 100% in patients younger than 40 years age. On the other hand post operative MEPS was more than 80% in all ages in patients treated with Olecranon osteotomy. Chen recommended olecranon osteotomy approach for patients more than 60 years age while either approach can be can be utilized for patients less than 40 years of age.

In our study we had noted only two cases with superficial surgical site infection which resolved with antibiotics and dressing. Variable complication rates have been reported in literature. Bryan and Morrey [16]noted triceps weakness in 29% of their patients while 02 patients in their series were re operated for triceps avulsion. Saruket and colleagues[5] treated 13 intra-articular distal humerus fractures utilizing Bryan-Morrey approach and documented average Quick DASH score of 3.85, average Mayo score 89, average Triceps muscle power MRC grade 5 and elbow range of motion of 23-114 degrees. One screw breakage and one wound dehiscence was noted in their study.These authors concluded that Bryan-Morrey is a better option to treat distal intra-articular humerus fractures as it avoids Olecranon osteotomy and its complications.

The descriptive design and short follow up were the limitations of our study. We recommend further studies to conform our results.

CONCLUSION

Excellent and good functional outcomes were achieved in majority of our patients with intra-articular distal humerus fractures fixed with Bryan-Morrey approach. We therefore recommend Bryan-Morrey approach as a technique of first choice for all intra-articular distal humerus fractures.

Conflict of Interest: None

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REFERENCES

1. Kiricarslan K, Bektaser B, Ueguder A, Dogan M, Ugurlu M, Yildirim H.Results of early surgical treatment of intra-articular complex fracture of the humerus in adults. Bratisl Lek Listy.2011; 112:501-505.
2. Ek ET, Goldwasser M, Bonomo AL. Functional outcome of complex intracondylar fractures of distal humerus treated through a triceps sparing

approach. J Shoulder Elbow Surg.2008;17(3):441-446.
3. Schildhauer TA, Nork SE, Mills WJ, Henley MB. Extensor mechanism-sparing paratricipital posterior approach to the distal humerus. J Orthop Trauma.2003;17(5):374-378.
4. Iselin LD, Mett T, Babst R, Jakob M, Rikli D. The triceps reflecting approach (Bryan-Morrey) for distal humerus fracture osteosynthesis. BMC Musculoskelet Disord. 2014;15: 406-12.
5. Sarukte V, Bhanushali R, Nagrale U, Vishwakarma S.A study of functional outcomes of distal humerus fractures operated by triceps reflecting approach. Int J Med Res Rev.2017;5(02):105-112.
6. Ljungquist KL, Beran MC, Awan H. Effects of surgical approach on functional outcomes of open reduction and internal fixation of intra-articular distal humeral fractures: a systematic review. J Shoulder Elbow Surg 2012;21:126-35.
7. Wong AS, Baratz ME. Elbow fractures: distal humerus. J Hand Surg.2009;34(1):176-190.
8. Amir S, Jannis S, Daniel R. Distal humerus fractures: A review of current therapy concepts. Curr Rev Musculoskelet Med. 2016;9(2):199-206.
9. Jagadeesh N, Sanil N, Vishwanath MS. Randomised prospective comparative analysis of functional outcome of osteosynthesis of intra-articular distal humerus fracture using triceps reflecting and trans olecrenon approach. Int J Res Orthop.2020;6:722-729.
10. Kasser JR, Richards K, Millis M. The tricepsdividing approach to open reduction of complex distal humerus fractures in adolescents: A Cybex evaluation of triceps function and motion. J Pediatr Orthop. 1990;10: 93-96.
11. Wilkinson JM, Stanley D. Posterior surgical approaches to the elbow: A comparative anatomic study. J Shoulder Elbow Surg. 2001;10(4):380-384.
12. Dakoure PW, Ndiaye A, Ndoye JM, Sane AD, Niane MM, Seye SI, *et al*. Posterior surgical approaches to the elbow: a simple method of comparison of the articular exposure. Surg Radiol Anat. 2007;29(8):671-674.
13. Remia LF, Richards K, Waters PM. The Bryan-Morrey triceps-sparing approach to open reduction of T-condylar humeral fractures in adolescents: Cybex evaluation of triceps function and elbow motion. J Pediatr Orthop.2004;24(6):615-619.
14. Dayanand H, Holagundi L, Deepak S. Osteosynthesis of distal humerus fractures in adults using Triceps Reflecting approach. International Journal of Orthopaedics Traumatology and Surgical Sciences.2016;3(1): 316-318.
15. Muller ME, Nazarian S, Koch P. Classification AO des fractures: Les os longs. Berlin Heidelberg New York: Springer-Verlag;1987.
16. Morrey BF, An KN, Chao EYS. Functional evaluation of the elbow. In Morrey BF (ed.) The Elbow and Its Disorders, 2nd ed. Philadelphia: WB Saunders. 1993;86-89.
17. Kundel K, Braun W, Wieberneit JW, Ruter A. Intraarticular distal humerus fractures: Factors affecting functional outcome. Clinic Orthop Relat Res.1996;332:200-208.
18. Elhage R, Maynou C, Jugnet PM, Mestdagh H. Long term results of the surgical treatment of bicondylar fractures of the distal humerus extremity in adults. Chirurgie de la Main.2001; 20(2):144-154.
19. Gupta R, Khanchandani P. Intercondylar fractures of the distal humerus in adults: A critical analysis of 55 cases. Injury.2002;33(6):511-515.
20. Ring D, Gulotta L, Chin L, Jupiter JB. Olecranon osteotomy for exposure of fractures and nonunions of the distal humerus. J Orthop Trauma.2004;18(7):446-449.
21. Coles CP, Barei DP, Nork SE, Taitsman LA, Hanel DP, Henley MB. The olecranon osteotomy: A six-year experience in the treatment of intra articular fractures of the distal humerus. J Orthop Trauma.2006;20(3):164-171.
22. Doornberg JN, van Duijn PJ, Linzel D.Surgical treatment of intra-articular fractures of the distal part of the humerus: Functional outcome after twelve to thirty years. J Bone Joint Surg Am.2007;89(7):1524-1532.
23. Greiner S, Haas NP, Bail HJ. Outcome after open reduction and angular stable internal fixation for supra-intercondylar fractures of the distal humerus: Preliminary results with the LCP distal humerus system. Archives of Orthopaedic and Trauma Surgery.2008;128(7):723-729.
24. Sane AD, Dakoure PW, Dieme CB. Olecranon osteotomy in the treatment of distal humeral fractures in adults: Anatomical and functional evaluation of the elbow in 14 cases. Chirurgie de la Main.2009;28(2):93-99.
25. Athwal GS, Hoxie SC, Rispoli DM, Steinmann SP. Precontoured parallel plate fixation of AO/OTA

type C distal humerus fractures. J Orthop Trauma.2009;23(8):575-580.
26. Lakhey S, Sharma S, Pradhan RL, Pandey BK , Manandhar RR, Rijal KP. Osteosynthesis of intercondylar humerus fracture using bryan and morrey approach. Kathmandu University Medical Journal.2010;8(2):154-157.
27. Fernandez-Valencia JA, Munoz-Mahamud E, Ballesteros JR, Prat S. Treatment of AO Type C Fractures of the Distal Part of the Humerus through the Bryan-Morrey Triceps-Sparing Approach. ISRN Orthop.2013;525-532.
28. Gupta G, Ghosh S, Chaudhuri A, Datta S, Dutta S, Dugar N. Comparative study of different approaches for open reduction and internal fixation in fractures of distal humerus. Saudi J Sports Med. 2015;15:68-73.
29. Sharmaa S, Johnb R, Dhillona MS , Kishorec K. Surgical approaches for open reduction and internal fixation of intra-articular distal humerus fractures in adults: A systematic review and meta-analysis.Injury.Int. J Care Injured.2018;49:1381-1391.
30. Chen G, Liao Q , Luo W, Li K, Zhao Y, Zhong D. Triceps-sparing versus olecranon osteotomy for ORIF: Analysis of 67 cases of intercondylar fractures of the distal humerus. Injury. 2011;42(4):366-370.