Evaluation Of Functional Outcome Of Proximal Humerus Fracture Managed With Proximal Humerus Locking Plate-A Prospective Study

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Year Of Acceptance Of Thesis: 2014.

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Abstract

Introduction: Proximal humeral fractures are the common fracture in elderly patients. The increased incidence in the older population is thought to be related to osteoporosis. Over the past decade, the trend has been toward angular stable plate fixation

Aims and Objectives: The present study is designed to evaluate the functional outcome of proximal humerus fracture managed with proximal humerus locking plate fixation in adult patients.

Material and Method: This study will be done on patients with proximal humerus fracture admitted in during May 2011-May 2013.

Inclusion criteria: Patient >18 year are included, Neer's classification : grade 2 to grade 4.

Exclusion criteria: Medically unfit patients, Pathological fractures, Fractures in pediatric age group, Shaft humerus fractures with proximal extension, Multiple fracture in same upper limb, Open fracture, Acute infection.

Results: 20 patients were included in the study. The union of most of the patients was less than and equal to 10 wks (70.0%). 6 patients have treatment related complication (30.0%) with 10.0% screw perforation and 20.0% shoulder stiffness.

However, at final evaluation, the functional outcome of most of the patients were found to be excellent (70.0%) followed by good (15.0%), poor (10.0%) and fair the least (5.0%).

Conclusions: The Proximal humerus LCP is a good implant which requires accurate positioning and fixation for satisfactory results. Proper physiotherapy and co-ordination of the patients during post-operative period is very important for obtaining better results.

Keywords: Proximal humeral fractures, stable angle plate, osteoporosis.

THESIS SUMMARY

Introduction

Proximal humeral fractures are the common fracture in elderly patients. The increased incidence in the older population is thought to be related to osteoporosis. Proximal humeral fractures are nondisplaced fractures or fractures with minimal displacement and adequate stability that can successfully be managed nonoperatively. However, the optimal treatment of displaced or unstable fractures remains controversial. Whilst the fixed angle locking screw design of the plate has been designed to improve the quality of fixation in osteoporotic bone, there have been reports in the literature of failure of fixation using the proximal humerus locking plate.

Aims and Objectives

The present study is designed to evaluate the functional outcome of proximal humerus fracture managed with proximal humerus locking plate fixation in adult patient admitted between may 2011 to may 2013.

Materials and Methodology

Written informed consent will be taken by every patient before the study.

Laboratory investigation will done to evaluate for surgical fitness as per requirement.

Inclusion criteria: Patient >18 year are included, Neer's classification : grade 2 to grade 4

Exclusion criteria: Medically unfit patients, Pathological fractures, Fractures in pediatric age group, Shaft humerus fractures with proximal extension, Multiple fracture in same upper limb, Open fracture, Acute infection.

Result

Basic Characteristics

The present study evaluates the functional outcome of proximal humerus fracture management with proximal humerus locking plate in a prospective manner. A total of 20 patients were recruited and evaluated. The basic characteristics (demographic and clinical) of patients at admission are summarized in Table 1 and also shown graphically in Fig. 1 to Fig. 8.

The age of all patients ranged from 25-69 yrs with mean (± SD) 49.70 ± 12.16 yrs. Most of the patients were above 45 yrs of age (65.0%) and mostly males (60.0%). There were 9 patients with neer classification part 2 (45.0%), similarly with part 3 (45.0%) and 2 were with part 4 (10.0%). All patients had closed fracture (100.0%). The mode of injury of most of the patients were MF (40.0%), followed by RTA (35.0%), ERAA (5.0%) and DB the least (10.0%). The patients mostly affected at right side (75.0%). Among patients, 17 (85.05) patients were without associated injury while 1 (5.0%) each with left proximal tibia fracture, right distal radius fracture and right shaft tibia fracture injury. Similarly, 12 patients were without associated comorbidities (85.0%) while 8 patients with comorbidities (40.0%) with highest being of BP (15.0%). Further, 13 patients with dominant extremity (65.0%) and 7 were with non dominant extremity (35.0%).

Surgical Outcome

The surgical outcomes of all patients are summarized in Table 2 and also shown graphically in Fig. 9 to Fig. 15. The duration from injury to surgery of all patients ranged from 1-5 days with mean (± SD) 3.10 ± 1.37 days. The duration from injury to surgery of most of the patients was more than 2 days (55.0%).

Similarly, the duration of surgery of all patients ranged from 70-140 min with mean (± SD) 100.00 ± 20.84 min. The duration of surgery of most of the patients was more than 90 min (55.0%).

Further, the blood loss of all patients ranged from 200-500 ml with mean (± SD) 315.00 ± 108.94 ml. The blood loss of most of the patients was less than and equal to 300 ml (55.0%).

Furthermore, the union of all patients ranged from 8-12 wks with mean (± SD) 10.40 ± 1.23 wks. The union of most of the patients was less than and equal to 10 wks (70.0%).

Similarly, the duration of hospital stay after surgery of all patients ranged from 4-12 days with mean (± SD) 6.40 ± 2.04 days. The duration of hospital stay after surgery of most of the patients was less than and equal to 6 days (70.0%).

14 patients did not have treatment related complications (70.0%). However, 6 patients have treatment related complication (30.0%) with 10.0% screw perforation and 20.0% shoulder stiffness.

However, at final evaluation, the functional outcome (i.e. efficacy of the treatment) of most of the patients were found to be excellent (70.0%) followed by good (15.0%), poor (10.0%) and fair the least (5.0%).

Association With Functional Outcomes

The association of functional (treatment or surgical) outcomes with different risk factors (demographic, clinical and surgical) is summarized in Table 3. Table 3 showed that the most favorable functional outcome "Excellent" did not ($p>0.05$). However, most favorable outcome mostly associated with male gender (78.6%), significantly ($p<0.001$) associated with neer classification especially part 2 (64.3%), mode of injury RTA (42.9%), affected side right (71.4%), without associated injury (92.9%), without associated comorbidities (78.6%), significantly ($p<0.01$) associated with dominant extremity (92.9%), duration of surgery ≤ 90 min (57.1%), blood loss ≤ 300 ml (71.4%), union ≤ 10 wks (78.6%) and significantly ($p<0.001$) without complications (100.0%).

Conclusion

The Proximal humerus locking plate is an example of a device that combines fixed angle locking screw technology with the option for conventional screw. From the present study the following points were concluded:-

- In proximal humerus fractures 2 and 3 parts fractures (Neer Classification) are more common, road traffic accidents being the most common cause.
- 2 part fractures have better results as compared to 3 part and 4 part fractures.
- The Proximal humerus LCP is a good implant to use for these type of fractures, with requirement of accurate positioning and fixation for satisfactory results.
- Proper physiotherapy and co-ordination of the patients during post-operative period is very important for obtaining better results.
- Increased age of the patient, especially more than 50 yrs has a negative effect on functional outcome.
- Associated medical co-morbidities have a negative effect on functional outcome.
- Shoulder stiffness and infection are common complications to be looked for in subsequent follow ups, keeping in mind the injury severity, fracture configuration and patient profile.
- Dominant extremity has good functional outcome as compare to non dominant extremity

Clinical Importance

Proximal humeral LCP is a good implant for rigid internal fixation for the proximal humeras fracture, provided there is good anatomical reduction and accurate implant positioning.

References

1. D M Wright, A Acharya, R H Austin and J C Kaye. Complications and suggestions encountered with the philos plating system, J Bone Joint surgery 2004; 87-B:165e.
2. Baron JA, Barrett JA, Karagas MR: The epidemiology of peripheral

fractures. Bone 1996;18(3 suppl):209S-213S.
3. Naranja RJ Jr, Iannotti JP: Displaced three- and four-part proximal humerus fractures: Evaluation and management.J Am Acad Orthop Surg 2000; 8:373-382.
4. Schlegel TF, Hawkins RJ: Displaced proximal humerus fractures: Evaluation and treatment. J Am Acad Orthop Surg 1994;2:54-66.
5. Neer CS II: Displaced proximal humeral fractures: I. Classification and evaluation. J Bone Joint Surg Am 1970;52:1077-1089.
6. Cornell CN: Internal fracture fixation in patients with osteoporosis. J Am Acad Orthop Surg 2003;11:109-119.
7. Fankhauser F, Boldin C, Schippinger G, Haunschmid C, Szyszkowitz R: A new locking plate for unstable fractures of the proximal humerus. Clin Orthop Relat Res 2005;430:176-181.
8. Gerber C, Werner CM, Vienne P: Internal fixation of complex fractures of the proximal humerus. J Bone Joint Surg Br 2004;86:848-855.
9. Haidukewych GJ: Innovations in locking plate technology. J Am Acad Orthop Surg 2004;12:205-212.
10. Robinson CM, Page RS: Severely impacted valgus proximal humeral fractures: Results of operative treatment. J Bone Joint Surg Am 2003;85:1647-1655.
11. Wanner GA, Wanner-Schmid E,Romero J, et al: Internal fixation of displaced proximal humeral fractures with two one-third tubular plates.J Trauma 2003;54:536-544.
12. Resch H, Povacz P, Frohlich R, Wambacher M: Percutaneous fixation of three- and four-part fractures of the proximal humerus. J Bone Joint Surg Br 1997;79:295-300.
13. Strohm PC, Kostler W, Sudkamp NP:Locking plate fixation of proximal humerus fractures. Techniques inShoulder & Elbow Surgery 2005;6:8-13.
14. Resch H, Beck E, Bayley I: Reconstruction of the valgus-impacted humeral head fracture. J Shoulder Elbow Surg 1995;4:73-80.
15. Zyto K, Ahrengart L, Sperber A,Tornkvist H: Treatment of displaced proximal humeral fractures in elderly patients. J Bone Joint Surg Br 1997; 79:412-417.
16. Zyto K,WallaceWA, Frostick SP, PrestonBJ: Outcome after emiarthroplasty for three- and four-part fractures of the proximal humerus.J Shoulder Elbow Surg 1998;7:85-89.
17. Aggarwal S, Bali K, Dhillon MS, Kumar U, Mootha AK. Displaced proximal humeral fracture : An Indian experience with locking plate J Orthop Surg Res 2010;5:60.
18. Felxi Brunner , MD, Christopher Sommer,MD, et al " Open reduction and internal fixation of proximal humerus fractures using a proximal humeral locking plates : A prospective Multicenter study" Journal of orthopaedic trauma 2009;23:163-172
19. MA Fazal, FS Haddad "PHILOS plate fixation for displaced proximal humeral fractures" Journal of orthopaedic surgery 2009;17(1)15-8.
20. AA Martinez,J Cuenca, A Herrera "PHILOS plate fixation for proximal humerus" Journal of orthopaedic surgery 2009;17(1):10-4
21. Sudkamp N,Bayer J, Hepp P, Voigt C, Ostern H, Kaab M, et al.Open reduction and internal fixation of proximal humerus plate. Result of a prospective, multicentric, observational study. J Bone Joint Surgery Am 2009;91:1320-8.
22. Bigorre N, Talha A, Cronier P, et al. A prospective study of a new locking plate for proximal humeral fracture. Injury.2009;40:192–196. doi: 10.1016/j.injury.2008.06.023.
23. Felxi Brunner , MD, Christopher Sommer,MD, et al " Open reduction and internal fixation of proximal humerus fractures using a proximal humeral locking plates : A prospective Multicenter study" Journal of orthopaedic trauma 2009;23:163-172
24. Bogner R, Hubner C, Matis N, Auffarth A, Lederer S, Resch H.Minimally-invasive treatment of three- and four-part fractures of the proximal humerus in elderly patients. J Bone Joint Surg Br 2008;90: 1602-7. doi:10.1302/0301-620X.90B12.20269
25. Laflamme GY, Rouleau DM, Berry GK, Beaumont PH, Reindl R, Harvey EJ. Percutaneous humeral plating of fractures of the proximal humerus: results of a prospective multicenter clinical trial. J Orthop Trauma. 2008; 22(3):153-158.
26. Egol KA, Ong CC, Walsh M, Jazrawi LM, Tejwani NC, Zuckerman JD. Early complications in proximal humerus fractures (OTA Types 11) treated with locked plates. J Orthop Trauma. 2008;22(3):159–64.
27. Handschin AE, Cardell M, Contaldo C, Trentz O, Wanner GA. Functional results of angular-stable plate fixation in displaced proximal humeral fractures. Injury. 2008;39(3):306-313.
28. Korkmaz MF, Aksu N, Göğüş A, Debre M, Kara AN, Işıklar ZU. The results of internal fixation of proximal humeral fractures with the PHILOS locking plate. [Article in Turkish] Acta Orthop Traumatol Turc 2008;42:97-105.
29. Egol KA, Ong CC, Walsh M, Tejwani LM, Tejwani NC, Zuckermann JD.Early complication in proximal humerus fracture (OTA Type II) treated with locked plate. J Orthop Trauma 2008;22:159-64.
30. Shahid R, Mushtaq A, Northover J, Maqsood M. Outcome of proximal humerus fractures treated by PHILOS plate internal fixation. Experience of a district general hospital. Acta Orthop Belg. 2008;74(5):602-8.
31. Bulent KILIC, Mustafa UYSAL, Bekir Murat CINAR, Gurkan OZKOC, Huseyin DEMIRORS,1 Sercan AKPINAR. Early results of treatment of proximal humerus fractures with the PHILOS locking plate. Acta Orthop Traumatol Turc 2008;42(3):149-153
32. C.P Charalambous, I .Siddiqe, et al "Proximal humerus internal locking system for the treatment of proximal humerus fracture" Archieve of Orthopaedic and truma surgery (2007)127:205-210
33. Alexander E.Handschin, Markus Cardell Et al "Funtional results of angular- stable plate fixationin displaced proximal humeral fractures" Injury,int J.care Injured 2008 39,306-33
34. Moonot P. et all. Early Results for treatment of three and four part fractures of the proximal humerus using the PHILOS plate system. JBJS Br.2007; 89-B :1206-1208.

35. Gardner MJ, Weil Y, Barker JU, Kelly BT, Helfet DL, Lorich DG. The importance of medial support in locked plating of proximal humerus fractures. J Orthop Trauma. 2007;21:185-91.
36. Koukakis Athanasios, Apostolou Constantinos, Taneja Tarun. Fixation of proximal humeral fractures using the philos plate, early experience, Clinical orthopaedics and related research 2006; 115-120.
37. Kettler M, Biberthaler P, Braunstein V, et al. [Treatment of proximal humeral fractures with the PHILOS angular stable plate. Presentation of 225 cases of dislocated fractures]. Unfallchirurg. 2006;109-(2):1032-40.
38. Fankhauser F, Boldin C, Schippinger G, Haunschmid C, Szyszkowitz R: A new locking plate for unstable fractures of the proximal humerus. Clin Orthop Relat Res 2005;430:176-181.
39. Strohm PC, Kostler W, Sudkamp NP: Locking plate fixation of proximal humerus fractures. Techniques in Shoulder & Elbow Surgery 2005;6:8- 13.
40. PLECKO, M., KRAUS, A.: Internal fixation of proximal humerus fractures using the locking proximal humerus plate. Oper. Orthop. Traumatol., 17: 25–50, 2005.
41. Hente R, Kampshoff J, Kinner B, Fuchtmeier B, Nerlich M. Treatment of dislocated 3- and 4-part fractures of the proximal humerus with an angle-stabilizing fixation plate. Unfallchirurg. 2004; 107(9):769-782.
42. Boileau P, Huten D, Pietu G, et al. L'arthroplastie prostheÃ©tique dans les fractures reÃ©centes complexes de l'extreÃ©miteÃ© supeÃ©rieure de l'humeÃ©rus: technique et indications. Paris: Expansion Scientifique Publications, 1999.
43. Debevoise NT, Hyatt GW, Townsend GB. Humeral torsion in recurrent shoulder dislocations: a technic of determination by X-ray. Clin Orthop 1971;76:87â€“93.
44. Hill JA, Tkach L, Hendrix RW. A study of glenohumeral orientation in patients with anterior recurrent shoulder dislocations using computerized axial tomography. Orthop Rev 1989;18:84â€“91.
45. Krahl V. The torsion of the humerus: its localization, cause, duration in man. Am J Anat 1947;80:275â€“319.
46. Kronberg M, Brostrom LA, Soderlund V. Retroversion of the humeral head in the normal shoulder and its relationship to the normal range of motion. Clin Orthop 1990;253:113â€“117.
47. Neer CS. Articular replacement for the humeral head. J Bone Joint Surg Am 1955;37:215â€“228.
48. Pieper HG. Shoulder dislocation in skiing: choice of surgical method depending on the degree of humeral retrotorsion. Int J Sports Med 1985;6:155â€“160.
49. Randelli M, Gambrioli PL. Glenohumeral osteometry by computed tomography in normal and unstable shoulders. Clin Orthop 1986;208:151â€“156.
50. Hall MC, Rosser M. The structure of the upper end of the humerus, with reference to osteoporotic changes in senescence leading to fractures. Can Med Assoc J 1963;88:290â€“294.
51. Hepp P, Lill H, Bail H, et al. Where should implants be anchored in the humeral head? Clin Orthop 2003;415:139â€“147.
52. Saitoh S, Nakatsuchi Y. Osteoporosis of the proximal humerus: comparison of bone mineral density and mechanical strength with the proximal femur. J Shoulder Elbow Surg 1993;2:78â€“84.
53. Saitoh S, Nakatsuchi Y, Latta L, et al. Distribution of bone mineral density and bone strength of the proximal humerus. J Shoulder Elbow Surg 1994;3:234â€“242.
54. Tingart M, Apreleva M, von Stechow D, et al. Cortical thickness of the proximal humeral diaphysis predicts bone mineral density of the proximal humerus. J Bone Joint Surg Br 2003;85(4):611â€“617.
55. Tingart M, Lehtinen J, Zurakowski D, et al. Proximal humeral fractures: regional differences in bone mineral density affect the fixation strength of cancellous screws. J Shoulder Elbow Surg (submitted), 2005.
56. Galle P, Munk P, Passl R, et al. Zur Gefassversorgung des Oberarmkopfes. Hefte Unfallheilkd 1975;126:19â€“20.
57. Gerber C, Hersche O, Berberat C. The clinical relevance of posttraumatic avascular necrosis of the humeral head. J Shoulder Elbow Surg 1998;7:586â€“590.
58. Laing PG. The arterial supply of the adult humerus. J Bone Joint Surg Am 1956;38:1105â€“1116.
59. Moseley HF, Goldie I. The arterial pattern of the rotator cuff and the shoulder. J Bone Joint Surg Br 1963;45:780â€“789.
60. Rothman RH, Parke WW. The vascular anatomy of the rotator cuff. Clin Orthop 1965;41:176â€“186.
61. Brooks CH, Revell WJ, Heatley FW. Vascularity of the humeral head after proximal humeral fractures: an anatomical cadaver study. J Bone Joint Surg Br 1993;75:132â€“136.
62. Horak J, Nilsson B. Epidemiology of fractures of the upper end of the humerus. Clin Orthop 1975;112:250â€“253.
63. Lind T, Kroner K, Jensen J. The epidemiology of fractures of the proximal humerus. Arch Orthop Trauma Surg 1989;108:285â€“287.
64. Codman EA. The shoulder: rupture of the supraspinatus tendon and other lesions in or about the subacromial bursa. Boston: Thomas Todd, 1934.
65. Gold AM. Fractured neck of the humerus with separation and dislocation of the humeral head (fracture-dislocation of the shoulder, severe type). Bull Hosp Jt Dis 1971;32:87â€“99.
66. Kocher MS, Feagin JAJ. Shoulder injuries during Alpine skiing. Am J Sports Med 1996;24:665â€“669.
67. Kocher T. BeitrÃ¤ge zur Kenntnis Einiger Praktisch Wichtiger Fracturformen. Basel: Carl Sallmann, 1896.
68. Howard NJ, Eloesser L. Treatment of fractures of the upper end of the humerus: an experimental and clinical study. J Bone Joint Surg 1934;32:1â€“29.
69. Garceau GJ, Cogland S. Early physical therapy in the treatment of fractures of the surgical neck of the humerus. Indiana Med 1941;34:293â€“295.
70. Breasted JH. The Edwin Smith surgical papyrus. Chicago: University of Chicago Press, 1930.

71. Peltier LF. Fractures: a history and iconography of their treatment. San Francisco: Norman Publishing, 1990.
72. Bertoft ES, Lundh I, Ringqvist I. Physiotherapy after fracture of the proximal end of the humerus. Scand J Rehabil Med 1984;16:11â€“16.
73. Gordon D. Fractures of the upper end of the humerus. JAMA 1931;96:332â€“336.
74. Gurd FB. A simple effective method for the treatment of fractures of the upper part of the humerus. Am J Surg 1940;47:433â€“453.
75. Lucas-ChampionniÃ¨re J. Traitement des fractures par le massage et la mobilization. Paris: Rueff, 1895.
76. Young TB, Wallace WA. Conservative treatment of fractures and fracture-dislocations of the upper end of the humerus. J Bone Joint Surg Br 1985;67:373â€“377.
77. Caldwell JA, Smith J. Treatment of unimpacted fractures of the surgical neck of the humerus. Am J Surg 1936;31:141â€“144.
78. Coonse GK. An improved humerus splint for hospital use. J Bone Joint Surg 1931;13:374â€“375.
79. Coonse GK, Moore H. Treatment of fractures of the humerus by mobilization and traction. N Engl J Med 1930;203:829â€“832.
80. Jones R. On certain fractures about the shoulder. Ir J Med Sci 1932;78:282â€“291.
81. Santee HE. Fractures about the upper end of the humerus. Ann Surg 1924;80:103â€“114.
82. Stevens JH. Fracture of the upper end of the humerus. Ann Surg 1919;69:147â€“160.
83. Callahan DJ. Anatomic considerations: closed reduction of proximal humeral fractures. Orthop Rev 1984;13:79â€“85.
84. de Mourgues G, Razemon JP, Leclaire HP, et al. Les fractures-luxations de l'eÃ©paule. Rev Chir Orthop Reparatrice Appar Mot 1965;51:151â€“165.
85. Frankau C. A manipulative method for the reduction of fractures of the surgical neck of the humerus. Lancet 1933;2:755.
86. Griswold RA, Hucherson DC, Strode EC. Fractures of the humerus treated with hanging cast. South Med J 1941;34:777â€“778.
87. Koval KJ, Gallagher MA, Marsicano JG, et al. Functional outcome after minimally displaced fractures of the proximal part of the humerus. J Bone Joint Surg Am 1997;79:203â€“207.
88. Aldredge RH, Knight MP. Fractures of the upper end of the humerus treated by early relaxed motion and massage. New Orleans Med Surg J 1940;92:519â€“524.
89. Basti JJ, Dionysian E, Sherman PW, et al. Management of proximal humeral fractures. J Hand Ther 1994;7(2):111â€“121.
90. Brostrom F. Early mobilization of fractures of the upper end of the humerus. Arch Surg 1943;46:614â€“615.
91. DePalma AF, Cautilli RA. Fractures of the upper end of the humerus. Clin Orthop 1961;20:73â€“93.
92. Drapanas T, McDonald J, Hale HW. A rational approach to classification and treatment of fractures of the surgical neck of the humerus. Am J Surg 1960;99:617â€“624.
93. Ekstrom T, Lagergren C, von Schreeb T. Procaine injections and early mobilization for fractures of the neck of the humerus. Acta Chir Scand 1965;130:18â€“24.
94. Hermann OJ. Fractures of the shoulder joint with special reference to correction of defects. AAOS Instr Course Lect 1944;2:359â€“370.
95. Lundberg BJ, Svenungson-Hartwig E, Vikmark R. Independent exercises versus physiotherapy in non-displaced proximal humeral fractures. Scand J Rehabil Med. 1979;11:133â€“136.
96. Mills KL. Severe injuries of the upper end of the humerus. Injury 1974;6:13â€“21.
97. Roberts SM. Fractures of the upper end of the humerus: an end-result study which shows the advantage of early active motion. JAMA 1932;98:367â€“373.
98. Clifford PC. Fractures of the neck of the humerus: a review of the late results. Injury 1980;12:91â€“95.
99. Keene JS, Huizenga RE, Engber WD, et al. Proximal humeral fractures: a correction of residual deformity with long-term function. Orthopedics 1983;6:173â€“178.
100. Leyshon RL, Rehn J, Decker S, et al. Closed treatment of fractures of the proximal humerus (results of rotation osteotomy in habitual shoulder dislocation): radiology of the humeral head in recurrent anterior shoulder dislocations: brief report. Acta Orthop Scand 1984;55:48â€“51.
101. Zyto K, Ahrengart L, Sperber A, et al. Treatment of displaced proximal humeral fractures in elderly patients. J Bone Joint Surg Br 1997;79:412â€“417.
102. Colton CL. The history of fracture treatment. Philadelphia: WB Saunders, 1992.
103. Van Der Ghinst M, Houssa P. Acrylic prosthesis in fractures of the head of the humerus. Acta Chir Belg 1951;50:31â€“40.
104. Lorenzo FT. Osteosynthesis with Blount staples in fracture of the proximal end of the humerus: a preliminary report. J Bone Joint Surg Am 1955;37:45â€“48.
105. Krakovic M, Schmidt A, El Sigai A. Indication for surgery in shoulder-joint proximal fractures of the humerus and results. Monatsschr Unfallheilkd 1975;78:326â€“332.
106. Kristiansen B, Christensen SW. Plate fixation of proximal humeral fractures. Acta Orthop Scand 1986;57:320â€“323.
107. Moda SK, Chadha NS, Sangwan SS, et al. Open reduction and fixation of proximal humeral fractures and fracture-dislocations. J Bone Joint Surg Br 1990;72:1050â€“1052.
108. Savoie FH, Geissler WB, Vander Griend RA. Open reduction and internal fixation of three-part fractures of the proximal humerus. Orthopedics 1989;12:65â€“70.
109. Weise K, Meeder PJ, Wentzensen A. Indications and operative technique in osteosyn thesis of fracture-dislocations of the shoulder joint in adults. Langenbecks Arch Chir 1980;351:91â€“98.
110. Yamano Y. Comminuted fractures of the proximal humerus treated with hook plate. Arch Orthop Trauma Surg 1986;105:359â€“363.
111. Neviaser JS. Complicated fractures and dislocations about the shoulder joint. J Bone Joint Surg Am 1962;44:984â€“998.

112. Sehr JR, Szabo RM. Semitubular blade plate for fixation in the proximal humerus. J Orthop Trauma 1988;2:327â€“332.
113. Chandler RW. Displaced proximal humeral fractures treated with a locked intramedullary device. Tech Orthop 1994;8:192â€“198.
114. Cuomo F, Flatow EL, Maday M, et al. Open reduction and internal fixation of two- and three-part displaced surgical neck fractures of the proximal humerus. J Shoulder Elbow Surg 1992;1:287â€“295.
115. Doursounian L, Grimberg J, Touzard RC. A new method of internal fixation for fractures of the upper end of the humerus: the Bilboquet implant. A study of 27 cases reviewed after more than 2 years. Orthop Trans 1996;20:457â€“458.
116. Haas K. Displaced proximal humeral fractures operated by Rush pin technique. Opuscula Med 1978;23:100â€“102.
117. Habernek H, Orthner E. A locking nail for fractures of the humerus. J Bone Joint Surg Br 1991;73:651â€“653.
118. Lentz W, Meuser P. The treatment of fractures of the proximal humerus. Arch Orthop Trauma Surg 1980;96:283â€“285.
119. Mazet R. Intramedullary fixation in the arm and the forearm. Clin Orthop 1953;2:75â€“92.
120. Mouradian WH. Displaced proximal humeral fractures: seven years' experience with a modified Zickel supracondylar device. Clin Orthop 1986;212:209â€“218.
121. Seidel H. Humeral locking nail: a preliminary report. Orthopedics 1989;12:219â€“226.
122. Weseley MS, Barenfeld PA, Eisenstein AL. Rush pin intramedullary fixation for fractures of the proximal humerus. J Trauma 1977;17:29â€“37.
123. Widen A. Fractures of the upper end of humerus with great displacement treated by marrow nailing. Acta Chir Scand 1959;97:439â€“441.
124. Zuipp H, Thermann H, Tscherne H. Interlocking screw-nail: a new device for unstable 2- and 3-part fractures of the proximal humerus. Orthop Trans 1992;16:231.
125. Checchia SL, Miranda DL, Carneiro MU, et al. Tratamento das fracturas do colo ciruÃ©rgico do uÃ©mero pela teÃ©cnica de Kapandji. Rev Bras Ortop 1993;28:43â€“49.
126. Geneste R, Durandeau A, Gauzere JM, et al. The treatment of fracture-dislocation of the humeral head by blind pinning. Rev Chir Orthop Reparatrice Appar Mot 1980;66:383â€“386.
127. Halder SC, Chapman JA. Proximal humeral fractures: a new internal fixation device. J Bone Joint Surg Br 1997;79[Suppl 4]:408â€“409.
128. Henley MB, Chapman JR, Claudi BF. Closed retrograde Hackethal nail stabilization of humeral shaft fractures. J Orthop Trauma 1992;6:18â€“24.
129. Ingman AM, Waters DA. Locked intramedullary nailing of humeral shaft fractures: implant design, surgical technique, clinical results. J Bone Joint Surg Br 1994;76:23â€“29.
130. Kapandji A. L'osteÃ©osynthÃ¨se par la technique des broches â€œen palmierâ€ des fractures du col chirurgical de l'humeÃ©rus. Ann Chir Main 1989;8:39â€“52.
131. Markel DC, Donley BG, Blasier RB. Percutaneous intramedullary pinning of proximal humeral fractures. Orthop Rev 1994;23:667â€“671.
132. Yano S, Takamura S, Kobayashi I, et al. Use of the spiral pin for fracture of the humeral neck: case report 165:BCG-osteomyelitis of the proximal end of the humerus with an abscess dissecting into the deltoid muscle. Nippon Seikeigeka Gakkai Zasshi 1981;55:1607â€“1619.
133. Zifko B, PoigenfÃ¼rst J, Pezzei C, et al. Flexible intramedullary pins in the treatment of unstable proximal humeral fractures. Injury 1991;22:60â€“62.
134. Kristiansen B. External fixation of proximal humerus fracture: clinical and cadaver study of pinning technique. Acta Orthop Scand 1987;58:645â€“648.
135. Kristiansen B, Kofoed H. External fixation of displaced fractures of the proximal humerus: technique and preliminary results. J Bone Joint Surg Br 1987;69:643â€“646.
136. Kristiansen B, Kofoed H. Transcutaneous reduction and external fixation of displaced fractures of the proximal humerus: a controlled clinical trial. J Bone Joint Surg Br 1988;70:821â€“824.
137. Flatow EL, Cuomo F, Madey MG, et al. Open reduction and internal fixation of two-part displaced fractures of the greater tuberosity of the proximal part of the humerus. J Bone Joint Surg Am 1991;73:1213â€“1218.
138. Hawkins RJ, Switlyk P. Acute prosthetic replacement for severe fractures of the proximal humerus. Clin Orthop 1993;289:156â€“160.
139. Jakob RP, Miniaci A, Anson PS, et al. Four-part valgus-impacted fractures of the proximal humerus. J Bone Joint Surg Br 1991;73:295â€“298.
140. Koval KJ, Sanders R, Zuckerman JD, et al. Modified-tension band wiring of displaced surgical neck fractures of the humerus. J Shoulder Elbow Surg 1993;2:85â€“92.
141. Magerl F. Osteosyntheses in the shoulder region: pertubercular humeral fractures, scapular neck fractures. Helv Chir Acta 1974;41:225â€“232.
142. Meeder PJ, Wiese K, Wentzensen A. Results of an operative therapy of dislocated fractures of the humeral head in adults. Aktuel Traumatol 1980;10:201.
143. Stewart MJ, Hundley JM. Fractures of the humerus: a comparative study in methods of treatment. J Bone Joint Surg Am 1955;37:681â€“692.
144. WÃrsdÃrfer O, Magerl F. Operative Behandlung der proximalen Humerusfrakturen. Hefte Unfallheilkd 1982;160:136â€“154.
145. Muller ME, Allgower M, Willeneger H. Manual of internal fixation. New York: Springer-Verlag, 1970.
146. Neer CS. I. Displaced proximal humeral fractures. II. Treatment of three-part and four-part displacement. J Bone Joint Surg Am 1970;52:1090â€“1103.
147. Paavolainen P, Bjorkenheim JM, Slatis P, et al. Operative treatment of severe proximal humeral fractures. Acta Orthop Scand 1983;54:374â€“379.
148. Neer CS II. Displaced proximal humerus fractures, I: Classification

and evaluation. J Bone Joint Surg Am. 1970; 52(6):1077-1089.
149. Stimson, B.B. A Manual of Fractures and Dislocations, 2nd Ed. Philadelphia, Lea & Febiger, 1947.
150. Rose, S.H., Melton, L.J., III., Morrey, B.F., et al. Epidemiologic features of humeral fractures. Clin. Orthop. 1982; 168: 24-30.
151. Kristiansen, B., Barfod, G., Bredesen, J., et al. Epidemiology of proximal humeral fractures. Acta. Orthop. Scand. 1987; 58: 75-77.
152. Jensen, G.F., Christiansen, C., Boesen, J., et al. Relationship between bone mineral content and frequency of postmenopausal fractures. Acta. Med. Scand. 1983; 213: 61-63.
153. Neer, C.S. Four-segment classification of displaced proximal humeral fractures. AAOS Instr. Course Lect. 1975; 24: 160-168.
154. Marke. D.C. and Blasier, R.B. Bilateral anterior dislocation of the shoulders with greater tuberosity fractures. Orthopedics. 1994; 17: 945-949.
155. Gerber, A. and Warner, J.J.P. Hemiarthroplasty for management of complex proximal humerus fractures: preoperative planning and surgical solution. Philadelphia: Uppincott- Raven. 2005.
156. Wijgman, A.T., Roolker, W., Patt, l.W., et al. Open reduction and internal fixation of three- and fourpart fractures of the proximal part of the humerus. J. Bone Joint Surg. Am. 2002; 84(11): 1919-1925.
157. Bellumore, Y., Determe, P., Bonnevialle, M., et al. Preliminary results of internal fixation combined with disto-proximal Kapandji nailing in fractures of the head and tuberosities of the humerus. J. Bone Joint Surg. Br. 1997; 79: 45.

Conflict of Interest: Nil
Source of Support: None

How to Cite this Article:
Mourya A, Shukla S, Bajpai J, Jah M. Evaluation Of Functional Outcome Of Proximal Humerus Fracture Managed With Proximal Humerus Locking Plate-A Prospective Study. Journal Medical Thesis 2016 Sep-Dec ; 4(2):6-12.