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A systematic Review to Compare between Bridging Plate and Spanning External Fixator in Management of Comminuted Distal End Radius Fractures

M.F.Eldeeb[1], G.E.Kazem[2] and A.I.Bakr[2]
[1]M.B.B.Ch, Zagazig Univ., 2013
[2]Orthopedic Surgery, Dept., Faculty of Medicine, Benha Univ., Benha, Egypt
E-mail: meldeep73@gmail.com

Abstract

Background: The use of a spanning external fixator in the treatment of distal radius fractures is well-established. It is a relatively new technique that builds on the concept of spanning and fixing a reduced and distracted distal radius fracture, but it has some additional potential benefits, including less obvious hardware complications, the ability to keep the hardware in position for longer, and the ability to allow immediate weight bearing over the fractured distal radius. Upper extremity surgeons benefit from having both methods at their disposal. In this study, researchers compared the effects and outcomes of internal fixation with bridging plates and external fixation of comminuted distal end radius fractures. Methods: Searches were conducted using keywords (Distal radial fractures, Bridging plate fixation, Radius, Comminuted radial fractures, external fixation, distal radius spainning external fixator). It was necessary to conduct a complete literature search from the SCI, PubMed, Cochrane Library, and Embase between January 2000 and October 2021 in order to identify all publications related to the research aim. The number of patients, average age, and length of time between internal and exterior fixation were all statistically examined. PubMed, MEDLINE and Life Science Citations were all searched. As a result, in 37% of patients treated with spanning external fixation, a pin track infection developed. An advantage of using a bridge plate over a spanning external fixator was shown in our analysis of individuals who had had treatment with the device. According to the DASH system, there was no difference between the two groups. For distal radius fractures, bridge plating looks to be a viable option to Spanning external fixation. In terms of clinical superiority and safety, there are only a limited number of comparison trials to make conclusions. For distal radius fractures, bridge plating looks to be a viable option to Spanning external fixation. In terms of clinical superiority and safety, there are just a few comparison trials to make conclusions. Preliminary comparison studies comparing the Spanning external fixator and bridge plating might be useful in the future, looking at both functional and radiographic results and problems.

Keywords: Bridging Plate, Spanning External Fixator, Management, Comminuted Distal End Radius Fractures

1. Introduction

Distal radius fractures are prevalent, accounting for one-sixth of all fractures in the ER. Wrist location, amplitude and direction of forces, as well as bone characteristics, are all factors that might cause damage. A distal radial fracture with dorsal displacement is the result of a fall on a supinated extended hand with the wrist in dorsiflexion between 40 and 90 degrees. The Orthopedic Trauma Association (OTA) divided distal radius fractures into three primary types: [3-8]

fractures that develop outside of the joint are called extra-articular.

B. Partial articular fractures: Those that occur near the joint's edge.

Inside and outside of the joint surface fractures, known as articular fractures.

Distal radial fractures may be treated either surgically or non-surgically, depending on the patient's characteristics, the kind of fracture, and the availability of implants.

[3] A considerable percentage of elderly patients continue to have very active and demanding lives. As a result, pre-injury activity status is a significant consideration when deciding on treatment for distal radial fractures. In addition, the kind of surgery to be performed may be influenced by this. Secondly, the autonomy of patients is a crucial factor in determining the best course of action. Surgical fixation provides these patients with a more predictable and expedited clinical course, allowing them to recover to their pre-injury abilities more rapidly. Management strategy must also take into account the role of the dominant hand. In addition, there are a number of debates over the optimal surgical indications, surgical methods, and treatment options for each kind of distal end radius fracture. Non-displaced distal radius fractures have long been regarded a viable choice for treatment with a cast. As a consequence, many people end up with limited functionality or even disability. Distal radius fractures may be successfully treated with percutaneous Kirschner wire fixation or external fixation, according to several studies. Complications including pin tract infection, radial shortening and malunion are common, but so are aesthetic deformities and nerve damage. These are all related to the recurrent collapse at the fracture site. Dissection of soft tissues, surgical wound problems, and post-operative stiffness are common side effects of traditional open reduction and internal fixation procedures. For heavily comminuted distal radius fractures, Burke and Singer developed the dorsal distraction plating technique in 1998. As a dorsal buttress for the fracture pieces that have been comminuted, ligamentotaxis may be an effective way for decreasing and stabilising fractures in certain circumstances. Internal bridge plating is another name for it. [9-11] Distal radius fractures with metaphyseal and diaphyseal extension, in patients who have had many injuries, in older patients with poor bone quality, and even for distal radius non-unions have all been successfully treated with this approach [9-11]. Bridge plating is

preferable in an all-internal design than external fixing in many of these instances. [12,13]

The key benefit of this method is that it may be used to treat elderly patients with difficult fractures instead of traditional methods. Osteoporosis sufferers should use it. Patients may use their limbs in regular activities, avoiding disuse osteoporosis that may exacerbate the initial condition, and may even help improve local osteoporosis at the distal end of the radius, thanks to the plate's stability. In addition to [14, 5]

On the other hand, the requirement for a second treatment to remove the plate following a fracture union and probable improvement in local osteoporosis should be noted.
[14,15]

In this study, researchers compared the effects and outcomes of internal fixation with bridging plates and external fixation of comminuted distal end radius fractures.

2. Patients and Methods

Search Strategy and study selection

Keywords:

A literature search was performed using keyword (Distal radial fractures, Bridging plate fixation, Radius, Comminuted radial fractures,external fixation,distal radius spainning external fixator). A systematic literature review was performed to identify all papers relevant to the study objective and comprehensive literature search was performed from the SCI, PubMed, Cochrane Library; and Embase between January 2000 and October 2021. Some major data were statistically analyzed , including number of patients, mean age, internal fixation or external fixation time . Searches was performed in the MEDLINE , Life Science Citations , PubMed.

- (http://www.ncbi.nih.gov/sites/entrez),Google Scholar
- (http://www.scholar.google.it) and Embase Biochemical
- (http://www.embase.com/) databases will be accessed to search studies with no limits set during research..

Study design:

Systematic literature review Journal articles, studies and papers are all involved.

Patient group:

Inclusion criteria

The study will be applied on patients with the following criteria:

- Distal end radias Comminuted fractures.
- Journal articles, studies and papers are all involved.
- Prospective or retrospective clinical studies within last 20 years

Exclusion criteria:

- Non-human studies.
- Cadaveric studies
- Reviews, commentaries, and general discussion papers not presenting data on impacts.

Methods

The PubMed database was searched from January 1, 2000, to the end of October 2021, for articles. Implant technology variability was minimised by using this "contemporary" time period as a reference point for analysis. There were search phrases like "(external fixator) and radius" or "(bridge or bridging or span) and radius" for the spanning external fixator and bridge plate investigations. A set of inclusion and exclusion criteria guided the evaluation and selection of all papers. All studies that met the inclusion criteria used wrist spanning external fixators or bridge plates and had functional outcome data available, such as case series, retrospective studies, observational cohort studies, and randomised controlled trials. Use of a dynamic Spanning external fixator, a nonspanning wrist external fixator, or a Spanning external fixator or bridge plating reinforced with any extra internal fixation were all ruled out as possibilities for inclusion.

For each article, demographic data, AO (Arbeitsgemeinschaft für Osteosynthesefragen) fracture classification, functional outcome measures, postoperative radiographic parameters and complications were retrieved. We gathered functional outcome data from the DASH and Gartland and Werly questionnaires for arm, shoulder, and hand disabilities. Radial height, radial inclination, volar tilt, and ulnar variance were all radiographic measurements. Generalized linear models (GLMs) and descriptive statistics were used to compare the data from all trials across the two treatment teams.

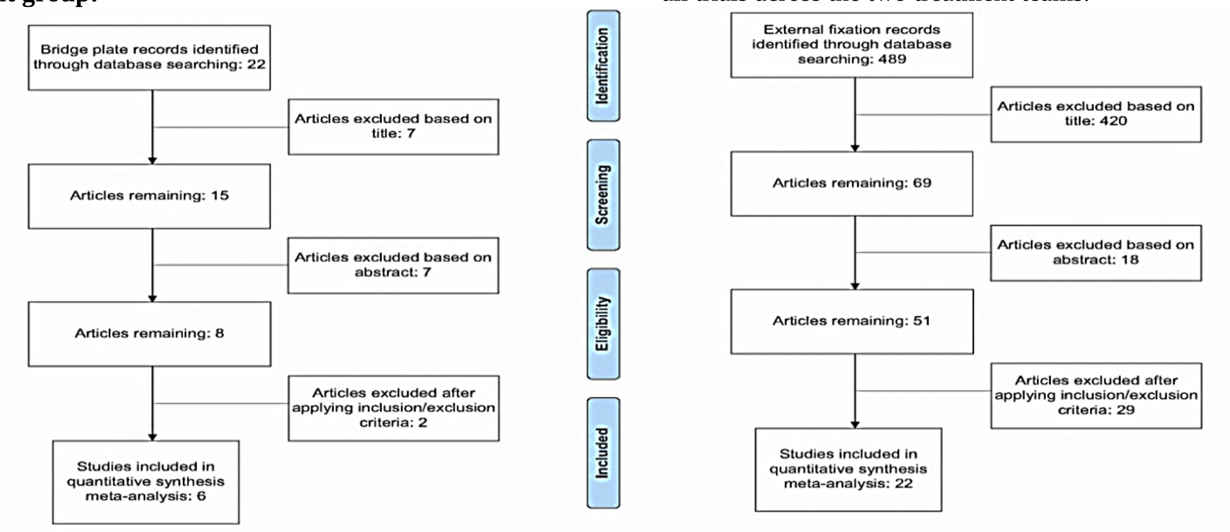

Fig. (1) Flow chart diagram of inclusion process.

3. Results

The mean age for the bridge plate group was 56.9 years. The mean age for the spanning external fixator group was 53.9 years. There was no statistically significant difference between the two groups regarding age. The bridge plating group consisted of a higher proportion of male patients (55 vs. 35.8%, $p = 0.011$). Mean follow-up time was comparable between the two groups and it was 17.3 and 18.9 months, respectively. There was no statistically significant difference between the two groups regarding follow up time.

Time to hardware removal for the bridge plate group was significantly higher than the Spanning external fixator group (17.6 vs. 6.2 weeks, $p < 0.001$).

The bridge plate group also consisted of more dominant extremities (70.6 vs. 50.4%, $p = 0.03$).

While there were no significant differences in proportion of AO fracture type A (14 vs. 24.5%, $p = 0.31$) and C (80.1 vs. 76.9%, $p = 0.73$), the bridge plate group had a statistically significant higher proportion of AO fracture type B (5.8 vs. 0.3%, $p = 0.013$). Table (1)

As demonstrated in table 3 The bridge plating group demonstrated higher rates of hardware failure compared with Spanning external fixator (4.10 ^{o} vs. 1%, $p = 0.026$). However, The external fixator group demonstrated a statistically significant higher rates of infection (10 vs. 2%, $p = 0.05$) and complex-regional pain syndrome (4 vs. 1%, $p = 0.04$). There were no iatrogenic fractures cited in both groups.

Although Spanning external fixator demonstrated higher rates of nerve palsy and other nerve complications, this was not statistically significant (3 vs. 1%, $p = 0.063$).

There were no differences in the rate of unplanned reoperations. And there was no statistically significant difference regarding finger stiffness between both groups. Table 3 demonstrates a complete list of comparative outcomes between the bridge plating and spanning external fixator groups.

Bridge plating demonstrated higher rates of excellent/good ratings under the Gartland and Werley outcome score compared with Spanning external fixator (91 vs. 83%, $p = 0.016$). Table (3)

Table (1) Comparison between the two groups according to variables and demographic factors

Variable	Bridge plate mean	External fixation mean	*p* -Value
Age (y)	56.90 (47.84–65.96)	53.85 (49.84–57.86)	0.532
Male gender	88 (55.0%)	215 (35.8%)	0.011
Follow-up (mo)	17.29 (6.71–27.86)	18.85 (14.08–23.61)	0.784
Time to removal of hardware (wk)	17.63 (14.06–21.21)	6.20 (5.61–6.78)	<0.001
Dominant extremity *n* (%)	72 (70.6)	138 (50.4)	0.028
AO fracture type A *n* (%)	24 (14.0)	144 (24.5)	0.308
AO fracture type B *n* (%)	10 (5.8)	2 (0.3)	0.013
AO fracture type C *n* (%)	137 (80.1)	452 (76.9)	0.729

Regarding radiographic parameters, radial height was comparable in both groups post treatment (10.30 mm vs. 10.11 mm , P=0.708).

There was no statistically significant difference between the two groups regarding radial inclination degrees (20.90^{o} vs. 21.31^{o} , p = 0.760) .

Volar tilt was similar in both groups (4.10^{o} Vs. 4.56^{o} , p = 0.589) .

The spanning external fixator group had more ulnar variance but the difference was statistically insignificant (0.72 mm vs 1.24 mm, p= 0.202).

There were no statistically significant differences in DASH score. Table (2)

Table (2) Comparison according to the outcome

Variables	Bridge plate mean (95% CI)	External fixation mean (95% CI)	*p* -Value
Radial height (mm)	10.30 (10.30–10.30)	10.11 (8.97–11.25)	0.708
Radial inclination (degrees)	20.90 (18.68–23.12)	21.31 (19.62–23.01)	0.760
Volar tilt (degrees)	4.10 (3.14–5.06)	4.56 (3.09–6.04)	0.589
Ulnar variance (mm)	0.72 (0.08–1.37)	1.24 (0.73–1.75)	0.202
DASH score	23.80 (8.02–39.58)	17.16 (10.40–23.92)	0.416

Table (3) Comparison according to complications

Variables	Bridge plate est. rate (95% CI)	External fixation est. rate (95% CI)	Odds ratio	*p* -Value
Infections	2 (1–10)	10 (7–14)	0.21	0.050
Iatrogenic fracture	0 (0–0)	0 (0–1)	–	–
Hardware failure	4 (1–10)	1 (0–2)	5.22	0.026
Complex regional pain syndrome	1 (0–3)	4 (2–7)	0.14	0.040
Nerve palsy and complications	1 (0–3)	3 (2–6)	0.16	0.063
Scar complications	1 (0–8)	2 (1–3)	0.77	0.810
Late carpal tunnel syndrome	0 (0–0)	3 (1–6)	–	–
Loss of reduction	0 (0–0)	2 (1–5)	–	–
Malunion or delayed union	0 (0–0)	3 (1–9)	–	–
Arthritis	0 (0–0)	0 (0–3)	–	–
Pseudoarthrosis	0 (0–0)	0 (0–1)	–	–
Finger stiffness	6 (1–29)	3 (1–10)	2.30	0.492
Shoulder capsulitis	0 (0–0)	1 (0–2)	–	–
Unplanned reoperation	4 (1–10)	3 (2–6)	1.11	0.880

4. Discussion

Several noteworthy discoveries emerged from our examination of the literature. When compared to Spanning external fixator, bridge plating showed reduced rates of infection and complicated regional pain syndrome, but greater rates of hardware failures. Pin track infection was the most prevalent consequence recorded in 37 percent of patients treated with spanning external fixation, according to Anderson and colleagues [16].

Pin tract infections are one of the acknowledged drawbacks of the Spanning external fixator and a major constraint on the time it takes to remove the hardware.

[17,18] and [3] Unplanned reoperation rates were not affected by variations in infection, hardware failure, and complicated regional pain syndrome complication rates. Two external fixator patients had a subsequent irrigation and debridement procedure for infection after antibiotics were used to treat the majority of pin tract infections. [20] In the bridge plating group, hardware failure commonly occurred 8 weeks after the fracture had healed, as would have been expected. [20, 21] Because patients treated with a bridge plate will have the hardware removed as part of a later treatment, failure of the hardware in this group happens after the fracture has healed with little clinical importance.

Complex regional pain syndrome (CRPS) was more prevalent in the Spanning external fixator group and was often treated with treatment, according to our study.

Seventeen to twenty-five Complex regional pain syndrome (CRPS) was shown to be more common in patients who received an external fixator, compared to those who had non-operative therapy [26]. It's not apparent why this is the case. The comminuted intra-articular fracture may be the culprit, or maybe distraction is to blame [27]. This, however, contrasted sharply with the multicenter prospective cohort research conducted by Zollinger et al., which found that external fixation did not necessarily increase the prevalence of complex regional pain syndrome (CRPS) in distal radial fractures. In the case of an unanticipated reoperation, this variation had no impact on functional and satisfaction results.

Patients who had bridge plate treatment had higher Gartland and Wearly scores than those who received spanning external fixator treatment in our research. Gartland and Werley first presented their scoring method in 1951. [29]. Despite its widespread usage in the literature, no studies have been conducted to back it up. Sommerkamp et. al. concluded that 92 percent of the outcomes at one year were excellent or good in the static-fixator group using the grading method of Gartland and Werley, which was in conflict with Sommerkamp et. alfindings. .'s Using a patient-reported outcome instrument, the DASH, we were able to quantify the severity of upper limb impairment and symptoms, with a score ranging from zero to 100. [31] There were no differences between the two groups in our analyses when utilizing the validated DASH questionnaire. As a result, we cannot say that one therapy group outperformed the other in terms of clinical results.

This research has certain drawbacks. Bridge plating and the Spanning external fixator were not compared in our literature search for effectiveness and results in a single cohort. The literature on bridge plating is sparse, with most research based on retrospective case studies. We were unable to construct and compare effect estimates for outcome measures because of this limitation.

As seen by disparities in baseline patient characteristics across bridge plating and external fixator groups, there is a lack of randomization. The male patients in the bridge plating group were more likely to be hospitalized. In addition, there were more severe injuries to the extremities and AO fracture type B in the bridge plating group. A greater patient compliance in the bridge plate group may be responsible for this, enabling the patient to utilize his hand more effectively. The variations between the two groups, however, may not have a major influence on clinical outcomes.

5. Conclusion

For distal radius fractures, bridge plating looks to be a viable option to Spanning external fixation. In terms of clinical superiority and safety, there are just a few comparison trials to make conclusions. Preliminary comparison studies comparing the Spanning external fixator and bridge plating might be useful in the future, looking at both functional and radiographic results and problems.

References

[1] CM.Court-Brown, B .Caesar. Epidemiology of adult fractures: A review.Injury.vol.37(8),pp.691-7, 2006.
[2] Graff S, Jupiter J.Fracture of the distal radius: classification of treatment and indications for external fixation. Injury;25 Suppl .vol.4:S-d,pp.14-25,1994.
[3] D.Havemann, FW.Busse. Accident mechanisms and classification in distal radius fracture. Langenbecks Arch Chir Suppl II Verh Dtsch Ges Chir.vol.639,pp.42,1990.
[4] P .Cherubino, A .Bini, D. Marcolli. Management of distal radius fractures: treatment protocol and functional results. Injury.vol.41(11),pp.1120-6,2010.
[5] T.Westphal, S.Piatek, S.Schubert, S.Winckler. Outcome after surgery of distal radius fractures: no differences between external fixation and ORIF. Arch Orthop Trauma Surg.vol.125(8),pp.507-14,2005.
[6] H.Kapoor, A.Agarwal, BK. Dhaon. Displaced intra-articular fractures of distal radius: a comparative evaluation of results following closed reduction, external fixation and open reduction with internal fixation. Injury.vol.31(2),pp.75-9,2000.
[7] HJ.Kreder, DP.Hanel, J.Agel, M.McKee, EH.Schemitsch, TE.Trumble. Indirect reduction and percutaneous fixation versus open reduction and internal fixation for displaced intra-articular fractures of the distal radius: a randomised, controlled trial. J Bone Joint Surg Br.vol.87(6),pp.829-36,2005.
[8] EF.Burke, RM.Singer. Treatment of comminuted distal radius with the use of an internal distraction plate. Tech Hand Up Extrem Surg.vol.2(4),pp.248-52,1998.
[9] DS.Ruch, TA.Ginn, CC.Yang, BP.Smith, J.Rushing, DP. Hanel. Use of a distraction plate for distal radial fractures with metaphyseal and diaphyseal comminution. J Bone Joint Surg Am.vol.87(5),pp.945-54,2005.
[10] DP.Hanel, TS.Lu, WM.Weil. Bridge plating of distal radius fractures: the Harborview method. Clin Orthop Relat Res.vol.445,pp.91-9,2006.
[11] MJ.Richard, LI.Katolik, DP.Hanel, DA.Wartinbee, DS.Ruch. Distraction plating for the treatment of highly comminuted distal radius fractures in elderly patients. J Hand Surg Am.vol.37(5),pp.948-56,2012.
[12] SK.Mithani, RC.S.rinivasan, R.Kamal, MJ .Richard, FJ.Leversedge, DS.Ruch. Salvage of distal radius nonunion with a dorsal spanning distraction plate. J Hand Surg Am.vol.39(5),pp.981-4,2014.
[13] TS.Axelrod, RY.McMurtry. Open reduction and internal fixation of comminuted, intraarticular fractures of the distal radius. J Hand Surg Am.vol.15(1),pp.1-11,2010.
[14] JK.Bradway, PC.Amadio, WP.Cooney. Open reduction and internal fixation of displaced, comminuted intra-articular fractures of the distal end of the radius. J Bone Joint Surg Am.vol.71(6),pp.839-47,1989.
[15] WH, Jr.Seitz. Complications and problems in the management of distal radius fractures. Hand Clin.vol.10(1),pp.117-23,2011.
[16] JT.Anderson, GL.Lucas, BR.Buhr. Complications of treating distal radius fractures with external fixation: a community experience. Iowa Orthop J.vol.24,pp.53-9,2004.
[17] M.Kumbaraci, L.Kucuk, L.Karapinar, C.Kurt, Coskunol E. Retrospective comparison of external fixation versus volar locking plate in the treatment of unstable intra-articular distal radius fractures. Eur J Orthop Surg Traumatol.vol.24(2),pp.173-8,2014.
[18] JH.Williksen, F.Frihagen, JC.Hellund, HD.Kvernmo, T.Husby. Volar locking plates versus external fixation and adjuvant pin fixation in unstable distal radius fractures: a randomized, controlled study. J Hand Surg Am.vol.38(8),pp.1469-76,2013.
[19] R.Grewal, JC.MacDermid, GJ.King, KJ.Faber. Open reduction internal fixation versus percutaneous pinning with external fixation of distal radius fractures: a prospective, randomized clinical trial. J Hand Surg Am.vol.36(12),pp.1899-906,2011.
[20] F.Leung, YK.Tu, WY.Chew, SP.Chow. Comparison of external and percutaneous pin fixation with plate fixation for intra-articular distal radial fractures. A randomized study. J Bone Joint Surg Am.vol.90(1),pp.16-22,2008.
[21] BA.Tinsley, AM.Ilyas. Distal Radius Fractures in a Functional Quadruped: Spanning Bridge Plate Fixation of the Wrist. Hand Clin.vol.34(1),pp.113-20,2018.
[22] SD.Dodds, AV. Save, A.Yacob. Dorsal spanning plate fixation for distal radius fractures. Tech Hand Up Extrem Surg.vol.17(4),pp.192-8,2013.
[23] CN.Aktekin, M.Altay, Z.Gursoy, LA.Aktekin, AM .Ozturk, AY.Tabak. Comparison between external fixation and cast treatment in the management of distal radius fractures in patients aged 65 years and older. J Hand Surg Am.vol.35(5),pp.736-42,2010.
[24] TW.Wright, M .Horodyski, DW.Smith. Functional outcome of unstable distal radius fractures: ORIF with a volar fixed-angle tine plate versus external fixation. J Hand Surg Am.vol.30(2),pp.289-99,2005.

[25] JH.Hegeman, J.Oskam, PA.Vierhout, HJ.Ten Duis. External fixation for unstable intra-articular distal radial fractures in women older than 55 years. Acceptable functional end results in the majority of the patients despite significant secondary displacement. Injury m vol.36(2), pp.339-44, 2005.
[26] JJ.van Raay, C.Boot, HJ.Oostvogel, van der Werken C. [External fixation of unstable wrist fractures]. Ned Tijdschr Geneeskd.vol.134(33),pp.1607-11,1990.
[27] PE.Zollinger, WE.Tuinebreijer, RW.Kreis, RS.Breederveld. Effect of vitamin C on frequency of reflex sympathetic dystrophy in wrist fractures: a randomised trial. Lancet.vol.354(9195),pp.2025-8,1999.
[28] PE.Zollinger, RW.Kreis, HG.van der Meulen, M .van der Elst, RS.Breederveld,WE. Tuinebreijer. No Higher Risk of CRPS After External Fixation of Distal Radial Fractures - Subgroup Analysis Under Randomised Vitamin C Prophylaxis. Open Orthop J.vol.4:7,pp.1-5, 2010.
[29] JJ, Jr.Gartland, CW.Werley. Evaluation of healed Colles' fractures. J Bone Joint Surg Am.vol.33-a(4),pp.895-907,1951.
[30] TG.Sommerkamp, M.Seeman, J.Silliman, A.Jones,S.Patterson, J .Walker . Dynamic external fixation of unstable fractures of the distal part of the radius. A prospective, randomized comparison with static external fixation. J Bone Joint Surg Am.vol.76(8),pp.1149-61, 1994.
[31] C.Gummesson, I.Atroshi, C.Ekdahl. The disabilities of the arm, shoulder and hand (DASH) outcome questionnaire: longitudinal construct validity and measuring self-rated health change after surgery. BMC Musculoskelet Disord.vol.,pp.4:11, 2003.
[32] PL.Hudak, PC.Amadio, C.Bombardier. Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand) [corrected]. The Upper Extremity Collaborative Group (UECG). Am J Ind Med.vol.29(6),pp.602-8, 1996.