INTRODUCTION

The upper extremity is an integral part of our body for physical functioning. The upper extremity is performing various activities of daily living such as eating, combing, bathing, writing, picking up objects, carrying things from one place to other, and many activities [1].

The incidence of proximal humerus fracture is more common in women than men above the age of 60 years. In all the fractures of proximal humerus, 48% occurred at home, 43% at street, and remaining circumstances were not recorded. 89% of fractures are caused by moderate trauma. The convulsive seizures are also a cause in rare cases [2]. Supracondylar fracture of humerus is a common childhood injury accounting for 3–7% of all fractures. Supracondylar fracture occurs on playground includes fall from a monkey bar, fall from swing, slide, teeter-totter, and other. 70% of supracondylar fractures occur due to fall from height [3]. Distal radius fracture occurs 25% of all fractures of all fractures in pediatric population and 18% of all fractures in elderly age group. This fracture has a significant impact on health and well-being of young adults. In the age group of 19–49 years, men and women have a risk of equal incidence; while in the age group of 19–65 years, women have doubles the risk of incidence of distal radius fractures [it may be because of osteoporotic changes in women after the age of 50 years] [4]. The fractures most commonly occur due to increased level of physical activity reduced physical fitness and trauma [5,6]. The fractures of hand complex most commonly occur in men between the age of 15 and 35 years.

The fractures are having various complications which include hypovolemic shock, adult respiratory distress syndrome, compartment syndrome, injury to nerves, injury to vessels, injury to muscles, malunion, non-union, delayed union, muscle stiffness, avascular necrosis, and reflex sympathetic dystrophy. Along with these complications, paresthesia and hyperesthesia are most important sensory impairments in post-fracture conditions. Hypersensitivity is also most commonly seen [7]. Paresthesia is numbness and tingling sensations, and hyperesthesia is increased sensitivity to mild painful stimuli [8]. Hypersensitivity leads to referred pain, deep aching, and steady pain [9]. The transmission of pain signals toward brain occurs due to the stimulation of nociceptors [10].

Prevalence of sensory impairments after fractures of upper extremity is 46%. Those increased sensory perceptions lead to difficulty in performing range of motion (ROM) activities in early post-immobilization phase after fractures [11]. To overcome such sensory impairments in early phase of mobilization, the technique called desensitization is used. Desensitization techniques are implemented to assist with normalizing sensations to the affected area. Desensitization includes the sensitization of peripheral nociceptors which helps in pain reduction [12]. The sensation of pain is carried out by nociceptors present over the nerve endings. During the process of desensitization when we stimulate them repeatedly, the temporal summation of these impulses takes place and the threshold level is increased. The temporal summation occurs when one presynaptic terminal is stimulated repeatedly. It plays an important role in facilitation of responses. Hence, the pain gets reduced [13,14]. Thus, in this study, the attempt is made to study the effects of desensitization methods for reducing pain, improving the ROM and maintaining the activities of daily living, and improving the quality of life of the patient.

METHODS

This study was a randomized, prospective, comparative study conducted at our institution from June 2017 to February 2018, after obtaining the approval from the institutional scientific and ethics committee.
Sample size was calculated using the following formula:

\[ n = \frac{2(Z_{\alpha} + Z_{\beta})^2 \sigma^2}{d^2} \]

Power of the study:
\[ Z_{\alpha} = 1.96 \text{ at } 95\% \text{ confidence level.} \]
\[ Z_{\beta} = 1.28 \text{ at } 90\% \text{ power.} \]
\[ \sigma = \text{Combination of standard deviation.} \]
\[ d = \text{Mean difference between groups.} \]

The criteria for inclusion were both male and female of every age group having fractures of one or both upper extremity. Subjects having sensory loss, diabetic neuropathy, arterial involvement, and pain with radiculopathy were excluded. 30 subjects with the mean age for Group A 38.86±18.201 and for Group B 43.13±20.66 (range 5–84 years, 19/30 women) participated in the study; written consent form was taken. Subjects were divided into two groups.

Group A: 15 subjects received conventional treatment (hot moist fomentation, mobilization, free exercises, resisted exercises, and strength training exercises).

Group B: 15 received desensitization methods (general shaking movements, gentle rub, light touch, warm and cold test tubes, joint compression, osteopressure, mirror therapy, tapping, quick icing, stretch resistance, and tendinous pressure). All the subjects were informed about the experimental protocol and gave written consent before their participation.

Measurement procedure

The pre-treatment and post-treatment assessment was done by outcome measures such as visual analog scale (VAS), ROM, manual muscle testing (MMT), and disability of the arm, shoulder and hand (DASH) questioner.

VAS score was taken before and after the treatment. ROM of upper extremity is calculated before and after the treatment using universal goniometer. MMT of all muscle groups of upper extremity is noted.

Table 1: Pre-post data analysis in Group A

| Group A | VAS | ROM | MMT | DASH |
|---------|-----|-----|-----|------|
|         | Flexion | Abduction | Shoulder | Elbow | Shoulder | Abduction | Shoulder | Elbow |
| Pre     | 6.73±2.549 | 119.2±33.616 | 102.8±40.010 | 104±37.154 | 3.6±0.5071 | 3.26±3.266 | 3.6±0.5071 | 58.04±21.800 |
| Mean±SD | 6.73±2.549 | 119.2±33.616 | 102.8±40.010 | 104±37.154 | 3.6±0.5071 | 3.26±3.266 | 3.6±0.5071 | 58.04±21.800 |
| Post    | 4.86±2.346 | 133.7±33.82 | 115.8±38.059 | 119.6±33.698 | 3.86±0.3519 | 3.86±0.3519 | 3.86±0.3519 | 39.05±17.692 |
| Mean±SD | 4.86±2.346 | 133.7±33.82 | 115.8±38.059 | 119.6±33.698 | 3.86±0.3519 | 3.86±0.3519 | 3.86±0.3519 | 39.05±17.692 |
| p value | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0046 | 0.0004 | 0.0046 | 0.0001 |
| T value | 8.671 | 18.077 | 9.008 | 7.562 | 2.256 | 4.583 | 2.256 | 11.597 |

Table 2: Pre-post data analysis in group B

| Group B | VAS | ROM | MMT | DASH |
|---------|-----|-----|-----|------|
|         | Flexion | Abduction | Shoulder | Elbow | Shoulder | Abduction | Shoulder | Elbow |
| Pre     | 5.73±3.432 | 112.86±8.280 | 74.33±22.723 | 29.86±5.449 | 3.73±0.4577 | 3.26±0.4577 | 3.73±0.4577 | 59.428 |
| Mean±SD | 5.73±3.432 | 112.86±8.280 | 74.33±22.723 | 29.86±5.449 | 3.73±0.4577 | 3.26±0.4577 | 3.73±0.4577 | 59.428 |
| Post    | 3.53±2.100 | 127.06±5.873 | 91.26±23.526 | 37.23±8.40 | 4.2±0.4140 | 4.13±0.3519 | 4.2±0.4140 | 37.684 |
| Mean±SD | 3.53±2.100 | 127.06±5.873 | 91.26±23.526 | 37.23±8.40 | 4.2±0.4140 | 4.13±0.3519 | 4.2±0.4140 | 37.684 |
| p value | 0.0003 | 0.0001 | 0.0001 | 0.0001 | 0.0035 | 0.0001 | 0.0035 | 0.0001 |
| T value | 4.785 | 10.551 | 6.745 | 9.648 | 3.500 | 9.539 | 3.500 | 5.928 |

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elbow flexion (p≤0.0234). Pre-intervention MMT showed statistically no significant difference for shoulder flexion (p≤0.4560), shoulder extension (p≤0.4560), shoulder abduction (p≤0.4560), shoulder adduction (p≤0.4560), elbow flexion (p≤0.7025), elbow extension (p≤0.9999), wrist flexion (p≤0.4605), and wrist extension (p≤0.2849). Pre-intervention DASH score showed no significance with p≤0.8588 (Table 3). The exercises are having a great importance during the early mobilization phase in post-fracture conditions of upper extremity. The desensitization methods are also been used along with these exercises to control the pain and in improving the strength and ROM of an affected area. The purpose of this study was to find out the effect of desensitization methods during the early mobilization phase in post-fracture conditions of upper extremity. Reviewing the various studies, it was analyzed that conservative management, surgical management, and post-operative rehabilitation were the routine guidelines for treating the subjects with an upper extremity fractures. This study was undertaken considering all the mentioned points and sole aim of this study was to evaluate the effect of desensitization methods during early mobilization phase in early mobilization phase in post-fracture conditions of upper extremity. Harden et al. in complex regional pain syndrome studied that the desensitization methods are an effective as a treatment protocol for the complex regional pain syndrome [11]. They studied about the various aspects of desensitization methods and this was combined with the psychotherapy. This study showed that desensitization is important to improve ROM and aerobic capacity of the individual. Norman Harden et al. in article complex regional pain syndrome: Practical diagnostic and treatment guidelines 4th edition studied that the gradual desensitization improves the functions of the joint and reduces the pain. This improves the functional capability of the individuals [11].

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Table 3: Pre‑pre and post‑post data analysis between Group A and Group B

| Outcome measures | Mean±SD | Group A | Group B | p value | T value |
|------------------|---------|---------|---------|---------|---------|
| VAS Pre          | 6.73±2.549 | 5.73±3.432 | 0.3727 | 0.9059 |
| Post            | 4.86±2.356 | 3.53±2.100 | 0.1130 | 1.636  |
| ROM Abduction Shoulder Pre | 119.6±34.054 | 112.8±28.280 | 0.4630 | 0.7441 |
| Post            | 153.6±92.122 | 127.4±55.533 | 0.2809 | 1.099  |
| Elbow Flexion Pre | 103.5±30.574 | 74.7±22.723 | 0.0234 | 2.399  |
| Post            | 115.8±38.059 | 91.2±23.526 | 0.0427 | 2.124  |
| MMT Abduction Shoulder Pre | 104±37.154 | 126±17.422 | 0.0435 | 2.114  |
| Post            | 119.5±33.619 | 139±18.791 | 0.0533 | 2.018  |
| Shoulder Flexion Pre | 3.6±0.5071 | 3.73±0.4577 | 0.4560 | 0.7559 |
| Post            | 3.86±0.3519 | 4.2±0.4140 | 0.0246 | 2.376  |
| Elbow Abduction Pre | 3.26±0.4577 | 3.3±0.4880 | 0.7025 | 0.3854 |
| Post            | 3.86±0.3519 | 4.06±0.4577 | 0.1905 | 1.342  |
| DASH Pre-intervention | 58.17±21.649 | 59.4±16.127 | 0.8588 | 0.1795 |
| Post-intervention | 39.05±17.692 | 37.6±19.261 | 0.8407 | 0.2029 |

VAS: Visual analog scale, ROM: Range of motion, MMT: Manual muscle testing, DASH: Disability of the arm, shoulder and hand, SD: Standard deviation

Various recent approaches are used in treating subjects of post-operative upper extremity fractures, but this study concluded that the combination of desensitization along with conventional physiotherapy rehabilitation was effective in decreasing pain and improving quality of life than providing post-operative rehabilitation alone. The advantage of desensitization methods is that it normalizes the sensations of an affected area. This reduces the pain and ultimately it helps in improving the ROM and strength of an affected part. This was results in the lessening the duration of rehabilitation process. Hence, it improves the quality of life of patients.

CONCLUSION

We conclude that the combination of desensitization along with conventional physiotherapy was effective in decreasing pain, improving ROM, and muscle strength than the conventional physiotherapy alone. Desensitization showed significant improvement in ROM for elbow flexion and in strength for all the components except wrist flexion and extension when compared to the conventional treatment, but the...
conventional treatment showed overall improvement in all outcome variables.

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AUTHOR’S CONTRIBUTION

Poonam S. Shah conducted literature review for this manuscript, developed introduction section of the manuscript together with the discussion of the study findings, collected data, and analyzed the data. Dr. Sandeep B. Shinde provided a description of the background information and participated in preparation of the manuscript. All the authors read and approved the final manuscript.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest concerning the content of the present study.

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