Original Article

Comparison of Digit Pain between the Water Hyacinth Finger Trap and Steel Wire Finger Trap in Closed Reduction of Distal End Radius Fractures

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Background: Most of distal end radius fractures can be treated conservatively. Standard treatment involves closed reduction with finger trap contraption and traction with weight. Steel wire finger traps are widely used. Problems are observed significant pain and skin abrasions after reduction.

Objective: To find out if finger traps made from water hyacinth could reduce digit pain in closed reduction of distal end radius in comparison to conventional steel wire finger trap.

Materials and Methods: Prospective randomized control trial was performed on distal end radius fracture patients. Two groups were blinded randomly assigned to either group. VAS scores were recorded at 1 and 10 minutes after application.

Results: 40 patients were enrolled. Demographic data showed no significant differences between groups. Water hyacinth finger trap group showed significantly lesser VAS pain score at both 1 minute and 10 minutes after application of weighted traction. The change in VAS pain score was also less observed in water hyacinth group. The satisfactory score was also significantly better in the water hyacinth group.

Conclusion: Water hyacinth finger trap is a reliable reduction tool in distal end radius fracture. Pain is significantly reduced with better satisfaction score in comparison to the conventional steel wire finger trap.

Keywords: Water hyacinth finger trap; Steel wire finger trap; Distal end radius fracture

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Distal end radius fractures are a common orthopedic injury. Its prevalence can be as high as 17.5% of all the fractures in adults[1]. Most of the distal end radius fractures can be treated conservatively without requiring surgery[2,3].

Standard treatment involves closed reduction with finger trap contraption and traction with weights[3]. Steel wire finger traps are widely used in hospitals across Thailand.

Problems are observed from steel wire finger traps used in the traction method. Significant pain and skin abrasions could arise from the hard steel fibers of the finger traps with long periods of weighted tractions. In patients with thin delicate skins, such traction with steel wire finger traps proved to be a challenge in terms of adequate reduction.

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Water hyacinth is a common type of an aquatic plant found in abundance across aquatic ecosystems in Thailand. It poses as a problem as an aquatic weed, disrupting the ecosystem and water balance in reservoir causing impediment to water flow and eventually flooding of regions. Recently, water hyacinth has been utilized as daily use products due to their fiber durability. They are weaved into bags, baskets and even shoes. This benefit both the rural villages in Thailand and restores balance to the aquatic ecosystem. Their proven durability has led to the invention of the water hyacinth finger traps used in this study.

This study aims to utilize the durability property of the water hyacinth in creating a tool that could be used for reduction of distal end radius fractures. We believe that the softer but durable fibres of the water hyacinth would decrease the amount of pain generated by the weight finger trap traction. Furthermore, the cost efficiency of a water hyacinth finger trap is lower when compared to steel wire finger trap, which is beneficial to areas with financial difficulties.

Materials and Methods

Ethical approval was obtained prior to initiation of this study by The Ethical committee of Srinakharinwirot University (SWUEC/F-488/2561). Patients diagnosed with acute distal end radius fracture were recruited between December 2019 and August 2020 for this prospective

randomized controlled trial. Inclusion criteria were age more than 18 years old, radiographically confirmed distal end radius fractures, and non-operative distal end radius fractures. Exclusion criteria were open fractures, patients with wound on the thumb used for traction, previous closed reduction, impaired sensation, unstable patients, and patients with inflammatory joint diseases. Informed consent was obtained from all patients prior to the enrolment.

Diagnosed distal end radius fracture patients were randomized into two groups. Both underwent the same method of finger trap traction with the difference of the finger trap used (Figure 1).

The control group were reduced with steel wire finger trap and the experimental group with water hyacinth finger trap. The steel wire finger trap used in this study is a standard wire finger grip (Zimmer, USA) and a water hyacinth finger (Sava, Thailand) (Figure 2).

The finger trap closed reduction protocol used is as follows. A hematoma block was done at the fracture site with 2% lidocaine without vasoconstrictor added. Adequacy of hematoma block was checked after the administration of the local anesthesia. The thumb of the fractured wrist was carefully secured with the finger trap. Tightness and proper fitting of the thumb was rechecked. With the elbow flexed at 90 degrees, 5 kgs of weight was applied for longitudinal traction of the fracture in the duration of 10 minutes (Figure 3). The patient was blindfolded at the time of finger trap application. After 10 minutes of traction the weights were removed, the closed manipulation was performed. The hand and forearm were wrapped with 4 cotton pad (Specialist® 100) and an anteroposterior slab was applied with Gypsona®S.

Visual Analogue Scale (VAS) pain score (Figure 4) were obtained at 1 minute after the application of traction weights and at 10 minutes (completion of the traction).

Statistical analyses

Based on the results of the pilot study in acute distal end radius fracture patients, a standard deviation (SD) of VAS pain scores in steel wire group was 1.2, and water hyacinth group was 0.8. Assuming 17 subjects per group, there is 80% power to demonstrate a difference of 1 score between any two groups at two-sided alpha of 0.05. Adjustment for 10% for dropout or loss to follow-up rate, and a total of 38 subjects (19 per group) were, therefore, planned to achieve the target of 20 subjects per group. Demographic data such as age, sex, hand side, and hand dominance are presented as mean and standard deviation (SD) for continuous variables, and as numbers and percentages for categorical variables. We performed an independent t-test and Wilcoxon rank-sum test to compare pain scores and satisfactory scores. A p-value of <0.05 was considered statistically significant. All analyses were conducted with

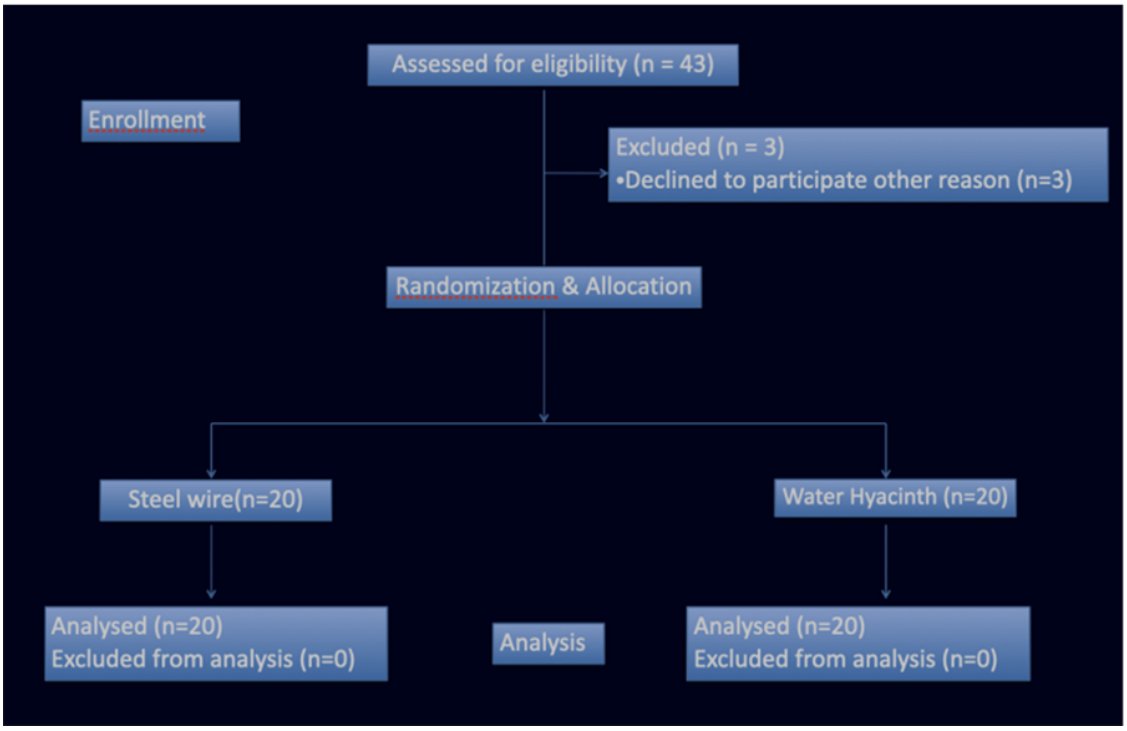

Figure 1. Diagnosis of patients with distal end radius fracture and they were randomized into two groups.

SPSS 22 (IBM Corp).

Results

Demographic data

Forty patients identified as 15 male and 25 female patients with a mean age of 47 (range 26 to 75) years in the steel wire group and a mean age of 50 (range 23 to 82) in the water hyacinth group. Twenty-four patients (60%) injured their dominant hands with 13 (65%) in the steel wire group and 11 (55%) in the water hyacinth group. A total of twenty-three patients injured their right hands and seventeen patients injured their left hands (Table 1). The calculated p-value showed no significant difference between the two groups.

Figure 2. Steel wire finger trap and water hyacinth finger trap

Figure 3. Application of the finger trap.

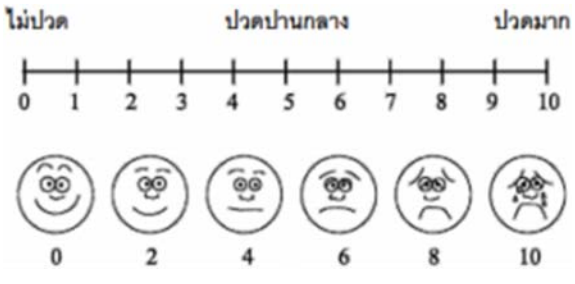

Figure 4. Visual Analogue Scale (VAS).

Water hyacinth group had lower VAS pain scores at both 1 minute and 10 minutes time from reduction (Table 2).

Pain score at 1-minute time was statistically significant with steel wire group at mean of 2.7 and water hyacinth group at 1.84 with a p-value of 0.043 between the two groups. VAS pain score at 10-minute time was statistically significant at a mean of 7 for steel wire group and 2.8 for water hyacinth group with a p-value of 0.021 between the two groups. Difference for change of VAS pain score from 1-minute to 10-minute time was also statistically significant (+3.81 in steel wire group and +0.81 in water hyacinth group, p-value = 0.027). The water hyacinth also had better post-reduction satisfactory score (Table 3).

There were five cases in the steel wire group that presented with skin pressure marks at the thumb digit that

Table 1. Demographic data

Characteristic	Steel wire (n=20)	Water hyacinth (n=20)
Age (mean range)	47 (26 to 75)	50 (23 to 82)
Sex		
Male	7 (35%)	8 (40%)
Female	13 (65%)	12 (60%)
Hand dominance		
Right	12 (60%)	11 (55%)
Left	8 (40%)	9 (45%)

Table 2. Pain score of finger trap reduction at 1 and 10 minutes

Time	Steel wire (n=20)	Water hyacinth (n=20)	p-value
1 minute	2.7 (1 to 4)	1.84 (0 to 3)	0.043
10 minutes	7 (5 to 8)	2.8 (1 to 4)	0.021
Pain score difference	+3.8 (2 to 5)	+0.81 (0 to 2)	0.027

Table 3. Post reduction satisfactory score

Time	Steel wire	Water hyacinth	p-value
Post-reduction	4 (3 to 7)	7.54 (6 to 9)	0.0377

was used for finger trap reduction. No skin breakage or abrasion were observed in those patients. None of the water hyacinth study group had any skin lesions.

Discussion

From the study of Earnshaw et al[4], there were no differences between closed reduction methods of manual manipulation and finger-trap traction in terms of alignment and long-term results in distal end radius fractures. However, Holkenrg et al[5] found the difference in terms of fracture site pain. The manual manipulation method proved to produce more pain at the fracture site when compared to the finger-trap traction. Pain at the digit used for traction was noted in the study[5].

Finger trap traction reduction method with steel wire finger traps can cause pain at the digit utilized for traction (commonly the thumb). A study by Spurrier E et al[6] found that the usage of 'Chinese finger trap' for distraction of wrist joint in wrist arthroscopy results with increased pressure to the finger used for traction. This causes pain and potential soft tissue injury. A pilot study, completed by the author of this study investigated the magnitude of pain generated from steel wire finger trap traction in fifteen patients and found the pain score to be clinically relevant at mean VAS pain score of 6.8.

Water hyacinth finger trap is both durable and comfortable. The cost of a finger trap made from the company Sava is lower than the standard wire one. No known study has ever used a durable, environment friendly and cost-effective finger trap for orthopedic procedures.

From our results, we compared the VAS pain score of steel wire finger trap and water hyacinth finger in the finger-trap traction method in close reduction of distal end radius fracture. Water hyacinth finger trap group has a significantly lower VAS pain score both initially at 1 minute and at 10 minutes. It was also clinically significant at a pain score of 2.8 compared to 7. The water hyacinth group also had better satisfactory score. There were five known cases of skin pressure marks in the steel wire group. There were no complications of finger trap slippage or skin abrasion in both groups. Both equipments did not fail throughout the whole duration of this study.

The strength of this study is the prospective randomized control trial design with blinding of the patients. The protocol for reduction of the distal end radius was also consistent throughout the study with the author of this study as the sole person who performs the reduction. There were also no risks of recall bias as the data collection was done immediately post-reduction and there was no follow-up required. There were, however, some limitations in this study. The study size was believed to be small at 40 subjects. There was no blinding of the intervention, since it was not possible to prevent the operator from seeing the finger trap used in this study. Lastly, the sizes of the water hyacinth finger trap were also limited which causes some subjects to not have 'perfect fit' of the traction digit. This could be eliminated with created more specific finger trap sizes in the future.

Conclusion

Water hyacinth finger trap is a reliable reduction tool in distal end radius fracture. Pain is significantly reduced with better satisfaction score in comparison to the conventional steel wire finger trap. Further study may be needed to explore on the shelf-life of this tool for its possible reusable potential and a larger sample size to see more effect variations.

What is already known on this topic?

Most of the distal end radius fractures can be treated conservatively without requiring surgery. Standard treatment involves closed reduction with finger trap contraption and traction with weights[3]. Steel wire finger traps are widely used in hospitals across Thailand.

What this study adds?

Water hyacinth finger trap is both durable and comfortable. It is a reliable reduction tool in distal end radius fracture that more comfortable, less skin complication and cheaper than Steel wire finger traps.

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Potential conflicts of interest

The authors declare no conflict of interest.

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