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Factors influencing functional outcome of proximal interphalangeal joint collateral ligament injury when treated with buddy strapping and exercise

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ABSTRACT

Study Design: Prospective cohort.

Introduction and Purpose: This study evaluates the factors influencing treatment outcomes of proximal interphalangeal (PIP) joint collateral ligament injuries when treated with buddy strapping.

Methods: Sixty-seven patients treated with buddy strapping for a PIP joint injury were enrolled. The finger range of motion (ROM), grip strength, and a Quick Disability of the Arm, Shoulder, and Hand (QuickDASH) score were assessed at 3 and 6 months after the initial injury. The factors that were assessed for their influence on the functional outcomes included age, sex, hand dominance, affected finger, type of injury, injury severity, time to treatment, the duration of buddy strapping, and exercise training.

Results: Buddy strapping for PIP joint injuries led to satisfactory results with 77% recovery of grip strength, 84% recovery in ROM, and mean QuickDASH scores of 14 at 6 months. A decrease in grip strength was associated with an increase in age and injury severity at 6 months, and these 2 factors accounted for 22% of the variance in the grip strength. A decrease in ROM was associated with the delayed treatment, which accounted for 18% of the variance in ROM at 6 months. An increased disability was associated with delayed treatment, female gender, and radial digit injury at 3 months, and these 3 factors accounted for 37% of the variance in disability. At 6 months, only the delayed treatment remained an associated factor, which accounted for 20% variance in disability.

Discussion and Conclusions: PIP collateral ligament injuries had very good outcomes with buddy strapping. However, delayed treatment was significantly associated with poor functional outcomes in terms of the ROM and disability. An increase in age and injury severity were associated with lower grip strength up to 6 months, whereas a female gender and radial digit injury were associated with an increased disability up to 3 months.

Level of evidence: 2

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Conflict of interest: All named authors hereby declare that they have no conflicts of interest to disclose.

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Introduction

The proximal interphalangeal (PIP) joint is the most commonly injured joint in the hand.¹ Due to its unprotected location, long lever arm, and low lateral and rotational mobility, the PIP joint is highly susceptible to injury during athletic activities, especially in ball-handling sports.² Angular forces may cause a partial or a complete rupture in the collateral ligament, and lateral dislocation can occur when combined with a volar plate rupture, of which the incidence is estimated to be 11.3 per 100,000 persons per year.³

These injuries are often regarded as a jammed finger or as finger sprains, and appropriate attention by a health care provider is often delayed after the initial injury.⁴

Although most lateral dislocations are easily reduced and do not exhibit a gross instability, the PIP joint is prone to stiffness after injury, and if it is not properly diagnosed and treated, a permanent impairment of the hand function may result.⁵ Protective motion allows the PIP joint to move through an arc in which the joint remains reduced, and managing these injuries must be proactive to restore mobility as soon as feasible to prevent stiffness and disability. The methods that can be used for most stable injuries include buddy strapping, figure-of-8 orthotic device, and extension block orthotic devices.⁶ Although satisfactory results are achieved in most cases, some patients experience problems that affect their daily and sports activities, and several types of PIP joint injuries can result in permanent disability if they are left undiagnosed or are untreated.⁷

In spite of the possible delay or missed diagnosis for PIP joint injuries,^{4,8} the effect of a delayed treatment on functional outcomes has not yet been investigated in depth. Furthermore, little information is currently available analyzing unsatisfactory outcomes after a PIP joint collateral ligament injury. Thus, the primary purpose of this study was to evaluate the factors that influence the treatment outcomes and prognoses for patients with a PIP joint injury who were treated conservatively. We asked whether the baseline patient characteristics (age, gender, hand dominance, and affected finger), the type of injury (the type of injury and injury severity), or the mode of treatment (time to treatment, duration of buddy strap application, and length of exercise training) are related to the patient's functional outcome 6 months after PIP joint injuries.

Methods

A total of 67 patients, 18 years or older, who had been conservatively treated for a PIP joint collateral ligament injury of the index, middle, ring, or little finger between September 2013 and October 2015 were consecutively enrolled in this prognostic study. The patients were recruited from a tertiary care university hospital that serves as a regional emergency trauma center, and the institutional review board of the university approved this study. All patients were recruited by a research assistant (trained nurse) when they attended the orthopedic outpatient clinic, and all patients provided informed consent after the purpose, and procedures of this study had been explained. Conservative treatment was performed when the PIP joint was stable in an active range of motion (ROM) even if a small avulsion fragment existed.

Patients were excluded if they had more than 1 finger injured; prior injuries or abnormalities on the contralateral hand; a comorbid chronic pain condition such as severe arthritis; or worker's compensation status. Of 67 potentially eligible subjects, 3 patients were excluded, and 4 subjects were lost during follow-up. **Table 1** shows the demographics of the remaining 60 patients.

An orthopedic hand physician applied a buddy strapping of the injured finger, and all patients were instructed in the same exercise program that was started at the onset of treatment by occupational therapist. Patients treated with buddy strapping for PIP joint injuries are reported to be able to return to preinjury activity levels faster than those treated with immobilization.¹ A self-adherent wrap (Coban; 3M Company, St. Paul, MN) or paper plaster tape was used for buddy strapping. Both the proximal and middle phalanges were strapped, and a piece of gauze was placed between fingers to stave off moisture and blister. The index and middle fingers were strapped together, or the ring and little fingers were strapped together. If the long finger sustained an injury to the PIP

Table 1
Demographic and clinical characteristics of participants

Characteristics	Number or score
Participants	60
Mean age (y)	37 ± 13
Younger than 65	53 (88%)
65 and older	7 (12%)
Male/female	43 (72%)/17 (28%)
Injured side (dominant:nondominant)	39 (65%):21 (35%)
Location	
index/middle/ring/little finger	13/15/9/23
Injury severity ^a	
I:II:III	12 (20%):30 (50%):18 (30%)
Sports related/not sports related	45 (75%)/15 (25%)
The presence of initial dislocation	17 (28%)
The presence of bony avulsion fragment	11 (18%)
Time to diagnosis	
<3 wk	42 (70%)
≥3 wk	18 (30%)
Duration of buddy strapping (wk)	3.1 ± 0.8
Length of exercise training (wk)	2.7 ± 1.0

Values are expressed with mean ± standard deviations or number of cases, that is, proportion (%).

^a Injury severity was evaluated using the Bowers' classification.

radial collateral ligament, the long finger was strapped together with the index finger to avoid ulnar stress and promote neutral alignment.¹ In case the little finger was much shorter than the ring finger, we angled the plaster tape to properly strap the ring and little fingers together. All subjects were provided specific written instruction regarding the care of the finger and buddy strapping (including adjustment or replacement of the buddy strap). Patients discontinued the buddy strapping after 3–4 weeks of continuous wear.⁷ The exercise training consisted of 4 exercises: making a fist, making a small fist (flexing the PIP and distal interphalangeal [DIP] joints only), flexing the metacarpophalangeal joints while keeping the PIP and DIP joints stretched, and spreading the fingers as far as possible with the hand lying flat on a table. They were instructed to do every exercise for 10 minutes 5 times daily. Encouragement and reassurance was provided by an occupational therapist to patients to let them know that they could achieve good functional outcomes through the exercise training in spite of pain and stiffness. To monitor the patients' adherence, they were asked to write an exercise diary (noting date, time, and duration of exercise). All patients were offered oral nonsteroidal anti-inflammatory drugs 3 times per day for 2 weeks.

A research assistant rated patient adherence with buddy strapping based on the duration of buddy strap appliance; as 3 (compliant) when a buddy strap was applied for more than 3 weeks, 2 (secondary compliant) when a buddy strap was applied for 2–3 weeks, and 1 (noncompliant) when a buddy strap was applied for less than 2 weeks. Patient adherence with exercise training was also measured based on self-reported length of regular exercise training; as 3 (compliant) when exercise training was regularly conducted for more than 3 weeks, 2 (secondary compliant) when exercise training applied for 2–3 weeks, and 1 (noncompliant) when exercise training was conducted for less than 2 weeks.

The patients returned for their functional assessment at 3 (11–15 weeks) and 6 months (24–27 weeks) after their injury. Reminder phone calls were provided to patients 1 day before appointment to reduce the attrition rate of this study. During the visit, 2 orthopedic hand physicians assessed the finger ROM and grip strength, and after the clinical examination, a Quick Disability of the Arm, Shoulder, and Hand (QuickDASH) score⁹ was administered. A research assistant (trained nurse) who did not know the patients' clinical information checked all the returned questionnaires for completion and assisted the participants in completing

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